# When Markets Care: Discrimination in Pricing Biodiversity Risk

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## Abstract

Biodiversity loss is among the most pressing challenges confronting business and society and is becoming an increasingly relevant concern in international business as biodiversity and nature-related disclosure frameworks continue to emerge. This paper examines the equity market pricing of corporate biodiversity risk using firm-level biodiversity footprints and the implied cost of equity capital for 2,070 firms across 39 countries from 2018 to 2021. Consistent with our main predictions, we use disaggregated biodiversity measures to show that markets impose a clear and economically meaningful pricing penalty on firms with larger direct biodiversity impacts arising from their own operations and energy use (Scopes 1 and 2), while largely ignoring indirect impacts embedded in global supply chains (Scope 3), which account for most biodiversity loss. The effect is stronger for firms subject to greater market scrutiny, operating in biodiversity-intensive, nature-dependent, or highly competitive industries, and located in countries with weaker environmental protections and right-leaning political regimes. The results are robust to alternative size measures, ESG controls, alternative fixed-effects specifications, individual implied cost-of-equity estimates, and adjustments for analyst forecast bias. Overall, the findings show that financial markets discipline visible and attributable biodiversity damage but fail to internalize supply-chain impacts, pointing to limits of market-based discipline and the need for complementary policy and disclosure frameworks to address biodiversity loss. These insights have important implications for corporate managers, investors, and policymakers.



**Keywords:** Biodiversity footprint; Global equity market; Environmental performance; Institutions; Implied cost of capital

# INTRODUCTION

Biodiversity—the variety of life across species, within species, and among ecosystems—underpins human well-being and global economic activity. The World Economic Forum (2020) estimates that over half of global gross domestic product (GDP) depends directly on nature. In Europe, over 70% of corporations rely on at least one ecosystem service, from freshwater and pollination to pest control and genetic materials (Boldrini et al., 2023). This reliance reflects the significant role that functioning ecosystems play in supporting business operations and resilience. Yet, biodiversity is declining at alarming rates, posing a crisis that rival climate change (Karolyi & Tobin-de la Puente, 2023). Despite facing one of the most urgent sustainability challenges of our time, we know little about how corporate biodiversity footprints (CBFs) influence mainstream investment decisions or whether financial markets effectively discipline firms for their impact on planetary health. Our paper addresses this gap by providing insights into how global financial markets respond to distinct sources of corporate biodiversity impact.

Despite recent research exploring whether capital markets price in biodiversity risks, evidence remains mixed and appears heavily influenced by the widely publicized global initiatives of 2021, including the Taskforce on Nature-related Financial Disclosures and Kunming Declaration.[1] For instance, Garel et al. (2024) find no overall effect on realized returns over 2019–2022 but document a footprint premium, with higher returns for larger-CBF firms in 2021 following these key milestones. Similarly, Coqueret et al. (2025) report that post-2021, U.S. firms exposed to biodiversity risks commanded a negative (positive) CBF premium on realized (expected) returns. Xiong (2023) also finds weak and inconsistent global pricing effects that strengthen only after the Kunming Declaration. In contrast, Giglio et al. (2023) show that ecological concerns were already reflected in U.S. stock valuations prior to 2021, though an accompanying investor survey reveals a sharp divide on whether biodiversity risks were adequately priced. This divergence

[1] Launched in June 2021, the global Taskforce on Nature-related Financial Disclosures aims to develop a disclosure framework for organizations to report nature-related risks and opportunities. The Kunming Declaration, adopted in October 2021 during the first phase of the UN Biodiversity Conference, is a major international commitment to halt biodiversity loss that helped establish the post-2020 Global Biodiversity Framework.

in findings raises a critical question: does biodiversity pricing reflect enduring market discipline or merely short-lived reactions to high-profile events that may wane as attention shifts? We address this question by showing that global markets incorporated biodiversity risks prior to recent international commitments, indicating actions that are not merely event-driven. However, we also find that this pricing is highly selective and more sensitive to a firm's direct ecological impacts than it is to the indirect impact caused by a firm's upstream or downstream supply chain activity. This critical distinction helps reconcile the mixed evidence from prior work that uses aggregate measures.

Our analysis draws on data from Iceberg Data Lab (IDL), which quantifies CBFs for more than 3,000 firms worldwide and decomposes them into three scopes: Scope 1 captures ecological impacts arising from firm' own operations, Scope 2 from use of energy purchased (e.g., electricity) that firms can directly control, and Scope 3 indirectly from a firm's value chain engagement. To gauge investor expectations, we use the implied cost of equity capital, a forward-looking metric derived from analyst earnings forecasts and stock prices that is well established in accounting research (e.g., Dhaliwal et al., 2006; Hail & Leuz, 2006). This measure helps clarify the compensation investors require for biodiversity risks while avoiding the short-term noise and event-driven volatility embedded in realized returns. Combining these datasets and focusing on the pre-milestone period of 2018–2021 yields an international sample of 6,981 firm-year observations from 2,070 firms across 39 countries.

We find that although a firm's aggregate CBF shows little relation to its cost of capital— echoing the mixed pre-milestone evidence—disaggregated measures reveal a sharp divide wherein investors demand significantly higher returns from firms with Scopes 1 and 2 footprints (i.e., direct-impact CBFs).[2] Specifically, a one-standard-deviation increase in direct-impact CBFs raises the cost of capital by 56 basis points, compared to no meaningful effect for firms with Scope 3 footprint (i.e., indirect-impact CBFs). These results suggest that equity holders notice a firm's biodiversity risk more when it is local, observable,

[2] We group Scopes 1 and 2 as direct-impact CBFs, reflecting firms' direct influence over these impacts through operational and energy-contracting decisions, paralleling the collective treatment of operational emissions (Scope 1 and Scope 2) in greenhouse gas metrics (SBTi, 2025).

and directly attributable to the firm, compared to when attribution and accountability are less certain, such as through upstream or downstream supply-chain effects. This asymmetry also may shape shareholder composition: investors avoid firms with visible impacts, leading to under-diversification, and price idiosyncratic risks into valuations (Bolton & Kacperczyk, 2021), reinforcing the dichotomy. This premium associated with direct-impact CBFs is robust to controls for environmental, social, and governance (ESG) scores, confirming that biodiversity loss represents a distinct risk factor beyond traditional environmental considerations, such as carbon and toxic pollution premiums (e.g., Hsu et al., 2023). Our results also hold under alternative fixed effects, different cost of capital proxies, and adjustments for analyst forecast noise.

We further demonstrate that investor sensitivity to direct-impact CBFs intensifies with market scrutiny. Partitioning firms by size and analyst coverage reveals a significantly larger biodiversity premium for highly scrutinized firms, consistent with reduced uncertainty and information asymmetry related to biodiversity risks enabling more effective pricing. Penalties for direct biodiversity damage also increase for industries with high exposure to local and tangible risks, namely those that substantially contribute to ecosystem degradation or depend heavily on ecosystem services. Socially responsible investors may target these sectors for exclusionary screening, which may limit risk-sharing and amplify the required returns. Competitive industries exhibit stronger pricing effects as well, supporting the view that robust biodiversity performance allows firms to differentiate themselves as part of a corporate social responsibility strategy. This interpretation aligns with the ESG literature (e.g., Fernández-Kranz & Santaló, 2010; Flammer, 2015) and points to the financial materiality of corporate social responsibility in competitive markets.

Finally, country-level conditions shape how markets price biodiversity risk. As local ecosystem degradation raises the likelihood of operational disruptions and stranded assets, firms in countries with weaker environmental protections, limited political commitment to environmental issues, or poorer environmental performance face higher risk and correspondingly larger market penalties.

This paper contributes to the emerging literature on biodiversity and its financial implications. In contrast to recent work pointing to mixed or short-lived investor responses to biodiversity events (e.g., Coqueret et

al., 2025; Garel et al., 2024; Xiong, 2023), we provide compelling evidence that investors systematically price direct biodiversity footprint before these issues gain widespread attention. In this way, our findings help reconcile the mixed results of prior research by demonstrating how aggregating biodiversity factors without distinguishing their sources, impacts, or measurability can obscure their true relations with asset values. The markets' uneven treatment of direct vs. indirect biodiversity concerns suggests that asset price penalties imposed by investors may not be sufficient to drive meaningful ecosystem conservation. Our findings point to the limits of financial markets in disciplining firms toward environmentally sustainable behavior, particularly when environmental impacts are imbedded in global supply chains. We also contribute to the ESG asset pricing literature. Prior work demonstrates that overall ESG and environmental performance affect the cost of capital and valuation (e.g., El Ghoul et al., 2011, 2017, 2018) or focuses on specific environmental dimensions, such as the carbon premium (e.g., Bolton & Kacperczyk, 2021; Sautner et al., 2023; Zerbib, 2022; Zhang, 2025) or toxic pollution premium (Hsu et al., 2023). Our study extends this literature by showing that biodiversity risks constitute a distinct pricing dimension, separate from climate and other environmental concerns. Unlike climate risks, however, biodiversity risks are not consistently incorporated across supply chains. We thus offer a more comprehensive perspective on how financial markets price planetary health.

# HYPOTHESES

### Background and Prior Research

Biodiversity loss is among the most pressing challenges confronting business and society. Wildlife populations have fallen by nearly 70% in the past 50 years due to intensive commercial activities, such as land use and overexploitation (World Economic Forum, 2023). The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (2019) estimates that up to one million species face extinction, posing systemic risks to economies heavily dependent on nature's services (Dasgupta, 2021). Global policy efforts to address biodiversity loss trace back to the 1992 Rio Earth Summit, also known as the United Nations Conference on Environment and Development, which led to the adoption of the

Convention on Biological Diversity, a landmark international treaty aimed at conserving biological diversity. Since the treaty, more recent global initiatives include the 2021 Kunming Declaration and 2022 Kunming-Montreal Agreement, which set ambitious global targets for reversing biodiversity loss.

Yet, funding gaps persist, making private capital critical (Flammer et al., 2025).[3] Investors thus have begun to look beyond climate change to natural capital, the stock of ecosystems, biodiversity, and natural resources that support economic activity. Surveys report strong demand for conservation-focused projects (Cooper & Trémolet, 2019), and biodiversity-linked debt has expanded rapidly within the ESG market (Jacobs & Buff, 2024). Large asset managers such as BNP Paribas and ACTIAM now incorporate "planetary boundary" frameworks, which identify ecological thresholds beyond which environmental degradation may become irreversible, into investment screening. These developments reflect growing recognition that biodiversity carries material implications for investor decision-making.

Despite this momentum, it remains unclear how investors incorporate biodiversity factors into firm valuation and whether financial markets can effectively internalize ecological externalities into corporate decisions. Xin et al. (2025) find no link between biodiversity scores from MSCI ESG ratings and global stock returns, suggesting that markets overlook ecological performance. Xiong (2023) reports positive return alphas for biodiversity-friendly U.S. firms prior to the Kunming Declaration but limited effects elsewhere, with the pattern reversing after 2021. Garel et al. (2024) and Coqueret et al. (2025) similarly find that the association between aggregate CBF and equity pricing is weak before 2021 and that valuation shifts afterward, but their interpretations differ, with the former attributing higher realized returns among large-CBF firms to rising investor awareness and litigation risks and the latter arguing that decreased investor demand for high-impact firms drives down returns of large-CBF firms. Giglio et al. (2023) show that ecological concerns are priced into U.S. equities even before 2021, yet their investor survey reveals disagreement over whether markets adequately reflect biodiversity risks. Bohnet et al. (2025), in turn, study

[3] Estimates suggest that reversing biodiversity loss will require between US $722 billion and US $967 billion annually (Deutz et al., 2020), far exceeding current biodiversity finance and government investments of about US $100 billion per year (OECD, 2018).

deforestation exposure and find negative return premiums, which increase after the Kunming Declaration and 2022 EU Deforestation Regulation.

These findings raise questions about how markets value biodiversity impacts: do pricing effects reflect lasting concerns and genuine market pressure that discipline firms' ecological actions, or are they merely short-term investor responses to high-profile events that fade as attention wanes? Our study offers a distinct perspective. Rather than focusing on aggregate metrics or realized returns, we disaggregate the CBF along the value chain and rely on the implied cost of equity capital to capture forward-looking investor expectations. Unlike ESG scores, which tend to suffer from opacity and inconsistency (Berg et al., 2022), disaggregated CBFs provide a more precise measure of ecological harm and reveal meaningful variation in how investors evaluate sources of impact. Using the implied cost of capital also avoids distortions from short-term price shocks that complicate interpretation based on realized returns (Elton, 1999; Pástor et al., 2008, 2022).

**Hypothesis Development**

Firms with larger CBFs are likely to face penalties through two primary channels. First, heightened exposure to physical and transition risks increases required returns as investors price in potential negative effects on cash flows and profitability (El Ghoul et al., 2018). Physical risks include operational disruptions from the loss of natural resources and ecosystem services, such as pollination and water filtration (Boldrini et al., 2023). Transition risks arise from regulatory changes, reputational pressures, and shifting technologies or consumer preferences, which may force high-impact firms to adopt costlier business models or abandon assets (Garel et al., 2024). Second, large-CBF firms risk a shrinking shareholder base due to divestment by responsible investors, mirroring the "sin stock" effect (Hong & Kacperczyk, 2009). The resulting lack of risk-sharing causes idiosyncratic risk to be priced in, elevating the cost of capital. These mechanisms should meaningfully shape investor and market assessments even in the absence of publicized events and their accompanying temporary surges in attention.

However, we posit that these penalties are not uniform: investors focus on firms with larger direct-impact CBFs (i.e., larger Scopes 1 and 2 footprints) but largely overlook firms with indirectly impacted CBFs (i.e., Scope 3 footprint). We argue that investors make this distinction based on differences in materiality, measurability, and attribution. Unlike the global effects of climate change, biodiversity loss is typically localized, with varying significance across different places (Fenichel et al., 2024). Whereas direct impacts are visible, easily attributable to a firm, and have obvious effects on a firm's own operations and liabilities, indirect impacts are embedded in complex supply chains, affecting distant ecosystems and communities, which renders them less material to the firm's immediate financial performance. Compared to direct impacts, indirect effects are more difficult to measure and trace due to the multidimensionality of biodiversity and lack of standardized reporting frameworks (von Zedlitz, 2023). Moreover, ESG rating providers typically exclude Scope 3 environmental indicators due to concerns over the reliability and comparability of metrics (Dai et al., 2024). Consequently, investors struggle to incorporate indirect effects and, as prior work confirms, largely dismiss these cascading risks (Chen et al., 2024; Ranger et al., 2023). This dichotomous effect of CBFs thus motivates our baseline hypothesis:

*Hypothesis 1: Direct-impact CBFs increase the cost of equity, whereas indirect-impact CBFs have no effect on the cost of equity.*

We next examine the conditions under which the premium from direct-impact CBFs is more strongly priced. Given the sparsity and inconsistency of biodiversity disclosures, the salience of biodiversity risk depends heavily on how much attention the market pays to particular firm details. Adler et al. (2018) report that fewer than 15 of the top 150 Fortune Global companies provide meaningful reporting on ecosystem and habitat threats. Bassen et al. (2024) show that such disclosures are frequently delayed, increasing stock price crash risk. Greater transparency and market scrutiny can reduce information asymmetry and enhance the valuation relevance of biodiversity risks. Accordingly, we propose our second hypothesis:

*Hypothesis 2: Market attention amplifies the relation between direct-impact CBFs and the cost of equity capital.*

Industry variation further shapes how equity holders assess ecological concerns. Firms in sectors that extensively deplete natural capital (e.g., agriculture, mining) face elevated transition risks and are straightforward targets for exclusionary screening by socially responsible investors (Chava, 2014), amplifying the financial materiality of their direct-impact CBFs. Industries reliant on ecosystem services (e.g., fisheries, forestry) are likewise more exposed to local physical risks from habitat degradation (Boissinot et al., 2022). Firms also may leverage strong environmental performance to gain a competitive advantage (Fernández-Kranz & Santaló, 2010; Flammer, 2015), as supported by recent findings on green practices and innovation (Dai et al., 2025). Biodiversity performance thus is highly relevant in these corporate settings, leading to our next hypothesis:

*Hypothesis 3: The effect of direct-impact CBFs on the cost of equity is stronger in more biodiversity-intensive, nature-dependent, or competitive industries.*

Finally, we posit that the pricing implications of biodiversity vary across countries. Regulatory frameworks, societal norms, and political ideologies drive differences in environmental protection and performance (e.g., Aguilera et al., 2007; Bernauer & Koubi, 2009; Crossland & Hambrick, 2011; Hartmann & Uhlenbruck, 2015). In countries with weaker regulations, societal eco-consciousness, or environmental protections, the overuse of ecosystem services accelerates natural capital depletion and increases firms' exposure to biodiversity-related physical risks. Conversely, weaker institutional environments also may reduce transition risks, making investors less likely to treat biodiversity as a salient pricing factor. Accordingly, we propose alternative hypotheses:

*Hypothesis 4a: The positive relation between direct-impact CBFs and the cost of equity capital is stronger in countries with weaker environmental performance, where political ideologies and regulatory frameworks place less emphasis on environmental protection.*

*Hypothesis 4b: The positive relation between direct-impact CBFs and the cost of equity capital is weaker in countries with stronger environmental performance, where political ideologies and regulatory frameworks place greater emphasis on environmental protection.*

## DATA AND SAMPLE

To investigate how markets discipline firms for biodiversity loss, we obtain data from several sources: (i) global CBF data from IDL; (ii) consensus analyst earnings forecasts and stock prices from the Institutional Brokers' Estimate System (IBES); (iii) financial data from Compustat Global; (iv) ESG scores from LSEG; (v) country-level development indicators from the World Bank; (vi) environmental protection values from the World Values Survey; and (vii) political orientation information from the Database of Political Institutions. Our primary sample intersects these key databases.

Our sample begins with all publicly listed firms covered by IDL between 2018 and 2021. We merge these data with IBES forecasts and Compustat data on book values, dividends, industry affiliation, and inflation to compute the implied cost of equity capital through 2021 and with other sources for firm- and country-level controls. We exclude firms in countries with fewer than five observations, those with negative book equity, and those missing values for key variables. The final dataset comprises 6,981 firm-year observations from 2,070 unique firms across 39 countries. All continuous variables are winsorized at the 1st and 99th percentiles to mitigate outlier effects. See Appendix A for key variable definitions.

**Corporate Biodiversity Footprint**

Our key CBF measure comes from IDL, an environmental data provider that has tracked over 3,000 firms globally since 2018. It quantifies ecosystem degradation as the surface area of pristine land lost, expressed in square kilometers weighted by the mean species abundance (MSA) score.[4] An MSA score of 100% reflects an undisturbed ecosystem, and 0% reflects complete biodiversity loss. For instance, a CBF value

[4] MSA is a biodiversity indicator widely recognized by global entities including the Intergovernmental Panel on Climate Change, Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, Convention on Biological Diversity, and the UN.

of -100 km² × MSA indicates that a firm's activities degraded the equivalent of 100 square kilometers of intact land in that year. IDL employs a life-cycle-assessment approach, incorporating both reported and extrapolated data from company disclosures and public information. It considers four primary drivers of biodiversity loss—land use, greenhouse gas emissions, air pollution, and water pollution—translating them into biodiversity damage using established ecological impact functions.

*Total CBF* aggregates a firm's nature-depleting activities across its entire value chain and is decomposed according to the three previously defined scopes: Scope 1 covers direct impacts from firm-owned or firm-controlled operations, Scope 2 includes impacts from firm-purchased energy, and Scope 3 encompasses all other indirect impacts from the firm's value chain, including those upstream from purchased inputs and downstream from product use. We define *Direct CBF* as the sum of Scopes 1 and 2, as both impacts are directly attributable to firm's internal decisions—such as production processes, energy-efficiency investments, and energy-contracting arrangements—reflecting firms' ability to influence them. This classification parallels established carbon accounting practices (e.g., SBTi, 2025). *Indirect CBF* correspond to Scope 3 impacts, which depend substantially on the actions of suppliers and customers and are therefore far less controllable by the focal firm. For ease of interpretation, we multiply CBF values by -1 so that higher values indicate a larger footprint. To control for firm size, we also construct normalized measures, scaling CBFs by total assets. All CBF variables are log-transformed to mitigate skewness.

**Implied Cost of Equity Estimates**

We measure investors' required returns using the implied cost of equity, derived from analyst forecasts and stock prices. This forward-looking approach avoids the distortions of realized returns, which may conflate expected premia with unanticipated investor demand shifts or short-term stock price volatility (Pástor et al., 2008, 2022). It therefore provides a more straightforward and robust assessment of how investors price biodiversity risks. Following established practice (e.g., Dhaliwal et al., 2006; El Ghoul et al., 2011; Hail & Leuz, 2006), we estimate the *ex ante* expected return using four implied cost of capital models. $K_{CT}$ is the estimate using Claus and Thomas' (2001) model. $K_{GLS}$ is from Gebhardt et al. (2001). $K_{OJ}$ is from Ohlson

and Juettner-Nauroth (2005). Finally, $K_{MPEG}$ uses Easton's (2004) model. $K_{CT}$ and $K_{GLS}$ are based on the residual income valuation framework, and $K_{OJ}$ and $K_{MPEG}$ are derived from the abnormal earnings growth model. We implement these models strictly following the methodology and data requirements detailed in El Ghoul et al. (2018, Appendix 1, pp. 355–357). Our primary measure, $K_{AVG}$, is the average of the four estimates, with robustness tests conducted for each model.

**Control Variables**

Our regressions include firm- and country-level controls that prior work identifies as determinants of the cost of equity. *Beta* is estimated from an international market model using stock returns from the preceding 12 months. *BM* is the ratio of book value to market value of equity, a well-established risk factor (Fama & French, 1992). We measure *Size* as the natural logarithm of total assets in U.S. dollars but also test the logarithm of sales and market value as alternatives, given conflicting predictions on size effects (e.g., Berger et al., 2022; Chen et al., 2010). *Leverage*, defined as the ratio of long-term debt to total assets, is expected to increase the cost of equity (Gode & Mohanram, 2003; Modigliani & Miller, 1958). We further control for analysts' *Forecast Bias*, the scaled difference between forecasted and actual earnings, and *Forecast Dispersion*, the coefficient of variation in earnings forecasts, to mitigate potential inflation in our $K_{AVG}$ estimates (e.g., Chen et al., 2010; Dhaliwal et al., 2016).

At the country level, we account for *Inflation*, as nominal analyst forecasts may incorporate inflation expectations that influence the estimated cost of capital (Hail & Leuz, 2009). We also include the natural logarithm of GDP per capita, *Ln(GDP per Capita)*, to capture differences in economic development, which can affect capital availability and the required return on equity (Ritter, 2005).

**Descriptive Statistics**

Table 1 reports summary statistics and correlations in Panels A and B, respectively. The implied cost of equity averages 11.1% (median 9.5%), consistent with prior international evidence (Hail & Leuz, 2009). Firms' total CBF averages about 1,500 km² × MSA, but the distribution is highly skewed. On average,

direct activities account for roughly 9% of total biodiversity loss, and supply-chain activities represent the remaining 91%. This distribution point to the importance of evaluating both direct and indirect impacts. Consequently, our investigation into whether investors price these components selectively carries major implications for the potential of financial markets to incentivize biodiversity conservation.

[Insert Table 1 Here]

The correlation matrix shows positive associations between the cost of equity and biodiversity measures, indicating that investors require higher returns from firms associated with greater ecosystem depletion. Correlations among control variables are generally moderate, mitigating concerns about multicollinearity and consistent with patterns documented in prior studies.

Table A1 in the Online Appendix reports summary statistics of the CBF measures and expected returns, by country (Panel A) and industry (Panel B). The data demonstrate wide global coverage, with the U.S. and China together accounting for nearly 40% of observations and smaller economies such as Portugal and Luxembourg each contributing less than 1%. The table also illustrates the uneven distribution of biodiversity pressures. Resource-intensive sectors (e.g., Paper & Forest, Metals & Mining, Oil & Gas) exhibit some of the largest direct footprints, whereas service-oriented industries display high indirect but low direct impacts. These distinct cross-sectional patterns motivate our decomposition of the CBF measure and our examination of heterogeneous pricing effects across countries and industries.

# METHOD AND RESULTS

### Baseline Regression

To test Hypothesis 1, we analyze how distinct CBF components relate to expected returns as follows:

$$K_{AVG\,i,t} = \beta_0 + \beta_1 Ln(CBF_{i,t}) + \beta_2 X_{i,t} + FE + \varepsilon_{i,t}, \quad (1)$$

where $K_{AVG\,i,t}$ is the implied cost of capital for firm *i* in year *t*, and $CBF_{i,t}$ is one of the three CBF measures, *Total CBF*, *Direct CBF*, or *Indirect CBF*, in log form. We examine both the absolute level of CBF and its

ratio to total assets. $X_{i,t}$ is a vector of control variables including *Beta*, *BM*, *Leverage*, *Inflation*, *Size*, *Forecast Bias*, *Forecast Dispersion*, and *Ln(GDP per Capita)*. We include country, industry, and year fixed effects (*FE*) and cluster standard errors at the firm level (Hail & Leuz, 2006). See Appendix A for detailed variable definitions.

Table 2 reports the results. Columns (1)–(2) show that total footprints, whether absolute or scaled by assets, are insignificantly related to the cost of equity, which aligns with earlier studies documenting muted or inconsistent market responses to biodiversity exposure before 2021 (Coqueret et al., 2025; Garel et al., 2024). However, disaggregating the footprint shows a clear dichotomy. As reported in columns (3)–(4), direct-impact CBFs are positively and significantly associated with the cost of equity ($p$-value = 0.00 for both proxies). Economically, a one-standard-deviation increase in *Ln(Direct CBF)* raises the expected return by roughly 56 basis points, equivalent to about 9.9% of its sample standard deviation. By contrast, indirect-impact CBFs, presented in columns (5)–(6), exhibit no meaningful association ($p$-value > 0.10). These patterns support Hypothesis 1, indicating that investors selectively penalize firms associated with more direct, visible, and traceable biodiversity harm.

[Insert Table 2 Here]

Table A2 in the Online Appendix decomposes the direct-impact CBF into land use, greenhouse gas emissions, air pollution, and water pollution components to examine how investors price each. The results show positive and significant effects across all components, confirming that markets penalize all four. This result suggests that the observed premium reflects a comprehensive assessment of ecological impact, rather than repricing of any single environmental factor, such as the carbon or toxic pollution premium, as previously documented (Bolton & Kacperczyk, 2021; Hsu et al., 2023). We corroborate this finding with additional robustness tests, presented in a later section.

Overall, these results reveal three key insights. First, investors price biodiversity risks even in the absence of high-profile global events, suggesting that markets discipline violating firms persistently rather than in

response to short-term price pressures (e.g., global biodiversity summits, media attention). Second, the distinction between direct and indirect impacts helps explain why prior studies relying on aggregated biodiversity indicators yield inconsistent evidence. Aggregation masks the selective nature of investor expectations. Third, the absence of pricing effects for indirect-impact CBFs, despite their accounting for over 90% of total corporate biodiversity loss, reflects the limitations of market-based mechanisms in addressing ecological externalities. Given the consistent evidence that investors focus on firms with direct-impact CBFs, all subsequent analyses concentrate on these firms.

**Market Attention and Pricing of Biodiversity Risk**

Hypothesis 2 predicts that market attention will strengthen the relation between direct-impact CBFs and the cost of equity capital. Such attention promotes information gathering, leading to more precise assessments of biodiversity performance, accountability, and greater salience of these risks in valuation. To test for accentuating effects, we employ firm-level proxies for visibility and investor attention, i.e., firm size and analyst coverage, respectively. We re-estimate Model (1) across subsamples partitioned by these proxies and report the results in Table 3. Splitting the sample each year into above- and below-median firm size, we find that the coefficients on the direct-impact CBF measures are significantly higher for large firms than for small ones (*p*-values = 0.092 and 0.027 for Wald tests on *Ln(Direct CBF)* and *Ln(Direct CBF/Assets*, respectively). Economically, a one-standard-deviation increase in *Ln(Direct CBF)* raises the cost of equity by 32 basis points more for large firms than for small firms.[5] This difference corresponds to approximately 5.7% of the standard deviation of the cost of equity. A similar pattern emerges for analyst coverage, measured as the natural logarithm of one plus the number of analysts following. Firms with above-median analyst coverage experience a stronger market penalty for biodiversity damage (Wald test *p*-values = 0.034 and 0.037, respectively).

[5] A one-standard deviation increase in *Ln(Direct CBF)* is associated with a (0.255-0.145) ×2.925 = 0.322% larger increase in cost of equity for above-median-size firms than for below-median-size firms.

[Insert Table 3 Here]

As complementary evidence, we replicate the analysis using a time-series measure of public concern as a proxy for marketwide attention to biodiversity risks. The Biodiversity Attention Index developed by Giglio et al. (2023) tracks Google search activity for terms including "biodiversity loss," "ecosystem services," and "species loss."[6] Results reported in Table A3 of the Online Appendix show a consistent pattern: firms with direct-impact CBFs are priced more strongly during periods of heightened public attention to ecological issues.

These results confirm Hypothesis 2. Market attention acts as a critical information channel, enhancing the transparency and accountability of biodiversity performance and thereby prompting investors to adjust expected returns.

**Industry Conditions and Pricing of Biodiversity Risk**

We next examine how industry context shapes the market's sensitivity to CBFs. Hypothesis 3 predicts that the premium for direct CBF will be stronger in industries with greater ecological impact, heavier dependence on ecosystem services, or higher competitive intensity. These settings heighten both the financial materiality and strategic relevance of a firm's biodiversity performance.

First, industries with more nature-depleting activities likely face higher transition risks and a more concentrated investor base, partly due to investment exclusions by socially responsible investors. To test for heterogeneity across industries, we partition the sample into above- and below-median groups based on the size of the industry-level, aggregated, direct-impact CBF. As reported in Table 4, Panel A, the positive association between direct-impact CBFs and expected return is concentrated among high-impact industries, and the difference is both statistically and economically significant. A one-standard-deviation increase in *Ln(Direct CBF)* raises $K_{AVG}$ by approximately 118 basis points in high-impact industries, compared to a

[6] The index exhibits an upward trend over time, with pronounced spikes in public attention during major international events focused on biodiversity conservation (e.g., UN Biodiversity Conference). Although based on keyword search activity in the U.S., the measure reasonably captures global interest in biodiversity issues.

negligible 6 basis points in low-impact industries. Wald tests ($p$-value < 0.01) confirm that the coefficients differ significantly across subsamples. Similar patterns are observed when examining individual environmental pressures, as shown in Online Appendix Table A4, where investor responses are strongest in industries causing extensive ecological damage through land use, greenhouse gas emissions, air pollution, and water pollution.

[Insert Table 4 Here]

Second, eco-dependent industries are more susceptible to the physical risks arising from natural habitat depletion. IDL scores quantify firms' dependence on ecosystem services that are vital for firm survival and competitiveness, including 1) provisioning (e.g., water and food), 2) regulating (e.g., climate activity), and 3) cultural (e.g., recreation and inspiration) services. Using the industry-average ecosystem dependence score, we classify industries into above- and below-median groups and report the subsample analysis in Panel B of Table 4. Consistent with Hypothesis 3, the pricing effects on direct-impact CBFs are significantly stronger in more eco-dependent industries. A closer examination reveals that the effect is primarily driven by firms that rely on provisioning and regulating services, whereas dependence on cultural services has negligible pricing implications (see Online Appendix Table A5). This asymmetry supports our view that investors prioritize risks with direct financial consequences (Chen et al., 2024). Although cultural services hold value for corporate stakeholders, such as employees, their link to firm risk is indirect and thus exerts little influence on equity pricing.

Finally, using the Herfindahl–Hirschman Index as a measure of industry concentration, Panel C shows that firms in more competitive industries experience a stronger price impact. This evidence suggests that competitive dynamics amplify the financial materiality of biodiversity considerations, leading investors to assign greater importance to firms' biodiversity strategies.

**Country Conditions and Pricing of Biodiversity Risk**

We present competing predictions on how national characteristics affect the financial relevance of ecological impact. Hypothesis 4a posits that weaker environmental institutions strengthen the biodiversity premium because firms in these settings face higher physical risks from ecosystem collapse. Conversely, Hypothesis 4b argues that weaker institutions weaken the premium due to lower transition risks.

To evaluate these competing arguments, we employ three country-level proxies based on the World Values Survey. The first, Environmental Performance Score, reflects respondents' assessments of local environmental quality and management. It aggregates responses on a four-point scale (1 = "very serious" to 4 = "not serious at all"), with higher country-year averages indicating more favorable environmental perceptions. The second, Environmental Protection Score, is based on whether respondents prioritize "protecting the environment" (coded 1) or "economic growth and creating jobs" (coded 2). We reverse this coding (2 minus the original value) so that higher scores reflect stronger environmental preferences. The third proxy, Consumer Environmental Awareness, captures willingness to pay more for environmentally friendly goods and services. It uses a four-point Likert scale (1 = "strongly agree" to 4 = "strongly disagree"), rescaled (4 minus the original value) so that higher scores indicate greater awareness.

Results reported in Panel A of Table 5 reveal that the relation between direct-impact CBFs and cost of equity is significantly stronger in countries with below-median environmental performance, protection, , or awareness scores. This observation supports Hypothesis 4a, suggesting that in environments with weaker ecological safeguards and more pronounced physical risks, investors require higher expected returns as compensation.

We also explore the moderating role of political orientation using classifications from the Database of Political Institutions. We group countries into "Left and Center" (communist, socialist, social democratic, centrist) and "Right and Others" (conservative, Christian democratic, right-wing, and unclassified). Results in Table 5, Panel B show that biodiversity loss is priced only in right-leaning systems, where environmental

regulation is generally weaker (Neumayer, 2003, 2004). No significant association is observed in left- or center-governed countries.

[Insert Table 5 Here]

Collectively, these findings provide strong support for H4a. Investors appear to internalize biodiversity risks more acutely in contexts characterized by limited environmental oversight and greater physical vulnerabilities, where governance gaps render nature loss economically costly.

**Robustness Checks**

This section tests the robustness of the positive association between the required return and direct-impact CBFs under alternative specifications, control vectors, and cost of equity estimates. To address potential measurement sensitivity in firm size (Dang et al., 2018), we replace our baseline size control with alternative proxies—log sales and log market value. As shown in Table 6, columns (1)–(4), the premium imposed on firms with direct-impact CBFs remains stable and significant, regardless of the size measure, even though the sign of the size coefficient varies.

We next test whether the biodiversity premium is merely a proxy for overall ESG performance or previously established environmental risk factors. If biodiversity risks are fully captured by existing environmental scores, a separate premium would be redundant. Moreover, as large-CBF firms may overlap with high-emission firms, the results could reflect a known carbon or pollution premium rather than a distinct biodiversity effect. To disentangle these effects, we augment our baseline regression with ESG ratings from LSEG, incorporating both individual ESG pillars and composite scores. The results, presented in Table 6, columns (5)–(12), indicate that stronger ESG performance, particularly along the environmental dimension, is associated with a lower cost of equity, consistent with prior evidence (e.g., El Ghoul et al., 2011, 2018; Chava, 2014). However, the cost of equity premium associated with direct-impact CBFs remains positive and highly significant. The persistence of this premium confirms that investors perceive biodiversity loss as a distinct risk factor incremental to standardized ESG metrics. This distinction likely arises from the

localized, ecosystem-specific nature of biodiversity risks, which are not fully captured by global environmental indicators.

[Insert Table 6 Here]

Additional robustness analyses in Online Appendix Tables A6–A7 confirm that our results are not driven by model specification or measurement error. The results are unchanged when alternative fixed-effects structures are used in Table A6, including country and industry × year or industry and country × year fixed effects. Likewise, the biodiversity premium persists across all four individual implied cost of equity model estimates in Table A7, Panel A, and continues to hold after addressing earnings forecast bias through weighted least squares and sample trimming in Panel B, following the approaches of Guay et al. (2005) and Hail and Leuz (2006).

## DISCUSSION AND CONCLUSION

Biodiversity forms the foundation of global economic activity, yet its financial implications remain poorly understood. Our study offers novel evidence showing how equity markets price corporate biodiversity impacts and risks. We find that investors demand higher returns from firms with larger CBFs, and this demand predates major global initiatives such as the Kunming-Montreal Framework or Taskforce on Nature-related Financial Disclosures. The findings indicate that markets proactively incorporate ecological degradation into risk assessments, rather than merely reacting to short-term shocks or surges in public attention. In this regard, financial markets may function—albeit imperfectly—as a disciplining mechanism that partially internalizes biodiversity loss, a cost firms have traditionally treated as an externality.

However, this pricing is highly selective. Markets impose higher penalties for damage arising directly from a firm's own operations and production but largely overlook indirect effects that result from a firm's supply chain activity. This crucial distinction indicates that investors notice and price straightforward, visible, and material impacts that are directly attributable to a firm, but they tend to ignore impacts that are harder to trace, measure, and assign to a specific firm. Our results help reconcile prior mixed evidence from earlier

studies, which relies on aggregate biodiversity measures and realized returns and thus may obscure important variations in investor expectations. By disaggregating CBFs based on the scope of firms' environmental impact and by focusing on expected returns, we uncover a multi-faceted and robust understanding of how financial markets evaluate biodiversity risks.

This study also clarifies the conditions under which biodiversity concerns become financially salient. Firms subject to greater market scrutiny face stronger price penalties for biodiversity damage. These premiums are concentrated in biodiversity-intensive and nature-dependent sectors and in more competitive markets, where strong biodiversity performance serves as both risk mitigation and strategic differentiation. Cross-country evidence further indicates that penalties are strongest in countries with weaker institutional safeguards for environmental protection.

These insights carry important implications for corporate managers, investors, and policymakers. For corporate leaders, biodiversity is emerging as an economically material dimension of sustainability. Thus, firms that continue to generate significant, visible ecological harm may face higher financing costs and reduced access to capital. In contrast, proactive biodiversity management can yield tangible financial benefits. For investors, the findings suggest that valuation frameworks should extend beyond conventional carbon metrics to capture the full spectrum of nature-related risks. They also indicate the need to assess ecological impacts across entire value chains to gain a comprehensive understanding of corporate biodiversity exposure. For policymakers, the results illustrate the role of institutional infrastructure in enabling markets to address ecological externalities. Initiatives aimed at improving risk disclosures, information asymmetry, and accountability are critical, but effective policy design must extend beyond firms' immediate operations to promote traceability and comprehensive reporting. Enhanced regulatory requirements can further improve comparability and reduce measurement uncertainty, enabling investors to integrate biodiversity risks more systematically into capital-allocation decisions.

Finally, our work opens several avenues for future research. An important question is whether markets can—or should—fully internalize biodiversity risks, particularly those arising indirectly along global value

chains. Future research could explore how advances in data transparency, digital traceability, and regulatory interventions influence the pricing of such risks. Another promising direction is to examine how businesses respond to biodiversity-related financing penalties and whether these pressures translate into measurable ecological improvements. Researchers may also explore why conventional ESG metrics have failed to capture biodiversity risks and develop more refined frameworks that better integrate ecological considerations. By addressing these gaps, research in this field can play a pivotal role in aligning market incentives with the pressing need to restore and safeguard planetary health.

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# Appendix A Variable definitions and data sources

| Variable | Definition | Source |
|---|---|---|
| Panel A: Dependent variables | | |
| $K_{CT}$ | Implied cost of equity capital, estimated from Claus and Thomas' (2001) model ten months after fiscal year-end. | Authors' calculations based on IBES and Compustat data |
| $K_{GLS}$ | Implied cost of equity capital, estimated from Gebhardt et al.'s (2001) model ten months after fiscal year-end. | As above |
| $K_{OJ}$ | Implied equity premium capital, estimated from Ohlson and Juettner-Nauroth's (2005) model ten months after fiscal year-end. | As above |
| $K_{MPEG}$ | Implied cost of equity capital, estimated from Easton's (2004) model ten months after fiscal year-end. | As above |
| $K_{AVG}$ | Average of $K_{CT}$, $K_{GLS}$, $K_{OJ}$, and $K_{ES}$. | As above |
| Panel B: Independent variables | | |
| *Total CBF* | Total biodiversity impact (CBF) from four sources of environmental pressure along the supply chain: land use, greenhouse gas emissions, air pollution, and water pollution. It is computed as the sum of Scope 1 (direct impact from facilities owned or controlled by the firm), Scope 2 (impact from firm's consumption of purchased energy), and Scope 3 (impact induced by firm but from sources not owned or controlled by firm) footprints. Each component is multiplied by -1 to represent the km² MSA of undisturbed area degraded by corporate activities. | Authors' calculations based on IDL data |
| *Direct CBF* | Sum of Scopes 1 and 2 footprints multiplied by -1. | As above |
| *Indirect CBF* | Scope 3 footprint multiplied by -1. | As above |
| *Total CBF/Assets* | *Total CBF* scaled by total assets in millions of U.S. dollars. | As above |
| *Direct CBF/Assets* | *Direct CBF* scaled by total assets in millions of U.S. dollars. | As above |
| *Indirect CBF/Assets* | Indirect CBF scaled by total assets in millions of U.S. dollars. | As above |
| *Forecast Bias* | Signed forecast error, defined as difference between one-year-ahead consensus earnings forecast and realized earnings deflated by beginning-of-period assets per share. | Authors' calculations based on I/B/E/S and Compustat data |
| *Forecast Dispersion* | Dispersion of analyst forecasts, defined as coefficient of variation of one-year-ahead analyst forecasts of earnings per share. | Authors' calculations based on I/B/E/S data |
| *Beta* | Market beta estimated using international version of the market model and incorporating stock returns from preceding 12 months. | Authors' calculations based on Compustat data |
| *BM* | Book value to market value of equity. | As above |
| *Leverage* | Ratio of long-term debt to total assets. | As above |
| *Size* | Natural logarithm of total assets in millions of U.S. dollars. | As above |
| *Ln(Sales)* | Natural logarithm of sales in millions of U.S. dollars. | As above |
| *Ln(MV)* | Natural logarithm of market value of equity in millions of U.S. dollars. | As above |
| *Momentum* | Compound stock return over the prior 12 months. | As above |
| *Inflation* | Realized inflation rate over the subsequent year. | As above |
| *Ln(GDP per Capita)* | Natural logarithm of GDP per capita in millions of 2015 U.S. dollars. | World Bank |
| *E Score* | Environmental pillar score is measured on a 0–100 scale and constructed using publicly disclosed information across environmental themes such as resource use, emissions, and environmental innovation. Higher values indicate stronger environmental performance relative to industry peers. | LSEG |
| *S Score* | Social pillar score is measured on a 0–100 scale and constructed using publicly disclosed information across social themes such as | As above |

| | | |
|---|---|---|
| | workforce practices, human rights, community relations, and product responsibility. | |
| *G Score* | Governance pillar score is measured on a 0–100 scale and constructed using publicly disclosed information across governance themes such as board structure and independence, executive compensation, shareholder rights, and audit practices. | As above |
| *ESG Score* | ESG score, computed as weighted sum of scores from environmental, social, and corporate governance pillars. | As above |
| Panel C: Variables for cross-sectional tests | | |
| *Analyst Coverage* | Natural logarithm of 1 plus number of analysts following the firm. | Authors' calculations based on IBES data |
| *Industry-Total Direct CBF* | Natural logarithm of sum of Direct CBF of all firms in same industry. | Authors' calculations based on IDL data |
| *Industry-Level Economic Dependence on Overall Ecosystem Services* | Overall dependence score measuring extent to which firm relies on ecosystem for survival and success, averaged across all firms in the same industry. Services refer to benefits including food and water, climate regulation, disease control, and recreation and aesthetic enjoyment. We sum dependence scores across the three main categories of ecosystem services. | As above |
| *HHI* | Herfindahl–Hirschman Index, computed as the sum of squared market share of all firms in the same industry, where market share is a firm's sales divided by the industry's total sales. | Authors' calculations based on Compustat data |
| *Environmental Performance Score* | Degree to which respondent finds serious environmental problems in their community with respect to air, water, sewage, and sanitation, based on the WVS Wave 4. Responses are recorded on a survey-defined four-point scale ranging from 1 ("very serious") to 4 ("not serious at all"). We compute the respondent-level average across environmental concern items and take the mean across all respondents within each country-year. | Authors' calculations based on WVS data |
| *Environmental Protection Score* | Degree to which respondents prioritize environmental protection over economic growth. The survey codes "protecting the environment" as 1 and "economic growth and creating jobs" as 2. The measure is rescaled by subtracting the response from 2 so that higher values indicate stronger environmental orientation. It is averaged across all respondents within each country-year. | As above |
| *Consumer Environment Awareness* | Degree to which respondents are willing to buy products and services at a 20% higher price if it helps protect the environment. Responses are recorded on a four-point scale ranging from 1 ("strongly agree") to 4 ("strongly disagree"). The measure is rescaled by subtracting the response from 4 so that higher values indicate stronger environmental willingness to pay, and then averaged across all respondents within each country-year. | As above |
| *Political Orientation* | Political orientation of the ruling party of a country with respect to economic policy. "Left" indicates communist, socialist, social democratic, or otherwise left-wing. "Center" indicates centrist parties. "Right" indicates conservative, Christian democratic, or otherwise right-wing. "Others" indicates cases that do not fit into the above-mentioned categories. | Database of Political Institutions |

## Table 1 Summary statistics and correlation matrix

| Variable | N | Mean | SD | Min | P25 | P50 | P75 | Max |
|---|---|---|---|---|---|---|---|---|
| Panel A: Summary statistics | | | | | | | | |
| $K_{AVG}$ | 6981 | 11.064 | 5.694 | 4.105 | 7.428 | 9.510 | 12.767 | 35.719 |
| *Total CBF* | 6981 | 1,500.454 | 3,653.977 | 0.065 | 33.381 | 234.816 | 1,156.412 | 23,885.672 |
| *Direct CBF* | 6973 | 132.855 | 409.458 | 0.009 | 0.605 | 5.534 | 51.432 | 2,804.708 |
| *Indirect CBF* | 6971 | 1,356.953 | 3,518.040 | 0.019 | 22.150 | 186.413 | 956.847 | 23,680.064 |
| *Total CBF/Assets* | 6849 | 0.096 | 0.216 | 0.000 | 0.005 | 0.025 | 0.090 | 1.564 |
| *Direct CBF/Assets* | 6841 | 0.007 | 0.019 | 0.000 | 0.000 | 0.001 | 0.004 | 0.129 |
| *Indirect CBF/Assets* | 6841 | 0.088 | 0.210 | 0.000 | 0.003 | 0.020 | 0.077 | 1.543 |
| *Ln(Total CBF)* | 6981 | 4.968 | 2.885 | -2.740 | 3.508 | 5.459 | 7.053 | 10.081 |
| *Ln(Direct CBF)* | 6973 | 1.747 | 2.925 | -4.745 | -0.503 | 1.711 | 3.940 | 7.939 |
| *Ln(Indirect CBF)* | 6971 | 4.661 | 3.073 | -3.962 | 3.098 | 5.228 | 6.864 | 10.072 |
| *Ln(Total CBF/Assets)* | 6849 | -4.250 | 2.657 | -12.402 | -5.322 | -3.705 | -2.408 | 0.448 |
| *Ln(Direct CBF/Assets)* | 6841 | -7.498 | 2.768 | -14.224 | -9.544 | -7.177 | -5.454 | -2.046 |
| *Ln(Indirect CBF/Assets)* | 6841 | -4.550 | 2.888 | -13.748 | -5.678 | -3.932 | -2.561 | 0.434 |
| *Beta* | 6981 | 0.779 | 0.722 | -1.081 | 0.309 | 0.768 | 1.229 | 2.755 |
| *BM* | 6981 | 0.563 | 0.610 | 0.021 | 0.187 | 0.382 | 0.720 | 3.967 |
| *Leverage* | 6981 | 0.197 | 0.150 | 0.000 | 0.065 | 0.180 | 0.305 | 0.594 |
| *Inflation* | 6981 | 0.040 | 0.036 | 0.004 | 0.016 | 0.030 | 0.051 | 0.296 |
| *Size* | 6981 | 9.218 | 1.549 | 5.915 | 8.166 | 9.139 | 10.135 | 13.785 |
| *Forecast Bias* | 6981 | 0.032 | 1.847 | -6.450 | -0.544 | -0.042 | 0.463 | 8.569 |
| *Forecast Dispersion* | 6981 | 0.156 | 0.314 | 0.004 | 0.033 | 0.072 | 0.148 | 2.500 |
| *Ln(GDP per Capita)* | 6981 | 10.226 | 0.974 | 7.503 | 9.326 | 10.547 | 10.976 | 11.375 |

**Table 1 (continued)**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Panel B: Correlation matrix | | | | | | | | | | | | | | | |
| 1. $K_{AVG}$ | 1 | | | | | | | | | | | | | | |
| 2. *Ln(Total CBF)* | 0.215 | 1 | | | | | | | | | | | | | |
| 3. *Ln(Direct CBF)* | 0.303 | 0.672 | 1 | | | | | | | | | | | | |
| 4. *Ln(Indirect CBF)* | 0.167 | 0.980 | 0.581 | 1 | | | | | | | | | | | |
| 5. *Ln(Total CBF/Assets)* | 0.071 | 0.847 | 0.524 | 0.851 | 1 | | | | | | | | | | |
| 6. *Ln(Direct CBF/Assets)* | 0.151 | 0.475 | 0.851 | 0.406 | 0.628 | 1 | | | | | | | | | |
| 7. *Ln(Indirect CBF/Assets)* | 0.033 | 0.822 | 0.431 | 0.866 | 0.979 | 0.536 | 1 | | | | | | | | |
| 8. *Beta* | 0.092 | -0.031 | 0.000 | -0.038 | -0.098 | -0.062 | -0.100 | 1 | | | | | | | |
| 9. *BM* | 0.453 | 0.246 | 0.296 | 0.215 | 0.022 | 0.057 | 0.007 | 0.016 | 1 | | | | | | |
| 10. *Leverage* | 0.085 | 0.024 | 0.183 | -0.010 | -0.115 | 0.056 | -0.136 | 0.104 | -0.030 | 1 | | | | | |
| 11. *Inflation* | 0.169 | -0.016 | 0.005 | -0.032 | -0.024 | 0.005 | -0.041 | 0.106 | -0.059 | 0.165 | 1 | | | | |
| 12. *Size* | 0.279 | 0.405 | 0.360 | 0.363 | -0.141 | -0.187 | -0.148 | 0.115 | 0.382 | 0.246 | 0.019 | 1 | | | |
| 13. *Forecast Bias* | 0.075 | 0.032 | -0.002 | 0.033 | 0.051 | 0.010 | 0.051 | -0.059 | 0.009 | -0.047 | -0.146 | -0.030 | 1 | | |
| 14. *Forecast Dispersion* | 0.247 | 0.033 | 0.081 | 0.019 | 0.023 | 0.073 | 0.011 | 0.050 | 0.155 | 0.079 | 0.036 | 0.016 | 0.101 | 1 | |
| 15. *Ln(GDP per Capita)* | -0.051 | -0.027 | -0.034 | -0.031 | -0.210 | -0.204 | -0.202 | 0.229 | -0.040 | 0.233 | -0.041 | 0.319 | -0.077 | -0.078 | 1 |

Notes: This table reports the summary statistics (Panel A) and Pearson correlations (Panel B) of the major variables of our analysis. The sample encompasses 6,981 firm-year observations from 39 countries over the period 2018-2021. Appendix A provides definitions and data sources for all variables.

## Table 2 CBF and the cost of capital

| | Total CBF | | Direct CBF | | Indirect CBF | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| *Ln(CBF)* | 0.052 | | 0.192 | | -0.044 | |
| | (0.212) | | (0.000) | | (0.295) | |
| *Ln(CBF/Assets)* | | 0.072 | | 0.197 | | -0.014 |
| | | (0.087) | | (0.000) | | (0.732) |
| *Beta* | 0.503 | 0.508 | 0.484 | 0.489 | 0.500 | 0.506 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| *BM* | 3.018 | 3.462 | 3.010 | 3.456 | 3.015 | 3.456 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| *Leverage* | 2.166 | 2.048 | 2.065 | 1.925 | 2.052 | 1.957 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| *Inflation* | 24.377 | 23.893 | 24.610 | 24.058 | 24.569 | 24.093 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| *Size* | 0.548 | 0.558 | 0.416 | 0.568 | 0.649 | 0.565 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| *Forecast Bias* | 0.211 | 0.210 | 0.222 | 0.223 | 0.211 | 0.211 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| *Forecast Dispersion* | 2.481 | 2.268 | 2.427 | 2.215 | 2.482 | 2.267 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| *Ln(GDP per capita)* | -0.746 | -1.648 | -0.875 | -1.773 | -0.674 | -1.514 |
| | (0.736) | (0.452) | (0.693) | (0.419) | (0.762) | (0.490) |
| Country FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 6,981 | 6,849 | 6,973 | 6,841 | 6,971 | 6,841 |
| Adjusted $R^2$ | 0.374 | 0.370 | 0.378 | 0.375 | 0.373 | 0.370 |

Notes: This table reports results from regressing the implied cost of capital on CBFs and control variables. All regressions include country, industry, and year fixed effects. Industry fixed effects follow Iceberg Data Lab's classification (similar to the Revere Business Industry Classification System). The *p*-values (in parentheses) are based on robust standard errors clustered at the firm level. Appendix A provides definitions and data sources for all variables.

## Table 3 CBF and the cost of capital across firm characteristics

| | Low | High | Low | High |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Partition by firm size | | | | |
| *Ln(Direct CBF)* | 0.145 | 0.255 | | |
| | (0.004) | (0.000) | | |
| *Ln(Direct CBF/Assets)* | | | 0.131 | 0.286 |
| | | | (0.009) | (0.000) |
| *p*-value: Low < High | 0.092 | | 0.027 | |
| Controls | Yes | Yes | Yes | Yes |
| Observations | 2,566 | 2,713 | 2,547 | 2,635 |
| Adjusted $R^2$ | 0.342 | 0.287 | 0.339 | 0.284 |
| Partition by analyst coverage | | | | |
| *Ln(Direct CBF)* | 0.114 | 0.259 | | |
| | (0.052) | (0.000) | | |
| *Ln(Direct CBF/Assets)* | | | 0.124 | 0.263 |
| | | | (0.030) | (0.000) |
| *p*-value: Low < High | 0.034 | | 0.037 | |
| Controls | Yes | Yes | Yes | Yes |
| Observations | 3,617 | 3,354 | 3,551 | 3,288 |
| Adjusted $R^2$ | 0.376 | 0.392 | 0.366 | 0.396 |

Notes: This table reports results from regressing the implied cost of equity capital on direct-impact CBF and control variables. The sample is partitioned by year into above- and below-median values of the corresponding moderating proxy. All regressions include country, industry, and year fixed effects. The *p*-values (in parentheses) are based on robust standard errors clustered at the firm level. Appendix A provides definitions and data sources for all variables.

## Table 4 CBF and the cost of capital across industry characteristics

| | Low | High | Low | High |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Panel A: Partition by industry-total biodiversity footprint | | | | |
| *Ln(Direct CBF)* | *0.020* | 0.404 | | |
| | *(0.746)* | (0.000) | | |
| *Ln(Direct CBF/Assets)* | | | 0.013 | 0.410 |
| | | | (0.831) | (0.000) |
| *p*-value: Low < High | | 0.000 | | 0.000 |
| Controls | Yes | Yes | Yes | Yes |
| Observations | 3,486 | 3,486 | 3,453 | 3,387 |
| Adjusted $R^2$ | 0.391 | 0.322 | 0.386 | 0.320 |
| Panel B: Partition by industry-average economic dependence on biodiversity | | | | |
| *Ln(Direct CBF)* | 0.100 | 0.254 | | |
| | (0.080) | (0.000) | | |
| *Ln(Direct CBF/Assets)* | | | | 0.121 |
| | | | (0.026) | (0.000) |
| *p*-value: Low < High | | 0.029 | | 0.072 |
| Controls | Yes | Yes | Yes | Yes |
| Observations | 3,528 | 3,441 | 3,467 | 3,370 |
| Adjusted R2 | 0.386 | 0.397 | 0.379 | 0.397 |
| Panel C: Partition by industry Herfindahl–Hirschman Index | | | | |
| *Ln(Direct CBF)* | 0.029 | 0.414 | | |
| | (0.580) | (0.000) | | |
| *Ln(Direct CBF/Assets)* | | | 0.033 | 0.431 |
| | | | (0.533) | (0.000) |
| *p*-value: Low > High | | 0.000 | | 0.000 |
| Controls | Yes | Yes | Yes | Yes |
| Observations | 3,481 | 3,479 | 3,457 | 3,370 |
| Adjusted R2 | 0.350 | 0.344 | 0.346 | 0.344 |

Notes: This table reports results from regressing the implied cost of equity capital on direct-impact CBF and control variables. The sample is partitioned by year into above- and below-median values of the corresponding moderating proxy. All regressions include country, industry, and year fixed effects. The *p*-values (in parentheses) are based on robust standard errors clustered at the firm level. Appendix A provides definitions and data sources for all variables.

## Table 5 CBF and the cost of capital across country characteristics

| | Low | High | Low | High |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Panel A: Partition by country-level environmental scores | | | | |
| | Environmental performance score | | | |
| *Ln(Direct CBF)* | 0.243 | 0.103 | | |
| | (0.000) | (0.126) | | |
| *Ln(Direct CBF/Assets)* | | | 0.253 | 0.081 |
| | | | (0.000) | (0.214) |
| *p*-value: Low > High | 0.055 | | 0.023 | |
| Controls | Yes | Yes | Yes | Yes |
| Observations | 3,755 | 2,068 | 3,739 | 1,958 |
| Adjusted $R^2$ | 0.396 | 0.420 | 0.397 | 0.394 |
| | Environmental protection score | | | |
| *Ln(Direct CBF)* | 0.259 | 0.112 | | |
| | (0.000) | (0.074) | | |
| *Ln(Direct CBF/Assets)* | | | 0.269 | 0.100 |
| | | | (0.000) | (0.109) |
| *p*-value: Low > High | 0.040 | | 0.022 | |
| Controls | Yes | Yes | Yes | Yes |
| Observations | 3,963 | 2,821 | 3,943 | 2,709 |
| Adjusted $R^2$ | 0.383 | 0.403 | 0.386 | 0.383 |
| | Customer environmental awareness | | | |
| *Ln(Direct CBF)* | 0.275 | 0.090 | | |
| | (0.000) | (0.186) | | |
| *Ln(Direct CBF/Assets)* | | | 0.286 | 0.077 |
| | | | (0.000) | (0.255) |
| *p*-value: Low > High | 0.021 | | 0.010 | |
| Controls | Yes | Yes | Yes | Yes |
| Observations | 2,882 | 2,675 | 2,868 | 2,564 |
| Adjusted $R^2$ | 0.337 | 0.427 | 0.340 | 0.419 |

**Table 5 (continued)**

| | Left and Center | Right and Others | Left and Center | Right and Others |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Panel B: Partition by political orientation | | | | |
| *Ln(Direct CBF)* | 0.032 | 0.235 | | |
| | (0.654) | (0.000) | | |
| *Ln(Direct CBF/Assets)* | | | -0.011 | 0.249 |
| | | | (0.869) | (0.000) |
| *p*-value: Left < Right | | 0.013 | | 0.002 |
| Controls | Yes | Yes | Yes | Yes |
| Observations | 1,410 | 3,615 | 1,332 | 3,601 |
| Adjusted $R^2$ | 0.412 | 0.383 | 0.408 | 0.384 |

Notes: This table reports results from regressing the implied cost of equity capital on direct-impact CBF and control variables. Panel A partitions the sample by year into above- and below-median values of the corresponding moderating proxy. Panel B divides the sample by the ruling party's political orientation. All regressions include country, industry, and year fixed effects. The *p*-values (in parentheses) are based on robust standard errors clustered at the firm level. Appendix A provides definitions and data sources for all variables.

## Table 6 Robustness tests using alternative controls

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Ln(Direct CBF)* | 0.158 | | 0.401 | | 0.196 | | 0.193 | | 0.191 | | 0.195 | |
| | (0.000) | | (0.000) | | (0.000) | | (0.000) | | (0.000) | | (0.000) | |
| *Ln(Direct CBF/Assets)* | | 0.148 | | 0.201 | | 0.197 | | 0.196 | | 0.194 | | 0.197 |
| | | (0.000) | | (0.000) | | (0.000) | | (0.000) | | (0.000) | | (0.000) |
| *Ln(Sales)* | 0.468 | 0.575 | | | | | | | | | | |
| | (0.000) | (0.000) | | | | | | | | | | |
| *Ln(MV)* | | | -0.415 | -0.014 | | | | | | | | |
| | | | (0.000) | (0.841) | | | | | | | | |
| *E Score* | | | | | -0.007 | -0.005 | | | | | | |
| | | | | | (0.025) | (0.098) | | | | | | |
| *S Score* | | | | | | | -0.007 | -0.006 | | | | |
| | | | | | | | (0.094) | (0.116) | | | | |
| *G Score* | | | | | | | | | -0.003 | -0.002 | | |
| | | | | | | | | | (0.450) | (0.525) | | |
| *ESG Score* | | | | | | | | | | | -0.010 | -0.008 |
| | | | | | | | | | | | (0.043) | (0.089) |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 6,964 | 6,832 | 6,973 | 6,841 | 4,941 | 4,851 | 4,941 | 4,851 | 4,941 | 4,851 | 4,941 | 4,851 |
| Adjusted $R^2$ | 0.368 | 0.368 | 0.365 | 0.353 | 0.374 | 0.378 | 0.373 | 0.378 | 0.373 | 0.378 | 0.374 | 0.378 |

Notes: This table reports results from regressing the implied cost of equity capital on direct-impact CBFs and alternative control variables. Columns (1)–(4) replace the baseline size control with alternative proxies, *Ln(Sales)* and *Ln(MV)*. Columns (5)–(12) control for individual ESG pillars and the composite ESG rating from LSEG. All regressions include country, industry, and year fixed effects. The *p*-values (in parentheses) are based on robust standard errors clustered at the firm level. Appendix A provides definitions and data sources for all variables.

**Online Appendix**

**When Markets Care: Discrimination in Pricing Biodiversity Risk**

This online appendix provides the following additional tables for the paper:


Table A1 Summary statistics, by country and industry

Table A2 Corporate biodiversity footprint and the cost of capital, by direct-impact sources

Table A3 Corporate biodiversity footprint and the cost of capital, by public attention

Table A4 Corporate biodiversity footprint and the cost of capital, by industry impact

Table A5 Corporate biodiversity footprint and the cost of capital, by ecosystem service reliance

Table A6 Robustness tests using alternative fixed effects

Table A7 Robustness tests using cost of equity capital estimates

**Table A1 Summary statistics, by country and industry**

| Country | Obs. | $K_{AVG}$ | Total CBF | Scope 1 CBF | Scope 2 CBF | Scope 3 CBF |
|---|---|---|---|---|---|---|
| Panel A: Means by country | | | | | | |
| Australia | 193 | 11.570 | 920.819 | 103.982 | 1.332 | 816.268 |
| Austria | 31 | 15.024 | 1,050.127 | 194.993 | 1.149 | 853.986 |
| Belgium | 42 | 11.912 | 1,919.131 | 55.728 | 1.832 | 1,861.658 |
| Brazil | 60 | 16.565 | 2,865.276 | 233.263 | 1.134 | 2,596.376 |
| Canada | 74 | 12.124 | 2,151.410 | 482.303 | 1.071 | 1,577.238 |
| Chile | 23 | 15.595 | 639.986 | 71.326 | 1.708 | 566.951 |
| China | 954 | 11.785 | 1,324.963 | 171.348 | 1.197 | 1138.864 |
| Denmark | 57 | 10.180 | 649.073 | 14.375 | 0.362 | 634.355 |
| Finland | 48 | 10.607 | 2,121.389 | 438.366 | 0.984 | 1,632.246 |
| France | 227 | 12.197 | 1,968.759 | 127.820 | 2.586 | 1,831.080 |
| Germany | 200 | 12.423 | 2125.377 | 111.594 | 3.043 | 2,011.601 |
| Greece | 21 | 13.947 | 182.312 | 52.719 | 1.058 | 128.535 |
| Hong Kong | 79 | 14.175 | 1,117.520 | 207.706 | 2.381 | 921.880 |
| India | 389 | 10.231 | 1,106.421 | 191.865 | 0.812 | 863.308 |
| Indonesia | 60 | 10.547 | 1,081.477 | 118.928 | 1.192 | 961.456 |
| Ireland | 28 | 12.232 | 1,070.203 | 73.356 | 1.468 | 995.378 |
| Israel | 24 | 10.419 | 1,126.369 | 8.980 | 0.735 | 1,116.654 |
| Italy | 83 | 11.423 | 1,135.429 | 219.975 | 1.516 | 893.227 |
| Japan | 949 | 10.577 | 1,024.254 | 56.742 | 1.790 | 966.660 |
| Luxembourg | 12 | 18.641 | 769.771 | 386.595 | 11.638 | 367.531 |
| Malaysia | 83 | 9.866 | 1,052.271 | 78.585 | 0.648 | 973.077 |
| Mexico | 58 | 15.410 | 1,926.601 | 225.720 | 2.701 | 1,626.559 |
| Netherlands | 105 | 12.223 | 1,386.308 | 45.776 | 2.124 | 1,338.430 |
| New Zealand | 41 | 8.786 | 427.723 | 12.457 | 0.016 | 415.252 |
| Norway | 55 | 11.690 | 596.628 | 170.441 | 1.518 | 412.542 |
| Philippines | 31 | 11.318 | 1,279.606 | 58.574 | 1.434 | 1,219.737 |
| Poland | 26 | 18.591 | 1,098.246 | 299.303 | 4.125 | 794.814 |
| Portugal | 19 | 12.783 | 1,190.615 | 175.052 | 2.635 | 1,012.929 |
| Saudi Arabia | 41 | 12.565 | 938.313 | 136.943 | 7.958 | 772.685 |
| Singapore | 53 | 12.432 | 1,331.093 | 118.693 | 1.345 | 1,305.494 |
| South Africa | 65 | 15.992 | 833.492 | 280.019 | 4.172 | 553.994 |
| South Korea | 290 | 14.338 | 926.313 | 117.633 | 2.812 | 805.388 |
| Spain | 62 | 14.461 | 2,107.375 | 351.403 | 2.030 | 1,704.945 |
| Sweden | 141 | 10.996 | 960.029 | 75.399 | 0.301 | 899.248 |
| Switzerland | 127 | 8.999 | 1,448.493 | 56.872 | 1.517 | 1,401.714 |
| Thailand | 100 | 10.431 | 1,009.172 | 65.033 | 0.898 | 943.285 |
| Turkey | 77 | 19.059 | 697.425 | 98.761 | 0.708 | 598.028 |
| United Kingdom | 279 | 12.843 | 2,254.977 | 203.253 | 1.664 | 1,997.031 |
| United States | 1,774 | 10.329 | 2,081.078 | 110.834 | 2.225 | 1,958.542 |

**Table A1 (continued)**

| Sector | Obs. | $K_{AVG}$ | Total CBF | Scope 1 CBF | Scope 2 CBF | Scope 3 CBF |
|---|---|---|---|---|---|---|
| Panel B: Means by industry | | | | | | |
| Asset Management | 32 | 13.823 | 13,580.758 | 0.065 | 0.994 | 13,516.116 |
| Automotive & Logistics | 245 | 13.801 | 715.775 | 10.827 | 1.503 | 703.715 |
| Bank | 136 | 15.522 | 6,088.138 | 0.058 | 0.660 | 6,081.462 |
| Beverages | 136 | 8.893 | 1,678.201 | 6.341 | 0.602 | 1,671.262 |
| Building Products | 37 | 11.861 | 92.086 | 17.543 | 0.324 | 74.220 |
| Chemicals | 599 | 11.322 | 2,014.241 | 59.019 | 2.649 | 1,954.290 |
| Construction & Real Estate | 374 | 11.377 | 909.490 | 141.196 | 0.502 | 776.897 |
| Defense | 45 | 11.999 | 2,182.659 | 236.551 | 0.227 | 1,945.882 |
| Education | 4 | 11.630 | 6.889 | 0.263 | 0.048 | 6.578 |
| Electrical Equipment | 91 | 10.344 | 1,531.429 | 11.595 | 1.170 | 1,518.597 |
| Electronics | 507 | 10.218 | 418.812 | 18.905 | 2.736 | 396.755 |
| Financial Services | 187 | 11.349 | 395.508 | 12.717 | 0.566 | 388.592 |
| Food | 493 | 10.259 | 4,441.667 | 80.798 | 2.409 | 4,364.471 |
| Healthcare | 276 | 8.517 | 231.464 | 2.923 | 0.289 | 229.093 |
| Hotel & Accommodations | 33 | 20.441 | 1,169.485 | 20.787 | 3.762 | 1,146.994 |
| Household Goods | 143 | 10.942 | 608.331 | 54.942 | 1.130 | 564.118 |
| Industrial Equipment | 295 | 9.620 | 629.481 | 7.141 | 0.284 | 622.055 |
| Insurance | 144 | 14.056 | 1,241.383 | 56.840 | 0.815 | 1,227.127 |
| Internet & Data | 140 | 9.467 | 95.900 | 2.513 | 1.816 | 91.571 |
| Leisure | 147 | 10.856 | 30.828 | 2.254 | 0.305 | 28.310 |
| Materials | 96 | 14.062 | 1,038.754 | 295.787 | 5.814 | 736.202 |
| Media | 37 | 9.678 | 23.284 | 1.088 | 0.763 | 21.430 |
| Metals & Mining | 417 | 15.440 | 1,994.213 | 689.111 | 3.808 | 1,226.087 |
| Oil & Gas | 316 | 15.061 | 2,872.943 | 658.999 | 2.988 | 2,095.194 |
| Paper & Forest | 81 | 11.556 | 4,675.709 | 507.034 | 1.532 | 3,909.590 |
| Pharmaceutical | 379 | 9.897 | 1,858.496 | 34.809 | 0.336 | 1,822.900 |
| Power | 321 | 12.527 | 649.472 | 264.727 | 3.874 | 373.224 |
| Retail & Wholesale | 102 | 11.932 | 3,508.525 | 126.745 | 6.624 | 3,431.431 |
| Services | 110 | 8.370 | 34.895 | 3.815 | 0.160 | 30.920 |
| Software | 278 | 7.894 | 117.467 | 1.315 | 0.571 | 115.585 |
| Telecommunications | 240 | 11.378 | 20.021 | 0.828 | 2.811 | 16.381 |
| Textiles | 107 | 9.746 | 1,760.828 | 73.559 | 0.390 | 1,649.691 |
| Thrifts & Mortgage Finance | 6 | 18.784 | 516.782 | 0.786 | 0.165 | 515.830 |
| Tobacco | 21 | 12.314 | 2,532.096 | 49.179 | 1.105 | 2,481.812 |
| Transportation | 365 | 13.996 | 522.005 | 126.885 | 0.949 | 383.804 |
| Waste | 20 | 7.886 | 240.713 | 183.181 | 3.499 | 54.034 |
| Water | 21 | 9.715 | 99.025 | 51.953 | 2.689 | 44.383 |

Notes: This table presents the summary statistics by country (Panel A) and industry according to Iceberg Data Lab's classification (Panel B). Appendix A provides definitions and data sources for all variables.

**Table A2 Corporate biodiversity footprint and the cost of capital, by direct-impact source**

| | *Land Use* | | *GHG Emissions* | | *Air Pollution* | | *Water Pollution* | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| *Ln(Direct CBF)* | 0.142 | | 0.231 | | 0.196 | | 0.030 | |
| | (0.001) | | (0.000) | | (0.000) | | (0.050) | |
| *Ln(Direct CBF/Assets)* | | 0.153 | | 0.207 | | 0.196 | | 0.042 |
| | | (0.000) | | (0.000) | | (0.000) | | (0.002) |
| *Beta* | 0.462 | 0.433 | 0.486 | 0.494 | 0.480 | 0.485 | 0.443 | 0.445 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| *BM* | 3.069 | 3.641 | 2.983 | 3.416 | 2.992 | 3.449 | 2.988 | 3.418 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| *Leverage* | 2.196 | 2.182 | 2.040 | 1.910 | 2.252 | 2.104 | 1.974 | 1.803 |
| | (0.008) | (0.007) | (0.000) | (0.001) | (0.000) | (0.000) | (0.001) | (0.001) |
| *Inflation* | 19.117 | 18.636 | 24.595 | 24.052 | 23.600 | 23.076 | 24.998 | 24.573 |
| | (0.002) | (0.003) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| *Size* | 0.459 | 0.598 | 0.386 | 0.577 | 0.398 | 0.553 | 0.556 | 0.543 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| *Forecast Bias* | 0.202 | 0.207 | 0.224 | 0.224 | 0.223 | 0.223 | 0.209 | 0.209 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| *Forecast Dispersion* | 2.162 | 1.961 | 2.470 | 2.265 | 2.442 | 2.235 | 2.458 | 2.238 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| *Ln(GDP per Capita)* | -4.436 | -4.210 | -1.040 | -1.895 | -0.876 | -1.758 | -0.409 | -1.289 |
| | (0.144) | (0.161) | (0.640) | (0.390) | (0.693) | (0.425) | (0.854) | (0.559) |
| Country FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 3,967 | 3,884 | 6,960 | 6,828 | 6,915 | 6,783 | 6,762 | 6,630 |
| Adjusted $R^2$ | 0.349 | 0.345 | 0.379 | 0.374 | 0.381 | 0.377 | 0.376 | 0.372 |

Notes: This table reports regression results for the implied cost of equity capital on decomposed measures of firms' direct-impact CBFs arising from land use, GHG emissions, air pollution, and water pollution, along with control variables. All regressions include country, industry, and year fixed effects. The *p*-values (in parentheses) are based on robust standard errors clustered at the firm level. Appendix A provides definitions and data sources for all variables.

**Table A3 Corporate biodiversity footprint and the cost of capital, by public attention**

| | *Low* | *High* | *Low* | *High* |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Partition by Biodiversity Attention Index (entire sample) | | | | |
| *Ln(Direct CBF)* | 0.118 | 0.249 | | |
| | (0.026) | (0.000) | | |
| *Ln(Direct CBF/Assets)* | | | 0.123 | 0.253 |
| | | | (0.020) | (0.000) |
| *p*-value: Low < High | 0.033 | | 0.013 | |
| Controls | Yes | Yes | Yes | Yes |
| Observations | 3,152 | 3,821 | 3,095 | 3,746 |
| Adjusted $R^2$ | 0.443 | 0.336 | 0.452 | 0.325 |
| Partition by Biodiversity Attention Index (U.S. sample only) | | | | |
| *Ln(Direct CBF)* | 0.135 | 0.376 | | |
| | (0.062) | (0.001) | | |
| *Ln(Direct CBF/Assets)* | | | 0.136 | 0.418 |
| | | | (0.074) | (0.000) |
| *p*-value: Low < High | 0.033 | | 0.014 | |
| Controls | Yes | Yes | Yes | Yes |
| Observations | 806 | 965 | 801 | 957 |
| Adjusted $R^2$ | 0.421 | 0.250 | 0.421 | 0.257 |

Notes: This table reports results from regressing the implied cost of equity capital on direct-impact CBF and control variables. The sample is partitioned into two subperiods based on Giglio et al.'s (2023) time-series Biodiversity Attention Index. The "Low" subsample includes observations with below-median index scores, and the "High" subsample includes those with above-median scores. The table reports analyses for both the full international sample and U.S.-only sample. All regressions include country, industry, and year fixed effects. The *p*-values (in parentheses) are based on robust standard errors clustered at the firm level. Appendix A provides definitions and data sources for all variables.

**Table A4 Corporate biodiversity footprint and the cost of capital by industry impact**

| | *Low* (1) | *High* (2) | *Low* (3) | *High* (4) |
|---|---|---|---|---|
| Partition by industry-level biodiversity impact from land use | | | | |
| *Ln(Direct CBF)* | -0.036 | 0.358 | | |
| | (0.647) | (0.008) | | |
| *Ln(Direct CBF/Assets)* | | | -0.031 | 0.401 |
| | | | (0.689) | (0.004) |
| *p*-value: Low < High | 0.006 | | 0.003 | |
| Controls | Yes | Yes | Yes | Yes |
| Observations | 1,983 | 1,980 | 1,977 | 1,903 |
| Adjusted $R^2$ | 0.330 | 0.314 | 0.336 | 0.312 |
| Partition by industry-level biodiversity impact from greenhouse gas emissions | | | | |
| *Ln(Direct CBF)* | 0.029 | 0.414 | | |
| | (0.580) | (0.000) | | |
| *Ln(Direct CBF/Assets)* | | | 0.033 | 0.431 |
| | | | (0.533) | (0.000) |
| *p*-value: Low < High | 0.000 | | 0.000 | |
| Controls | Yes | Yes | Yes | Yes |
| Observations | 3,481 | 3,479 | 3,457 | 3,370 |
| Adjusted $R^2$ | 0.350 | 0.344 | 0.346 | 0.344 |
| Partition by industry-level biodiversity impact from air pollution | | | | |
| *Ln(Direct CBF)* | 0.013 | 0.378 | | |
| | (0.803) | (0.000) | | |
| *Ln(Direct CBF/Assets)* | | | 0.021 | 0.400 |
| | | | (0.680) | (0.000) |
| *p*-value: Low < High | 0.000 | | 0.000 | |
| Controls | Yes | Yes | Yes | Yes |
| Observations | 3,459 | 3,456 | 3,422 | 3,361 |
| Adjusted $R^2$ | 0.357 | 0.333 | 0.349 | 0.331 |
| Partition by industry-level biodiversity impact from water pollution | | | | |
| *Ln(Direct CBF)* | 0.198 | 0.280 | | |
| | (0.000) | (0.001) | | |
| *Ln(Direct CBF/Assets)* | | | 0.182 | 0.305 |
| | | | (0.001) | (0.000) |
| *p*-value: Low < High | 0.210 | | 0.109 | |
| Controls | Yes | Yes | Yes | Yes |
| Observations | 3,383 | 3,379 | 3,327 | 3,303 |
| Adjusted $R^2$ | 0.402 | 0.347 | 0.386 | 0.350 |

Notes: This table reports results from regressing the implied cost of equity capital on direct-impact CBF and control variables. The sample is partitioned into below- and above-median values of industry-total *Direct CBF* for land use, greenhouse gas emissions, air pollution, and water pollution, respectively. All regressions include country, industry, and year fixed effects. The *p*-values (in parentheses) are based on robust standard errors clustered at the firm level. Appendix A provides definitions and data sources for all variables.

**Table A5 Corporate biodiversity footprint and the cost of capital, by ecosystem service reliance**

| | *Low* | *High* | *Low* | *High* |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Partition by reliance on provisioning ecosystem services | | | | |
| *Ln(Direct CBF)* | 0.110 | 0.279 | | |
| | (0.064) | (0.000) | | |
| *Ln(Direct CBF/Assets)* | | | 0.137 | 0.263 |
| | | | (0.015) | (0.000) |
| *p*-value: Low < High | | 0.018 | | 0.056 |
| Controls | Yes | Yes | Yes | Yes |
| Observations | 3,497 | 3,471 | 3,428 | 3,408 |
| Adjusted $R^2$ | 0.378 | 0.400 | 0.371 | 0.400 |
| Partition by reliance on regulating ecosystem services | | | | |
| *Ln(Direct CBF)* | 0.100 | 0.259 | | |
| | (0.052) | (0.000) | | |
| *Ln(Direct CBF/Assets)* | | | 0.124 | 0.234 |
| | | | (0.010) | (0.000) |
| *p*-value: Low < High | | 0.026 | | 0.081 |
| Controls | Yes | Yes | Yes | Yes |
| Observations | 3,499 | 3,470 | 3,439 | 3,398 |
| Adjusted $R^2$ | 0.396 | 0.382 | 0.381 | 0.389 |
| Partition by reliance on cultural ecosystem services | | | | |
| *Ln(Direct CBF)* | 0.205 | 0.184 | | |
| | (0.001) | (0.001) | | |
| *Ln(Direct CBF/Assets)* | | | 0.193 | 0.191 |
| | | | (0.001) | (0.001) |
| *p*-value: Low < High | | 0.603 | | 0.510 |
| Controls | Yes | Yes | Yes | Yes |
| Observations | 3,516 | 3,453 | 3,439 | 3,398 |
| Adjusted $R^2$ | 0.396 | 0.376 | 0.400 | 0.358 |

Notes: This table reports results from regressing the implied cost of equity capital on direct-impact CBF and control variables. The sample is partitioned into below- and above-median values of the corresponding ecosystem dependence scores, obtained from Iceberg Data Lab. All regressions include country, industry, and year fixed effects. The *p*-values (in parentheses) are based on robust standard errors clustered at the firm level. Appendix A provides definitions and data sources for all variables.

**Table A6 Robustness tests against alternative fixed effects**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| *Ln(Direct CBF)* | 0.220 | 0.239 | 0.188 | 0.196 | | | | |
| | (0.000) | (0.000) | (0.000) | (0.000) | | | | |
| *Ln(Direct CBF/Assets)* | | | | | 0.223 | 0.240 | 0.192 | 0.199 |
| | | | | | (0.000) | (0.000) | (0.000) | (0.000) |
| *Beta* | 0.462 | 0.687 | 0.476 | 0.614 | 0.481 | 0.687 | 0.483 | 0.618 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| *BM* | 3.263 | 3.119 | 3.059 | 3.008 | 3.647 | 3.570 | 3.520 | 3.458 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| *Leverage* | 1.574 | 1.025 | 2.070 | 2.072 | 1.543 | 0.908 | 1.938 | 1.932 |
| | (0.003) | (0.072) | (0.000) | (0.000) | (0.003) | (0.097) | (0.001) | (0.000) |
| *Inflation* | 27.419 | 25.049 | 24.280 | 24.615 | 27.490 | 24.447 | 23.869 | 22.878 |
| | (0.000) | (0.000) | (0.000) | (0.003) | (0.000) | (0.000) | (0.000) | (0.006) |
| *Size* | 0.263 | 0.440 | 0.413 | 0.411 | 0.447 | 0.618 | 0.559 | 0.566 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| *Forecast Bias* | 0.251 | 0.217 | 0.224 | 0.229 | 0.250 | 0.218 | 0.223 | 0.228 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| *Forecast Dispersion* | 2.553 | 2.668 | 2.333 | 2.425 | 2.327 | 2.461 | 2.110 | 2.202 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| *Ln(GDP per Capita)* | -0.245 | -0.821 | -2.270 | | -0.250 | -1.809 | -3.026 | |
| | (0.002) | (0.714) | (0.331) | | (0.001) | (0.412) | (0.188) | |
| Country FE | No | Yes | Yes | No | No | Yes | Yes | No |
| Industry FE | Yes | No | No | Yes | Yes | No | No | Yes |
| Year FE | Yes | Yes | No | No | Yes | Yes | No | No |
| Country × Year FE | No | No | No | Yes | No | No | No | Yes |
| Industry × Year FE | No | No | Yes | No | No | No | Yes | No |
| Observations | 6,973 | 6,973 | 6,967 | 6,973 | 6,841 | 6,841 | 6,835 | 6,841 |
| Adjusted $R^2$ | 0.353 | 0.354 | 0.385 | 0.385 | 0.348 | 0.349 | 0.383 | 0.383 |

Notes: This table reports regressions of the implied cost of equity capital on direct-impact CBFs and control variables under alternative fixed effects specifications. Columns (1) and (5) include industry and year fixed effects; columns (2) and (6) include country and year fixed effects; columns (3) and (7) include country and industry × year fixed effects; and columns (4) and (8) include industry and country × year fixed effects. The *p*-values (in parentheses) are based on robust standard errors clustered at the firm level. Appendix A provides variable definitions and data sources.

**Table A7 Robustness tests on cost of equity capital estimates**

| | $K_{MPEG}$ | | $K_{OJN}$ | | $K_{CT}$ | | $K_{GLS}$ | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Panel A: Individual cost of capital estimates | | | | | | | | |
| *Ln(Direct CBF)* | 0.312 | | 0.170 | | 0.158 | | 0.133 | |
| | (0.000) | | (0.000) | | (0.000) | | (0.000) | |
| *Ln(Direct CBF/Assets)* | | 0.319 | | 0.179 | | 0.163 | | 0.136 |
| | | (0.000) | | (0.000) | | (0.000) | | (0.000) |
| *Beta* | 0.785 | 0.769 | 0.512 | 0.506 | 0.400 | 0.409 | 0.280 | 0.248 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| *BM* | 3.505 | 4.653 | 2.048 | 2.848 | 1.826 | 2.148 | 3.394 | 3.867 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| *Leverage* | 3.220 | 2.976 | 1.693 | 1.938 | 2.494 | 2.438 | -0.089 | -0.001 |
| | (0.010) | (0.014) | (0.001) | (0.000) | (0.000) | (0.000) | (0.842) | (0.999) |
| *Inflation* | -2.019 | -3.535 | 51.629 | 50.838 | 57.029 | 56.894 | -2.189 | -2.028 |
| | (0.843) | (0.731) | (0.000) | (0.000) | (0.000) | (0.000) | (0.254) | (0.291) |
| *Size* | 0.623 | 0.845 | 0.311 | 0.420 | 0.313 | 0.445 | 0.483 | 0.555 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| *Forecast Bias* | 0.393 | 0.393 | 0.155 | 0.160 | 0.141 | 0.139 | 0.112 | 0.121 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.001) | (0.000) | (0.000) |
| *Forecast Dispersion* | 6.010 | 5.643 | 4.114 | 3.917 | 0.688 | 0.582 | 0.013 | -0.164 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.009) | (0.028) | (0.928) | (0.198) |
| *Ln(GDP per Capita)* | -11.714 | -13.223 | 3.192 | 1.988 | 2.467 | 1.809 | 3.329 | 4.070 |
| | (0.021) | (0.009) | (0.113) | (0.319) | (0.275) | (0.407) | (0.009) | (0.002) |
| Country FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 6,580 | 6,453 | 5,666 | 5,575 | 6,606 | 6,494 | 6,963 | 6,831 |
| Adjusted $R^2$ | 0.238 | 0.240 | 0.415 | 0.428 | 0.324 | 0.334 | 0.581 | 0.578 |

**Table A7 (continued)**

| | Forecast optimism bias less than *j*th percentile | | | | Accuracy-weighted regression | | Sluggish forecasts | | Price momentum | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *j* = 95% | | *j* = 75% | | | | | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Panel B: Noise in analyst forecasts | | | | | | | | | | |
| *Ln(Direct CBF)* | 0.207 | | 0.141 | | 0.190 | | 0.216 | | 0.194 | |
| | (0.000) | | (0.001) | | (0.003) | | (0.000) | | (0.000) | |
| *Ln(Direct CBF/Assets)* | | 0.214 | | 0.156 | | 0.247 | | 0.227 | | 0.198 |
| | | (0.000) | | (0.000) | | (0.000) | | (0.000) | | (0.000) |
| *Momentum* | | | | | | | | | –0.012 | –0.012 |
| | | | | | | | | | (0.000) | (0.000) |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 6,625 | 6,495 | 5,232 | 5,129 | 6,858 | 6,727 | 6,973 | 6,841 | 6,967 | 6,835 |
| Adjusted $R^2$ | 0.377 | 0.374 | 0.367 | 0.366 | 0.445 | 0.431 | 0.324 | 0.319 | 0.385 | 0.382 |

Notes: This table reports results from regressing alternative implied cost of equity capital estimates on direct-impact CBFs and control variables, and from robustness tests against noises in analyst forecasts. In Panel A, dependent variables are the individual cost of equity estimates from the four models developed by Claus and Thomas (2001), Gebhardt et al. (2001), Ohlson and Juettner-Nauroth (2005), and Easton (2004). In Panel B, columns (1)–(2) exclude the top 5% of observations for *Forecast Bias*; columns (3)–(4) exclude the top 25% observations for *Forecast Bias*; columns (5)–(6) use weighted least squares, with weights equal to the inverse of the earnings forecast error; columns (7)–(8) measure stock prices 6 months after the fiscal year-end to compute the implied cost of equity; columns (9)–(10) include a control for the compound return over the prior 12 months. The *p*-values (in parentheses) are calculated based on robust standard errors clustered at the firm level. Appendix A provides variable definitions and data sources.