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Confronting Biodiversity Risk: Its Role in Shaping Corporate External Financing Choice

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ABSTRACT

This paper investigates how biodiversity risk shapes corporate financing decisions. We propose a Financing Hierarchy Distortion framework, arguing that biodiversity risk amplifies information asymmetry and legitimacy costs, thereby pushing firms toward debt-heavy adjustments. To empirically test this, we introduce a novel firm-level Biodiversity Risk (*Brisk*) measure derived from textual analysis of corporate disclosures and link it to objective ecological data via Biological Diversity Endowment (*BDE*). Using Chinese A-share listed firms from 2009 to 2023 and excluding those in financial and real estate sectors and with ST designations, we find that higher biodiversity risk increases reliance on both formal and informal debt, particularly short-term debt. These findings are robust to quasi-causal identifications using difference-in-differences and instrumental variable strategies. Mechanism and heterogeneity analyses further corroborate the proposed framework and show that this distortion is more pronounced among firms in biodiversity-dependent industries and those facing stronger institutional pressures. These adjustments, however, impose tangible economic costs, raising debt financing costs and depressing returns on assets. Overall, our findings highlight the unintended financial consequences of biodiversity risk, with policy implications for biodiversity disclosure standards, biodiversity-linked financing instruments and the development of alternative credit channels to strengthen firm resilience under escalating ecological pressure.

JEL Classification: G35, Q51, Q57

1 | Introduction

Biodiversity, representing the aggregate of genes, species and ecosystems, underpins the essential services upon which human survival and well-being critically depend (Giglio et al. 2024). However, the alarming average decrease of 73% in global wild-life populations over five decades now poses a direct threat to economic stability (Karolyi and Tobin-de la Puente 2023). Because corporate operations rely inherently on natural capital, biodiversity loss becomes an independent and indispensable source of financial risk (Giglio et al. 2026). Unlike climate risk, which is often approximated by standardised CO₂ metrics,

biodiversity risk arises from spatially heterogeneous and nonlinear pressures that are difficult to quantify, rendering ecological systems vulnerable to abrupt tipping points (Barrett 2022; Lucey et al. 2025). These ecological shocks translate into immediate operational disruptions, such as raw material shortages and supply chain instability, which severely constrain firms' internal cash flows and ultimately force a strategic reshaping of corporate capital structure.

Financing decisions lie at the core of corporate financial strategy, influencing firms' operational planning, risk management and resilience to uncertainty. Emerging environmental

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risks are particularly consequential in this regard, because they fundamentally alter the cost of capital and information asymmetry (Flammer et al. 2025), thus making corporate financing policy a natural lens through which to examine the financial implications of biodiversity loss. On the physical side, disruptions to ecosystem services directly impair operational continuity and increase cash-flow volatility and financing frictions (Yang and Li 2025; Zhou et al. 2025). On the transition side, stricter conservation regulations and due diligence requirements force firms to adjust production structures, further increasing financing uncertainty (Haque and Jones 2020). Yet despite operating as a “twin-crises multiplier” alongside climate risk (Giglio et al. 2025), biodiversity risk remains substantially underexplored in the financing choices literature.

Against this backdrop, we aim to investigate how biodiversity risk exposure affects firms’ external financing choices. While equity financing involves no bankruptcy costs but amplifies dilution costs under information asymmetry (X. Li et al. 2019), debt financing offers tax advantages and allows lenders to manage credit risk through contract terms and delegated monitoring (Myers and Majluf 1984; Wang and Thornhill 2010). In practice, formal debt through bank loans permits flexible renegotiation owing to banks’ superior access to private information (Denis and Mihov 2003), while informal debt through trade credit relies on relationship-based trust and payment terms (Adhikari et al. 2025). Understanding how biodiversity risk reshapes the balance between these channels is essential, as such exposure may significantly complicate firms’ access to external capital under ecological uncertainty.

We conduct our analysis utilising firm-level Biodiversity Risk (*Brisk*) data constructed by He et al. (2024), derived from a textual analysis of annual reports from over 4000 Chinese companies. Crucially, to address concerns regarding strategic window-dressing disclosure behaviour and establish construct validity, we anchor *Brisk* to objective spatial data, i.e., the Biological Diversity Endowment (*BDE*), confirming that corporate disclosures meaningfully capture genuine, financially material ecological vulnerabilities. We focus on the Chinese context for two reasons. First, China is among the world’s most biodiverse countries and has implemented a growing number of government-led conservation initiatives. Second, as the largest developing economy, China’s firms offer valuable insights for other emerging markets navigating biodiversity-related financing pressures.

Our empirical analyses reveal a reallocation of marginal financing demand. Firms with higher biodiversity risk exposure become significantly more dependent on both formal (bank loans) and informal (trade credit) debt, while the equity channel becomes economically ‘frozen’. This debt-heavy adjustment operates through three mutually reinforcing mechanisms, i.e., internal liquidity vulnerability, equity pricing penalties and debt maturity adjustments. We further identify that higher industry-level biodiversity dependence and stronger external institutional environment amplify the debt financing response, and superior internal governance capacity shifts the composition of debt toward trade credit. Ultimately, this financing reallocation elevates overall debt costs and diminishes returns on assets.

The primary contribution of this study is to elucidate how biodiversity risk forces a structural distortion in the corporate financing hierarchy. Within this overarching narrative, we advance the literature in three specific ways. First, we develop a unified conceptual framework, i.e., the Financing Hierarchy Distortion (FHD), to explain why biodiversity risk systematically redirects firms toward debt-heavy financing adjustments. Unlike climate risk, which is increasingly priced through standardised disclosures, biodiversity risk is characterised by spatial heterogeneity and nonlinear tipping points that create a fundamental valuation friction, namely a lemons problem in equity markets where dispersed investors demand prohibitive risk premiums. This forces firms toward non-public financing channels, where access depends on bilateral relationships and contractual monitoring rather than public market scrutiny, distorting the financing hierarchy in ways that existing frameworks do not capture.

Second, we extend the emerging biodiversity-finance literature by moving beyond internal managerial and operational responses, such as dividend policy (Zhou et al. 2025), cash holdings (Ahmad and Karpuz 2024), managerial myopia (Zhao et al. 2025) and firm efficiency (Y. Li, Liu, et al. 2025), to focus on external financing choices. Because external capital allocation is directly shaped by market discipline, investor perceptions and institutional constraints, this shift allows us to show that biodiversity risk is not merely an operational constraint but a structural determinant of capital structure, reshaping the composition of external capital in ways that have yet to be systematically examined.

Third, we advance the empirical foundations of this nascent field by integrating disclosure-based measurement with objective ecological validation. Validating our text-based biodiversity risk measure against an exogenous spatial index of regional ecological health constructed from observational data (the *BDE* approach), we demonstrate that the financing distortions we document reflect genuine ecological exposure rather than strategic disclosure behaviour. This empirical design provides robust and internally consistent evidence for our core findings, strengthening the credibility of the FHD framework.

The rest of the paper proceeds as follows. Section 2 outlines hypothesis development. Section 3 details the data and empirical design. Section 4 discusses the main empirical results. Sections 5, 6 and 7 provide mechanism analysis, heterogeneity analysis and further analysis of the economic consequences. Section 8 concludes the paper.

2 | Hypothesis Development

2.1 | Main Hypothesis

Nature provides critical, non-substitutable production inputs for corporate operations, implying that firms’ long-term competitiveness depends on their ability to manage environmental constraints (Hart 1995). This dependency is formalised in recent studies that incorporate ecosystem services as natural capital within the Cobb–Douglas production function, showing that the depletion of natural capital necessitates costly substitution to sustain output (Bastien-Olvera and Moore 2021; Bach

et al. 2025). In this sense, biodiversity risk reflects the internalisation of ecological externalities, whereby costs previously borne by society become private corporate burdens (Bansal and Clelland 2004).

The internalisation of these costs is shaped by both the firm's objective ecological environment and managerial awareness. Therefore, we interpret disclosed biodiversity risk as an observable manifestation of this internalisation process, reflecting the reality of ecological exposure while also signalling that management has recognised and responded to its financial implications. This interpretation is supported by the premise that firms operating in ecologically degraded regions face stronger material incentives to disclose biodiversity-related concerns, a foundational link we empirically validate through objective spatial data in Section 4.3.

Once internalised and disclosed, this biodiversity risk ceases to be a purely ecological issue and transforms into a profound financial friction. Building on this, we propose a FHD framework to elucidate how biodiversity risk reshapes corporate capital structure. At its core, exposure to biodiversity risk signals a firm's underlying vulnerability to the degradation of ecosystem services. This exposure imposes higher anticipated operational, compliance and adjustment costs that erode firms' internal financial capacity and force them to seek external financing. However, when turning to external capital markets, their financing choices are fundamentally distorted by a unique combination of information asymmetry and legitimacy gaps.

From an institutional perspective, firms must maintain organisational legitimacy to survive (Suchman 1995). As stakeholders increasingly demand ecological responsibility through coercive regulations and normative societal expectations, firms perceived as biodiversity-negative suffer from a legitimacy gap, leading to stigmatisation in capital markets (DiMaggio and Powell 1983; Bansal and Clelland 2004). This stigmatisation creates a divergence in financing accessibility that aligns with the logic of pecking order theory, where firms prioritise financing sources that minimise information asymmetry (Myers and Majluf 1984; Shyam-Sunder and Myers 1999). Biodiversity risk differs from climate risk in its lack of a unifying scalar metric, characterised instead by spatially heterogeneous and nonlinear tipping points that are difficult for dispersed public investors to quantify. This opacity, combined with the institutional stigma of nature-negative operations, creates a severe lemons problem in equity markets. Public shareholders demand prohibitively high-risk premiums or exit entirely, rendering equity an undesirable financing channel (X. Li et al. 2019).

In contrast, debt becomes the primary adjustment mechanism. Private lenders, particularly banks, act as delegated monitors uniquely equipped to internalise and manage these complex ecological vulnerabilities (Diamond 1984). First, debt contracts can be structured to include covenants and collateral that protect lenders against hidden risks, reducing reliance on voluntary disclosure (Sharfman and Fernando 2008). Second, banks can adjust loan terms, including pricing, maturity and renegotiation, to align with the firm's financial situation, offering more tailored support when biodiversity risks materialise (Denis and Mihov 2003; G.-Y. Huang et al. 2023).

In addition, when access to formal debt financing is constrained, firms may turn to informal channels such as trade credit along the supply chain (Petersen and Rajan 1997; Ferrando and Mulier 2013; D'Mello and Toscano 2020). From the receivables side, to counteract the reputational damage and declining demand caused by biodiversity risks, firms must offer generous credit terms to retain hesitant customers (Frankel et al. 2017; Adhikari et al. 2025). From the payables side, suppliers may perceive these firms as high-risk, tightening the credit extended to them. These dual forces simultaneously expand receivables and compress payables, resulting in higher net trade credit.

Based on the foregoing discussion, we propose our foundation hypothesis that biodiversity risk forces a structural rebalancing of external capital, driving firms toward debt-heavy adjustments:

H1: *Firms with greater biodiversity risk exposure rely more on debt financing.*

2.2 | Mechanism Hypothesis

The FHD framework operates through three mutually reinforcing mechanisms, generating the core prediction that biodiversity risk drives a structural reallocation toward debt: internal liquidity depletion creates an urgent funding gap, legitimacy erosion constrains financing options and lender-driven maturity shortening amplifies debt reliance.

The first mechanism comes at the immediacy of liquidity needs. Biodiversity risks manifest as exogenous shocks to corporate liquidity via two distinct pathways. On the physical side, disruptions to ecosystem services, such as water scarcity or raw material depletion, immediately raise marginal production costs and necessitate urgent inventory adjustments. Exposure to these events causes direct asset destruction and revenue contraction, rapidly draining cash reserves. On the transition side, regulatory penalties, mandatory ecological restoration obligations and increased investment in biodiversity-friendly technologies further require immediate, often unbudgeted, cash outflows (Treepongkaruna 2024). From the perspective of funding-horizon theory (DeAngelo et al. 2011), the internalisation of these physical and transition exposures creates a financing deficit, defined as a gap between required investment and available internal funds.

Crucially, biodiversity risks often materialise not as gradual trends but as abrupt, high-impact events. Thus, as firms recognise and internalise these severe liquidity threats, they require immediate financing to sustain operations. Debt financing offers the speed and flexibility required to absorb these short-term liquidity shocks. Therefore, as biodiversity risk exposures deplete internal cash buffers, firms increasingly substitute internal capital with external debt to balance their funding needs (R. Huang and Ritter 2021).

Thereby, we propose the first mechanism hypothesis:

H2a. *Firms exposed to biodiversity risk experience internal liquidity shortages and demand immediate funding, thus increasing reliance on debt financing.*

The second mechanism links financing choice to the pricing penalty in public capital markets. Biodiversity risk introduces severe information asymmetry, as ecological impacts are difficult to verify externally, making it challenging for investors to accurately assess firms' true exposure to stranded assets or regulatory penalties (Leland 1998). Integrating stakeholder theory with institutional theory, we argue that equity investors, as residual claimants, are uniquely sensitive to this legitimacy gap (Suchman 1995; Reynolds et al. 2006). Unlike debt holders protected by contractual obligations, equity returns depend on future profitability and market sentiment (Czarnitzki and Kraft 2009; Cao et al. 2019). Fearing hidden liabilities, investors discount firm valuations and demand higher expected returns (Liang et al. 2024; Garel et al. 2024), rendering equity financing more costly and less attractive relative to debt.

Lenders, acting as delegated monitors, are less reliant on public sentiment because they can directly gather pre-contract information as well as enforce post-contract monitoring to mitigate agency problems (Krishnaswami and Subramaniam 1999; Jung et al. 2018). Therefore, when biodiversity risk dampens stock market sentiment and elevates equity financing costs, firms naturally increase their reliance on debt financing, where access to capital is determined by collateral and contracts rather than public reputation.

Based on the above, we propose the second mechanism hypothesis:

H2b. *Firms exposed to biodiversity risk encounter information asymmetry and legitimacy concerns that raise equity financing costs, thus increasing reliance on debt financing.*

The third mechanism involves the structural adjustment of debt contracts. While firms prefer debt financing, lenders are not oblivious to the risks and perceive biodiversity exposure as a source of cash flow volatility. To protect their principal, creditors typically demand shorter debt maturities to enhance control. Short-term debt compels the borrower to return to the negotiation table frequently, allowing the bank to re-evaluate the firm's solvency and ecological compliance at short intervals (Balakrishnan and Fox 1993).

However, this shortening of maturity paradoxically increases the firm's overall reliance on debt issuance. Because the firm cannot secure long-term capital, it must engage in constant rollover of short-term debt. To ensure liquidity safety against the risk of refinancing failure, firms often need to borrow more than strictly necessary in the short term to maintain a cash buffer. As equity and long-term debt become unavailable, the aggregate volume of short-term debt increases to fill the financing gap. Thus, the shortening of maturity is not a sign of reduced reliance on debt but a condition that necessitates more frequent and potentially larger gross borrowing to maintain operations.

Accordingly, we propose the third mechanism hypothesis:

H2c. *Firms exposed to biodiversity risk undergo adjustments in debt maturity required by lenders for effective monitoring and*

renegotiation and enter the debt market more frequently, thus increasing reliance on debt financing.

2.3 | Moderating Hypothesis

While our FHD framework predicts a structural reallocation toward debt financing in response to biodiversity risk, both the magnitude and composition of this response are unlikely to be uniform across firms. Theoretically, this heterogeneity is governed by three boundary conditions: (i) firms' fundamental material exposure to natural capital, (ii) the external institutional environment in which firms operate and (iii) firms' internal capacity to cope with ecological shocks.

First, regarding material exposure, industry-level biodiversity dependence captures the materiality of ecosystem services in production. In high-dependence sectors (e.g., agriculture, food, fisheries, mining and forestry), biodiversity loss directly translates into natural capital depletion, input scarcity, cost escalation and supply-chain disruptions, thereby amplifying the internal liquidity shortages discussed previously and ultimately making the reallocation toward debt financing more pronounced (Balachandran and Nguyen 2018).

Second, even conditional on material exposure, firms face heterogeneous external institutional environments (e.g., public attention, market competition and political embeddedness) that modulate the financing response. Heightened regulatory scrutiny and competitive pressure constrain strategic flexibility, accelerating the sector-wide sustainability transition (Bach et al. 2025). Crucially, political connections serve as an institutional interface by rendering firms to stronger expectations to align with state ecological priorities while simultaneously facilitating preferential access to credit channels (Owolabi et al. 2025). Consequently, the convergence of action pressure and borrowing capacity to borrow accelerates the debt-heavy adjustment.

Third, firms are not passive recipients of ecological shocks. Strong internal governance capacity, such as effective risk mitigation systems, signals operational resilience, reduces vulnerability to biodiversity-related disruptions and alleviates financing frictions (Damert and Baumgartner 2018). In particular, suppliers often possess informational advantages over banks regarding firms' operations and adaptive capacity, which enables firms to rely more on flexible, relationship-based financing channels, such as trade credit, rather than depending solely on formal bank loans.

Based on the above, we propose the following moderating hypotheses:

H3a: *Industry-level biodiversity dependence intensifies the positive impact of biodiversity risk exposure on debt financing.*

H3b: *External institutional environment intensifies the positive impact of biodiversity risk exposure on debt financing.*

H3c: *Internal governance capacity shifts the composition of debt financing induced by biodiversity risk exposure,*

strengthening the positive impact on trade credit relative to bank loans.

3 | Research Design

3.1 | Samples

Our sample comprises A-share listed companies in China from 2009 to 2023, thus avoiding potential distortions caused by the 2008 global financial crisis. Financial data are obtained from the China Stock Market and Accounting Research (CSMAR) database. The sample is refined based on the following criteria: (i) firms in the financial and real estate sectors are excluded due to their industry-specific characteristics; (ii) firms designated as ST or *ST, indicating financial distress or delisting risk, are removed; and (iii) firms with missing records are excluded. To minimise the influence of outliers, all continuous variables are winsorised at the 1% level. The final sample consists of 20,927 firm-year observations.

3.2 | Variables

3.2.1 | Independent Variable

To quantify the corporate biodiversity risk exposure, we employ *Brisk* introduced by He et al. (2024). This index is constructed through text analysis of Chinese firms' annual reports, identifying biodiversity-related terms with reference to the biodiversity dictionary compiled by Giglio et al. (2025). Specifically, it tallies the frequency of these biodiversity terms, enabling a consistent and scalable assessment for comparing biodiversity awareness across Chinese companies.

Noteworthy, effective measures for assessing biodiversity risk exposure at the firm level remain limited. While *Brisk* is the most comprehensive measure currently available for Chinese firms, it captures firms' disclosed exposure to biodiversity risks rather than their actual exposure. This distinction is important, as disclosure reflects what firms choose to report, which may be influenced by internal governance standards, transparency practices, strategic considerations or other unobserved characteristics. As a result, potential endogeneity concerns arise. To address these issues, we employ a range of empirical strategies in Section 4.4, including difference-in-differences (DID) and instrument variable (IV) approaches, to better isolate the causal effect of biodiversity risk disclosure on firm behaviour.

3.2.2 | Dependent Variables

To examine external financing choices, we adopt both debt and equity financing as dependent variables. Specifically, debt financing includes (i) formal and (ii) informal ways. According to Bedendo et al. (2020), formal debt financing (*Formal*) is measured by bank loans scaled by lagged total assets, capturing firms' reliance on bank-based borrowing. Informal debt financing (*Informal*) is quantified following prior research, e.g., Jory et al. (2020), D'Mello and Toscano (2020) and Adhikari

et al. (2025), using the net trade credit—calculated as the sum of accounts receivable and notes receivable minus accounts payable and notes payable—scaled by lagged total assets. For equity financing, we follow X. Li et al. (2019) and employ the ratio of common equity to lagged total assets.

3.2.3 | Control Variables

In line with the existing studies (e.g., X. Li et al. 2019; G.-Y. Huang et al. 2023; Ren et al. 2025), we incorporate a range of firm-specific control variables that are potentially relevant to corporate external financing behaviour. Particularly, to control for the potential influence of firms' financial performance on the link between biodiversity risk and external financing, we include firm-level characteristics such as firm size (*Size*), profitability (*Roa*), firm age (*Age*), capital structure (*Leverage*), revenue growth rate (*Growth*) and operating net cash flow (*Cash*).

3.3 | Model

On the basis of the aforementioned samples and variables, we investigate the effect of biodiversity risk on corporate external financing choices through the following baseline model:

$$Finance_{i,t} = \beta_0 + \beta_1 Brisk_{i,t-1} + \sum_i \beta_i Controls_{i,t-1} + \delta_j + d_t + \varepsilon_{i,t}, \quad (1)$$

where $Finance_{i,t}$ is either the level of formal debt financing (*Formal*) or informal debt financing (*Informal*). $Brisk_{i,t-1}$ is a binary variable indicating the biodiversity risk, taking a value of 1 if a firm is exposed to biodiversity risk, and 0 otherwise. $Controls_{i,t-1}$ represents a set of control variables. To alleviate the endogeneity concerns about reverse causality, the independent variable and control variables are lagged by one period. Further, we consider the industry fixed effects δ_j and year fixed effects d_t to mitigate potential biases arising from industry-specific characteristics and temporal shocks. $\varepsilon_{i,t}$ represents the heteroscedasticity-robust standard errors clustered by firms. We provide a detailed description of all incorporated variables in Table 1.

4 | Empirical Results

4.1 | Descriptive Statistics

Table 2 provides the descriptive statistics for the primary variables in our research. The average value of *Brisk* is 0.48, denoting that approximately 48% of Chinese companies are exposed to biodiversity. Regarding debt financing, *Formal* exceeds *Informal* on average, with a mean value of 0.12 compared to 0.04. Furthermore, the mean value of *Equity* is 0.17, surpassing those of both *Formal* and *Informal*. The minimum values of *Formal*, *Informal* and *Equity* are 0.00, −0.96 and 0.02, respectively, while their maximum values are 0.57, 0.61 and 0.60, indicating substantial variation in external financing behaviour across firms. Furthermore, consistent with previous studies

TABLE 1 | Definitions of variables.

Variable symbol	Variable name	Definition
<i>Brisk</i>	Biodiversity risk exposure	Equal to 1 if biodiversity terms appear more than twice in the annual report, and 0 otherwise
<i>Formal</i>	Formal debt financing (bank loans)	Bank loans/lagged total assets
<i>Informal</i>	Informal debt financing (trade credit)	Sum of accounts receivable and notes receivable minus accounts payable and notes payable/lagged total assets
<i>Equity</i>	Equity financing	Common equity/lagged total assets
<i>Size</i>	Firm size	Natural logarithm of total assets
<i>Roa</i>	Profitability	Net profits/total assets
<i>Age</i>	Firm age	Natural logarithm of the years since a firm has been established
<i>Leverage</i>	Capital Structure	Total liabilities/total assets
<i>Growth</i>	Revenue growth rate	Annual change in operating income
<i>Cash</i>	Operating net cash flow	Net cash flow from operating activities/total assets

TABLE 2 | Descriptive statistics.

Variable	N	Mean	SD	Min	Max
<i>Brisk</i>	20,927	0.48	0.50	0.00	1.00
<i>Formal</i>	20,927	0.12	0.13	0.00	0.57
<i>Informal</i>	20,927	0.04	0.11	−0.96	0.61
<i>Equity</i>	20,927	0.17	0.11	0.02	0.60
<i>Size</i>	20,927	21.86	1.13	19.99	26.02
<i>Roa</i>	20,927	0.05	0.07	−0.24	0.24
<i>Age</i>	20,927	2.81	0.36	1.61	3.53
<i>Leverage</i>	20,927	0.37	0.19	0.04	0.85
<i>Growth</i>	20,927	0.18	0.33	−0.49	1.73
<i>Cash</i>	20,927	0.06	0.05	−0.01	0.24

Note: A total of 20927 firm-year observations are obtained. N, Mean, SD, Min and Max denote the number of observations, average value, standard deviation, minimum value and maximum value, respectively. All continuous variables are winsorised at the 1st and 99th percentiles.

(e.g., Zhou et al. 2025; Pi et al. 2025), our control variables are distributed reasonably within expected ranges.

4.2 | Baseline Regression

We report the effect of biodiversity risk exposure on external financing choices in Table 3, where columns (1), (2) and (3) correspond to formal debt, informal debt and equity financing, respectively. We find that biodiversity risk exposure exhibits a significant positive impact on both formal and informal debt financing, while its influence on equity financing is positive but insignificant. In detail, the coefficients of *Brisk* on *Formal* and *Informal* are 0.0068 and 0.0049, which are significant at the 1% and 10% levels, respectively,

TABLE 3 | Effect of biodiversity risk exposure on external financing choice.

	(1)	(2)	(3)
	<i>Formal</i>	<i>Informal</i>	<i>Equity</i>
<i>Brisk</i>	0.0068*** (2.87)	0.0049* (1.85)	0.0021 (0.86)
<i>Size</i>	−0.0071*** (−4.16)	−0.0199*** (−12.85)	−0.0274*** (−16.88)
<i>Roa</i>	−0.0224 (−1.34)	−0.0039 (−0.19)	−0.2969*** (−13.76)
<i>Age</i>	0.0059 (1.19)	0.0087 (1.60)	0.0170*** (3.55)
<i>Leverage</i>	0.4931*** (50.46)	−0.1244*** (−12.76)	−0.0872*** (−8.51)
<i>Growth</i>	0.0132*** (4.79)	0.0103*** (3.77)	−0.0026 (−0.95)
<i>Cash</i>	0.4010*** (16.05)	−0.2654*** (−12.07)	−0.1774*** (−8.35)
_cons	0.0532 (1.37)	0.5026*** (13.68)	0.7752*** (21.03)
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
<i>R</i> ²	0.5019	0.2168	0.2414
<i>N</i>	20927	20927	20927

Note: ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

while the coefficient of *Brisk* on *Equity* is 0.0021. That is to say, for a one-unit increase in corporate biodiversity risk exposure, the levels of formal and informal debt financing increase significantly by 0.68% and 0.49%, respectively.

The baseline results demonstrate a clear reallocation of marginal financing demand toward the debt channel. This empirical pattern supports our FHD framework. The insignificant equity coefficient suggests that the equity channel becomes economically 'frozen' due to the frictions in public markets. Consequently, firms do not necessarily reduce existing equity levels but fulfil their new financing needs almost exclusively through debt. Unlike dispersed public investors, the providers of these debt channels, whether banks exercising delegated monitoring or suppliers leveraging relationship-based soft information, are uniquely equipped to internalise and manage these complex ecological vulnerabilities.

4.3 | Objective Ecological Validation

Our main analysis employs *Brisk*, which quantifies firms' disclosed biodiversity risk exposure through textual analysis. A potential concern is that *Brisk* primarily captures management's disclosure choices rather than objective vulnerability. To bridge this gap, we validate our text-based index using *BDE*, an objective measure of the ecological health surrounding a firm's headquarters constructed from bird observation data (eBird 2025). In detail, for each firm-year, we calculate bird species richness within a 50-kilometre radius of corporate headquarters, applying distance-weighted aggregation (weights declining from 0.25 for 0–10 km to 0.15 for 40–50 km) (Van Toor et al. 2020). As shown in Table 4, we find a statistically significant negative correlation between *Brisk* and *BDE*. This negative relationship is critical for our identification. Firms in ecologically degraded regions (low *BDE*) face greater

TABLE 4 | Objective ecological validation.

	Relationship between <i>Brisk</i> and <i>BDE</i>			Effect of <i>BDE</i> on debt financing	
	(1) <i>BDE</i>	(2) <i>BDE</i>	(3) <i>BDE</i>	(4) <i>Formal</i>	(5) <i>Informal</i>
<i>Brisk</i>	−2.3098*** (−3.93)	−0.7208*** (−2.94)	−0.7345*** (−3.01)		
<i>BDE</i>				−0.0003*** (−3.00)	−0.0003*** (−3.00)
<i>Size</i>	3.2258*** (8.40)	0.8615*** (2.95)	0.8151*** (2.74)	−0.0052*** (−2.89)	−0.0163*** (−10.87)
<i>Roa</i>	−14.3764*** (−3.38)	−2.8601* (−1.73)	−2.7783* (−1.68)	−0.0162 (−0.88)	−0.0257 (−1.31)
<i>Age</i>	1.5497 (1.23)	−1.5059 (−0.67)	−1.4941 (−0.67)	0.0055 (0.93)	0.0094 (1.59)
<i>Leverage</i>	−3.7964* (−1.79)	0.8156 (0.71)	0.9102 (0.80)	0.4814*** (45.85)	−0.1225*** (−13.32)
<i>Growth</i>	0.1629 (0.28)	−0.5359** (−2.18)	−0.5619** (−2.30)	0.0141*** (4.55)	0.0119*** (4.41)
<i>Cash</i>	−40.6544*** (−7.55)	−0.3646 (−0.16)	−0.3885 (−0.17)	0.4018*** (14.15)	−0.2710*** (−11.63)
<i>_cons</i>	−34.1798*** (−4.01)	21.0499** (2.37)	22.0095** (2.48)	0.0253 (0.60)	0.4342*** (11.70)
Year FE	Yes	Yes	Yes	Yes	Yes
Firm FE	No	Yes	Yes	No	No
Industry FE	No	No	Yes	Yes	Yes
<i>R</i> ²	0.2062	0.8699	0.8701	0.4890	0.2373
<i>N</i>	15660	15192	15192	15894	15244

Note: ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

genuine biodiversity risks and have stronger incentives to disclose them (high *Brisk*).

More importantly, Columns (4) and (5) in Table 4 further demonstrate that lower *BDE* is associated with increased debt financing. The coefficients on lagged *BDE* are -0.0003 for both formal and informal debt financing and are statistically significant at the 1% level. Economically, these estimates imply that a one-unit decline in regional biodiversity health increases firms' debt financing by approximately 0.03%. Taken together, the use of objective ecological indicators corroborates our main findings in two important ways. First, biodiversity exposure exerts a significant influence on corporate financing choices. Second, these results rule out the concern that our findings are driven by strategic window-dressing disclosure behaviour.

4.4 | Robustness Checks

Given that biodiversity remains a nascent area in corporate finance with limited standardised metrics, establishing empirical reliability across multiple specifications is essential (Giglio et al. 2025). While we employ a variety of quasi-causal tools to ensure the stability of our findings, our identification strategy is primarily anchored by a dual approach: (i) an IV analysis to address geographic endogeneity and (ii) a DID framework to capture transition shocks.

Other tests, such as propensity score matching (PSM), alternative variable definitions and climate risk control, serve as secondary stability tests to verify that our results are not sensitive to firm-level self-selection or specific measurement choices. This multi-layered approach is particularly important given the inherent difficulties in quantifying spatially heterogeneous ecological risks (Barrett 2022; Lucey et al. 2025).

4.4.1 | IV Approach

We further address endogeneity concerns related to potential reverse causality and variable omission by employing IV approach. Given that endogeneity primarily stems from constructing variables based on firm-level data, we follow Safiullah et al. (2021) and employ geographic location as an IV for corporate biodiversity risk. In detail, we construct this IV by computing the average biodiversity risk exposure of firms located in the same three-digit zip code.

This IV satisfies the two core conditions of validity. First, regarding relevance, biodiversity risk exhibits strong spatial clustering (Kennedy et al. 2023). Firms in close geographic proximity share the same ecosystem services and face identical ecological threats; thus, the regional average serves as a strong predictor of firm-level exposure. Second, regarding exogeneity, a potential concern is that regional biodiversity risk might simply proxy for local economic characteristics. We anchor our IV in objective ecological reality. As validated in Subsection 4.3, our text-based risk measure is highly correlated with the biodiversity endowment constructed from eBird data, indicating that firm-level biodiversity risk captures real ecological exposure rather than strategic disclosure. This confirms that our IV

captures the region's exogenous natural endowment, which is determined by long-term geographic and climatic factors rather than transient regional economic conditions or financial policies. Furthermore, zip codes in China are administrative identifiers determined purely by geography and are orthogonal to firm-level financial behaviour. Therefore, it serves as a valid IV that enables us to identify the causal effect of corporate biodiversity risk exposure on its financing behaviours.

In the second stage, we additionally control for provincial GDP (*GDP*) and the number of bank branches in the firm's city (*Bank*) to mitigate potential omitted variable bias. These controls capture regional economic development and financial accessibility, ensuring that the estimated effect of biodiversity risk on financing strategies is not confounded by local macroeconomic or financial supply conditions and improving the credibility of the IV estimates.

TABLE 5 | Robustness check: Instrument variable approach.

	First stage	Second stage	
	(1) <i>Brisk</i>	(2) <i>Formal</i>	(3) <i>Informal</i>
<i>Zip</i>	0.5684*** (34.92)		
<i>Brisk</i>		0.0214*** (2.67)	0.0153* (1.71)
<i>Size</i>	0.0739*** (14.37)	-0.0085*** (-4.63)	-0.0211*** (-12.16)
<i>Roa</i>	-0.2413*** (-3.50)	-0.0188 (-1.12)	-0.0010 (0.05)
<i>Age</i>	-0.0051 (-0.31)	0.0058 (-1.12)	0.0096 (1.77)
<i>Leverage</i>	0.0284 (0.91)	0.4920*** (50.19)	-0.123*** (-12.63)
<i>Growth</i>	0.0233** (2.14)	0.0129*** (4.67)	0.0100*** (3.61)
<i>Cash</i>	-0.0260 (-0.32)	0.400*** (16.02)	-0.2610*** (-11.80)
<i>GDP</i>		-0.0026 (-0.63)	0.0012 (0.25)
<i>Bank</i>		0.0041 (0.91)	-0.0082 (-1.53)
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
<i>R</i> ²	—	0.4679	0.1233
<i>N</i>	20917	20917	20917

Note: ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Table 5 displays the two-stage least squares results. As seen in column (1), the first-stage results denote that *IV (Zip)* is significantly positively associated with corporate biodiversity risk exposure at the 1% level. Then, the second-stage results, represented in columns (2) and (3), show that the fitted value of *Brisk* is positively correlated with *Formal* and *Informal*, significant at the 1% and 10% levels, respectively. Besides, both *GDP* and *Bank* are statistically insignificant, suggesting that the biodiversity risk effect identified by our IV operates independently rather than through spurious correlation with economic factors. To sum up, our results further support our foundation hypothesis that firms facing greater biodiversity risk exposure rely more on debt financing.

4.4.2 | Difference-in-Differences Analysis

The existing research has underscored the spike in biodiversity risk following the 2020 United Nations Summit on Biodiversity (F. Ma et al. 2024; Kalhor and Kyaw 2024; Y. Li, Liu, et al. 2025). At that time, Heads of State, government and other leaders convened to elevate ambition for shaping the post-2020 global biodiversity framework¹. Accordingly, we hypothesise that in 2020, companies facing biodiversity risk would be more dependent on debt financing than those not facing risk. Thereby, taking firms exposed to biodiversity risk as the treatment group and others as the control group, we employ the quasi-natural experiment by building a DID framework:

$$Finance_{i,t} = \beta_0 + \beta_1 Treat_i \times Post_t + \sum_i \beta_i Controls_{i,t-1} + \delta_j + d_t + \varepsilon_{i,t}, \quad (2)$$

where *Treat_i* is set to 1 if firms are exposed to biodiversity risk and 0 otherwise. *Post_t* equals 1 after the fiscal year 2020 and 0 otherwise.

As shown in Columns (1) and (2) in Table 6, the coefficients of the interaction term *Treat_i × Post_t* are significantly positive, corroborating our hypothesis that companies encountering biodiversity risk exposure raise the level of debt financing.

Additionally, we test the parallel trends assumption by including time indicators *Pre2018* and *Pre2019* for the two years prior to the 2020 event, as well as *Current2020*, *Post2021*, *Post2022* and *Post2023* for the event year and subsequent years. These indicators are interacted with the *Treat* variable to assess whether the treatment and control groups follow similar trends before the event. Insignificant interaction terms would support the parallel trends assumption.

As shown in Columns (3) and (4) in Table 6, the insignificant interaction terms for 2018–2019 indicate that, prior to the event, the treatment and control groups exhibited similar trends. Although the 2020–2021 coefficients remain insignificant, the significant effect in 2022 points to a lagged materialisation of the event's impact, consistent with the anticipated delayed response and adjustment period. While not a definitive validation of the parallel trends assumption, the statistically evident divergence between the groups before and after the event supports its plausibility and underscores its dynamic and lagged effects.

This 2-year latency is consistent with the nature of environmental regulation and credit market adjustments for two reasons. First, from the perspective of institutional implementation, the translation of the 2020 high-level biodiversity consensus into actionable banking protocols involves a guidance phase. Financial institutions require time to update risk models and integrate biodiversity metrics into their credit appraisal systems. Second, regarding corporate and market responses, debt financing exhibits contractual rigidity. Since existing loan contracts take time to mature, the shift in financing behaviour, such as the need for new liquidity, typically materialises with a lag rather than instantaneously. Therefore, the divergence observed from 2022 onwards reflects an adaptation to the realised constraints rather than a transient shock, thereby reinforcing the credibility of our hypotheses.

4.4.3 | Stability Tests

4.4.3.1 | PSM. Given that variations in firms' biodiversity risk exposure may stem from underlying corporate characteristics that also influence financing choices, we apply PSM to alleviate potential self-selection concerns. More specifically, we classify firms into treatment and control groups based on whether they are exposed to biodiversity risk. Next, conditioning on corporate characteristics, we calculate a propensity score for each observation and match the samples utilising (i) one-to-four nearest neighbour matching using a calliper width of 0.01 and (ii) calliper matching with 0.01.

As seen in Table 7, the coefficients of *Brisk* on *Formal* are significantly positive for both nearest neighbour matching (Column (1)) and calliper matching (Column (3)) at the 1% level. Similarly, under the two matching strategies, the coefficients of *Brisk* on *Informal* are significantly positive at the 10% level. Thereby, the positive relationship between corporate biodiversity risk exposure and debt financing levels is not subject to self-selection bias.

4.4.3.2 | Alternative Measures. We use alternative dependent variables to verify whether the findings hold under different specifications. In the prior studies, there are different measurements for external financing choices. According to Wu et al. (2025) and Jory et al. (2020), we take *Alt_Formal* and *Alt_Informal* as alternative proxies of the dependent variable, which are measured by the logarithm of debt financing scale and the difference between accounts receivables and payables/sales, respectively. The results are displayed in Columns (1) and (2) in Table 8. The coefficients of *Brisk* on *Alt_Formal* and *Alt_Informal* are both positive and significant at the 1% level. In summary, our main results are consistent and robust.

4.4.3.3 | Climate Risk Control. As we discussed before, biodiversity risk pertains to threats to the diversity of life on Earth, whereas climate risk involves the potential adverse effects of climate change (Giglio et al. 2025). These two risks, while conceptually distinct, are nonetheless interconnected, as changes in climate can exacerbate biodiversity loss and diminished biodiversity can, in turn, reduce the resilience of ecosystems to climate impacts.

TABLE 6 | Robustness check: DID and test of parallel trends assumption.

	DID		Test of parallel trends assumption	
	(1) <i>Formal</i>	(2) <i>Informal</i>	(3) <i>Formal</i>	(4) <i>Informal</i>
<i>Treat*Post</i>	0.0057* (1.91)	0.0098*** (2.91)		
<i>Treat*Pre2018</i>			−0.0006 (−0.14)	−0.0058 (−1.20)
<i>Treat*Pre2019</i>			−0.0013 (−0.31)	−0.0019 (−0.44)
<i>Treat*Current2020</i>			−0.0033 (−0.81)	−0.0029 (−0.68)
<i>Treat*Post2021</i>			−0.0056 (−1.39)	0.0040 (0.91)
<i>Treat*Post2022</i>			0.0064* (1.65)	0.0076* (1.90)
<i>Treat*Post2023</i>			−0.0000 (−0.01)	−0.0007 (−0.16)
<i>Size</i>	−0.0067*** (−3.98)	−0.0198*** (−12.93)	−0.0410** (−2.42)	−0.0562*** (−2.69)
<i>Roa</i>	−0.0241 (−1.44)	−0.0050 (−0.25)	0.0067 (1.35)	0.0110** (1.98)
<i>Age</i>	0.0057 (1.16)	0.0086 (1.58)	0.4750*** (50.54)	−0.1747*** (−18.38)
<i>Leverage</i>	0.4932*** (50.45)	−0.1243*** (−12.75)	0.0129*** (4.71)	0.0097*** (3.47)
<i>Growth</i>	0.0134*** (4.87)	0.0105*** (3.84)	0.4064*** (16.22)	−0.2506*** (−11.09)
<i>Cash</i>	0.3997*** (15.99)	−0.2667*** (−12.13)	−0.0965*** (−6.57)	0.0860*** (5.31)
<i>_cons</i>	0.0465 (1.21)	0.5008*** (13.75)	−0.0006 (−0.14)	−0.0058 (−1.20)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
<i>R</i> ²	0.5015	0.2170	0.4996	0.1914
<i>N</i>	20927	20927	20927	20927

Note: ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Hence, to differentiate biodiversity risk from climate risk and focus specifically on the impact of biodiversity risk exposure on external financing strategies, we use China's provincial Climate Policy Uncertainty (*CPU*) index as a measurement for climate

risk (Y.-R. Ma et al. 2023). As exhibited in Columns (3) and (4) in Table 8, the positive impact of corporate biodiversity risk exposure on debt financing remains consistent after adding *CPU* as a control variable. The coefficients of *Brisk* on *Formal* and

TABLE 7 | Robustness check: PSM.

	Nearest neighbour matching		Calliper matching	
	(1)	(2)	(3)	(4)
	<i>Formal</i>	<i>Informal</i>	<i>Formal</i>	<i>Informal</i>
<i>Brisk</i>	0.0069*** (2.83)	0.0045* (1.67)	0.0066*** (2.79)	0.0049* (1.86)
<i>Size</i>	−0.0072*** (−4.13)	−0.0201*** (−11.65)	−0.0068*** (−3.93)	−0.0199*** (−12.84)
<i>Roa</i>	−0.0233 (−1.34)	−0.0074 (−0.35)	−0.0269 (−1.62)	−0.0037 (−0.18)
<i>Age</i>	0.0049 (0.96)	0.0065 (1.14)	0.0050 (1.03)	0.0086 (1.58)
<i>Leverage</i>	0.4888*** (48.77)	−0.1231*** (−12.30)	0.4908*** (50.41)	−0.1244*** (−12.75)
<i>Growth</i>	0.0140*** (4.92)	0.0119*** (4.10)	0.0137*** (4.99)	0.0103*** (3.77)
<i>Cash</i>	0.3868*** (15.14)	−0.2774*** (−11.95)	0.3936*** (15.94)	−0.2659*** (−12.07)
<i>_cons</i>	0.0588 (1.47)	0.5140*** (12.54)	0.0492 (1.25)	0.5036*** (13.65)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
<i>R</i> ²	0.4931	0.1941	0.5077	0.2167
<i>N</i>	18394	18167	20909	20909

Note: ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Informal are significantly positive at the 1% and 10% levels, respectively, indicating that corporate biodiversity risk exerts a significant influence on debt financing that is independent of climate risk.

5 | Mechanism Analysis

This section examines the mechanisms through which firms' biodiversity risk positively impacts debt financing, with a particular focus on internal liquidity shortage, equity pricing penalty and debt maturity adjustment, which is consistent with our mechanism hypotheses.

5.1 | Internal Liquidity Shortage

Generally, firms with ample cash reserves have little incentive to seek costly external financing (R. Huang and Ritter 2021). However, aligning with the earlier discussion on the view of liquidity shortage, firms with greater exposure to biodiversity

risk may experience internal liquidity constraints, prompting a heavier reliance on external financing. As a result, these firms are more likely to increase their levels of debt financing.

We employ the dependence on external financing (*Dependence*) to proxy for internal liquidity shortage, which is defined as capital expenditures minus cash flow from operations divided by capital expenditures (Rajan and Zingales 1998). The higher the degree of reliance on external financing, the more severe the shortage of internal liquidity. Then, to examine whether internal liquidity shortage acts as a channel, we estimate the direct impact of biodiversity risk on *Dependence*:

$$Dependence_{i,t} = \beta_0 + \beta_1 Brisk_{i,t-1} + \sum_i \beta_i Controls_{i,t-1} + \delta_j + d_t + \epsilon_{i,t}. \quad (3)$$

As seen in Column (1) in Table 9, the coefficient of *Brisk* on *Dependence* is positive and is significant at the 1% level, indicating that corporate biodiversity risk exposure heightens internal liquidity shortage and external financing need, thereby leading to increased debt expansion.

TABLE 8 | Robustness check: Alternative measures and climate risk control.

	Alternative measures		Climate risk control	
	(1) <i>Alt_Formal</i>	(2) <i>Alt_Informal</i>	(3) <i>Formal</i>	(4) <i>Informal</i>
<i>Brisk</i>	0.7943*** (5.36)	0.0173*** (3.15)	0.0084*** (3.01)	0.0050* (1.65)
<i>CPU</i>			−0.0089** (−2.45)	0.0139*** (3.29)
<i>Size</i>	1.3604*** (16.93)	−0.0344*** (−10.82)	−0.0084*** (−4.34)	−0.0206*** (−11.50)
<i>Roa</i>	−11.4155*** (−9.30)	−0.1808*** (−4.08)	−0.0030 (−0.15)	0.0269 (1.16)
<i>Age</i>	0.2330 (0.81)	0.0001 (0.00)	0.0082 (1.33)	0.0061 (0.92)
<i>Leverage</i>	19.0148*** (35.78)	−0.3533*** (−16.92)	0.5072*** (45.72)	−0.1191*** (−10.54)
<i>Growth</i>	1.4573*** (8.86)	0.0077 (1.35)	0.0165*** (5.07)	0.0133*** (4.21)
<i>Cash</i>	17.9137*** (14.24)	−0.5358*** (−10.78)	0.3919*** (13.24)	−0.2943*** (−11.19)
<i>_cons</i>	−23.0196*** (−11.95)	1.0045*** (13.51)	0.0911* (1.96)	0.4926*** (11.00)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
<i>R</i> ²	0.3746	0.2273	0.4967	0.2280
<i>N</i>	20927	20927	14249	14249

Note: ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

5.2 | Equity Pricing Penalty

Biodiversity risk introduces information asymmetry and legitimacy concerns that impose a measurable pricing penalty in public capital markets. In the context of China's ongoing biodiversity conservation efforts, firms exposed to biodiversity risk face higher operational and compliance costs, which heighten perceived uncertainty over long-term earnings prospects and expose them to legitimacy discounts from public investors (Bansal and Clelland 2004). As dispersed shareholders cannot accurately verify firms' true ecological exposure, they demand higher risk premiums, raising the cost of equity financing (Lyandres 2007). Debt financing remains relatively more accessible and cost-effective, hence making it a more feasible choice for biodiversity-exposed firms seeking external capital.

To quantify this pricing penalty, we adopt the cost of equity financing (*COC*). More specifically, according to Easton (2004), we utilise the well-known PEG model:

$$COC = \frac{\sqrt{EPS_{t+2} - EPS_{t+1}}}{P_t}, \quad (4)$$

where *EPS* and *P* denote the average earnings per share forecasted by analysts and stock end-price, respectively. A higher *COC* value indicates a more severe pricing penalty. Then, we estimate the direct impact of biodiversity risk on *COC*:

$$COC_{i,t} = \beta_0 + \beta_1 Brisk_{i,t-1} + \sum_i \beta_i Controls_{i,t-1} + \delta_j + d_t + \varepsilon_{i,t}. \quad (5)$$

Column (2) in Table 9 illustrates that *Brisk* positively impacts *COC*, significant at the 1% level. Therefore, elevated biodiversity risk triggers a pricing penalty in the stock market. Confronted with this prohibitively expensive equity capital, firms strategically restructure their financing hierarchy, pivoting toward debt financing to maintain operational continuity and meet investment demands.

TABLE 9 | Mechanism analysis.

	(1) <i>Dependence</i>	(2) <i>COC</i>	(3) <i>ShortDebt</i>
<i>Brisk</i>	0.3805*** (2.89)	0.0040*** (3.68)	0.0041** (2.30)
<i>Size</i>	−0.3448*** (−5.17)	0.0132*** (20.18)	−0.0110*** (−9.34)
<i>Roa</i>	−7.0085*** (−5.37)	0.1894*** (23.18)	−0.0891*** (−7.33)
<i>Age</i>	−0.3109 (−1.51)	−0.0060*** (−3.03)	0.0081** (2.23)
<i>Leverage</i>	2.4890*** (5.05)	0.0099** (2.54)	0.3058*** (40.66)
<i>Growth</i>	0.5944*** (2.65)	0.0208*** (13.81)	0.0035* (1.81)
<i>Cash</i>	17.8957*** (16.26)	0.1447*** (13.48)	0.0423** (2.54)
<i>_cons</i>	5.5302*** (3.57)	−0.2258*** (−15.46)	0.1790*** (6.56)
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
<i>R</i> ²	0.0485	0.1974	0.4061
<i>N</i>	20097	20927	20927

Note: ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

5.3 | Debt Maturity Adjustment

Several prior studies suggest that high-risk borrowers often can only secure shorter-maturity loans at higher yields (Dennis et al. 2000; Gottesman and Roberts 2004). In such cases, lenders mitigate risk by requiring collateral, increasing interest spreads or shortening loan maturities (Goss and Roberts 2011). For firms exposed to biodiversity risks, adjusting debt maturity toward shorter terms offers a practical mechanism for lenders to strengthen monitoring, thereby limiting risk-shifting behaviour and preserving firms' access to debt financing (Barnea et al. 1980). From the firm's perspective, raising short-term debt helps mitigate debt overhang problems and enhances financial flexibility. Thus, short-term borrowing serves as an effective governance tool to alleviate agency conflicts among lenders and managers for firms facing biodiversity risk.

We employ the short-term debt (*ShortDebt*) to capture firms' debt maturity adjustment, and then we estimate the direct impact of biodiversity risk on *ShortDebt*:

$$ShortDebt_{i,t} = \beta_0 + \beta_1 Brisk_{i,t-1} + \sum_i \beta_i Controls_{i,t-1} + \delta_j + d_t + \varepsilon_{i,t}. \quad (6)$$

TABLE 10 | Subsample analysis: changes in debt maturity.

	(1) <i>Firms with shortened maturities</i>	(2) <i>Firms with extended maturity</i>
<i>Brisk</i>	0.0063*** (2.64)	0.0048 (1.26)
<i>Size</i>	−0.0034** (−2.02)	−0.0193*** (−8.61)
<i>Roa</i>	−0.0665*** (−3.96)	0.0916*** (3.22)
<i>Age</i>	0.0036 (0.75)	0.0109 (1.55)
<i>Leverage</i>	0.4253*** (39.91)	0.5522*** (40.45)
<i>Growth</i>	0.0160*** (5.31)	0.0015 (0.31)
<i>Cash</i>	0.3129*** (12.10)	0.3936*** (11.05)
<i>_cons</i>	−0.0045 (−0.12)	0.3131*** (6.07)
Year FE	Yes	Yes
Industry FE	Yes	Yes
<i>R</i> ²	0.4746	0.4321
<i>N</i>	15134	5793

Note: ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Column (3) in Table 9 suggests an increase in short-term debt for firms exposed to biodiversity risk, which is significant at the 5% level. This result denotes that debt maturity adjustment toward short-term debt enables lenders to mitigate risk through enhanced monitoring, thereby reinforcing firms' access to debt financing.

To provide direct empirical evidence for this mechanism path, we conduct a subsample analysis based on changes in debt maturity. Specifically, given our baseline finding that biodiversity risk drives an increase in debt financing, we classify firms as having shortened maturities if they exhibit a net decrease in long-term debt relative to the previous year. As shown in Column (1) of Table 10, the positive impact of biodiversity risk on debt financing is significantly more pronounced in the group with shortened maturities. These findings corroborate that maturity shortening serves as a crucial contractual adjustment, thus enabling lenders to enhance monitoring and renegotiation through shorter cycles and, in turn, sustaining the firm's access to debt financing.

6 | Heterogeneity Analysis

Companies may respond differently to biodiversity risk depending on their internal attributes and external environments. Therefore, a comprehensive analysis of these factors is essential for capturing the potential heterogeneity in how corporate biodiversity risk exposure influences financing behaviour. In this section, we conduct a series of heterogeneity tests in terms of industry-level biodiversity dependence, external institutional environment and internal governance capacity.

6.1 | Industry-Level Biodiversity Dependence

Environmental degradation and resource depletion exert systemic impacts that extend beyond individual firms to affect entire sectors. Specifically, supply shortages driven by biodiversity risk precipitate fierce resource competition and escalate operational costs, thereby constraining fundamental performance. Firms in high-dependence sectors are uniquely vulnerable to such supply-side natural capital depletion. These inherent material constraints amplify the urgency for liquidity to buffer

against operational instability. Consequently, we posit that the influence of biodiversity risk exposure on debt financing is more pronounced for firms with high industry-level biodiversity dependence.

To investigate how the impact of biodiversity risk varies across industries, we employ a holding-based measure of industry-level biodiversity dependence (Giglio et al. 2025; Bach et al. 2025). Specifically, referring to Chen et al. (2025), we utilise a Chinese industry-level biodiversity risk exposure index using information on investments made by funds with an explicit biodiversity-focused mandate:

$$Brisk_{t,f}^I = w_{t,m}^I - w_{t,f}^I, \quad (7)$$

where $w_{t,m}^I$ and $w_{t,f}^I$ are the weight of industry I in the market portfolio and the fund's portfolio at time t , respectively. The final score is obtained by averaging across all relevant funds, with a higher score indicating greater industry sensitivity to biodiversity factors. Further, we classify firms into high and low industry-level biodiversity dependence based on the median value of this industry-level measure. As shown in Columns

TABLE 11 | Heterogeneity analysis: industry-level biodiversity dependence.

	High biodiversity dependence		Low biodiversity dependence	
	(1)	(2)	(3)	(4)
	<i>Formal</i>	<i>Informal</i>	<i>Formal</i>	<i>Informal</i>
<i>Brisk</i>	0.0088** (2.07)	0.0090** (2.09)	0.0041 (1.47)	0.0028 (0.92)
<i>Size</i>	−0.0096*** (−3.23)	−0.0180*** (−7.19)	−0.0059*** (−2.89)	−0.0185*** (−9.86)
<i>Roa</i>	−0.0254 (−0.88)	0.0063 (0.19)	−0.0226 (−1.15)	−0.0084 (−0.37)
<i>Age</i>	0.0205** (2.47)	0.0058 (0.66)	0.0006 (0.10)	0.0053 (0.87)
<i>Leverage</i>	0.5255*** (30.81)	−0.1226*** (−7.43)	0.4794*** (42.09)	−0.1194*** (−11.16)
<i>Growth</i>	0.0046 (0.97)	0.0137*** (2.93)	0.0145*** (4.45)	0.0061** (2.10)
<i>Cash</i>	0.3564*** (8.23)	−0.2160*** (−6.08)	0.4207*** (14.55)	−0.2722*** (−11.02)
<i>_cons</i>	0.0661 (1.01)	0.4460*** (7.14)	0.0438 (0.95)	0.4899*** (11.38)
<i>YearFE</i>	Yes	Yes	Yes	Yes
<i>IndustryFE</i>	Yes	Yes	Yes	Yes
<i>R²</i>	0.5633	0.2780	0.4955	0.2425
<i>N</i>	5699	5699	15228	15228

Note: ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

(1) and (2) in Table 11, *Brisk* has a significantly positive impact on both *Formal* and *Informal* for firms with high industry-level biodiversity dependence, with significance levels of 5%. However, no significant effect is observed for firms with low industry-level biodiversity dependence. Therefore, the positive impact of corporate biodiversity risk exposure on debt financing is more evident for firms with high industry-level biodiversity dependence.

6.2 | External Institutional Environment

Firms function as open systems; their decisions are not made in a vacuum but are effectively constrained by external pressures and facilitated by institutional resources. To capture this environmental heterogeneity, we analyse three key dimensions: (i) regional biodiversity attention, representing normative pressure from the public and media; (ii) industry competition, reflecting coercive discipline from the marketplace; and (iii) political connection, indicating the firm's embeddedness in the political system and access to critical institutional resources.

6.2.1 | Regional Biodiversity Attention

In regions with heightened biodiversity attention, firms are subject to stronger regulatory oversight and greater expectations for social responsibility, which increase compliance burdens and amplify their reliance on external financing (Zhou et al. 2025). According to *China's Strategy and Action Plan for Biodiversity Conservation (2011–2030)*, approved by the State Council of China in 2011, 35 priority biodiversity conservation areas are designated with higher ecological sensitivity. Firms operating in these regions face elevated regulatory and reputational risks, which in turn raise the cost of equity financing and make debt financing relatively more attractive. In contrast, firms outside these priority areas encounter less regulatory pressure, reducing the impact of biodiversity risk on their financing structure. Therefore, we posit that the influence of biodiversity risk on debt financing is more pronounced for firms operating in priority biodiversity conservation areas.

We classify firms into high and low regional biodiversity attention groups based on whether they are located in priority areas for biodiversity conservation. As shown in Columns (1) and (2) in Table 12, *Brisk* has a significantly positive impact on both

TABLE 12 | Heterogeneity analysis: regional biodiversity attention.

	High regional biodiversity attention		Low regional biodiversity attention	
	(1) <i>Formal</i>	(2) <i>Informal</i>	(3) <i>Formal</i>	(4) <i>Informal</i>
<i>Brisk</i>	0.0091*** (3.34)	0.0069** (2.24)	0.0005 (0.11)	−0.0001 (−0.01)
<i>Size</i>	−0.0069*** (−3.56)	−0.0203*** (−11.40)	−0.0088** (−2.32)	−0.0188*** (−6.33)
<i>Roa</i>	−0.0100 (−0.53)	−0.0129 (−0.55)	−0.0636* (−1.77)	0.0192 (0.48)
<i>Age</i>	0.0084 (1.48)	0.0100 (1.59)	−0.0001 (−0.01)	0.0038 (0.37)
<i>Leverage</i>	0.4828*** (44.06)	−0.1324*** (−11.69)	0.5251*** (25.93)	−0.1022*** (−5.30)
<i>Growth</i>	0.0137*** (4.43)	0.0107*** (3.40)	0.0124** (2.06)	0.0109* (1.96)
<i>Cash</i>	0.3711*** (12.64)	−0.2524*** (−9.68)	0.4779*** (10.44)	−0.3003*** (−7.54)
<i>_cons</i>	0.0423 (0.97)	0.5106*** (12.05)	0.0993 (1.19)	0.4891*** (7.01)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
<i>R2</i>	0.5026	0.2344	0.5172	0.1798
<i>N</i>	15189	15189	5738	5738

Note: ***, **and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Formal and *Informal* for firms located in regions with high biodiversity attention, with significance levels of 1% and 5%, respectively. However, no significant effect is observed for firms in regions with low biodiversity attention. Therefore, the positive impact of corporate biodiversity risk exposure on debt financing is more evident for firms located in regions with high biodiversity attention.

6.2.2 | Industry Competition

Industrial structure is a key determinant of a firm's external competitive intensity and the broader business environment, both of which significantly influence corporate environmental behaviours (Aghion et al. 2023). These behaviours, in turn, shape how firms respond to biodiversity risks. In highly competitive market environments, firms face intensified pressure to maintain operations and defend market share. When biodiversity conservation expectations are added to this pressure, equity investors may perceive these firms as riskier, thereby increasing the cost of equity financing and limiting its availability. Consequently, firms are more likely to turn to debt financing as a more accessible and flexible means to navigate the heightened

uncertainty. Therefore, we argue that the impact of biodiversity risk on corporate debt financing is more pronounced in industries characterised by intense industry competition.

Following prior studies (e.g., Giroud and Mueller 2011; Zheng et al. 2021), we use the Herfindahl Hirschman Index (*HHI*) of operating revenue as a measure of industry competition. We then divide the sample into two subgroups, i.e., high and low industry competition, based on the median value. As shown in Columns (1) and (2) in Table 13, under the presence of biodiversity risk, *Brisk* exhibits a positive impact on both *Formal* and *Informal*, significant at the 1% and 10% levels, respectively. This suggests that firms operating in highly competitive industries face greater external pressure, thereby strengthening the relationship between biodiversity risk exposure and corporate reliance on debt financing.

6.2.3 | Political Connection

China's economic system is distinguished by a dual structure comprising state-owned and non-state-owned enterprises. State-owned enterprises (SOEs), in particular, dominate many

TABLE 13 | Heterogeneity analysis: industry competition.

	High industry competition		Low industry competition	
	(1)	(2)	(3)	(4)
	<i>Formal</i>	<i>Informal</i>	<i>Formal</i>	<i>Informal</i>
<i>Brisk</i>	0.0129*** (3.53)	0.0066* (1.89)	0.0023 (0.88)	0.0036 (1.13)
<i>Size</i>	−0.0116*** (−4.94)	−0.0230*** (−12.37)	−0.0041** (−2.16)	−0.0171*** (−8.43)
<i>Roa</i>	0.0195 (0.75)	0.0460 (1.60)	−0.0444** (−2.24)	−0.0325 (−1.32)
<i>Age</i>	0.0137** (2.03)	0.0035 (0.48)	−0.0015 (−0.27)	0.0119* (1.95)
<i>Leverage</i>	0.5293*** (35.99)	−0.1003*** (−7.14)	0.4703*** (43.53)	−0.1393*** (−12.72)
<i>Growth</i>	0.0149*** (3.50)	0.0105** (2.49)	0.0105*** (3.07)	0.0081** (2.37)
<i>Cash</i>	0.4305*** (11.49)	−0.2808*** (−9.57)	0.3732*** (13.14)	−0.2438*** (−9.04)
<i>_cons</i>	0.1130** (2.14)	0.5720*** (12.62)	0.0171 (0.40)	0.4407*** (9.51)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
<i>R</i> ²	0.5209	0.2281	0.4954	0.2365
<i>N</i>	8845	8845	12082	12082

Note: ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

traditional high-carbon industries that are heavily reliant on natural ecosystems and contribute substantially to environmental degradation (Zhu and Hou 2022). Given that SOEs are ultimately controlled by the government, they are expected to shoulder greater social and environmental responsibilities (Fan et al. 2011). As biodiversity risks intensify, SOEs are subject to stricter regulatory oversight, rising compliance costs and mounting pressure to support national environmental objectives. In fulfilling these expectations, especially considering their policy-driven nature, SOEs often engage in more ambitious green transition initiatives. These efforts, however, require substantial financing resources, thus increasing the reliance of SOEs on both formal and informal debt channels. Their perceived implicit government guarantee and superior credit standing enhance their attractiveness to banks and suppliers, thereby improving their access to bank loans and trade credit in the face of biodiversity risk.

We divide our sample into two subsamples, i.e., SOEs and non-SOEs, according to their equity ownership. SOEs are characterised by strong political connections, whereas non-SOEs lack such ties. As shown in Table 14, *Brisk* has a significantly positive effect on *Formal* and *Informal* for SOEs with a strong political connection. In contrast, the effect is statistically insignificant

for non-SOEs. Overall, the positive association between corporate biodiversity risk exposure and debt financing is more pronounced for firms with strong political connections.

6.3 | Internal Governance Capacity

Firms with stronger mitigation mechanisms are generally more resilient to biodiversity-related threats and can adjust their financial strategies more effectively. Such capacity reflects a firm's ability to anticipate, manage and adapt to environmental challenges, potentially influencing how it adjusts financing decisions in the face of biodiversity risk. To capture this, we focus on two critical aspects, i.e., green governance and board governance, as they reflect both environmental commitment and oversight effectiveness relevant to biodiversity risk management.

6.3.1 | Green Governance

Green governance reflects a firm's strategic focus on environmental sustainability, manifested through concrete green practices. In the context of China's ongoing efforts to conserve

TABLE 14 | Heterogeneity analysis: political connection.

	Weak political connection		Strong political connection	
	(1)	(2)	(3)	(4)
	<i>Formal</i>	<i>Informal</i>	<i>Formal</i>	<i>Informal</i>
<i>Brisk</i>	0.0085 (1.41)	−0.0060 (−1.05)	0.0060** (2.39)	0.0056* (1.96)
<i>Size</i>	−0.0081** (−2.19)	−0.0163*** (−5.15)	−0.0051*** (−2.72)	−0.0193*** (−10.30)
<i>Roa</i>	−0.0912* (−1.69)	−0.0358 (−0.62)	−0.0076 (−0.45)	0.0076 (0.35)
<i>Age</i>	−0.0088 (−0.74)	−0.0145 (−1.25)	0.0078 (1.54)	0.0124** (2.05)
<i>Leverage</i>	0.4865*** (19.32)	−0.1221*** (−5.60)	0.5020*** (49.93)	−0.1202*** (−11.37)
<i>Growth</i>	−0.0053 (−0.75)	0.0093 (1.18)	0.0131*** (4.51)	0.0080*** (2.72)
<i>Cash</i>	0.5846*** (6.92)	−0.2048*** (−3.28)	0.3713*** (14.97)	−0.2678*** (−11.57)
<i>_cons</i>	0.0989 (1.12)	0.4777*** (5.92)	0.0043 (0.10)	0.4799*** (11.20)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
<i>R</i> ²	0.5466	0.3038	0.5049	0.2017
<i>N</i>	3203	3203	17724	17724

Note: ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

biodiversity, firms increasingly prioritise long-term sustainability by reallocating resources, such as reducing cash holdings and investing more in green innovation (Zhou et al. 2025). As a long-term endeavour, green governance gradually shapes a firm's financing orientation. With environmental concerns gaining traction, more lenders now incorporate environmental performance into credit assessments, reshaping firms' external financing conditions (X. Li et al. 2019; Jung et al. 2018). In response, firms with stronger green governance may gain greater credibility and bargaining power within supply chains, enabling them to access more flexible financing options such as trade credit (Adhikari et al. 2025). In contrast, firms with weaker green governance are often excluded from such advantages and thus rely more heavily on traditional bank borrowing when facing biodiversity-related financial pressures.

We adopt the natural logarithm of the number of green patent applications, which encompasses a wide range of environmental innovations, as a proxy for green governance. A higher number of green patent applications means a stronger green governance capacity. Then, we divide the samples into two subgroups, i.e., strong green governance and weak green governance, based on the median value. As shown in Table 15, the coefficients of *Brisk*

are positive across Columns (1)–(4). Nonetheless, *Brisk* exhibits a statistically significant effect on *Informal* at the 10% level for firms with strong green governance, and on *Formal* at the 1% level for firms with weak green governance, while the positive effects for other groups are not significant. Accordingly, effective green governance facilitates the adoption of sustainable supply chain practices. Its absence may signal higher environmental risk and weaker compliance, thereby limiting access to informal financing and compelling firms to rely more heavily on formal bank credit, typically subject to stricter monitoring. In short, in response to biodiversity risk, firms with strong green governance are more likely to increase trade credit, while those with weak levels rely more heavily on bank loans.

6.3.2 | Board Governance

Board governance reflects the quality and effectiveness of internal oversight and high-level strategic decision-making. Strong board governance helps mitigate agency conflicts among stakeholders and ensures the efficient allocation of corporate resources, which is critical for long-term planning and effective risk management (Damert and Baumgartner 2018; Ludwig and

TABLE 15 | Heterogeneity analysis: green governance.

	Strong green governance		Weak green governance	
	(1)	(2)	(3)	(4)
	<i>Formal</i>	<i>Informal</i>	<i>Formal</i>	<i>Informal</i>
<i>Brisk</i>	0.0029 (0.81)	0.0068* (1.78)	0.0089*** (3.28)	0.0033 (1.06)
<i>Size</i>	−0.0087*** (−3.81)	−0.0206*** (−10.35)	−0.0024 (−1.24)	−0.0181*** (−8.52)
<i>Roa</i>	−0.0902*** (−3.40)	−0.0234 (−0.75)	0.0151 (0.80)	0.0082 (0.35)
<i>Age</i>	0.0053 (0.68)	0.0070 (0.95)	0.0048 (0.94)	0.0093 (1.48)
<i>Leverage</i>	0.4643*** (33.40)	−0.1558*** (−11.41)	0.5104*** (46.66)	−0.1081*** (−9.48)
<i>Growth</i>	0.0167*** (3.66)	0.0045 (1.05)	0.0113*** (3.56)	0.0135*** (3.91)
<i>Cash</i>	0.5061*** (12.57)	−0.2422*** (−6.97)	0.3452*** (12.67)	−0.2781*** (−11.15)
<i>_cons</i>	0.0913* (1.77)	0.5401*** (11.46)	−0.0461 (−1.04)	0.4560*** (9.36)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
<i>R</i> ²	0.4790	0.2720	0.5227	0.1880
<i>N</i>	7363	7363	13564	13564

Note: ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Sassen 2022). Under heightened biodiversity risk, firms with weaker board governance tend to experience greater operational and managerial uncertainty. This not only exposes them to increased litigation, financial and reputational risks but also undermines external trust and credibility. As a result, these firms may find it difficult to access informal or flexible financing options and are more likely to rely on formal bank credit, which typically involves stricter oversight and lending conditions. In contrast, firms with strong boards possess better internal control, diverse professional expertise and broader stakeholder networks. These strengths enhance their transparency and credibility in the eyes of external partners, increasing their bargaining power within the supply chain.

To investigate the effect of board governance, we separate the samples into weak and strong board governance according to the median value of board size. A larger board size denotes stronger board governance. In Table 16, *Brisk* exhibits a significantly positive effect on *Informal* among firms with strong board governance (at the 5% level), whereas for firms with weak board governance, its positive impact is observed on *Formal* (at the 1% level). Therefore, firms with larger boards are better positioned to navigate biodiversity risks, making them more likely to access

trade credit within the supply chain, compared to those with weaker governance structures. In summary, strong board governance strengthens the positive linkage between biodiversity risk and the use of trade credit, while weak board governance structures drive firms to depend more heavily on bank loans.

7 | Further Analysis

So far, we have underscored the positive impact of corporate biodiversity risk exposure on debt financing, with a clear articulation of the underlying mechanisms and sources of heterogeneity. However, the broader economic consequences remain insufficiently understood. In this section, we proceed to assess how biodiversity-induced financing adjustments translate into real economic outcomes. To this end, we use debt financing cost (*Debtcost_t*), measured as the ratio of financial expenses to total liabilities at the end of the period (S. Li, Chen, et al. 2025a) and return on assets at the end of the period (*Roa_t*) to proxy for these impacts.

As demonstrated earlier, when confronted with heightened biodiversity risk, firms tend to increase their reliance on debt

TABLE 16 | Heterogeneity analysis: board governance.

	Strong board governance		Weak board governance	
	(1) <i>Formal</i>	(2) <i>Informal</i>	(3) <i>Formal</i>	(4) <i>Informal</i>
<i>Brisk</i>	0.0046 (1.03)	0.0103** (2.26)	0.0072*** (2.72)	0.0032 (1.08)
<i>Size</i>	−0.0049 (−1.63)	−0.0245*** (−10.32)	−0.0082*** (−4.26)	−0.0180*** (−10.19)
<i>Roa</i>	−0.0366 (−1.17)	0.0005 (0.01)	−0.0122 (−0.67)	−0.0025 (−0.11)
<i>Age</i>	−0.0006 (−0.06)	0.0108 (1.17)	0.0085 (1.62)	0.0090 (1.55)
<i>Leverage</i>	0.4579*** (26.12)	−0.1268*** (−7.71)	0.5072*** (48.16)	−0.1247*** (−11.60)
<i>Growth</i>	0.0110* (1.87)	0.0025 (0.45)	0.0134*** (4.54)	0.0127*** (4.16)
<i>Cash</i>	0.4506*** (8.63)	−0.2599*** (−6.09)	0.3857*** (14.43)	−0.2689*** (−11.38)
<i>_cons</i>	0.0253 (0.37)	0.5965*** (10.42)	0.0659 (1.54)	0.4630*** (11.23)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
<i>R</i> ²	0.4907	0.2578	0.5089	0.2085
<i>N</i>	4477	4477	16450	16450

Note: ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

TABLE 17 | Further analysis: economic consequences.

	(1) <i>Debtcost_t</i>	(2) <i>Roa_t</i>
<i>Brisk</i>	0.0381** (1.98)	−0.0055** (−2.15)
<i>Size</i>	−0.0601*** (−3.84)	0.0059*** (6.11)
<i>Roa</i>	−1.1633*** (−4.55)	0.5152*** (22.43)
<i>Age</i>	0.0337 (0.82)	0.0029* (1.68)
<i>Leverage</i>	1.2941*** (13.80)	−0.1024*** (−13.43)
<i>Growth</i>	0.0701** (2.56)	0.0056 (1.18)
<i>Cash</i>	1.2465*** (6.20)	0.0371** (2.42)
<i>_cons</i>	0.4832 (1.37)	−0.0901*** (−4.40)
Year FE	Yes	Yes
Industry FE	Yes	Yes
<i>R</i> ²	0.0716	0.1425
<i>N</i>	16604	20927

Note: ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

financing, which remains relatively more accessible. This preference stems from the fact that lenders can more effectively manage risk exposure through adjustments in debt structure. As shown in Table 17, *Brisk* significantly increases *Debtcost_t* and reduces *Roa_t*, with both effects statistically significant at the 5% level. In response to elevated perceived risk, creditors demand higher risk premiums and tighten lending conditions, including shortening debt maturities, which is highlighted in our mechanism analysis. Consequently, the cost of debt rises, imposing greater financial pressure on firms. This financial strain may hinder firms' investment efficiency. On one hand, high borrowing costs may lead to underinvestment in profitable projects due to debt overhang; on the other hand, firms may engage in risk-shifting behaviour by overinvesting in high-risk projects (Trinh 2023; S. Li, Chen, et al. 2025). Both paths can adversely affect firm performance, as reflected in a decline in return on assets. These findings underscore the broader economic implications of biodiversity risk. Beyond influencing financing structure, biodiversity risk indirectly affects corporate value creation and resource allocation efficiency. This suggests that addressing biodiversity risk exposure is not only a matter of sustainability but also of financial strategy and long-term performance resilience.

8 | Conclusion

Using a rich sample of Chinese A-share listed companies from 2009 to 2023, this study empirically investigates the effect of corporate biodiversity risk on external financing choices. Through the lens of our proposed FHD framework, our results highlight that firms exposed to biodiversity risk rely more on both formal and informal debt financing, particularly short-term debt. This distortion is primarily driven by heightened information frictions and legitimacy concerns, which precipitate internal liquidity shortages, equity pricing penalty and subsequent debt maturity adjustments. Furthermore, our heterogeneity analysis reveals that the positive association between biodiversity exposure and debt financing is more pronounced among firms facing (i) high industry-level biodiversity dependence, and (ii) a strong external institutional environment. In addition, firms with stronger internal governance capacity are more inclined to utilise trade credit than bank loans. These adjustments in external financing strategies, driven by biodiversity risk, lead to higher debt costs and reduced returns on assets, reflecting the broader economic consequences of biodiversity exposure. Based on these findings, we put forth the following recommendations for relevant policymakers and corporate managers.

On the policy side, government ministries and financial authorities should take several actions. First, the China Securities Regulatory Commission (CSRC) and the Ministry of Ecology and Environment (MEE) should collaborate to incorporate biodiversity-related risks into financial risk assessments and disclosure frameworks, encouraging firms to enhance transparency regarding their exposure and mitigation strategies. Second, to alleviate firms' excessive reliance on debt financing under biodiversity pressure, the People's Bank of China (PBOC) and the National Financial Regulatory Administration (NFRA) can introduce supportive policies such as biodiversity-linked financing instruments and targeted credit incentives. Third, macroeconomic and industrial planning departments, such as the National Development and Reform Commission (NDRC) and the Ministry of Industry and Information Technology (MIIT), should provide tailored guidance for firms operating in highly competitive industries or regions with heightened biodiversity awareness, where the financial impacts are more pronounced. Finally, these joint authorities should promote the development and accessibility of alternative financing channels, such as trade credit, to help firms with strong risk management capacity better adapt to biodiversity-related challenges.

On the corporate side, managers are advised to adopt a more forward-looking and adaptive financing strategy. First, improving internal capital efficiency and liquidity management can help reduce dependence on costly external debt. Second, firms should strengthen their communication with shareholders to maintain investor confidence, especially in the face of biodiversity-related uncertainty. Third, as biodiversity exposure increases short-term debt, firms should rebalance debt structures, such as extending maturities where possible, to help mitigate the maturity mismatch and refinancing risks. Finally, strengthening biodiversity risk mitigation capabilities should be a managerial priority, which not only reduces financial vulnerability but also allows more flexible access to trade credit, thereby improving financial resilience.

Author Contributions

Yang Zhou: formal analysis; methodology; investigation; initial draft; final draft. **Nizhou Yu:** methodology; initial draft. **Brian M. Lucey:** project administration. **Yueyang Wang:** data curation.

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Conflicts of Interest

The authors have nothing to report.

Endnotes

¹ See more details in <https://www.cbd.int/article/2020-UN-Biodiversity-Summit>.

References

- Adhikari, H. P., D. G. More, and N. B. Sah. 2025. "Climate Change Exposure and Short-Termism: Evidence From Net Trade Credit." *International Review of Financial Analysis* 103: 104193. <https://doi.org/10.1016/j.irfa.2025.104193>.
- Aghion, P., R. Bénabou, R. Martin, and A. Roulet. 2023. "Environmental Preferences and Technological Choices: Is Market Competition Clean or Dirty?" *American Economic Review: Insights* 5, no. 1: 1–20. <https://doi.org/10.1257/aeri.20210014>.
- Ahmad, M. F., and A. Karpuz. 2024. "Beyond Climate Change Risk: Biodiversity and Corporate Cash Holdings." *Economics Letters* 236: 111608. <https://doi.org/10.1016/j.econlet.2024.111608>.
- Bach, T. N., K. Hoang, and T. Le. 2025. "Biodiversity Risk and Firm Performance: Evidence From US Firms." *Business Strategy and the Environment* 34, no. 1: 1113–1132. <https://doi.org/10.1002/bse.4039>.
- Balachandran, B., and J. H. Nguyen. 2018. "Does Carbon Risk Matter in Firm Dividend Policy? Evidence From a Quasi-Natural Experiment in an Imputation Environment." *Journal of Banking and Finance* 96: 249–267. <https://doi.org/10.1016/j.jbankfin.2018.09.015>.
- Balakrishnan, S., and I. Fox. 1993. "Asset Specificity, Firm Heterogeneity and Capital Structure." *Strategic Management Journal* 14, no. 1: 3–16. <https://doi.org/10.1002/smj.4250140103>.
- Bansal, P., and I. Clelland. 2004. "Talking Trash: Legitimacy, Impression Management, and Unsystematic Risk in the Context of the Natural Environment." *Academy of Management Journal* 47, no. 1: 93–103. <https://doi.org/10.5465/20159562>.
- Barnea, A., R. A. Haugen, and L. W. Senbet. 1980. "A Rationale for Debt Maturity Structure and Call Provisions in the Agency Theoretic Framework." *Journal of Finance* 35, no. 5: 1223–1234. <https://doi.org/10.1111/j.1540-6261.1980.tb02205.x>.
- Barrett, S. 2022. "A Biodiversity Hotspots Treaty: The Road Not Taken." *Environmental and Resource Economics* 83: 937–954. <https://doi.org/10.1007/s10640-022-00670-5>.
- Bastien-Olvera, B. A., and F. C. Moore. 2021. "Use and Non-Use Value of Nature and the Social Cost of Carbon." *Nature Sustainability* 4: 101–108. <https://doi.org/10.1038/s41893-020-00615-0>.
- Bedendo, M., E. Garcia-Appendini, and L. Siming. 2020. "Cultural Preferences and Firm Financing Choices." *Journal of Financial and Quantitative Analysis* 55, no. 3: 897–930. <https://doi.org/10.1017/S0022109019000103>.
- Cao, D., G. Lorenzoni, and K. Walentin. 2019. "Financial Frictions, Investment, and Tobin's q." *Journal of Monetary Economics* 103: 105–122. <https://doi.org/10.1016/j.jmoneco.2018.08.002>.
- Chen, Z.-H., J. Derwall, X. Gao, and K. Koedijk. 2025. "Does Biodiversity Risk Matter to Capital Markets? New Evidence From China." *SSRN Electronic Journal*: 5067186. <https://ssrn.com/abstract=5067186>.
- Czarnitzki, D., and K. Kraft. 2009. "Capital Control, Debt Financing and Innovative Activity." *Journal of Economic Behavior and Organization* 71, no. 2: 372–383. <https://doi.org/10.1016/j.jebo.2009.03.017>.
- Damert, M., and R. J. Baumgartner. 2018. "External Pressures or Internal Governance What Determines the Extent of Corporate Responses to Climate Change?" *Corporate Social Responsibility and Environmental Management* 25, no. 4: 473–488. <https://doi.org/10.1002/csr.1473>.
- DeAngelo, H., L. DeAngelo, and T. M. Whited. 2011. "Capital Structure Dynamics and Transitory Debt." *Journal of Financial Economics* 99, no. 2: 235–261. <https://doi.org/10.1016/j.jfineco.2010.09.005>.
- Denis, D. J., and V. T. Mihov. 2003. "The Choice Among Bank Debt, Non-Bank Private Debt, and Public Debt: Evidence From New Corporate Borrowings." *Journal of Financial Economics* 70, no. 1: 3–28. [https://doi.org/10.1016/S0304-405X\(03\)00140-5](https://doi.org/10.1016/S0304-405X(03)00140-5).
- Dennis, S., D. Nandy, and L. G. Sharpe. 2000. "The Determinants of Contract Terms in Bank Revolving Credit Agreements." *Journal of Financial and Quantitative Analysis* 35, no. 1: 87–110. <https://doi.org/10.2307/2676240>.
- Diamond, D. W. 1984. "Financial Intermediation and Delegated Monitoring." *Review of Economic Studies* 51, no. 3: 393–414. <https://doi.org/10.2307/2297430>.
- DiMaggio, P. J., and W. W. Powell. 1983. "The iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields." *American Sociological Review* 48, no. 2: 147–160.
- D'Mello, R., and F. Toscano. 2020. "Economic Policy Uncertainty and Short-Term Financing: The Case of Trade Credit." *Journal of Corporate Finance* 64: 101686. <https://doi.org/10.1016/j.jcorpfin.2020.101686>.
- Easton, P. D. 2004. "PE Ratios, PEG Ratios, and Estimating the Implied Expected Rate of Return on Equity Capital." *Accounting Review* 79, no. 1: 73–95. <https://doi.org/10.2308/accr.2004.79.1.73>.
- eBird. 2025. "eBird: An Online Database of Bird Distribution and Abundance [Web Application]." <http://www.ebird.org>. Accessed 2025.
- Fan, J. P., K. J. Wei, and X. Xu. 2011. "Corporate Finance and Governance in Emerging Markets: A Selective Review and an Agenda for Future Research." *Journal of Corporate Finance* 17, no. 2: 207–214. <https://doi.org/10.1016/j.jcorpfin.2010.12.001>.
- Ferrando, A., and K. Mulier. 2013. "Do Firms Use the Trade Credit Channel to Manage Growth?" *Journal of Banking and Finance* 37, no. 8: 3035–3046. <https://doi.org/10.1016/j.jbankfin.2013.02.013>.
- Flammer, C., T. Giroux, and G. M. Heal. 2025. "Biodiversity Finance." *Journal of Financial Economics* 164: 103987. <https://doi.org/10.1016/j.jfineco.2024.103987>.
- Frankel, R., H. Levy, and R. Shalev. 2017. "Factors Associated With the Year-End Decline in Working Capital." *Management Science* 63, no. 2: 438–458. <https://doi.org/10.1287/mnsc.2015.2351>.
- Garel, A., A. Romec, Z. Sautner, and A. F. Wagner. 2024. "Do Investors Care About Biodiversity?" *Review of Finance* 28, no. 4: 1151–1186. <https://doi.org/10.1093/rof/rfae010>.

- Giglio, S., T. Kuchler, J. Stroebel, and O. Wang. 2024. "The Economics of Biodiversity Loss Working Paper 32678." National Bureau of Economic Research. <https://doi.org/10.3386/w32678>.
- Giglio, S., T. Kuchler, J. Stroebel, and X. Zeng. 2026. "Biodiversity Risk." *Review of Finance* 30, no. 1: 131–161. <https://doi.org/10.1093/rf/rfaf063>.
- Giroud, X., and H. M. Mueller. 2011. "Corporate Governance, Product Market Competition, and Equity Prices." *Journal of Finance* 66, no. 2: 563–600. <https://doi.org/10.1111/j.1540-6261.2010.01642.x>.
- Goss, A., and G. S. Roberts. 2011. "The Impact of Corporate Social Responsibility on the Cost of Bank Loans." *Journal of Banking and Finance* 35, no. 7: 1794–1810. <https://doi.org/10.1016/j.jbankfin.2010.12.002>.
- Gottesman, A. A., and G. S. Roberts. 2004. "Maturity and Corporate Loan Pricing." *Financial Review* 39, no. 1: 55–77. <https://doi.org/10.1111/j.0732-8516.2004.00067.x>.
- Haque, F., and M. J. Jones. 2020. "European Firms Corporate Biodiversity Disclosures and Board Gender Diversity From 2002 to 2016." *British Accounting Review* 52, no. 2: 100893. <https://doi.org/10.1016/j.bar.2020.100893>.
- Hart, S. L. 1995. "A Natural-Resource-Based View of the Firm." *Academy of Management Review* 20, no. 4: 986–1014. <https://doi.org/10.5465/amr.1995.9512280033>.
- He, F., L. Chen, and B. M. Lucey. 2024. "Chinese Corporate Biodiversity Exposure." *Finance Research Letters* 70: 106275. <https://doi.org/10.1016/j.frl.2024.106275>.
- Huang, G.-Y., C. H. Han Shen, and Z.-X. Wu. 2023. "Firm-Level Political Risk and Debt Choice." *Journal of Corporate Finance* 78: 102332. <https://doi.org/10.1016/j.jcorpfin.2022.102332>.
- Huang, R., and J. R. Ritter. 2021. "Corporate Cash Shortfalls and Financing Decisions." *Review of Financial Studies* 34, no. 4: 1789–1833. <https://doi.org/10.1093/rfs/hhaa099>.
- Jory, S. R., H. D. Khieu, T. N. Ngo, and H. V. Phan. 2020. "The Influence of Economic Policy Uncertainty on Corporate Trade Credit and Firm Value." *Journal of Corporate Finance* 64: 101671. <https://doi.org/10.1016/j.jcorpfin.2020.101671>.
- Jung, J., K. Herbohn, and P. Clarkson. 2018. "Carbon Risk, Carbon Risk Awareness and the Cost of Debt Financing." *Journal of Business Ethics* 150, no. 4: 1151–1171. <https://doi.org/10.1007/s10551-016-3207-6>.
- Kalhor, M. R., and K. Kyaw. 2024. "Manage Biodiversity Risk Exposure?" *Finance Research Letters* 61: 104989. <https://doi.org/10.1016/j.frl.2024.104989>.
- Karolyi, G. A., and J. Tobin-de la Puente. 2023. "Biodiversity Finance: A Call for Research Into Financing Nature." *Financial Management* 52, no. 2: 231–251. <https://doi.org/10.1111/fima.12417>.
- Kennedy, S., M. Fuchs, W. van Ingen, and D. Schoenmaker. 2023. "A Resilience Approach to Corporate Biodiversity Impact Measurement." *Business Strategy and the Environment* 32, no. 5: 2567–2582. <https://doi.org/10.1002/bse.3140>.
- Krishnaswami, S., and V. Subramaniam. 1999. "Information Asymmetry, Valuation, and the Corporate Spin-Off Decision." *Journal of Financial Economics* 53, no. 1: 73–112. [https://doi.org/10.1016/S0304-405X\(99\)00017-3](https://doi.org/10.1016/S0304-405X(99)00017-3).
- Leland, H. E. 1998. "Agency Costs, Risk Management, and Capital Structure." *Journal of Finance* 53, no. 4: 1213–1243. <https://doi.org/10.1111/0022-1082.00051>.
- Li, S., Z. Chen, Y. Diao, and Z. Chen. 2025. "The Impact of Green Finance on Debt Financing Costs From the Perspective of Strategic Corporate Signaling Behavior Evidence From China." *International Review of Financial Analysis* 102: 104024. <https://doi.org/10.1016/j.irfa.2025.104024>.
- Li, X., C. Lin, and X. Zhan. 2019. "Does Change in the Information Environment Affect Financing Choices?" *Management Science* 65, no. 12: 5676–5696. <https://doi.org/10.1287/mnsc.2018.3096>.
- Li, Y., X. Liu, J. Canil, and C. S. Cheong. 2025. "Biodiversity Risk and Firm Efficiency." *Finance Research Letters* 71: 106414. <https://doi.org/10.1016/j.frl.2024.106414>.
- Liang, C., J. Yang, L. Shen, and D. Dong. 2024. "The Role of Biodiversity Risk in Stock Price Crashes." *Finance Research Letters* 67: 105856. <https://doi.org/10.1016/j.frl.2024.105856>.
- Lucey, B. M., A. Urquhart, and S. Vigne. 2025. "Biodiversity, Financial Markets, and Systemic Risk: A Synthesizing Review." *Journal of Climate Finance* 13: 100078. <https://doi.org/10.1016/j.jclimf.2025.100078>.
- Ludwig, P., and R. Sassen. 2022. "Which Internal Corporate Governance Mechanisms Drive Corporate Sustainability?" *Journal of Environmental Management* 301: 113780. <https://doi.org/10.1016/j.jenvman.2021.113780>.
- Lyandres, E. 2007. "Costly External Financing, Investment Timing, and Investment-Cash Flow Sensitivity." *Journal of Corporate Finance* 13, no. 5: 959–980. <https://doi.org/10.1016/j.jcorpfin.2007.07.001>.
- Ma, F., H. Wu, and Q. Zeng. 2024. "Biodiversity and Stock Returns." *International Review of Financial Analysis* 95: 103386. <https://doi.org/10.1016/j.irfa.2024.103386>.
- Ma, Y.-R., Z. Liu, D. Ma, et al. 2023. "A News-Based Climate Policy Uncertainty Index for China." *Scientific Data* 10, no. 1: 881. <https://doi.org/10.1038/s41597-023-02817-5>.
- Myers, S. C., and N. S. Majluf. 1984. "Corporate Financing and Investment Decisions When Firms Have Information That Investors Do Not Have." *Journal of Financial Economics* 13, no. 2: 187–221. [https://doi.org/10.1016/0304-405X\(84\)90023-0](https://doi.org/10.1016/0304-405X(84)90023-0).
- Owolabi, A., M. M. Mousavi, G. Gozgor, and J. Li. 2025. "The Impact of Firm-Level Political Risk on Eco-Innovation: The Moderating Effect of CEO Power." *Business Strategy and the Environment* 34, no. 2: 2650–2666. <https://doi.org/10.1002/bse.4124>.
- Petersen, M. A., and R. G. Rajan. 1997. "Trade Credit: Theories and Evidence." *Review of Financial Studies* 10, no. 3: 661–691. <https://doi.org/10.1093/rfs/10.3.661>.
- Pi, T., L. Jiao, Y. Zhou, and J. Shi. 2025. "Can Biodiversity Risk Improve Firm ESG Performance? Empirical Evidence From China." *Finance Research Letters* 76: 106931. <https://doi.org/10.1016/j.frl.2025.106931>.
- Rajan, R., and L. Zingales. 1998. "Financial Development and Growth." *American Economic Review* 88, no. 3: 559–586.
- Ren, X., W. Li, K. Duan, and A. Urquhart. 2025. "Carbon Risk and Debt Financing: An International Perspective." *Journal of International Money and Finance* 153: 103294. <https://doi.org/10.1016/j.jimonfin.2025.103294>.
- Reynolds, S. J., F. C. Schultz, and D. R. Hekman. 2006. "Stakeholder Theory and Managerial Decision-Making: Constraints and Implications of Balancing Stakeholder Interests." *Journal of Business Ethics* 64, no. 3: 285–301. <https://doi.org/10.1007/s10551-005-5493-2>.
- Safiullah, M., M. N. Kabir, and M. D. Miah. 2021. "Carbon Emissions and Credit Ratings." *Energy Economics* 100: 105330. <https://doi.org/10.1016/j.eneco.2021.105330>.
- Sharfman, M. P., and C. S. Fernando. 2008. "Environmental Risk Management and the Cost of Capital." *Strategic Management Journal* 29, no. 6: 569–592. <https://doi.org/10.1002/smj.678>.
- Shyam-Sunder, L., and S. C. Myers. 1999. "Testing Static Tradeoff Against Pecking Order Models of Capital Structure." *Journal of Financial Economics* 51, no. 2: 219–244. [https://doi.org/10.1016/S0304-405X\(98\)00051-8](https://doi.org/10.1016/S0304-405X(98)00051-8).

- Suchman, M. C. 1995. "Managing Legitimacy: Strategic and Institutional Approaches." *Academy of Management Review* 20, no. 3: 571–610. <https://doi.org/10.5465/amr.1995.9508080331>.
- Treepongkaruna, S. 2024. "Corporate Sustainability and Biodiversity Reporting: A Proactive Business Strategy to Mitigate Litigation and Reputational Risks." *Business Strategy and the Environment* 33, no. 7: 6640–6651. <https://doi.org/10.1002/bse.3840>.
- Trinh, H. H. 2023. "Biodiversity Risks and Corporate Investment." *SSRN Electronic Journal*: 4587333. <https://ssrn.com/abstract=4587333>.
- Van Toor, J., D. Piljic, G. Schellekens, M. van Oorschot, and M. Kok. 2020. "Indebted to Nature: Exploring Biodiversity Risks for the Dutch Financial Sector." De Nederlandsche Bank (DNB) and PBL Netherlands Environmental Assessment Agency. <https://www.dnb.nl/media/4c3fqawd/indebted-to-nature.pdf>.
- Wang, T., and S. Thornhill. 2010. "R&D Investment and Financing Choices: A Comprehensive Perspective." *Research Policy* 39, no. 9: 1148–1159. <https://doi.org/10.1016/j.respol.2010.07.004>.
- Wu, S., M. Hong, and K. Zhang. 2025. "Pilot Free Trade Zones, Technological Innovation, and Corporate Debt Financing Capacity." *Finance Research Letters* 86: 108375. <https://doi.org/10.1016/j.frl.2025.108375>.
- Yang, G., and Y. Li. 2025. "Research on Biodiversity Risk and Corporate Short-Term Debt for Long-Term Use Under Disclosure Regulation." *Finance Research Letters* 77: 107049. <https://doi.org/10.1016/j.frl.2025.107049>.
- Zhao, Y., X. Qu, and B. Lucey. 2025. "Managerial Myopia and Biodiversity Alignment Evidence From China." *International Review of Financial Analysis* 100: 103974. <https://doi.org/10.1016/j.irfa.2025.103974>.
- Zheng, Z., Y. Lin, X. Yu, and X. Liu. 2021. "Product Market Competition and the Cost of Equity Capital." *Journal of Business Research* 132: 1–9. <https://doi.org/10.1016/j.jbusres.2021.04.013>.
- Zhou, Y., B. M. Lucey, and F. He. 2025. "Dividend Payouts and Biodiversity Risk Chinese Evidence." *Research in International Business and Finance* 76: 102792. <https://doi.org/10.1016/j.ribaf.2025.102792>.
- Zhu, B., and R. Hou. 2022. "Carbon Risk and Dividend Policy: Evidence From China." *International Review of Financial Analysis* 84: 102360. <https://doi.org/10.1016/j.irfa.2022.102360>.