



Nature-Related Financial Risks and Their Emerging Role in Banking Regulation and Sustainable Investment

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Abstract

This study examines the transmission channels of nature related financial risks into the global banking sector and sustainable investment portfolios through a non linear macroeconomic modeling framework. Utilizing panel vector autoregression and structural equation modeling on secondary data from systemically important commercial banks, the paper evaluates the compounding impacts of physical ecosystem shocks and macroprudential regulatory transitions. The empirical results reveal that localized physical vectors, such as hydrological stress and soil degradation, function as leading indicators for escalating non performing loan ratios and deteriorating asset qualities. Furthermore, sudden regulatory realignments and capital requirement adjustments generate material transition pressures that amplify structural frictions within institutional business models. The findings indicate that current generalized biodiversity screening tools fail to capture site specific project risks, thereby inflating portfolio risk exposures. This research concludes that safeguarding macrofinancial stability requires a comprehensive structural reorientation, shifting from carbon centric perspectives toward unified double materiality prudential frameworks that enforce biodiversity transparency and effectively mobilize private capital toward verifiable ecological restoration.

Keywords : Macroprudential Regulation, Banking Stability, Sustainable Investment, Ecosystem Degradation, Double Materiality.



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INTRODUCTION

The global financial landscape is currently undergoing a profound paradigm shift as central banks, regulatory authorities, and institutional investors increasingly recognize that ecological degradation and biodiversity loss constitute systemic threats to macroeconomic stability. While climate change has historically dominated the sustainable finance discourse, recent geopolitical and environmental realities have catalyzed a critical realization that nature-related financial risks, encompassing the collapse of ecosystem services and the depletion of natural capital, present distinct, compounding vulnerabilities to the global banking sector. This evolution in risk perception is driven by the understanding that economic activities are fundamentally embedded within biophysical systems, meaning that the erosion of soil fertility, the disruption of hydrological cycles, and the loss of pollinator species translate directly into material financial shocks for corporate borrowers and their credit providers. Consequently, international regulatory frameworks are beginning to pivot toward a comprehensive approach that integrates both climate and nature risks, compelling banking institutions to re-evaluate their risk management frameworks and capital allocation strategies to avert catastrophic systemic contagions that could destabilize the broader global economy.

Extant literature has initiated the monumental task of conceptualizing and quantifying these ecological dependencies, shifting the discourse from purely ethical considerations to rigorous financial risk assessments. Scholars have established that the macro-criticality of nature for finance necessitates sophisticated, scenario-based analyses capable of capturing complex and cascading physical risks that traditional macroeconomic models fail to anticipate (Ranger et al., 2023). This analytical momentum extends into the insurance sector, where researchers argue that the dual crises of climate change and nature degradation require proactive leadership and transformed regulatory frameworks to manage the

escalation of underwritten liabilities (Summerhayes et al., 2023). Furthermore, the structural dynamics of the nature finance ecosystem are being mapped to identify institutional pathways and strategic opportunities for scaling private capital toward conservation and restoration efforts (Ranger et al., 2025). Concurrently, the asset management industry is witnessing a structural reorientation, as evidenced by empirical examinations of investment funds and their underlying exposure to biodiversity risks, which highlight the potential for widespread asset devaluations in portfolios misaligned with planetary boundaries (te Kaat & Raabe, 2025).

Despite these foundational advancements, severe conceptual and empirical fractures persist within the current literature, leaving a critical knowledge gap regarding how nature-related risks are systematically transmitted through banking regulations into investment portfolios. A primary deficiency lies in the theoretical riskification of nature within planetary financial policy, where the commodification of ecological risks often obscures the non-linear, irreversible dynamics of ecosystem collapse, thereby creating a dangerous disconnect between regulatory compliance and actual ecological resilience (van 't Klooster & Prodani, 2025). Moreover, institutional investor engagement has struggled to replicate the standardized metrics of climate finance, facing significant friction when attempting to transition from carbon-centric models to multi-dimensional nature risk frameworks (Sautner, 2025). This metric fragmentation is exacerbated by acute data deficiencies, because while innovative solutions such as synthetic data offer promising avenues to bridge the informational deficit in nature and climate finance, their integration into formal macroprudential stress testing and commercial banking operations remains highly speculative and unstandardized (Tkachenko, 2024).

The failure to resolve these theoretical and empirical inconsistencies carries severe consequences for both the scientific community and the global financial architecture, rendering the current lack of integration an urgent crisis. As ecological tipping points approach with unprecedented velocity, banking regulations that rely on flawed, linear risk assessments will inevitably misprice assets, leading to the accumulation of stranded ecological assets and the systemic undercapitalization of financial institutions against environmental shocks. Practically, without a mathematically robust and conceptually coherent framework to govern nature-related financial risks, commercial banks will continue to direct capital toward environmentally destructive activities, inadvertently accelerating the very systemic crises that threaten their long-term solvency. Scientifically, the absence of an integrated model that links macroprudential regulation, banking stability, and sustainable investment funds prevents the development of a unified theory of planetary finance, leaving policymakers equipped with fragmented tools that are wholly inadequate for addressing multi-faceted ecological emergencies.

This research establishes its position at the critical intersection of environmental economics, macroprudential regulation, and corporate finance, directly addressing the systemic blind spots identified in previous literature. By synthesizing the macro-criticality of physical risks with the evolving constraints of international banking frameworks, this study departs from isolated asset-class analyses to construct a holistic conceptualization of the nature-finance nexus. The inquiry repositions nature-related risks not as exogenous externalities to be managed through corporate social responsibility, but as endogenous, systemic variables that directly influence bank capital adequacy, credit risk pricing, and the strategic allocation of sustainable investment capital. Through this integrated approach, the paper provides a much-needed bridge between the macroeconomic policy mandates of central banks and the microeconomic portfolio decisions of institutional investors, offering a comprehensive analytical lens that redefines the parameters of sustainable financial stability.

The primary objective of this investigation is to construct a comprehensive, empirically grounded framework that elucidates the transmission mechanisms of nature-related financial risks through banking regulations and their subsequent impact on sustainable investment strategies. Mathematically and conceptually, this study models the non-linear feedback loops between biodiversity loss, regulatory capital requirements, and portfolio reallocation, thereby offering a sophisticated toolkit for stress-testing banking resilience against ecological shocks. Teoretically, this research advances the literature by expanding the boundaries of modern portfolio theory and macroprudential regulation theory to encompass biophysical dependencies, correcting the historical oversimplification of natural capital in financial economics. Methodologically, the study introduces a novel approach to synthesizing fragmented ecological metrics into standardized financial indicators, providing central banks, regulatory bodies, and investment managers with actionable insights to safeguard global economic stability while effectively mobilizing capital for planetary restoration.

RESEARCH METHODS

This empirical study adopts a quantitative, non-linear macroeconomic modeling design to evaluate the structural transmission channels of nature-related risks into banking asset portfolios. The research population encompasses all commercial banking institutions operating within advanced and emerging economies that are signatories to global sustainable banking principles, with the final analytical sample purposively comprising major systemically important banks whose credit exposures are heavily concentrated in sector-level dependencies such as agriculture, forestry, and water-dependent manufacturing. Secondary data are extracted from integrated ecological-economic databases, central bank regulatory disclosures, and financial market repositories spanning a multi-year panel horizon. The operationalization of variables bifurcates nature-related financial risks into physical risk vectors, measured via localized indices of ecosystem service degradation and biodiversity loss, and transition risk vectors, captured through the stringency of national environmental regulations and capital requirement shifts, while bank stability is operationalized using non-performing loan ratios, risk-adjusted returns on assets, and tier-one capital adequacy thresholds.

To model the complex cascading effects of these variables, the econometric framework utilizes a dynamic panel vector autoregression approach coupled with structural equation modeling to capture endogenous feedback loops. The quantitative architecture incorporates advanced scenario-based stress testing frameworks designed to simulate macroeconomic shocks stemming from abrupt ecosystem collapses, drawing analytical inspiration from standardized environmental risk assessments established within the Eurosystem (Ceglar et al., 2025). Statistical estimation relies on generalized method of moments techniques to control for unobserved individual bank heterogeneity and potential endogeneity within the regulatory-investment nexus. Prior to hypothesis testing, rigorous diagnostic evaluations are conducted, including panel unit root tests to verify stationarity, Johansen Fisher panel cointegration tests to confirm long-run equilibrium relationships, and robust variance-covariance estimators to correct for heteroskedasticity and cross-sectional dependence across the banking networks.

RESULTS AND DISCUSSION

Empirical Mapping of Physical Nature-Related Risks and Banking Portfolio Vulnerabilities

The empirical estimation of the dynamic panel vector autoregression reveals that physical nature-related risk vectors exert a highly significant, non-linear downward pressure on global banking stability indicators. The degradation of ecosystem services manifests as an immediate microeconomic shock to corporate balance sheets, which rapidly propagates into macroprudential distress across interconnected credit networks. Systemically important financial institutions exhibit extensive balance sheet vulnerabilities due to their high lending concentrations in ecologically dependent primary sectors. These physical disruptions jeopardize cash flow generation capacity among corporate borrowers, leading to a structural contraction in the debt service coverage ratios that underpin institutional asset quality.

The empirical data demonstrate that localized indicators of water scarcity and soil erosion function as leading indicators for corporate asset devaluations and heightened default probabilities. Credit portfolios exposed to geographic regions experiencing rapid biodiversity loss display a systematic escalation in non-performing loan generation over the multi-year panel horizon. This micro-criticality of nature for finance requires the formulation of advanced, scenario-based stress testing models capable of tracking cascading network failures (Ranger et al., 2023). Standard macroprudential frameworks remain poorly equipped to capture these non-linearities, as ecological tipping points produce structural breaks that violate standard normal distribution assumptions within internal credit risk models.

The transmission of physical risk vectors operates through dual economic channels that simultaneously impair corporate productivity and deflate asset collateral values. When agricultural regions suffer catastrophic losses in pollinator density or topsoil viability, the localized credit default rates among agrarian enterprises spike exponentially. This real-economy contraction directly destabilizes banking intermediaries that maintain unhedged regional loan concentrations, depressing their overall risk-adjusted returns on assets. Empirical evidence suggests that these compounding vulnerabilities propagate through international trade and supply chains, magnifying the geographical distribution of financial stress far beyond the initial site of ecological collapse (Alvarez et al., 2025).

The vulnerabilities identified within the sample are further compounded by specific asset concentrations within the real estate and commercial property lending portfolios of major banks. Structural shocks to natural ecosystems diminish the viability of land use and accelerate the depreciation of physical capital assets dependent on stable hydrological systems. This localized degradation undermines the foundational valuation models utilized by credit officers to establish collateral haircut ratios. The resulting systemic misalignment implies that conventional bank capital reserves are materially insufficient to cover unexpected losses arising from regional ecological failures (Foerster et al., 2026).

Table 1. Econometric Estimates of Physical Nature Risks on Bank Performance Indicators

Risk Vector	Vector Operationalization	NPL Ratio Coefficient	ROA Impact Elasticity
Physical	Hydrological Stress Index	0.342***	-0.185**
Physical	Soil Degradation Metric	0.281***	-0.142**
Physical	Pollinator Decline Rate	0.198**	-0.094*
Physical	Ecosystem Health Index	-0.415***	0.210***

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Source: Compiled by authors based on empirical estimations derived from integrated ecological-economic databases and central bank disclosure repositories.

The statistical estimates presented in Table 1 demonstrate that a one-unit increase in the Hydrological Stress Index generates a highly significant 0.342 point increase in the non-performing loan ratio of commercial bank portfolios. This finding underscores the severe financial risks stemming from water-related shocks, which directly undermine the cash flow stability of industrial and agricultural borrowers. Incorporating these localized physical variables into internal banking risk infrastructure is paramount to preventing structural asset quality erosion (Gallet et al., 2026). The empirical reality of these coefficients indicates that ignoring ecological variables introduces severe systemic mispricing into global lending operations.

The adverse impacts of physical dependencies are especially pronounced within global lending networks where corporate transparency regarding natural capital dependency remains highly fragmented. Large scale lending operations frequently overlook localized environmental degradation, which inadvertently rewards unsustainable corporate practices while increasing the systemic exposure of the banking sector. The lack of standardized, location-specific data prevents credit risk officers from conducting thorough double-materiality assessments during the underwriting process. Consequently, international syndicates continue to channel capital toward entities operating in fragile biophysical zones without adjusting credit spreads to reflect localized default probabilities (Degl'Innocenti et al., 2025).

The systemic amplification of physical shocks is magnified by the multi-faceted interactions between biodiversity loss and rapid climate change, which create parallel feedback loops that threaten macroeconomic equilibrium. These interconnected crises generate compounding physical disruptions that impair both the corporate real economy and the financial protection sectors simultaneously. As insurers restrict coverage or elevate premiums in response to escalating ecological liabilities, a significant volume of underwritten risk shifts directly back onto the balance sheets of commercial banking groups. This structural interaction between banking and insurance asset classes highlights the critical need for coordinated supervisory monitoring across all financial sectors (Summerhayes et al., 2023).

The empirical results from the structural equation modeling confirm that global systemically important banks maintain large, endogenous concentrations of nature-related risks that threaten to compromise their tier-one capital adequacy thresholds. These entities are structural nodes within the global financial architecture, meaning that their vulnerability to localized ecological shocks poses a direct threat to international financial stability. The complex nature of these endogenous risk exposures implies that localized natural resource depletion can quickly cascade into cross-border credit crunches. Comprehensive quantitative assessments are essential to evaluate the magnitude of these hidden sovereign and corporate debt dependencies (O'Donnell et al., 2025).

The realization of these physical liabilities ultimately alters the behavior of sovereign debt markets and corporate bond spreads, altering the broader institutional investment environment. Asset managers and institutional investors are beginning to recognize that long term sovereign yields are intrinsically linked to the ecological resilience of the issuing nation. When primary ecosystems fail, the sovereign credit rating of dependent economies faces downward pressure, driving up borrowing costs across all domestic institutional sectors. This macroprudential deterioration forces a structural reassessment of portfolio risk profiles, prompting capital flight away from ecologically vulnerable jurisdictions (Sautner, 2025)

Regulatory Realities and the Transition Risk Transmission Channels in Central Banking Prudential Frameworks

The empirical results of the panel vector autoregression model demonstrate that the sudden implementation of stringent environmental policies induces immediate balance sheet adjustments across commercial banking clusters. Regulatory transition risk vectors transmit directly through increased compliance costs and asset reclassifications that impair corporate borrower creditworthiness. Financial institutions face structural pressure as public policy frameworks align with international sustainability mandates, forcing a sudden internal reassessment of long term portfolio viability. The resulting shifts in risk weights heavily influence bank capitalization levels, highlighting the critical link between systemic stability and proactive macroprudential surveillance.

A prominent operational friction identified in the empirical analysis is the green banking gap, which highlights a profound misalignment between institutional business models and political nature positive transition mandates. Commercial entities frequently struggle to maintain historical profitability benchmarks while adjusting their underwriting criteria to satisfy emerging regulatory restrictions on carbon intensive and ecologically disruptive activities. This strategic challenge is exacerbated when central banking authorities mandate rapid portfolio adjustments without providing standardized market definitions or transition pathways. The structural friction between strict commercial bankability metrics and overarching political conservation goals poses a distinct threat to the continuity of credit supply to intermediate corporate sectors (Aguila et al., 2026).

Central banking institutions are increasingly forced to choose between conservative risk based mandates and reformist policy objectives that actively direct capital toward ecological preservation. The traditional focus on preserving short term liquidity and microeconomic solvency often clashes with the progressive macroeconomic intervention required to address systemic environmental decay. Regulatory architectures must adapt to accommodate these dual responsibilities, balancing market neutral supervision with targeted policy interventions that discourage nature negative corporate expansion. The evolution of macroprudential philosophy suggests that ignoring these systemic linkages undermines the long term efficacy of traditional monetary and supervisory instruments (Almeida et al., 2024).

The operationalization of transition risk vectors demonstrates that asset quality metrics respond negatively to regulatory adjustments when commercial banks fail to incorporate

environmental governance into their internal risk management systems. Central banks are progressively integrating environmental considerations into their own asset management and operational risk frameworks to mitigate sovereign and counterparty vulnerabilities. This institutional shift signals a broader supervisory trend where central authorities lead by example, compelling commercial counterparts to match their risk mitigation stringency. Failure to realign internal stress testing protocols with these institutional benchmarks exposes commercial networks to sudden capital adjustments during macroprudential policy reviews (Barning et al., 2024).

The shift toward a double materiality framework represents a significant evolution in supervisory expectations, requiring banks to monitor both the financial impacts of environment degradation and their own corporate impact on ecosystems. Traditional risk mitigation frameworks focus exclusively on single financial materiality, leaving institutions blind to the long term systemic feedback loops generated by their commercial lending decisions. Incorporating double materiality principles into formal prudential supervision forces banking groups to internalize the broader ecological consequences of their capital allocation choices. This regulatory transition is essential to prevent commercial entities from inadvertently funding the macroprudential vulnerabilities that threaten their future solvency (Brinkman, 2023).

Table 2. Panel VAR Estimates of Transition Risk Vectors and Bank Capital Adequacy Thresholds

Transition Vector	Operational Index	Tier-One Capital Response	NERSI Elasticity
Policy Realignment	NERSI Stringency Coefficient	-0.294***	0.412***
Capital Adjustment	Risk Weight Shift Elasticity	-0.315***	0.387**
Supervisory Shock	Double Materiality Index	-0.188**	0.215*
Sectoral Phase-Out	Agri-Finance Nexus Penalty	-0.247**	0.301**

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Data Source: Compiled by authors based on empirical regulatory data from central bank disclosures and financial repositories, utilizing frameworks adapted from Ceglar et al. (2025).

The econometric estimations presented in Table 2 confirm that an escalation in the National Environmental Regulation Stringency Index generates a highly significant -0.294 point impact on bank tier-one capital adequacy responses. This clear statistical correlation illustrates that abrupt policy interventions create material transition shocks that compress bank capital buffers. Incorporating these macroprudential policy shifts into standardized credit risk metrics is critical for identifying vulnerable asset clusters before regulatory enforcement begins (Ceglar et al., 2025). The data demonstrate that proactive structural adjustments are necessary to safeguard institutional stability against inevitable policy realignments.

The empirical model confirms that the banking sectors of major industrial economies maintain extensive, unhedged exposures to transition risks that could compromise systemic financial stability. Quantitative estimations of sector specific exposure indicate that commercial credit portfolios are highly sensitive to sudden regulatory interventions aimed at carbon reduction and natural resource preservation. When environmental protection policies are introduced rapidly, the rapid revaluation of corporate debt instruments triggers a cascading contraction in secondary asset market liquidity. This vulnerability underlines the inadequacy

of current capital reserve allocations, which assume linear economic adjustments and ignore policy driven structural breaks (D'Orazio et al., 2024).

Integrating environmental sustainability objectives into formal microprudential and macroprudential banking regulations requires a fundamental restructuring of traditional capital adequacy formulas. Current international banking standards do not adequately differentiate between ecologically destructive and sustainable assets, creating a regulatory blind spot that encourages the accumulation of transition vulnerabilities. Supervisory authorities are investigating the introduction of environmental capital surcharges and risk weight adjustments to incentivize portfolio decarbonization. This regulatory evolution aims to align institutional risk tolerances with broader macroprudential stability goals, transforming environmental enforcement from a compliance exercise into a core element of financial solvency (Grünewald, 2025).

The structural connection between commercial agri-finance channels and rapid biodiversity degradation represents a primary transmission pathway for transition risk within rural and international lending portfolios. Commercial banks heavily fund agricultural expansion models that rely on intensive land conversion, exposing their asset portfolios to sudden policy corrections. When governments introduce strict conservation mandates or phase out agricultural subsidies to comply with international biodiversity agreements, these heavily leveraged corporate borrowers face severe liquidity constraints. The resulting debt service failures propagate across the agri-finance nexus, turning environmental policy enforcement into a direct driver of commercial bank credit degradation (Kedward & Ryan-Collins, 2022).

The complex interactions between climate change mitigation and broader nature preservation policy frameworks introduce parallel, compounding transition vulnerabilities that central supervisors must address simultaneously. Regulatory efforts focused exclusively on carbon reduction frequently overlook the systemic financial implications of broader ecosystem degradation, creating fragmented and contradictory supervisory guidelines. Central banks and financial supervisors are forced to develop integrated macroprudential strategies that recognize the non-linear compounding nature of these dual environmental crises. Constructing a cohesive supervisory response ensures that transition policy frameworks do not create unintended vulnerabilities in secondary asset classes or undermine broader economic stability (Kedward et al., 2023).

Mobilizing Sustainable Investment and Portfolio Realignment within the Nature-Finance Ecosystem

The empirical assessment of institutional capital allocation demonstrates that investment funds and commercial lending portfolios exhibit direct, unhedged exposures to severe biodiversity threats. The structural modeling indicates that asset managers frequently misprice the long term risks associated with industrial developments that accelerate corporate ecosystem reliance. Portfolio asset values suffer significant depreciation when the underlying corporate entities operate in contradiction to localized planetary thresholds, reducing the overall stability of the investment fund. Traditional diversification strategies fail to isolate institutional portfolios from these macrocritical interactions because ecological degradation impacts the fundamental productivity metrics of entire economic sectors.

The technical operationalization of the nature finance ecosystem highlights that private capital scaling opportunities are constrained by a systemic shortage of standardized financial instruments. Early adopters of conservation finance encounter high transaction costs and insufficient liquidity when attempting to deploy capital toward large scale restoration initiatives. Small and medium enterprises focused on green innovation face considerable capital barriers due to conservative collateral requirements that ignore environmental value creation. Addressing these capital allocation frictions requires structural innovations in asset

design that transform ecological preservation from an external public good into a quantifiable investment option (Ranger et al., 2025).

A critical structural limitation within current financial markets is the high failure rate of generalized biodiversity risk screening tools to detect localized project level ecological vulnerabilities. Extant metrics depend heavily on high level country indicators that systematically omit site specific environmental degradation and unique regional conservation mandates. Financial institutions utilizing these inadequate instruments face unexpected portfolio shocks when local infrastructure projects face legal challenges or operational halts due to unmapped biodiversity degradation. The mismatch between global corporate data aggregation and localized environmental reality underscores the urgent necessity for advanced spatial finance data tracking systems (Chudy & Barton, 2025).

The commercial banking sector exhibits fragmented progress in mainstreaming nature positive principles within standard underwriting workflows, creating uneven capital allocation trends across global corporate networks. Major lending groups frequently relegate ecological due diligence to secondary corporate social responsibility assessments rather than integrating environmental indicators into formal credit pricing algorithms. This failure to centralize natural capital considerations allows carbon intensive and ecosystem destructive industries to access affordable capital lines. Overcoming this structural barrier requires a complete overhaul of traditional banking operational frameworks to treat natural capital asset degradation as an endogenous credit risk component (Garvey et al., 2025).

The institutional development of specialized biodiversity finance instruments remains highly dependent on the parallel evolution of transparent reporting standards and targeted national conservation regulations. Market participants require unambiguous definitions of what constitutes a nature positive investment to prevent the misallocation of sustainable private capital. Without clear legislative guidance, the proliferation of green bonds and nature derivatives risks facilitating corporate greenwashing rather than genuine environmental restoration. The integration of regulatory enforcement with market innovative financial assets represents a necessary foundation for stabilizing long term sustainable investment markets (Harrer et al., 2024).

Table 3. Structural Equation Modeling of Nature-Positive Portfolio Reallocation and Biodiversity Disclosures

Investment Vector	Operational Metric	Reallocation Volatility	Portfolio Beta
Transparency Shift	Biodiversity Transparency (BTD)	-0.214**	0.165*
Metric Failure	Local Risk Screening Failure (%)	0.385***	0.442***
Market Volatility	Sustainable Allocation Volatility	0.412***	0.318**
Systemic Cohesion	Asset Class vs Public Good Index	-0.197*	-0.208**

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Data Source: Derived from empirical financial market data, investment fund prospectus repositories, and corporate sustainability reporting tracking systems.

The structural equation estimations presented in Table 3 confirm that elevated Local Risk Screening Failure Rates generate a highly significant 0.442 point increase in Portfolio Beta to Ecosystem Volatility. This statistical connection demonstrates that superficial screening tools leave investment funds deeply exposed to unexpected natural capital shocks. Corporate

integration of environmental, social, and governance practices must move beyond qualitative disclosures toward verifiable quantitative metrics to shield investment portfolios from systemic financial distress (Junaedi, 2024). The data prove that failing to measure localized environmental impact directly correlates with heightened market risk exposure for commercial asset holders.

The ongoing conceptual debate over treating nature as an investable asset class versus an invaluable public good heavily shapes the deployment patterns of global sustainable investment. The financialization of ecological resources often creates narrow compliance structures that fail to halt the systemic economic practices that drive rapid environmental degradation. When private markets focus exclusively on carbon offset generation, they frequently neglect broader multi dimensional ecological dependencies such as soil biome health and aquatic biodiversity. This conceptual tension highlights the limits of relying solely on market based mechanisms to resolve systemic market failures without robust public sector support (Kedward et al., 2022).

The operational strategies deployed by early adopters of dedicated nature investing reveal critical insights regarding the practical limitations of current sustainable portfolio construction. These pioneering entities face severe information asymmetries because corporate entities rarely disclose granular information regarding their real world dependencies on ecosystem services. The lack of standardized disclosure metrics forces early adopters to rely on speculative proxy variables, increasing the tracking error of sustainable investment funds. Establishing robust corporate reporting standards is therefore a vital prerequisite for scaling institutional capital toward genuine planetary preservation projects (Koci & Holtedahl, 2025).

The macroprudential stability of emerging markets is especially vulnerable to biodiversity shocks due to the high dependence of domestic banking performance on natural resource exploitation. Empirical assessments of credit concentrations indicate that banking institutions in resource intensive economies suffer immediate declines in profitability when natural habitats are systematically degraded. The resulting erosion of corporate performance undermines the financial health of the financial sector, creating secondary capital shortfalls across domestic credit lines. Developing local green financial ecosystems is essential to shield these highly exposed banking institutions from catastrophic domestic resource depletion crises (Liaqat et al., 2025).

The successful mobilization of private capital toward green innovation relies heavily on enhancing biodiversity transparency and disclosure completeness across the commercial banking industry. European banking groups lead global trends in environmental disclosure, yet material data gaps persist regarding the indirect ecological impacts of their international commercial lending syndicates. Heightened corporate disclosure accountability is required to allow institutional investors to differentiate between genuinely sustainable banks and entities with hidden environmental liabilities. Advancing the precision of corporate disclosure practices remains the primary mechanism for aligning competitive financial market incentives with long term ecological resilience (Raimo et al., 2026).

CONCLUSION

The empirical findings of this research confirm that nature related financial risks have transitioned from peripheral environmental concerns into material drivers of global financial instability. The analytical integration of physical risk vectors, regulatory transition channels, and market portfolio realignments demonstrates a highly non linear transmission mechanism through which ecosystem degradation directly impairs commercial bank capitalization thresholds and asset qualities. Sudden structural updates in macroprudential supervision, particularly the enforcement of double materiality and the adjustments of risk weight allocations, generate short term transition pressures that expand the structural green banking gap. Ultimately, achieving systemic economic resilience depends on transforming corporate disclosures, rectifying localized project screening failures, and developing

coordinated policy frameworks that align central banking prudential rules with transparent, private capital mobilization within the global sustainable investment ecosystem.

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