Biodiversity Regulatory Risk and Stock Returns*

Ricardo Peña† Shikhar Singla‡ Zirui Wang§

April 30, 2025

Abstract

We construct a novel firm-level measure of biodiversity regulatory risk. We combine endangered species habitat models with establishment locations to identify firm exposure to Areas of Unprotected Biodiversity Importance (AUBI)—areas likely to be targeted by future conservation policy. Between 2020 and 2023, firms in nature- and location-dependent sectors earned 5.53% lower annual returns per standard deviation of AUBI exposure. Returns for high-exposure firms in nature-dependent sectors fell following Biden's 2021 "30 by 30" executive order and increased after the 2024 election. These effects are distinct from carbon risk, suggesting biodiversity regulation is increasingly being priced into equity markets.

Keywords: Biodiversity, Endangered Species, Stock Returns, Asset Pricing, Regulatory Risk

*We thank Thomas Brown, Jonathan Cohn, Winston Dou, Andrey Ordin, Aaron Pancost, Amiyatosh Purnanandam, Michael Sockin, Laura Starks, and Stijn Van Nieuwerburgh for helpful comments. We are also thankful for comments from seminar participants at the University of Texas at Austin. The authors have read the NBER disclosure policy and have no conflicts of interest to disclose.

†McCombs School of Business, University of Texas at Austin. Email: jesus.pena@utexas.edu.

‡McCombs School of Business, University of Texas at Austin. Email: shikhar.singla@utexas.edu.

§McCombs School of Business, University of Texas at Austin. Email: zirui.wang@utexas.edu.

I. Introduction

Biodiversity loss has accelerated markedly in recent decades.[1] This ecological crisis is increasingly recognized as a material economic threat with projections suggesting that unchecked biodiversity decline could reduce global GDP by over 2% annually by 2030, as natural ecosystems play a fundamental role in supporting economic activity (Johnson, Ruta, Baldos, Cervigni, Chonabayashi, Corong, Gavryliuk, Gerber, Hertel, Nootenboom, et al., 2021). In response, governments, firms, and international organizations have begun reallocating resources and crafting strategic frameworks to confront the crisis. Among mitigation strategies, land conservation remains the most effective approach, and recent legislation has increasingly focused on protecting areas of high biodiversity importance (Carroll and Noss (2022), Pulido-Chadid, Virtanen, and Geldmann (2023), Allan, Possingham, Atkinson, Waldron, Di Marco, Butchart, Adams, Kissling, Worsdell, Sandbrook, et al. (2022), and Langhammer, Bull, Bicknell, Oakley, Brown, Bruford, Butchart, Carr, Church, Cooney, et al. (2024)). One prominent framework, the Global Biodiversity Framework (GBF), was introduced in 2020 and formally adopted by the United Nations at the COP15 Biodiversity Conference in 2022, with a cornerstone goal to conserve 30% of the planet's land and oceans by 2030—a target widely known as the "30 by 30" initiative (Dinerstein, Vynne, Sala, Joshi, Fernando, Lovejoy, Mayorga, Olson, Asner, Baillie, et al., 2019). The United States joined this global effort in 2021 via Executive Order 14008, but by the end of that year, only 13% of U.S. land met the required conservation standard,[2] underscoring the potential for substantial regulatory expansion in pursuit of conservation goals.

In this paper, we examine how biodiversity-related regulatory risk is priced in equity markets. Specifically, we study the financial implications of potential restrictions or disruptions to firms' operations stemming from biodiversity regulations.[3] These regulatory risks include land use restrictions, permit revocations, mandatory disclosure of ecological

[1] Extinction rates are now estimated to be 10 to 100 times higher than the historical average over the past 10 million years (Marques, Martins, Kastner, Plutzar, Theurl, Eisenmenger, Huijbregts, Wood, Stadler, Bruckner, et al., 2019).

[2] According to the U.S. Geological Survey, this figure includes land classified as GAP Status 1 or 2, which denotes areas with permanent protections and a primary management mandate for biodiversity conservation (U.S. Geological Survey, 2021).

[3] Within the broader environmental finance literature, regulatory risk—compared to physical and technological risk—is widely viewed as the most immediate and financially material component (Stroebel and Wurgler, 2021; Krueger, Sautner, and Starks, 2020).

impacts, fines for habitat destruction, and requirements to offset biodiversity loss. We expect such risks to be especially pronounced in sectors that are highly dependent on specific locations and natural ecosystems, including Mining, Construction, Oil & Gas, Utilities, and Manufacturing.

While much of the environmental finance literature has focused on climate transition risk, particularly carbon emissions, the pricing implications of biodiversity-related regulatory risk have received comparatively little empirical attention. This gap persists despite the growing policy emphasis on biodiversity conservation. Two key challenges contribute to the limited focus. First, firm-level exposure to biodiversity regulatory risk is difficult to quantify, as it requires detailed geospatial mapping of threatened ecosystems rather than relying on standardized disclosures like emissions data. Second, many of the most ambitious conservation policies, such as those introduced under the 30 by 30 initiative, have only recently emerged. However, the rise of these new policies not only underscores the relevance of biodiversity risk but also provides an opportunity to examine a central question: Do stock returns reflect firm-level exposure to biodiversity-related regulatory risk?

To capture firm-level exposure to biodiversity regulatory risk, we construct a measure that quantifies the extent to which a firm's operations are located in areas most susceptible to conservation or protection efforts. Our measure relies on data from NatureServe, a leading authority in biodiversity monitoring and conservation science whose data are used by U.S. federal and state agencies for regulatory and land management decisions. To estimate biodiversity vulnerability at a fine spatial scale, we follow the methodology of Hamilton, Smyth, Young, Howard, Tracey, Breyer, Cameron, Chazal, Conley, Frye, et al. (2022), who integrate NatureServe data with machine learning to model habitat suitability for at-risk species. Their framework generates two key metrics: Protection-weighted Range-size Rarity (PWRSR), which assigns higher scores to species with rare, vulnerable habitats lacking legal protection, and Areas of Unprotected Biodiversity Importance (AUBI),[4] which spatially aggregate PWRSR to identify high-risk, unprotected areas. To map these ecological risks onto firm operations, we merge AUBI data with 2021 establishment-level employment and location records from Dun & Bradstreet. Each

[4] AUBIs are defined as 990m x 990m areas where PWRSR values exceed a fixed threshold, marking them as conservation priorities despite lacking formal protection under U.S. GAP Status 1 or 2 designations.

firm's exposure is calculated as the employment-weighted share of its workforce located in or near AUBIs, yielding a continuous score from 0 to 1. A value of 0 indicates no presence in biodiversity-sensitive areas, while 1 implies full concentration within them. We merge it with monthly CRSP-Compustat financial data from 2020 to 2023 to create our main sample, resulting in a panel of 1,039 firms with a mean AUBI exposure of 0.10 and a standard deviation of 0.22. Most importantly, when we regress AUBI exposure on firm-level financial and environmental characteristics, we find low explanatory power across specifications. This suggests that our measure captures a dimension of risk that is largely orthogonal to standard firm fundamentals and commonly used environmental metrics.

Our analysis centers on the period spanning the Biden administration onward, as biodiversity-related transition risks were less salient in U.S. financial and regulatory discourse prior to this era. Although the 30 by 30 initiative was first proposed in 2014,[5] it only began to gain substantive traction in scientific and policy communities in subsequent years, culminating in the European Commission's 2020 proposal for a Biodiversity Strategy for 2030 and its formal prioritization under the Biden presidency via Executive Order 14008.

It is also important to note that while the 30 by 30 initiative marked the first large-scale conservation effort of President Biden's tenure, it was not the only one. A suite of legislative and executive actions—including the Infrastructure Investment and Jobs Act (IIJA), Executive Order 14072, the Bureau of Land Management's Public Lands Rule, and the Inflation Reduction Act (IRA)[6]—collectively reflect a historically strong federal commitment to environmental protection. These efforts signal a regulatory environment increasingly supportive of biodiversity conservation. As a result, investors may rationally anticipate a greater likelihood of future biodiversity-related regulation. Given the nature of these initiatives, regulatory focus would likely fall on areas of high biodiversity importance. Our measure, based on detailed species range and protection data, is explicitly designed

[5]The 30 by 30 target was first proposed at the IUCN's World Parks Congress in Sydney in 2014, where global conservation leaders set a vision for protected areas through 2050.

[6]These actions include: the IIJA (Nov. 2021), which funded ecosystem restoration and climate resilience through agencies like the U.S. Forest Service and NOAA; EO 14072 (Apr. 2022), which focused on conserving mature and old-growth forests; the BLM's 2024 Public Lands Rule, which authorized conservation leases on public lands; and the IRA (Aug. 2022), which allocated over $20 billion to biodiversity-related initiatives including climate-smart agriculture and habitat restoration.

to capture firm-level exposure to these areas of biodiversity importance and the associated regulatory risks.

However, while these efforts signal strong political will and channel unprecedented funding toward conservation, the mechanisms for achieving biodiversity targets remain largely unspecified. Much of the language across these legislative and executive actions centers on increasing financial support for federal agencies, NGOs, and landowners, or on identifying areas of ecological importance—rather than directly restricting private-sector activity. As a result, these policies primarily elevate the perceived likelihood of future regulation, rather than imposing it outright. This contributes to heightened regulatory uncertainty, as it remains unclear when, where, and how such regulations will be implemented. In line with theoretical models such as Pástor and Veronesi (2013) and empirical evidence from Brogaard and Detzel (2015), which show that political uncertainty around regulatory policy can affect asset prices, this uncertainty may exert pressure on valuations—particularly for firms operating in high-priority conservation areas.

We consider two main possibilities for the relationship between AUBI exposure and stock returns during this period. One possibility is that there is no significant relationship, either because biodiversity risk is not salient to investors or because it is difficult to measure reliably at the firm level. Unlike climate change, which often affects investors directly—through personal experience with extreme weather events (Choi, Gao, and Jiang, 2020)—and benefits from standardized firm-level emissions disclosures, biodiversity loss is spatially fragmented and lacks uniform disclosure standards, making it harder to quantify and less salient. Alternatively, as biodiversity regulatory risk increases and becomes more credible—through policy developments such as the 30 by 30 initiative, increased media coverage, or heightened investor awareness—firms operating in areas of biodiversity importance would face elevated risk, leading to reduced valuations and reduced realized returns. Regulatory uncertainty around these policy developments may amplify this risk as investors adjust for the potential of future conservation mandates.

We find strong evidence in support of this second hypothesis: firms with greater AUBI exposure earn significantly lower realized monthly returns. This result rejects the null of no pricing of biodiversity regulatory risk. A one-standard deviation increase in AUBI exposure is associated with a 3.48% annual reduction in returns, based on cross-sectional regressions of realized monthly returns on AUBI exposure. This result remains

robust across specifications, including models that control for Industry-by-Year-Month fixed effects,[7] which absorb time-varying industry shocks. The AUBI coefficient is both economically and statistically significant, reinforcing the interpretation that biodiversity regulatory risk is priced in the cross-section of returns. To confirm our measure is unrelated to carbon risk, we control for Scope 1, Scope 2, and Scope 3 carbon emissions, in levels and intensity, using data from Trucost, further validating our measure as a distinct source of risk.

In line with our hypothesis, the relationship between AUBI exposure and returns is concentrated in sectors whose operations are heavily nature- and location-dependent—such as Mining, Construction, Oil & Gas, Utilities, and Manufacturing. These sectors rely on physical land use, extraction, and infrastructure, and often require permits, environmental assessments, and proximity to specific ecological features. In these sectors, a one-standard-deviation increase in AUBI exposure reduces annual returns by 5.53%. The effect is only one-third as large—and statistically insignificant—in other sectors. Notably, the relationship emerges only after 2020 and is insignificant prior, consistent with improved data availability and increased investor awareness following the 30 by 30 initiative.[8] Together, the timing and industry-specificity of the effect validate the design of our measure as targeting biodiversity-related regulatory vulnerability.

We find that the relationship between AUBI exposure and stock returns is amplified during periods of heightened biodiversity-related media attention, which may reflect underlying policy movements or broader issue salience. To capture this variation, we compile monthly data on U.S.-based media mentions of the 30 by 30 initiative using article counts from Factiva, applying keyword filters to ensure relevance. We extend our baseline regression by interacting AUBI exposure with an indicator variable equal to unity in months that fall within the top tercile of media mention growth. We find that the negative association between AUBI exposure and returns is significantly stronger during

[7] These fixed effects absorb all variation common to firms in the same industry and month—including stable industry characteristics (e.g., regulatory environment) and time-varying industry shocks (e.g., commodity price movements for energy firms)—as well as broader macroeconomic trends, allowing us to isolate firm-level variation in biodiversity exposure.

[8] NatureServe's data offerings have become increasingly granular and accessible over this period, coinciding with a surge in policy momentum. In parallel, the Biden administration's 30 by 30 commitment and related conservation initiatives elevated biodiversity as a financially material consideration within ESG investing discourse.

high-growth media months, particularly within nature-dependent sectors. This pattern suggests that investor sensitivity to biodiversity risk intensifies during periods of elevated public awareness. Importantly, the results remain robust when controlling for climate-related media coverage,[9] reinforcing that our measure captures biodiversity-specific risk rather than general environmental risk.

To evaluate the economic significance of AUBI exposure, we construct a value-weighted long-short portfolio: long in the top tercile and short in the bottom tercile of firms based on AUBI exposure. This portfolio yields monthly alphas between -0.63% and -0.82%, depending on the specification, and these are not explained by standard asset pricing factors. The return differential disappears prior to 2020 and among sectors with low reliance on physical land or ecological proximity, reinforcing the view that biodiversity risk only recently began to be priced—and that our measure effectively isolates firms most exposed to it. Importantly, this result remains significant even when excluding January 2021,[10] confirming that the observed pricing effect is not an artifact of a single policy announcement.

We also conduct event studies around two major political events with contrasting implications for environmental policy. Following President Biden's issuance of Executive Order 14008, an equally-weighted long-short portfolio consisting of firms in location- and nature-dependent sectors earned a cumulative abnormal return (CAR) of -9.76% over the five trading days following the announcement. This result remains robust when controlling for carbon risk using long-short portfolios based on Scope 1–3 emissions intensity, as well as a green-minus-brown factor. These benchmarks help isolate biodiversity-specific effects from broader green transition risk. In contrast, following the 2024 election of President Trump—who has publicly opposed environmental regulation—we observe a reversal: a positive CAR of 2.87% for the same portfolio in the five days post-election. This asymmetric response is consistent with an anticipatory pricing channel, where investors adjust valuations based on expected shifts in biodiversity regulation.[11] We also

[9] As a robustness check, we include an interaction between AUBI exposure and media mentions of climate change, constructed using a parallel query in Factiva. The biodiversity effect persists, suggesting that our results are not driven by general environmental attention.

[10] To rule out that the effect is solely driven by the 30 by 30 executive order issued in January 2021, we repeat the analysis excluding this month. The results remain statistically and economically significant.

[11] We further verify this by replicating results with firm-level CARs and robustness checks across alternative specifications and placebo dates. No significant effects are found prior to 2020 or in sectors less exposed

examine several pre-2020 policy-relevant dates and find no significant return responses, reinforcing that our measure identifies a risk channel that only began to materialize in recent years.

To assess how institutional investors respond to biodiversity risk, we leverage our AUBI exposure measure alongside 13F and 12F holdings data from Thomson Reuters. We focus our analysis on actively managed mutual funds and hedge funds, excluding passive index funds, under the hypothesis that sophisticated investors are more likely to detect and act upon emerging forms of regulatory risk—particularly those that are difficult to quantify or not yet priced by the broader market. If biodiversity exposure represents a financially material but underappreciated risk, these investors should be among the first to adjust their portfolios accordingly. Consistent with this view, we find that actively managed funds systematically reduce their positions in firms with high AUBI exposure.[12]

We also examine whether ESG-oriented funds respond differently and find no additional disinvestment among funds with above-average ESG ratings, as measured by Morningstar's globe-based sustainability scores. This suggests that the observed trading behavior reflects broad institutional repricing of biodiversity risk, rather than ESG-specific screening. Finally, using a dynamic difference-in-differences framework, we identify the timing of these portfolio adjustments. The relationship between AUBI exposure and institutional holdings becomes significantly negative beginning in January 2021, with repeated significant disinvestment observed in April, May, and June 2021—corresponding to key biodiversity-related policy events including Executive Order 14008, the USDA's climate-smart conservation expansion, and the release of the "America the Beautiful" initiative. We also observe significant reductions in April 2023, coinciding with the Bureau of Land Management's proposed Public Lands Rule and in October 2023, during the close of the public comment period on major Endangered Species Act revisions. These patterns validate our measure, demonstrating that institutional investors adjust their portfolios in line with salient biodiversity policy shocks.

Taken together, our findings demonstrate that firm-level exposure to biodiversity regulatory risk—captured through our novel AUBI measure—is reflected in realized

to land-based regulatory pressure.

[12]Regression results show a significant negative relationship between AUBI exposure and mutual fund ownership, after controlling for firm size, leverage, book-to-market ratio, capital expenditures, and climate-related risk proxies.

stock returns and institutional investor behavior. We construct this measure by linking establishment-level firm operations to spatial data on areas of biodiversity importance, producing a replicable and geographically grounded proxy for firm-level exposure to potential conservation regulation. We validate the measure through multiple empirical strategies. Firms with higher AUBI exposure experience lower realized returns, particularly in nature- and location-dependent industries, and the relationship is robust to controls for carbon emissions, ESG scores, and firm fundamentals. The effect strengthens during periods of elevated biodiversity-related media attention, consistent with growing issue salience and policy credibility. We further show that institutional investors—mutual funds and hedge funds—systematically reduce their holdings in high-exposure firms, indicating that the risk is being incorporated into valuations by informed market participants. Even as executive-level policies such as the 30 by 30 initiative are reversed, biodiversity-related regulation remains a persistent source of financial risk. Ongoing ecological degradation and durable legal frameworks like the Endangered Species Act suggest that land conservation will remain a primary regulatory lever. As biodiversity loss accelerates, this risk channel is likely to become more salient. Our study provides a validated and scalable framework for measuring biodiversity regulation exposure and contributes to a broader understanding of how financial markets respond to emerging forms of ecological and regulatory risk.

Related Literature: We contribute to several strands of the literature. First, our study advances a nascent but growing literature on biodiversity in finance, a subfield of the broader environmental finance literature. Despite increasing policy and investor attention to biodiversity loss, Karolyi and Tobin-de la Puente (2023) document a striking absence of biodiversity-focused research in top-tier finance journals. Recent contributions such as Flammer, Giroux, and Heal (2025) and Junge, Feuer, and Sassen (2023) examine the role of private capital in financing biodiversity conservation. Others, including Garel, Romec, Sautner, and Wagner (2024), Coqueret, Giroux, and Zerbib (2025), and Xiong (2023), use firm-level impact data (e.g., land use and pollution) to estimate biodiversity exposure, but often struggle to disentangle it from correlated climate risks. Giglio, Kuchler, Stroebel, and Zeng (2023) employ a text-based measure from 10-K statements and show that biodiversity risk is priced, though coverage is limited. We contribute to this effort by introducing a

geographically grounded, firm-level measure that isolates regulatory risk arising from proximity to areas of biodiversity importance, rather than firm activity per se.

Second, we contribute to the broader environmental finance literature documenting that ESG risks influence investor decisions. Pástor, Stambaugh, and Taylor (2022) show that green stocks have outperformed brown stocks, attributing this to evolving investor preferences. In contrast, we take a more agnostic stance on preferences and attribute our findings to a shift in the regulatory environment—specifically, increasing policy momentum toward biodiversity conservation. Our framing aligns with Bolton and Kacperczyk (2021), who argue that investors price carbon risk, though Zhang (2025) later emphasize the role of data timing and transition dynamics. We extend this logic to biodiversity, emphasizing a form of transition risk that is spatially rooted: firms located in areas of unprotected biodiversity importance are disproportionately exposed to emerging regulatory constraints. Importantly, we show that this effect is strongest among firms in nature- and location-dependent industries—those most likely to materially impact their surrounding ecosystems—underscoring the regulatory salience of firm geography and operational characteristics in pricing biodiversity risk.

Finally, we contribute to an extensive literature on regulatory uncertainty and asset pricing. Pástor and Veronesi (2013) formally model how political news and regulatory uncertainty can depress asset prices. Empirically, Brogaard and Detzel (2015) provide evidence that uncertainty shocks influence the cross-section and time-series of returns. We complement this work by showing that biodiversity-related regulatory uncertainty—amplified by major policy events such as the 30 by 30 initiative—can similarly reduce valuations, particularly for firms exposed to areas of unprotected biodiversity importance.

II. Background and Data

In this section, we provide an overview of the essential background for biodiversity conservation and the 30 by 30 Initiative. We then describe the datasets used in our analysis.[13] Our aim is to construct a firm-level dataset by aggregating establishment-level measures of biodiversity importance and merging it with financial data.

[13]Datasets that are well known in the literature are detailed more thoroughly at Table IA.4

A. Biodiversity and the 30 by 30 Initiative

Biodiversity refers to the variety of life forms on Earth, including ecosystems, species, and genetic diversity. It can be measured on various levels, from the genetic differences within a species to the number of species in a specific area. In simple terms, biodiversity is often understood as the richness of species within an ecosystem.

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) has reported that human activity now threatens more species with global extinction than ever before (Díaz, Settele, Brondízio, Ngo, Guèze, Agard, Arneth, Balvanera, Brauman, Butchart, et al. (2019), Marques et al. (2019)). Nearly one-quarter of animal and plant species face extinction, while local extinctions within specific ecosystems are becoming more widespread. A report by the World Wildlife Fund (Fund (2020)) revealed a staggering 69% decline in the monitored wildlife on earth between 1970 and 2018.

This profound loss of biodiversity is likely to impact billions of people as the degradation of natural systems presents a significant risk to quality of life. Additional studies have supported these findings (Jones, Venter, Fuller, Allan, Maxwell, Negret, and Watson (2018), Pereira, Martins, Rosa, Kim, Leadley, Popp, van Vuuren, Hurtt, Quoss, Arneth, et al. (2024), Allan et al. (2022), Senior, Bagwyn, Leng, Killion, Jetz, and Wilcove (2024)), showing that biodiversity loss can have serious economic consequences (Blarel, Ruta, Gavryliuk, Poisson, Stewart, Power, Guillon, Likhachova, and Choux (2023), WEF (2020)). Recent evidence shows that biodiversity loss can have direct and measurable human and economic costs, as seen in the collapse of vultures in India leading to higher mortality and sanitation costs (Frank and Sudarshan, 2024) and the decline of bats in North America increasing insecticide use, health risks, and crop losses (Frank, 2024). Biodiversity loss could also lead to an increased risk of future pandemics (Daszak, das Neves, Amuasi, et al. (2020)). To address accelerating biodiversity loss, the 30 by 30 Initiative aims to protect 30% of the Earth's land and marine areas by 2030. Proposed by the High Ambition Coalition for Nature and People, the initiative was adopted by over 100 nations and formally incorporated into the Kunming-Montreal Global Biodiversity Framework (GBF) at the 2022 COP15 conference; this is often referred to as the "Paris Agreement for Nature".

The United States joined this commitment in January 2021, with President Biden signing an executive order to conserve 30% of U.S. lands and waters by 2030. However, in

addition to 30 by 30, the Biden administration has enacted several regulatory measures that impact land conservation and biodiversity protection in the last few years. Executive actions include Executive Order 14008 on January 27, 2021 (30 by 30) and Executive Order 14072 issued in 2022 which focuses on forest conservation and promoting biodiversity. Legislative actions such as the Inflation Reduction Act and the Bipartisan Infrastructure Law have allocated substantial funding to conservation programs and habitat restoration, increasing compliance costs for businesses operating in sensitive ecological areas. Governmental actions such as these increase biodiversity regulatory risk and its salience.[14]

By setting these goals, the U.S. government has created new regulatory risks for firms operating in regions likely to be designated as protected areas under 30 by 30. Firms with operations in these areas may face restrictions on land use, increased conservation obligations, or higher compliance costs. As of the end of 2021, less than 13% of the United States is permanently protected and primarily managed to support biodiversity (U.S. Geological Survey (2021)). Panel A of Figure 2 shows these protected areas color-coded by ownership types, such as federal, state, regional agencies, NGOs, and private entities.

Identifying which firms may be exposed to these regulatory and transition risks requires understanding which regions are most likely to be designated as conservation areas under 30 by 30. However, pinpointing areas of high conservation priority remains challenging due to a lack of detailed data on species distribution and habitat vulnerability across landscapes. This data gap is critical to bridging firm-specific exposure to regulatory risk in the context of biodiversity conservation.

[14]See: https://www.federalregister.gov/documents/2021/02/01/2021-02177/tackling-the-climate-crisis-at-home-and-abroad (Executive Order 14008); https://www.federalregister.gov/documents/2022/04/27/2022-09138/strengthening-the-nations-forests-communities-and-local-economies (Executive Order 14072); https://www.congress.gov/bill/117th-congress/house-bill/5376/text (Inflation Reduction Act); https://www.congress.gov/bill/117th-congress/house-bill/3684 (Bipartisan Infrastructure Law); https://www.federalregister.gov/documents/2023/04/03/2023-06310/conservation-and-landscape-health (Bureau of Land Management Regulation); https://www.fws.gov/project/endangered-species-act-regulation-revisions-overview (ESA Regulations); https://www.usda.gov/about-usda/news/press-releases/2021/05/06/biden-harris-administration-outlines-america-beautiful-initiative (America the Beautiful Initiative)

B. NatureServe

In this section, we detail the data services provided by NatureServe and how we utilize these resources in our analysis. In particular, we highlight NatureServe's critical role in supplying geographically precise, science-based information that informs both biodiversity conservation and climate change risk assessments. We divide this section into two subsections: one describing the climate exposure data and another focusing on biodiversity modeling and species risk rankings.

B.1 Climate Exposure Data

We utilize two geographical climate datasets from NatureServe: the Climate Change Exposure Score and the Habitat Climate Change Vulnerability Index (HCCVI) score. These variables are included to emphasize that our biodiversity exposure measure captures a risk distinct from physical climate risks. The Climate Change Exposure Score evaluates the stress induced by climate change on ecosystem-specific processes, focusing on changes in temperature and precipitation patterns. This score incorporates baseline climate conditions, historical climate variability, and future climate projections, emphasizing deviations from historical norms. It is based on two measures of climate vulnerability: Climate Departure, which predicts shifts in temperature and precipitation between mid-20th-century averages and future 21st-century estimates, and Climate Sensitivity, which evaluates changes in modeled habitat suitability over time.

The Habitat Climate Change Vulnerability Index (HCCVI) score assesses the climate change vulnerability of various habitats and ecosystems within a 7-square-mile hexagonal spatial unit. The Climate Change Exposure Score serves as a critical input to the HCCVI framework, which provides average scores across 99 habitat types. Higher HCCVI scores reflect lower vulnerability (high resilience or low exposure), while lower scores indicate greater vulnerability (low resilience or high exposure). Both datasets include two temporal assessments: mid-to-late century and near-century projections, offering insights into the evolving impacts of climate change on natural habitats.

We perform the same steps as how we calculate firm-level biodiversity risk measures to obtain firm-level climate change exposure score and HCCVI score. We first compute the score for each establishment, and then aggregate it to the firm level by weighting each

establishment by its number of employees. The maps of these scores are plotted in figures IA.1 and IA.2. In our regressions, we include three climate-related controls: the Climate Change Exposure Score for both mid-to-late century and near-century projections, and the Habitat Climate Change Vulnerability Index (HCCVI) for the mid-to-late century. We omit the HCCVI near-century score because it is a linear combination of the other three variables, and thus would introduce perfect multicollinearity.

B.2 Biodiversity Data and Habitat Modeling

Beyond climate-related risks, NatureServe plays a central role in biodiversity conservation by modeling the habitat ranges of imperiled species and assessing ecosystem vulnerability. We incorporate these data into our firm-level biodiversity exposure measure, described in more detail below.

NatureServe is a nonprofit organization dedicated to advancing biodiversity conservation by providing high-quality, science-based data on species and ecosystems. Through its expertise in species distribution, conservation status assessments, and ecosystem analysis, NatureServe addresses critical data gaps that government agencies alone often cannot fill. It collaborates with over 60 governmental and non-governmental organizations across North America, working with a network of 1,000 conservation scientists to gather and analyze biodiversity data. By offering detailed biodiversity data, NatureServe supports conservation planning and policy, assisting researchers, policymakers, and businesses in identifying high-priority areas for biodiversity protection.

To categorize species, NatureServe uses a system of conservation status ranks, ranging between GH (possibly extinct), G1 (critically imperiled), G2 (imperiled), G3 (vulnerable), G4 (apparently secure), and G5 (secure). This ranking system has been endorsed by the U.S. government as a valuable tool for identifying species and ecosystems at risk and for shaping both policy decisions and practical conservation strategies.[15] While the Endangered Species Act (ESA) similarly addresses at-risk species, federal limitations in staff and resources prevent comprehensive assessments for all species NatureServe considers at risk. NatureServe therefore supplements federal listings by providing a broader set of observations for assessing the health of additional species and ecosystems

[15]It also aligns closely with international standards, such as the IUCN Red List, ensuring consistency in global biodiversity risk assessments.

at various scales. These ranks also supply critical status information for species that have not yet been listed or are under evaluation for listing under the ESA.

Traditional biodiversity assessments typically rely on "coarse-range" maps, which depict broad species distribution ranges. While informative at a general scale, these maps lack the spatial precision needed to capture specific habitat features and environmental variations critical to accurately identifying high-priority conservation areas. This limitation is particularly significant for rare or at-risk species, which often inhabit smaller, specialized environments that coarse mapping cannot adequately represent. To overcome these limitations, Hamilton et al. (2022)[16] employ habitat suitability models (HSMs) enhanced by machine learning. HSMs predict suitable habitats by analyzing environmental variables such as climate, land cover, and soil types, to identify areas that best support a species' survival and reproduction. Using machine learning, Hamilton et al. (2022) predict biodiversity importance by training on environmental variables and verified species locations, enabling accurate habitat suitability estimates even in data-sparse regions. This method produces finely detailed habitat suitability maps.

The study specifically focuses on 2,216 imperiled species from four taxonomic groups: vertebrates, vascular plants, freshwater invertebrates (such as mussels and crayfish), and pollinators (including bumble bees, butterflies, and skippers). Only species classified as critically imperiled (G1) or imperiled (G2) by NatureServe, or listed as endangered under the U.S. Endangered Species Act, were included. By concentrating on these high-priority species, the assessment identifies regions with urgent conservation needs, aligning with our research goal to evaluate regulatory risks for areas likely to receive protection under initiatives like 30 by 30.

C. Measures of Biodiversity Importance

Biodiversity risk is a complex and multidimensional concept. Hamilton et al. (2022) introduce three distinct measures to capture different aspects of this risk: Range-Size Rarity (RSR), Protection-Weighted Range-Size Rarity (PWRSR), and Areas of Unprotected Biodiversity Importance (AUBI). These measures combine species rarity, habitat protection,

[16] Although not formally published by NatureServe, the top three coauthors of this study are affiliated with NatureServe, underscoring the organization's direct involvement in developing the methodology.

and the prioritization of unprotected regions to provide a comprehensive assessment of biodiversity significance. In this study, we employ all three measures to analyze how biodiversity risks influence firms' financial outcomes. Below, we introduce each measure in detail.

Range-Size Rarity (RSR). Range-Size Rarity (RSR) is designed to quantify the rarity of species within a given geographic area. The measure is calculated in two steps: first, the inverse of the modeled habitat area is computed for each species, e, and second, these values are summed across all species within the geographical area, g, to obtain the RSR score at the geographical level.

$$RSR_g = \sum_e RSR_{eg} = \sum_e \frac{1}{Habitat\ Area_{eg}}$$

A higher range-size rarity indicates that a species has a smaller habitat, making it more vulnerable to threats. By highlighting areas with greater ecological sensitivity, RSR serves as a critical tool for identifying biodiversity hotspots. The data for RSR is available at a resolution of 990 meters, enabling fine-grained spatial analysis across the continental United States.

Protection-Weighted Range-Size Rarity (PWRSR). Protection-Weighted Range-Size Rarity (PWRSR) extends the RSR metric by incorporating the extent of habitat protection for each species. Protected areas, as defined in the study, are those classified with GAP Status 1 or 2 in the Protected Areas Database for the United States, which are areas mandated for biodiversity conservation. For each species, e, the PWRSR score is calculated as the product of its RSR score and the proportion of its habitat that remains unprotected. These scores are then summed across all species within a geographic area, g, to produce the PWRSR score at the geographical level.

$$PWRSR_g = \sum_e PWRSR_{eg} = \sum_e \frac{1}{Habitat\ Area_{eg}} \times Percentage\ Unprotected_g$$

Overall, protection-weighted Range-Size Rarity (PWRSR) signifies the vulnerability of a species based on its habitat range and the degree to which its habitat remains unprotected.

A higher PWRSR score indicates a species with a small, rare habitat that is largely unprotected, making it especially susceptible to extinction risks. Thus, this measure identifies not only regions with ecologically rare species but also those where such species face significant conservation gaps. By integrating protection data, PWRSR highlights regions with high biodiversity risks due to inadequate conservation measures. Like RSR, PWRSR is computed at a 990-meter resolution, providing detailed insights into biodiversity vulnerabilities at the local level. The study found that concentrations of protection-weighted range-size rarity (PWRSR) for imperiled species were most prominent in California, with additional clusters across parts of the West, Southwest, Texas, Arkansas, and the southeastern United States.

Areas of Unprotected Biodiversity Importance (AUBI). Areas of Unprotected Biodiversity Importance (AUBI) is a binary measure derived from PWRSR score. A region is classified as AUBI if its summed PWRSR score equals or exceeds a threshold of 0.0005; otherwise, it is assigned a value of 0. This PWRSR value of 0.0005 corresponds to a single species with a 500 km^2 range that is 25% unprotected, a species with a smaller range of 20 km^2 that is 1% unprotected, or multiple co-occurring species with lower individual PWRSR values. This binary classification pinpoints regions where biodiversity risks are both significant and unprotected, making them priorities for conservation efforts. AUBI is particularly relevant for assessing regulatory risks faced by firms, as these areas could be targeted by government initiatives like 30 by 30. The AUBI measure offers a practical tool for identifying regions where firms are likely to face heightened conservation scrutiny and potential regulatory interventions.

AUBIs spanned 510,521.3 km^2, or 6.3% of the contiguous United States (CONUS). These AUBIs often included habitats for multiple threatened species: 86% of AUBIs contained more than one imperiled species, with an average of 4.8 species (SD 3.21) predicted in each area. Overall, habitats for 2,124 species, representing 96% of all modeled species, were expected to occur within AUBIs. California stands out with the highest percentage of land area designated as AUBIs (27.6%), while Florida, Georgia, and Tennessee each had nearly 20% of their land overlapping with AUBIs. Except for Rhode Island, every state included AUBIs, with 90% of the CONUS population residing within 50 kilometers of one. Notably, regions with significant populations of unprotected imperiled species such as northern

Sierra Nevada, central and northern Arizona, Utah and Colorado's Rocky Mountains, southeastern Texas, southwestern Arkansas, and Lake Wales Ridge in Florida have rarely been highlighted in past biodiversity studies. These three measures, RSR, PWRSR and AUBI, cover the entire continental United States at a resolution of 990 meters. Figure 1 plots these measures.

The biodiversity data we use is cross-sectional because habitat suitability, species distributions, and protection statuses change slowly over time. The measures are constructed using extensive historical data on species ranges, habitat characteristics, and conservation efforts, capturing long-term ecological trends and landscape dynamics. We rely on a 2020 AUBI spatial dataset—derived from Protection-Weighted Range-Size Rarity (PWRSR) and released for the first time in 2020—as representative throughout our sample period. Accordingly, our AUBI measure should be interpreted as a forward-looking proxy for long-run biodiversity-related regulatory vulnerability, reflecting structural geographic risk rather than real-time land-use constraints.

III. Firm-Level AUBI Exposure

Building on the biodiversity risk measures introduced above, we construct two firm-level proxies for exposure to Areas of Unprotected Biodiversity Importance (AUBIs). Our primary measure, *Employee Weighted AUBI Exposure*, captures the share of a firm's workforce located within AUBI-designated areas. To complement this, we construct a proximity-based alternative, *Employee Weighted Distance AUBI Exposure*, which accounts for how close each establishment is to AUBI boundaries. These measures allow us to map ecological vulnerability onto firm operations with spatial precision. In this section, we detail the construction of each measure and demonstrate that they are orthogonal to firm-level financial characteristics, physical climate risk, and regulatory climate risk.

A. Measure Construction

We obtain establishment-level data for US public firms from Dun & Bradstreet, which provides detailed information on firm establishments, including the parent company name, establishment name, location and number of employees. Using Google Maps API,

we geocode each establishment's coordinates and match these locations to a grid from NatureServe which has RSR, PWRSR, and AUBI scores. Given that our biodiversity risk data covers the entire contiguous U.S., we assign each establishment a risk measure based on the longitude and latitude of its location. This linkage between the establishment's geographic coordinates and the biodiversity risk grid enables us to accurately capture biodiversity regulatory risk exposure for each establishment.[17]

A.1 Employee Weighted AUBI Exposure

To construct firm-level biodiversity regulatory risk exposure, we gather establishment-level data from NETS. For each firm, certain establishments may be located in an AUBI while others may not. We assign a binary value of 1 to establishments located in an AUBI and 0 otherwise. To account for the relative size of each establishment, we weigh the biodiversity regulatory risk exposure by the number of employees at each establishment. For example, suppose Caterpillar, Inc has two establishments: one with 400 employees located in an AUBI, and another with 600 employees outside such areas. In this case, the weighted average biodiversity regulatory risk exposure for Caterpillar, Inc would be 0.4, reflecting the proportion of its workforce in an AUBI region.

After constructing the establishment-level biodiversity exposure measures, we aggregate them to the firm level and merge the resulting dataset with CRSP-Compustat. The merge is performed using a combination of firm names and geographic proximity. Specifically, we geocode firm headquarters from CRSP and match them to public company establishments in the Dun & Bradstreet NETS database using both fuzzy string matching on firm names and spatial distance between geocoded coordinates. Firms are retained only if the name similarity score exceeds 70 and the headquarters location is within 1 kilometers of a D&B establishment. This approach ensures a high-confidence match between financial data and establishment-level biodiversity exposure. Our final sample includes 1,039 public firms, each assigned a fixed AUBI exposure score based on 2021 employment footprints and 2020 spatial biodiversity risk. We merge this with CRSP-Compustat data spanning 2016 to 2024 to construct the panel used in our analyses. Figure 3 dis-

[17] Using establishment-level presence to measure environmental risk exposure is consistent with prior work in climate finance.Acharya, Johnson, Sundaresan, and Tomunen (2022) use establishment-level geographic distribution to estimate firm exposure to regional heat stress.

plays the geographic distribution of firm establishments overlaid on Areas of Unprotected Biodiversity Importance.

The result of this merging process is a firm-level dataset containing biodiversity risk measures and monthly stock returns for a broad cross-section of publicly traded U.S. firms. This dataset forms the basis of our analysis, allowing us to examine how biodiversity regulatory risk impacts firm performance in the U.S. equity market. We provide summary statistics of the final dataset in Table 1.

A.2 Employee Weighted Distance AUBI Exposure

To confirm the robustness of our findings, we construct an alternative, distance-weighted measure of firm-level exposure to Areas of Unprotected Biodiversity Importance (AUBIs). While our primary measure captures whether an establishment lies within an AUBI, this alternative accounts for how close each establishment is to an AUBI boundary, even if it lies just outside of one. Using 2020 NatureServe data, we calculate the distance from each establishment to the nearest AUBI-designated pixel. Establishments located within 1 kilometer of an AUBI are assigned a weight of 1; otherwise, they receive a weight equal to the inverse of their distance (i.e. $1/d$, where d is the distance in kilometers). These proximity-based weights are then aggregated to the firm level by computing the employment-weighted average across all of a firm's establishments.

The resulting measure, which we refer to as *Employee Weighted Distance AUBI Exposure*, captures how physically close a firm's operations are to high-risk conservation zones. Firms with higher values on this metric are more likely to face land-use restrictions or regulatory scrutiny due to their proximity to ecologically sensitive areas. Importantly, regulatory actions are unlikely to align perfectly with the static boundaries defined in Hamilton et al. (2022), making this distance-based approach valuable for accounting for policy actions beyond explicitly designated AUBIs. In our empirical analysis, we present results using both the binary and distance-weighted exposure measures and find that our main conclusions remain robust.

B. Firm-Level Determinants

In this section, we outline our expectations regarding which firms are most likely to be affected by biodiversity-related regulation and explain the logic behind this heterogeneity. Specifically, we hypothesize that firms whose operations are more dependent on local ecosystems and land use—such as those in extractive or resource-intensive industries—face greater exposure to regulatory interventions targeting areas of unprotected biodiversity importance (AUBIs). We also assess the empirical novelty of our exposure measure by examining its relationship with other firm-level characteristics and common ESG risk proxies. The goal is to establish that our AUBI exposure variable captures a distinct regulatory risk channel rather than reflecting existing observable traits or correlated climate risks.

B.1 Location- and Nature-Dependent Firms

We begin by motivating our decision to categorize firms into two distinct groups: those that are location- and nature-dependent, and those that are not. Our central hypothesis is that firms most vulnerable to biodiversity-related regulation are those whose operations rely directly on the surrounding physical environment. For example, consider two oil drilling companies—one operating within, or near, an AUBI and one well outside it. If conservation policy restricts industrial activity in ecologically sensitive regions, only the firm within the AUBI would be directly affected, facing potential operational disruptions or compliance costs. In contrast, sectors such as Technology or Financial Services are less tied to natural capital or fixed geographies and may therefore exhibit weaker pricing of biodiversity-related risks.

To capture this heterogeneity in exposure, we segment firms based on their primary industry classification. Specifically, we define location- and nature-dependent firms as those with a two-digit NAICS[18] code ≤ 33, which includes sectors as Agriculture/Forestry,

[18]We classify firms using the North American Industry Classification System (NAICS), a standardized framework developed by U.S., Canadian, and Mexican statistical agencies to categorize businesses by economic activity. Each firm is assigned a NAICS code ranging from two to six digits, where additional digits denote increasing specificity. For instance, the 2-digit code 23 refers broadly to the Construction sector, 236 to Construction of Buildings, 2362 to Nonresidential Building Construction, and 236210 to Industrial Building Construction. This hierarchy illustrates that finer-grained codes often reflect more specialized but closely related operations, suggesting diminishing within-sector heterogeneity beyond the 2-digit level.

Mining/Oil & Gas, Utilities, Construction, and Manufacturing. These industries depend heavily on land use, resource extraction, and proximity to natural ecosystems, making them especially sensitive to local environmental regulation. Firms in other sectors (NAICS codes > 33) are assumed to be less reliant on physical geography and thus less exposed to direct biodiversity regulatory risk.

We maintain this distinction throughout the paper and report counts for each sectoral category in Table IA.3.

B.2 Predictability of Firm-level AUBI Exposure

In this section, we validate the empirical distinctiveness of our firm-level AUBI exposure measure. Establishing that AUBI exposure is orthogonal to known firm-level characteristics and ESG risk proxies is essential to interpreting our results as reflecting a novel regulatory risk. We first examine whether AUBI exposure is mechanically related to standard firm-level observables by regressing it on a broad set of financial and emissions variables. As shown in Table 2, aside from marginally statistically significant coefficients on market cap and capex, we find little evidence of systematic correlation, regardless of industry segmentation. This suggests that AUBI exposure is not simply capturing size effects, investment intensity, or existing climate-related disclosures.

We also address the concern that AUBI exposure may be inadvertently correlated with physical climate vulnerability, since regions with high biodiversity, such as coastal zones or forested areas, may also be particularly susceptible to climate change. To account for this possibility, we include controls for NatureServe's Climate Change Exposure Score and Habitat Climate Change Vulnerability Index (HCCVI). The Climate Exposure Score incorporates two dimensions of climate stress: *Climate Departure*, which measures projected deviations in temperature and precipitation from historical norms, and *Climate Sensitivity*, which captures modeled shifts in habitat suitability. The HCCVI provides a composite measure of vulnerability at the ecosystem level. Even after including these controls, we find no meaningful explanatory power: adjusted R^2 values remain below 0.06 across both nature-dependent and other industry groups. This reinforces that our AUBI measure captures a distinct dimension of regulatory risk not subsumed by climate vulnerability or firm fundamentals.

IV. Cross-Sectional Results

We study the cross-sectional relationship between stock returns and firm-level exposure to Areas of Unprotected Biodiversity Importance (AUBI) to determine whether investors consider biodiversity regulatory risk. We place particular emphasis on industry heterogeneity, focusing on sectors that are highly nature- and location-dependent, where biodiversity exposure is most likely to be financially material. We also explore how salience, proxied by the 30 by 30 initiative and media attention, amplifies the pricing of biodiversity regulatory risk. Further, to confirm that our results are not confounded by climate-related risk factors, we control for firm-level Scope 1, 2, and 3 carbon emissions.

A. Cross-Sectional Evidence

Our baseline specification estimates the relationship between firm-level AUBI exposure and monthly stock returns using the following pooled OLS regression:

$$\textit{Monthly Return}_{it} = \beta_0 + \beta_1 \textit{Employee Weighted AUBI Exposure}_i + \beta_2 X_{i,t-1} + \gamma_{jt} + \epsilon_{it} \quad (1)$$

where $\textit{Monthly Return}_{it}$ is the return of firm i in year-month t, $\textit{Employee Weighted AUBI Exposure}_i$ is our main firm-level measure of AUBI exposure, γ_{jt} denotes industry-by-year-month fixed effects, and $X_{i,t-1}$ is a set of lagged firm-level control variables.

Our control set follows prior literature on the asset pricing implications of environmental risks (e.g., Bolton and Kacperczyk, 2023; Hsu, Li, and Tsou, 2023; Garel et al., 2024). Annual controls include log(total assets), leverage, capital expenditures scaled by assets, PPE-to-assets, ROA, asset growth, log(market cap), book-to-market, and sales growth, all lagged one year. Monthly controls include volatility and momentum, lagged one month. The sample spans 2020–2023, and standard errors are clustered at the firm level.

We are particularly interested in the heterogeneous effect of AUBI exposure across industries. The relationship between AUBI exposure and stock returns may vary substantially by sector, reflecting differences in reliance on natural resources and geographic specificity. To examine this heterogeneity, we divide the sample into two groups: (i) industries with high nature- and location-dependence and (ii) all other industries. We estimate the cross-sectional regression separately for each group and find that the negative

relationship between AUBI exposure and stock returns is concentrated in high nature-dependent sectors, while the effect is muted and statistically insignificant in the residual group.

To further isolate biodiversity-specific effects, we include Climate Change Exposure Score and Habitat Climate Change Vulnerability Index (HCCVI). By controlling for these scores, we address the possibility that the observed relationship between AUBI exposure and returns may be confounded by climate risk, particularly if biodiversity hotspots overlap geographically with regions facing heightened climate stress. Our findings remain robust: AUBI exposure continues to predict lower returns even after accounting for these dimensions of physical climate risk.

Table 3 presents the results of these regressions, with Mining, Oil & Gas, Utilities, Construction, and Manufacturing industries represented in Columns (1)-(6), and all other industries in Columns (7)-(12). The results reveal a strong and statistically significant negative relationship between AUBI exposure and stock returns in nature- and location-dependent sectors. For example, in Column (1), the coefficient on Employee-Weighted AUBI Exposure is -1.646, significant at the 1% level, implying that a one-standard-deviation increase in AUBI exposure (SD = 0.28) is associated with a 5.53% decline in annualized returns. This relationship remains robust across specifications that employ alternative AUBI constructions (even-numbered columns) and more granular fixed effects (Columns 3 and 5).

We also analyze the full sample without industry segmentation and report the results in Table IB.2. Across all specifications, we find a negative and statistically significant relationship between AUBI exposure and realized stock returns. The coefficient β_1 is estimated at -1.317, implying that a one-standard-deviation increase in AUBI exposure (SD = 0.22) reduces annualized returns by 3.48%.

Interestingly, as we refine our fixed effects from 2-digit to 3-digit NAICS industry codes, the magnitude of the coefficient increases while remaining statistically significant. Although the coefficient slightly attenuates at the 4-digit level, it retains its significance and economic relevance. This pattern is noteworthy, as firms within a 4-digit NAICS code are highly homogeneous.[19] Controlling for industry-by-year-month fixed effects at this

[19]For example, within NAICS 2121 (Coal Mining), distinctions are primarily between surface coal mining and underground coal mining.

level absorbs highly specific industry shocks, essentially isolating firm-level variation in geographic exposure to AUBIs. The persistence of the AUBI-return relationship under such stringent controls underscores the locational nature of the risk and supports the interpretation that AUBI captures an economically distinct and priced form of regulatory exposure.

In contrast, the relationship is substantially weaker and statistically insignificant in other industries, with a coefficient of -0.575 in Column (7).[20] These results reinforce our central hypothesis: biodiversity-related regulatory risks are more pertinent to firms with high-dependence on natural resources and fixed geographic operations. These firms are most likely to face heightened regulatory scrutiny and potential operational constraints stemming from conservation efforts.

A.1 Launch of 30 by 30 Initiative

The launch of the 30 by 30 initiative in 2020 introduced a credible source of regulatory risk for firms operating in areas of high biodiversity importance. By setting ambitious conservation targets, the initiative created the potential for new land-use restrictions that could affect firm operations and decrease profitability. It also heightened investor awareness of biodiversity-related risks, thereby increasing their salience in asset pricing. As such, we would expect the relationship between AUBI exposure and stock returns to be stronger and more persistent in the post-2020 period.

To test this hypothesis, we re-estimate our baseline regressions using data from 2016 to 2019. Table IB.4 presents the results. Columns (1)-(4) replicate our baseline specification under different fixed effects, while Columns (5)-(8) incorporate alternative AUBI exposure measures and climate change exposure controls, with industry-by-year-month fixed effects. Across all specifications, the coefficients on AUBI exposure measures are small and statistically insignificant. These findings indicate that the relationship between AUBI exposure and stock returns emerged only after 2020. The absence of a pre-2020 relationship likely reflects limited investor attention and the lack of binding regulatory initiatives prior to the formal adoption of the 30 by 30 conservation framework.

[20] In Column (7) our Employee Weighted Distance AUBI measure has significance, but we highlight that it disappears as we refine our fixed effects down to the 4-digit level.

A.2 Controlling for Firm-level Carbon Risk

Carbon transition risk has been extensively studied in the environmental finance literature (e.g., Bolton and Kacperczyk (2021), Bolton and Kacperczyk (2023)) and may potentially confound the relationship between biodiversity exposure and stock returns. To ensure our findings are not driven by firm-level carbon risk, we obtain Scope 1, Scope 2, and Scope 3 emissions data from Trucost and re-estimate our baseline regressions, controlling for both the levels and intensities of these emissions.

Table IB.6 reports results for the full sample, while Table 4 presents separate estimates for nature- and location-dependent firms versus other firms. Among nature-dependent firms, we find that controlling for log(Scope Emissions) slightly diminishes the magnitude and significance of the coefficients on *Employee Weighted AUBI Exposure* and *Employee Weighted Distance AUBI Exposure*. However, both coefficients remain statistically significant, indicating that biodiversity exposure continues to explain return variation above and beyond carbon risk. As before, we find no statistically significant relationship between AUBI exposure and returns in firms outside nature- and location-dependent sectors.

B. Media Attention

Growing regulatory attention to biodiversity risks, particularly through initiatives like the 30 by 30 conservation effort, has heightened the salience of these issues among investors. To systematically measure media attention to biodiversity conservation, we extract data from Factiva, which aggregates news articles from major publications. Using a structured query approach, we collect the unique number of articles mentioning the 30 by 30 initiative, ensuring relevance by applying keyword filters, as detailed in Figure IA.3. Specifically, the query is designed to capture various forms of the phrase "30 by 30" while filtering out irrelevant terms. The dataset is limited to U.S.-based sources and English-language articles, and we include only articles that contain at least one additional keyword related to conservation or environmental policy to improve precision. A qualitative review of retrieved articles reveals that coverage is predominantly focused on regulatory developments—such as executive actions, agency rulemaking, and conservation legislation—rather than general biodiversity loss or ecosystem narratives. This reinforces the interpretation of our media variable as a proxy for regulatory policy salience rather than

environmental awareness more broadly.

Figure 4 presents the monthly trend in media mentions of the 30 by 30 initiative. The 30 by 30 initiative was first proposed in 2014 during the World Parks Congress and gradually gained traction in scientific and policy discussions over the following years. This early engagement led to sporadic media coverage before 2020, as conservation groups and policymakers debated its implementation. However, media attention remained relatively low during this period, as biodiversity conservation had not yet become a mainstream regulatory focus. The number of articles referencing the initiative increases sharply following the announcement of the executive order. This trend suggests a substantial rise in public and regulatory attention to biodiversity conservation, reinforcing the potential for market reactions to such developments.

To assess whether media coverage amplifies the relationship between AUBI exposure and stock returns, we extend our baseline regression by interacting AUBI exposure with a lagged binary variable indicating whether the given month falls within the top tercile of media mention growth. This variable captures periods of heightened public and investor focus on biodiversity-related regulations. Since media mentions were relatively low before 2021, we compute media growth only for months starting in 2021 to ensure that growth measures are meaningful. Table 5 presents the results. Columns (1)-(4) restrict the sample to firms in nature-dependent industries, while Columns (5)-(8) include firms in all other sectors. Odd-numbered columns include industry-by-year-month fixed effects, while even-numbered columns also control for firm fixed effects to account for time-invariant firm characteristics. Standard errors are clustered at the firm level.

Across all specifications in Columns (1)-(4), we find that higher media attention strengthens the negative relationship between AUBI exposure and stock returns. The interaction term is consistently negative and significant, suggesting that investor sensitivity to biodiversity risks is amplified during periods of high media salience. By contrast, Columns (5)-(8), which examine firms in other industries, yield smaller and statistically insignificant interaction effects, consistent with our earlier finding that biodiversity risk is primarily priced in nature-dependent sectors.

To further validate that our biodiversity risk measure captures investor sensitivity to biodiversity-specific information—rather than general environmental or climate salience—we augment our baseline specification by including interaction terms for both

biodiversity-related and climate-related media attention. Specifically, we interact AUBI exposure with indicator variables for months in the top tercile of biodiversity and climate media mention growth, respectively. Climate media attention is constructed using news sentiment scores from the Sentometrics Climate Change Index (Ardia, Bluteau, Boudt, and Inghelbrecht, 2023). The sample is again restricted to 2021-2023 to ensure meaningful variation in media salience.

Table IB.7 presents the results. Across all specifications, we continue to find that biodiversity-related media coverage significantly amplifies the negative relationship between AUBI exposure and returns, particularly in nature-dependent industries (Columns 1-4). In contrast, the interaction terms involving climate media growth are small and statistically insignificant, suggesting that the pricing of our biodiversity risk measure is not merely a reflection of general climate concerns.

Taken together, the results in Table IB.7 reinforce our interpretation that the AUBI exposure measure captures risks that are distinctively biodiversity-related, and that investor sensitivity to these risks increases during periods of high biodiversity media salience — not just during broader climate news cycles.

C. AUBI Exposure Sorted Portfolios

To further validate our findings, we construct a long-short portfolio strategy based on firm-level exposure to Areas of Unprotected Biodiversity Importance (AUBI). While our regression analyses provide strong evidence that firms with high AUBI exposure exhibit lower returns, potential econometric concerns, such as omitted variables or model specification issues, may still arise. To address these concerns, we examine whether the excess returns of a long-short portfolio sorted on AUBI exposure can be explained by known risk factors. We begin by sorting stocks into three individual portfolios based on their AUBI exposure: high, medium, and low. In addition, we construct a long-short portfolio that takes a long position in firms with high AUBI exposure and a short position in firms with low AUBI exposure. Using the sample period from 2020 to 2023, we analyze whether the monthly returns of the long-short portfolio are explained by standard asset pricing models. Specifically, we estimate alphas using the Fama-French three-factor model, the Carhart four-factor model, and extended factor models that include investment and profitability,

carbon, and green factors.

Table 6 presents the results from portfolio regressions using standard asset pricing models. Columns (1) through (5) report regressions of the long-short portfolio's monthly returns (in percent) using the Fama-French 3-factor model (Column 1), the 3-factor plus momentum (Column 2), Fama-French 5-factor plus momentum (Column 3), and further controlling for intangible-related factors (Column 4). Column (5) adds the Green-minus-Brown (GMB) factor from Pástor, Stambaugh, and Taylor (2021). Across all specifications, the long-short portfolio delivers consistently negative and statistically significant alpha, with magnitudes around -0.63% to -0.82% per month. This suggests that firms with high AUBI exposure underperform relative to those with low exposure, and this return spread is not explained by standard risk factors, including ESG-related ones like GMB. These results reinforce our central finding: biodiversity regulatory risk is associated with lower stock returns, especially in nature-dependent sectors.

To assess whether the return differential associated with AUBI exposure existed prior to the period of heightened biodiversity policy salience, Table IC.1 analyzes long-short portfolios formed by taking a long position in the high-AUBI exposure portfolio and a short position in the low-AUBI exposure portfolio. Firms are sorted into terciles based on their employee-weighted AUBI exposure. Columns (1)-(5) focus on firms in industries outside of the nature-dependent sectors, while Columns (6)-(10) restrict the sample to firms in Mining, Oil & Gas, Utilities, Construction, and Manufacturing during the 2016-2019 period. Each column adds additional asset pricing factors, beginning with the Fama-French three factors and progressively including momentum, investment, profitability, and the green-minus-brown (GMB) factor from Pástor, Stambaugh, and Taylor (2022). Across all ten columns, we do not observe statistically significant alphas, indicating that the AUBI-related return spread documented in the post-2020 period does not appear prior to the surge in biodiversity-related regulatory attention. These results reinforce the view that the return differential is a recent phenomenon, concentrated in salient industries and time periods.

In addition, we test whether our results are solely driven by the executive order signed in January 2021, which includes the 30 by 30 initiative. Table IC.2 replicates our main long-short portfolio analysis but removes January 2021 from the sample. The results remain statistically significant, confirming that the negative return effect associated with

high AUBI exposure is not solely driven by this particular policy announcement.

V. Event Study

In this section, we examine two key events that serve as exogenous shocks to investor expectations regarding biodiversity-related regulation. On January 27, 2021, President Joseph Biden signed an executive order initiating the "30 by 30" conservation initiative. This policy announcement likely prompted a reassessment of regulatory risks for firms with high AUBI exposure. We also analyze November 5, 2024—the date of President Donald Trump's election—given his well-documented opposition to environmental regulation and the anticipated implications for biodiversity policy.[21] We treat this election outcome as a proxy for a reversal in expected regulatory direction.

These events provide a unique opportunity to examine short-term market reactions to shifts in anticipated biodiversity-related regulation. To isolate the immediate pricing effects, we conduct an event study of daily cumulative abnormal returns (CARs) around each announcement. We estimate baseline betas over a 100-trading-day window ending 10 days prior to the event window. The short window spans $t = -3$ to $t = 10$, while longer windows extend to $t = 30$ and $t = 90$.

Our baseline models include the Fama-French three-factor (FF3) and Fama-French-Carhart four-factor (FFC4) models. We then augment these with daily returns on a green-minus-brown (GMB) portfolio, denoted as G, and on three carbon portfolios sorted by emissions intensity (Scopes 1-3), denoted collectively as C.[22] These additions help ensure that observed CARs reflect biodiversity-specific risks, rather than broader green or carbon transition effects. Details on factor construction are provided in the Data section.

A. CARs of Long-Short Portfolio

To illustrate the differential market response to biodiversity regulatory shocks, we construct an equal-weighted long-short portfolio that buys firms in the top tercile of AUBI

[21] President Trump revoked the 30 by 30 initiative via executive order on his first day in office. While this revocation date would offer a cleaner test of realized policy change, we await the release of Fama-French factor data for early 2025 to maintain consistency in our methodology.

[22] Details on construction of these portfolios can be found at Table IA.4.

exposure and shorts those in the bottom tercile.[23]

This long-short design isolates the return spread between firms most and least exposed to biodiversity regulatory risk. By controlling for carbon and GMB factors in the regression, we further disentangle biodiversity-driven pricing effects from those related to the broader green transition.

We consider several potential CAR graphs around January 27, 2021. A muted or flat response would suggest either that biodiversity risk was already priced in or that our AUBI measure fails to capture biodiversity regulatory risk. In contrast, a pronounced negative CAR would support the hypothesis that biodiversity exposure entails regulatory risk that was previously unanticipated. Importantly, we expect any such response to be most pronounced in sectors that are highly nature- or location-dependent, consistent with our hypothesis.

Panel A of Figure 5 presents cumulative abnormal returns (CARs) for our long-short portfolio around the January 27, 2021 executive order. We report results for three groups of firms: the full sample, a subset of nature- and location-dependent sectors, and a residual group comprising all other sectors. Solid lines correspond to estimates from the FFC4 model, dotted lines include controls for the green-minus-brown (FFC4 + G) portfolio, and dashed lines additionally control for carbon (FFC4 + G + C) portfolios sorted by emissions intensity. These specifications demonstrate robustness to broader green and carbon transition risks.

Prior to the January 27, 2021 announcement, differential CARs across all groups remained relatively stable, exhibiting minimal drift. Following the executive order, however, we observe a pronounced divergence in returns. Specifically, the long-short portfolio experiences an immediate and sustained negative CAR in nature-dependent industries. This indicates significant underperformance by high-AUBI firms relative to low-AUBI firms, consistent with investors rapidly repricing biodiversity regulatory risks associated with the 30 by 30 initiative. The persistent downward trajectory of the differential CAR throughout the post-event window further supports ongoing market reassessment. In contrast, differential CARs in non-nature-dependent industries exhibit only mild movements, remaining relatively flat overall. The full-sample CAR shows moderate negative returns,

[23] Firms in our sample have zero exposure up to roughly the 36th percentile, so the short leg effectively captures the bottom 36% of the distribution.

driven predominantly by the strong differential effect among nature-dependent firms. In Panel B of Figure 5, we extend the event window to 90 days to evaluate the persistence of this differential effect. We continue to observe substantially negative differential CARs for nature-dependent firms, while non-nature-dependent firms exhibit minimal changes.

We further test a set of placebo policy dates—including President Trump's first election and inauguration, the U.S. withdrawal from the Paris Climate Accord on June 1, 2017, and President Biden's election in 2020. We selected these events because they represent major shifts in U.S. environmental policy, particularly on climate, but occurred before biodiversity regulation had emerged as a salient or prioritized issue. If AUBI exposure captured general environmental or transition risk, we would expect similar return differential between high- and low-AUBI exposure firms around these dates, regardless of sector.

Figure 7 presents CARs around each of these placebo events. While minor fluctuations are visible, none approach the magnitude, direction, or persistence of the differential return we observe following the January 27, 2021 executive order initiating the 30 by 30 biodiversity conservation initiative. Notably, even the U.S. withdrawal from the Paris Agreement, a highly salient climate policy event with substantial implications for carbon regulation, elicits no clear negative return differential. Similarly, President Trump's 2016 election and inauguration, which broadly signaled deregulatory intent, do not produce the kind of pronounced reversal we observe following his 2024 re-election. These muted placebo responses underscore a key distinction: the market reaction to the 30 by 30 initiative is not simply a reflection of general environmental sentiment or climate risk pricing. Rather, it appears to capture investor recognition of a specific shift in the regulatory landscape surrounding biodiversity. This distinction is crucial. Unlike carbon emissions, which are tied to firm-level production and often internalized via disclosures or existing investor frameworks, biodiversity exposure was not salient in financial markets until recently. Our results suggest that it is only with the rise of concrete conservation policy, increased media attention, and mounting regulatory credibility around biodiversity that markets began to incorporate these risks into firm valuations.

In Figure 6, we replicate our analysis around November 5, 2024, the date of President Trump's re-election. Given President Trump's documented opposition to environmental regulation, we hypothesize a reversal of the pattern observed around January 27, 2021.

A lack of such reversal would cast doubt on our measure's ability to capture biodiversity regulatory risk. However, consistent with our expectations, we observe a contrasting effect: the long-short portfolio for nature-dependent firms generates positive differential CARs following President Trump's election, partially offsetting the earlier negative returns. This positive return is smaller in magnitude compared to the initial negative response, which aligns with the interpretation that investors remain cautious of potential future regulatory actions beyond the current administration.

Panel B of Figure 6 extends the analysis to a 30-day event window around November 5, 2024, demonstrating that this positive differential CAR persists beyond the immediate post-election period. We provide results for all analyses using the Fama-French three-factor model in Figures ID.1, ID.2, and ID.3. Taken together, the results in this section strongly indicate that our AUBI measure effectively captures biodiversity regulatory risk, reinforcing our conclusion that investors have actively priced this risk predominantly after 2020.

B. Firm-Level CARs

To formally test whether firms with high AUBI exposure exhibited significantly different stock price reactions, we estimate firm-level CARs and conduct a cross-sectional regression analysis. CARs are computed using the same 100-trading-day estimation window as in the portfolio-level analysis, and we evaluate event windows of $t = [-3, 3]$, $t = [-3, 5]$, and $t = [-3, 10]$. We then regress firm-level CARs on a binary variable indicating whether a firm falls within the top tercile of AUBI exposure:

$$CAR_i = \beta_0 + \beta_1 Top\ Tercile_i + \epsilon_i \tag{2}$$

where β_1 captures the differential abnormal return for high-AUBI firms relative to low-AUBI firms. Panel A of Table 7 presents regression estimates for firm-level cumulative abnormal returns (CARs) around the January 27, 2021 executive order. CARs are estimated using the Fama-French-Carhart four-factor (FFC4) model, as well as specifications augmented with the green-minus-brown portfolio (G) and three carbon portfolios sorted by emission intensity (Scopes 1–3), collectively denoted as C. All coefficients are expressed in percentage points.

For the full sample, we find statistically significant negative coefficients for the longer event windows across all model specifications. This implies that firms with high AUBI exposure experienced between -3.85% and -4.06% cumulative abnormal returns 5 days following the executive order, controlling for market-wide and green transition factors. The results are consistent under the FFC4, FFC4+G, and FFC4+G+C models.

When focusing on nature- and location-dependent firms, the effect becomes even more pronounced. Across both 5-day and 10-day windows, we observe larger and more statistically significant negative CARs. Specifically, coefficients range from -9.44% to -9.83% under different model variants. For the $t = [-3, 5]$ window, results are significant at the 5% level under the FFC4 and FFC4+G models, and at the 10% level under FFC4+G+C. For the $t = [-3, 10]$ window, all models yield 5% significance.

By contrast, we find no statistically significant CARs for firms in other industries. Across all specifications and event windows, coefficients remain small and indistinguishable from zero, underscoring that biodiversity exposure is primarily relevant for nature- and location-dependent sectors. These results confirm that biodiversity regulatory risk was most salient for firms heavily reliant on land and natural ecosystems. By controlling for firm-level carbon emissions, incorporating a GMB factor, and focusing on an event that directly targets biodiversity policy, we show that our measure captures exposure to biodiversity-specific regulatory risk rather than broader environmental or climate-related factors.

We replicate this analysis for the November 5, 2024 election of President Donald Trump. Results for this event, presented in Panel B of Table 7, show that top-tercile AUBI firms in nature- and location-dependent sectors experienced significantly positive CARs, with a return of approximately 2.74% over the $[-3, 5]$ window. This finding suggests a partial reversal of the earlier valuation discount observed after the 2021 executive order. The effect is statistically significant across all model variants, though not uniformly across all specifications. It reaches 10% significance under our preferred specification, which includes the full set of green and carbon controls.

As with the earlier event, the effect is concentrated in sectors most exposed to biodiversity regulation. However, the overall magnitude and statistical significance of the response are more muted. We attribute this to the inherent uncertainty and noise surrounding election-day returns: overlapping macroeconomic and political factors make it

harder to isolate biodiversity-specific effects, particularly when the signal is expected to be more subtle.

Nonetheless, the significant positive abnormal return for high-AUBI firms supports the interpretation that investors reassessed biodiversity regulatory risk in response to the anticipated policy reversal. This interpretation is further reinforced by the long-short portfolio analysis, which reveals a clear and persistent divergence in returns between firms in nature-dependent sectors and those in other industries.

We further test a set of placebo policy dates—including President Trump's first election and inauguration, the U.S. withdrawal from the Paris Climate Accord on June 1, 2017, and President Biden's election in 2020. Results for these alternative events are presented in Table ID.2, using both FF3 and FFC4 model specifications. We find no consistent evidence of significant CARs for high-AUBI firms around these events. Effects are minimal under the FFC4 specification and none persist in the $[-3, 10]$ window. These results reinforce that the market began pricing biodiversity regulatory risk primarily in response to the heightened policy salience that followed the launch of the 30 by 30 initiative and related post-2020 developments.

Taken together, the event study results provide strong evidence that investors have increasingly priced biodiversity regulatory risk into equity valuations—particularly for firms operating in areas of biodiversity importance. The asymmetric market reactions to policy signals in 2021 and 2024, combined with the absence of effects in placebo periods or for unaffected sectors, underscore both the timing and sector-specific nature of this risk channel. These findings reinforce the validity of our AUBI measure and highlight the growing salience of biodiversity as a financially material dimension of environmental risk.

VI. Explanatory Mechanisms

In the previous sections, we documented a robust negative relationship between firm-level exposure to Areas of Unprotected Biodiversity Importance (AUBI) and stock returns. This relationship holds across a range of tests, including controls for climate risk, firm-level carbon emissions, and industry-specific characteristics. In this section, we explore potential mechanisms behind this pricing pattern by examining how institutional in-

vestors—particularly active funds—respond to biodiversity regulatory risk.

One potential explanation is that sophisticated investors recognize the emergence of biodiversity regulation and adjust their portfolios accordingly, reducing exposure to firms most at risk. We investigate this by analyzing holdings data from institutional investors and actively managed mutual funds. Additionally, we test whether ESG-oriented funds respond differently to biodiversity risk or whether divestment reflects broader financial risk reallocation.

A. Institutional Ownership

We hypothesize that institutional investors may respond to emerging biodiversity regulatory risk by reallocating away from firms with high AUBI exposure. To test this, we begin with a broad analysis of institutional ownership using 13F filings from Thomson Reuters, which report the percentage of shares held by different types of institutional investors. Our dataset spans 2020 to 2023 and categorizes investors into banks, insurance companies, investment companies, and independent investment advisors. We estimate the following regression:

$$\textit{Institutional Ownership}_{it} = \beta_0 + \beta_1 \textit{Employee Weighted AUBI Exposure}_i + \beta_2 X_{i,t-1} + \gamma_{jt} + \epsilon_{it} \quad (3)$$

where $\textit{Institutional Ownership}_{it}$ represents the percentage of shares held by certain type of institutional investors for firm i at time t. $X_{i,t-1}$ is a set of control variables, and γ_{jt} represents industry-by-year-quarter fixed effects. $\textit{Employee Weighted AUBI Exposure}_i$ captures firm-level exposure to AUBI and β_1 is the coefficient of interest. We include firm characteristics such as size, leverage, book-to-market ratio, and capital expenditures, as well as controls for climate change exposure.

Table 8 reports results by investor type. For banks, insurance companies, and independent investment advisors, we find no significant relationship between ownership and AUBI exposure. However, for investment companies—a category that includes some of the most sophisticated investor groups, such as mutual funds and hedge funds—the coefficient on AUBI exposure is negative and statistically significant. In Column (5), for instance, the estimated β_1 on *Employee Weighted AUBI Exposure* is -0.194, suggesting a systematic reduction in holdings of firms with higher biodiversity exposure. No such

relationship is present in other sectors (Column 6), reinforcing the idea that biodiversity exposure is most salient where firms directly interact with natural ecosystems. These results indicate that more informed investors have begun reallocating away from firms facing emerging biodiversity regulatory risk.

B. Active Fund Behavior and ESG Reallocation

We now turn to a more granular analysis of active institutional investor behavior to understand how sophisticated market participants respond to biodiversity regulatory risk. In particular, we focus on actively managed mutual funds, which are more likely to engage in forward-looking portfolio reallocation than passive index funds. To that end, we analyze fund holdings data from the CRSP Mutual Funds database, restricting our sample to U.S.-domiciled, actively managed equity funds. We remove index funds and other passive vehicles based on CRSP classifications. The analysis covers the period from 2016 to 2023, allowing us to examine how fund behavior evolves around the rise in biodiversity regulatory salience beginning in 2020.

We begin by estimating a dynamic difference-in-differences model that compares monthly changes in the share of fund assets allocated to firms in the top and bottom terciles of AUBI exposure. Figure 8 plots the resulting coefficients over time for firms in nature- and location-dependent sectors, focusing exclusively on active mutual funds and excluding passive indexers. Relative to December 2020, we observe a persistent decline in holdings of high-AUBI firms, with statistically significant differences at the 5% level in nine separate months: January 2021, April 2021, May 2021, June 2021, September 2021, October 2021, February 2023, April 2023, and October 2023. These months coincide with several key moments in U.S. biodiversity policy development, including the issuance of Executive Order 14008, the launch of the America the Beautiful Initiative, the announcement of the Inflation Reduction Act, the proposal of the Bureau of Land Management's Public Lands Rule, and the close of the public comment period on three major ESA regulatory revisions. This temporal alignment suggests that active investors reallocate away from biodiversity-exposed firms in response to heightened regulatory salience.

In the second part of our analysis, we test whether mutual funds with higher ESG orientations exhibit stronger responses to biodiversity risk. To do so, we merge in fund-

level sustainability ratings from Morningstar Direct. Morningstar assigns ESG scores on a 1-to-5 "globe" scale, with higher values indicating lower ESG risk. We estimate a triple-difference regression that interacts post-2020 timing, high AUBI exposure, and ESG orientation to assess whether sustainability-focused funds are more likely to reduce exposure to biodiversity risk.

The regression is specified as follows:

$$\begin{aligned} \textit{Fund Holdings}_{ift} = \beta_0 &+ \beta_1(\textit{Top Tercile AUBI}_i \times \textit{Post-2020}_t) \\ &+ \beta_2(\textit{Top Tercile AUBI}_i \times \textit{Post-2020}_t \times \textit{High ESG Fund}_f) \\ &+ \beta_3 X_{it-1} + \textit{Fixed Effects} + \epsilon_{ift} \end{aligned} \tag{4}$$

where $\textit{Holdings}_{ift}$ denotes the percentage of total net assets that mutual fund portfolio f allocates to firm i in month t; $\textit{Top Tercile AUBI}_i$ is a binary indicator equal to one if firm i is in the top tercile of biodiversity regulatory exposure, based on our AUBI measure; $\textit{Post-2020}_t$ is a binary variable equal to one for all months in 2020 and beyond; and $\textit{High ESG Fund}_f$ equals one if fund f has a Morningstar sustainability rating of three or more globes. X_{it-1} is a vector of lagged firm-level control variables, including financial characteristics and environmental risk indicators. β_1 captures the difference-in-differences estimate: the change in mutual fund holdings of high-AUBI firms after 2020 relative to before 2020, compared to the change in holdings of low-AUBI firms. β_2 captures whether this post-2020 divestment effect is stronger among funds classified as high ESG, consistent with sustainability-driven portfolio reallocation.

Table 9 presents the results. Columns (1)-(3) report estimates for nature-dependent sectors, while Columns (4)-(6) report results for all other sectors. All specifications include fund-by-industry-by-year-month fixed effects, and standard errors are clustered at the firm level. Column (1) includes a baseline difference-in-differences specification using the interaction *Post-2020* × *Top Tercile AUBI*. Column (2) adds the triple interaction with the high ESG fund indicator, and Column (3) includes only the triple interaction, along with firm-by-year-month and fund-by-firm fixed effects. Columns (4)-(6) follow the same structure for firms in other sectors. The inclusion of high-dimensional fixed effects absorbs time-varying shocks at the fund, sector, and month level, as well as persistent firm-level heterogeneity in the fully saturated specifications.

Across nature-dependent sectors (Columns 1-3), we find a consistently negative and statistically significant estimate of β_1 in Columns (1) and (2), indicating that active mutual funds reduced their holdings in firms with high AUBI exposure following 2020. In contrast, there is no consistent or statistically significant evidence of divestment in non–nature-dependent sectors (Columns 4-6), where β_1 is small and insignificant. Further, the coefficient on the triple interaction term (β_2) is small and statistically insignificant across both nature-dependent (Columns 2-3) and other sectors (Columns 5-6), suggesting that ESG-oriented funds do not divest from biodiversity regulation-exposed firms at higher rates than other active funds. This lack of differential behavior by sustainability-focused investors highlights a central feature of our measure: because AUBI exposure is derived from geospatial proximity to ecologically sensitive areas—rather than from firm-level emissions, disclosures, or ESG scores—it likely falls outside the scope of conventional ESG screening. The absence of an ESG-driven response reinforces our interpretation that biodiversity regulatory exposure represents a novel and distinct source of risk that remains orthogonal to existing ESG frameworks.

Taken together, our results provide evidence that sophisticated, active investors systematically reduce their holdings in nature-dependent firms with high exposure to biodiversity regulatory risk. Perhaps most notably, we find that ESG-oriented funds do not divest at higher rates than other active funds. These findings point to two key conclusions. First, because our AUBI measure is spatially grounded and independent of firm-level ESG characteristics, it is unlikely to be captured by conventional ESG screening strategies. And second, the observed divestment appears to reflect broader portfolio reallocation driven by regulatory risk or mispricing associated with impending biodiversity regulation.

VII. Conclusion

Biodiversity loss poses a distinct and underexplored financial risk, often overlooked in empirical asset pricing and inadequately captured by climate-focused literature. We address this gap by introducing a novel firm-level measure of biodiversity exposure (AUBI), derived from endangered species habitat modeling.

Our findings show that firms with higher AUBI exposure earn significantly lower returns, especially during periods of elevated biodiversity-related media coverage and

following major regulatory events like the U.S. 30 by 30 initiative. These effects are robust to controls for carbon risk and are not subsumed by the Green-Minus-Brown (GMB) factor, highlighting biodiversity as a unique and independent risk channel.

Institutional investors—particularly active mutual and hedge funds—respond to this risk by systematically reducing holdings in high-exposure firms. These results have important implications: investors must account for biodiversity risk in portfolio strategies, and policymakers should develop targeted disclosure standards. Our AUBI measure offers a scalable framework for integrating biodiversity risk into financial analysis as conservation policies continue to evolve.

References

Acharya, Viral V, Timothy Johnson, Suresh Sundaresan, and Tuomas Tomunen, 2022, *Is physical climate risk priced? Evidence from regional variation in exposure to heat stress*, number w30445 (National Bureau of Economic Research Cambridge, MA, USA).

Agarwal, Vikas, Wei Jiang, Yuehua Tang, and Baozhong Yang, 2013, Uncovering hedge fund skill from the portfolio holdings they hide, *The Journal of Finance* 68, 739–783.

Allan, James R, Hugh P Possingham, Scott C Atkinson, Anthony Waldron, Moreno Di Marco, Stuart HM Butchart, Vanessa M Adams, W Daniel Kissling, Thomas Worsdell, Chris Sandbrook, et al., 2022, The minimum land area requiring conservation attention to safeguard biodiversity, *Science* 376, 1094–1101.

Ardia, David, Keven Bluteau, Kris Boudt, and Koen Inghelbrecht, 2023, Climate change concerns and the performance of green vs. brown stocks, *Management Science* 69, 7607–7632.

Blarel, Benoit Paul, Giovanni Ruta, Olga Gavryliuk, Pauline Elodie Poisson, Fiona Elizabeth Stewart, Samantha Elizabeth Power, Benjamin Marie Camille Guillon, Irina Likhachova, and Lisa Michelle Choux, 2023, Mobilizing private finance for nature: A world bank group paper on private finance for biodiversity and ecosystem services .

Bolton, Patrick, and Marcin Kacperczyk, 2021, Do investors care about carbon risk?, *Journal of Financial Economics* 142, 517–549.

Bolton, Patrick, and Marcin Kacperczyk, 2023, Global Pricing of Carbon-Transition Risk, *The Journal of Finance* 78, 3677–3754.

Brogaard, Jonathan, and Andrew Detzel, 2015, The asset-pricing implications of government economic policy uncertainty, *Management science* 61, 3–18.

Carroll, Carlos, and Reed F Noss, 2022, How percentage-protected targets can support positive biodiversity outcomes, *Conservation Biology* 36, e13869.

Choi, Darwin, Zhenyu Gao, and Wenxi Jiang, 2020, Attention to global warming, *The Review of Financial Studies* 33, 1112–1145.

Coqueret, Guillaume, Thomas Giroux, and Olivier David Zerbib, 2025, The biodiversity premium, *Ecological Economics* 228, 108435.

Daszak, P, C das Neves, J Amuasi, et al., 2020, Ipbes workshop on biodiversity and pandemics, Workshop Report.

Díaz, Sandra Myrna, Josef Settele, Eduardo Brondízio, Hien Ngo, Maximilien Guèze, John Agard, Almut Arneth, Patricia Balvanera, Kate Brauman, Stuart Butchart, et al., 2019, The global assessment report on biodiversity and ecosystem services: Summary for policy makers .

Dinerstein, Eric, Carly Vynne, Enric Sala, Anup R Joshi, Sanjiv Fernando, Thomas E Lovejoy, Juan Mayorga, David Olson, Gregory P Asner, Jonathan EM Baillie, et al., 2019, A global deal for nature: Guiding principles, milestones, and targets, *Science advances* 5, eaaw2869.

Flammer, Caroline, Thomas Giroux, and Geoffrey M Heal, 2025, Biodiversity finance, *Journal of Financial Economics* 164, 103987.

Frank, Eyal, and Anant Sudarshan, 2024, The social costs of keystone species collapse: Evidence from the decline of vultures in india, *American Economic Review* 114, 3007–3040.

Frank, Eyal G, 2024, The economic impacts of ecosystem disruptions: Costs from substituting biological pest control, *Science* 385, eadg0344.

Fund, World Wide, 2020, Living planet report, Technical report.

Garel, Alexandre, Arthur Romec, Zacharias Sautner, and Alexander F Wagner, 2024, Do investors care about biodiversity?, *Review of Finance* 28, 1151–1186.

Giglio, Stefano, Theresa Kuchler, Johannes Stroebel, and Xuran Zeng, 2023, Biodiversity Risk, Working Paper.

Hamilton, Healy, Regan L Smyth, Bruce E Young, Timothy G Howard, Christopher Tracey, Sean Breyer, D Richard Cameron, Anne Chazal, Amy K Conley, Charlie Frye, et al., 2022, Increasing taxonomic diversity and spatial resolution clarifies opportunities for protecting us imperiled species, *Ecological Applications* 32, e2534.

Hsu, Po-Hsuan, Kai Li, and Chi-Yang Tsou, 2023, The Pollution Premium, *The Journal of Finance* 78, 1343–1392.

Johnson, Justin Andrew, Giovanni Ruta, Uris Baldos, Raffaello Cervigni, Shun Chonabayashi, Erwin Corong, Olga Gavryliuk, James Gerber, Thomas Hertel, Christopher Nootenboom, et al., 2021, The economic case for nature: A global earth-economy model to assess development policy pathways. world bank. washington, dc.

Jones, Kendall R, Oscar Venter, Richard A Fuller, James R Allan, Sean L Maxwell, Pablo Jose Negret, and James EM Watson, 2018, One-third of global protected land is under intense human pressure, *Science* 360, 788–791.

Junge, Lisa, Yu-Shan Lin Feuer, and Remmer Sassen, 2023, How could the financial sector contribute to limiting biodiversity loss? a systematic review, *A Systematic Review* .

Karolyi, G Andrew, and John Tobin-de la Puente, 2023, Biodiversity finance: A call for research into financing nature, *Financial Management* 52, 231–251.

Krueger, Philipp, Zacharias Sautner, and Laura T Starks, 2020, The importance of climate risks for institutional investors, *The Review of financial studies* 33, 1067–1111.

Langhammer, Penny F, Joseph W Bull, Jake E Bicknell, Joseph L Oakley, Mary H Brown, Michael W Bruford, Stuart HM Butchart, Jamie A Carr, Don Church, Rosie Cooney, et al., 2024, The positive impact of conservation action, *Science* 384, 453–458.

Marques, Alexandra, Inês S Martins, Thomas Kastner, Christoph Plutzar, Michaela C Theurl, Nina Eisenmenger, Mark AJ Huijbregts, Richard Wood, Konstantin Stadler, Martin Bruckner, et al., 2019, Increasing impacts of land use on biodiversity and carbon sequestration driven by population and economic growth, *Nature ecology & evolution* 3, 628–637.

Pástor, L'uboš, Robert F Stambaugh, and Lucian A Taylor, 2021, Sustainable investing in equilibrium, *Journal of financial economics* 142, 550–571.

Pástor, L'uboš, Robert F Stambaugh, and Lucian A Taylor, 2022, Dissecting green returns, *Journal of Financial Economics* 146, 403–424.

Pástor, L'uboš, and Pietro Veronesi, 2013, Political uncertainty and risk premia, *Journal of financial Economics* 110, 520–545.

Pereira, Henrique M, Inês S Martins, Isabel MD Rosa, HyeJin Kim, Paul Leadley, Alexander Popp, Detlef P van Vuuren, George Hurtt, Luise Quoss, Almut Arneth, et al., 2024, Global trends and scenarios for terrestrial biodiversity and ecosystem services from 1900 to 2050, *Science* 384, 458–465.

Pulido-Chadid, Katherine, Elina Virtanen, and Jonas Geldmann, 2023, How effective are protected areas for reducing threats to biodiversity? a systematic review protocol, *Environmental Evidence* 12, 18.

Senior, Rebecca A, Ruby Bagwyn, Danyan Leng, Alexander K Killion, Walter Jetz, and David S Wilcove, 2024, Global shortfalls in documented actions to conserve biodiversity, *Nature* 1–5.

Stroebel, Johannes, and Jeffrey Wurgler, 2021, What do you think about climate finance?

U.S. Geological Survey, 2021, Analysis of updated usgs database finds increase in america's lands and waters under conservation, Accessed: 2024-03-14.

WEF, PwC, 2020, Nature risk rising: Why the crisis engulfing nature matters for business and the economy, *WEF, Geneva, Switzerland* .

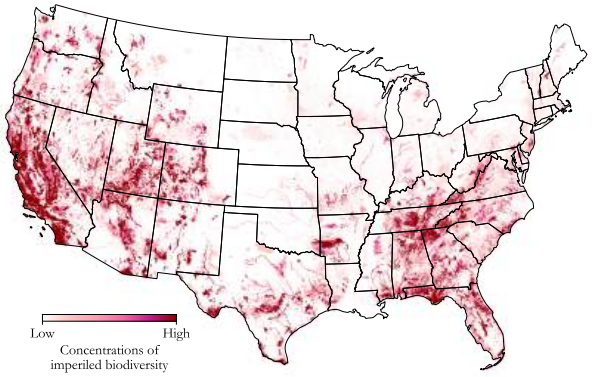
Xiong, William W, 2023, The world market price of biodiversity risk, *Available at SSRN 5043322* .

Zhang, Shaojun, 2025, Carbon returns across the globe, *The Journal of Finance* 80, 615–645.

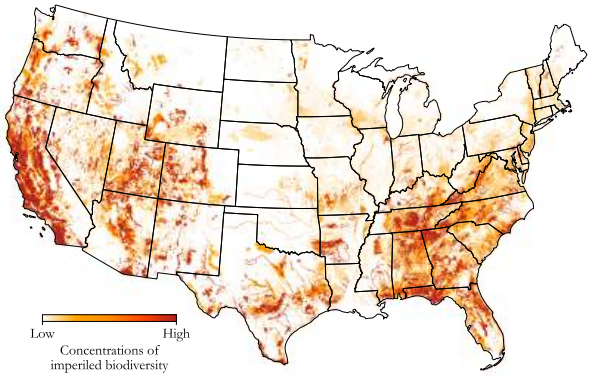
Figure 1: Measures of Endangered Biodiversity

This figure shows the primary measures of biodiversity risk that we adopted from NatureServe. Panel A shows the main continuous measure, Protection-weighted Range-size Rarity (PWRSR). Panel B shows range-size rarity, which is the inverse of the modeled habitat area. Panel C shows the main binary measure, which is the Areas of Unprotected Biodiversity Importance (AUBIs). For each species, PWRSR is the product of two components: range-size rarity and the percentage of this habitat that lies outside protected areas. AUBIs are all map pixels with a summed PWRSR of 0.0005 or greater—a threshold set to identify areas with notable conservation importance. This PWRSR value of 0.0005 corresponds to a single species with a 500 km² range that is 25% unprotected, or a species with a smaller range of 20 km² that is 1% unprotected, or even multiple co-occurring species with lower individual PWRSR values. Both PWRSR and AUBI metrics are determined at a resolution level of 990 meters, providing a detailed spatial scale for biodiversity risk.

Panel A: Range Size Rarity (PSR)



Panel B: Protected Weighted Range Size Rarity (PWRSR)



Panel C: Areas of Unprotected Biodiversity Importance (AUBIs)

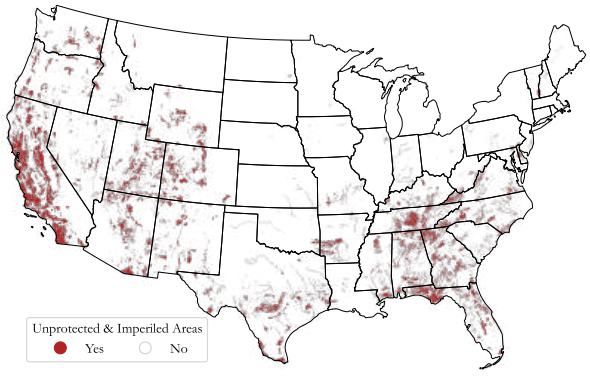
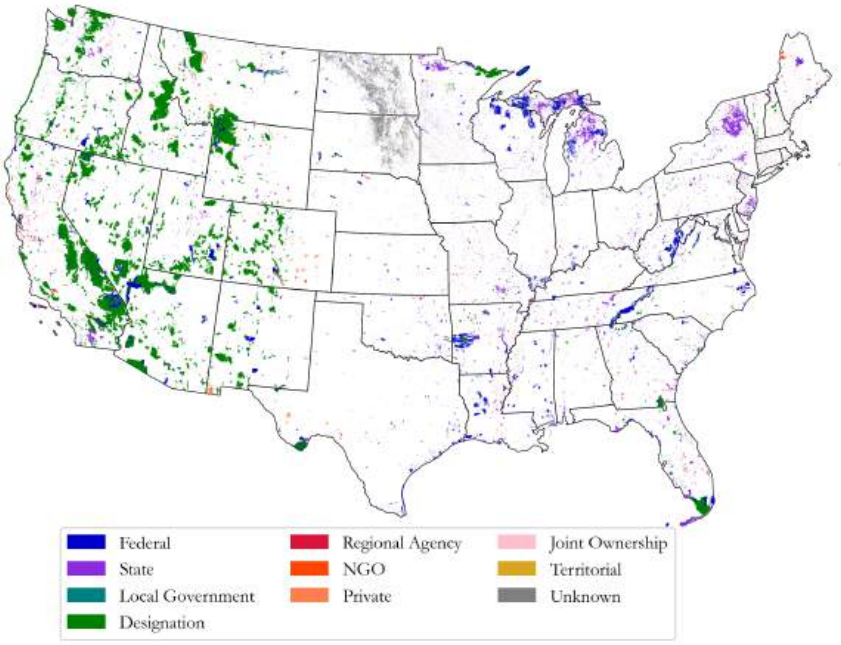


Figure 2: Protected Areas

This figure shows the areas that are permanently protected for biodiversity conservation. Panel A shows the protected areas. Protected areas are those classified with GAP Status 1 or 2 in the Protected Areas Database for the United States, which are areas mandated for biodiversity conservation. The areas are colored by the type of agency that owns the land. Panel B shows both the protected areas and the main continuous measure of biodiversity risk, Protected Weighted Range Size Rarity (PWRSR). Note, Designation here demonstrates territory that is not owned in the traditional sense, instead they are lands protected by designation rather than explicit ownership.

Panel A: Protected Areas by Ownership Type



Panel B: Protected Areas and PWRSR

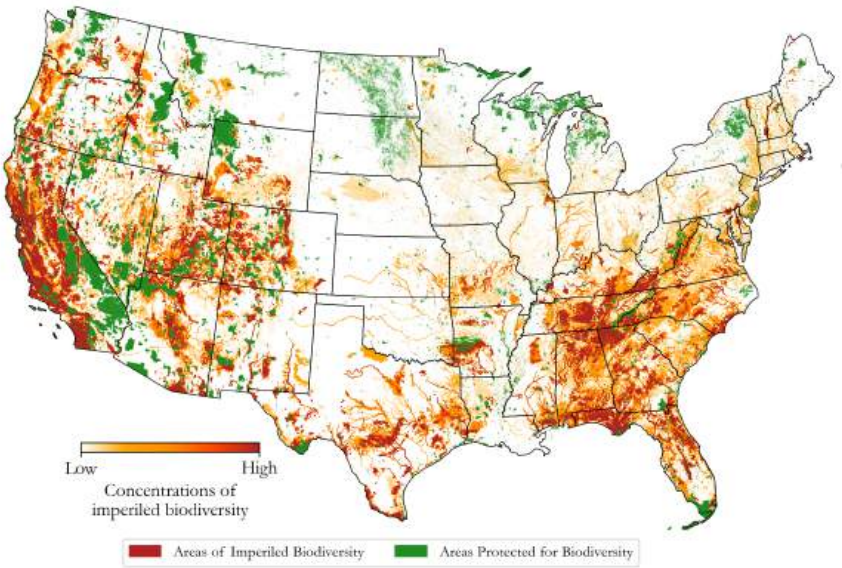
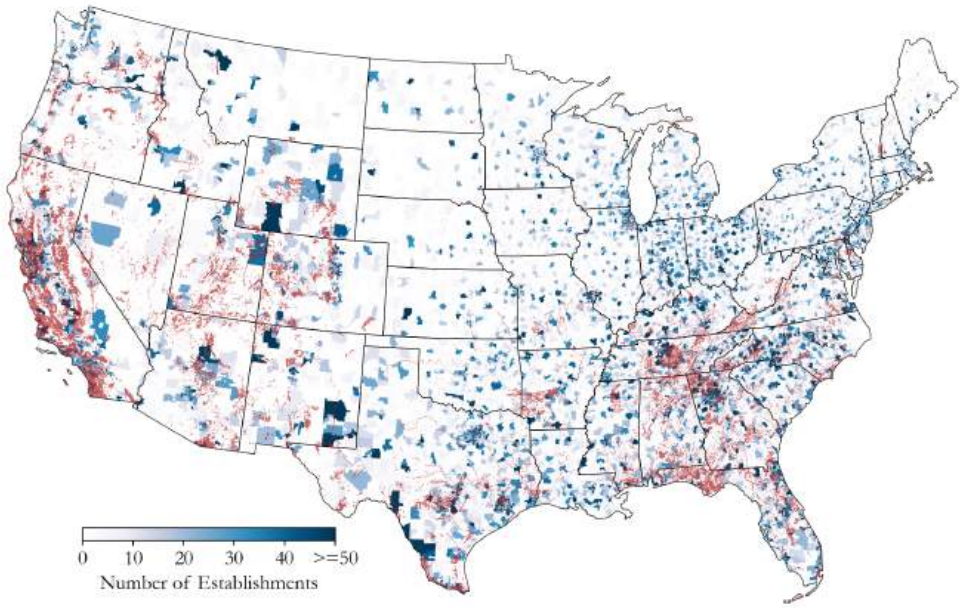


Figure 3: Establishments and Employees by County

This figure illustrates the geographical distribution of public firms' establishments in the sample, overlaid with the main binary measure of biodiversity risk, the Areas of Unprotected Biodiversity Importance (AUBIs). Panel A displays the number of establishments per county, where darker blue shades indicate higher concentrations of establishments. Panel B shows the number of employees per county, with darker blue shades representing counties with a larger employee count. In both panels, regions in red indicate areas where the AUBI measure equals one.

Panel A: Number of Establishments by County



Panel B: Number of Employees in the Establishments by County

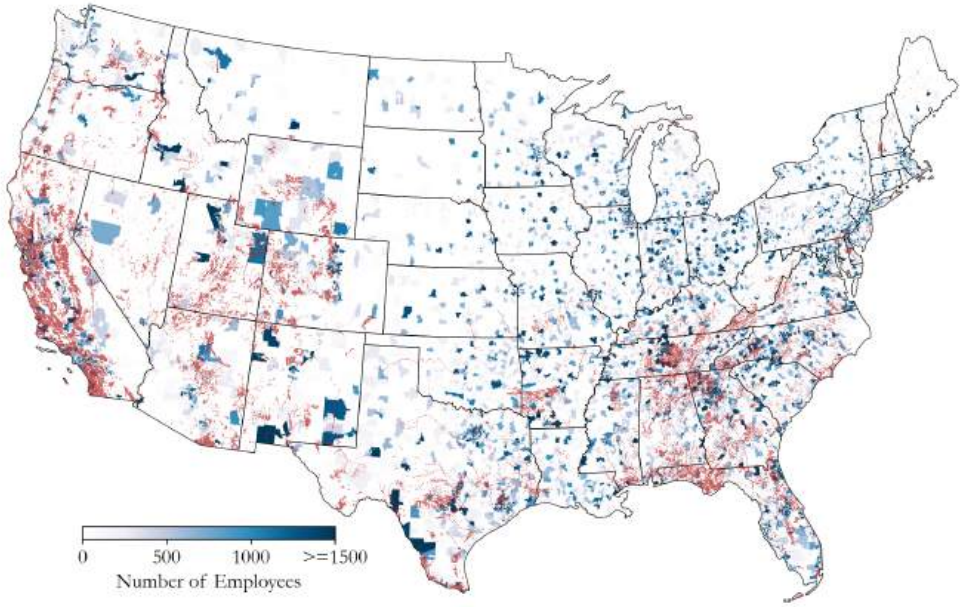


Figure 4: Media Attention to 30 by 30

This figure illustrates the media attention surrounding the 30 by 30 initiative over time. It presents the unique number of articles mentioning the initiative on a monthly basis. The 30 by 30 initiative was first proposed in 2014 during the World Parks Congress and gained traction in scientific and policy discussions over the following years. The data was retrieved from Factiva, using an advanced query designed to capture relevant articles discussing 30 by 30 while filtering out unrelated mentions. The query is limited to U.S.-based sources and English-language articles. The query required (1) the mention of "30 by 30" in various formats, (2) the inclusion of at least one relevant keyword related to policy, conservation, or environmental initiatives, and (3) the exclusion of measurement-related terms to ensure relevance. These details are a large reason we examine post-2020 data primarily- media and investor awareness seem to be driving the relationship. The details of the query and filtering process are provided in Figure IA.3.

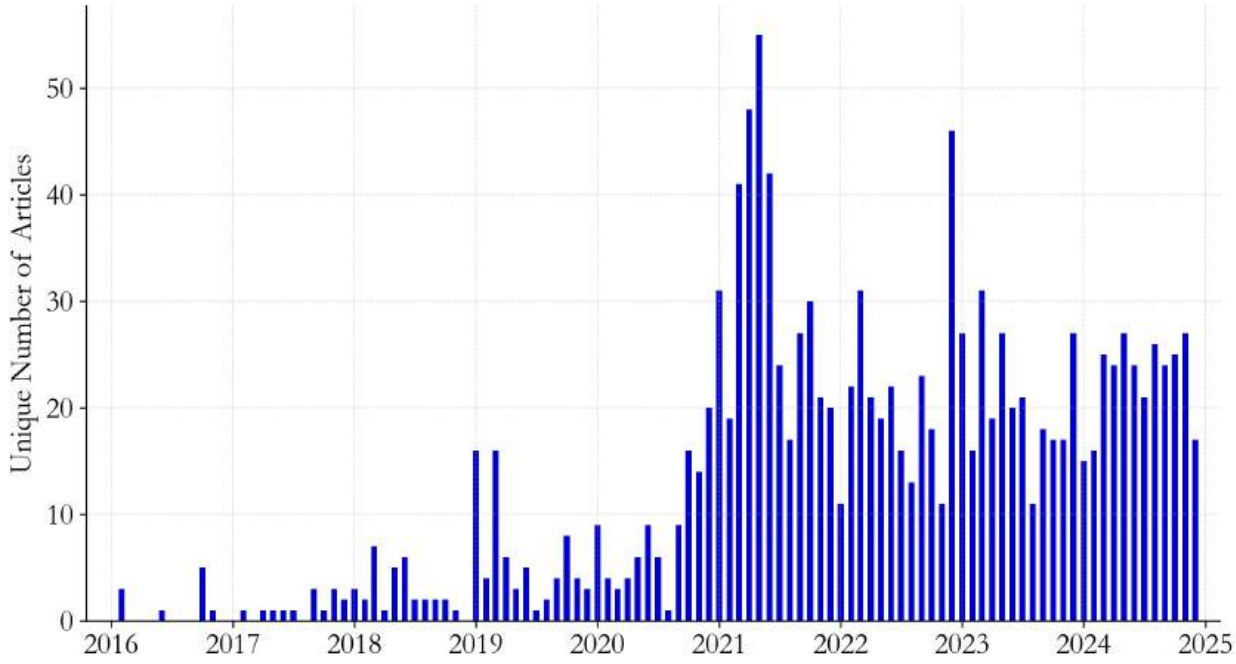
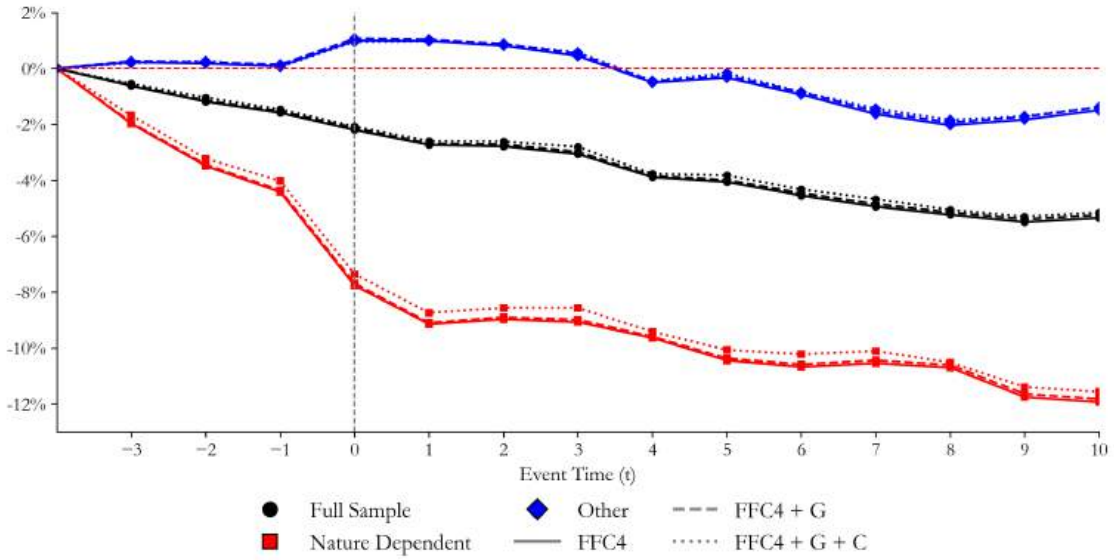


Figure 5: Cumulative Abnormal Returns around 30 by 30

This figure presents the cumulative abnormal returns (CARs) of an equal-weighted long-short portfolio that takes long positions in firms within the top tercile of AUBI exposure and short positions in firms within the bottom tercile around January 27, 2021. Expected returns are obtained from factor model predictions, where factor loadings are estimated using a 100-trading-day window ending 10 days before the event window. Panel A covers the event window from $t = -3$ to $t = 10$; Panel B extends this window to $t = 90$. The dashed vertical line represents $t = 0$, January 27, 2021. CARs are computed using the Fama-French-Carhart four-factor (FFC4) model, controlling for a daily GMB factor (FFC4 + G), and Scope 1, 2, and 3 Carbon Intensity portfolios (FFC4 + G + C) when specified. The figure plots the CAR for three long-short portfolios: black lines represent the full sample, red lines correspond to location and nature-dependent firms (Mining, Utilities, Oil & Gas, Manufacturing, or Construction), and blue lines represent other firms.

Panel A: Event Window $t = [-3, 10]$



Panel B: Event Window $t = [-3, 90]$

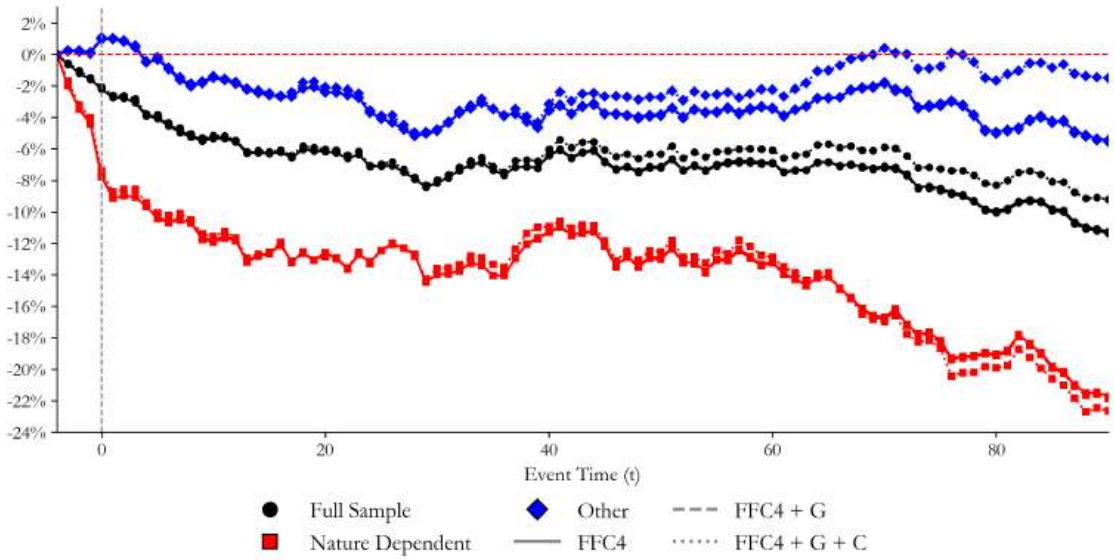
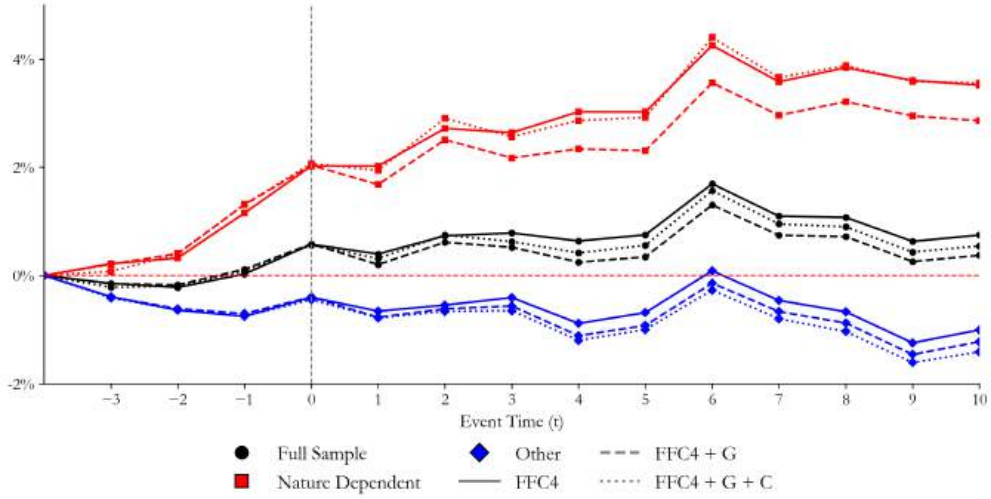


Figure 6: Cumulative Abnormal Returns around President Trump's Re-Election

This figure presents the cumulative abnormal returns (CARs) of an equal-weighted long-short portfolio that takes long positions in firms within the top tercile of AUBI exposure and short positions in firms within the bottom tercile around November 5, 2024. Expected returns are obtained from factor model predictions, where factor loadings are estimated using a 100-trading-day window ending 10 days before the event window. Panel A covers the event window from $t = -3$ to $t = 10$; Panel B extends this window to $t = 30$. The dashed vertical line represents $t = 0$, November 05, 2024. CARs are computed using the Fama-French-Carhart four-factor (FFC4) model, controlling for a daily GMB factor (FFC4 + G), and Scope 1, 2, and 3 Carbon Intensity (FFC4 + G + C) when specified. The figure plots the CAR for three long-short portfolios: black lines represent the full sample, red lines correspond to location and nature-dependent firms (Mining, Utilities, Oil & Gas, Manufacturing, or Construction), and blue lines represent other firms.

Panel A: Event Window $t = [-3, 10]$



Panel B: Event Window $t = [-3, 30]$

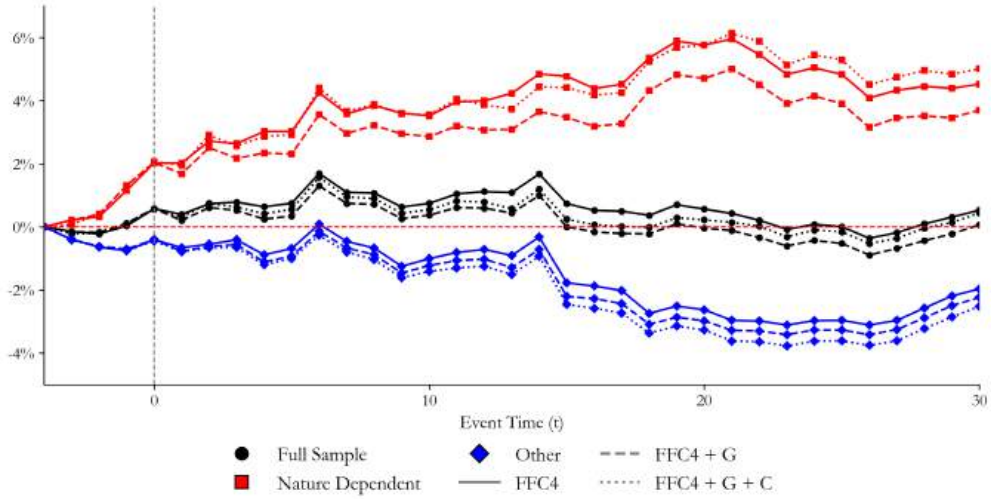
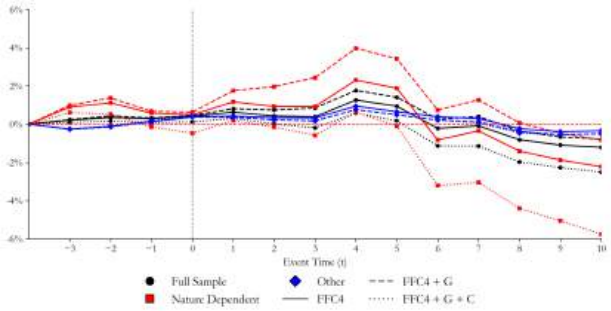


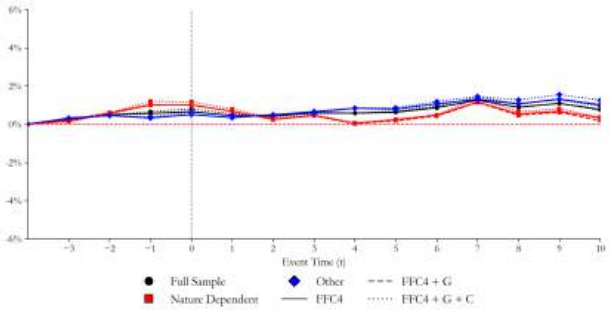
Figure 7: Cumulative Abnormal Returns around Key U.S. Political Events

This figure presents the cumulative abnormal returns (CARs) of an equal-weighted long-short portfolio that takes long positions in firms within the top tercile of AUBI exposure and short positions in firms within the bottom tercile around key U.S. political events. Expected returns are obtained from factor model predictions, where factor loadings are estimated using a 100-trading-day window ending 10 days before the event window. All panels cover the event window from $t = -3$ to $t = 10$. The dashed vertical line represents $t = 0$, corresponding to the event date. CARs are computed using the Fama-French-Carhart four-factor (FFC4) model, controlling for a daily GMB factor (FFC4 + G), and Scope 1, 2, and 3 Carbon Intensity portfolios (FFC4 + G + C) when specified. The figure plots the CAR for three long-short portfolios: black lines represent the full sample, red lines correspond to location and nature-dependent firms (Mining, Utilities, Oil & Gas, Manufacturing, or Construction), and blue lines represent other firms.

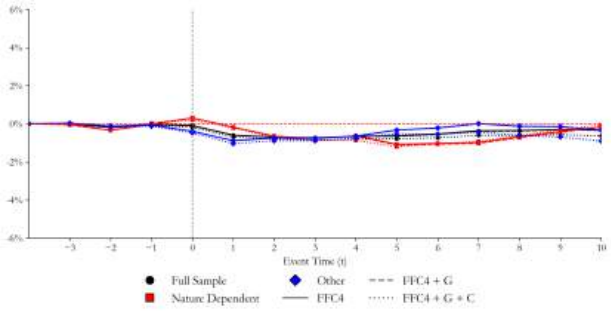
Panel A: President Trump's Election - November 08, 2016



Panel B: President Trump's Inauguration - January 20, 2017



Panel C: Paris Agreement Exit - June 01, 2017



Panel D: President Biden's Election - November 03, 2020

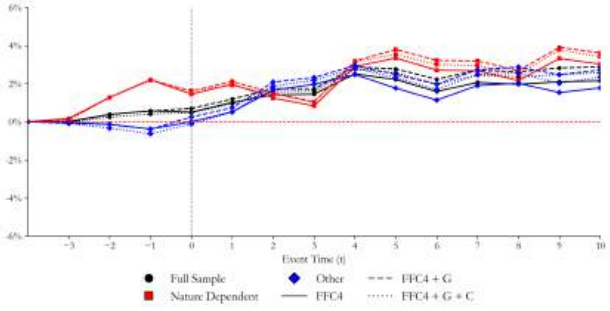


Figure 8: Dynamic Effects on Institutional Holdings

This figure presents monthly coefficients from a high-dimensional panel regression estimating the dynamic relationship between mutual fund holdings and firm-level exposure to Areas of Unprotected Biodiversity Importance (AUBI) using December 2020 as a baseline. The dependent variable is the percentage of total net assets (TNA) allocated to each firm by mutual funds. The regression interacts month-year indicators with a dummy variable for firms in the top tercile of employee-weighted AUBI exposure. The sample is restricted to firms in nature- and location-dependent sectors (NAICS 2-digit ≤ 33), and includes extensive firm-level controls: lagged firm size, leverage, capital expenditures, property, plant, and equipment, book-to-market ratio, return on assets, asset and sales growth, volatility, and momentum. All specifications include firm and mutual fund-by-industry-by-year-month fixed effects, with standard errors clustered at the firm level. The y-axis plots the estimated coefficients for each month, capturing how mutual fund allocations to high-AUBI-exposure firms evolve over time. Coefficients significantly different from zero at the 5% level are shown in red. Shaded regions indicate key biodiversity-related regulatory events: (1) the signing of Executive Order 14008 establishing the "30 by 30" conservation goal in January 2021, (2) the release of the America the Beautiful Initiative in April 2021, (3) the Inflation Reduction Act in September 2021, (4) the proposal of the Public Lands Rule in March 2023, and (5) the close of the TNFD comment period in October 2023. The figure highlights dynamic disinvestment patterns by mutual funds following major biodiversity policy signals.

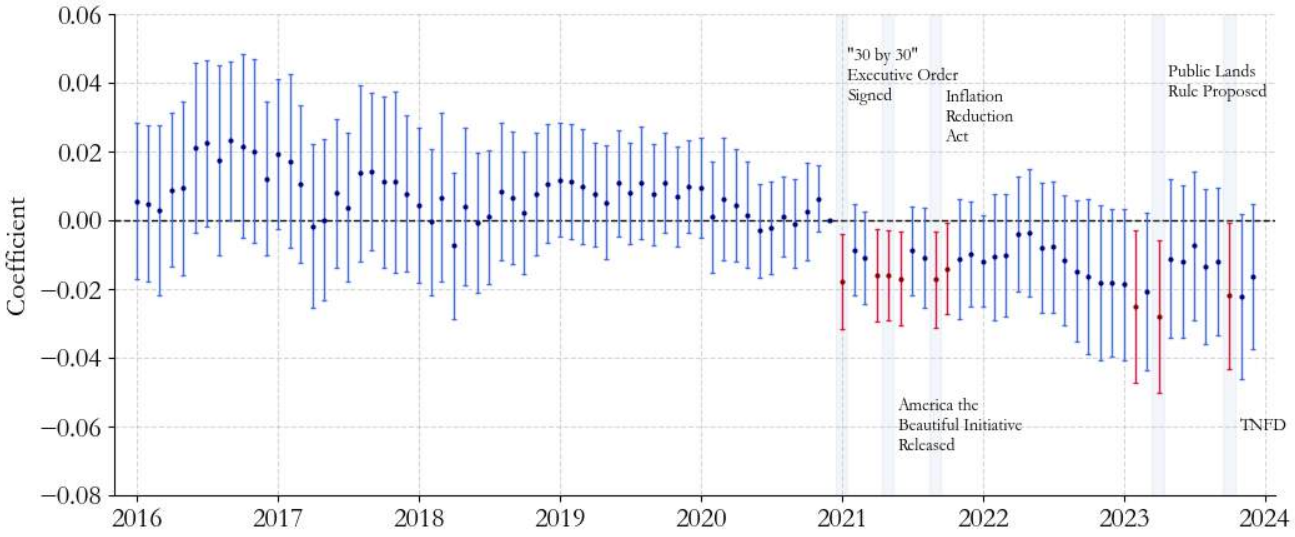


Table 1: Summary Statistics

This table presents the summary statistics for the variables used in the paper. Panel A presents the statistics for the set of firms that are location and nature dependent, which are defined as firms in Mining, Utilities, Oil & Gas, Manufacturing, or Construction, while Panel B shows the statistics for the rest of the firms. The sample period is from 2020 to 2023. Employee Weighted AUBI Exposure, Employee Weighted PWRSR Exposure, Employee Weighted RSR Exposure, Employee Weighted Distance AUBI Exposure, Climate Change Exposure Near Century, Climate Change Exposure Mid to Late Century, Habitat Climate Change Vulnerability Score Near Century are at the firm level, volatility and momentum are at the monthly level and remaining variables are at the annual level.

	Number of Obs.	Mean	Std Dev	p5	p25	Median	p75	p95
Panel A: Location & Nature Dependent Firms								
Monthly Returns	23254	1.70	22.65	-21.38	-7.34	0.07	8.42	27.71
Asset growth	23254	0.12	0.44	-0.23	-0.03	0.05	0.15	0.66
Sales growth	23254	0.60	9.71	-0.36	-0.06	0.07	0.22	0.80
Ln(Total assets)	23254	7.10	2.22	3.40	5.66	7.22	8.67	10.83
Leverage	23254	0.24	0.17	0.00	0.08	0.23	0.35	0.56
Capex/Total assets	23254	0.03	0.04	0.00	0.01	0.02	0.04	0.11
PPE/Total assets	23254	0.25	0.21	0.03	0.10	0.19	0.33	0.75
Ln(Market cap)	23254	7.29	2.42	3.27	5.62	7.44	8.89	11.13
Book-to-market	23254	0.57	0.55	0.07	0.22	0.42	0.72	1.58
ROA	23254	-0.01	0.26	-0.47	-0.03	0.04	0.10	0.21
Volatility	23254	15.80	15.39	6.38	9.18	12.64	18.11	32.17
Momentum	23254	1.72	6.53	-5.67	-1.13	1.10	3.65	10.24
Employee Weighted AUBI Exposure	522	0.13	0.28	0.00	0.00	0.01	0.09	0.99
Employee Weighted PWRSR Exposure	522	0.00086	0.00482	0.00000	0.00002	0.00009	0.00029	0.00292
Employee Weighted RSR Exposure	522	0.00107	0.00642	0.00000	0.00002	0.00010	0.00032	0.00381
Employee Weighted Distance AUBI Exposure	522	0.31	0.28	0.03	0.10	0.22	0.42	1.00
Climate Change Exposure Near Century	494	0.75	0.11	0.58	0.70	0.76	0.82	0.91
Climate Change Exposure Mid to Late Century	494	0.62	0.13	0.39	0.55	0.62	0.69	0.83
Habitat Climate Change Vulnerability Score Near Century	494	0.59	0.05	0.51	0.56	0.59	0.62	0.67
Panel B: Other Firms								
Monthly Returns	23096	1.53	19.84	-19.34	-6.41	0.59	8.06	24.06
Asset growth	23096	0.13	0.81	-0.17	-0.02	0.05	0.15	0.54
Sales growth	23096	0.28	7.97	-0.27	-0.03	0.08	0.19	0.53
Ln(Total assets)	23096	7.93	2.09	4.46	6.70	7.91	9.13	11.46
Leverage	23096	0.32	0.22	0.01	0.12	0.30	0.49	0.71
Capex/Total assets	23096	0.03	0.04	0.00	0.00	0.02	0.04	0.10
PPE/Total assets	23096	0.24	0.25	0.00	0.04	0.12	0.40	0.76
Ln(Market cap)	23096	7.71	2.24	3.75	6.30	7.79	9.16	11.29
Book-to-market	23096	0.68	0.94	0.06	0.20	0.45	0.87	1.85
ROA	23096	0.03	0.16	-0.14	0.00	0.04	0.08	0.19
Volatility	23096	13.74	13.20	6.24	8.64	11.40	15.54	25.49
Momentum	23096	1.48	5.83	-4.81	-0.94	1.07	3.28	8.62
Employee Weighted AUBI Exposure	517	0.07	0.17	0.00	0.00	0.03	0.07	0.34
Employee Weighted PWRSR Exposure	517	0.00036	0.00117	0.00000	0.00002	0.00012	0.00028	0.00112
Employee Weighted RSR Exposure	517	0.00042	0.00137	0.00000	0.00003	0.00014	0.00033	0.00145
Employee Weighted Distance AUBI Exposure	517	0.26	0.21	0.05	0.12	0.22	0.32	0.75
Climate Change Exposure Near Century	511	0.78	0.09	0.64	0.73	0.77	0.83	0.91
Climate Change Exposure Mid to Late Century	511	0.65	0.12	0.46	0.59	0.65	0.73	0.87
Habitat Climate Change Vulnerability Score Near Century	511	0.60	0.04	0.53	0.58	0.60	0.63	0.67

Table 2: Determinants of Firm-Level AUBI Exposure

This table reports firm-level regressions where the dependent variable is Employee-Weighted AUBI Exposure. The sample spans 2016–2019, and all explanatory variables are constructed as firm-level averages over this period. Regressions are estimated separately for firms in nature- and location-dependent industries—Mining, Oil & Gas, Utilities, Construction, and Manufacturing (Columns 1–4)—and for all other industries (Columns 5–8). Columns (1) and (5) include climate risk exposures, namely Climate Change Exposure Near Century and Climate Change Exposure Mid to Late Century. Columns (2) and (6) additionally include log-transformed Scope 1, Scope 2, and Scope 3 carbon emissions. Columns (3) and (7) incorporate firm financial characteristics, including the log of total assets, leverage (debt-to-assets), investment ratios (capital expenditures and property, plant, and equipment, each scaled by total assets), return on assets, log market capitalization, and the book-to-market ratio. Columns (4) and (8) include all of the aforementioned controls as well as the share of a firm's establishments located in urban areas. All regressions include 2-digit NAICS industry fixed effects. Robust Standard Errors are given in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	Mining, Oil, Utilities, Construction, Manufacturing				Others			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Climate Change Exposure Near Century	0.042			0.147	0.205			0.152
	(0.213)			(0.224)	(0.151)			(0.166)
Climate Change Exposure Mid to Late Century	0.011			-0.055	-0.118			-0.086
	(0.176)			(0.187)	(0.092)			(0.116)
Ln(Scope 1 Emissions)		-0.016		0.011		-0.009*		-0.006
		(0.013)		(0.013)		(0.005)		(0.006)
Ln(Scope 2 Emissions)		0.022		0.013		-0.004		-0.009
		(0.020)		(0.021)		(0.009)		(0.011)
Ln(Scope 3 Emissions)		-0.019		-0.031		0.004		-0.003
		(0.015)		(0.020)		(0.008)		(0.012)
Ln(Total assets)			-0.042	-0.068			-0.010	-0.010
			(0.026)	(0.043)			(0.012)	(0.018)
Leverage			-0.087	0.005			0.003	0.011
			(0.078)	(0.083)			(0.042)	(0.048)
Capex/Total assets			-0.834*	-0.130			0.021	-0.069
			(0.447)	(0.393)			(0.189)	(0.156)
PPE/Total assets			-0.053	-0.148			-0.016	-0.017
			(0.091)	(0.112)			(0.034)	(0.040)
Ln(Market cap)			0.043	0.085**			0.011	0.019
			(0.026)	(0.035)			(0.013)	(0.015)
Book-to-market			-0.027	0.098			0.002	0.017
			(0.041)	(0.067)			(0.015)	(0.018)
ROA			-0.069	-0.060			0.019	0.048
			(0.065)	(0.113)			(0.031)	(0.064)
Share of Urban Establishments				0.102				0.093
				(0.110)				(0.076)
R-squared	0.0462	0.0679	0.0952	0.103	0.0216	0.0509	0.0223	0.0682
Adj. R-squared	.0301	.0481	.0715	.0577	-.0123	.00729	-.0216	-.00244
Within R-squared	.000392	.022	.057	.0759	.00412	.0153	.00443	.034
Obs.	482	432	511	396	508	388	513	384
Ind FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 3: Cross-Sectional Returns and AUBI Exposure: Climate Controls and Industry Segmentation

The dependent variable here is firm-level monthly returns (in percent). Regressions are run separately for firms in industries with high location and nature dependence—namely Mining, Oil & Gas, Utilities, Construction, and Manufacturing (Columns 1–6)—and all other industries (Columns 7–12). The sample spans 2020-2023. The main explanatory variables are Employee Weighted AUBI Exposure (Columns 1, 3, 5, 7, 9, and 11) and Employee Weighted Distance AUBI Exposure (Columns 2, 4, 6, 8, 10, and 12). All regressions include the following firm-level control variables: the natural logarithm of total assets (Ln(Total assets)), leverage (total debt scaled by total assets), capital expenditures scaled by total assets (Capex/Total assets), property, plant, and equipment scaled by total assets (PPE/Total assets), return on assets (ROA), the natural logarithm of market capitalization (Ln(Market cap)), the book-to-market ratio, asset growth, sales growth, return volatility (measured as the standard deviation of the past 36 months of returns), and momentum (average return over the past 12 months). Climate risk exposures are also included as controls: Climate Change Exposure Near Century, Climate Change Exposure Mid to Late Century, and the Habitat Climate Change Vulnerability Score Near Century. Columns (1)–(6) and (7)–(12) vary the level of fixed effects, with Columns (1) and (7) including NAICS 2-digit × year-month fixed effects, Columns (3) and (9) using NAICS 3-digit × year-month fixed effects, and Columns (5) and (11) using NAICS 4-digit × year-month fixed effects. Columns (2), (4), (6), (8), (10), and (12) follow the same structure as their adjacent columns but replace Employee Weighted AUBI Exposure with Employee Weighted Distance AUBI Exposure. Standard errors are clustered at the firm level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	Mining, Oil, Utilities, Construction, Manufacturing						Others					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Employee Weighted AUBI Exposure	-1.646***		-1.877***		-1.716***		-0.575		-0.263		-0.308	
	(0.507)		(0.540)		(0.565)		(0.417)		(0.457)		(0.449)	
Employee Weighted Distance AUBI Exposure		-1.460***		-1.719***		-1.497***		-0.821**		-0.520		-0.258
		(0.538)		(0.601)		(0.525)		(0.390)		(0.411)		(0.425)
Ln(Total assets)	-0.842**	-0.831**	-0.914**	-0.900**	-1.210***	-1.201***	-0.489*	-0.494*	-0.411*	-0.414*	-0.743***	-0.744***
	(0.364)	(0.365)	(0.396)	(0.394)	(0.367)	(0.367)	(0.257)	(0.257)	(0.240)	(0.240)	(0.281)	(0.280)
Leverage	-0.491	-0.495	-0.215	-0.266	-0.517	-0.546	0.844	0.753	0.684	0.630	1.326*	1.288*
	(1.064)	(1.070)	(1.113)	(1.120)	(1.124)	(1.131)	(0.589)	(0.581)	(0.562)	(0.563)	(0.703)	(0.711)
Capex/Total assets	-13.758***	-13.603***	-13.891***	-13.538***	-17.768***	-17.447***	-5.767**	-5.838**	-7.631**	-7.654**	-6.349	-6.359
	(4.047)	(4.008)	(4.304)	(4.286)	(5.229)	(5.160)	(2.759)	(2.769)	(3.240)	(3.245)	(4.660)	(4.667)
PPE/Total assets	4.603***	4.763***	3.818***	4.054***	4.740***	4.918***	1.066	1.097*	1.069	1.110	1.052	1.075
	(1.044)	(1.040)	(1.007)	(1.006)	(1.194)	(1.196)	(0.663)	(0.664)	(0.798)	(0.803)	(1.113)	(1.116)
Climate Change Exposure Near Century	-0.443	-0.728	-0.938	-1.170	2.909	2.735	-0.193	0.177	-1.264	-0.958	-2.208	-2.195
	(4.419)	(4.205)	(5.844)	(5.652)	(3.947)	(3.862)	(2.529)	(2.563)	(2.699)	(2.779)	(2.814)	(2.921)
Climate Change Exposure Mid to Late Century	0.331	0.617	0.014	0.306	-2.357	-2.164	-0.160	-0.073	0.444	0.485	0.649	0.665
	(2.762)	(2.802)	(3.035)	(3.074)	(1.971)	(1.963)	(1.178)	(1.187)	(1.244)	(1.254)	(1.406)	(1.411)
Habitat Climate Change Vulnerability Score Near Century	-0.804	0.176	0.874	1.960	-0.508	0.447	-0.051	-0.804	1.475	0.861	4.056	4.055
	(6.452)	(6.205)	(6.974)	(6.634)	(7.552)	(7.319)	(5.251)	(5.350)	(5.596)	(5.766)	(6.071)	(6.265)
Ln(Market cap)	0.616*	0.603*	0.641*	0.627*	1.069***	1.063***	0.350	0.353	0.302	0.304	0.643**	0.643**
	(0.333)	(0.332)	(0.376)	(0.373)	(0.355)	(0.354)	(0.259)	(0.258)	(0.255)	(0.254)	(0.295)	(0.294)
Book-to-market	-0.593	-0.593	-0.551	-0.564	-0.942	-0.964	-0.666***	-0.668***	-0.667***	-0.666***	-0.529**	-0.529**
	(0.736)	(0.740)	(0.726)	(0.728)	(0.670)	(0.675)	(0.253)	(0.253)	(0.253)	(0.252)	(0.224)	(0.224)
ROA	2.985***	2.963***	2.879***	2.851***	2.970***	2.951***	4.284**	4.248**	4.296**	4.275**	3.875**	3.865**
	(0.857)	(0.886)	(0.843)	(0.874)	(0.985)	(1.005)	(1.905)	(1.895)	(1.916)	(1.907)	(1.790)	(1.786)
Asset growth	2.834***	2.846***	2.799***	2.818***	3.051***	3.057***	0.137	0.153	0.130	0.141	0.091	0.097
	(0.776)	(0.775)	(0.784)	(0.783)	(0.850)	(0.851)	(0.220)	(0.217)	(0.212)	(0.211)	(0.175)	(0.175)
Sales growth	-0.002	-0.002	-0.005	-0.006	-0.009	-0.010	-0.003	-0.003	-0.003	-0.003	-0.003	-0.003
	(0.012)	(0.011)	(0.011)	(0.011)	(0.012)	(0.012)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Volatility	0.027	0.027	0.025	0.025	0.104***	0.107***	0.037*	0.037*	0.040**	0.040**	0.037**	0.037**
	(0.034)	(0.035)	(0.035)	(0.036)	(0.020)	(0.019)	(0.022)	(0.022)	(0.019)	(0.019)	(0.018)	(0.018)
Momentum	-0.146**	-0.146**	-0.151**	-0.151**	-0.277***	-0.277***	-0.107*	-0.107*	-0.117**	-0.117**	-0.122**	-0.122**
	(0.068)	(0.068)	(0.072)	(0.071)	(0.048)	(0.048)	(0.064)	(0.064)	(0.056)	(0.056)	(0.059)	(0.059)
Adj. R-squared	0.142	0.142	0.137	0.136	0.235	0.235	0.178	0.178	0.213	0.213	0.242	0.242
Obs.	22,033	22,033	22,033	22,033	21,132	21,132	22,868	22,868	22,712	22,712	21,337	21,337
Ind × Year-Month FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 4: Cross-Sectional Returns and AUBI Exposure: Carbon Controls and Industry Segmentation

This table investigates the relationship between firm-level AUBI exposure and stock returns while accounting for carbon emissions and climate exposures, separately by industry group. The dependent variable is firm-level monthly return (in percent). The sample spans 2020–2023. Columns (1)–(4) focus on firms in Mining, Utilities, Oil& Gas, Construction, and Manufacturing industries, while Columns (5)–(8) include all other industries. The key explanatory variables are Employee Weighted AUBI Exposure and Employee Weighted Distance AUBI Exposure, each entered separately. All regressions include controls for climate-related firm exposures—Climate Change Exposure Near Century, Mid to Late Century, and Habitat Climate Change Vulnerability Score Near Century—and a full set of firm-level controls: firm size (Ln(Total assets), Ln(Market cap)), leverage, investment (Capex/Assets, PPE/Assets), profitability (ROA), valuation (Book-to-market), asset and sales growth, return volatility (36-month trailing standard deviation), and momentum (12-month average return). Columns (1), (3), (5), and (7) include emissions intensity controls (Scope 1–3), while Columns (2), (4), (6), and (8) include the log of total emissions (Scope 1–3). All regressions absorb industry × year-month fixed effects at the 2-digit NAICS level. Standard errors are clustered at the firm level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	Mining, Oil, Utilities, Construction, Manufacturing				Others			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Employee Weighted AUBI Exposure	-1.096**	-1.021*			-0.981	-0.958		
	(0.515)	(0.531)			(0.660)	(0.664)		
Employee Weighted Distance AUBI Exposure			-1.235**	-1.173*			-0.705	-0.717
			(0.619)	(0.629)			(0.525)	(0.508)
Scope 1 Emissions Intensity	-0.000		-0.000		0.000		0.000	
	(0.000)		(0.000)		(0.000)		(0.000)	
Scope 2 Emissions Intensity	0.000		0.000		-0.000		-0.000	
	(0.001)		(0.001)		(0.001)		(0.001)	
Scope 3 Emissions Intensity	0.000		0.000		0.003		0.003	
	(0.001)		(0.001)		(0.003)		(0.003)	
Ln(Scope 1 Emissions)		-0.097		-0.105		0.075		0.076
		(0.113)		(0.112)		(0.076)		(0.076)
Ln(Scope 2 Emissions)		0.059		0.049		0.160		0.152
		(0.240)		(0.240)		(0.152)		(0.151)
Ln(Scope 3 Emissions)		0.243		0.256		-0.484**		-0.486**
		(0.201)		(0.200)		(0.192)		(0.192)
Ln(Total assets)	-0.589	-0.883**	-0.588	-0.878**	-0.740*	-0.550	-0.734*	-0.538
	(0.419)	(0.377)	(0.419)	(0.379)	(0.402)	(0.374)	(0.398)	(0.368)
Leverage	-1.311	-1.258	-1.358	-1.303	0.929	0.789	0.833	0.693
	(1.302)	(1.277)	(1.306)	(1.281)	(0.795)	(0.774)	(0.775)	(0.756)
Capex/Total assets	-14.254***	-13.664***	-14.526***	-13.904***	-6.927*	-7.229**	-7.046*	-7.354**
	(5.287)	(5.251)	(5.249)	(5.207)	(3.734)	(3.623)	(3.733)	(3.633)
PPE/Total assets	4.343***	4.262***	4.480***	4.426***	1.248	1.420	1.282	1.462
	(1.375)	(1.368)	(1.363)	(1.352)	(0.982)	(0.969)	(0.975)	(0.962)
Climate Change Exposure Near Century	-1.365	-1.045	-1.108	-0.778	-0.188	-1.032	-0.451	-1.264
	(5.250)	(5.378)	(4.926)	(5.079)	(3.002)	(3.016)	(2.958)	(3.008)
Climate Change Exposure Mid to Late Century	-1.155	-1.039	-0.913	-0.800	-1.240	-1.256	-1.158	-1.163
	(3.621)	(3.668)	(3.696)	(3.752)	(1.362)	(1.359)	(1.365)	(1.353)
Habitat Climate Change Vulnerability Score Near Century	1.975	1.236	1.836	1.020	6.512	7.742	6.938	8.077
	(7.365)	(6.926)	(7.036)	(6.605)	(5.891)	(5.969)	(5.866)	(5.990)
Ln(Market cap)	0.383	0.482	0.375	0.472	0.668	0.709*	0.659	0.702*
	(0.375)	(0.359)	(0.373)	(0.358)	(0.406)	(0.414)	(0.401)	(0.410)
Book-to-market	-0.952	-0.866	-0.983	-0.899	-0.373	-0.379	-0.389	-0.396
	(1.022)	(0.922)	(1.024)	(0.922)	(0.542)	(0.546)	(0.539)	(0.543)
ROA	2.587**	1.921	2.525**	1.866	1.318	1.424	1.315	1.426
	(1.187)	(1.455)	(1.188)	(1.448)	(2.047)	(2.048)	(2.045)	(2.044)
Asset growth	2.677***	2.797***	2.687***	2.807***	0.169	0.130	0.182	0.143
	(0.858)	(0.882)	(0.858)	(0.884)	(0.159)	(0.149)	(0.156)	(0.145)
Sales growth	0.003	0.003	0.002	0.003	0.290**	0.356***	0.292***	0.358***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.115)	(0.096)	(0.112)	(0.094)
Volatility	0.020	0.021	0.020	0.021	0.029	0.029	0.030	0.030
	(0.032)	(0.034)	(0.033)	(0.034)	(0.024)	(0.025)	(0.024)	(0.025)
Momentum	-0.129*	-0.132*	-0.129*	-0.133*	-0.076	-0.078	-0.077	-0.079
	(0.077)	(0.079)	(0.077)	(0.079)	(0.065)	(0.065)	(0.065)	(0.065)
Adj. R-squared	0.144	0.144	0.144	0.144	0.172	0.172	0.172	0.172
Obs.	17,732	17,708	17,732	17,708	16,860	16,860	16,860	16,860
Ind × Year-Month FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 5: Cross-Sectional Returns, AUBI Exposure, and Media

This table examines the relationship between monthly stock returns (dependent variable in percent) and firm-level AUBI exposure. Columns (1)–(4) restrict the sample to firms in Mining, Oil & Gas, Utilities, Construction, and Manufacturing sectors, while Columns (5)–(8) include firms in all other sectors. The sample is from 2021-2023. The main explanatory variables are Employee Weighted AUBI Exposure and Employee Weighted Distance AUBI Exposure, interacted with a High Media Mention Growth variable based on monthly changes in biodiversity-related news coverage from Factiva. High Media Mention Growth equals one if the previous month falls in the top tercile of growth. All models control for firm size (Ln(Total assets)), leverage (total debt scaled by total assets), investment (Capex/Total assets), physical assets (PPE/Total assets), profitability (ROA), firm valuation (Ln(Market cap), Book-to-market), asset growth, sales growth, return volatility (36-month standard deviation), and momentum (12-month average return). Climate risk is captured through Climate Change Exposure Near Century, Climate Change Exposure Mid to Late Century, and the Habitat Climate Change Vulnerability Score Near Century. Columns (1), (3), (5), and (7) include industry × year-month fixed effects (NAICS 2-digit), while Columns (2), (4), (6), and (8) additionally include firm fixed effects. All explanatory variables are lagged by one year. Standard errors are clustered at the firm level. ***, **, and * denote significance at the 1%, 5% and 10% levels, respectively.

	Mining, Oil, Utilities, Construction, Manufacturing				Others			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Employee Weighted AUBI Exposure	-0.918				-0.492			
	(0.740)				(0.538)			
Employee Weighted AUBI Exposure	-2.290**	-2.152**			-0.623	0.226		
× High Biodiversity Media Mention Growth	(0.977)	(0.956)			(0.949)	(0.935)		
Employee Weighted Distance AUBI Exposure			-0.871				-0.036	
			(0.687)				(0.580)	
Employee Weighted Distance AUBI Exposure			-2.814*	-2.168**			-1.949*	-1.669
× High Biodiversity Media Mention Growth			(1.539)	(1.085)			(1.089)	(1.241)
Ln(Total assets)	-0.525*	-6.935**	-0.536*	-6.937**	-0.268	-5.569*	-0.271	-5.589*
	(0.296)	(3.163)	(0.304)	(3.163)	(0.309)	(3.017)	(0.309)	(3.020)
Leverage	-0.748	11.290**	-0.732	11.261**	0.457	22.810**	0.369	22.799**
	(0.787)	(5.032)	(0.797)	(5.031)	(0.669)	(9.660)	(0.654)	(9.658)
Capex/Total assets	-13.137***	-2.058	-13.325***	-2.047	-9.085***	-74.754**	-9.120***	-74.820**
	(3.988)	(14.151)	(4.046)	(14.150)	(3.480)	(35.629)	(3.484)	(35.618)
PPE/Total assets	4.314***	-11.561	4.523***	-11.579	2.456**	29.899*	2.480***	29.962*
	(1.075)	(9.061)	(1.077)	(9.054)	(0.952)	(15.961)	(0.952)	(15.951)
Climate Change Exposure Near Century	-1.483		-1.424		-2.907		-2.740	
	(5.503)		(5.214)		(2.923)		(3.043)	
Climate Change Exposure Mid to Late Century	3.030		3.413		-1.094		-1.045	
	(3.366)		(3.449)		(1.300)		(1.309)	
Habitat Climate Change Vulnerability Score Near Century	-3.662		-3.589		6.476		6.186	
	(6.215)		(6.148)		(6.632)		(6.889)	
Ln(Market cap)	0.374	5.753***	0.381	5.750***	0.180	6.107***	0.181	6.107***
	(0.263)	(2.117)	(0.265)	(2.116)	(0.324)	(1.170)	(0.323)	(1.169)
Book-to-market	-0.770	0.160	-0.763	0.161	-0.672**	-0.054	-0.671**	-0.053
	(0.695)	(1.102)	(0.703)	(1.103)	(0.289)	(0.787)	(0.289)	(0.787)
ROA	4.294***	3.961*	4.216***	3.968*	4.643**	4.917	4.619**	4.928
	(1.119)	(2.384)	(1.146)	(2.379)	(2.057)	(3.461)	(2.046)	(3.463)
Asset growth	0.635	0.557	0.675	0.556	0.328	0.784	0.342	0.799
	(0.527)	(0.855)	(0.526)	(0.855)	(0.342)	(0.576)	(0.339)	(0.579)
Sales growth	-0.027	0.024	-0.029	0.024	-0.003	-0.002	-0.003	-0.002
	(0.021)	(0.067)	(0.021)	(0.067)	(0.002)	(0.008)	(0.002)	(0.008)
Volatility	0.003	-1.833	0.003	-1.832	0.016	-3.139**	0.016	-3.139**
	(0.024)	(1.396)	(0.025)	(1.396)	(0.012)	(1.247)	(0.012)	(1.247)
Momentum	-0.070	-0.242*	-0.070	-0.242*	-0.055	-0.233*	-0.055	-0.233*
	(0.047)	(0.134)	(0.047)	(0.134)	(0.054)	(0.132)	(0.055)	(0.132)
Adj. R-squared	0.0997	0.237	0.0998	0.237	0.117	0.370	0.117	0.370
Obs.	16,498	16,498	16,498	16,498	17,100	17,100	17,100	17,100
Firm FEs	No	Yes	No	Yes	No	Yes	No	Yes
Ind × Year-Month FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 6: AUBI Exposure Sorted Portfolios

This table examines the performance of portfolios constructed based on firm-level AUBI exposure. Firms are sorted into terciles based on their employee-weighted AUBI exposure, and we construct three value-weighted portfolios representing high, medium, and low exposure. A long-short portfolio is then formed by taking a long position in the high-exposure portfolio and a short position in the low-exposure portfolio. The dependent variable in Columns (1)–(5) is the monthly return (in percent) of this long-short portfolio within Mining, Oil & Gas, Utilities, Construction, and Manufacturing sectors for 2020-2023. Columns (1)–(5) present regressions of this long-short return on a sequence of asset pricing factors. Column (1) controls for the Fama-French three factors: excess market return (MktRF), size (SMB), and value (HML). Column (2) adds the momentum factor (MOM). Column (3) adds profitability (RMW) and investment (CMA) to form the Fama-French five factors plus momentum. Column (4) further controls for two fundamental return predictors: changes in investment-to-assets (R_IA) and return-on-equity (R_ROE). Column (5) adds the green minus brown (GMB) factor from Pástor, Stambaugh, and Taylor (2022), measuring the return spread between green and brown firms based on environmental characteristics. All return predictors are obtained from Kenneth French's and Stambaugh's data libraries and are of monthly frequency. Robust Standard Errors are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	H-L				
	(1)	(2)	(3)	(4)	(5)
MktRF	0.097	0.028	0.010	-0.020	-0.023
	(0.069)	(0.059)	(0.062)	(0.090)	(0.087)
SMB	-0.519**	-0.654**	-0.610*	-0.650*	-0.741*
	(0.240)	(0.287)	(0.303)	(0.341)	(0.371)
HML	0.240***	0.235***	0.325**	0.364**	0.298*
	(0.052)	(0.072)	(0.133)	(0.167)	(0.150)
MOM		-0.264	-0.204	-0.196	-0.202
		(0.171)	(0.137)	(0.127)	(0.127)
RMW			0.111	0.160	0.084
			(0.160)	(0.207)	(0.192)
CMA			-0.233	0.106	0.061
			(0.222)	(0.404)	(0.405)
R_IA				-0.342	-0.411
				(0.487)	(0.519)
R_ROE				-0.095	-0.134
				(0.196)	(0.203)
GMB					-37.834
					(31.142)
Constant	-0.817*	-0.768**	-0.784**	-0.731**	-0.632*
	(0.432)	(0.379)	(0.350)	(0.327)	(0.314)
Adj. R-squared	0.234	0.323	0.325	0.306	0.334
Obs.	48	48	48	48	48

Table 7: AUBI Exposure and CARs: β_1 Estimates

This table reports the estimated betas from the regression specified in Equation 2, around two key events: January 27, 2021, and November 5, 2024. Firm-level cumulative abnormal returns (CARs) are computed using a 100-trading-day estimation window ending 10 days before the start of the event window. We analyze three event windows: $t = [-3, 3]$, $t = [-3, 5]$, and $t = [-3, 10]$. The regressions are based on the Fama-French-Carhart four-factor (FFC4) model and, depending on the specification, additionally control for a daily Green-minus-Brown (GMB) factor (FFC4 + G) and Scope 1, 2, and 3 carbon intensity-sorted portfolio returns (FFC4 + G + C). Results are presented for three samples: the full sample, nature-dependent firms, and non-nature-dependent firms (denoted as "Other"). ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: January 27, 2021

	FFC4			FFC4 + G			FFC4 + G + C		
Sample	[-3,3]	[-3,5]	[-3,10]	[-3,3]	[-3,5]	[-3,10]	[-3,3]	[-3,5]	[-3,10]
All									
	-3.064	-4.059**	-5.348***	-2.98	-3.99**	-5.244***	-2.854	-3.846*	-5.195**
	(2.09)	(1.987)	(2.041)	(2.078)	(1.976)	(2.018)	(2.075)	(1.982)	(2.042)
Other									
	-0.282	-0.914	-2.644	-0.128	-0.788	-2.452	-0.191	-0.779	-2.563
	(1.583)	(1.384)	(1.608)	(1.562)	(1.361)	(1.55)	(1.557)	(1.376)	(1.617)
Nature Dependent									
	-8.413*	-9.767**	-10.616**	-8.485*	-9.827**	-10.706**	-8.023	-9.437*	-10.32**
	(4.997)	(4.866)	(4.816)	(4.977)	(4.85)	(4.8)	(4.976)	(4.859)	(4.813)

Panel B: November 05, 2024

	FFC4			FFC4 + G			FFC4 + G + C		
Sample	[-3,3]	[-3,5]	[-3,10]	[-3,3]	[-3,5]	[-3,10]	[-3,3]	[-3,5]	[-3,10]
All									
	0.786	0.75	0.747	0.52	0.343	0.373	0.72	0.745	0.804
	(0.701)	(0.839)	(1.118)	(0.715)	(0.868)	(1.129)	(0.724)	(0.895)	(1.148)
Other									
	-0.507	-0.851	-1.226	-0.681	-1.117	-1.471	-0.674	-1.034	-1.428
	(0.804)	(0.928)	(1.256)	(0.808)	(0.925)	(1.224)	(0.803)	(0.939)	(1.252)
Nature Dependent									
	2.462*	2.744*	3.446	1.977	2.001	2.762	2.464*	2.865*	3.776*
	(1.287)	(1.564)	(2.108)	(1.326)	(1.661)	(2.189)	(1.364)	(1.734)	(2.206)

Table 8: AUBI Exposure and Institutional Ownership

This table examines the relationship between institutional ownership and firm-level exposure to endangered species and Areas of Unprotected Biodiversity Importance (AUBIs), focusing on heterogeneity across institutional investor types (Equation 3). The dependent variable is institutional ownership, measured as the percentage of shares held by each of four investor types: by banks in Columns (1)–(2), by insurance companies in Columns (3)–(4), by investment companies in Columns (5)–(6), and by independent investment advisors in Columns (7)–(8). The sample period covers 2020–2023. Columns (1), (3), (5), and (7) restrict the sample to firms in Manufacturing, Construction, Utilities, Mining, and Oil & Gas, while Columns (2), (4), (6), and (8) restrict to NAICS industries above 33. All regressions include industry × year-quarter fixed effects (NAICS 2-digit), and standard errors are clustered at the firm level. The key explanatory variable is Employee Weighted AUBI Exposure. Control variables include Climate Change Exposure Near Century, Climate Change Exposure Mid to Late Century, Habitat Climate Change Vulnerability Score Near Century, firm size (measured by the natural log of total assets), leverage (total debt divided by total assets), investment (capital expenditures over total assets), physical asset intensity (PPE over total assets), firm valuation (log of market capitalization and book-to-market ratio), profitability (return on assets), asset growth (year-over-year change in total assets), and sales growth (year-over-year change in sales). Volatility is defined as the standard deviation of monthly returns over the prior 36 months, and momentum is defined as the average monthly return over the prior 12 months. Climate and biodiversity exposures are measured at the firm level, while financial statement variables are annual and volatility and momentum are computed monthly. Standard errors are clustered at the firm level and reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	Banks		Insurance Companies		Investment Companies		Independent Investment Advisors	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Employee Weighted AUBI Exposure	-0.034	-0.107	-0.122	-0.460	-0.194**	-0.413	0.767	2.025
	(0.361)	(0.729)	(0.206)	(0.337)	(0.083)	(0.271)	(0.969)	(2.099)
Climate Change Exposure Near Century	-1.083	-0.001	1.948	-0.720	1.883*	-1.094	-12.984*	-8.673
	(2.512)	(3.020)	(1.658)	(2.269)	(1.136)	(1.555)	(7.602)	(7.978)
Climate Change Exposure Mid to Late Century	-0.179	-2.414	-0.656	-0.192	-0.303	0.015	0.317	-5.496
	(1.423)	(1.638)	(1.039)	(1.016)	(0.369)	(0.886)	(4.610)	(3.468)
Habitat Climate Change Vulnerability Score Near Century	2.824	3.549	-0.809	3.440	-3.165	0.456	26.369*	28.553*
	(5.097)	(6.192)	(3.276)	(4.752)	(2.287)	(2.433)	(14.434)	(16.827)
Ln(Total assets)	0.559***	0.438***	-0.051	-0.066	0.082	-0.133	-0.810*	-0.574*
	(0.189)	(0.126)	(0.123)	(0.101)	(0.064)	(0.162)	(0.458)	(0.334)
Leverage	-0.655	-1.413***	0.338	0.491	0.285	0.963	8.018***	2.376*
	(0.690)	(0.517)	(0.435)	(0.356)	(0.176)	(0.694)	(1.915)	(1.419)
Capex/Total assets	-0.497	2.215	0.549	3.100	0.764	-0.152	-0.022	-4.200
	(3.608)	(3.399)	(2.291)	(2.761)	(1.199)	(1.303)	(9.023)	(7.895)
PPE/Total assets	0.567	-1.903**	-0.110	-0.112	-0.537**	-0.166	-2.763	-1.255
	(0.870)	(0.806)	(0.390)	(0.781)	(0.272)	(0.311)	(2.178)	(1.928)
Ln(Market cap)	0.747***	0.702***	0.196*	0.146	-0.034	0.136	1.906***	1.841***
	(0.181)	(0.119)	(0.115)	(0.100)	(0.073)	(0.163)	(0.424)	(0.316)
Book-to-market	-0.275	-0.140	-0.032	-0.087	-0.007	0.759	1.394**	-0.196
	(0.239)	(0.144)	(0.139)	(0.128)	(0.147)	(0.484)	(0.696)	(0.277)
ROA	-0.174	-0.236	0.343	0.034	0.025	-1.365	1.141	-2.098
	(0.323)	(0.410)	(0.258)	(0.354)	(0.187)	(1.038)	(0.849)	(1.846)
Asset growth	-0.401***	-0.105	-0.171***	0.006	0.006	-0.027	-0.149	-0.130
	(0.138)	(0.090)	(0.065)	(0.026)	(0.033)	(0.063)	(0.331)	(0.104)
Sales growth	-0.003*	0.183	-0.000	-0.035	-0.000	-0.021	0.032***	-0.014***
	(0.002)	(0.241)	(0.001)	(0.033)	(0.000)	(0.049)	(0.007)	(0.003)
Volatility	-0.011	-0.011**	-0.005	-0.006*	0.006	0.010	-0.051***	-0.042***
	(0.007)	(0.004)	(0.004)	(0.003)	(0.005)	(0.011)	(0.015)	(0.009)
Momentum	-0.018**	-0.035**	0.006	0.000	-0.002	-0.019	-0.019	-0.061**
	(0.008)	(0.014)	(0.007)	(0.008)	(0.007)	(0.014)	(0.022)	(0.029)
Adj. R-squared	0.573	0.486	0.0778	0.00947	0.0399	0.0367	0.213	0.229
Obs.	6,889	6,807	5,573	5,751	5,622	5,868	6,886	6,830
Ind × Year-Quarter FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 9: AUBI Exposure and ESG Fund Holdings

This table examines the relationship between mutual fund holdings and firm-level exposure to Areas of Unprotected Biodiversity Importance (AUBIs), focusing on heterogeneity by fund ESG orientation in a sample of non-index funds. The dependent variable is mutual fund holdings, measured as the percentage of a firm's shares held by each fund in each year-month. The sample period covers 2016–2023. Columns (1)-(3) restrict the sample to firms in Manufacturing, Construction, Utilities, Mining, and Oil & Gas (NAICS $\leq$ 33), while Columns (4)-(6) restrict the sample to firms in NAICS industries above 33. All regressions include fund × industry × year-month fixed effects, and standard errors are clustered at the firm level. Columns (2), (3), (5), and (6) additionally include fund × firm fixed effects, while Columns (3) and (6) also absorb firm × year-month fixed effects. The key explanatory variable is *Top Tercile Employee Weighted AUBI Exposure*, a binary indicator equal to 1 for firms in the top tercile of AUBI exposure and 0 for those in the bottom tercile. *Post-2020* is a binary variable equal to 1 for years 2020 and onward. *High ESG Fund* equals 1 if the fund has a Morningstar Sustainability Rating of "average" or higher (three or more globes). The main coefficient of interest is the interaction of *Top Tercile AUBI Exposure* with *Post-2020*, as well as its triple interaction with *High ESG Fund*. Control variables include firm size (log of total assets), leverage (total debt over total assets), investment (capital expenditures over total assets), physical asset intensity (PPE over total assets), valuation (log market capitalization and book-to-market ratio), profitability (return on assets), asset growth, sales growth, volatility (standard deviation of monthly returns over the prior 36 months), and momentum (average return over the prior 12 months). Financial variables are annual; volatility and momentum are monthly. Standard errors are clustered at the firm level and reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	Mining, Oil, Utilities, Construction, Manufacturing			**Others**		
	(1)	(2)	(3)	(4)	(5)	(6)
Post-2020 × Top Tercile Employee Weighted AUBI Exposure	-0.027***	-0.025***		-0.010	-0.015	
	(0.007)	(0.009)		(0.011)	(0.013)	
Post-2020 × Top Tercile Employee Weighted AUBI Exposure × High ESG Fund		0.004	0.005		-0.011	-0.014
		(0.013)	(0.014)		(0.012)	(0.012)
Ln(Total assets)	0.006	0.011		-0.010	0.025	
	(0.014)	(0.013)		(0.010)	(0.020)	
Leverage	-0.018	0.017		0.003	-0.018	
	(0.032)	(0.031)		(0.024)	(0.033)	
Capex/Total assets	0.037	0.112		-0.107	-0.135	
	(0.072)	(0.091)		(0.106)	(0.097)	
PPE/Total assets	0.063	0.067		-0.011	-0.013	
	(0.050)	(0.042)		(0.040)	(0.061)	
Ln(Market cap)	0.070***	0.115***		0.082***	0.122***	
	(0.008)	(0.009)		(0.010)	(0.013)	
Book-to-market	0.025**	0.049***		0.025**	0.034**	
	(0.012)	(0.015)		(0.010)	(0.015)	
ROA	0.014	0.036		0.007	-0.019	
	(0.019)	(0.023)		(0.043)	(0.051)	
Asset growth	-0.011*	-0.022***		0.001	-0.010	
	(0.006)	(0.006)		(0.004)	(0.007)	
Sales growth	-0.000**	-0.000***		0.003	0.000	
	(0.000)	(0.000)		(0.004)	(0.004)	
Volatility	-0.002***	-0.002***		-0.001***	-0.001***	
	(0.000)	(0.000)		(0.000)	(0.000)	
Momentum	0.005***	0.008***		0.004***	0.006***	
	(0.001)	(0.001)		(0.002)	(0.002)	
Adj. R-squared	0.702	0.884	0.890	0.702	0.901	0.907
Obs.	2,694,093	890,206	890,206	2,376,501	785,135	785,135
Firm FEs	Yes	-	-	Yes	-	-
Fund × Ind × Year-Month FEs	Yes	Yes	Yes	Yes	Yes	Yes
Fund × Firm FEs	No	Yes	Yes	No	Yes	Yes
Firm × Year-Month FEs	No	No	Yes	No	No	Yes

Internet Appendix for: "Biodiversity Regulatory Risks and Stock Returns"

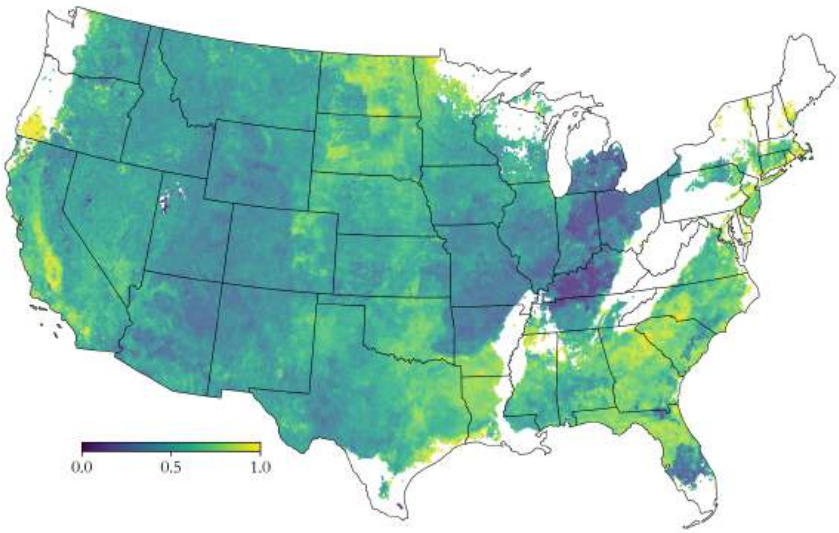
Ricardo Peña, Shikhar Singla, and Zirui Wang

IA Descriptive and Summary Statistics

Figure IA.1: Climate Change Exposure

This figure shows the spatial distribution of climate change exposure, as measured by NatureServe's climate risk metrics, for mid to late century (Panel A) and near century (Panel B) scenarios across the continental United States. Climate change exposure represents the extent to which natural habitats are projected to experience significant changes in temperature and precipitation patterns, based on six key variables. Scores range from 0 (low exposure) to 1 (high exposure), where higher values indicate areas with greater sensitivity to climate shifts. Areas in white denote areas for which NatureServe does not have data.

Panel A: Climate Exposure Mid to Late Century



Panel B: Climate Exposure Near Century

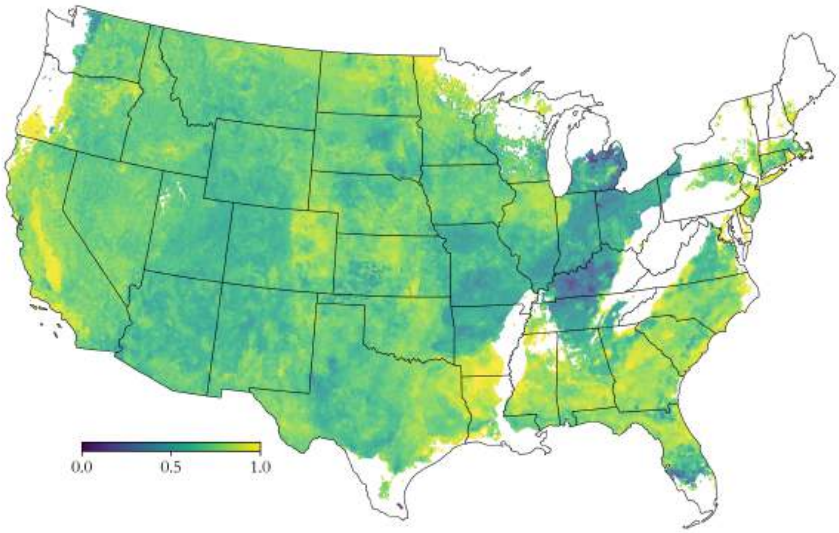
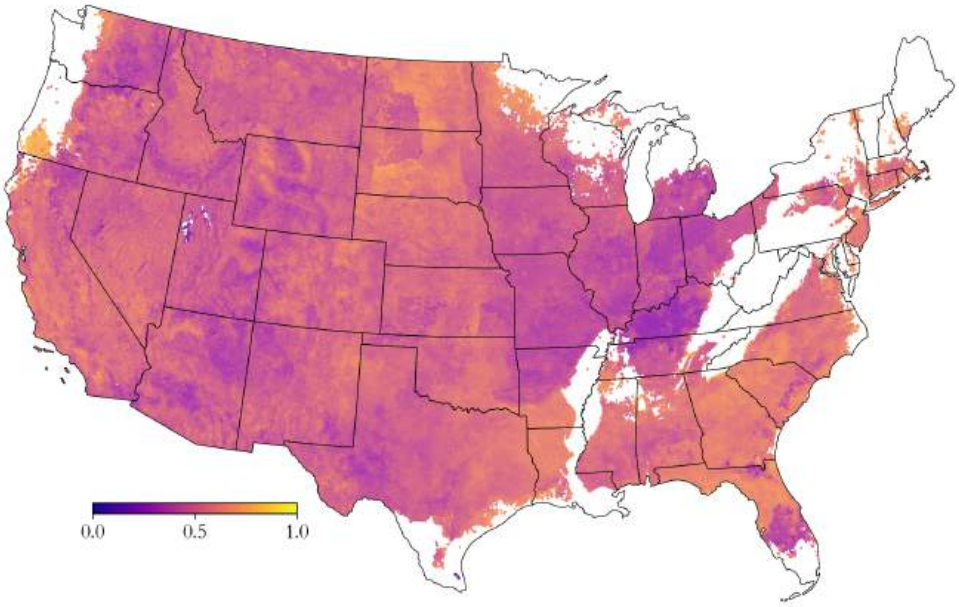


Figure IA.2: Habitat Climate Change Vulnerability Index (HCCVI)

This figure shows the spatial distribution of the Habitat Climate Change Vulnerability Index (HCCVI) scores for mid to late century (Panel A) and near century (Panel B) scenarios across the continental United States. The HCCVI score quantifies the vulnerability of natural habitats to climate change, accounting for factors such as exposure to climatic shifts, sensitivity of the habitat to those changes, and adaptive capacity of the ecosystem. Scores range from 0 (low vulnerability) to 1 (high vulnerability), where higher scores indicate areas more at risk of habitat degradation or loss due to climate change. Areas in white denote areas for which NatureServe does not have data.

Panel A: HCCVI Score Mid to Late Century



Panel B: HCCVI Score Near Century

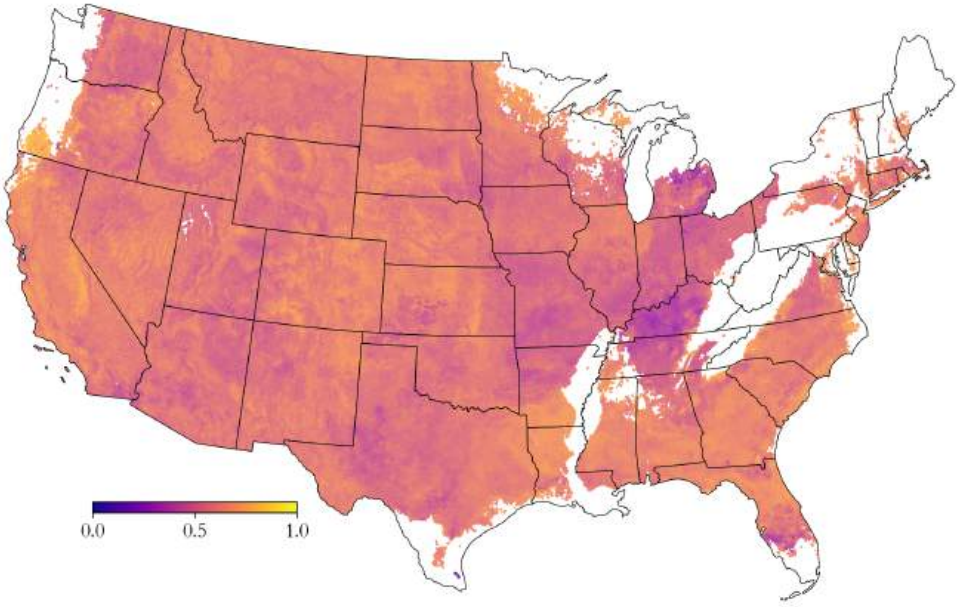
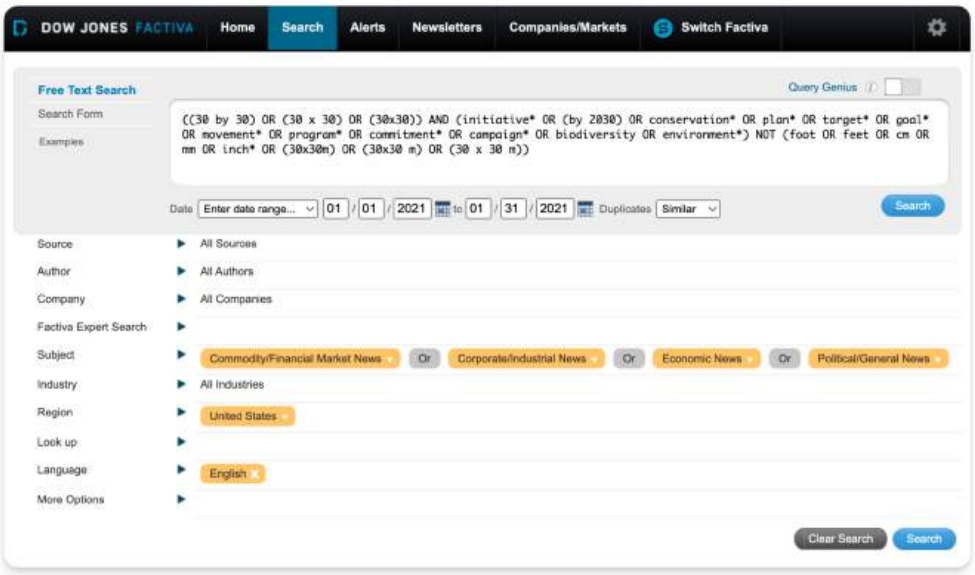


Figure IA.3: Factiva Search Process

This figure shows our search process in Factiva to retrieve relevant articles on the "30 by 30" initiative. Panel A shows the search filters and the query we used in Factiva. The query we used is `((30 by 30) OR (30 x 30) OR (30x30)) AND (initiative* OR (by 2030) OR conservation* OR plan* OR target* OR goal* OR movement* OR program* OR commitment* OR campaign* OR biodiversity OR environment*) NOT (foot OR feet OR cm OR mm OR inch* OR (30x30m) OR (30x30 m) OR (30 x 30 m))`. The query requires (1) mentioning "30 by 30" in any of its common formats, (2) including at least one relevant keyword (with '*' capturing word variations), and (3) excluding measurement-related terms to filter out irrelevant results. The query is limited to U.S.-based sources and English-language articles. Panel B shows an example of the search results for January 2021. The search returned 41 articles, with 10 identified as duplicates, resulting in 31 unique articles.

Panel A: Search Filters and Query



Panel B: Example Search Results

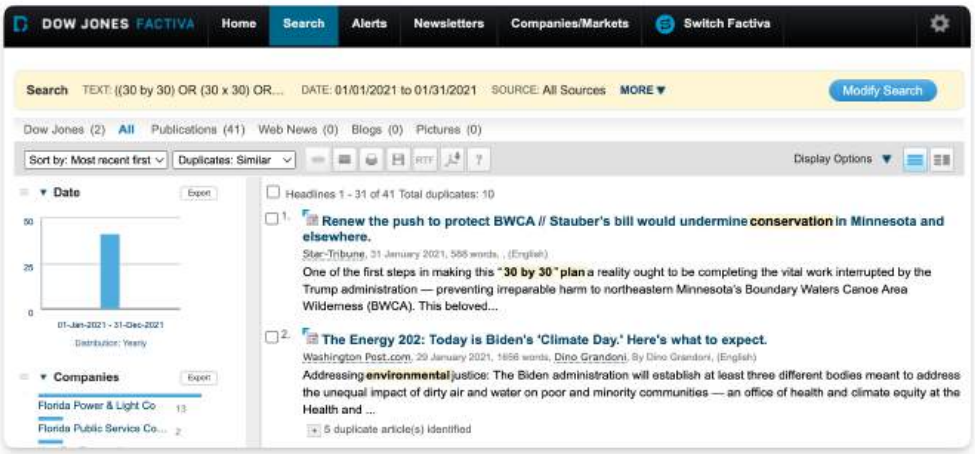


Table IA.1: Variable Definitions

Variables	Definitions	Sources
	Biodiversity-related Variables	
RSR	Range-size rarity. First, calculate the inverse of the modeled habitat area for each species. Second, sum these values across species to aggregate range-size rarity at the geographical level. Data are at a 990-meter resolution.	Hamilton et al. (2022)
PWRSR	Protection-weighted range-size rarity. First, calculate for each species as the product of its range-size rarity and the percentage of habitat outside protected areas. Second, sum these values across species to aggregate protection-weighted range-size rarity at the geographical level. Data are at a 990-meter resolution.	Hamilton et al. (2022)
AUBI	Areas of unprotected biodiversity importance. A binary variable equal to 1 if the summed PWRSR at the geographical level is $\geq$ 0.0005; otherwise, it equals 0. Data are at a 990-meter resolution.	Hamilton et al. (2022)
Employee-weighted RSR exposure	A firm-level measure calculated as the employment-weighted average of RSR scores across the firm's establishments.	Self-constructed
Employee-weighted PWRSR exposure	A firm-level measure calculated as the employment-weighted average of PWRSR scores across the firm's establishments.	Self-constructed
Employee-weighted AUBI exposure	A firm-level measure calculated as the proportion of the firm's total workforce located in establishments within AUBI.	Self-constructed
	Climate-related Variables	
CCE	Climate Change Exposure. Measures climate-induced stress on ecosystems within spatial units over 100 square kilometers. Scores range from 0.0 (highest stress) to 1.0 (lowest stress), with projections for near-century and mid-to-late-century timeframes.	NatureServe
HCCVI	Habitat Climate Change Vulnerability Index. Assesses habitat vulnerability based on exposure, sensitivity, and adaptive capacity within spatial units over 100 square kilometers. Scores range from 0.0 (highest vulnerability) to 1.0 (lowest vulnerability), with near-century and mid-to-late-century projections.	NatureServe
CCE (firm-level)	A firm-level measure calculated as the employment-weighted average of CCE scores across the firm's establishments.	Self-constructed
HCCVI (firm-level)	A firm-level measure calculated as the employment-weighted average of HCCVI scores across the firm's establishments.	Self-constructed
Scope 1/2/3 emissions intensity	The intensity of Scope 1, Scope 2, or Scope 3 GHG emissions. Annual data.	Trucost
Ln(Scope 1/2/3 emissions)	The natural logarithm of Scope 1, Scope 2, or Scope 3 greenhouse gas (GHG) emissions. Annual data.	Trucost

(Continued)

Table IA.1: Variable Definitions *(Continued)*

Variables	Definitions	Sources
	Stock Return Variables	
Monthly return (%)	Monthly stock return. We build total return using stock prices expressed in $ (prccd), adjustment factors (ajexdi), exchange rates (exratd), and total return factors (trfd). Winsorized at the 1% and 99% levels. Monthly data.	Compustat
Volatility (%)	Standard deviation of the monthly returns over the 36 preceding months. Winsorized at the 1% and 99% levels. Monthly data.	Compustat
Momentum (%)	Average monthly return over the twelve preceding months. Winsorized at the 1% and 99% levels. Monthly data.	Compustat
	Firm Characteristic Variables	
Total assets	Total assets. Winsorized at the 1% and 99% levels. Annual data.	Compustat
Book-to-market	Ratio of book equity to market capitalization. Winsorized at the 1% and 99% levels. Monthly data.	Compustat
Leverage	Total debt, divided by total assets. Winsorized at the 1% and 99% levels. Annual data.	Compustat
Capex/Total assets	Capital expenditures, divided by total assets. Winsorized at the 1% and 99% levels. Annual data.	Compustat
PPE/Total assets	Net property, plant, and equipment, divided by total assets. Winsorized at the 1% and 99% levels. Annual data.	Compustat
ROA	Income before extraordinary items, divided by total assets. Winsorized at the 1% and 99% levels. Annual data.	Compustat
Asset growth	Percentage change in total assets. Winsorized at the 1% and 99% levels. Annual data.	Compustat
Sales growth	Percentage change in sales. Winsorized at the 1% and 99% levels. Annual data.	Compustat
Market cap	Market capitalization. Winsorized at the 1% and 99% levels. Monthly data.	Compustat
SUE	One-year earnings surprise measured as the actual earnings per share minus the I/B/E/S median analyst forecast 8 months prior to the end of the forecast period, scaled by the stock price.	IBES
	Ownership Variables	
Institutional ownership	Institutional ownership in terms of the percentage of shares of a specific firm held by banks, insurance companies, investment companies, or independent investment advisors. Quarterly data.	Thomson Reuters
Mutual fund holdings	The percentage of a mutual fund's total net assets invested in a specific security. Quarterly data.	CRSP
High ESG fund	A binary variable that equals one if a fund has 3 or more globes based on Morningstar sustainability ratings.	Morningstar

Table IA.2: Corporate Biodiversity Commitments

This table showcases examples of how companies across various industries address biodiversity and 30 by 30 initiatives in their recent annual or sustainability reports.

Company	Industry	Excerpt	Source
3M Company	Manufacturing	The emergence of biodiversity and ecosystems as a new priority topic in 2022 has validated a category of work we've engaged in for years across all three pillars.	Global Impact Report 2023
BP P.L.C	Oil & Gas Supply Chain	Biodiversity and protected areas: Our biodiversity position builds on robust practices already in place to manage biodiversity across bp projects. We are committed to not operate any new oil or gas exploration or production activities inside natural or cultural UNESCO World Heritage sites, or in Strict Nature Reserves and Wilderness Areas as listed on 1 January 2020 and defined by the International Union for Conservation of Nature (IUCN).	Sustainability Report 2023
Caterpillar Inc.	Manufacturing	Over the past two decades, the Foundation's innovative approaches to nature-based solutions help create resilient, more sustainable communities that thrive in a rapidly changing world. In 2023, the Foundation supported 20 organizations in 21 countries in building basic infrastructure services, like water and energy, and restoring natural ecosystems to withstand natural disasters and environmental challenges.	Sustainability Report 2023
Enagas	Oil & Gas Supply Chain	A commitment to biodiversity is reaffirmed as one of Enagás' priority lines of action. For this reason, the company has joined the new Pact for Biodiversity and Natural Capital with the highest level of commitment. This initiative is backed by the Spanish Business and Biodiversity Initiative (IEEB).	Annual Report 2023
Endeavour Mining	Metals & Mining	Turning to ESG Reporting, we have become early adopters of the Task Force on Nature-related Financial Disclosures (TNFD), demonstrating industry leadership on the importance of nature, particularly biodiversity in our case.	Sustainability Report 2024
Heidelberg Materials	Metals & Mining	A study investigated the role that mining sites can play as alternative habitats for insects that are potentially endangered due to landscape changes. The project complements our measures to improve biodiversity management at our quarries.	Annual and Sustainability Report 2023
Newmont Corporation	Metals & Mining	Our commitment to No Net Loss of Key Biodiversity Values (KBVs) from mine-related activities is integral to our approach and essential for achieving positive nature outcomes. In 2023, we conducted audits of biodiversity risks at Ahafo South, Akyem and Boddington.	Sustainability Report 2023

Table IA.3: Firm Count by NAICS Sectors

This table displays the number of firms in our sample by two-digit NAICS sectors.

Code	Two-Digit NAICS Sectors	Number of Firms
11	Agriculture, Forestry, Fishing and Hunting	3
21	Mining, Quarrying, and Oil and Gas Extraction	39
22	Utilities	7
23	Construction	18
31	Manufacturing	46
32	Manufacturing	138
33	Manufacturing	271
42	Wholesale Trade	47
44	Retail Trade	23
45	Retail Trade	45
48	Transportation and Warehousing	30
49	Transportation and Warehousing	2
51	Information	88
52	Finance and Insurance	115
53	Real Estate Rental and Leasing	49
54	Professional, Scientific, and Technical Services	36
56	Administrative and Support and Waste Management and Remediation Services	21
61	Educational Services	6
62	Health Care and Social Assistance	21
71	Arts, Entertainment, and Recreation	6
72	Accommodation and Food Services	22
81	Other Services (except Public Administration)	4
Total		1039

Table IA.4: Description of Additional Datasets Used in the Analysis

Dataset	Description
Protected Areas	We obtain data on protected areas from the U.S. Geological Survey's (USGS) Protected Areas Database of the United States. This database provides comprehensive spatial data on protected lands across the U.S., including information on ownership type, conservation designation, and management intent. For this study, we focus on areas with GAP Status 1 and 2, as they are explicitly designated for biodiversity conservation. GAP Status 1 includes areas with the strictest protections, managed to maintain natural ecosystems with minimal human impact, prohibiting extractive activities entirely. GAP Status 2 areas are also managed for biodiversity conservation but may allow for limited human activities that do not degrade the ecological conditions. Figure 2 illustrates these protected areas. Panel A shows the protected areas color-coded by ownership type, such as federal, state, regional agencies, NGOs, and private entities. Panel B overlays these areas with the Protected Weighted Range Size Rarity (PWRSR) measure.
Mututal Funds	We obtain mutual fund characteristics from Morningstar Direct and mutual fund holdings data from the CRSP Mutual Funds database. Our sample includes all U.S.-domiciled equity funds that have sustainability ratings from Morningstar. We merge the fund characteristics from Morningstar with the CRSP holdings data, resulting in a dataset of 1,574 unique funds. Each fund is associated with a Morningstar Sustainability Rating, which measures portfolio-level environmental, social, and governance (ESG) risks. These ratings are based on company-level ESG risk assessments from Sustainalytics, aggregated to the portfolio level on an asset-weighted basis. Morningstar assigns sustainability ratings on a scale of 1 to 5 "globes." Funds with higher ESG risks relative to their Morningstar Global Category receive fewer globes, with 1 globe indicating the highest risk and 5 globes the lowest. For our analysis, we classify funds with 3 or more globes as "high ESG" funds (i.e., average, above average or high sustainability rating).

(Continued on next page)

(Continued from previous page)

Dataset	Description
Carbon Emissions Data	To ensure our results are not driven by climate-related risks, we obtained firm-level carbon emission data from Trucost. Trucost is a leading carbon emission data provider and has been widely used in the literature. Trucost provides information on corporate Scope 1, Scope 2, and Scope 3 carbon emissions and other greenhouse gas emissions; merging with Trucost data led to a 23% reduction in observations. In our analysis, we control for both carbon emission levels and intensity. Specifically for our CAR event-study we construct a daily, value-weighted portfolios for Scope 1, 2, and 3 carbon emissions ranked on level, intensity, and year-over-year changes. The portfolios are created following the methodology of GMB from (Pástor, Stambaugh, and Taylor, 2022). We long firms the top tercile of carbon and short firms in the bottom tercile with monthly reweighting and sorting. Taking note from Zhang (2025), which finds corporate emissions data is published with delay, we construct portfolios using 0m, 6m, and 12m lags but focus on 12m lags to lower the amount of forward-looking sales bias. We still find statistical significance accounting for these portfolios, signaling biodiversity risk is being priced into equities.
Institutional Ownership	We obtain institutional ownership data from the Thomson/ Refinitiv Institutional (13f) Holdings database. The dataset is constructed from 13f filings, which are submitted quarterly to the SEC by investment companies and professional money managers overseeing assets above the reporting threshold. We process the data to compute the institutional holdings of each firm in our sample, disaggregated by institutional type, including banks, insurance companies, investment companies, and independent investment advisors. Note, here we follow the methodology of Agarwal, Jiang, Tang, and Yang (2013) and focus primarily on the first 4 type codes; banks (type code = 1), insurance companies (type code = 2), investment companies (type code = 3), and independent investment advisors (type code = 4). The "other" (type code = 5) category, which accounts for a substantial portion of the entire dataset, has been known to be problematic since it includes many misclassified institutions. This problem is acknowledged by the database.

(Continued on next page)

(Continued from previous page)

Dataset	Description
S&P Global ESG Scores	To control for a daily GMB factor, as in Pástor, Stambaugh, and Taylor (2022), we construct Green and Brown portfolios using S&P ESG data. We do not have access to MSCI data to recreate their daily portfolios but follow their methodology of monthly portfolio sorting and monthly reweighting on S&P Environment (E) scores. Note, we do use the authors monthly GMB portfolio returns for regressions since their replication data can be found through the authors' personal websites.[24] S&P provides scores along Environmental, Social, and Governance dimensions. For our construction we focus solely on their modeled Environmental score. We create our daily GMB portfolio returns by longing the highest tercile of E scores and shorting the lowest. In addition to its Environmental (E) score, S&P provides a modeled Biodiversity criteria score for a subset of firms. While potentially informative, the coverage is extremely limited. After merging with our AUBI sample, we find non-missing biodiversity scores for only 76 firms in nature- and location-dependent sectors (NAICS $\leq$ 33) and 77 firms in other sectors (NAICS $>$ 33). Due to this sparse overlap, we do not include the S&P biodiversity score in our main analysis or in Table 2. However, for the limited sample of overlapping firms, we note that the correlation between the S&P biodiversity score and our AUBI exposure measure is very low, suggesting the two measures capture fundamentally different dimensions of biodiversity risk.

[24] See: https://data.mendeley.com/datasets/dnskbdnmsz/1

Table IA.5: Summary Statistics of Other Datasets

This table presents the summary statistics for the variables used in the other datasets in the paper. The sample includes all firms in the sample, and the sample period is from 2020 to 2023. Factor premiums are obtained from Fama-French Data Library. Carbon emission data are obtained from Trucost. Institutional ownership data are from Thomson Reuters 13F institutional holdings data. Mutual fund ratings are obtained from MorningStar Direct. Mutual fund holdings are obtained from the CRSP Mutual Funds database.

	Number of Obs.	Mean	Std Dev	p5	p25	Median	p75	p95
Panel A: Fama-French Factors								
MktRF	48	0.95	5.89	-9.03	-2.74	1.86	4.88	9.31
SMB	48	0.02	3.40	-4.52	-2.29	-0.15	1.90	6.23
HML	48	0.13	5.04	-7.75	-2.33	-0.15	3.13	7.78
RMW	48	0.70	2.84	-3.54	-1.52	0.62	2.43	6.03
CMA	48	0.23	3.25	-4.62	-1.85	-0.59	2.89	5.63
MOM	48	-0.07	4.59	-7.31	-2.40	0.79	2.81	5.58
R_IA	48	0.27	3.78	-5.55	-2.31	-0.45	3.20	6.33
R_ROE	48	0.52	3.93	-4.21	-1.80	0.90	3.32	5.82
Panel B: Trucost								
Scope 1 Emissions	34592	711237.17	3579630.80	276.00	3017.48	16426.78	87707.89	2365000.00
Scope 2 Emissions	34592	270038.04	983407.68	569.58	5858.57	25161.00	102425.00	1262328.00
Scope 3 Emissions	34592	1523096.03	5864799.35	4000.86	38826.21	171194.15	719451.72	5677346.23
Scope 1 Emissions Intensity	34592	87.01	357.74	0.38	3.79	12.18	23.55	305.22
Scope 2 Emissions Intensity	34592	30.96	115.80	1.71	7.04	14.95	29.56	90.97
Scope 3 Emissions Intensity	34592	139.16	154.13	22.94	45.04	88.03	182.76	396.29
Panel C: 13-f Institutional Ownership								
By Banks (%)	14141	6.03	3.72	0.12	3.44	6.42	8.55	11.84
By Insurance Companies (%)	11521	1.51	1.73	0.24	0.60	1.05	1.67	4.63
By Investment Companies (%)	11703	0.62	1.83	0.07	0.18	0.35	0.65	1.62
By Indept. Investment Advisors (%)	14161	12.48	7.51	1.34	6.86	11.92	17.15	25.64
Panel D: Mutual Fund								
MorningStar ESG Rating	1685569	2.89	0.87	2.00	2.00	3.00	3.00	4.00
Mutual Fund Holdings (%)	4990045	0.38	0.71	0.00	0.02	0.09	0.46	1.71

IB Cross-Sectional Results

Table IB.1: Cross-Sectional Returns and AUBI Exposure

This table examines the relationship between firm-level biodiversity exposure and monthly stock returns, focusing on three distinct measures of exposure: Employee Weighted AUBI, PWRSR, and RSR. The dependent variable is firm-level monthly returns (in percent). The regressions are estimated over the 2020–2023 period without time fixed effects or firm fixed effects. Columns (1)–(3) include no fixed effects, while Columns (4)–(6) control for NAICS 2-digit industry fixed effects. The main explanatory variables are measures of firm-level biodiversity risk: Employee Weighted AUBI Exposure (Columns 1 and 4), Employee Weighted PWRSR Exposure (Columns 2 and 5), and Employee Weighted RSR Exposure (Columns 3 and 6). All regressions include a standard set of firm-level control variables: the natural logarithm of total assets (Ln(Total assets)), leverage (total debt scaled by total assets), capital expenditures scaled by total assets (Capex/Total assets), property, plant, and equipment scaled by total assets (PPE/Total assets), return on assets (ROA), the natural logarithm of market capitalization (Ln(Market cap)), the book-to-market ratio, asset growth, sales growth, return volatility (measured as the standard deviation of monthly returns over the past 36 months), and momentum (average return over the past 12 months). Standard errors are clustered at the firm level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Monthly Returns					
	(1)	(2)	(3)	(4)	(5)	(6)
Employee Weighted AUBI Exposure	-1.238***			-1.337***		
	(0.369)			(0.381)		
Employee Weighted PWRSR Exposure		-41.051*			-38.920*	
		(23.452)			(22.374)	
Employee Weighted RSR Exposure			-32.258**			-31.045**
			(13.288)			(12.854)
Ln(Total assets)	-0.630***	-0.602***	-0.603***	-0.925***	-0.898***	-0.898***
	(0.171)	(0.169)	(0.169)	(0.206)	(0.205)	(0.205)
Leverage	-0.034	-0.058	-0.056	0.553	0.517	0.519
	(0.501)	(0.500)	(0.500)	(0.517)	(0.515)	(0.515)
Capex/Total assets	-15.349***	-14.983***	-15.030***	-17.362***	-17.005***	-17.044***
	(2.758)	(2.740)	(2.743)	(2.873)	(2.858)	(2.861)
PPE/Total assets	2.991***	2.965***	2.966***	3.587***	3.625***	3.622***
	(0.521)	(0.520)	(0.520)	(0.639)	(0.637)	(0.637)
Ln(Market cap)	0.510***	0.482***	0.483***	0.750***	0.722***	0.723***
	(0.182)	(0.180)	(0.180)	(0.215)	(0.214)	(0.214)
Book-to-market	-0.711***	-0.706***	-0.706***	-0.639**	-0.632**	-0.632**
	(0.244)	(0.243)	(0.243)	(0.259)	(0.258)	(0.258)
ROA	3.215***	3.348***	3.348***	2.996***	3.111***	3.115***
	(0.817)	(0.805)	(0.805)	(0.845)	(0.837)	(0.837)
Asset growth	0.946	0.938	0.939	0.978*	0.972*	0.972*
	(0.585)	(0.581)	(0.582)	(0.588)	(0.586)	(0.586)
Sales growth	0.010	0.010	0.010	0.009	0.010	0.009
	(0.010)	(0.009)	(0.009)	(0.010)	(0.010)	(0.010)
Volatility	0.038	0.038	0.038	0.035	0.035	0.035
	(0.024)	(0.024)	(0.024)	(0.025)	(0.025)	(0.025)
Momentum	-0.118***	-0.117***	-0.117***	-0.129***	-0.128***	-0.128***
	(0.042)	(0.042)	(0.042)	(0.043)	(0.043)	(0.043)
Adj. R-squared	0.00457	0.00445	0.00446	0.00540	0.00526	0.00526
Obs.	46,350	46,350	46,350	46,350	46,350	46,350
Ind FEs	No	No	No	Yes	Yes	Yes

Table IB.2: Cross-Sectional Returns and AUBI Exposure: Industry FEs

This table analyzes the relationship between firm-level biodiversity exposure and monthly stock returns, accounting for time and industry-specific variation through the inclusion of fixed effects. The dependent variable is firm-level monthly returns (in percent). Columns (1)–(3) include year-month fixed effects, while Columns (4)–(6) include industry × year-month fixed effects (using NAICS 2-digit codes). The sample is restricted to 2020-2023. The main explanatory variables are Employee Weighted AUBI Exposure (Columns 1 and 4), Employee Weighted PWRSR Exposure (Columns 2 and 5), and Employee Weighted RSR Exposure (Columns 3 and 6). All regressions include the following firm-level controls: the natural logarithm of total assets (Ln(Total assets)), leverage (total debt scaled by total assets), capital expenditures scaled by total assets (Capex/Total assets), property, plant, and equipment scaled by total assets (PPE/Total assets), return on assets (ROA), the natural logarithm of market capitalization (Ln(Market cap)), the book-to-market ratio, asset growth, sales growth, return volatility (measured as the standard deviation of the past 36 months of returns), and momentum (average return over the past 12 months). Standard errors are clustered at the firm level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	Monthly Returns					
	(1)	(2)	(3)	(4)	(5)	(6)
Employee Weighted AUBI Exposure	-1.187***			-1.317***		
	(0.364)			(0.386)		
Employee Weighted PWRSR Exposure		-39.969*			-38.794*	
		(21.722)			(21.258)	
Employee Weighted RSR Exposure			-31.009**			-30.427**
			(12.600)			(12.500)
Ln(Total assets)	-0.518***	-0.490***	-0.491***	-0.725***	-0.698***	-0.698***
	(0.163)	(0.161)	(0.161)	(0.192)	(0.191)	(0.191)
Leverage	-0.183	-0.206	-0.204	0.292	0.256	0.258
	(0.475)	(0.474)	(0.474)	(0.484)	(0.482)	(0.482)
Capex/Total assets	-8.962***	-8.612***	-8.658***	-8.250***	-7.887***	-7.928***
	(2.504)	(2.487)	(2.489)	(2.448)	(2.441)	(2.442)
PPE/Total assets	2.207***	2.181***	2.183***	2.272***	2.307***	2.305***
	(0.486)	(0.485)	(0.485)	(0.587)	(0.584)	(0.584)
Ln(Market cap)	0.390**	0.363**	0.364**	0.554***	0.528**	0.528**
	(0.175)	(0.173)	(0.173)	(0.207)	(0.206)	(0.206)
Book-to-market	-0.687***	-0.682***	-0.682***	-0.594**	-0.587**	-0.587**
	(0.222)	(0.221)	(0.221)	(0.233)	(0.232)	(0.232)
ROA	3.462***	3.589***	3.590***	3.277***	3.391***	3.396***
	(0.773)	(0.764)	(0.764)	(0.803)	(0.799)	(0.799)
Asset growth	0.762	0.754	0.754	0.734	0.728	0.729
	(0.535)	(0.531)	(0.532)	(0.516)	(0.514)	(0.514)
Sales growth	0.009	0.009	0.009	0.004	0.004	0.004
	(0.009)	(0.009)	(0.009)	(0.008)	(0.008)	(0.008)
Volatility	0.032	0.032	0.032	0.030	0.030	0.030
	(0.021)	(0.021)	(0.021)	(0.020)	(0.020)	(0.020)
Momentum	-0.098**	-0.097**	-0.097**	-0.107***	-0.106***	-0.106***
	(0.040)	(0.040)	(0.040)	(0.039)	(0.039)	(0.039)
Adj. R-squared	0.137	0.136	0.136	0.155	0.155	0.155
Obs.	46,350	46,350	46,350	46,350	46,350	46,350
Year-Month FEs	Yes	Yes	Yes	-	-	-
Ind × Year-Month FEs	No	No	No	Yes	Yes	Yes

Table IB.3: Cross-Sectional Returns and AUBI Exposure: Climate Controls

This table examines the relationship between AUBI exposure and monthly stock returns while controlling for firm-level climate change exposure. The dependent variable is firm-level monthly returns (in percent). Columns (1) and (2) include year-month fixed effects, while Columns (3) and (4) include industry × year-month fixed effects (using NAICS 2-digit codes). The sample is restricted to 2020-2023. The main explanatory variables are Employee Weighted AUBI Exposure (Columns 1 and 3) and Employee Weighted Distance AUBI Exposure (Columns 2 and 4). All regressions control for climate-related firm exposures—Climate Change Exposure Near Century, Climate Change Exposure Mid to Late Century, and Habitat Climate Change Vulnerability Score Near Century—as well as standard firm-level characteristics: the natural logarithm of total assets (Ln(Total assets)), leverage (total debt scaled by total assets), capital expenditures scaled by total assets (Capex/Total assets), property, plant, and equipment scaled by total assets (PPE/Total assets), return on assets (ROA), the natural logarithm of market capitalization (Ln(Market cap)), the book-to-market ratio, asset growth, sales growth, return volatility (measured as the standard deviation of the past 36 months of returns), and momentum (average return over the past 12 months). Standard errors are clustered at the firm level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	Monthly Returns			
	(1)	(2)	(3)	(4)
Employee Weighted AUBI Exposure	-1.147***		-1.257***	
	(0.372)		(0.395)	
Employee Weighted Distance AUBI Exposure		-1.259***		-1.230***
		(0.358)		(0.383)
Climate Change Exposure Near Century	-1.096	-0.864	-0.570	-0.512
	(2.498)	(2.408)	(2.633)	(2.534)
Climate Change Exposure Mid to Late Century	1.060	1.205	0.527	0.695
	(1.309)	(1.321)	(1.400)	(1.419)
Habitat Climate Change Vulnerability Score Near Century	-2.570	-2.887	-1.229	-1.179
	(4.367)	(4.260)	(4.478)	(4.370)
Ln(Total assets)	-0.439***	-0.449***	-0.630***	-0.629***
	(0.159)	(0.159)	(0.187)	(0.186)
Leverage	-0.191	-0.266	0.249	0.151
	(0.474)	(0.474)	(0.482)	(0.483)
Capex/Total assets	-8.931***	-9.140***	-7.986***	-8.062***
	(2.485)	(2.476)	(2.421)	(2.417)
PPE/Total assets	2.154***	2.208***	2.122***	2.213***
	(0.487)	(0.487)	(0.568)	(0.569)
Ln(Market cap)	0.309*	0.315*	0.456**	0.454**
	(0.172)	(0.170)	(0.202)	(0.201)
Book-to-market	-0.722***	-0.720***	-0.641***	-0.643***
	(0.223)	(0.223)	(0.233)	(0.233)
ROA	3.557***	3.526***	3.399***	3.375***
	(0.796)	(0.806)	(0.817)	(0.828)
Asset growth	0.680	0.702	0.660	0.681
	(0.498)	(0.491)	(0.492)	(0.485)
Sales growth	0.007	0.007	0.003	0.003
	(0.008)	(0.008)	(0.008)	(0.007)
Volatility	0.033	0.033	0.031	0.031
	(0.023)	(0.023)	(0.022)	(0.022)
Momentum	-0.100**	-0.101**	-0.109***	-0.110***
	(0.042)	(0.042)	(0.041)	(0.041)
Adj. R-squared	0.138	0.138	0.157	0.157
Obs.	44,901	44,901	44,901	44,901
Year-Month FEs	Yes	Yes	-	-
Ind × Year-Month FEs	No	No	Yes	Yes

Table IB.4: Cross-Sectional Returns and AUBI Exposure Pre-2020

This table analyzes the relationship between biodiversity risk and monthly stock returns before 2020. The dependent variable is firm-level monthly returns (in percent). The sample is restricted to the pre-2020 period (2016-2019). The main explanatory variables are Employee Weighted AUBI Exposure, Employee Weighted PWRSR Exposure, Employee Weighted RSR Exposure, and Employee Weighted Distance AUBI Exposure, each included in a separate regression. Columns (1) through (4) sequentially add fixed effects: Column (1) includes no fixed effects; Column (2) includes 2-digit NAICS industry fixed effects; Column (3) includes year-month fixed effects; and Column (4) includes industry × year-month fixed effects at the 2-digit NAICS level. Columns (5) through (8) include the same set of fixed effects as Column (4) and additionally control for climate-related firm exposures—Climate Change Exposure Near Century, Climate Change Exposure Mid to Late Century, and Habitat Climate Change Vulnerability Score Near Century. All regressions include a standard set of firm-level controls: the natural logarithm of total assets (Ln(Total assets)), leverage (total debt scaled by total assets), capital expenditures scaled by total assets (Capex/Total assets), property, plant, and equipment scaled by total assets (PPE/Total assets), return on assets (ROA), the natural logarithm of market capitalization (Ln(Market cap)), the book-to-market ratio, asset growth, sales growth, return volatility (measured as the standard deviation of the past 36 months of returns), and momentum (average return over the past 12 months). Standard errors are clustered at the firm level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	Monthly Returns							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Employee Weighted AUBI Exposure	0.095	0.178	0.116	0.195	0.040			
	(0.343)	(0.332)	(0.329)	(0.321)	(0.336)			
Employee Weighted PWRSR Exposure						12.498		
						(8.137)		
Employee Weighted RSR Exposure							5.426	
							(7.296)	
Employee Weighted Distance AUBI Exposure								0.245
								(0.324)
Ln(Total assets)	-0.770***	-1.015***	-0.705***	-0.877***	-0.871***	-0.868***	-0.869***	-0.864***
	(0.121)	(0.131)	(0.113)	(0.122)	(0.124)	(0.124)	(0.124)	(0.124)
Leverage	0.356	0.478	0.383	0.460	0.421	0.417	0.418	0.428
	(0.401)	(0.407)	(0.379)	(0.389)	(0.397)	(0.397)	(0.397)	(0.398)
Capex/Total assets	-5.769**	-6.819***	-4.989**	-5.581**	-6.764***	-6.769***	-6.769***	-6.722***
	(2.360)	(2.472)	(2.141)	(2.195)	(2.291)	(2.284)	(2.284)	(2.291)
PPE/Total assets	0.343	1.542***	0.279	1.298**	1.485***	1.497***	1.492***	1.480***
	(0.436)	(0.560)	(0.406)	(0.525)	(0.535)	(0.537)	(0.537)	(0.538)
Ln(Market cap)	0.800***	1.056***	0.729***	0.906***	0.897***	0.893***	0.895***	0.891***
	(0.130)	(0.139)	(0.121)	(0.130)	(0.132)	(0.132)	(0.132)	(0.132)
Book-to-market	-0.951***	-0.910***	-0.816***	-0.781***	-0.791***	-0.795***	-0.794***	-0.790***
	(0.265)	(0.258)	(0.241)	(0.233)	(0.238)	(0.239)	(0.239)	(0.238)
ROA	2.509***	2.383***	2.293***	2.192***	2.002***	2.001***	2.001***	2.021***
	(0.729)	(0.709)	(0.703)	(0.704)	(0.715)	(0.715)	(0.715)	(0.715)
Asset growth	1.443***	1.483***	1.448***	1.510***	1.427***	1.422***	1.425***	1.419***
	(0.286)	(0.292)	(0.275)	(0.284)	(0.284)	(0.281)	(0.281)	(0.283)
Sales growth	0.035	0.040*	0.039*	0.044*	0.082	0.082	0.082	0.081
	(0.023)	(0.023)	(0.023)	(0.024)	(0.069)	(0.069)	(0.069)	(0.069)
Volatility	0.044*	0.063**	0.034	0.050*	0.047*	0.046*	0.047*	0.046*
	(0.026)	(0.029)	(0.024)	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)
Momentum	-0.344***	-0.369***	-0.268***	-0.278***	-0.281***	-0.281***	-0.281***	-0.281***
	(0.027)	(0.027)	(0.028)	(0.029)	(0.030)	(0.030)	(0.030)	(0.030)
Climate Change Exposure Near Century					2.935*	2.879*	2.918*	2.726*
					(1.649)	(1.619)	(1.620)	(1.621)
Climate Change Exposure Mid to Late Century					-0.041	-0.039	-0.040	-0.085
					(0.947)	(0.947)	(0.947)	(0.952)
Habitat Climate Change Vulnerability Score Near Century					-5.508	-5.412	-5.488	-5.038
					(3.411)	(3.391)	(3.395)	(3.385)
Adj. R-squared	0.0156	0.0173	0.142	0.165	0.167	0.167	0.167	0.167
Obs.	44,681	44,681	44,681	44,681	43,322	43,322	43,322	43,322
Ind FEs	No	Yes	No	-	-	-	-	-
Year-Month FEs	No	No	Yes	-	-	-	-	-
Ind × Year-Month FEs	No	No	No	Yes	Yes	Yes	Yes	Yes

Table IB.5: Cross-Sectional Returns and AUBI Exposure Pre-2020: Nature-Dependent Sectors

This table analyzes the relationship between biodiversity risk and monthly stock returns before 2020. The dependent variable is firm-level monthly returns (in percent). The sample is restricted to the pre-2020 period (2016-2019) and limited to firms in nature- and location-dependent sectors (2-digit NAICS $\leq$ 33). The main explanatory variables are Employee Weighted AUBI Exposure, Employee Weighted PWRSR Exposure, Employee Weighted RSR Exposure, and Employee Weighted Distance AUBI Exposure, each included in a separate regression. Columns (1) through (4) sequentially add fixed effects: Column (1) includes no fixed effects; Column (2) includes 2-digit NAICS industry fixed effects; Column (3) includes year-month fixed effects; and Column (4) includes industry × year-month fixed effects (2-digit). Columns (5) through (8) add climate exposure controls—Climate Change Exposure Near Century, Climate Change Exposure Mid to Late Century, and Habitat Climate Change Vulnerability Score Near Century—and maintain industry × year-month fixed effects throughout. All regressions control for standard firm characteristics: the natural logarithm of total assets (Ln(Total assets)), leverage (total debt scaled by assets), capital expenditures scaled by assets (Capex/Total assets), property, plant, and equipment scaled by assets (PPE/Total assets), return on assets (ROA), the natural logarithm of market capitalization (Ln(Market cap)), the book-to-market ratio, asset growth, sales growth, return volatility (standard deviation of returns over the past 36 months), and momentum (average return over the past 12 months). Standard errors are clustered at the firm level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	Monthly Returns							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Employee Weighted AUBI Exposure	-0.544	-0.524	-0.431	-0.400	-0.658			
	(0.464)	(0.453)	(0.448)	(0.442)	(0.470)			
Employee Weighted PWRSR Exposure						7.130		
						(10.678)		
Employee Weighted RSR Exposure							0.716	
							(8.461)	
Employee Weighted Distance AUBI Exposure								-0.480
								(0.473)
Ln(Total assets)	-1.312***	-1.509***	-1.153***	-1.303***	-1.324***	-1.276***	-1.281***	-1.313***
	(0.248)	(0.250)	(0.239)	(0.245)	(0.248)	(0.244)	(0.245)	(0.250)
Leverage	0.692	0.868	0.646	0.825	0.926	0.873	0.884	0.922
	(0.858)	(0.851)	(0.823)	(0.825)	(0.841)	(0.843)	(0.844)	(0.845)
Capex/Total assets	-10.231**	-13.886***	-8.280**	-10.590***	-14.488***	-14.051***	-14.050***	-14.325***
	(4.162)	(4.548)	(3.765)	(4.005)	(3.824)	(3.751)	(3.750)	(3.812)
PPE/Total assets	2.476***	3.939***	2.073***	3.189***	3.876***	3.918***	3.907***	3.923***
	(0.779)	(1.063)	(0.740)	(1.011)	(1.012)	(1.019)	(1.018)	(1.021)
Ln(Market cap)	1.236***	1.455***	1.085***	1.254***	1.253***	1.204***	1.210***	1.241***
	(0.235)	(0.237)	(0.226)	(0.232)	(0.236)	(0.231)	(0.232)	(0.237)
Book-to-market	-1.458***	-1.462***	-1.269***	-1.228***	-1.305***	-1.313***	-1.308***	-1.304***
	(0.325)	(0.327)	(0.304)	(0.304)	(0.314)	(0.311)	(0.312)	(0.316)
ROA	3.002***	2.754***	2.737***	2.559***	2.273**	2.274**	2.276**	2.258**
	(0.999)	(0.944)	(0.968)	(0.956)	(0.948)	(0.954)	(0.954)	(0.948)
Asset growth	1.580***	1.757***	1.629***	1.764***	1.625***	1.582***	1.588***	1.607***
	(0.477)	(0.483)	(0.470)	(0.479)	(0.488)	(0.486)	(0.485)	(0.487)
Sales growth	0.037	0.043*	0.040*	0.046*	0.101	0.097	0.097	0.099
	(0.023)	(0.024)	(0.024)	(0.025)	(0.071)	(0.072)	(0.072)	(0.072)
Volatility	0.059*	0.074**	0.049	0.060*	0.052	0.047	0.047	0.051
	(0.035)	(0.035)	(0.032)	(0.033)	(0.034)	(0.033)	(0.033)	(0.034)
Momentum	-0.379***	-0.402***	-0.309***	-0.319***	-0.325***	-0.323***	-0.323***	-0.324***
	(0.038)	(0.038)	(0.040)	(0.040)	(0.042)	(0.042)	(0.042)	(0.042)
Climate Change Exposure Near Century					4.492*	3.684	3.743	4.328*
					(2.401)	(2.310)	(2.313)	(2.368)
Climate Change Exposure Mid to Late Century					-0.608	-0.639	-0.640	-0.515
					(1.293)	(1.279)	(1.280)	(1.305)
Habitat Climate Change Vulnerability Score Near Century					-6.396	-4.298	-4.422	-5.848
					(4.641)	(4.573)	(4.579)	(4.582)
Adj. R-squared	0.0193	0.0212	0.142	0.159	0.162	0.162	0.162	0.162
Obs.	22,219	22,219	22,219	22,219	21,100	21,100	21,100	21,100
Ind FEs	No	Yes	No	-	-	-	-	-
Year-Month FEs	No	No	Yes	-	-	-	-	-
Ind × Year-Month FEs	No	No	No	Yes	Yes	Yes	Yes	Yes

Table IB.6: Cross-Sectional Returns and AUBI Exposure: Carbon Controls

This table examines the relationship between monthly stock returns (in percent) and firm-level exposure to Areas AUBI exposure. The dependent variable is monthly return in percent. The sample spans 2020-2023. Columns (1)–(3) use Employee Weighted AUBI Exposure as the main explanatory variable, while Columns (4)–(6) use Employee Weighted Distance AUBI Exposure. All models control for firm size (Ln(Total assets)), leverage (total debt scaled by total assets), investment (Capex/Total assets), physical assets (PPE/Total assets), profitability (ROA), firm valuation (Ln(Market cap), Book-to-market), asset growth, sales growth, return volatility (36-month standard deviation), and momentum (12-month average return). To account for climate risk, we include Climate Change Exposure Near Century, Climate Change Exposure Mid to Late Century, and Habitat Climate Change Vulnerability Score Near Century. Columns (2) and (5) add controls for emissions intensity: Scope 1, Scope 2, and Scope 3 Emissions Intensity. Columns (3) and (6) instead include the natural logarithm of emissions levels: Ln(Scope 1), Ln(Scope 2), and Ln(Scope 3). All explanatory variables are lagged by one year. Regressions include industry × year-month fixed effects (NAICS 2-digit), and standard errors are clustered at the firm level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	All Industries					
	(1)	(2)	(3)	(4)	(5)	(6)
Employee Weighted AUBI Exposure	-1.045**	-1.020**	-1.094**			
	(0.456)	(0.459)	(0.459)			
Employee Weighted Distance AUBI Exposure				-1.159**	-1.134**	-1.192**
				(0.475)	(0.484)	(0.479)
Scope 1 Emissions Intensity		0.000			0.000	
		(0.000)			(0.000)	
Scope 2 Emissions Intensity		0.000			0.000	
		(0.001)			(0.001)	
Scope 3 Emissions Intensity		0.000			0.000	
		(0.001)			(0.001)	
Ln(Scope 1 Emissions)			0.030			0.029
			(0.067)			(0.066)
Ln(Scope 2 Emissions)			0.064			0.051
			(0.132)			(0.133)
Ln(Scope 3 Emissions)			-0.145			-0.136
			(0.129)			(0.129)
Ln(Total assets)	-0.682**	-0.694**	-0.639**	-0.683**	-0.694**	-0.633**
	(0.270)	(0.270)	(0.280)	(0.270)	(0.269)	(0.280)
Leverage	0.022	0.042	0.006	-0.083	-0.061	-0.103
	(0.622)	(0.625)	(0.620)	(0.623)	(0.626)	(0.621)
Capex/Total assets	-8.681***	-8.531***	-8.941***	-8.894***	-8.746***	-9.145***
	(3.182)	(3.221)	(3.188)	(3.175)	(3.214)	(3.179)
PPE/Total assets	2.365***	2.222***	2.331***	2.433***	2.294***	2.423***
	(0.764)	(0.789)	(0.797)	(0.763)	(0.787)	(0.791)
Climate Change Exposure Near Century	-1.266	-1.081	-1.566	-1.121	-0.939	-1.450
	(3.271)	(3.374)	(3.334)	(3.101)	(3.202)	(3.173)
Climate Change Exposure Mid to Late Century	-0.774	-0.717	-0.791	-0.576	-0.523	-0.588
	(1.899)	(1.876)	(1.892)	(1.938)	(1.914)	(1.935)
Habitat Climate Change Vulnerability Score Near Century	2.953	2.520	3.326	2.741	2.313	3.177
	(5.024)	(5.150)	(4.988)	(4.823)	(4.915)	(4.787)
Ln(Market cap)	0.540**	0.549**	0.552**	0.534*	0.543**	0.544**
	(0.275)	(0.276)	(0.278)	(0.273)	(0.274)	(0.276)
Book-to-market	-0.566	-0.577	-0.562	-0.592	-0.602	-0.591
	(0.510)	(0.517)	(0.503)	(0.510)	(0.517)	(0.502)
ROA	2.061*	2.026*	2.140*	2.015*	1.981*	2.102*
	(1.056)	(1.054)	(1.104)	(1.062)	(1.059)	(1.106)
Asset growth	0.630	0.630	0.613	0.650	0.650	0.634
	(0.465)	(0.464)	(0.467)	(0.459)	(0.458)	(0.460)
Sales growth	0.013	0.013	0.012	0.012	0.012	0.011
	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.016)
Volatility	0.023	0.023	0.022	0.023	0.023	0.022
	(0.022)	(0.023)	(0.022)	(0.023)	(0.023)	(0.023)
Momentum	-0.085*	-0.085*	-0.085*	-0.086*	-0.086*	-0.086*
	(0.044)	(0.044)	(0.044)	(0.044)	(0.044)	(0.044)
Adj. R-squared	0.154	0.154	0.154	0.154	0.154	0.154
Obs.	34,592	34,592	34,568	34,592	34,592	34,568
Ind × Year-Month FEs	Yes	Yes	Yes	Yes	Yes	Yes

Table IB.7: Cross-Sectional Returns, AUBI Exposure, and Media: Climate Controls

This table examines the relationship between monthly stock returns (dependent variable, in percent) and firm-level AUBI exposure emphasizing media salience. The main explanatory variables are Employee Weighted AUBI Exposure and Employee Weighted Distance AUBI Exposure, each interacted with two measures of elevated media attention: biodiversity-related news coverage from Factiva, and climate-related media sentiment from the Sentometrics Climate Change Index (Ardia et al., 2023). The sample spans 2021-2023. Interaction terms reflect the conditional effect of exposure during periods of heightened media attention, defined as months in the top tercile of lagged month-over-month growth. Columns (1)–(4) restrict the sample to firms in the Mining, Oil & Gas, Utilities, Construction, and Manufacturing sectors, while Columns (5)–(8) comprise firms in all remaining sectors. Odd-numbered columns include industry × year-month fixed effects at the 2-digit NAICS level, and even-numbered columns incorporate firm fixed effects. All specifications include a set of firm-level controls, lagged by one year, including firm size (log of total assets), leverage (total debt scaled by total assets), investment (capital expenditures scaled by total assets), physical capital intensity (PPE scaled by total assets), profitability (return on assets), valuation (log of market capitalization and book-to-market ratio), asset growth, sales growth, return volatility (36-month standard deviation of returns), and momentum (12-month average return). Climate risk exposures are controlled for using three measures: Climate Change Exposure Near Century, Climate Change Exposure Mid to Late Century, and the Habitat Climate Change Vulnerability Score Near Century. All continuous variables are winsorized at the 1st and 99th percentiles. Standard errors are clustered at the firm level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	Mining, Oil, Utilities, Construction, Manufacturing				Others			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Employee Weighted AUBI Exposure	-0.877				-0.171			
	(0.753)				(0.588)			
Employee Weighted AUBI Exposure	-2.249**	-2.092**			-0.315	0.654		
× High Biodiversity Media Mention Growth	(1.067)	(0.987)			(1.059)	(0.999)		
Employee Weighted Distance AUBI Exposure			-1.028				0.175	
			(0.719)				(0.588)	
Employee Weighted Distance AUBI Exposure			-2.970*	-2.235**			-1.741	-1.421
× High Biodiversity Media Mention Growth			(1.765)	(1.132)			(1.211)	(1.328)
Employee Weighted AUBI Exposure	-0.167	-0.243			-1.277	-1.771		
× High Climate Media Mention Growth	(1.081)	(0.980)			(1.572)	(1.505)		
Employee Weighted Distance AUBI Exposure			0.627	0.268			-0.842	-1.003
× High Climate Media Mention Growth			(1.430)	(1.029)			(1.447)	(1.381)
Ln(Total assets)	-0.525*	-6.933**	-0.537*	-6.939**	-0.268	-5.562*	-0.271	-5.581*
	(0.296)	(3.163)	(0.305)	(3.161)	(0.309)	(3.018)	(0.309)	(3.018)
Leverage	-0.748	11.290**	-0.732	11.258**	0.458	22.823**	0.369	22.803**
	(0.788)	(5.033)	(0.797)	(5.032)	(0.669)	(9.662)	(0.654)	(9.660)
Capex/Total assets	-13.136***	-2.061	-13.328***	-2.042	-9.080***	-74.717**	-9.116***	-74.791**
	(3.988)	(14.151)	(4.047)	(14.154)	(3.480)	(35.625)	(3.485)	(35.620)
PPE/Total assets	4.314***	-11.564	4.524***	-11.579	2.456**	29.889*	2.479***	29.934*
	(1.075)	(9.061)	(1.076)	(9.054)	(0.952)	(15.961)	(0.952)	(15.958)
Climate Change Exposure Near Century	-1.482		-1.423		-2.905		-2.738	
	(5.504)		(5.212)		(2.924)		(3.044)	
Climate Change Exposure Mid to Late Century	3.030		3.414		-1.094		-1.045	
	(3.366)		(3.449)		(1.300)		(1.309)	
Habitat Climate Change Vulnerability Score Near Century	-3.663		-3.591		6.468		6.180	
	(6.216)		(6.148)		(6.632)		(6.892)	
Ln(Market cap)	0.374	5.750***	0.381	5.753***	0.180	6.106***	0.181	6.107***
	(0.263)	(2.118)	(0.265)	(2.113)	(0.324)	(1.170)	(0.323)	(1.170)
Book-to-market	-0.770	0.159	-0.763	0.163	-0.673**	-0.055	-0.671**	-0.054
	(0.695)	(1.102)	(0.703)	(1.103)	(0.289)	(0.787)	(0.289)	(0.787)
ROA	4.295***	3.961*	4.216***	3.969*	4.642**	4.913	4.617**	4.923
	(1.119)	(2.384)	(1.146)	(2.379)	(2.056)	(3.460)	(2.045)	(3.462)
Asset growth	0.634	0.557	0.676	0.556	0.328	0.784	0.339	0.792
	(0.527)	(0.855)	(0.526)	(0.855)	(0.342)	(0.576)	(0.340)	(0.577)
Sales growth	-0.027	0.024	-0.029	0.024	-0.003	-0.002	-0.003	-0.001
	(0.021)	(0.067)	(0.021)	(0.067)	(0.002)	(0.008)	(0.002)	(0.008)
Volatility	0.003	-1.833	0.003	-1.832	0.016	-3.139**	0.016	-3.139**
	(0.024)	(1.396)	(0.025)	(1.396)	(0.012)	(1.248)	(0.012)	(1.247)
Momentum	-0.070	-0.242*	-0.070	-0.242*	-0.055	-0.233*	-0.055	-0.233*
	(0.047)	(0.134)	(0.047)	(0.134)	(0.054)	(0.132)	(0.054)	(0.132)
Adj. R-squared	0.0996	0.237	0.0998	0.237	0.116	0.370	0.117	0.370
Obs.	16,498	16,498	16,498	16,498	17,100	17,100	17,100	17,100
Firm FEs	No	Yes	No	Yes	No	Yes	No	Yes
Ind × Year-Month FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table IB.8: Cross-Sectional Returns, AUBI Exposure, and Media: 3 Digit NAICS

This table examines the relationship between monthly stock returns (dependent variable, in percent) and firm-level AUBI exposure emphasizing media salience. The main explanatory variables are Employee Weighted AUBI Exposure and Employee Weighted Distance AUBI Exposure, each interacted with two measures of elevated media attention: biodiversity-related news coverage from Factiva, and climate-related media sentiment from the Sentometrics Climate Change Index (Ardia et al., 2023). The sample spans 2020-2023. Interaction terms reflect the conditional effect of exposure during periods of heightened media attention, defined as months in the top tercile of lagged month-over-month growth. Columns (1)–(4) restrict the sample to firms in the Mining, Oil & Gas, Utilities, Construction, and Manufacturing sectors, while Columns (5)-(8) comprise firms in all remaining sectors. Odd-numbered columns include industry × year-month fixed effects at the 3-digit NAICS level, and even-numbered columns incorporate firm fixed effects. All specifications include a set of firm-level controls, lagged by one year, including firm size (log of total assets), leverage (total debt scaled by total assets), investment (capital expenditures scaled by total assets), physical capital intensity (PPE scaled by total assets), profitability (return on assets), valuation (log of market capitalization and book-to-market ratio), asset growth, sales growth, return volatility (36-month standard deviation of returns), and momentum (12-month average return). Climate risk exposures are controlled for using three measures: Climate Change Exposure Near Century, Climate Change Exposure Mid to Late Century, and the Habitat Climate Change Vulnerability Score Near Century. All continuous variables are winsorized at the 1st and 99th percentiles. Standard errors are clustered at the firm level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	Mining, Oil, Utilities, Construction, Manufacturing				Others			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Employee Weighted AUBI Exposure	-1.415*				-0.441			
	(0.799)				(0.744)			
Employee Weighted AUBI Exposure	-2.509*	-2.205*			0.072	1.447		
× High Biodiversity Media Mention Growth	(1.513)	(1.172)			(1.462)	(1.530)		
Employee Weighted Distance AUBI Exposure			-1.435*				-0.063	
			(0.788)				(0.578)	
Employee Weighted Distance AUBI Exposure			-3.655	-2.709*			-0.950	-0.628
× High Biodiversity Media Mention Growth			(2.424)	(1.398)			(1.282)	(1.306)
Employee Weighted AUBI Exposure	1.061	0.816			0.106	-0.482		
× High Climate Media Mention Growth	(1.338)	(1.080)			(1.565)	(1.401)		
Employee Weighted Distance AUBI Exposure			1.911	1.356			0.062	-0.070
× High Climate Media Mention Growth			(1.848)	(1.174)			(1.473)	(1.410)
Ln(Total assets)	-0.645**	-6.571*	-0.652**	-6.586*	-0.256	-6.875**	-0.258	-6.889**
	(0.287)	(3.418)	(0.291)	(3.414)	(0.279)	(2.984)	(0.278)	(2.983)
Leverage	-0.211	11.711**	-0.242	11.678**	0.255	25.086**	0.208	25.057**
	(0.790)	(5.273)	(0.799)	(5.269)	(0.651)	(9.849)	(0.652)	(9.848)
Capex/Total assets	-12.782***	1.388	-12.762***	1.411	-9.575**	-77.631**	-9.612**	-77.726**
	(4.053)	(15.669)	(4.180)	(15.672)	(3.819)	(38.965)	(3.823)	(38.957)
PPE/Total assets	3.074***	-8.720	3.379***	-8.753	2.048*	32.098**	2.073*	32.126**
	(1.079)	(9.453)	(1.092)	(9.441)	(1.083)	(15.164)	(1.084)	(15.168)
Climate Change Exposure Near Century	-2.500		-2.509		-3.647		-3.581	
	(7.438)		(7.185)		(3.212)		(3.372)	
Climate Change Exposure Mid to Late Century	3.167		3.530		-0.487		-0.465	
	(3.775)		(3.861)		(1.476)		(1.483)	
Habitat Climate Change Vulnerability Score Near Century	-2.395		-1.953		7.582		7.475	
	(6.947)		(6.688)		(7.209)		(7.477)	
Ln(Market cap)	0.425	5.767***	0.430	5.771***	0.192	6.495***	0.193	6.494***
	(0.288)	(2.229)	(0.284)	(2.224)	(0.308)	(1.277)	(0.308)	(1.277)
Book-to-market	-0.727	0.289	-0.736	0.297	-0.669**	0.021	-0.668**	0.021
	(0.658)	(1.170)	(0.662)	(1.171)	(0.285)	(0.824)	(0.284)	(0.825)
ROA	4.229***	3.993	4.156***	4.006	4.700**	5.729	4.687**	5.736
	(1.143)	(2.572)	(1.173)	(2.565)	(2.105)	(3.626)	(2.095)	(3.628)
Asset growth	0.594	0.532	0.645	0.533	0.427	0.685	0.434	0.689
	(0.547)	(0.899)	(0.546)	(0.899)	(0.360)	(0.555)	(0.358)	(0.554)
Sales growth	-0.034	0.018	-0.037	0.017	-0.003	-0.008	-0.003	-0.008
	(0.023)	(0.069)	(0.023)	(0.069)	(0.002)	(0.006)	(0.002)	(0.006)
Volatility	0.001	-1.866	0.001	-1.866	0.021*	-3.095***	0.021*	-3.094***
	(0.025)	(1.444)	(0.026)	(1.443)	(0.012)	(1.153)	(0.012)	(1.153)
Momentum	-0.073	-0.235*	-0.074	-0.235*	-0.066	-0.253**	-0.066	-0.253**
	(0.047)	(0.139)	(0.047)	(0.138)	(0.049)	(0.116)	(0.049)	(0.117)
Adj. R-squared	0.0905	0.234	0.0908	0.234	0.147	0.391	0.147	0.391
Obs.	16,498	16,498	16,498	16,498	16,981	16,981	16,981	16,981
Firm FEs	No	Yes	No	Yes	No	Yes	No	Yes
Ind × Year-Month FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table IB.9: Cross-Sectional Returns and AUBI Exposure: Robustness

This table examines the relationship between monthly stock returns and firm-level AUBI exposure, as defined in Equation 1. The sample period is 2020-2023. The dependent variable in Columns (1)–(6) is monthly stock return (in percent), while Columns (7) and (8) use abnormal returns estimated from the Fama-French three-factor and Carhart four-factor models, respectively. Columns (1) and (2) include Employee Weighted AUBI Exposure as the main explanatory variable, with standard errors clustered at the NAICS 2-digit and 3-digit industry levels, respectively. Column (3) uses the natural logarithm of AUBI exposure instead of levels and clusters standard errors at the firm level. Column (4) includes a fully winsorized and employee-weighted set of firm-level controls, including log of total assets, leverage (total debt over assets), capital expenditures scaled by assets, PPE scaled by assets, return on assets, book-to-market ratio, log of market capitalization, asset growth, sales growth, return volatility (36-month trailing standard deviation), and momentum (12-month average return). Columns (5) and (6) augment this baseline by including additional non-financial firm-level risks: Column (5) includes lagged political risk exposure, while Column (6) controls for lagged COVID-related firm exposure. Columns (7) and (8) replicate the core specification from Columns (1) and (2), but with the dependent variable replaced. All regressions include fixed effects for NAICS 2-digit industry × year-month, and all continuous variables are winsorized at the 1st and 99th percentiles. Standard errors are reported in parentheses and clustered as noted above. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	Monthly Returns						Abnormal Returns	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Employee Weighted AUBI Exposure	-1.257**	-1.257***		-1.279***	-1.351***	-1.355***	-1.897***	-1.778***
	(0.474)	(0.472)		(0.327)	(0.447)	(0.450)	(0.486)	(0.495)
Ln(Employee Weighted AUBI Exposure)			-0.118***					
			(0.045)					
Political Risk					-0.001			
					(0.001)			
Covid Risk						-0.143		
						(1.029)		
Climate Change Exposure Near Century	-0.570	-0.570	-0.057	-1.571			-0.228	0.063
	(2.031)	(2.730)	(2.070)	(2.495)			(5.292)	(5.080)
Climate Change Exposure Mid to Late Century	0.527	0.527	-2.169*	-0.424			-0.088	0.026
	(1.004)	(1.276)	(1.261)	(1.256)			(3.148)	(3.148)
Habitat Climate Change Vulnerability Score Near Century	-1.229	-1.229	5.505	3.355			-1.813	-1.286
	(4.190)	(4.681)	(4.553)	(4.208)			(5.759)	(6.124)
Ln(Total assets)	-0.630*	-0.630**	-0.601**	-0.440*	-0.888**	-0.887**	-0.831**	-0.734*
	(0.323)	(0.256)	(0.240)	(0.238)	(0.349)	(0.349)	(0.357)	(0.382)
Leverage	0.249	0.249	0.059	-0.256	0.465	0.456	-0.968	-0.944
	(0.434)	(0.494)	(0.584)	(0.522)	(0.813)	(0.809)	(1.136)	(1.173)
Capex/Total assets	-7.986***	-7.986***	-9.692***	-10.911***	-9.062**	-9.039**	-10.596**	-10.348**
	(2.663)	(2.522)	(2.526)	(2.750)	(4.485)	(4.499)	(4.188)	(4.457)
PPE/Total assets	2.122**	2.122***	2.551***	2.461***	3.361***	3.358***	3.968***	3.935***
	(0.764)	(0.724)	(0.567)	(0.569)	(0.880)	(0.880)	(1.247)	(1.302)
Ln(Market cap)	0.456	0.456*	0.487**	0.424	0.885**	0.882**	0.554*	0.442
	(0.321)	(0.252)	(0.224)	(0.262)	(0.349)	(0.349)	(0.327)	(0.363)
Book-to-market	-0.641**	-0.641**	-0.588**	-1.137***	-0.211	-0.214	-0.839	-0.877
	(0.308)	(0.260)	(0.298)	(0.430)	(0.487)	(0.488)	(0.833)	(0.894)
ROA	3.399***	3.399***	4.396***	6.609***	3.764**	3.765**	2.513**	2.132**
	(1.109)	(1.142)	(1.437)	(0.979)	(1.608)	(1.613)	(0.998)	(0.993)
at_growth	0.660	0.660	0.940***	1.640***	2.148***	2.152***	2.090**	2.134**
	(0.561)	(0.567)	(0.273)	(0.599)	(0.658)	(0.657)	(0.868)	(0.878)
Sales growth	0.003	0.003	0.050	0.829*	-0.005	-0.005	-0.012*	-0.005
	(0.004)	(0.005)	(0.044)	(0.448)	(0.012)	(0.012)	(0.007)	(0.007)
Volatility	0.031	0.031	0.056**	0.182***	0.174***	0.174***	0.039	0.005
	(0.018)	(0.020)	(0.028)	(0.026)	(0.038)	(0.038)	(0.029)	(0.035)
Momentum	-0.109***	-0.109***	-0.132**	-0.208***	-0.285***	-0.285***	-0.034	-0.017
	(0.033)	(0.037)	(0.061)	(0.057)	(0.056)	(0.056)	(0.155)	(0.137)
Adj. R-squared	0.157	0.157	0.202	0.159	0.192	0.192	0.0194	0.0179
Obs.	44,901	44,901	31,392	44,901	22,307	22,307	20,581	20,581
Ind × Year-Month FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clustering	2-digit industry	3-digit industry	Firm	Firm	Firm	Firm	Firm	Firm

IC Portfolio Alpha Analysis

Table IC.1: AUBI Exposure Sorted Portfolios Pre-2020

This table evaluates the alpha of long-short portfolios sorted by firm-level AUBI exposure prior to 2020 (2016-2019). Firms are sorted into terciles and three value-weighted portfolios are constructed to represent high, medium, and low exposure. A long-short portfolio is then formed by taking a long position in the low-exposure portfolio and a short position in the high-exposure portfolio. The dependent variable in Columns (1)–(5) is the monthly return (in percent) of the long-short portfolio for firms in non-salient industries. Columns (6)–(10) repeat the analysis Mining, Oil & Gas, Utilities, Construction, and Manufacturing industries—but restricted to the 2016–2019 period. Column (1) includes the Fama-French three factors: excess market return (MktRF), size (SMB), and value (HML). Column (2) adds momentum (MOM). Column (3) adds profitability (RMW) and investment (CMA) to form the Fama-French five factors plus momentum. Column (4) further includes two fundamental return predictors: changes in investment-to-assets (R_IA) and return-on-equity (R_ROE). Column (5) adds the green-minus-brown (GMB) factor from Pástor, Stambaugh, and Taylor (2022), which captures return spreads between environmentally green and brown firms. All factor data are sourced from Kenneth French's and Stambaugh's data libraries and are of monthly frequency. Robust standard errors are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Other Industries					Mining, Oil & Gas, Utilities, Construction, Manufacturing				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
MktRF	-0.087	-0.084	-0.076	-0.033	-0.030	0.147	0.174	0.208	0.206	0.207
	(0.060)	(0.057)	(0.057)	(0.068)	(0.067)	(0.095)	(0.108)	(0.125)	(0.126)	(0.124)
SMB	-0.207	-0.200	-0.145	-0.088	0.009	-0.162	-0.147	-0.183	-0.184	-0.209*
	(0.155)	(0.201)	(0.204)	(0.219)	(0.209)	(0.101)	(0.094)	(0.110)	(0.117)	(0.113)
HML	0.151**	0.151**	-0.030	-0.063	0.007	-0.062	-0.013	-0.056	-0.054	-0.040
	(0.072)	(0.072)	(0.113)	(0.124)	(0.114)	(0.068)	(0.094)	(0.099)	(0.106)	(0.110)
MOM		0.014	-0.050	-0.097	-0.089		0.081	0.087	0.091	0.096
		(0.126)	(0.097)	(0.116)	(0.103)		(0.096)	(0.099)	(0.109)	(0.109)
RMW			0.028	-0.124	-0.043			-0.109	-0.088	-0.144
			(0.141)	(0.257)	(0.252)			(0.124)	(0.190)	(0.203)
CMA			0.364**	0.086	0.134			0.145	0.138	0.153
			(0.168)	(0.402)	(0.436)			(0.161)	(0.395)	(0.405)
R_IA				0.288	0.361				0.006	-0.047
				(0.405)	(0.397)				(0.440)	(0.451)
R_ROE				0.209	0.250				-0.022	-0.025
				(0.210)	(0.185)				(0.164)	(0.169)
GMB					40.278					-11.022
					(26.812)					(14.140)
Constant	0.126	0.124	0.032	-0.024	-0.129	-0.202	-0.203	-0.220	-0.215	-0.180
	(0.372)	(0.365)	(0.343)	(0.344)	(0.351)	(0.231)	(0.238)	(0.251)	(0.262)	(0.248)
Adj. R-squared	0.112	0.0918	0.150	0.143	0.194	0.0773	0.0754	0.0516	0.00329	-0.00481
Obs.	48	48	48	48	48	48	48	48	48	48

Table IC.2: AUBI Exposure Sorted Portfolios: Robustness

This table evaluates the alpha of long-short portfolios sorted by firm-level AUBI exposure after 2020, excluding January 2021 to remove potential confounding effects from known announcements. Firms are sorted into terciles based on their employee-weighted AUBI exposure, and three value-weighted portfolios are constructed to represent high, medium, and low exposure. A long-short portfolio is then formed by taking a long position in the low-exposure portfolio and a short position in the high-exposure portfolio. The analysis focuses on firms in Mining, Oil & Gas, Utilities, Construction, and Manufacturing during the 2020–2023 period. The dependent variable is the monthly return (in percent) of this long-short portfolio. Column (1) includes the Fama-French three factors: excess market return (MktRF), size (SMB), and value (HML). Column (2) adds momentum (MOM). Column (3) further includes profitability (RMW) and investment (CMA) to form the Fama-French five factors plus momentum. Column (4) adds two additional return predictors: changes in investment-to-assets (R_IA) and return-on-equity (R_ROE). Column (5) includes an industry-adjusted version of the green-minus-brown (GMB) factor from Pástor, Stambaugh, and Taylor (2022), which captures return spreads between green and brown firms based on environmental attributes.

	H-L				
	(1)	(2)	(3)	(4)	(5)
MktRF	0.041	0.022	0.012	0.026	0.025
	(0.041)	(0.048)	(0.053)	(0.062)	(0.064)
SMB	-0.273***	-0.326***	-0.263*	-0.236	-0.232
	(0.087)	(0.101)	(0.138)	(0.143)	(0.145)
HML	0.221***	0.220***	0.198**	0.182**	0.190*
	(0.046)	(0.051)	(0.077)	(0.077)	(0.101)
MOM		-0.080	-0.066	-0.077	-0.077
		(0.063)	(0.062)	(0.067)	(0.069)
RMW			0.101	0.054	0.055
			(0.140)	(0.162)	(0.161)
CMA			0.003	-0.098	-0.099
			(0.113)	(0.357)	(0.359)
R_IA				0.109	0.099
				(0.322)	(0.334)
R_ROE				0.066	0.061
				(0.111)	(0.112)
GMB_ind_adj					4.148
					(22.787)
Constant	-0.441*	-0.444*	-0.502**	-0.516**	-0.512*
	(0.247)	(0.245)	(0.237)	(0.251)	(0.256)
Adj. R-squared	0.282	0.287	0.266	0.235	0.215
Obs.	47	47	47	47	47

Table IC.3: AUBI Exposure Sorted Portfolios: Newey Standard Errors

This table presents time-series regressions evaluating the abnormal performance of portfolios sorted by firm-level AUBI exposure. Firms are partitioned into terciles based on their employee-weighted AUBI exposure, and a long-short portfolio is constructed by taking a long position in the low-exposure portfolio and a short position in the high-exposure portfolio. The analysis focuses on firms in Mining, Oil & Gas, Utilities, Construction, and Manufacturing sectors over the post-2020 period (2020-2023). The dependent variable in all columns is the monthly return (in percent) of this long-short portfolio. Columns (1)–(5) report coefficient estimates from regressions using Newey-West standard errors with 12 lags to account for serial correlation. Column (1) controls for the Fama-French three factors: market excess return (MktRF), size (SMB), and value (HML). Column (2) adds the momentum factor (MOM). Column (3) expands the model to include profitability (RMW) and investment (CMA), forming the Fama-French five-factor model with momentum. Column (4) further augments the specification by controlling for two firm-level return predictors: changes in investment-to-assets (R_IA) and return-on-equity (R_ROE). Column (5) includes the Green Minus Brown (GMB) factor from Pástor, Stambaugh, and Taylor (2022), which captures return differentials between environmentally green and brown firms. Newey-West adjusted standard errors are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

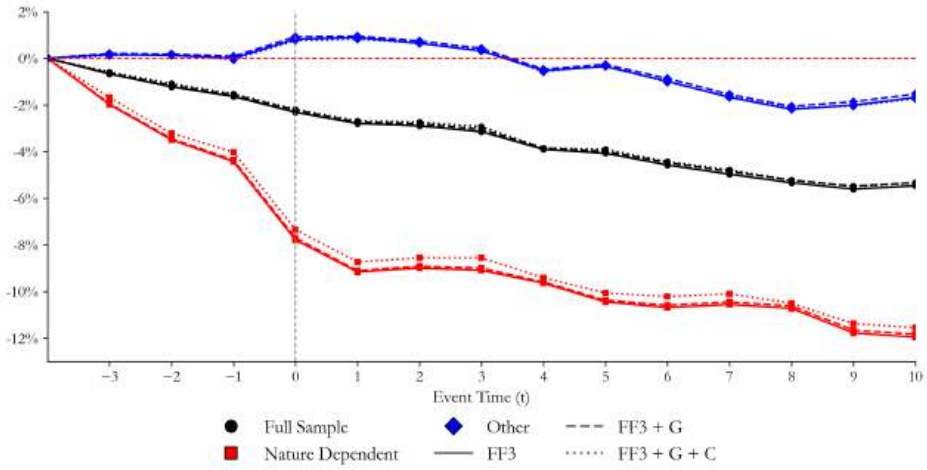
	H-L				
	(1)	(2)	(3)	(4)	(5)
MktRF	0.097*	0.028	0.010	-0.020	-0.023
	(0.050)	(0.025)	(0.042)	(0.071)	(0.056)
SMB	-0.519**	-0.654**	-0.610**	-0.650*	-0.741**
	(0.207)	(0.284)	(0.293)	(0.325)	(0.341)
HML	0.240***	0.235***	0.325***	0.364***	0.298**
	(0.037)	(0.056)	(0.107)	(0.128)	(0.140)
MOM		-0.264	-0.204	-0.196	-0.202
		(0.202)	(0.180)	(0.163)	(0.159)
RMW			0.111	0.160	0.084
			(0.178)	(0.202)	(0.187)
CMA			-0.233	0.106	0.061
			(0.149)	(0.423)	(0.395)
R_IA				-0.342	-0.411
				(0.460)	(0.448)
R_ROE				-0.095	-0.134
				(0.177)	(0.173)
GMB					-37.834
					(28.368)
Constant	-0.817**	-0.768**	-0.784**	-0.731**	-0.632**
	(0.347)	(0.302)	(0.298)	(0.285)	(0.250)
Adj. R-squared					
Obs.	48	48	48	48	48

ID Event CARs Analysis

Figure ID.1: Cumulative Abnormal Returns around 30 by 30: FF3

This figure presents the cumulative abnormal returns (CARs) of an equal-weighted long-short portfolio that takes long positions in firms within the top tercile of AUBI exposure and short positions in firms within the bottom tercile. Expected returns are obtained from factor model predictions, where factor loadings are estimated using a 100-trading-day window ending 10 days before the event window. Panel A covers the event window from $t = -3$ to $t = 10$; Panel B extends this window to $t = 90$. The dashed vertical line represents $t = 0$, January 27, 2021. CARs are computed using the Fama-French three-factor (FF3) model, controlling for GMB (G), and Scope 1, 2, and 3 Carbon Intensity (collectively, C) when specified. The figure plots the CAR for three long-short portfolios: black lines represent the full sample, red lines correspond to location and nature-dependent firms (Mining, Utilities, Oil & Gas, Manufacturing, or Construction), and blue lines represent other firms.

Panel A: Event Window $t = [-3, 10]$



Panel B: Event Window $t = [-3, 90]$

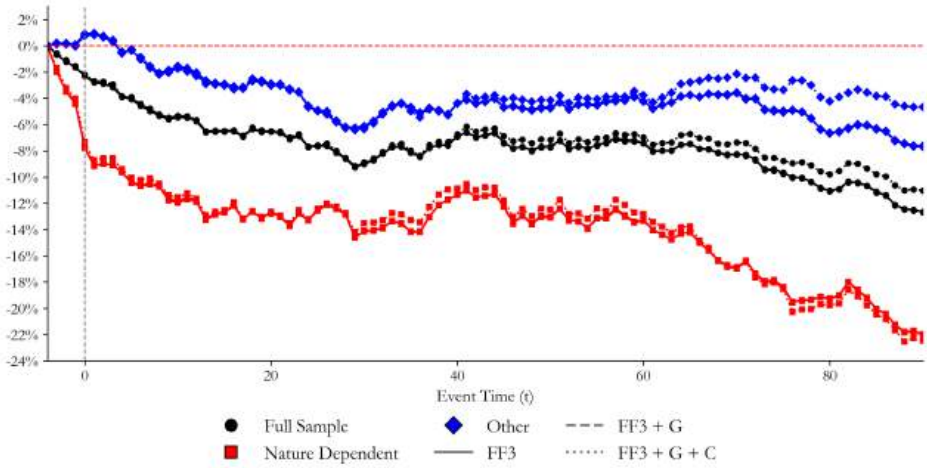
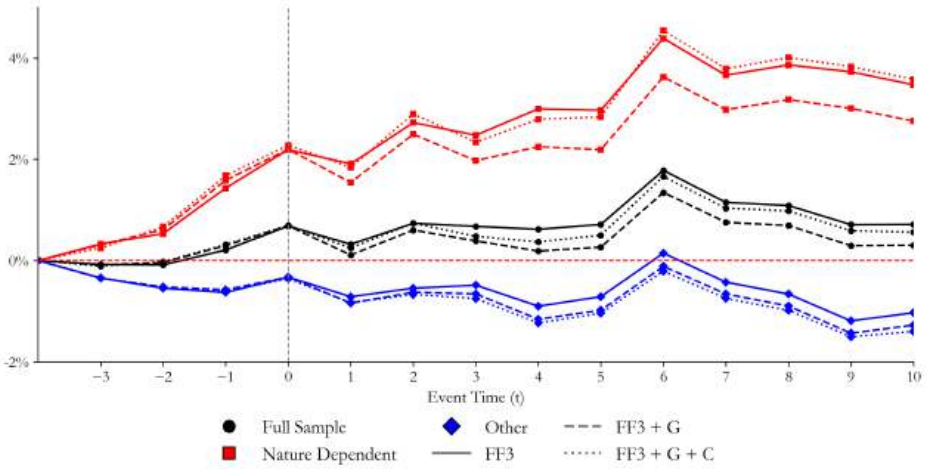


Figure ID.2: Cumulative Abnormal Returns around President Trump's Re-Election: FF3

This figure presents the cumulative abnormal returns (CARs) of an equal-weighted long-short portfolio that takes long positions in firms within the top tercile of AUBI exposure and short positions in firms within the bottom tercile. Expected returns are obtained from factor model predictions, where factor loadings are estimated using a 100-trading-day window ending 10 days before the event window. Panel A covers the event window from $t = -3$ to $t = 10$; Panel B extends this window to $t = 30$. The dashed vertical line represents $t = 0$, November 05, 2024. CARs are computed using the Fama-French three-factor (FF3) model, controlling for GMB (G), and Scope 1, 2, and 3 Carbon Intensity (collectively, C) when specified. The figure plots the CAR for three long-short portfolios: black lines represent the full sample, red lines correspond to location and nature-dependent firms (Mining, Utilities, Oil & Gas, Manufacturing, or Construction), and blue lines represent other firms.

Panel A: Event Window $t = [-3, 10]$



Panel B: Event Window $t = [-3, 30]$

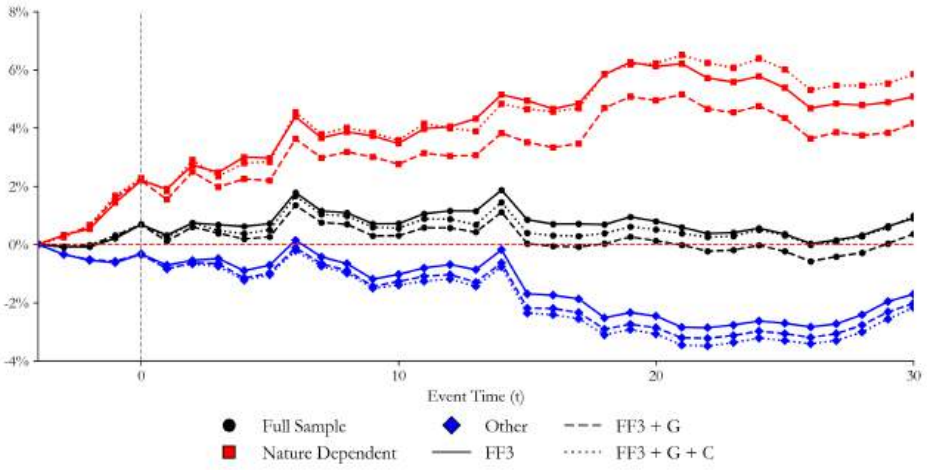
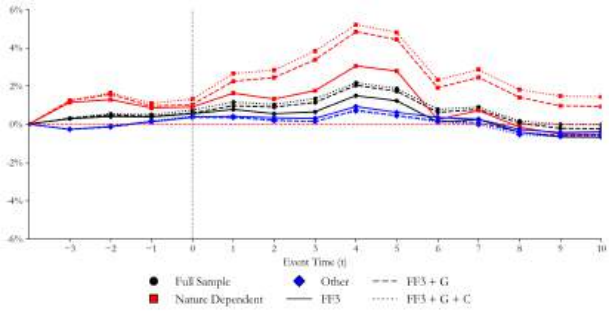


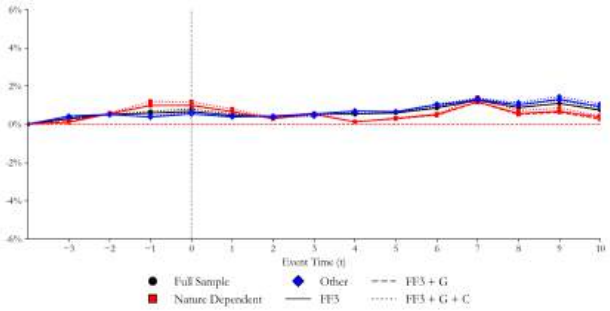
Figure ID.3: Cumulative Abnormal Returns around Key U.S. Political Events

This figure presents the cumulative abnormal returns (CARs) of an equal-weighted long-short portfolio that takes long positions in firms within the top tercile of AUBI exposure and short positions in firms within the bottom tercile. Expected returns are obtained from factor model predictions, where factor loadings are estimated using a 100-trading-day window ending 10 days before the event window. All subpanels cover the event window from $t = -3$ to $t = 10$. The dashed vertical line represents $t = 0$, corresponding to the event date. CARs are computed using the Fama-French three-factor (FF3) model, controlling for GMB (G), and Scope 1, 2, and 3 Carbon Intensity (collectively, C) when specified. The figure plots the CAR for three long-short portfolios: black lines represent the full sample, red lines correspond to location and nature-dependent firms (Mining, Utilities, Oil & Gas, Manufacturing, or Construction), and blue lines represent other firms.

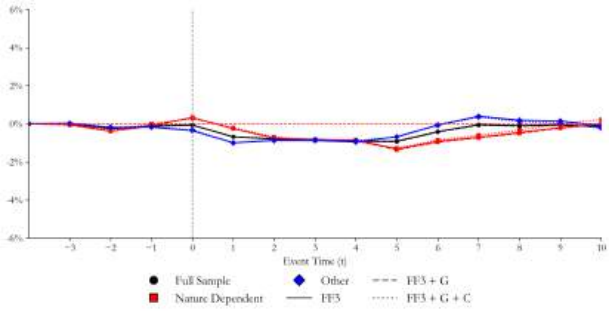
Panel A: President Trump's Election - November 08, 2016



Panel B: President Trump's Inauguration - January 20, 2017



Panel C: Paris Agreement Exit - June 01, 2017



Panel D: President Biden's Election - November 03, 2020

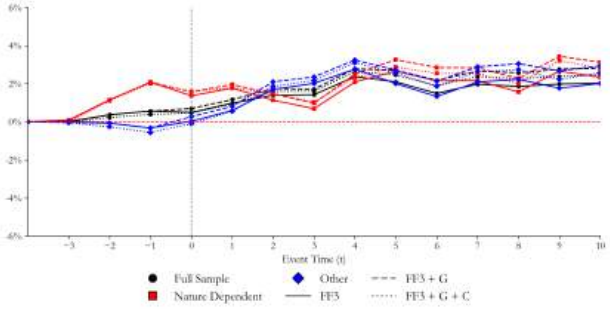


Table ID.1: AUBI Exposure and CARs: β_1 Estimates with FF3

This table reports the estimated betas from the regression specified in Equation 2, around two key events: January 27, 2021, and November 5, 2024. Firm-level cumulative abnormal returns (CARs) are computed using a 100-trading-day estimation window ending 10 days before the start of the event window. We analyze three event windows: $t = [-3, 3]$, $t = [-3, 5]$, and $t = [-3, 10]$. The regressions are based on the Fama-French three-factor (FF3) model and, depending on the specification, additionally control for a daily Green-minus-Brown (GMB) factor (FF3 + G) and Scope 1, 2, and 3 carbon intensity-sorted portfolio returns (FF3 + G + C). Results are presented for three samples: the full sample, nature-dependent firms, and non-nature-dependent firms (denoted as "Other"). ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: January 27, 2021

	FF3			FF3 + G			FF3 + G + C		
Sample	[-3,3]	[-3,5]	[-3,10]	[-3,3]	[-3,5]	[-3,10]	[-3,3]	[-3,5]	[-3,10]
All									
	-3.15	-4.071**	-5.463***	-3.045	-3.989**	-5.332***	-2.929	-3.903**	-5.351***
	(2.079)	(1.986)	(2.022)	(2.068)	(1.976)	(2.002)	(2.062)	(1.974)	(2.013)
Other									
	-0.289	-0.915	-2.653*	-0.128	-0.788	-2.451	-0.187	-0.775	-2.554
	(1.568)	(1.382)	(1.581)	(1.550)	(1.361)	(1.526)	(1.538)	(1.362)	(1.563)
Nature Dependent									
	-8.387*	-9.764**	-10.581**	-8.468*	-9.827**	-10.681**	-7.995	-9.416*	-10.263**
	(4.989)	(4.865)	(4.799)	(4.971)	(4.850)	(4.788)	(4.967)	(4.852)	(4.792)

Panel B: November 05, 2024

	FF3			FF3 + G			FF3 + G + C		
Sample	[-3,3]	[-3,5]	[-3,10]	[-3,3]	[-3,5]	[-3,10]	[-3,3]	[-3,5]	[-3,10]
All									
	0.676	0.713	0.714	0.387	0.265	0.302	0.479	0.502	0.56
	(0.7)	(0.837)	(1.116)	(0.713)	(0.865)	(1.124)	(0.721)	(0.888)	(1.135)
Other									
	-0.586	-0.878	-1.251	-0.777	-1.174	-1.523	-0.838	-1.2	-1.594
	(0.804)	(0.926)	(1.253)	(0.812)	(0.925)	(1.219)	(0.811)	(0.94)	(1.236)
Nature Dependent									
	2.279*	2.684*	3.391	1.755	1.871	2.644	2.056	2.454	3.362
	(1.279)	(1.561)	(2.106)	(1.31)	(1.65)	(2.181)	(1.334)	(1.7)	(2.178)

Table ID.2: AUBI Exposure and CARs: β_1 Estimates Across Events

This table reports the estimated betas from the regression specified in Equation 2, around four major climate-related and political events: (A) President Trump's Election (November 8, 2016), (B) President Trump's Inauguration (January 20, 2017), (C) the U.S. exit from the Paris Agreement (June 1, 2017), and (D) President Biden's Election (November 3, 2020). Firm-level cumulative abnormal returns (CARs) are computed using a 100-trading-day estimation window ending 10 days prior to each event window. We analyze three event windows: $t = [-3, 3]$, $t = [-3, 5]$, and $t = [-3, 10]$. Regressions are estimated using the Fama-French three-factor model (FF3) and the Fama-French-Carhart four-factor model (FFC4). Results are presented for the full sample, nature-dependent firms, and non-nature-dependent firms (denoted as "Other"). ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: President Trump's Election - November 08, 2016

	FF3			FFC4		
Sample	[-3,3]	[-3,5]	[-3,10]	[-3,3]	[-3,5]	[-3,10]
All	0.65	1.223*	-0.681	0.39	0.941	-1.213
	(0.695)	(0.738)	(1.251)	(0.67)	(0.702)	(1.218)
Other	0.293	0.65	-0.41	0.321	0.681	-0.352
	(0.654)	(0.675)	(0.806)	(0.647)	(0.669)	(0.81)
Nature Dependent	1.746	2.8*	-0.493	0.934	1.919	-2.154
	(1.509)	(1.63)	(3.124)	(1.435)	(1.522)	(3.024)

Panel B: President Trump's Inauguration - January 20, 2017

	FF3			FFC4		
Sample	[-3,3]	[-3,5]	[-3,10]	[-3,3]	[-3,5]	[-3,10]
All	0.567	0.595	0.742	0.6	0.633	0.768
	(0.424)	(0.469)	(0.602)	(0.441)	(0.487)	(0.604)
Other	0.389	0.473	0.814	0.538	0.64	0.928
	(0.424)	(0.536)	(0.727)	(0.428)	(0.539)	(0.723)
Nature Dependent	0.737	0.474	0.474	0.619	0.343	0.384
	(0.893)	(0.881)	(1.061)	(0.948)	(0.944)	(1.077)

Panel C: Paris Agreement Exit - June 01, 2017

	FF3			FFC4		
Sample	[-3,3]	[-3,5]	[-3,10]	[-3,3]	[-3,5]	[-3,10]
All	-0.828**	-0.919	-0.158	-0.731*	-0.63	-0.339
	(0.378)	(0.578)	(0.786)	(0.382)	(0.588)	(0.783)
Other	-0.726*	-0.549	0.236	-0.595	-0.159	-0.008
	(0.417)	(0.480)	(0.643)	(0.423)	(0.497)	(0.640)
Nature Dependent	-1.134	-1.631	-0.838	-1.088	-1.495	-0.924
	(0.727)	(1.337)	(1.840)	(0.730)	(1.353)	(1.831)

Panel D: President Biden's Election - November 03, 2020)

	FF3			FFC4		
Sample	[-3,3]	[-3,5]	[-3,10]	[-3,3]	[-3,5]	[-3,10]
All	1.424	2.096	2.024	1.45	2.219	2.146
	(0.991)	(1.34)	(1.48)	(1.004)	(1.391)	(1.515)
Other	2.009	1.389	1.447	1.979	1.244	1.303
	(1.378)	(1.695)	(1.758)	(1.401)	(1.848)	(1.9)
Nature Dependent	0.647	1.93	1.475	0.813	2.732*	2.274
	(1.263)	(1.486)	(2.026)	(1.265)	(1.54)	(2.036)

IE Earnings Surprises Results

Another potential explanation for the observed negative relationship between firm-level exposure to AUBI and stock returns is that firms with high AUBI exposure may face unexpected biodiversity-related costs or engage in mitigation efforts. These costs, if not fully anticipated by investors, may lead to earnings surprises that negatively affect returns.

To test this hypothesis, we examine the relationship between earnings surprises and AUBI exposure. Specifically, we estimate the following regression:

$$\textit{Earnings Surprise}_{imt} = \beta_0 + \beta_1 \textit{Employee Weighted AUBI Exposure}_i + \beta_2 X_{i,t-1} + \gamma_{jmt} + \epsilon_{imt} \tag{5}$$

where $\textit{earnings surprises}_{imt}$ is the Earnings Surprise for firm i in month m of year t. We define earnings surprises as the difference between actual earnings per share and the I/B/E/S median analyst forecast made 8 months prior to the end of the forecast period, scaled by the stock price. $X_{i,t-1}$ is a set of control variables, and γ_{jmt} represents industry-by-year-month fixed effects. $\textit{Employee Weighted AUBI Exposure}_i$ captures firm-level exposure to AUBI and β_1 is the coefficient of interest. We include firm characteristics such as size, leverage, book-to-market ratio, and capital expenditures, as well as controls for climate change exposure.

Tables IE.1 and IE.2 present the results for all industries (Columns 1-4) and for industries heavily reliant on natural resources and specific locations, such as Mining, Oil & Gas, Utilities, Construction, and Manufacturing (Columns 5-8). Across all specifications, the coefficients on *Employee Weighted AUBI Exposure* and *Employee Weighted Distance AUBI Exposure* are statistically insignificant, suggesting that there is no consistent link between AUBI exposure and earnings surprises. The results provide no evidence that firms with high AUBI exposure systematically underperform expectations due to unanticipated costs or biodiversity-related mitigation efforts.

Table IE.1: Biodiversity Regulatory Risk and Earnings Surprises

This table examines the relationship between earnings surprises and firm-level AUBI exposure, as defined in Equation 5. The dependent variable is the one-year standardized earnings surprise, computed as the difference between actual earnings per share and the I/B/E/S median analyst forecast made eight months prior to the fiscal period end, scaled by stock price. The sample period spans 2020–2023 and includes only firm-year observations with fiscal year-ends in December. Columns (1)–(4) include firms from all industries, while Columns (5)–(8) restrict the sample to firms in the Mining, Oil & Gas, Utilities, Construction, and Manufacturing sectors. The main explanatory variable is Employee Weighted AUBI Exposure. Columns (1)–(3) progressively introduce fixed effects, with Column (1) including no fixed effects, Column (2) controlling for NAICS 2-digit industry fixed effects, and Column (3) including NAICS 2-digit × year fixed effects. Column (4) augments the core specification with additional firm-level climate-related exposures: Climate Change Exposure Near Century, Climate Change Exposure Mid to Late Century, and the Habitat Climate Change Vulnerability Score Near Century. Columns (5)–(8) replicate this progression of fixed effects and controls on the restricted industry sample. All regressions include a standard set of lagged firm-level controls: log of total assets, leverage (total debt over assets), capital expenditures scaled by assets, PPE scaled by assets, return on assets, book-to-market ratio, log of market capitalization, asset growth, and sales growth. Additionally, two time-varying monthly variables—volatility (computed as the trailing 36-month standard deviation of monthly returns) and momentum (12-month average return)—are included. All continuous variables are winsorized at the 1st and 99th percentiles. Fixed effects structure and their inclusion are reported at the bottom of the table. Standard errors are clustered at the firm level and are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	All				Mining, Oil, Utilities, Construction, Manufacturing			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Employee Weighted AUBI Exposure	0.016	-0.018	-0.014	-0.013	-0.099	-0.109	-0.103	-0.068
	(0.083)	(0.079)	(0.077)	(0.059)	(0.092)	(0.104)	(0.099)	(0.074)
Ln(Total assets)	0.104	0.128	0.125	0.129	0.032	0.034	0.027	0.032
	(0.096)	(0.113)	(0.112)	(0.116)	(0.024)	(0.025)	(0.022)	(0.025)
Leverage	-0.201	-0.208	-0.207	-0.220	-0.230	-0.237	-0.217	-0.258
	(0.135)	(0.138)	(0.137)	(0.143)	(0.180)	(0.185)	(0.172)	(0.197)
Capex/Total assets	-0.314	-0.480	-0.519	-0.503	0.029	0.091	-0.053	0.299
	(0.303)	(0.451)	(0.425)	(0.455)	(0.211)	(0.247)	(0.212)	(0.419)
PPE/Total assets	0.024	0.062	0.064	0.056	-0.035	-0.059	-0.028	-0.055
	(0.051)	(0.093)	(0.081)	(0.072)	(0.045)	(0.104)	(0.085)	(0.102)
Ln(Market cap)	-0.130	-0.157	-0.154	-0.158	-0.037	-0.039	-0.033	-0.037
	(0.112)	(0.132)	(0.130)	(0.134)	(0.027)	(0.028)	(0.024)	(0.027)
Book-to-market	-0.377	-0.400	-0.400	-0.406	-0.093	-0.094	-0.082	-0.096
	(0.306)	(0.320)	(0.320)	(0.323)	(0.076)	(0.078)	(0.072)	(0.077)
ROA	0.395	0.471	0.465	0.508	-0.323	-0.302	-0.344	-0.399
	(0.546)	(0.579)	(0.602)	(0.655)	(0.386)	(0.362)	(0.390)	(0.456)
Asset growth	-0.005	-0.011	-0.005	-0.006	-0.024	-0.026	-0.022	-0.019
	(0.024)	(0.023)	(0.024)	(0.023)	(0.027)	(0.028)	(0.026)	(0.024)
Sales growth	0.000	-0.000	0.000	0.000	-0.000	-0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Volatility	0.000	0.000	-0.000	-0.000	-0.001	-0.001	-0.002	-0.003
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.003)	(0.003)
Momentum	0.003	0.004	0.006	0.007	-0.004	-0.004	-0.001	-0.001
	(0.004)	(0.005)	(0.006)	(0.006)	(0.004)	(0.005)	(0.003)	(0.004)
Climate Change Exposure Near Century				-0.008				-0.846
				(0.609)				(0.815)
Climate Change Exposure Mid to Late Century				0.158				0.222
				(0.134)				(0.214)
Habitat Climate Change Vulnerability Score Near Century				-0.338				2.130
				(1.710)				(2.011)
Adj. R-squared	0.0667	0.0712	0.0621	0.0630	0.00831	0.00432	-0.00271	0.00159
Obs.	2,578	2,578	2,574	2,508	1,294	1,294	1,292	1,240
Industry FEs	No	Yes	-	-	No	Yes	-	-
Ind × Year-Month FEs	No	No	Yes	Yes	No	No	Yes	Yes

Table IE.2: Biodiversity Regulatory Risk and Earnings Surprises- Robustness Check

This table examines the relationship between earnings surprises and firm-level AUBI exposure, as defined in Equation 5. The dependent variable is the one-year standardized earnings surprise, computed as the difference between actual earnings per share and the I/B/E/S median analyst forecast made eight months prior to the fiscal period end, scaled by stock price. The sample period spans 2020–2023 and includes only firm-year observations with fiscal year-ends in December. Columns (1)–(4) include firms from all industries, while Columns (5)–(8) restrict the sample to firms in the Mining, Oil & Gas, Utilities, Construction, and Manufacturing sectors. The main explanatory variable is Employee Weighted Distance AUBI Exposure. Columns (1)–(3) progressively introduce fixed effects, with Column (1) including no fixed effects, Column (2) controlling for NAICS 2-digit industry fixed effects, and Column (3) including NAICS 2-digit × year fixed effects. Column (4) augments the core specification with additional firm-level climate-related exposures: Climate Change Exposure Near Century, Climate Change Exposure Mid to Late Century, and the Habitat Climate Change Vulnerability Score Near Century. Columns (5)–(8) replicate this progression of fixed effects and controls on the restricted industry sample. All regressions include a standard set of lagged firm-level controls: log of total assets, leverage (total debt over assets), capital expenditures scaled by assets, PPE scaled by assets, return on assets, book-to-market ratio, log of market capitalization, asset growth, and sales growth. Additionally, two time-varying monthly variables—volatility (computed as the trailing 36-month standard deviation of monthly returns) and momentum (12-month average return)—are included. All continuous variables are winsorized at the 1st and 99th percentiles. Fixed effects structure and their inclusion are reported at the bottom of the table. Standard errors are clustered at the firm level and are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	All				Mining, Oil, Utilities, Construction, Manufacturing			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Employee Weighted Distance AUBI Exposure	0.086	0.056	0.059	0.067	0.084	0.083	0.087	0.131
	(0.071)	(0.067)	(0.069)	(0.089)	(0.092)	(0.092)	(0.095)	(0.133)
Ln(Total assets)	0.107	0.131	0.128	0.132	0.045	0.046	0.039	0.045
	(0.093)	(0.111)	(0.110)	(0.114)	(0.030)	(0.031)	(0.026)	(0.030)
Leverage	-0.197	-0.206	-0.204	-0.217	-0.218	-0.226	-0.205	-0.253
	(0.134)	(0.137)	(0.136)	(0.142)	(0.169)	(0.175)	(0.161)	(0.192)
Capex/Total assets	-0.272	-0.446	-0.485	-0.454	0.190	0.222	0.069	0.537
	(0.326)	(0.476)	(0.442)	(0.484)	(0.316)	(0.340)	(0.265)	(0.613)
PPE/Total assets	0.020	0.062	0.064	0.054	-0.049	-0.055	-0.022	-0.065
	(0.052)	(0.092)	(0.079)	(0.072)	(0.058)	(0.100)	(0.080)	(0.110)
Ln(Market cap)	-0.133	-0.159	-0.157	-0.160	-0.048	-0.050	-0.044	-0.049
	(0.111)	(0.130)	(0.129)	(0.133)	(0.032)	(0.033)	(0.029)	(0.032)
Book-to-market	-0.376	-0.399	-0.400	-0.406	-0.091	-0.092	-0.080	-0.096
	(0.306)	(0.320)	(0.320)	(0.323)	(0.076)	(0.078)	(0.072)	(0.077)
ROA	0.404	0.478	0.472	0.516	-0.298	-0.284	-0.327	-0.384
	(0.534)	(0.570)	(0.593)	(0.646)	(0.363)	(0.345)	(0.374)	(0.441)
Asset growth	-0.006	-0.011	-0.005	-0.007	-0.026	-0.026	-0.023	-0.021
	(0.025)	(0.024)	(0.025)	(0.023)	(0.028)	(0.029)	(0.026)	(0.025)
Sales growth	0.000	-0.000	0.000	0.000	-0.000	-0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Volatility	0.000	0.000	-0.000	-0.000	-0.001	-0.001	-0.002	-0.003
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.003)	(0.003)
Momentum	0.003	0.004	0.007	0.007	-0.003	-0.003	-0.000	0.001
	(0.004)	(0.005)	(0.006)	(0.006)	(0.004)	(0.004)	(0.003)	(0.003)
Climate Change Exposure Near Century				-0.110				-1.118
				(0.770)				(1.081)
Climate Change Exposure Mid to Late Century				0.138				0.158
				(0.120)				(0.162)
Habitat Climate Change Vulnerability Score Near Century				-0.090				2.872
				(2.095)				(2.741)
Adj. R-squared	0.0675	0.0715	0.0625	0.0634	0.00780	0.00348	-0.00327	0.00318
Obs.	2,578	2,578	2,574	2,508	1,294	1,294	1,292	1,240
Industry FEs	No	Yes	-	-	No	Yes	-	-
Ind × Year-Month FEs	No	No	Yes	Yes	No	No	Yes	Yes