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Research article

Transforming experience into action: the role of organisational learning on biodiversity engagement in banks

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ABSTRACT

This paper offers a novel dynamic learning-based perspective to explain why some banks engage with biodiversity. Drawing on the Organisational Learning Theory and Dynamic Capabilities Theory, we suggest that repetitive use over time of sustainable governance tools fosters long-term internal capabilities that enhance responses to complex environmental challenges. Using a fixed-effects panel regression on 3614 bank-year observations from 671 banks operating in 66 countries from 2016 to 2023, we find that sustainability experience – measured as the number of years a bank has adopted ESG-linked compensation or sustainability committees – is positively associated with biodiversity engagement in the banking industry. The effect emerges only after an 8-year threshold, suggesting a cumulative learning process. Robustness checks, including alternative dependent variables, a two-stage least squares model, propensity score matching and entropy balance, support the validity of the results. We also show that this relationship is stronger and emerges earlier in megadiverse countries, where ecological pressures are more salient. Overall, our results call for a shift in evaluating environmental sustainability: managers should embed it into decision-making routines as part of a long-term learning journey, supported by ongoing leadership commitment.

1. Introduction

Environmental crises represent some of the most pressing challenges for global sustainability. While climate change is a significant concern for scientific and policy-making communities due to its extensive impacts, the importance of loss in biodiversity – i.e., the decline in the variety of life forms on Earth – is often underestimated. Recent estimates report that approximately one million species are currently at risk of extinction, many within the coming decades, unless urgent measures are taken to mitigate the intensity of drivers of biodiversity loss (IPBES, 2019).

Although biodiversity is typically studied within ecological and environmental sciences, there is a growing interest in examining biodiversity loss and ecosystem degradation in current finance research. However, empirical studies on biodiversity finance are still relatively challenging to develop as neither companies nor Environmental, Social and Governance (ESG) literature has prioritised the development of practical tools and methods to measure and communicate the impacts and dependencies of business on biodiversity (Kopnina et al., 2024).

Only a handful of recent contributions in finance have begun assessing the biodiversity decline effect to demonstrate that the financial impact could be severe in businesses that are highly dependent on natural ecosystems. For instance, Li et al. (2025) show that investors require higher returns from companies significantly exposed to biodiversity risks, thereby increasing their financing costs, as such firms are perceived to entail higher risk due to regulatory uncertainty, operational disruptions, and reputational concerns. Companies may also face increased production expenses because essential ecosystem services (e.g., pollination, water purification, and soil fertility) deteriorate in quality or become less accessible. As a result, they need to redirect resources away from productive investments and find alternatives or implement mitigation solutions, thus leading to a reduction in productivity, operational efficiency, and growth (Bach et al., 2025). The above evidence is even more concerning considering the magnitude of

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businesses exposed to biodiversity risks. Carvalho et al. (2023) found that approximately $20 trillion of corporate enterprise value is exposed to material biodiversity dependency risks, with $7.2 trillion linked to unmanaged risks. Surprisingly, the study reveals that in 2018, only 30 % of companies exposed to biodiversity risks had adopted any biodiversity policy.

The financial sector is not immune to these risks. For instance, banks face indirect exposure through lending, investment, and other financial activities (Azizi et al., 2025). By financing companies, banks might support firms that harm the environment through land-use change, overexploitation of natural resources, or pollution. Thus, they can experience biodiversity-related risks due to asset value reductions, legal consequences, and reputational damage when financed companies negatively impact biodiversity (Mulder and Koellner, 2011). Recent estimates show that 75 % of corporate lending relies on at least one essential ecosystem service, with bank losses expected to grow by three times their current value if the Paris Agreement target scenarios diverge from projection estimates (Boldrini et al., 2023). Similarly, Hadji-Lazaro et al. (2024) report that French financial institutions hold 40 % of their corporate bond value in companies that depend heavily on at least one critical ecosystem service, highlighting the need for better risk assessments for the financial sector.

Motivated by recent calls for further research suggested by the existing literature (e.g., Cosma et al., 2023; Karolyi and Tobin-de la Puente, 2023) which stress the need to advance the understanding of how financial institutions can effectively engage and address biodiversity-related risks, we respond by shifting the focus away from external institutional pressures and the static presence of specific governance tools towards a dynamic learning-based prospective as a novel internal driver to explain corporate biodiversity attention. To the best of our knowledge, this is the first study that analyses this additional channel in the context of biodiversity finance literature. Indeed, prior studies (e.g., Coqueret et al., 2025; El Ouadghiri et al., 2025; Garel et al., 2024) have predominantly focused on how investor awareness and institutional signals, such as the Kunming Declaration in 2021, have negatively impacted stock market valuations of companies with high biodiversity impacts. On the other hand, other contributions have examined how the presence of specific sustainable governance structures and board attributes can significantly influence the biodiversity disclosure. For instance, Orazalin et al. (2025) demonstrate that firms with stronger corporate governance, measured by the presence of shareholder protection, CSR practices, and management effectiveness, develop capabilities that promote biodiversity reporting. The authors also demonstrate that national governance quality (rule of law, absence of corruption, and regulatory quality) improves the above mechanism. However, even without stronger institutional pressures, Duho et al. (2024) show that companies tend to standardise biodiversity disclosure due to normative and mimetic isomorphism or by participating in voluntary frameworks. Additional research in corporate governance (e.g., Haque and Jones, 2020; Velte, 2023; Velte, 2024; Hambali and Adhariani, 2024) shows that the presence of sustainable investors, larger and a more independent board or a higher presence of female directors can enhance environmental performance and biodiversity disclosure by encouraging firms to treat environmental issues as strategic priorities rather than marginal concerns. This is because better CSR practices serve to receive external legitimacy and align with major institutional pressures and societal demands (Candio, 2024). Moreover, Issa and Zaid (2023) signal that eco-innovation, consumption reduction, and CSR-related awards can enhance corporate biodiversity disclosure, as these actions are perceived as a sign of credible environmental commitment.

However, it is worth noting that the effectiveness of governance structures alone can be insufficient unless supported by internal learning processes, organisational expertise and board-level proactive engagement (Bhatia and Jakhar, 2021; Derchi et al., 2021). Starting from this premise, we extend biodiversity finance literature by arguing that internal knowledge and the cumulative years of sustainability-related experience can act as an additional potential driver to explain why financial institutions engage with biodiversity. We explain this mechanism based on the insights of the Organisational Learning Theory and the Dynamic Capability Theory. We believe that the motivation behind this analysis becomes particularly relevant when considering the current limitations in how financial institutions assess and monitor biodiversity-related risks. First, there is a general lack of granular and systematic data on banks' direct exposure to biodiversity-related risks (Mundaca and Heintze, 2024). This complicates the application of alternative analytical approaches. Second, biodiversity remains significantly underrepresented in mainstream ESG scores, where climate-related metrics largely dominate the environmental dimension, while biodiversity considerations receive minimal attention (Zhu and Carrasco, 2025). Third, prior literature mainly focuses on general environmental dimensions, indicating that biodiversity represents a niche theme within banking sustainability strategies, often overshadowed by more institutionalised topics like climate change. Indeed, banks struggle to integrate biodiversity into their operational strategy as governance factors, operational barriers, lack of reliable data, capacities, and organisational inertia can constitute a significant obstacle (Mundaca and Heintze, 2024).

To conduct our research, we construct a novel proxy for organisational sustainability experience defined as the cumulative number of years in which a bank has implemented at least one of the following governance tools: (i) ESG-linked executive remuneration and/or (ii) a dedicated sustainability committee. Indeed, the presence of sustainability committees and the introduction of incentives for pursuing sustainable objectives in managers' compensation, observed over a long historical period, predating the growing attention on biodiversity, arise from clear and strong strategic directions. Implementing projects and pursuing eco-sustainable objectives requires knowledge and skills that are refined and strengthened over time, in a natural learning process that applies to all fields, well known as "learning by doing." Therefore, measuring the years in which the bank has adopted these tools to implement, incentivise, and monitor its sustainability strategies can be considered a good proxy for the advancement of knowledge and experience in the field, which cannot be precisely measured without directly interviewing the managers responsible for these processes at various levels. To examine whether this matured experience fosters biodiversity-related engagement over time, we use a global sample of 671 listed banks between 2016 and 2023. In line with the organisation learning perspective and dynamic capability, our results show that accumulated sustainability experience is significantly and positively associated with biodiversity engagement. Since biodiversity is still a niche issue, unregulated and not measured with universal standard metrics, only those who know how to safely and profitably manage sustainable activities can act as pioneers in undertaking projects specifically related to biodiversity, assessing their risks and potential returns. This is because a sustainable governance mechanism can enhance managerial expertise, supporting faster decisions and better information flow (Driss et al., 2024). Moreover, we also find that the relationship between experience and biodiversity engagement emerges only after a critical threshold of continuity: a few years of experience show no effect, while positive effects become stronger only from the 8th year onward. Finally, this learning process is context-dependent, stronger, and faster in megadiverse areas (i.e., biodiversity-rich countries), where ecological concerns are more salient and institutional pressures more intense in line with the protection motivation theory. These findings suggest the existence of a cumulative learning effect where banks progressively learn how to translate knowledge gained via governance mechanisms into tangible environmental actions. Our main results are robust to various robustness checks, including alternative model specifications, measurement variations, and endogeneity assessments.

Our study makes several important contributions to the literature. First, we extend the biodiversity finance literature by introducing

sustainability-related experience as a novel internal driver to explain why organisations engage with biodiversity, thus offering a more comprehensive understanding of the determinants of corporate biodiversity engagement. Specifically, we go beyond the external institutional pressure perspective (e.g., Garel et al., 2024) and we complement the focus on governance structures (e.g., Orazalin et al., 2025) by highlighting how the accumulation of sustainability knowledge and routines through past ESG engagement can foster proactive attention to new environmental challenges. Second, we provide robust empirical evidence that such accumulated experience significantly enhances biodiversity engagement after a critical threshold of experience is reached. Third, we contribute to the emerging literature on biodiversity finance by uncovering context-dependent engagement patterns, showing that institutional and ecological environments shape the speed and effectiveness of sustainability learning. Fourth, we introduce a novel measure of ESG-based experience, which captures the cumulative nature of governance-based learning. Finally, our findings introduce insightful implications for managers, policymakers, and society about the necessity of framing the loss of biodiversity as a significant issue on par with climate change.

The remainder of the paper is structured as follows. Section 2 reviews the relevant literature and develops the research hypotheses. Section 3 describes the data, variables, and empirical methodology. Section 4 presents the main findings along with robustness checks. Section 5 concludes by discussing the theoretical contributions and outlining the managerial and policy implications.

2. Background and hypothesis development

2.1. Environmental performance, executive sustainable incentives and sustainability committees

An abundant stream of literature has been produced on the effectiveness of sustainability-linked incentives and sustainability committees in motivating management efforts toward better environmental achievements.

Over time, scholars have investigated the relationship between corporate governance and sustainability performance using several theories. Among these, the Stakeholder-Agency Theory (Hill and Jones, 1992) is particularly relevant for explaining the link between managerial incentive systems and environmental sustainability. According to the theory, agency conflicts arise when managers (agents) prioritise personal, short-term objectives over stakeholders' (principals) interests. These conflicts are especially relevant in sustainability, where long-term environmental goals may conflict with short-term financial performance (Cordeiro and Sarkis, 2008). Without dedicated incentives, executives may be less inclined to prioritise environmental goals, particularly when these initiatives require significant investments or may negatively impact short-term financial results. Tying compensation to environmental performance (e.g., carbon footprint reduction, biodiversity goals, or ESG ratings) serves as a governance mechanism to reduce agency costs by aligning managerial interests with broader long-term sustainability goals required by stakeholders. This alignment reduces managerial opportunism and promotes decisions consistent with maximising firm value and stakeholder welfare, lowering investment-related agency costs and encouraging executives to balance financial performance and long-term sustainability goals (Belghitar and Clark, 2015; Flammer and Bansal, 2017).

In line with Incentive Contracting Theory – which holds that linking executive pay to non-financial performance indicators can help mitigate agency conflicts – the inclusion of ESG metrics in CEO compensation enables boards to assess whether managerial decisions align with the long-term interests of stakeholders (Dutta and Reichelstein, 2003; Ittner et al., 1997). Since implementing sustainable strategies builds stakeholder trust (Nirino et al., 2021), companies might strengthen their legitimacy and establish long-term relationships with the main stakeholders by showing how they care about environmental issues. Thus, ESG incentives' rationale is comparable to integrating non-financial performance metrics into board pay (Cohen et al., 2023).

Campbell et al. (2007) show that CEO compensation includes a premium for environmental risk exposure, and this premium decreases when firm environmental performance is explicitly linked to compensation schemes, thus suggesting that such incentives help executives better manage exposure to non-financial risks. Hong et al. (2016) prove that strong governance and limited executive power boost executive incentives connected to environmental performance. According to them, the implementation of sustainability-linked remuneration contracts by companies results in substantial social performance enhancements, which become observable in the following years. This is further confirmed by Cordeiro and Sarkis (2008), who show that the relationship between a firm's environmental performance and CEO compensation emerges only when environmental outcomes are explicitly included in executive pay agreements. Their findings suggest that managers are unlikely to pursue sustainability goals unless they are directly incentivised to do so, due to the long-term nature and often uncertain returns of environmental initiatives. Cohen et al. (2023) recently documented an increasing usage of ESG targets within executive compensation packages. The study reveals that tying sustainability targets to executive incentives improves ESG performance, as firms seek to meet investor expectations, show their sustainability commitment, and align with regulations and peer practices. Moreover, sustainability-linked incentive plans guide executives to extend their strategic horizon and generate tangible outcomes, such as environmental initiatives and green innovations, by mitigating short-term pressures and refocusing managerial attention on long-term oriented stakeholders (Flammer et al., 2019).

However, the relationship between ESG incentives and corporate environmental performance is still unclear among scholars since they have not yet reached a consensus. Berrone and Gomez-Mejia (2009) and Haque and Ntim (2020) demonstrate that incentives linked to sustainability enable organisations to meet institutional pressures by implementing symbolic and formal environmental actions, such as policies, disclosures, or governance structures. However, these initiatives do not lead to genuine environmental commitment. According to them, this occurs because such actions are more visible, controllable, and less risky than genuine environmental efforts, and thus are more easily rewarded under incentive schemes. As a result, companies may create false impressions of environmental involvement, although they do not produce noteworthy environmental progress. Similarly, Haque (2017) argues that the symbolic use of sustainability incentives rewards easily reportable activities and actions instead of outcomes that require structural changes and long-term investments. In the context of the banking industry, Soana (2024) demonstrated how banks that tied executive compensation to sustainability criteria face ESG controversies more frequently. According to the author, this paradox arises because such incentive schemes drive organisations to boost their reputation instead of mitigating actual environmental risks, which are harder to manage.

The above literature points out that a formal sustainability-linked incentive policy may not be enough to ensure that top management prioritises environmental performance over financial outcomes. Conyon and Peck (1998) argue that a board of directors' compensation committee is crucial in evaluating CEO performance and structuring effective incentive plans for top executives, as monitoring executive conduct and implementing performance-based compensation reduces opportunistic behaviours. However, a simple compensation committee does not guarantee sufficient implementation of tangible ESG actions. Indeed, other organisational monitoring systems, such as environmental or CSR committees, enhance the supervisory process. This aligns with Burke et al. (2019), who claim that firms with a sustainability focus are more likely to set sustainability committees within their board of directors, as they are a mechanism to create shared value and meet diverse stakeholders' interests. Although companies may establish these committees

in response to institutional pressures (Luoma and Goodstein, 1999), at the same time, they also ensure that ESG initiatives become tangible achievements rather than remaining symbolic gestures (Hussain et al., 2018; Baraibar-Diez et al., 2019).

The Resource Dependency Theory has been employed to explain how sustainability committees enable organisations to reach strategic resources – such as knowledge, experience, and skills – that help improve firm sustainability strategies (Orazalin, 2020; Abdullah et al., 2024). Here, they are seen as fundamental strategic elements that enable firms to get the necessary external resources needed for enhancing performance and environmental complexity management (Orazalin, 2020). The Resource Dependency Theory suggests that organisations do not operate in isolation, but depend on critical resources found in the external environment. Since these resources are often scarce and controlled by other actors, companies must structure themselves in such a way as to manage this dependence and reduce uncertainty.

Establishing sustainability committees allows boards to specialise their knowledge, add technical expertise, and optimise operational efficiency by decentralising ESG oversight responsibilities, fastening the decision-making process, and reducing information asymmetries (Driss et al., 2024). This governance structure makes the directors carrying specific roles within the committee individually responsible for monitoring ESG-related policies and performance (Harrison, 1987). By monitoring social and environmental activities and identifying stakeholder needs, sustainability committees help companies meet stakeholders' interests and enable companies to integrate sustainability into their corporate strategy and reporting (Tahat and Hassanein, 2024). Furthermore, sustainability committees stimulate the allocation of resources and investment toward environmental initiatives (Bhuiyan et al., 2021). As a result, companies can signal an increased ESG commitment, thus, drawing socially responsible stakeholders who enhance external oversight, which in turn creates better ESG outcomes through reputational and financial pressures (García-Sánchez et al., 2019). However, the link between sustainability committees and environmental performance may not always be direct. For instance, Orazalin (2020) finds that board sustainability committees do not directly affect environmental performance but strengthen the firm's overall CSR strategy, thus fostering overall environmental and social outcomes.

Overall, the role of sustainability committees is not merely symbolic, but is truly associated with better environmental transparency, especially in contexts where external environmental monitoring institutions are too weak to monitor corporate environmental disclosure properly (Driss et al., 2024). However, a sustainability committee must be appropriately structured by including experienced non-executive and independent directors, appointing members with expertise in environmental sustainability, and allowing the sustainability committee some autonomy to carry out its duties (Oyewo, 2023).

2.2. Sustainability experience and biodiversity engagement

When a firm has a strong sustainability culture, sustainability practices are integrated throughout all levels of the organisational structure as shared values and beliefs influence decisions and behaviours across the organisation (Assoratgoon and Kantabutra, 2023). However, unlike mainstream environmental concerns like climate change or carbon emissions, banks struggle to integrate biodiversity into their organisational strategies due to its inherent complexity and scarcity of data (Mundaca and Heintze, 2024). Therefore, it seems unlikely, at least in the short run and at the beginning of their sustainability experience, that companies can enhance their specific commitment toward biodiversity by merely introducing ESG-based incentives in the board pay or setting up sustainability committees. Instead, it is reasonable to expect that, over time, companies should acquire environmental management expertise through practical experience, enabling them to build better systems for making decisions about biodiversity conservation.

This study draws on the Organisational Learning Theory (Levitt & March 1988) and Dynamic Capabilities Theory (Teece et al., 1997) to understand how banks with a more extended sustainability-related experience promote better biodiversity engagement. According to Organisational Learning Theory, companies boost their long-term performance by learning from experience in executing and adapting formal procedures (Argote and Miron-Spektor, 2011; Mani and Muthulingam, 2019). The main idea is that organisations transform successful and unsuccessful past experiences into routines, i.e., procedures, rules, and structures, that guide future behaviour. In this sense, success triggers the repetition of learned behaviours, and failure prevents behaviours from recurring (Anjum et al., 2025). Over time, cumulative years of experience enrich the knowledge of companies and contribute to building an organisational memory, also defined as a stable accumulation of knowledge that makes learning enduring. The accumulation of organisational memory allows firms to become more responsive and flexible in facing emerging challenges (Bhatia and Jakhar, 2021). This happens because companies progressively develop new dynamic capabilities that incorporate their accumulated learning from past experiences, allowing them to respond quickly to new circumstances and adapt old strategies to new situations. These capabilities enable firms not only to refine existing routines, but also to sense new opportunities, seize them effectively, and transform their resources and processes in response to changing environments (Teece et al., 1997). Thus, dynamic capabilities follow a path dependence mechanism where the organisational memory accumulated through past learning determines how organisations integrate knowledge and evolve in the future (Vergne and Durand, 2011). By focusing on the flexibility and strategic responsiveness of organisations, the Dynamic Capability Theory suggests that only once a critical threshold of learning has been accumulated can firms effectively adapt and reconfigure their existing competencies in response to emerging external challenges. The focus here is not only on how organisations react to environmental change, but also on the ability to anticipate and guide the change, promptly identify signals, and translate them into operational opportunities. Dynamic capabilities are also closely linked to the concept of absorptive capacity, which represents a mechanism through which organisations enhance their adaptiveness and innovation capability. In particular, what distinguishes more innovative and adaptive organisations is their ability to recognise the value of external knowledge, assimilate it, transform it, and apply it for strategic purposes (Cohen and Levinthal, 1990). Absorptive capacities do not develop spontaneously; rather, they depend on the organisation's existing base knowledge, its openness to external sources, and the presence of internal structures capable of processing and integrating information. Hence, absorptive capacity conceptualises the organisational capabilities associated with achieving desired innovation outcomes (Daspit et al., 2019).

Some empirical studies suggest that the long-term use of sustainable governance instruments enhances experiential learning, generating benefits across multiple dimensions. For instance, Derchi et al. (2021) explain that long-term adoption of ESG-based incentives produces organisational feedback that progressively allows companies to integrate these practices into their managerial routines. With growing experience, firms can balance potentially competing CSR goals and focus on the areas where these governance tools are most effective, optimising them for the future. They also demonstrate that companies improve their environmental performance and reduce environmental concerns when they accumulate experience in implementing ESG-linked executive compensation over time. Anjum et al. (2025) support this viewpoint by showing that successful environmental process design and performance depend on the ability to learn from a real-world implementation iteratively. Bhatia and Jakhar (2021) show that proactive managerial choice and strategic approaches make organisational learning successful for sustainability implementation. Similarly, Chen et al. (2024) find that executives' experience improves firms' ESG performance by stimulating environmental innovation and strengthening their engagement with sustainability-oriented stakeholders.

Overall, converting past experiences into enduring organisational

change needs prolonged time, repeated practices, and continuous active support at the management level. As suggested in Derchi et al. (2023), when companies introduce their green strategy, they possess a limited understanding and practical experience of environmental challenges. However, as they gain experience and knowledge about environmental sustainability, they learn to identify essential environmental goals for their operational needs. Yet, most of these studies adopt a broad perspective, focusing on environmental practices as a whole without clearly differentiating between distinct thematic areas. Based on the above premises, we believe that banks with greater environmental experience are more likely to engage in biodiversity, as they are better equipped to translate experiential learning, represented by the long adoption of sustainability committees and sustainability-based incentives, into effective practices and decision-making routines. Fig. 1 provides a visual representation of our research model. We formulate our research hypothesis as follows.

H1. Banks are more likely to engage in biodiversity as they accumulate sustainability experience.

3. Empirical design

3.1. Data source and sample selection

To conduct this study, we employ information from a number of sources. In particular, we use bank-level information provided by LSEG Data and Analytics (formerly Refinitiv Eikon) to capture biodiversity engagement. Bank-level characteristics are also obtained from the LSEG database. Country-level information is drawn from the World Bank Database and Our World in Data. Our sample construction starts with a full universe of 738 listed banks for which biodiversity-related information exists in Refinitiv over the period 2016–2023.[1] We avoid further exclusion criteria to guarantee broad coverage and a representative sample for the banking industry. After removing 67 banks due to missing observations in the independent and control variables, our working final sample covers 671 banks operating in 66 countries over the period 2016–2023. This results in a panel dataset of 3614 bank–year observations. To prevent the influence of potential outliers, all continuous control variables are winsorised at the 1 % level for both tails (Soana, 2024). Details on the geographical distribution of the sample are provided in Appendix A1.

3.2. Dependent variable measurement

In line with previous studies (Haque and Jones, 2020; Orazalin et al., 2025), we construct our biodiversity engagement score (BIODIV) combining six binary biodiversity data points obtained from LSEG environmental database. Each item is coded as 1 if the bank provides related information, and 0 otherwise. These indicators are designed to focus on different aspects of both corporate biodiversity management operations and reporting practices. Specifically, we consider whether the bank: (i) shows a specific commitment to reducing biodiversity impacts (Biodiversity Commitment); (ii) aims to achieve a net positive impact on biodiversity through restoration or compensation initiatives (Biodiversity Net Positive Impact); (iii) integrates biodiversity risk assessments into new projects (Biodiversity Due Diligence); (iv) monitors biodiversity risks in ongoing operations (Biodiversity Risk Assessment); (v) disclose its activities and initiative to reduce its biodiversity impact (Biodiversity Impact Reduction); and (vi) sets measurable biodiversity targets with deadlines (Biodiversity Targets). Although the maximum possible score is 6, the highest value in our sample is 5.

As further control, we modified our dependent variable using a binary version of the BIODIV variable (BIODIV_dummy). The variable equals 1 if the bank has a BIODIV score greater than zero and 0 otherwise. This alternative specification allows us to test whether our results hold when focusing simply on biodiversity engagement's presence, rather than the intensity. In addition, to better capture temporal dynamics, we computed the annual change in the biodiversity score (ΔBIODIV) defined as the year-on-year difference in a bank's BIODIV score (e.g., Duho et al., 2024). This allows us to assess whether increases or decreases in biodiversity engagement over time are systematically associated with prior experience. Table 1 provides information regarding variable descriptions and sources.

3.3. Independent variable measurement

As discussed in Section 2.2 and following the spirit of Derchi et al. (2021), we assume that banks accumulate environmental experience over time through experiential learning in the continuous use of formal sustainable governance mechanisms. This process follows the rationale of the organisational learning theory: when banks continuously adopt sustainability practices over time, they accumulate experience that enhances their ability to recognise and address complex environmental issues, such as biodiversity.

The core variable of interest in our study, EXPERIENCE, proxy the bank's sustainability experience based on the cumulative number of years in which the bank has adopted at least one of the following governance tools: (i) the existence of a sustainability committee at the board or senior management level; or the adoption of a sustainability-linked incentive policy in the executive compensation. We retrieve these variables from LSEG ESG database. Each year, we assign a value of 1 if the bank discloses at least one of the two practices, and 0 otherwise. Then, we sum the years, starting from 2002, in which the bank has adopted at least one of the two tools. Although our analysis covers the period 2016–2023, the construction of EXPERIENCE draws on data from 2002 to consider the complete cumulative learning that occurred over time. This approach helps to reduce concerns about reverse causality, as the main independent variable is based on governance practices implemented in the past, long before biodiversity became a relevant issue of concern integrated in corporate strategies (Haque and Jones, 2020; Orazalin et al., 2025). Indeed, biodiversity has emerged as a key driver of sustainability strategies only in recent years. According to Garel et al. (2023), biodiversity was largely absent from global sustainability agendas prior to 2021, and global investors historically did not incorporate biodiversity-related risks into their investment decisions until the Kunming declaration in October 2021. This temporal gap reinforces the plausibility of our identification strategy by reducing the likelihood that biodiversity concerns influenced the earlier adoption of governance practices. In our setting, the variable EXPERIENCE can range from 0 to 22 years. Table 1 provides information regarding variable descriptions and sources.

3.4. Controls variable measurement

In line with prior studies (e.g., Haque and Ntim, 2020; Issa and Zaid, 2023; Soana, 2024; Duho et al., 2024; Orazalin et al., 2025), we include a set of control variables capturing corporate governance features, firm-level characteristics, and country-specific variables that may influence biodiversity engagement.

We control for several board-level characteristics. First, we consider the total number of directors on a board (BSIZE). Larger boards promote biodiversity disclosure by bringing in diverse perspectives and increasing the likelihood of having members with environmental expertise (Duho et al., 2024). Boards with a prevalence of female directors (BFEMALE) respond to institutional pressures by enhancing corporate biodiversity transparency (Haque and Ntim, 2020). Moreover,

[1] The timeframe of the sample starts from 2016 for two main reasons: (i) due to the limited availability of biodiversity-related data before this fiscal year; and (ii) because several key variables used to construct our biodiversity score only became available starting from 2016.

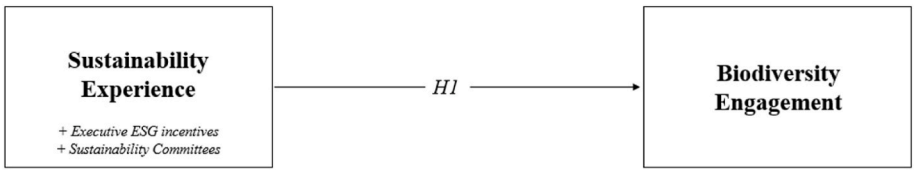

Fig. 1. The figure illustrates the conceptual model of our research work.

environmental performance may be enhanced through a more independent board (BINDEP), and the board's expertise (BSKILLS) enables organisations to obtain essential skills and external resources that support sustainability initiative implementation (Cosma et al., 2025).

Following related empirical studies, we also use several firm-specific characteristics as control variables. Specifically, size (SIZE), profitability (ROA), efficiency (CINC), leverage (LEV), and capitalisation (TIER1) are used as previous literature suggests that they can affect bank sustainability performance (Issa and Zaid, 2023; Soana, 2024).

Our research incorporates two country-level variables: the annual GDP per capita growth rate (Soana, 2024) from the World Bank Database as well as the Red List Index (RLI) (Martínez and Melo, 2025) from Our World in Data. In detail, the latter is published by the International Union for Conservation of Nature (IUCN), which monitors extinction risks against species throughout each country and helps governments track their progress toward biodiversity loss reduction targets. RLI levels range between 1 and 0, with a lower value indicating higher biodiversity decline. The addition of RLI in our model specification enables a better evaluation of the environmental stress experienced by each country. A faster decline in biodiversity and ecosystems leads to increased social and regulatory pressure on firms operating in those countries, where it is essential to establish action plans (Daddi et al., 2016).

Table 1 provides details regarding how each control variable is defined and constructed.

3.5. Empirical model

In order to assess whether and to what extent EXPERIENCE influences biodiversity engagement, we estimate the following model:

$$BIODIV_{i,t} = \alpha + \beta EXPERIENCE_{i,t-1} + \gamma Controls_{i,t-1} + Years\ dummies + \epsilon_{i,t} \quad (1)$$

where $BIODIV_{i,t}$ refers to the biodiversity measure taken into consideration; $EXPERIENCE_{i,t-1}$ refers to the proxy used to capture the bank's matured sustainability experience over time; $Controls_{i,t-1}$ represent the control variables included to capture firm-level, board-level and country-level characteristics; $\epsilon_{i,t}$ represents the residual or that portion of the endogenous variable that is not explained by the exogenous regressors, and *i* represents the bank *i*.

The model is estimated using a fixed effects (FE) panel data regression based on significant Lagrange multiplier tests, F-tests for overall significance, and the Hausman test. This methodology considers omitted or unobserved time-invariant variables and controls for unobserved heterogeneity in the sample and reduces the omitted variable bias. We also include year dummies to account for time-specific shocks or trends that may affect all firms simultaneously, such as changes in regulation, market conditions, or environmental awareness. Following Derchi et al. (2021), to mitigate simultaneity issues and reverse causality, the independent and control variables in our model are 1 year lagged. Finally, standard errors are clustered at the bank level.

4. Results and discussion

4.1. Descriptive statistics

Table 2 presents the descriptive statistics with the number of observations (N), means, standard deviations (SDs), minimums (Min), and maximums (Max). The biodiversity engagement score (BIODIV) has a mean value of 0.098 and a standard deviation of 0.412, on a scale 0–5. The relatively high standard deviation suggests that the BIODIV values vary widely from the mean. Consistent with prior studies (e.g., Haque and Ntim, 2020; Treepongkaruna, 2024), the fact that only 104 out of 671 banks (roughly 15 % of our sample) report a BIODIV score greater than 0 suggests that, despite growing global awareness of ecological issues, just a small subset of banks presents a positive commitment toward biodiversity and are actively addressing it in their operations. For the core variable of interest, the mean value of EXPERIENCE is 3.68 years with a standard deviation of 4.78. This indicates that, on average, the banks in our sample have accumulated moderate years of sustainability experience, measured in terms of adopting sustainability committees and/or ad hoc remuneration incentives, with some institutions having much more or less experience than others. In our sample, the years of cumulated experience range from 0 to 18.

Fig. 2 shows the trend in the average biodiversity score (BIODIV) from 2016 to 2024. The overall average biodiversity score surged notably during 2021. This could be mainly due to major international biodiversity-related events such as the launch of the Taskforce on Nature-related Financial Disclosures (TNFD) in June and the Kunming Declaration in October 2021. This pattern reinforces the validity of our biodiversity measure, as it aligns with the evidence reported in Garel et al. (2024).

Table 3 presents the Pearson correlation coefficients and displays that BIODIV is positively and significantly correlated with EXPERIENCE, consistent with our expectations. The correlation coefficients between the independent and control variables are all below 0.70, suggesting that multicollinearity is not a significant concern (Duho et al., 2024). This is further confirmed by the variance inflation factors, all of which are below 2 (mean VIF = 1.37; maximum VIF = 1.86).

4.2. Baseline results

Table 4 reports the results for two fixed-effects panel regressions. The baseline model presented in Column 1 tests the effect of the experience matured over time via sustainable governance practices (EXPERIENCE) and biodiversity engagement (BIODIV). The coefficient for EXPERIENCE is positive and significant ($p < 0.01$), suggesting that each additional year in which a bank accumulates sustainability-related experience through a sustainable governance mechanism (as a sustainability committee or ESG-linked executive compensation) is associated with an increase of 0.045 points in the BIODIV score, thus supporting our research question.

Our findings align with the organisational learning perspective embraced in Section 2.2, suggesting that the adoption of a sustainable governance mechanism is not a symbolic signal, but can serve as a vehicle for top management to accumulate knowledge, refine internal processes, and progressively enhance environmental engagement toward issues typically treated as marginal.

In Column 2, we refine our baseline analysis by disaggregating the core variable EXPERIENCE into a set of dummy indicators as separate covariates, each capturing a specific number of years of experience accumulated by banks over time. This specification allows us to test for potential non-linearities in the relationship between gained sustainability-related experience and biodiversity engagement. The

Table 1
Variable description.

Variable	Symbol	Description	Source
Dependent variables			
Biodiversity Score	BIODIV	A sum of six binary variables reflecting whether the bank shows attention to key biodiversity-related practices. These include: (i) a specific commitment to reducing biodiversity impacts (Biodiversity Commitment); (ii) a commitment to achieving a net positive impact through restoration or compensation (Biodiversity Net Positive Impact); (iii) biodiversity risk assessments in new projects (Biodiversity Due Diligence); (iv) monitoring of biodiversity risks in ongoing operations (Biodiversity Risk Assessment); (v) reporting of concrete actions to reduce ecological impact (Biodiversity Impact Reduction); and (vi) measurable biodiversity targets with deadlines (Biodiversity Targets). The total score (ranging from 0 to 6) indicates the extent of biodiversity engagement disclosed by the bank.	LSEG Data and Analytics & Authors' calculations
Biodiversity Dummy	BIODIV_dummy	The variable equals 1 if the bank shows attention to at least one biodiversity-related practice. It is based on the same six items used to build the Biodiversity Score. If the bank shows no attention to any of them, the variable is 0.	LSEG Data and Analytics & Authors' calculations
Biodiversity Change	ΔBIODIV	The variable captures the intensity of change in biodiversity score from one year to the next. It is calculated as $BIODIV_t - BIODIV_{t-1}$.	LSEG Data and Analytics & Authors' calculations
Independent variable			
Sustainability Experience	EXPERIENCE	Cumulative number of years in which the bank adopted at least one of the following governance tools: (i) a sustainability committee at the board or senior management level, or (ii) an ESG-linked executive compensation policy. This represents our measure of a bank's sustainability experience over time.	LSEG Data and Analytics & Authors' calculations
Firm-level control variables			
Size	SIZE	Natural logarithm of total assets.	LSEG Data and Analytics
Return on Assets	ROA	The ratio of net income divided by total assets.	LSEG Data and Analytics
Business Model	BM	The ratio between total loans and total assets. A higher ratio means that the bank is more traditional.	LSEG Data and Analytics
Tier 1	TIER	The ratio between the bank's equity capital and disclosed reserves divided by its total risk-weighted assets. Indicates the bank's ability to absorb losses.	LSEG Data and Analytics
Efficiency	CINC	The ratio between operating expenses and operating income. A lower ratio indicates higher bank efficiency.	LSEG Data and Analytics
Leverage	LEV	The ratio between total debt and total equity.	LSEG Data and Analytics
Governance-level control variables			
Board Size	BSIZE	Total number of board directors.	LSEG Data and Analytics
Board Female	BFEMALE	Proportion of female directors on the board.	LSEG Data and Analytics
Board Independence	BINDEP	Proportion of independent directors on the board.	LSEG Data and Analytics
Board Skills	BSKILLS	Proportion of directors who have either an industry-specific or a strong financial background.	LSEG Data and Analytics
Country-level control variables			
Red List Index	RLI	Tracks changes in species extinction risk over time. Ranges from 1 (no extinction risk) to 0 (all species extinct). Lower values indicate greater biodiversity loss.	Our World in Data
GDP growth rate	GDP	The annual percentage growth rate of GDP per capita based on constant local currencies.	World Bank Database

results provide strong support for a monotonic non-linear relationship between EXPERIENCE and BIODIV, showing increasing marginal effects for higher levels of experience. Specifically, the second specification shows that while the early years of experience (from 1 to 7 years) show no significant association with BIODIV, the coefficients become positive, statistically significant, and progressively larger from year 8 onwards. For instance, banks with 11 years of experience show an increase in their BIODIV score of 0.405 points ($p < 0.01$) relative to non-experienced banks, which increases to 0.872 ($p < 0.01$) at 15 years and then stabilises.

Overall, the above evidence strongly corroborates our H1 and indicates that past sustainability-related experiential learning can promote biodiversity engagement. Moreover, these results are consistent with previous studies (e.g., Bhatia and Jakhar, 2021; Derchi et al., 2021). We interpret these results in light of the existence of a cumulative learning effect: the positive impact of sustainability governance mechanisms on biodiversity commitment emerges only after a sufficient period of cumulative experience. Interestingly, the observed threshold effect is also compatible with a path dependence mechanism (Teece et al., 1997). whereby an organisation's capabilities are determined by past choices and prior investments. Thus, in the early years, banks may struggle to translate sustainability commitments into practice, due to unclear objectives, lack of reliable data measurement tools, weak governance decisions, or limited expertise (Derchi et al., 2023; Mundaca and Heintze, 2024). However, over time, through repetition, feedback, and experience accumulation, they progressively develop higher-order dynamic capabilities needed to address biodiversity in a more structured and effective way. As a consequence, once these governance mechanisms take root in strategic decision-making, they help executives build concrete knowledge and experience, which in turn can support more credible, informed, and effective action on biodiversity. In this way, we advance prior evidence (e.g., Orazalin et al., 2025) by formally introducing the concept of path dependency and the existence of minimum experience thresholds required to develop dynamic capabilities for effective biodiversity engagement.

Most of the control variables do not show statistically significant coefficients. However, SIZE, ROA, and CINC stand out as exceptions,

Table 2
Descriptive statistics.

Variables	N	Mean	SD	Min	Max
BIODIV	3614	0.098	0.412	0	5
BIODIV_dummy	3614	0.0703	0.256	0	1
ΔBIODIV	3614	0.0354	0.263	−1	4
EXPERIENCE	3614	3.680	4.781	0	18
SIZE	3614	23.860	1.977	20.467	28.570
ROA	3614	1.307	0.847	−1.294	6.362
BM	3614	66.290	13.302	23.115	92.058
TIER	3614	14.266	3.573	9.040	29.630
CINC	3614	0.626	0.154	0.297	1.278
LEV	3614	121.378	125.842	0.453	670.548
BSIZE	3614	11.489	3.144	5	21
BFEMALE	3614	19.360	13.307	0	54.546
BINDEP	3614	64.934	24.873	0	100
BSKILLS	3614	42.546	19.395	0	87.500
RLI	3614	0.833	0.073	0.670	0.980
GDP	3614	1.920	3.423	−8.925	9.593

Note: This table reports the summary statistics for the variables included in our analysis. We include the number of observations, minimum, mean, maximum, and standard deviation. Variable definitions are presented in Table 1.

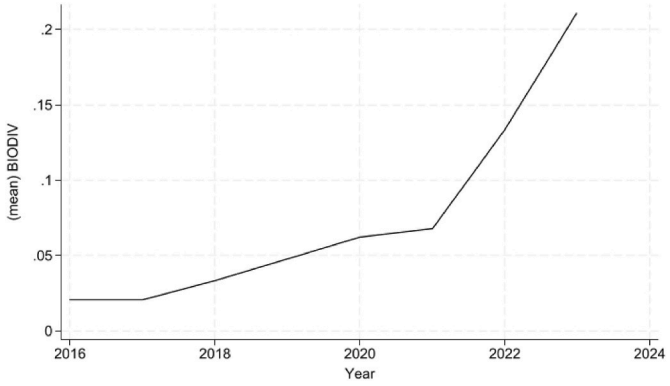

Fig. 2. The figure illustrates the temporal evolution in the average biodiversity engagement score (BIODIV) reported by banks from 2016 to 2023.

with each showing a significant and negative association with the dependent variable. This result is somewhat surprising, as one might expect larger, capitalised, and more profitable banks to have greater capacity to invest in biodiversity-related initiatives. A possible explanation is that smaller institutions (i.e., regional or cooperative banks) operate in geographically concentrated markets and often work closely with local small and medium-sized enterprises. This community-oriented approach makes them more sensitive to risks that directly affect the local community (Petach et al., 2021), including environmental ones. Since their lending is concentrated in a limited area, they are more financially exposed to the degradation of the local environment, which may simultaneously impact many of their borrowers (Do et al., 2023). As a result, smaller banks may have stronger incentives to proactively manage ecological and biodiversity-related risks.

In contrast to previous literature that examines how board characteristics are related to biodiversity commitment and disclosure, our board-level control variables are not significant in our models. By introducing our EXPERIENCE variable, which represents the bank's strategic positioning and commitment to sustainable business management, and which also translates into board selection, recruitment of the right skills for committees (Oyewo, 2023), and setting incentives for managers to achieve desired objectives, the specific characteristics of the board lose significance. The effect is captured at a higher level by the experience reflected in the organisational and governance model. Finally, macro-controls are not statistically significant.

4.3. Robustness analysis

In this section, we present the results of additional investigations conducted to ensure the robustness of the baseline findings presented earlier. In particular, we estimate our baseline model again by: (i) modifying our working sample, and (ii) introducing alternative biodiversity measures. A summary of findings is reported in Table 5 and described in the next sub-paragraph.

4.3.1. Sample manipulations

The first additional investigation addresses the potential bias arising from the over-representation of certain countries in our working sample. More precisely, the country with the highest number of banks in our sample is the United States, accounting for 40.54 %, followed by China with 7.15 % and India and Indonesia with 4.77 % and 2.78 %, respectively. Therefore, we estimate again the baseline model, eliminating data from banks' headquarters in the United States to verify if the results remain unaffected. As evident in Column 1 of Table 5, this exercise does not alter our results.

Consistent with prior evidence in the biodiversity finance literature (e.g., Carvalho et al., 2023; Garel et al., 2024), our data also reveal a very poor level of engagement in biodiversity-related initiatives

Table 3
Correlation matrix.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) BIODIV	1.00													
(2) EXPERIENCE	0.261***	1.00												
(3) SIZE	0.250***	0.681***	1.00											
(4) ROA	−0.040**	−0.148***	−0.216***	1.00										
(5) BM	−0.177***	−0.327***	−0.438***	0.02	1.00									
(6) TIER	0.087***	0.092***	−0.028*	0.180***	−0.201***	1.00								
(7) CINC	0.032*	0.127***	0.061***	−0.589***	−0.114***	−0.069***	1.00							
(8) LEV	0.157***	0.322***	0.437***	−0.252***	−0.192***	−0.063***	0.067***	1.00						
(9) BSIZE	0.083***	0.276***	0.335***	−0.129***	−0.177***	−0.215***	0.090***	0.055***	1.00					
(10) BFEMALE	0.064***	0.308***	0.188***	−0.100***	−0.062***	0.044***	0.01	0.205***	0.105***	1.00				
(11) BINDEP	−0.086***	−0.065***	−0.309***	0.01	0.264***	−0.136***	−0.105***	−0.145***	−0.039**	0.249***	1.00			
(12) BSKILLS	0.02	0.091***	0.087***	−0.02	−0.048***	−0.162***	−0.01	0.01	0.096***	0.098***	0.109***	1.00		
(13) RLI	0.00	0.092***	−0.056***	0.01	0.058***	0.189***	−0.044***	0.056***	−0.031*	0.242***	0.086***	−0.091***	1.00	
(14) GDP	0.045***	−0.01	0.062***	0.075***	−0.088***	−0.058***	−0.115***	0.01	0.030*	0.032*	−0.036**	0.055***	−0.134***	1.00

Note: This table reports the pairwise correlation coefficients among all independent, dependent, and control variables for the full sample. Variable definitions are presented in Table 1. Significance levels are indicated as follows: *p < 0.1; **p < 0.05; ***p < 0.01.

Table 4
Baseline results.

	(1) BIODIV		(2) BIODIV	
	β	*SE*	*β*	*SE*
EXPERIENCE $_{t-1}$	0.0455***	(0.0107)		
EXPERIENCE $_{t-1}$ = 1			0.0325	(0.0273)
EXPERIENCE $_{t-1}$ = 2			0.0146	(0.0304)
EXPERIENCE $_{t-1}$ = 3			0.0513	(0.0323)
EXPERIENCE $_{t-1}$ = 4			−0.00735	(0.0307)
EXPERIENCE $_{t-1}$ = 5			−0.0188	(0.0351)
EXPERIENCE $_{t-1}$ = 6			0.0237	(0.0434)
EXPERIENCE $_{t-1}$ = 7			0.0492	(0.0545)
EXPERIENCE $_{t-1}$ = 8			0.204**	(0.0945)
EXPERIENCE $_{t-1}$ = 9			0.219**	(0.107)
EXPERIENCE $_{t-1}$ = 10			0.266**	(0.113)
EXPERIENCE $_{t-1}$ = 11			0.405***	(0.135)
EXPERIENCE $_{t-1}$ = 12			0.440***	(0.132)
EXPERIENCE $_{t-1}$ = 13			0.514***	(0.141)
EXPERIENCE $_{t-1}$ = 14			0.670***	(0.152)
EXPERIENCE $_{t-1}$ = 15			0.872***	(0.195)
EXPERIENCE $_{t-1}$ > 15			0.775***	(0.178)
SIZE $_{t-1}$	−0.207***	(0.0606)	−0.135**	(0.0538)
ROA $_{t-1}$	−0.0492*	(0.0285)	−0.0531**	(0.0269)
BM $_{t-1}$	0.000792	(0.00169)	0.00526	(0.00559)
TIER $_{t-1}$	0.00608	(0.00571)	0.00132	(0.00165)
CINC $_{t-1}$	−0.250*	(0.152)	−0.248*	(0.144)
LEV $_{t-1}$	0.000321	(0.000202)	0.000279	(0.000191)
BSIZE $_{t-1}$	0.00374	(0.00589)	0.00649	(0.00560)
BFEMALE $_{t-1}$	−0.000768	(0.00112)	−0.000606	(0.00115)
BINDEP $_{t-1}$	0.000220	(0.000856)	9.47e-05	(0.000802)
BSKILLS $_{t-1}$	0.000240	(0.000683)	0.000563	(0.000679)
RLI $_{t-1}$	−3.196	(3.846)	−4.301	(3.531)
GDP $_{t-1}$	0.00271	(0.00427)	0.00250	(0.00428)
Constant	7.482**	(3.494)	6.715**	(3.336)
Firm FE	Yes		Yes	
Year FE	Yes		Yes	
Observations	3614		3614	
R-squared	0.097		0.135	

Note: This table shows the results obtained when estimating our baseline panel FE model in Equation (1). The dependent variable in both models is the biodiversity score (BIODIV). In Column (1), EXPERIENCE enters as a single continuous variable; in Column (2), EXPERIENCE is split into year-specific dummy indicators. All regressors are lagged one year. We include year fixed effects. Standard errors (in parentheses) are clustered at the bank level. See Table 1 for definitions of all variables. Significance levels are indicated as follows: *p < 0.1; **p < 0.05; ***p < 0.01.

between 2016 and 2020. Restricting the sample period to 2021–2023, when biodiversity risks became more relevant for firms and investors, allows for a more accurate assessment of the relationship of interest. Table 5, Column (2) confirms the robustness of our baseline results, as the coefficient EXPERIENCE remains positive and strongly significant (β = 0.0553, p < 0.01). Nonetheless, we note that the baseline model estimated over the 2016–2020 period (not tabulated) also yields a positive and significant coefficient for EXPERIENCE (β = 0.019, p < 0.05), suggesting that sustainability-related experience already played a role in fostering attention to biodiversity, although the effect was less pronounced compared to the more recent period. Overall, the evidence aligns with the Dynamic Capability Theory (Teece et al., 1997) and the Absorptive Capacity Theory (Cohen and Levinthal, 1990). Indeed, our findings suggest that sustainability-related experience strengthens all three dimensions of firms' dynamic capabilities. First, it enhances the ability to sense emerging issues such as biodiversity risks (sensing). This is proven by the fact that, even when biodiversity was not yet a global priority (2016–2020), banks with stronger ESG experience already showed greater attention to this issue (although with a weaker effect). Second, it increases the bank's readiness to mobilise resources and decision-making structures to seize new ESG-related opportunities (seizing). Third, it reinforces the bank's capacity to transform and reorganise structures, processes, and strategic priorities in response to evolving environmental and social pressures (reconfiguring). Thus, we believe that this evidence extends the biodiversity finance literature in an important way. While prior studies (e.g., Coqueret et al., 2025; El Ouadghiri et al., 2025; Garel et al., 2024) have primarily focused on external drivers of biodiversity engagement, such as regulatory changes or investor attentions, our results highlight the role of internal firm-level capabilities. Specifically, we show that pre-existing sustainability-related experience has enabled banks to anticipate and respond to emerging biodiversity institutional pressures even before biodiversity loss gained widespread attention.

4.3.2. *Alternative biodiversity measures*

Given that there are no globally accepted standards to measure biodiversity in the biodiversity finance literature, we construct and employ two different measures of the BIODIV score as described in Section 3.2. Specifically, we create a dummy variable (BIODIV_dummy) to assess the simple presence of a minimum signal of biodiversity engagement in a bank and a variable that represents the year-by-year difference of biodiversity score (ΔBIODIV) to consider also "how

Table 5
Robustness analysis.

	(1) Excluding USA	(2) 2021–2023	(3) Alternative Proxy	(4) Alternative Proxy
	BIODIV	BIODIV	BIODIV_dummy	ΔBIODIV
EXPERIENCE $_{t-1}$	0.0427**	0.0553***	0.0225***	0.0145***
	(0.0195)	(0.0171)	(0.00606)	(0.00554)
SIZE $_{t-1}$	−0.216*	−0.273***	−0.0847***	−0.0827***
	(0.121)	(0.0872)	(0.0312)	(0.0319)
ROA $_{t-1}$	−0.0634	−0.0488	−0.0112	−0.0275
	(0.0416)	(0.0322)	(0.0134)	(0.0226)
BM $_{t-1}$	−0.000983	−0.00186	0.000274	0.000286
	(0.00369)	(0.00267)	(0.000953)	(0.000985)
TIER $_{t-1}$	−0.000559	0.00998	0.00605**	0.00214
	(0.0104)	(0.0128)	(0.00273)	(0.00410)
CINC $_{t-1}$	−0.367*	−0.250	−0.0560	−0.0646
	(0.214)	(0.200)	(0.0631)	(0.106)
LEV $_{t-1}$	0.000315	0.000085	0.000303**	0.000089
	(0.000309)	(0.000180)	(0.000128)	(0.000126)
BSIZE $_{t-1}$	0.00587	0.00995	0.000839	0.00373
	(0.00930)	(0.00681)	(0.00335)	(0.00413)
BFEMALE $_{t-1}$	−0.000160	0.000588	−0.000183	0.000678
	(0.00181)	(0.00213)	(0.000781)	(0.000692)
BINDEP $_{t-1}$	−0.000308	−0.00149	0.000190	0.000778
	(0.00110)	(0.00114)	(0.000481)	(0.000683)
BSKILLS $_{t-1}$	0.000557	0.00341**	0.000202	−0.000354
	(0.00100)	(0.00159)	(0.000334)	(0.000391)
RLI $_{t-1}$	−4.666	−10.32*	−1.991	−0.492
	(4.711)	(5.506)	(1.857)	(2.398)
GDP $_{t-1}$	0.000522	0.00511	0.000511	0.00165
	(0.00458)	(0.00519)	(0.00273)	(0.00335)
Constant	9.368*	14.95***	3.520**	2.267
	(5.045)	(4.866)	(1.695)	(2.082)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	2001	1799	3614	3614
R-squared	0.126	0.096	0.090	0.024

Note: This table shows the results obtained when estimating our baseline panel FE model in Equation (1) under alternative scenarios. Column 1 reports the results when the sample is restricted to non-US banks. Column 2 reports the results when the sample is restricted to years 2021–2023. Columns 3–4 report the results when three alternative proxies of biodiversity are considered (BIODIV_dummy, ΔBIODIV). All regressors are lagged one year. We include year fixed effects. Standard errors (in parentheses) are clustered at the bank level. See Table 1 for definitions of all variables. Significance levels are indicated as follows: *p < 0.1; **p < 0.05; ***p < 0.01.

much" the bank's engagement changes over time. In Table 5, Column 3 reports the results from a FE Linear Probability Model (LPM) when BIODIV_dummy is considered as the main dependent variable,[2] whereas Column 4 reports the results from a FE Panel regression when ΔBIODIV is then substituted as the dependent variable. Both the sign and significance ($p < 0.01$) of EXPERIENCE remain the same for the two alternative proxies of biodiversity. Thus, further supporting the organisational learning view. We further decompose the dependent variable ΔBIODIV into positive and negative changes in order to gain insight into the dynamics behind this result. When we restrict the analysis to observations with a positive change in the biodiversity score (ΔBIODIV >0), cumulated sustainability-related experience remains positively and significantly associated with the dependent variable ($\beta = 0.0139$, $p < 0.05$). By contrast, when considering negative changes (ΔBIODIV <0), the effect of experience is not significant ($\beta = -0.0005$, $p > 0.1$). Our findings (not tabulated) suggest a form of asymmetric effect for the cumulated experience via sustainability-related governance practices, highlighting a monodirectional effect. In short, past sustainability experience enables banks to learn and build internal capacities that foster biodiversity commitment year by year. However, this learning process does not appear to provide resilience against setbacks, which may arise from discontinuities in managerial decisions, reporting practices or, more generally speaking, when biodiversity is not fully institutionalised into business practices. This is particularly plausible given that biodiversity disclosure and attention remain fragile, non-standardised, and still potentially subject to institutional and normative pressures (Haque and Jones, 2020; Duho et al., 2024).

4.4. Addressing endogeneity

A potential concern in our baseline specification is the presence of endogeneity, arising from issues such as reverse causality, omitted variable bias, or measurement error. We initially mitigate potential endogeneity issues using bank fixed effects to account for time-invariant unobservable variables that potentially affect both biodiversity engagement and experience. Moreover, we also used lagged explanatory variables in Equation (1) to mitigate reverse causality. However, as some endogeneity concerns may persist, we employ two alternative strategies to ensure robustness and enhance causal identification. First, we use an instrumental variable two-stage least squares (2SLS) model. Then, we implement a propensity score matching (PSM) and entropy balancing.

The most challenging aspect of using instrumental variables (IV) lies in the choice of the right instruments. In particular, the instrument must be strongly correlated with the possible endogenous variable (in our case, EXPERIENCE) and not correlated with the error term of the second-stage regression. In the first stage, EXPERIENCE is predicted by the instrument and all the exogenous variables used in the main analysis. In line with previous research (e.g., Soana, 2024), we chose as an instrument the annual mean level of cumulative experience in the country where the bank is headquartered (i.e., country-year averages) (EXPERIENCE_AVG). We select this instrument as these averages exclude the focal bank of analysis and are therefore considered exogenous to its own specific characteristics and environmental performance (Velte, 2024). In other words, the instrument reflects the general level of ESG-related experience within the national banking system, which ensures that the instrument is clearly exogenous with respect to the internal characteristics and environmental behaviour of the bank under analysis. The results of the first stage of the 2SLS regression are reported in Table 6, Column 1, while Column 2 shows the results for the second stage, where the predicted value of EXPERIENCE is used instead of its actual value. Table 6 confirms the validity of the instrument. Both the under-identification and weak identification tests are passed, indicating that the instrument is relevant and suitable for use in the 2SLS framework. The instrument (EXPERIENCE_AVG) performs as expected, as it shows a positive and significant coefficient ($p < 0.01$). Most importantly, in the second stage, the core variable of interest, EXPERIENCE, maintains both the direction and significance of its effect, confirming the robustness of the baseline findings.

Table 6
Addressing endogeneity.

DV: BIODIV	(1) First stage	(2) Second stage	(3) EB	(4) PSM
EXPERIENCE_AVG $_{t-1}$	0.284***			
	(0.0338)			
EXPERIENCE $_{t-1}$		0.192***	0.0641**	0.0225**
		(0.0428)	(0.0314)	(0.0109)
Constant			4.669	7.665**
			(2.839)	(3.360)
Controls	Yes	Yes	Yes	Yes
Observations	3614	3614	3593	2883
Adj R-squared			0.473	0.389
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Kleibergen-Paap rk LM statistic	96.90***			
Kleibergen-Paap Wald F statistic	70.57***			

Note: This table shows the results obtained when estimating a Two-Stage Least Squares (2SLS) model. Column 1 reports the first stage results, whereas Column 2 reports the second stage results. Column 3 reports the results for the entropy balancing (EB) and Column 4 for the propensity score matching (PSM). All regressors are lagged one year. We include year fixed effects. Standard errors (in parentheses) are clustered at the bank level. See Table 1 for definitions of all variables. Significance levels are indicated as follows: *p < 0.1; **p < 0.05; ***p < 0.01.

Finally, following previous research (e.g., Abdullah et al., 2024; Bach et al., 2025), we apply the nearest neighbour PSM approach and entropy balancing for mitigating endogeneity arising from sample selection bias and confounding factors.[3] PSM consists of estimating the probability that an observation belongs to the treatment group, conditional on a set of observed covariates. Subsequently, treated and control units with comparable scores are matched, leading to a more balanced comparison group. On the other hand, entropy balancing is a reweighting technique that adjusts the distribution of covariates in the control group so that their statistical moments (means, variances and skewness) match those of the treated group. Therefore, entropy balancing minimises the disparities between groups, ensuring comparability (Bach et al., 2025). Together, these approaches allow us to further address endogeneity concerns by correcting for sample selection and improving covariate balance, thereby reducing the risk that our results are driven by systematic differences in observable characteristics. In our setting, the treatment variable (EXPERIENCE_AVG) is equal to 1 for firms with a number of years of sustainability-related experience above the sample mean (treated group), and 0 otherwise (control group). Then, we run Equation (1) again using entropy balancing and PSM weights. Consistent with our baseline results, the coefficient of EXPERIENCE in Columns (3)−(4) in Table 6 is positive and significant ($p < 0.05$) in both model specifications. Thus, the results support our hypothesis and consistently

[2] Despite the binary nature of the BIODIV_dymmy, a LPM estimation was used instead of a FE logit model to prevent a drastic data reduction, as it drops all units with no within-group variation in the dependent variable. Nevertheless, a FE logit model was estimated as a robustness check for the results presented in Column 3. The findings (not tabulated) remained unchanged.

[3] Sample selection bias arises when the mechanism that determines inclusion in the sample is related to the outcome variable, resulting in biased or inconsistent estimates (Abdullah et al., 2024). Confounding effects, instead, occur when one or more variables simultaneously affect both the independent variable (treatment) and the outcome, thereby distorting the estimated relationship.

indicate that cumulative sustainability-related experience. positively influences biodiversity engagement.

4.5. Country-level heterogeneity analysis

Our analysis thus far confirms that banks with a longer track record in sustainability are more likely to actively engage in biodiversity-related initiatives in line with the organisational learning and dynamic capability view. However, previous research has shown that firm environmental behaviour is often shaped by the institutional and cultural context in which a company is headquartered (Chen et al., 2023). Following Hambali and Adhariani (2024), we perform a heterogeneity analysis by categorising banks according to whether they are headquartered in megadiverse or non-megadiverse countries. A country qualifies as megadiverse if it contains at least 5000 endemic species, i.e., those located only in a specific geographical area (Dunning, 2022). Megadiverse countries account for about 70 % of the planet's biodiversity. 17 countries have been identified as the most biodiversity-rich countries of the world.[4] These countries include the United States of America, Mexico, Colombia, Ecuador, Peru, Venezuela, Brazil, the Democratic Republic of Congo, South Africa, Madagascar, India, Malaysia, Indonesia, the Philippines, Papua New Guinea, China, and Australia.

Motivated by empirical research (e.g., Skouloudis et al., 2019; Chen et al., 2023) suggesting that businesses located in megadiverse countries tend to be more vulnerable to ecological pressures and face higher stakeholder demands for national natural capital conservation, this section furthers our analysis and explores whether the effect of cumulative sustainability experience on biodiversity engagement varies depending on the geographical location of banks. Our intuition is that, in megadiverse countries, where ecological degradation is a visible and widely recognised concern, firms may develop a basic environmental awareness more quickly. Suchman (1995) argues that external institutions, like culture, construct and shape organisations in every aspect. Thus, managerial decisions are often based on the same beliefs and values of the institutional context where the organisation operates (Gaganis et al., 2021). We link the protection motivation theory (PMT) to explain why, in certain contexts, prior experience can lead to anticipating biodiversity engagement. According to PMT, protective behaviours arise from two key cognitive processes: evaluating the threat and assessing coping ability. Threat evaluation involves judging the seriousness of the environmental risk, personal vulnerability, and maladaptive response rewards. Coping assessment focuses on the perceived effectiveness of protective actions, confidence in carrying them out, and associated costs. As a result, individuals are more inclined to act when they recognise a potential environmental threat, perceive its importance, and believe they can address it effectively (Zhang et al., 2024). Thus, this perspective can potentially explain why banks located in biodiversity-rich countries may not need to accumulate as much sustainability experience to start engaging with biodiversity-related practices. To carry out this exercise, we split the full sample by dividing banks where the headquarters were located in a megadiverse country and banks where the headquarters were located in non-megadiverse areas, i.e., the rest of the world. Then, we separately run Equation (1). Table 7 reports the results of our heterogeneity analysis.

In megadiverse countries (Column 1), we observe that even a few years of gained experience via sustainability-related governance practices show a weak but positive association with biodiversity engagement. Although these coefficients are only marginally significant ($p < 0.1$), it may indicate that banks in more biodiverse countries begin to develop environmental awareness relatively early, potentially consistent with PMT. The effect is more marked and consistent only starting from years 8–11, with coefficients that increase in magnitude and remain significant through year 15 and beyond. By contrast, in non-megadiverse countries (Column 2), the effect of sustainability experience appears much weaker and more delayed. Coefficients are generally small and statistically not significant across the first 13 years. Only at very high levels of cumulative experience, starting from year 14 and above, do we observe a significant increase in biodiversity engagement. As we expected, this delay may reflect a slower internalisation of sustainability governance in specific biodiversity practices, which require a longer organisational learning process as it is less influenced by external ecological pressure. Further support for this idea comes from the coefficients for the Red List Index (RLI), which captures the national trends in overall extinction risk for species. In megadiverse countries, the RLI coefficient is negative and statistically significant ($\beta = -9.758$, $p < 0.05$). Since a lower value of RLI signals a greater national ecological degradation, a negative coefficient in our analysis means that banks are more likely to engage in biodiversity actions when national biodiversity conditions are deteriorating. This finding shows a context-dependent pattern for engagement, whereby banks amplify their awareness and respond to worsening biodiversity by increasing their involvement in conservation efforts. By contrast, the RLI effect is not significant in non-megadiverse countries ($\beta = -6.925$, $p > 0.1$), underscoring the crucial role of environmental issues in activating institutional responses in firms. Overall, these results support the ideas of prior empirical research (e.g., Skouloudis et al., 2019; Chen et al., 2023), suggesting a form of context-dependent organisational learning, where cumulative sustainability experience supports biodiversity engagement more effectively in environments where biodiversity loss is a recognised and pressing concern.

5. Conclusion

Despite growing awareness of biological decline, financial institutions are slow to respond. While normative pressures, stakeholders' scrutiny, and voluntary standards encourage banks to evaluate and report on biodiversity and how it affects their operations, what remains unclear is how financial institutions build internal capabilities needed to address more emerging and complex environmental issues, such as biodiversity decline. Most existing studies (e.g., Haque and Jones, 2020; Dunning, 2022; Velte, 2023; Hambali and Adhariani, 2024; Orazalin et al., 2025) primarily focus on formal governance structures or specific characteristics of boards as determinants of corporate biodiversity disclosure. However, they often overlook the mechanism of experiential learning processes through the extended use of sustainable governance mechanisms to explain why organisations start engaging with biodiversity-related topics over time.

Motivated by recent calls (e.g., Cosma et al., 2023; Karolyi and Tobin-de la Puente, 2023) highlighting the critical challenge of biodiversity loss and the scarcity of empirical research on biodiversity in the financial sector, this paper contributes to the biodiversity-finance literature by introducing and empirically examining a novel mechanism explaining why financial institutions engage with biodiversity. Specifically, we address the following research question: Does a bank's past sustainability-related experience enhance biodiversity engagement? We use panel data for 671 listed banks in 66 countries from 2016 to 2023 to address this research question. Drawing on the Organisational Learning Theory and Dynamic Capabilities Theory, we demonstrate that a more extended history in implementing ESG governance mechanisms builds experience, internal knowledge, and strategic focus needed to engage more actively in biodiversity practices. Notably, we observe that the positive impact of sustainability experience on biodiversity engagement is not immediate; rather, it emerges only after a threshold of 8 years of matured experience, implying that it takes time for banks to translate the governance sustainability practices into real knowledge and action. Thus, our findings are consistent with the organisational learning perspective and align with prior evidence from the CSR literature (e.g.,

[4] For further details on the classification of megadiverse countries, please refer to http://www.biodiversitya-z.org/content/megadiverse-countries.

Table 7
Country-level heterogeneity analysis.

DV= BIODIV	(1) Megadiverse countries		(2) Rest of the World	
	β	*SE*	*β*	*SE*
EXPERIENCE $_{t-1}$ = 1	0.0468*	(0.0242)	0.0159	(0.0653)
EXPERIENCE $_{t-1}$ = 2	0.0473	(0.0394)	−0.0454	(0.0480)
EXPERIENCE $_{t-1}$ = 3	0.0558*	(0.0315)	0.00264	(0.0652)
EXPERIENCE $_{t-1}$ = 4	0.0264	(0.0303)	−0.0872	(0.0659)
EXPERIENCE $_{t-1}$ = 5	−0.0276	(0.0398)	−0.0726	(0.0775)
EXPERIENCE $_{t-1}$ = 6	0.0255	(0.0442)	−0.0545	(0.0952)
EXPERIENCE $_{t-1}$ = 7	0.0329	(0.0534)	−0.0191	(0.121)
EXPERIENCE $_{t-1}$ = 8	0.159**	(0.0786)	0.137	(0.193)
EXPERIENCE $_{t-1}$ = 9	0.176*	(0.0950)	0.129	(0.202)
EXPERIENCE $_{t-1}$ = 10	0.274*	(0.161)	0.142	(0.191)
EXPERIENCE $_{t-1}$ = 11	0.506**	(0.234)	0.218	(0.207)
EXPERIENCE $_{t-1}$ = 12	0.412**	(0.201)	0.308	(0.223)
EXPERIENCE $_{t-1}$ = 13	0.452**	(0.223)	0.382	(0.235)
EXPERIENCE $_{t-1}$ = 14	0.406**	(0.191)	0.591**	(0.258)
EXPERIENCE $_{t-1}$ = 15	0.392*	(0.203)	0.829***	(0.310)
EXPERIENCE $_{t-1}$ > 15	0.415**	(0.209)	0.705**	(0.298)
SIZE $_{t-1}$	−0.106*	(0.0615)	−0.129	(0.106)
ROA $_{t-1}$	−0.0494	(0.0321)	−0.0533	(0.0390)
BM $_{t-1}$	−0.00254	(0.00598)	0.00837	(0.00993)
TIER $_{t-1}$	−9.07e-05	(0.00153)	0.00213	(0.00323)
CINC $_{t-1}$	−0.0809	(0.111)	−0.320	(0.230)
LEV $_{t-1}$	0.000191	(0.000184)	0.000195	(0.000348)
BSIZE $_{t-1}$	0.00815	(0.00736)	0.00585	(0.00902)
BFEMALE $_{t-1}$	−0.00272**	(0.00120)	0.00208	(0.00211)
BINDEP $_{t-1}$	0.00236	(0.00168)	−0.00192**	(0.000913)
BSKILLS $_{t-1}$	2.43e-05	(0.000614)	0.00105	(0.00111)
RLI $_{t-1}$	−9.758**	(4.199)	−6.925	(6.430)
GDP $_{t-1}$	0.00393	(0.00814)	0.000221	(0.00522)
Constant	10.29***	(3.477)	9.170	(6.328)
Firm FE	Yes		Yes	
Year FE	Yes		Yes	
Observations	2250		1364	
R-squared	0.113		0.196	

Note: This table shows the results obtained when estimating our relationship dividing the full sample in Megadiverse countries (United States of America, Mexico, Colombia, Ecuador, Peru, Venezuela, Brazil, Democratic Republic of Congo, South Africa, Madagascar, India, Malaysia, Indonesia, Philippines, Papua New Guinea, China, and Australia) and rest of the world. As in Column 2 of Table 1, this model specification splits EXPERIENCE into year-specific dummy indicators. All regressors are lagged one year. We include year fixed effects. Standard errors (in parentheses) are clustered at the bank level. See Table 1 for definitions of all variables. Significance levels are indicated as follows: *p < 0.1; **p < 0.05; ***p < 0.01.

Derchi et al., 2021). Moreover, we also extend past research in governance literature (e.g., Haque and Jones, 2020; Issa and Zaid, 2023; Velte, 2023; Hambali and Adhariani, 2024; Orazalin et al., 2025), explicitly demonstrating that governance mechanisms can foster a genuine biodiversity engagement integrated in strategic decision-making only when combined with substantial years of past ESG experience. Thus, our main theoretical contribution is offering another plausible explanation for corporate biodiversity attention. Secondly, we also find that the effect of experience differs from country to country in line with the protection motivation view. In countries with greater biodiversity richness (commonly referred to as megadiverse countries), banks tend to respond to ecological issues earlier, as it takes less time to convert sustainability experience into tangible actions and initiatives. By contrast, the effect is initially weaker in the rest of the world and only becomes stronger after a much longer period. We interpret this difference as potentially driven by increased stakeholder pressure and greater public awareness of environmental degradation in biodiversity-rich regions. Similar to Orazalin et al. (2025), we also show that external pressures likely prompt earlier recognition of biodiversity issues, enabling banks to convert sustainability experience into tangible actions more rapidly. Finally, we contribute by introducing a novel proxy for sustainability experience, measured as the number of years in which banks have adopted a sustainability governance tool. This approach captures how banks accumulate knowledge over time and learn from past practices to strengthen their ESG engagement.

5.1. Implications

Our evidence has several implications for companies, board members, management teams, and policymakers.

From a managerial perspective, our findings suggest that certain forms of environmental sustainability require time to reflect in tangible action. This underscores the importance of rethinking sustainable governance practices as a long-term element of corporate strategy, not as a short-lived or superficial response to external pressure. Sustainable governance structures, such as board-level sustainability committees or ESG-linked executive remuneration, must be maintained and used for an extended period to foster the development of internal organisational knowledge and strategic direction. Managers should view these governance tools as means for developing internal skills through long-term learning processes. Without this long-term orientation, they would not promote the dynamic capability needed to address new environmental challenges. Moreover, our analysis calls on banks to institutionalise ESG learning by adopting formal routines for internal training, knowledge transfer, regular updates on environmental risks, particularly by integrating biodiversity-related risks into corporate decision-making

processes. Thus, the overall evidence underlines the concept that long-term learning in an organisation can only be achieved if the board guarantees that there are no interruptions to the sustainability efforts over time. Without the active involvement of the corporate strategy, there is a high risk that biodiversity will be treated as a secondary or symbolic issue, rather than as a topic that requires serious and ongoing commitment. Therefore, our study highlights the importance of banks to adopt sustainable governance tools continually over time. This is because the extended exposure to these tools facilitates feedback loops and experiential refinement (Derchi et al., 2021), ultimately leading to fostering an organisational memory that promotes a more informed and responsive approach to biodiversity concerns. Furthermore, our study shows the existence of minimum experience thresholds required to achieve tangible results in biodiversity management. This suggests that management should plan gradual and realistic pathways, avoiding unrealistic expectations of immediate outcomes and building ESG strategies based on progressive and achievable targets. Overall, this study serves as a monitor to encourage boards to institutionalise sustainable governance mechanisms, investing in environmental expertise at the executive level, ensuring stable oversight positions, and sustaining commitment even in the absence of short-term reward in performance.

From a policy-making perspective, the limited biodiversity engagement observed in our sample, together with the evidence that the effectiveness of sustainable governance tools develops gradually over time, suggests the need to overcome a "one-size-fits-all" regulatory approach. Our findings demonstrate that banks are at different stages in their journey of integrating biodiversity into their corporate strategy.

Policymakers should therefore design transitional arrangements that introduce graduated and tailored requirements for biodiversity-related disclosure and risk management. Consistent with the approach taken for Basel III implementation, these transitional arrangements allow institutions a reasonable timeframe to build internal capacity, develop adequate data and tools, and embed biodiversity risks into their governance structures. We strongly believe this point is crucial: without a sufficient period of organisational learning, some banks may lack the internal capabilities and knowledge required to effectively respond to new and more complex ESG regulations. At the same time, we recommend a collaborative approach among financial institutions, particularly by engaging in initiatives specifically designed to promote knowledge sharing, the exchange of practical experiences, and the development of strategic recommendations. Examples of such initiatives include: Finance for Biodiversity Community and Finance for Biodiversity Pledge Foundation. Thus, while we align with previous research (e.g., Treepongkaruna, 2024) highlighting the need to introduce biodiversity-related regulation, we extend this implication by suggesting a differentiated and progressive approach. Finally, placing biodiversity at the same level of importance as climate risk, for instance, pushing to adopt a voluntary sustainability framework as the TNFD and the Principles for Responsible Banking (PRB), supervisory integration, and internationally coordinated standards, may be crucial to align financial systems with global biodiversity goals and to support institutional learning on this still overlooked component of the ESG agenda.

5.2. Limitations and direction for future research

We identify some limitations that could be addressed in future studies. First, our measure of biodiversity engagement is based on self-reported data from the LSEG database (Eikon Refinitiv). While widely used in the biodiversity finance literature (e.g., Haque and Ntim, 2020; Issa and Zaid, 2023; Orazalin et al., 2025), our data mainly captures what banks say they do, but not necessarily the real impact of their actions. Future research could address this limitation by incorporating outcome-based metrics to assess the real bank environmental impact on biodiversity. Second, our proxy for sustainability experience is based on the presence of ESG-linked compensation or sustainability committees. Although relevant, they do not capture the full range of corporate governance sustainable practices through which banks can learn and improve. More importantly, they cover a broader set of ESG factors. As such, we cannot isolate whether the observed effects are really driven only by governance environmental practices, e.g., the presence of a specific environmental committee or incentive, or by other sustainability dimensions. Future research could refine this proxy by distinguishing between environmental and non-environmental components. Third, our empirical findings are based on data from listed banks, which may not be generalizable which may not be generalizable to private financial institutions. Future research could employ data for unlisted banks to explore the link between sustainability-related experience and biodiversity. Fourth, the differences in our results for megadiverse and non-megadiverse countries suggest that the influence of external pressures can act as an additional driver for biodiversity attention. Unfortunately, due to data limitations, we cannot directly measure these countries' ecological public awareness. Future research could address this limitation by integrating more granular, country-level indicators to better capture whether public informal institutions can moderate corporate biodiversity engagement. Despite these limitations, we hope these findings will encourage further research on the long-term drivers of environmental commitment and support the integration of biodiversity into mainstream financial and corporate practices.

CRediT authorship contribution statement

Michael Christofi: Supervision, Writing – review & editing. **Carlo Confalonieri:** Conceptualization, Investigation, Methodology, Formal analysis, Data curation, Writing – original draft. **Marina Damilano:** Conceptualization, Investigation, Project administration, Methodology, Supervision, Writing – review & editing. **Eleonora Isaia:** Conceptualization, Investigation, Project administration, Methodology, Supervision, Writing – review & editing. **Niccolò Nirino:** Conceptualization, Investigation, Project administration, Methodology, Supervision, Writing – review & editing.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the author(s) used ChatGPT in order to improve language and clarity of the manusctipt. After using this tool, the author(s) reviewed and edited the content as needed and take (s) full responsibility for the content of the publication.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jenvman.2025.126928.

Data availability

Data will be made available on request.

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