

Biodiversity Risk, Audit Pricing, and the Institutionalization of Ecological Risk

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ABSTRACT

This study examines the influence of enterprise-level biodiversity risk monitoring indicators on audit fees using a sample of Chinese A-share listed businesses from 2016 to 2021. The research finds that biodiversity risk is significantly positively correlated with audit fees. The reasons mainly include two aspects: first, verifying complex biological assets and compliance with environmental regulations requires increased audit investment; second, a risk premium needs to be charged for potential lawsuits and reputational losses related to environmental scandals. This research makes two principal contributions: first, it expands the research scope of the economic consequences of biodiversity. Second, it adds to the body of knowledge about the factors that influence audit fees.

Keywords: Biodiversity risk; Audit pricing; Ecological risk; Institutionalization; Professional judgment

INTRODUCTION

In the face of mounting worldwide environmental crises, biodiversity loss has emerged as a critical issue that transcends environmental concerns to exert profound impacts on corporate operations, capital market behavior, and regulatory frameworks. As a core component of environmental, social, and governance (ESG) performance, biodiversity has gradually shifted from a peripheral topic to a central consideration in corporate decision-making and stakeholder evaluation. While existing literature extensively documents the financial impacts of climate change and carbon emissions, biodiversity loss has received comparatively less attention, despite being recognized by the World Economic Forum as a top global risk. Unlike carbon emissions, which are fungible and global, biodiversity risks are location-specific and complex. As corporations face increasing pressure to account for their ecological footprint, a critical question arises regarding the external assurance of this information. Auditors, as key gatekeepers of capital markets, must assess whether these environmental risks threaten a firm's financial viability or reporting accuracy. However, it remains unclear whether auditors actively incorporate these specific ecological risks into their pricing decisions. This paper addresses this gap by asking: Does corporate biodiversity risk affect audit fees?

To address this question, we examine a sample of Chinese A-share listed companies from 2016 to 2021. Using a firm-level measure of biodiversity risk, we find a significant positive relationship between biodiversity risk and audit fees. Our analysis indicates that auditors charge higher fees for two main reasons: the increased audit effort required to verify complex biological assets and compliance with environmental laws, and the risk premium needed to mitigate potential liabilities and reputational damage associated with environmental scandals.

This research offers two key advances for theoretical understanding and applied contexts. First, it expands the academic inquiry into the economic consequences of biodiversity. Prior research has largely focused on how biodiversity disclosure affects stock prices or firm value (Akyildirim & Corbet, 2024). We shift the focus to the cost of external assurance, providing direct evidence that biodiversity risk is not just an externality but a tangible cost that firms pay through higher audit pricing. We distinguish biodiversity from general "environmental" or "carbon" risk, highlighting its unique impact on firm financial reporting.

Second, our work augments the established body of research concerning the factors that influence audit pricing. Traditional audit fee models predominantly center on financial metrics (such as firm size, leverage ratio, and return on assets) or general corporate governance attributes. By contrast, we identify biodiversity risk as a non-financial factor affecting audit pricing. Our empirical findings indicate that amid an era of stringent environmental regulation, auditors perceive ecological damage as a key driver of inherent risk and client business risk.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Current scholarship primarily addresses two domains: The economic consequences brought about by biodiversity and the determinant of audit fees.

Literature on the Economic Consequences of Biodiversity

Bach et al. (2024) investigate the influence of biodiversity risk on corporate outcomes by employing a novel metric of firm-specific risk derived from textual analysis of 10-K filings. Their study finds that biodiversity risk reduces sales growth and profit margins, while raising the cost of goods sold. These effects are more pronounced for companies operating in industries particularly vulnerable to biodiversity impacts.

The study by Xi (2024) reveals a significant gap in corporate reporting focused explicitly on biodiversity, and analyzes how such disclosure impacts firm market value, establishing a strong positive correlation between the extent of biodiversity information disclosed and a company's market valuation (Xi, 2024).

Literature on the Determinant of Audit Fees

Audit fees are influenced by various factors, which can be categorized into determinants related to the audited entity, the auditor, the corporate governance structure, and other determinants. Firstly, the size of the audited entity is usually positively correlated with audit fees; larger companies typically exhibit more intricate operational structures, higher transaction volumes, and a broader range of businesses, necessitating that auditors devote more time and resources to complete the audit work (Saputra et al., 2024). Secondly, the higher the financial risk of the audited entity, the greater the audit risk faced by the auditor, requiring more extensive audit procedures to reduce the risk of assuming responsibility for misstatements in the financial statements, which usually leads to an increase in audit fees. Additionally, the quality and consistency of accounting information are closely related to audit fees (Fan & Zhang, 2023). Regarding factors related to the auditor, large auditing firms, such as the "Big Four," are generally regarded as having higher auditing quality and stronger professional capabilities, allowing them to charge higher audit fees (Harshani, 2008). In terms of corporate governance structure, the proportion of management's holdings and the concentration of equity impact audit fees, with research indicating a negative correlation between management holdings and audit fees (Munisi, 2023). Other determinants include biodiversity risk exposure, which correlates with increased audit charges, whereas comprehensive environmental disclosures can efficiently mitigate audit risk, resulting in reduced audit pricing (Steindl et al., 2025). Additionally, Hou et al. (2022) found a significant inverse correlation between the ESG performance of listed companies and audit fees in China, indicating that better ESG performance leads to lower audit fees, particularly for non-state-owned firms audited by the Big Four. The investigation by Zhang et al. (2023) similarly observed that corporations providing ESG information are inclined to encounter elevated audit charges, where superior ESG disclosure scores are linked to heightened audit fees; moreover, an augmentation in the disclosure rating for any individual ESG pillar (environmental, social, or governance) results in increased audit costs.

Hypotheses Development

A notable positive correlation exists between the biodiversity-related risks encountered by corporations and their yearly audit charges. Specifically, the biodiversity risks may enhance a company's annual audit fees through several pathways listed below:

Firstly, at workload level. Biodiversity risks increase inherent and controlled risks, driving a surge in audit workload (Steindl, 2025). For example, companies depending on natural resources such as agriculture, mining, and forestry relies heavily on natural resources. The negative impacts of biodiversity loss pose a significant threat to companies' raw material supply. Companies with high environmental risks face significantly greater uncertainty in asset valuation and contingent liabilities, posing a material risk of misstatement in financial statements. These factors substantially increase inherent risk. Auditors must devote greater effort to verify the reasonableness of valuation and impairment testing for assets such as inventory, property, plant, and equipment.

Additionally, emerging and stringent biodiversity regulations pose significant compliance risks (De Carvalho, 2022). The most representative examples are the EU Corporate Sustainability Reporting Directive (CSRD) and its accompanying European Sustainability Reporting Standards (ESRS), with ESRS E4 specifically addressing "Biodiversity and Ecosystems." This standard requires companies to disclose in detail their dependence on

biodiversity, impacts, risks, and management strategies. This directly creates significant control risks. Companies must establish new internal control systems to collect and disclose biodiversity data. Any deficiencies in these internal controls could lead to misstatements in sustainability reporting and related financial information. Consequently, auditors must broaden their risk assessments and test the effectiveness of these new controls.

Finally, litigation and reputation risks arising from ecological damage constitute direct contingent liabilities (Phelps, 2021). When companies inflict negative impacts on ecosystems, they may face substantial litigation, fines, and remediation costs. For instance, the Samarco dam collapse in Brazil not only caused a massive ecological disaster but also resulted in tens of billions of dollars in compensation and lawsuits. Estimating such contingent liabilities is highly complex, while their potential financial impact remains incalculable. Auditors must dedicate substantial additional audit time to evaluate whether management's accounting treatment of these contingent matters is appropriate and whether disclosures are adequate.

In terms of premium level, Biodiversity risks heighten auditors' own professional risks. As gatekeepers of information integrity in capital markets, auditors' legal liabilities and brand reputation are intrinsically linked to their clients' conduct.

On one hand, auditors face heightened litigation risks. Should a company in a biodiversity-sensitive industry—such as oil or mining—suffer a financial crisis due to environmental violations, investors and regulators will hold all relevant parties accountable. Auditors who fail to disclose such risks in their audit reports or overlook financial issues stemming from environmental problems are highly likely to become targets of class-action lawsuits. For instance, auditors involved in the Brazilian dam collapse case faced rigorous scrutiny. This threat arising from clients' environmental issues leads auditors to demand higher fees when serving high-biodiversity-risk clients, thereby offsetting potential litigation costs and settlement expenses.

On the other hand, the audit firms own reputation faces a serious threat. An audit firm's brand reputation is their core competitive advantage (Gunn et al, 2024). Being perceived as complicit in environmental destruction would severely damage their public image, thereby undermining their ability to attract and retain high-quality clients. To protect their reputation, audit firms implement stricter quality control procedures for audit engagements involving high biodiversity risks. This typically manifests as adding additional layers of internal review, such as requiring a second review by a relevant technical department proficient in ESG matters or by a senior partner. For clients with high biodiversity risks, the audit process is no longer a linear path but a complex network incorporating multiple checkpoint nodes. These additional layers of review consume the firm's most expensive and scarce resources, directly driving up the cost of audit services. This ultimately manifests as higher audit fees.

In the hypotheses, this paper identifies three core components that collectively shape pricing: audit effort, litigation risk premium, and engagement complexity. For audit effort, companies facing high biodiversity risks necessitate auditors to perform more extensive substantive testing and conduct deeper risk assessments to address the unique environmental-related uncertainties. The litigation risk premium also plays a pivotal role—legal risks associated with environmental violations exert a highly significant influence on auditors' pricing strategies, prompting them to charge higher fees to effectively cover potential risk costs arising from such non-compliance. Additionally, engagement complexity has risen notably as a result of CSRD and ESRS policies, which impose more detailed disclosure requirements and stricter compliance testing standards, further contributing to the upward trend in audit fees.

Based on the above analysis, this study proposes the following hypothesis:

H1: There exists a significant correlation between corporate biodiversity risks and the relevant audit fees.

Sample and Data Sources

This study investigates the effect of Biodiversity risk on corporate audit fees by analyzing data from Chinese A-share listed companies from 2016 to 2021. The procedure for selecting the sample is outlined below: First, financing firms are excluded because they have significant differences with other firms in terms of their main business, company size, and disclosure. Second, *ST companies are excluded due to substantial discrepancies in their financial metrics and disclosure practices compared to other companies; third, companies listed in the current year are excluded as their shorter tenure as a public company results in a more limited history of available information and notable variations in their disclosure standards; finally, the samples with missing audit fees and control variables are excluded. Ultimately, a total of 15274 valid observations is obtained for the period 2016-2021. To minimize the effect of extreme observations on the analytical outcomes, continuous variables in this paper are winsorized at the 1% and 99% levels. The financial data is obtained from the CSMAR database.

Empirical Model

To validate the effect of using biodiversity risk on firms audit fee, the following model was used:

$$Audit\ Fee_{i,t+1} = a_0 + \beta_1 Biodiversity\ Risk + \gamma X + \delta + \varphi + \varepsilon \quad (1)$$

The dependent variable(Y) audit fees are charges levied by audit firms for providing audit services to audited entities. These fees are typically determined based on multiple factors, including the complexity, scope, risk, and manpower required for the audit work. Audit fees not only cover the costs of basic audit services but may also include additional services and other related expenses.; the main independent variable biodiversity risk encompasses two main dimensions: One is impact risk: The risk that a firm's activities directly harm biodiversity , which can lead to regulatory penalties, reputation damage, or loss of market access. Another is dependency risk: The risk that a firm relies on ecosystem services that may be degraded or lost, threatening its supply chains or operations; and the control variables include the size of the firm (SIZE, taking the natural logarithm with total assets), gearing ratio (LEV, dividing total liabilities by total assets) and return on assets (ROA, dividing net profit by total assets), while controlling for yearly and firm fixed effects, and lagged one-period values (N+1) are used for all independent and control variables.

Table 1: Variable Definition

Variable Type	Variable Name	Variable Value Description
Explained Variables	Audit fee	Audit fees are charges levied by audit firms for providing audit services to audited entities
Explanatory Variables	Biodiversity Risk	using the textual analyses and sentiment analysis, this study adopts the negative biodiversity-related words to define biodiversity risks
	Year	Year fixed effects
Control Variables	Size	The natural logarithm of the company's total assets
	PPE	Fixed assets/ Total assets
	Lev	Total liabilities / Total assets
	Growth	(This year's sales revenue- last year's sales revenue)/ last year's sales revenue
	ROA	Net income / Total assets
	Indep	Proportion of independent directors
	Board	The natural logarithm of the board directors
	SOE	State-owned Enterprises
	CURRA	The proportion of tradable shares

EMPIRICAL RESULTS

Table 2 presents the descriptive statistical summary for the key variables under investigation. Specifically, the variable *AuditFee* has a mean value of 13.938 and a standard deviation of 0.596, with its 25th and 75th percentiles standing at 13.528 and 14.286, respectively. For *BioRisk*, the mean is 0.043 and the standard deviation is 0.878. Combined with its 25th and 75th percentiles of -0.224 and 0.063, these figures suggest that the biological risk level of most sample enterprises remains relatively low. For the control variables, the mean value of Size is 22.367, and the standard deviation is 1.223, indicating that our sample firms size varies greatly. The mean value of PPE and Lev are 0.201 and 0.430, respectively. while those of Growth and ROA reach 0.161 and 0.030. The mean values of the remaining four control variables are 0.378, 2.108, 0.323 and 0.828.

Table 2: Descriptive Statistics

Variable	N	Mean	SD	p25	p50	p75
AuditFee	15274	13.938	0.596	13.528	13.864	14.286
BioRisk	15274	0.043	0.878	-0.224	-0.052	0.063
Size	15274	22.367	1.223	21.498	22.230	23.092
PPE	15274	0.201	0.153	0.082	0.170	0.287

Lev	15274	0.430	0.199	0.274	0.423	0.572
Growth	15274	0.161	0.366	-0.018	0.110	0.269
ROA	15274	0.030	0.078	0.012	0.035	0.065
Indep	15274	0.378	0.054	0.333	0.364	0.429
Board	15274	2.108	0.195	1.946	2.197	2.197
SOE	15274	0.323	0.468	0.000	0.000	1.000
CURRA	15274	0.828	0.212	0.702	0.928	1.000

Tables 3 and 4 present the regression outcomes analyzing the association between BioRisk and firm AuditFee. Industry and year fixed effects are incorporated into the models. In Table 3, without control variables, the coefficient on *BioRisk* is 0.051 and is statistically significant at the 1% level, indicating a positive association between *BioRisk* and AuditFee. In Table 4, with control variables, the coefficient on *BioRisk* is 0.013 and is statistically significant at the 1% level, indicating a positive association between *BioRisk* and AuditFee.

Table 3: Univariate Regression Results

	AuditFee
BioRisk	0.051***
	(6.93)
_cons	13.814***
	(169.55)
Year FE	YES
Industry FE	YES
N	15274
Adjusted R ²	0.075

Table 4: Multivariate Regression Results

	AuditFee
BioRisk	0.013***
	(3.29)
Size	0.372***
	(46.72)
PPE	-0.167***
	(-3.15)
Lev	0.133***
	(3.08)
Growth	-0.009
	(-0.85)
ROA	-0.776***
	(-10.92)
Indep	-0.027
	(-0.19)
Board	0.015
	(0.35)
SOE	-0.118***
	(-6.91)
BVPS	-0.003
	(-1.22)
CURRA	-0.095***
	(-3.70)
_cons	5.734***

	(31.11)
Year FE	YES
Industry FE	YES
N	15274
Adjusted R ²	0.556

In the baselines results, industry and year fixed effects are controlled for. For robustness concern, Tables 5 and 6 further controls for firm and year fixed effects to mitigate the influence of time-invariant firm-level characteristics and potential time trend (Luo and Wu, 2022; Jin and Wu, 2023). In Table 5, without control variables, the coefficient on *BioRisk* is 0.004 and is statistically significant at the 5% level, indicating a positive association between *BioRisk* and *AuditFee*. In Table 6, with control variables, the coefficient on *BioRisk* is 0.004 and is statistically significant at the 5% level, indicating a positive association between *BioRisk* and *AuditFee*.

Table 5: Robustness Tests (1)

	AuditFee
BioRisk	0.004**
	(2.05)
_cons	13.938***
	(163577.53)
Year FE	YES
Firm FE	YES
N	15274
Adjusted R ²	0.923

Table 6: Robustness Tests (2)

	AuditFee
BioRisk	0.004**
	(2.40)
Size	0.258***
	(13.68)
PPE	0.159***
	(3.46)
Lev	0.099***
	(2.64)
Growth	0.003
	(0.44)
ROA	-0.258***
	(-6.61)
Indep	-0.094
	(-1.25)
Board	0.008
	(0.29)
SOE	0.042**
	(2.06)
BVPS	-0.002
	(-1.15)
CURRA	-0.042***
	(-2.91)
_cons	8.145***
	(19.31)
Year FE	YES

Firm FE	YES
N	15274
Adjusted R ²	0.935

CONCLUSION

This study investigates the relationship between biodiversity risk and audit fees by using a sample of Chinese A-share listed firms from 2016 to 2021 with 15,274 valid observations. Specifically, without control variables, the coefficient of biodiversity risk is 0.051, which is statistically significant at the 1% level. After the inclusion of control variables, specifically firm size and ROA, and while continuing to account for industry and year fixed effects, the coefficient of biodiversity risk remains 0.013 and still passes the 1% significance test. Further robustness tests that control for firm and year fixed effects indicate that regardless of the empirical setting, biodiversity risk significantly boosts corporate audit fees, and the conclusion is robust.

We acknowledge that this study also has certain limitations. The research sample is limited to Chinese A-share listed firms, and the institutional background of China's capital market and environmental regulation may make the research conclusions have certain applicability boundaries, which may not be fully generalized to enterprises in other countries or regions.

And Future research can significantly expand the framework by embracing cross-country settings and advancing comprehensive database.

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