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Pricing nature across borders: global banks' response to nature-linked financial policies

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Summary

There is growing evidence that biodiversity degradation has an economically significant impact on the global financial system. Markets are beginning to factor biodiversity effects into asset prices, lowering the valuations of companies that harm nature and raising their external financing costs. Yet the influence of nature-related financial policies (NRFPs) on the financial system is underexplored. We provide insights into that dynamic by assessing the relationship between NRFPs in the home jurisdictions of global banks and the terms of cross-border loans to firms associated with biodiversity damage.

Drawing on loan-level data from Colombia (one of the world's most biodiverse countries), regional measures of biodiversity loss and a new global index of nature-related financial policies, we show that the introduction of stricter NRFPs is linked to higher loan spreads and longer maturities, but not to significant changes in total lending volumes. These effects are most apparent under disclosure- and principles-based policies, which prompt banks to price biodiversity-related risk into the terms of cross-border loans. This has important implications for domestic financial supervisors, the standardisation of biodiversity disclosures and technical assistance for firms in biodiversity-exposed sectors.

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1. Introduction

In recent decades, financial authorities worldwide have adopted a wide range of nature-related financial policies (NRFPs) to address the systemic risks of biodiversity loss and environmental degradation (FSB, 2024; NGFS, 2024). Although these measures are heterogeneous in scope and enforcement, they are all designed to integrate nature-related risks into financial decision-making. However, their implementation remains fragmented and uneven across jurisdictions, particularly between advanced and emerging economies (NGFS, 2022; D'Orazio and Thole, 2022).

To assess the global impact and potential unintended consequences of NRFPs, it is essential to understand whether and how they affect international lending. Given the extent of global banks' cross-border activities, it is unclear whether purely domestic policy measures such as these can address transnational environmental risks. Financial supervisory authorities often lack a comprehensive overview of banks' foreign exposure, which can encourage the relocation of environmental risks to jurisdictions with weaker oversight (Beck et al., 2013; Buch and Goldberg, 2017). Cross-border transmission can be explained by both information friction and incentives for regulatory arbitrage (Beck et al., 2013): internationally active banks may reprice or restructure lending in response to changes in capital requirements, reputational considerations or expectations of heightened future supervision, even when they are dealing with firms located outside the jurisdiction implementing NRFPs.

Despite the rapid expansion of NRFPs in global banks' home jurisdictions, there is limited systematic evidence of whether and how such policies affect cross-border lending conditions. Little is known about whether banks adjust loan pricing or contract structures when lending to firms that are relatively exposed to biodiversity degradation. These dynamics are critical to evaluating the externalities of NRFP regimes and the international effects of domestic policy initiatives.

Colombia provides an ideal setting in which to study these issues. First, the country is classified as one of the world's 17 megadiverse nations, ranking in second place for the diversity of its animal and plant species, and its habitats (UEA, 2020). Because biodiversity affects both productivity and risk, many firms depend on ecosystem services to make a profit. In Colombia, this is especially relevant to agribusiness – which relies on stable water supplies, fertile soil and pollinators – and to tourism, in which natural assets directly drive demand. The country is an informative setting in which to assess how NRFPs shape cross-border lending terms for firms linked to biodiversity degradation. As Edward Wilson once put it, "biodiversity is to Colombia what oil is to Saudi Arabia". Second, Colombia has a small, open economy with relatively high corporate access to cross-border credit – and is, therefore, exposed to changes in global financial conditions (Williams, 2018; Ahn and Sarmiento, 2019; Correa et al., 2025).

This paper focuses on whether the implementation of stronger NRFPs, such as green prudential regulations and taxonomies, in banks' home jurisdictions is associated with changes in the terms of cross-border loans to Colombian firms, particularly those with relatively high exposure to biodiversity degradation.[1] There is evidence that the introduction of stricter NRFP regimes is strongly associated with higher loan interest rate spreads and longer loan maturities, but not with changes in the volume of cross-border credit. The findings discussed in this study are drawn from the accompanying

"The introduction of stricter nature-related financial policy regimes is strongly associated with higher loan interest rate spreads and longer loan maturities, but not with changes in the volume of cross-border credit."

[1] Banco de la República (2023) incorporates the effects of economic growth contraction resulting from transition risk on credit risk into stress-test scenarios. Bohorquez-Penuela et al. (2024) find that the increased risk of stranded assets implied by the Paris Agreement resulted in a significant contraction in local bank credit to Colombian fossil fuel firms.

working paper (D'Orazio et al., 2026). The increase in spreads appears to be connected to transition risks: banks adjust loan margins in response to expectations around more stringent nature-related policy frameworks, which typically raise the compliance costs, scrutiny and uncertainty of activities linked to biodiversity. This is in line with previous findings that banks demand higher margins from borrowers that are exposed to environmental transition shocks (Ehlers et al., 2022).

While climate-related financial risks often receive attention in research and policy discussions, biodiversity risks are underexplored. This matters because there is growing evidence that biodiversity degradation has an economically significant impact on financial systems. For instance, markets are beginning to factor biodiversity effects into asset prices, lowering the valuations of companies that harm nature and raising their external financing costs (Ilhan et al., 2023; Garel et al., 2024). Yet there are few systematic analyses of how biodiversity risk influences bank credit supply. We address that shortfall by examining biodiversity exposure through the lens of cross-border lending – a novel approach to understanding how NRFPs affect the international financial system.

"There is growing evidence that biodiversity degradation has an economically significant impact on financial systems."

Strong institutional and regulatory frameworks shape financial activity in fundamental ways. Indeed, there is a consensus that the quality of legal institutions is a key driver of financial development and credit conditions (Levine, 1998; Beck et al., 2003). Building on this, recent studies provide initial insights into the ways in which nature-focused regulatory initiatives shape cross-border lending. These studies show that banks offer more favourable financing terms to companies with stronger environmental performance while tightening conditions for those facing higher environmental risk (Degryse et al., 2023; Erten and Ongena, 2023). However, the existing literature primarily focuses on climate-related factors and does not address the influence of nature-related policies on cross-border lending decisions.

Nonetheless, policymakers focused on NRFPs can draw important lessons from the evolution of climate-related financial policies, which are increasingly relevant to the mitigation of systemic financial risks associated with environmental degradation (D'Orazio and Thole, 2022). One of the main challenges policymakers face concerns the ways in which banks' cross-border operations can reduce the reach of nationally implemented rules (Beck et al., 2013) and create opportunities for regulatory arbitrage when information is imperfect (Giammarino et al., 1993; Houston et al., 2012; Ongena et al., 2013; Buch and Goldberg, 2017). Moreover, deeper global financial integration reinforces these mechanisms, increasing incentives for banks to reallocate risk across jurisdictions (Boyer and Kempf, 2020).

We provide insights into the transnational influence of NRFPs through the terms of loan contracts, as conditioned by borrowers' exposure to biodiversity risks. These dynamics have major implications for how policymakers design and coordinate NRFPs in an interconnected global financial system.

2. Data and methodology

The transnational influence of NRFPs is reflected in Colombia's administrative loan-level data on cross-border credit, the nature-related

financial policy intensity of countries in which lenders are based, and sectoral measures of borrowers' exposure to biodiversity degradation across Colombian regions. This influence becomes especially clear when comparing, within the same firm and year, loans provided by lenders headquartered in countries with different levels of policy intensity.

2.1. Data

Table 1 provides an overview of this administrative data, drawing on the Central Bank of Colombia's 2015–2022 records on loans from foreign financial institutions to Colombian non-financial firms. The most relevant parts of this data – covering 96,196 loans, 233 lenders in 34 countries, and 2,379 Colombian firms – relate to interest rate spread, maturity and loan volume.

Table 1. Main sources of data

Measure	What it captures	Source
Interest rate spread, maturity and loan volume	Terms of cross-border loan to Colombian firms	Central Bank of Colombia (2015–2022)
Nature-related financial policy intensity (country–year)	Policy intensity in the lender's home country	D'Orazio (2023); policies identified since the publication of this study
Legacy-adjusted Human Footprint Index (LHFI)	Ecosystem pressure and biodiversity degradation across regions	Correa Ayram et al. (2020)
Exposure	Localised sectoral exposure to environmental degradation	LHFI and regional shares by sector
Exploring Natural Capital Opportunities, Risks and Exposure (ENCORE) impact scores	Industries' direct impact on biodiversity (augmentation)	ENCORE database

2.2. Methodology

Nature-related financial risks can affect banks through multiple channels. Firms that rely on ecosystem services may face higher production costs as ecosystems degrade, increasing the likelihood that they will default on loans and, therefore, heightening banks' credit risk. In addition, bank loans to borrowers linked to significant biodiversity degradation can come with reputational and legal risks, including exposure to litigation and supervisory scrutiny. Against this backdrop, banks may respond to stronger NRFPs in their home jurisdictions by adjusting the pricing and structure of the cross-border loans they provide to biodiversity-exposed firms (see Box 1 below).

"Bank loans to borrowers linked to significant biodiversity degradation can come with reputational and legal risks."

Box 1. Baseline equation

The baseline equation below measures whether lenders headquartered in countries with stronger NRFPs price biodiversity exposure differently in cross-border lending:

$$Loan\_term_{i,s,k,c,t} = \alpha + \beta_1 Exposure_s + \beta_2 NRFPI_{c,t-1} + \beta_3 [Exposure_s \times NRFPI_{c,t-1}] + \mu_{i,t} + \varepsilon_{i,s,k,c,t}$$

$Loan\_term_{i,s,k,c,t}$ denotes the loan volume, interest rate spread or loan maturity for cross-border loans granted by foreign lender (k) located in country (c) to Colombian firm (i) operating in sector (s) at time (t). The interest rate spread is defined as the difference between the contractual loan rate and the corresponding reference rate. The coefficient of interest (β_3) captures whether the differences between loan terms for more and less exposed borrowers increase with the nature-related policy intensity of a lender's home country (measured by $NRFPI_{c,t-1}$). The equation is designed to compare, within the same firm and year, loan contracts originated by lenders headquartered in countries with different levels of nature-related policy intensity. Firm–year fixed effects ($\mu_{i,t}$) account for borrower-specific, time-varying factors, including shifts in credit demand, changes in risk characteristics, balance sheet dynamics and access to alternative sources of finance. Standard errors are two-way clustered at the bank and country levels.

3. Key measures: policy intensity and biodiversity exposure

The single measure of policy intensity described above is useful because banks' home countries differ not only in whether they adopt NRFPs but also in the breadth of these policies across various areas of activity and the degree to which the relevant policy instruments are binding. Nature-related financial policy intensity in banks' home countries is captured using the Nature-Related Financial Policy Index (NRFPI), a country–year measure based on financial authorities' observed policy actions. The NRFPI summarises the breadth of policy coverage across major areas of activity and whether instruments are voluntary or mandatory, enabling consistent comparisons between countries over time. The underlying policy inventory draws on D'Orazio (2023) – which covers 90 countries between 2000 and 2022 – and policies identified since the publication of this study. Policies are grouped into five areas, building on D'Orazio and Thole (2022): green prudential regulations; green financial principles (taxonomies and classification frameworks); other green disclosure requirements beyond core banking; green bond frameworks and standards; and green credit allocation policies. Figure 1 shows the evolution of policy activity by area over 2015–2022.

This paper measures borrowers' exposure to biodiversity degradation using each sector's footprint across Colombian regions whose ecosystems are under differing levels of pressure. The Legacy-adjusted Human Footprint Index (LHFI) for Colombia's 32 administrative departments – introduced by Correa Ayram et al. (2020) and retrieved from the BioTablero database of the Colombian Humboldt Institute –

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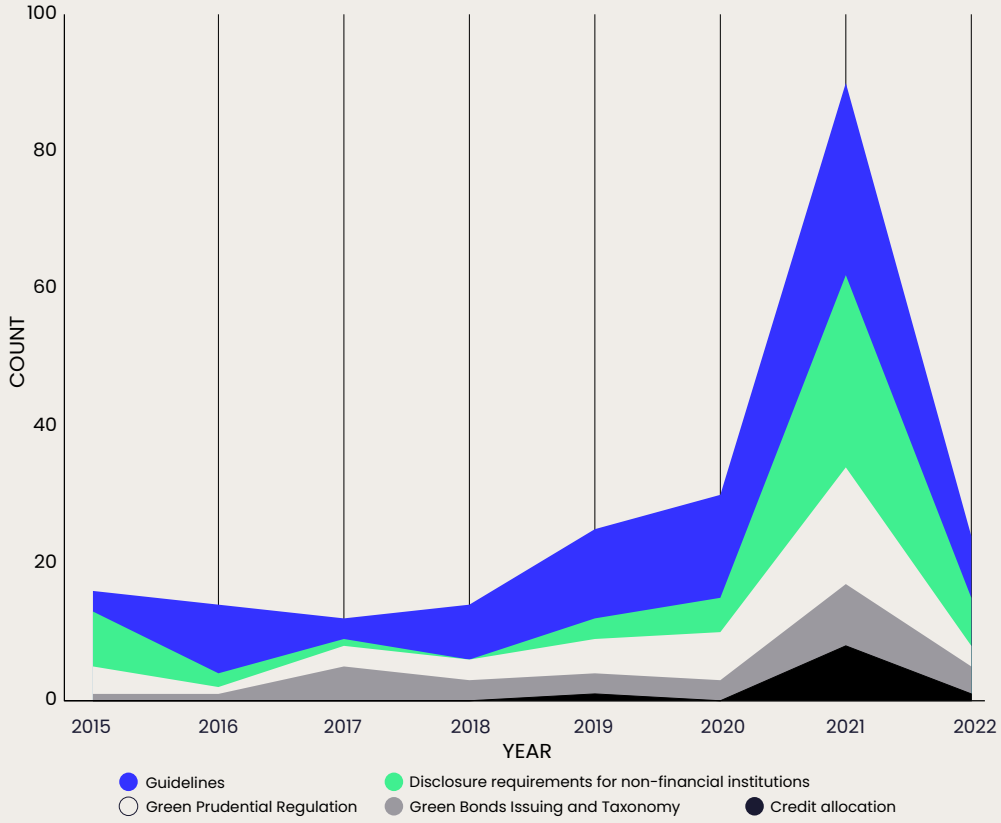
acts as an indicator of regional biodiversity degradation. The LHFI is a composite index built from seven spatial variables, capturing land-use intensity and the cumulative duration of human intervention. It is scaled to [0, 1], with higher values indicating more intense and longer-standing human pressure on ecosystems – and, therefore, greater risk of biodiversity degradation.

Figure 1. Number of NRFPs by area

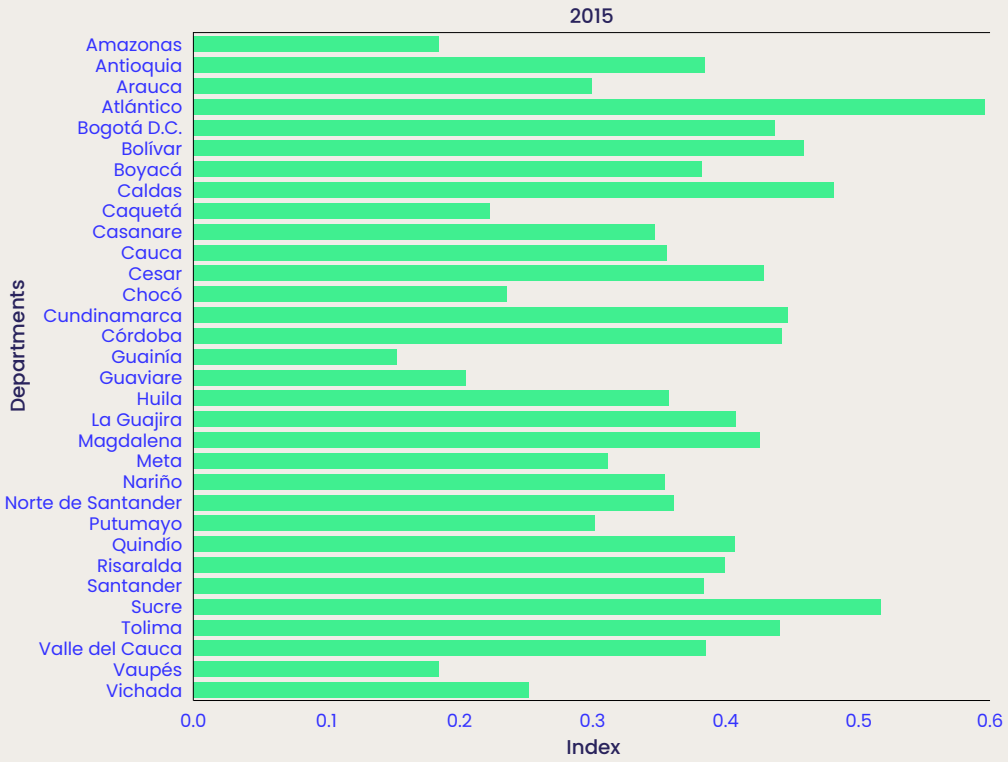


Source: Authors' elaboration on data from D'Orazio (2023) and newly identified policies.

This paper's measure of sector-level exposure comes from a combination of the level of biodiversity degradation in each department (via the LHFI) and the economic footprint of each sector across departments (as a share of regional GDP). The more exposed sectors are those that account for a larger share of economic activity in departments with higher LHFI values. To reduce concerns about reverse causality, this paper measures exposure as time-invariant by computing it using 2015 LHFI values, which are predetermined relative to loan outcomes between 2015 and 2022. To account for industries' direct contribution to biodiversity loss, the baseline exposure measure is augmented using industry-level biodiversity impact scores from the ENCORE database. Figure 2 shows the variation in biodiversity degradation across Colombia's departments in 2015.

"The more exposed sectors are those that account for a larger share of economic activity in departments with higher Legacy-adjusted Human Footprint Index values."

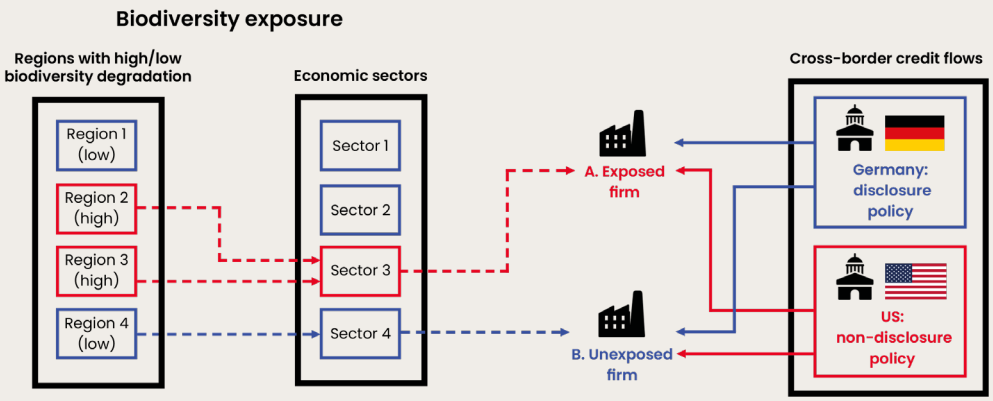
Figure 2. Human impact on highly biodiverse ecosystems (2015)



Source: Authors' elaboration on data from Correa Ayram et al. (2020).

Figure 3 summarises the methodology at the centre of this study. Borrower firms are classified as more exposed when their sector's activity is economically concentrated in regions with higher biodiversity degradation. Loan terms are compared across banks headquartered in jurisdictions with differing levels of nature-related financial policy intensity. As discussed above, this approach is useful for measuring whether the difference in loan terms between more and less exposed borrowers is larger when lenders are headquartered in countries with higher NRFPI.

Figure 3. Methodology



"Borrower firms are classified as more exposed when their sector's activity is economically concentrated in regions with higher biodiversity degradation."

4. Results and discussion

When countries that are home to major financial centres adopt NRFPs, this has measurable effects on cross-border credit conditions. There is evidence that global banks operating under stricter NRFPs in their home jurisdictions systematically change the terms of their cross-border loans.

On average, firms with greater exposure to biodiversity loss face higher borrowing costs and obtain longer-term loans from banks headquartered in foreign countries with stricter NRFPs. Importantly, these effects occur without a contraction in the average size of loans. Global banks continue to lend to environmentally exposed firms and jurisdictions, but do so on different terms – suggesting that they are increasingly factoring nature-related financial risks into their international lending decisions.

Across a wide range of lenders and borrowers, there is no evidence that stricter NRFPs lead banks to reduce the amount of cross-border credit they provide to biodiversity-exposed firms. Loans to more exposed firms come with higher interest rate spreads and are structured with longer maturities, indicating a recalibration of risk assessment rather than a reallocation of lending away from these firms. This pattern suggests that global banks internalise biodiversity-related risks primarily along the intensive margin, by repricing and reshaping contracts, while maintaining their lending relationships and market presence abroad. For policymakers, this distinction matters: there is a gradual and targeted transmission of NRFPs into global credit markets rather than abrupt credit tightening or capital flight.

These effects are not uniform across borrowers but are concentrated among firms with greater exposure to biodiversity loss and ecosystem degradation. As discussed above, when companies' activities are more closely linked to regions under higher biodiversity pressure, they systematically receive tighter lending terms from banks that are subject to stricter NRFPs. Importantly, this pattern holds not only when measuring exposure based on realised environmental degradation but also when measuring it based on firms' sectoral dependence on ecosystem services and their potential to contribute to future ecological damage. The evidence suggests that banks' repricing is driven primarily by prudential, principles-based and disclosure policies, indicating that policy tools that shape risk assessments and transparency matter most for cross-border loan pricing.

While these effects do not seem dramatic at the level of a single loan, they are meaningful and consistent across the Colombian economy. A representative tightening of NRFPs in banks' home countries is associated with an increase in borrowing costs of roughly 15–20 basis points for firms with an average level of biodiversity exposure – roughly 5% higher than typical cross-border loan spreads. In this scenario, loan maturities are several months longer, corresponding to an increase of almost 15–20% relative to the average maturity observed in the data. These adjustments are particularly relevant for firms that already operate in environmentally stressed regions, where financing conditions are often tight to begin with.

The coexistence of stable credit volumes, higher interest rate spreads and longer maturities is consistent with a simple trade-off between liquidity and risk. Faced with heightened regulatory scrutiny, reputational exposure and anticipated future compliance costs linked to biodiversity risk, banks

"Global banks continue to lend to environmentally exposed firms and jurisdictions, but do so on different terms."

appear to preserve lending relationships while adjusting contracts. Longer maturities ease the short-term liquidity pressure on firms – which is particularly relevant for borrowers that incur the high upfront adjustment costs of operating in ecologically stressed regions. Meanwhile, higher spreads compensate lenders for the increased risk associated with delayed repayment and longer exposure horizons. In this sense, longer maturities should not be interpreted as a sign of looser credit conditions but as part of a broader repricing strategy that balances borrowers' liquidity needs against lenders' risk management constraints.

5. Conclusion and policy recommendations

The introduction of stronger NRFPs in global banks' home jurisdictions is associated with higher interest rate spreads and longer maturities in cross-border loans to biodiversity-exposed Colombian firms, but not with statistically significant changes in aggregate cross-border credit volumes. A one standard deviation increase in NRFP intensity in these jurisdictions is associated with a rise in loan spreads of approximately 16 basis points and an extension of maturities by around six months (according to the baseline exposure measure). These changes are primarily a response to disclosure requirements and principles-based policies, while prudential tools play a more limited role. The use of firm–year fixed effects, combined with variation in NRFPs in banks' home countries, is consistent with a supply-side adjustment in loan terms rather than demand-driven reallocation.

This pattern – in which cross-border lenders appear to renegotiate and reprice contract terms as home-country supervisors integrate biodiversity into risk frameworks, but do not reduce overall lending volumes – differs from that in many other areas of climate finance, where policy changes often produce shifts in credit quantities across firms or sectors. Therefore, under current NRFP regimes, banks are internalising nature-related transition and physical risks primarily through loan pricing and maturity adjustments rather than extensive portfolio divestment.

For a megadiverse country such as Colombia, where biodiversity-dependent sectors are central to exports and employment, foreign NRFP regimes translate into materially higher borrowing costs for exposed firms – accounting for an estimated 5% of cross-sectional variation in spreads. This has at least three important policy implications:

- Domestic supervisors can improve their situational awareness by systematically tracking NRFP intensity in banks' home countries and incorporating it into cross-border surveillance dashboards.
- Standardised biodiversity disclosures that inform the decision-making of cross-border borrowers could reduce information premia and support more efficient risk pricing.
- Targeted technical assistance for firms in biodiversity-exposed sectors could help lower financing costs by improving disclosures' quality and comparability.

At the international level, these dynamics support the priorities of both the Network for Greening the Financial System and the Financial Stability Board, which aim to strengthen supervisory data-sharing and methodological cooperation on nature-related financial risks under the Kunming-Montreal

"Targeted technical assistance for firms in biodiversity-exposed sectors could help lower financing costs."

Global Biodiversity Framework. The fragmentation of national policies is already reflected in cross-border credit contracts, implying that enhanced coordination – particularly on disclosure standards, metrics and assurance practices – could improve efficiency without mechanically constraining credit supply. For central banks and supervisors in emerging markets, these dynamics also indicate that 'soft' tools such as principles, guidance and disclosure regimes can materially reshape cross-border lending conditions. This strengthens the case for establishing global nature-aligned disclosure norms.

By linking 96,196 Colombian credit-registry loans to a novel NRFP index spanning 34 jurisdictions in which lenders are based, this paper extends climate-focused research on spillovers into the biodiversity domain and documents a pricing channel that has received limited attention in prior empirical studies. As shown by the ENCORE-based exposure refinements discussed above, more granular nature-dependency metrics can help produce more accurate estimates – highlighting the value of emerging biodiversity assessment tools for financial-stability analysis. Policymakers could benefit from future research into these loan dynamics in the context of increased NRFP adoption since 2022, as well as firms' responses through nature-positive investment, operational adaptation and the reconfiguration of supply chains.

"The fragmentation of national policies is already reflected in cross-border credit contracts."

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