



Environmental Financial Risks

A Central Banking Perspective

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Abstract*

This paper examines the implications of environmental physical and transition risks for central banks in Latin America and the Caribbean. It reviews the evidence showing that droughts, floods, and other weather-related shocks, as well as risks associated with the transition to a low-carbon economy, can affect inflation, borrower repayment capacity, credit supply, and financial stability. Drawing on international experience, it discusses how central banks have incorporated these risks into stress-testing frameworks, disclosure requirements, and monetary policy operations. It also presents recent research conducted at the central banks of Argentina, Colombia, and Ecuador, illustrating how environmental risks can be integrated into existing analytical tools through credit-risk analysis, exposure mapping, and inflation dynamics. The main conclusion is that central banks do not require entirely new policy frameworks to address these challenges. Instead, existing tools can be adapted to improve risk assessment and strengthen resilience while remaining aligned with traditional mandates focused on price stability and financial stability.

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1

Introduction

Environmental risks are becoming increasingly relevant for central banks as they affect the macroeconomic and financial conditions they are mandated to monitor. Physical risks, such as droughts, floods, heatwaves, hurricanes, and other extreme weather events, can reduce output and increase prices, damage collateral, disrupt production, and weaken borrowers' repayment capacity. Transition risks, arising from changes in regulation, technology, and energy prices during the shift toward a low-carbon economy, can alter the value of firms and assets across sectors. Together, these risks can affect inflation, economic activity, credit risk, and financial stability.

Yet, the role of central banks in addressing these challenges must be defined carefully. Climate risks are addressed primarily through fiscal policy instruments, including carbon pricing and public investment. These fall outside central banks' policy tools. As Hansen (2022) emphasizes, central banks preserve credibility by acting within their mandates, maintaining their independence, and avoiding the creation of excessive public expectations of their ability to solve environmental problems. Maintaining this credibility is particularly important in economies where central banks already face difficult trade-offs involving inflation control, financial stability, and economic growth.

This does not mean that central banks can disregard physical and transition risks. Extreme weather events and policies associated with the low-carbon transition increasingly affect variables that central banks are responsible for safeguarding, including primarily financial and monetary stability. Environmental risks impact financial stability when they affect borrowers' cash flows, asset values, and repayment capacity (NGFS, 2024). Natural disasters can reduce household income, damage firms' productive capacity, lower collateral values, and increase non-performing loans (NGFS, 2024). Likewise, firms in emissions-intensive sectors may face higher costs, declining demand, or stranded assets as regulations, technologies, and consumer preferences evolve (NGFS, 2024). These effects can weaken bank balance sheets and reduce credit supply. That, in turn, creates a clear rationale for central banks and financial supervisors to measure exposures, develop stress-testing frameworks, improve disclosure, and incorporate such risks into banking supervision.

Physical and transition risks also affect monetary policy when they impact inflation and output. Extreme weather events may disrupt production and raise food and energy prices, while carbon pricing and energy reforms can alter prices during the transition. As a result, these risks influence the macro-financial environment that central banks already monitor, even if responsibility for mitigation and adaptation policies remains primarily with fiscal and regulatory authorities.

This issue is particularly relevant for Latin America and the Caribbean. The region is highly exposed to natural disasters and weather variability, including droughts, floods, hurricanes, and El Niño¹ and La Niña² events. At the same time, many economies face structural conditions that can amplify the economic costs of these shocks, including high inequality, limited fiscal space, dependence on weather-sensitive sectors, and financial systems in which banks hold most financial savings and serve as the primary channel of financial intermediation (Blackman et al., 2025; Calice and Miguel, 2021).

Against this background, the objective of this policy brief is not to argue that central banks should transform into authorities of environmental policymaking. Rather, it identifies areas where central banks have clear and well-justified points of engagement in a region where vulnerability to natural hazards, development challenges, and macro-financial risks often intersect. Its focus is on activities that support existing mandates: measuring physical and transition risks in the financial system, assessing their implications for bank balance sheets and credit provision, and understanding how these shocks affect inflation, economic activity, and the transmission of monetary policy. By concentrating on these areas, central banks can better account for emerging sources of risk while remaining within the scope of their traditional responsibilities.

The remainder of this policy brief is structured as follows. Section 2 provides evidence for the effects of physical and transition risks on the financial sector in Latin America and the Caribbean, with a particular focus on the banking system. Section 3 discusses the rationale for incorporating these risks into central bank monetary policy and regulatory frameworks. It also looks at the measures implemented and challenges encountered, drawing on examples from European and Asian central banks. Section 4 presents ongoing research by the central banks of Argentina, Colombia, and Ecuador on the impacts of climate shocks on financial stability and monetary policy, with a focus on methodology, findings, and policy implications.

1 El Niño is a climate phenomenon characterized by the unusually warm sea surface temperatures in the central and eastern equatorial Pacific Ocean. It alters atmospheric circulation patterns and can trigger heavy rainfall and flooding in parts of western South America, such as Peru and Ecuador, as well as drought conditions in other regions such as northeastern Brazil (National Geographic Society, 2025).

2 La Niña refers to the cooling of sea surface temperatures in the central and eastern equatorial Pacific Ocean. It is commonly associated with wetter-than-average conditions in parts of northern South America, such as Colombia, and drier-than-average conditions in parts of southern South America, including Argentina and Uruguay. La Niña is also associated with increased Atlantic hurricane activity. Its climate effects are generally the reverse of those associated with El Niño in many regions (National Geographic Society, 2024).

2

Physical and Transition Risks

Evidence from Latin America
and the Caribbean

This section reviews the evidence on physical and transition risks in Latin America and the Caribbean, with a particular focus on their implications for financial stability and monetary policy. While both types of risks are relevant for central banks, the literature has primarily focused on physical risks, reflecting the immediate macroeconomic consequences of weather-related shocks. The evidence shows that these risks can affect bank balance sheets, credit provision, and inflation dynamics.

2.1 Physical Risks

Banking Stability. A growing literature examines how weather-related shocks affect banking systems in Latin America and the Caribbean. Evidence from Peru, Colombia, Brazil, and the Caribbean suggests that El Niño and La Niña can increase credit risk and weaken asset quality. In Peru, El Niño increases delinquency rates among agricultural exporters, while banks adjust balance sheets in response to El Niño risk forecasts, increasing credit growth and bank capitalization before disasters occur (Azañedo Tintinapón et al., 2025; Cisneros et al., 2025). In Colombia, the 2010–11 La Niña episode increased bank loan provisions because of deteriorating asset quality (Reinders et al., 2021). Research for Brazil indicates that stressed physical-risk scenarios can raise the number of problematic assets in banks' portfolios, and that extreme rainfall and temperature deviations are associated with higher default rates (Central Bank of Brazil, 2025; Oliveira, 2022). Following hurricane strikes in Eastern Caribbean islands, banks experience deposit withdrawals and reduce their lending supply, although evidence does not show deterioration in loan portfolios (Brei et al., 2019). However, Branch et al. (2026) find higher loan default rates in The Bahamas after hurricanes.

Similar patterns emerge in studies focusing on precipitation variability, droughts, and extreme heat. Evidence for Colombia suggests that heavy rainfall increases provisions for consumer loans while reducing provisions for housing loans, consistent with a shift toward short-term borrowing under income stress (Rodríguez-Novoa, 2022). Similarly, Bohórquez-Peñuela et al. (2025) find that low rainfall variability (i.e., predictable rain) in Colombia increases credit access for credit backed by a public-funded guarantee and decreases disbursements of loans with private guarantees. Alvarado-Quesada et al. (2025) find that excess rainfall events in Costa Rica increase credit risk. Similarly, borrowers in Peru's northern coastal region and southern highland regions are likely to experience increased default risk due to heavy rainfall (Romero et al., 2024).

In Argentina, the 2022–23 drought reduced credit growth and increased non-performing loans among drought-exposed firms (Aguirre and Sangiacomo, 2026). Evidence for Uruguay shows that heatwaves, droughts, and wildfires affecting agriculture increase banks' expected credit losses (Barón et al., 2026). Extreme heat in Mexico increases delinquency rates and droughts are expected to cause more loan defaults for borrowers in Peru's rainforest regions (Aguilar-Gomez et al., 2024; Romero et al., 2024). Droughts can undermine the solvency of Colombian firms in the hydropower sector, which are highly dependent on rainfall. That, in turn, limits their ability to meet financial obligations.

Sectoral exposure also matters. In Chile, approximately 11% of lending is concentrated in natural resource-intensive sectors that are vulnerable to physical risks, where the most significant risks affect 3% of the portfolio (Gonzales and Rojas, 2024). Romero et al. (2024) estimate that, by December 2050, the probability of default across Peru's financial system will be 7.03% higher than in December 2020, reflecting the combined effects of heavy rainfall, droughts, sea surface temperature anomalies, and macroeconomic conditions. Taken together, the evidence suggests that physical risks are already affecting the balance sheets of households, firms, banks, and governments throughout the region. Their impact is particularly pronounced in economies where agriculture, energy, mining, and other resource-intensive activities remain important for output, exports, fiscal revenues, and bank lending.

Monetary Policy. Physical risks can also affect inflation and broader macroeconomic conditions. Ongoing work for Ecuador shows that precipitation and temperature shocks across regions influence inflation dynamics nationwide, while moderate El Niño episodes in Paraguay are estimated to increase core inflation, depreciate the exchange rate, and raise the stressed non-performing loan ratio. More broadly, weather-related disruptions can affect agricultural production, exports, and fiscal revenues particularly in economies that depend heavily on agriculture, hydropower, energy, or commodity exports. These channels can influence food prices, energy prices, exchange rates, and economic activity, ultimately affecting the environment in which monetary policy operates. Understanding these channels is therefore increasingly important for central banks whose primary mandates focus on price stability.

2.2 Transition Risks

Transition risks have received less attention in the region's literature. This partly reflects the fact that extreme weather events are already materializing across the region, making the economic consequences of natural hazards a more immediate policy concern, whereas transition risks depend on future policy and technological change. These transition risks arise primarily through sectoral adjustment and the repricing of carbon-intensive assets.

Existing evidence nevertheless suggests that transition risks are significant in Latin America and the Caribbean, where many economies rely heavily on mining, oil and gas, agriculture, and tourism revenues (Calice and Miguel, 2021; European Investment Bank, 2023). In Argentina, Bolivia, Paraguay, and Uruguay, bank exposure stems from high lending to agriculture, a major greenhouse gas-emitting sector exposed to policy changes (Calice and Miguel, 2021). Firms operating in transition-sensitive sectors may face rising production costs due to carbon pricing and emission caps, while the value of carbon-intensive assets may decline (Bos and Gupta, 2019; Calice and Miguel, 2021). As profitability falls, borrowers may experience greater difficulty meeting their financial obligations, thereby increasing credit risk and the likelihood of non-performing loans. In Chile, approximately 20% of loans are exposed to transition risks, with nearly 5% classified as highly exposed (Gonzales and Rojas, 2024).

Beyond traditional lending activities, banks and investors in major financial markets such as Argentina, Brazil, Chile, Colombia, and Mexico are also exposed through domestic capital markets (Cebreros et al., 2020). As environmental policies tighten and investors reassess the value of carbon-intensive activities, asset repricing may generate losses that extend beyond banks' loan portfolios. Delayed transitions may increase market volatility, amplify financial tail risks, and strengthen contagion effects across banks and investment funds (Roncoroni et al., 2021; Laliotis and Lamichhane, 2023). Transition policies may also affect inflation. Bauer et al. (2026) show that unexpected increases in carbon prices affect financial markets by raising energy futures prices and measures of inflation expectations, including inflation swaps and breakeven inflation rates. Thus, transition risks can affect financial stability directly through exposure to emissions-intensive sectors and indirectly through inflationary pressures and weaker borrower repayment capacity.

2.3 Main Lessons for Central Banks

The evidence points to three main conclusions. First, physical risks—including changes in precipitation patterns, droughts, hurricanes, and other extreme weather events—are already affecting households, firms, financial institutions, and governments across the region. These shocks can impair borrower repayment capacity, reduce collateral values, increase loan defaults, and weaken bank balance sheets, particularly in sectors such as agriculture, hydropower, and real estate. Second, these shocks have important macroeconomic consequences. By affecting food and energy production, exports, exchange rates, fiscal revenues, and the demand for and supply of credit, they can influence inflation dynamics and alter monetary policy operations. Third, although the evidence remains more limited, transition risks are likely to matter for banks and capital markets in economies with significant exposure to fossil fuels, mining, agriculture, and other emissions-intensive sectors. Together, these findings support a practical agenda for central banks centered on measuring loan-portfolio exposures, incorporating physical and transition risks into stress-testing exercises, strengthening disclosure frameworks, and incorporating environmental risks into macro-financial analysis.

3

What Can Latin America and the Caribbean Learn from International Experience?

Central banks have increasingly incorporated environmental risks into their monetary policy operations, reflecting the fact that even when climate policy is not part of a central bank's direct mandate, environmental shocks can affect inflation, credit risk, and financial stability. This section reviews selected international experiences, drawing on case studies from the Network for Greening the Financial System (NGFS) (2026). The goal is to identify practical lessons that may be relevant for central banks in the region. The discussion focuses on the motivations that have driven central bank action, the measures that have been implemented, and the implementation challenges encountered.

3.1 What Has Driven Central Bank Action?

Recognizing that physical and transition risks can affect both price stability and financial stability, some central banks have adjusted their analytical and operational frameworks. The measures adopted differ across countries depending on central bank mandates, operational frameworks, balance sheet structures, domestic financial markets, and political support for environmental action. Only a few central banks have mandates that explicitly refer to environmental objectives.

International experience suggests that central banks have generally acted under two motivations. The first is climate risk mitigation to support public policies promoting the low-carbon transition. Under this objective, central banks adjust their operations to encourage financing for environmentally sustainable activities that may reduce long-run financial risks (Narayan et al., 2025). The second motivation is financial risk protection to protect their own balance sheets and strengthen financial system resilience to physical and transition risks. Measures adopted under this objective include supervisory guidance, disclosure requirements, stress testing, and scenario analysis (NGFS, 2024).

3.2 Policy Responses and Operational Tools

Central banks conduct monetary policy primarily through collateralized lending operations and, in some jurisdictions, through purchases of financial assets (Siegert and Talbot, 2025). Thus, most operational measures have focused on three main areas: lending operations, collateral frameworks, and asset purchase programs. Figure 1 outlines the different measures implemented by central banks.

Figure 1:
Climate-Related Measures in The Monetary Policy Operations of Central Banks

	Lending operations			Collateral frameworks				Asset purchases		
	1	2	3	1	2	3	4	1	2	3
Objective	 Adjusting pricing based on type of lending	 Adjusting pricing to collateral	 Adjusting counter-parties' eligibility	 Adjusting haircut	 Negative screening	 Positive screening	 Aligning collateral pools	 Tilting	 Negative screening	 Positive screening
Climate change mitigation	 China Hungary Japan Malaysia			 Hungary				 England		 Hungary
Financial risk protection					 European Central Bank					
Both								 European Central Bank		

Note: The People's Bank of China, the Magyar Nemzeti Bank (Hungary), the Bank of Japan, and Bank Negara Malaysia have used credit operation measures. The Magyar Nemzeti Bank and the European Central Bank adjusted collateral policies. The Bank of England, European Central Bank, and Magyar Nemzeti Bank changed their asset purchase programs.

Source: Authors' elaboration based on NGFS (2024).

Lending Operations. Some central banks have adjusted the terms under which they lend to financial institutions. These measures include (1) changing interest rates according to borrowers' climate-related activities, (2) adjusting pricing depending on the types of assets pledged as collateral, and (3) revising which institutions are eligible to access central bank funding (Figure 1). Most initiatives have focused on preferential lending terms designed to reduce financing costs for activities aligned with the low-carbon transition and to encourage banks to expand lending to these sectors (NGFS, 2024).

Several central banks have refinanced green assets at preferential rates. The Bank of Japan introduced a funds-supplying operation to support private-sector investment related to climate change (Bank of Japan, 2026). The People's Bank of China created a carbon emission reduction facility that provides low-cost funding to financial institutions lending to eligible emission-reduction projects (NGFS, 2024). The Magyar Nemzeti Bank in Hungary offered subsidized refinancing to support energy-efficient housing, while Bank Negara Malaysia has provided financing facilities for small and medium-sized enterprises engaged in sustainable practices (NGFS, 2024; Bank Negara Malaysia, 2022).

These programs illustrate how credit operations can be adapted to support environmental objectives. However, their relevance for Latin America and the Caribbean depends on the role of central bank refinancing operations within domestic financial systems. In many countries in the region, supervisory tools, risk assessment frameworks, and financial-sector monitoring may have greater practical relevance than subsidized lending facilities.

Collateral Frameworks. Central banks can also adjust the criteria governing which assets are accepted as collateral. These measures include (1) applying higher haircuts to carbon-intensive assets (i.e., valuing them less), (2) excluding certain high-emitting assets from eligibility through negative screening, (3) requiring eligible collateral to meet specific standards (positive screening), and (4) imposing portfolio-level limits on exposures to high-emission sectors, such as capping the share of fossil fuel-related assets within a collateral pool (Figure 1).

The European Central Bank, for example, limited the share of high-carbon assets that could be pledged as collateral to reduce weather-related financial risks to the Eurosystem's balance sheet (European Central Bank, 2022). In Hungary, the Magyar Nemzeti Bank introduced preferential treatment for green securities, including lower haircuts (i.e., better valuation terms) and environmental reporting requirements for green covered bonds (Magyar Nemzeti Bank, 2023).

These experiences illustrate that collateral frameworks can be used both to manage financial risk and to support the development of green financial markets. For central banks in Latin America and the Caribbean, they also highlight the importance of understanding how physical and transition risks affect the value and quality of assets pledged as collateral.

Asset Purchase Programs. Some central banks have modified their asset purchase programs by (1) tilting purchases toward environmentally sustainable assets and away from carbon-intensive ones and (2) including or excluding assets based on their climate characteristics (i.e., positive or negative screening) (Figure 1). By increasing demand for green bonds, these purchases can raise their prices in secondary markets and lower the yields investors require on newly issued bonds. This reduces funding costs for low-carbon firms relative to more carbon-intensive peers, strengthening their competitive position, and incentivizing other issuers to align with the transition to a low-carbon economy (NGFS, 2024).

The Bank of England and the European Central Bank have both introduced climate tilting in their corporate bond portfolios. The Bank of England introduced climate tilting in its Corporate Bond Purchase Scheme, reallocating purchases towards stronger climate performers based on emissions, reduction targets, and disclosures to incentivize progress towards net zero (Bank of England, 2021). Similarly, the European Central Bank tilted reinvestments under its corporate bond purchase programs toward issuers with stronger environmental performance (Aubrechtova et al., 2023). Hungary also launched a Green Mortgage Bond Purchase Program targeting forint-denominated green mortgage bonds that met defined standards and required regular impact reporting. This was aimed at developing a domestic green mortgage bond market (Magyar Nemzeti Bank, 2023).

These experiences show that asset purchase programs can be adapted to environmental objectives and provide useful lessons regarding portfolio risk management, disclosure standards, and the treatment of environmental risks in financial markets.

3.3 Operational Challenges

International experience highlights that central banks face three main operational challenges when incorporating physical and transition risks into monetary policy operations: prioritization, calibration, and data availability. While data limitations impact operational feasibility, the strategic focus and calibration of measures affect the ability of central banks to meet the financial risk protection and climate mitigation objectives.

Prioritization. Many central banks are still developing expertise and must identify the most relevant risks and asset classes in their domestic context. In Latin America and the Caribbean, where financial systems are often bank-based and capital markets are smaller, policies focused on publicly traded securities may have limited effects on financial risk protection or environmental risk mitigation. For these economies, supervisory tools, loan-portfolio analysis, and stress testing may be more relevant than adjustments to corporate bond purchase programs. In practice, central banks have prioritized asset classes that are most material to their balance sheets or the broader economy (e.g., residential real estate) and for which environmental data are more readily available.

Calibration. Even when environmental measures are consistent with a central bank's mandate, it is difficult to determine the strength of interventions, such as the degree of tilting in asset purchases or the preferential rates in green lending operations. The appropriate calibration depends on the trade-off between managing environmental risks, exposure to other financial risks, and monetary policy effectiveness. Because these trade-offs are difficult to quantify, many central banks have adopted gradual approaches, beginning with disclosure requirements, scenario analysis, and limited portfolio adjustments before moving toward more interventionist measures. This strategy allows policymakers to evaluate effects, identify unintended consequences, and refine policies as experience accumulates (NGFS, 2024).

Data availability. Data limitations remain one of the most important obstacles to implementation. Scenario analysis relies on macroeconomic pathways, such as NGFS scenarios, adapted to national conditions. Operational measures often require more granular data, including issuer-level emissions, green bond classifications, or energy-efficiency measures. These data are often incomplete, inconsistent, or unavailable, especially in emerging markets. Central banks therefore rely on a combination of issuer-level disclosures, counterparty self-assessments, third-party certifications, estimates, sectoral averages, and historical data. Hybrid approaches that combine macro scenarios with asset-level data are emerging but require in-house capacity and modelling skills. This challenge is particularly relevant in Latin America and the Caribbean, where disclosure frameworks and environmental datasets remain less developed than in many advanced economies.

3.4 Lessons for Latin America and the Caribbean

Three broad lessons emerge from international experience. First, central banks have generally begun by strengthening measurement, disclosure, and risk assessment before introducing other measures. Improvements in data collection, supervisory reporting, and scenario analysis have often preceded changes in monetary policy operations.

Second, the choice of instruments depends heavily on institutional and economic context. The structure of financial markets, the level of development, the design of monetary policy operations, legal mandates, and data availability all influence which measures are feasible and effective. European central banks have been at the forefront, especially in collateral frameworks and asset purchases. Several Asian central banks have used credit operations to support low-carbon investment. Other jurisdictions have proceeded more cautiously, either because of narrower mandates, political constraints, or concerns about preserving the neutrality and effectiveness of monetary policy.

Third, successful implementation has required significant investments in analytical capacity, environmental data, and scenario analysis. Building these capabilities has often been a prerequisite for more advanced forms of risk management and policy intervention.

For Latin America and the Caribbean, these lessons suggest a gradual and pragmatic approach, in line with countries' policy priorities. Efforts should focus first on improving in-house capacity to measure physical and transition risks, strengthen supervisory and stress-testing frameworks, and develop analytical tools that help assess the implications of environmental shocks for financial stability, inflation, and monetary policy transmission. Such an approach allows central banks to address emerging risks while remaining firmly within their existing mandates of promoting price and financial stability.

4

Impacts on Monetary Policy and Financial Stability: Selected Central Bank Research

Multiple central banks in Latin America and the Caribbean are adapting existing analytical frameworks to quantify the potential effects of environmental shocks on financial stability and monetary policy. Rather than creating entirely new frameworks, researchers have increasingly focused on incorporating weather-related information into existing analytical and policy tools, including credit-risk analysis, financial surveillance, inflation forecasting, and stress testing. Climate stress tests help identify vulnerabilities in the banking system's loan portfolios and provide early indications of potential systemic shocks. By encouraging commercial banks to evaluate their exposure to climate-related risks, central banks can foster preventive measures that protect bank solvency, profitability, and liquidity.

This section presents examples from Argentina, Colombia, and Ecuador. Although the institutional contexts and research questions differ, the cases illustrate how central banks in the region are integrating environmental risks into their analytical frameworks and highlight the importance of granular data, sector-specific transmission channels, and country-specific vulnerabilities in assessing the macro-financial consequences of physical and transition risks.

4.1 Argentina: Drought, Credit, and Risk

4.1.1 Context

As a commodity-exporting country, Argentina is particularly exposed to weather-related shocks. Severe droughts took place in 2009, 2012, 2019 and 2022–23, each associated with economic recessions (Figure 2). Due to La Niña phenomenon, which in Argentina translates into droughts, average annual rainfall in 2022 was the lowest recorded since 1981. Argentina's most fertile agricultural area, the *pampa húmeda* (*Humid Pampas*), experienced its driest conditions in 62 years. This hampered agricultural production, exports and tax revenues. Wheat production plummeted, while soybean and corn planting was substantially delayed. Fruit production and cattle stock were also affected. Adverse weather conditions persisted and intensified in 2023, with droughts and early frosts weighing heavily on soybean and corn harvests. Agricultural GDP fell by 4% in 2022 and contracted by 24% in 2023, contributing to a recession in the broader economy, where GDP fell by 1.9% in 2023. This episode provides a useful opportunity to evaluate how a major physical shock affected firms, credit markets, and the banking system.

4.1.2 Methodology

Aguirre and Sangiacomo (2026) estimate the impact of the 2022–23 drought on commercial credit growth and credit risk at the bank-firm level. Using credit registry data covering the universe of Argentine firms indebted to the financial system under the Central Bank of Argentina's regulation and supervision, the analysis examines the effects of the drought on firms, bank-firm relationships, and banks themselves. The dataset allows for the identification of companies that were more exposed to the drought based on whether they were producers and/or exporters of the crops most severely affected by the 2022–23 drought. These firms are compared with the rest of the companies. Ideally, exposure would be identified using georeferenced information on firm location; however, such data are not available. Difference-in-differences panel models are used to assess whether credit growth and non-performing loans changed following the drought among affected and unaffected firms. The analysis also estimates changes in credit supply.

4.1.3 Main Findings

The results indicate that firms exposed to the drought experienced significantly lower credit growth and a deterioration in loan performance. At the bank-firm level, credit growth declined by approximately 7 percentage points (p.p.) year-on-year in real terms among exposed firms, while non-performing loans increased by around 8 p.p. relative to less exposed borrowers. At the firm level, credit growth fell by approximately 10 p.p., and non-performing loans increased by close to 5 p.p. (although the latter coefficient is not statistically significant). The analysis also finds evidence of a reduction in credit supply to drought-affected sectors of roughly 3 p.p.

The drought coincided with a period of economic stagnation and accelerating inflation, both of which could also affect credit dynamics and credit risk. To account for these factors that also affected firms' and banks' operations, the analysis controls for common macroeconomic conditions through time fixed effects. Additional controls capture the effects of interest rate policies, foreign-exchange regulations, and fiscal relief provided in response to the drought.

The estimates suggest that, beyond these factors and other firm- and bank-level controls, the drought itself contributed significantly to the observed decline in credit. In particular, firm-level credit declined by 10 p.p. among affected firms and credit decreased by 4.6 p.p. among firms borrowing from more than one bank (a phenomenon which identifies credit supply under certain conditions). These results also indicate that the drought may have had a somewhat larger impact on credit demand (over 5 p.p.). Because different crops were affected at different times, the analysis also considers a staggered drought impact. The results remain statistically significant and increase in magnitude for both credit and non-performing loans.

While the evidence points to substantial effects on firms' financing and repayment capacity, the analysis also assesses whether the drought generated broader financial stability concerns. It examines the performance of banks with greater exposure to drought-affected firms. The results show that, on average and weighting by bank credit stock size, banks more exposed to the drought did not lend significantly less to firms and did not experience significantly higher increases in non-performing loans than banks that lent less to exposed firms. Banks with greater exposure also accumulated more liquidity, although this result is statistically significant only at the 10% level.

These findings indicate that the drought had significant individual impacts on firms' access to credit and loan performance, but did not generate a discernible systemic effect on banks. Despite the materialization of a physical climate shock, the evidence does not point to a financial stability event.

Several country-specific factors should be considered when interpreting these results. Argentina's financial system is small by regional and international standards, although this does not preclude the possibility of financial instability. The country experienced banking crises in 1995 and 2001–02, as well as smaller but significant episodes of financial stress in 2018–19. Consequently, evidence that a major drought did not generate financial instability remains relevant.

4.1.4 Policy Implications

The Argentine experience illustrates that severe physical shocks can have important effects on firms' financing and repayment capacity without necessarily generating systemic financial instability. Although the 2022–23 drought significantly affected agricultural production, exports, and economic activity, its effects on the banking system remained contained. One explanation lies in the substantial liquidity and solvency buffers held by Argentine banks, reflecting both the country's history of financial crises and the prudential regulation developed in response to them. These buffers allow banks to absorb considerable shocks before standard financial stability indicators deteriorate. The results suggest that this resilience extended to the 2022–23 drought.

Firm behavior may also have played a role. Firms have adapted to a volatile macroeconomic environment and a relatively small financial system by relying heavily on self-financing and internal liquidity buffers, both in domestic and foreign currency. From a credit-demand perspective, the finding that banks exposed to drought-affected sectors did not significantly alter lending may partly reflect the availability of alternative financing resources among firms.

Overall, the evidence suggests that, despite the macroeconomic significance of the 2022–23 drought, the shock did not translate into a systemic financial stability event. In the Argentine context, substantial solvency and liquidity buffers appear to have helped contain the financial-sector consequences of a severe climate-related shock. The results indicate that the transmission of physical risks to financial stability depends not only on the magnitude of the shock but also on the resilience of the financial system and the balance sheets of affected borrowers. For central banks and supervisors, this highlights the importance of monitoring sectoral exposures and maintaining adequate prudential buffers as part of broader efforts to strengthen resilience to weather-related and other shocks.

4.2 Colombia: Environmental Risk Stress Testing and Financial Stability

4.2.1 Context

Given its geographic location, Colombia encompasses a wide range of ecosystems and climatic conditions. The climate is tropical along the coast and eastern lowlands, but becomes subtropical, temperate, and polar at higher altitudes across the Andes Mountains (World Bank, 2021). Most departments contain more than one climatic zone, making the country highly exposed and vulnerable to weather-related risks, including rising temperatures, changing precipitation patterns, wildfires, and more frequent extreme events such as floods and droughts (IDEAM, 2024; OECD, 2026).

Recognizing these risks, the Central Bank of Colombia has expanded its research agenda to examine how environmental shocks may affect macroeconomic performance and financial stability. In the latter area, work has focused on three complementary areas: assessing transition risks through macro-financial stress tests, measuring institutions' exposure to physical risks using geographically disaggregated data, and evaluating sectoral transmission channels through industries that are particularly vulnerable to weather shocks.

4.2.2 Transition Risk Analysis

Bernal-Ramírez et al. (2022) examined the implications of transition risks for economic activity, the external sector, fiscal sustainability, financial stability, and monetary policy. Among the study's various dimensions, the assessment of the financial-sector vulnerabilities relies on NGFS transition scenarios³ and the Central Bank's systemic stress-testing model (SYSMO)

3 The analysis uses the NGFS Phase II scenario framework. Since 2019, the Central Bank of Colombia has actively participated in NGFS activities, facilitating the incorporation of internationally recognized methodologies for assessing climate-related financial risks into its analytical and stress-testing exercises.

(Gamba et al., 2017), to evaluate how alternative transition pathways and how lower economic growth associated with climate transition risks may affect credit risk, profitability, and the solvency of financial institutions. The results indicate that all climate-transition scenarios generate higher credit risk than the baseline scenario. The current-policies scenario produces the largest increase in credit risk, followed by the delayed-transition scenario, whereas the net-zero emissions scenario generates the smallest increase. The adverse effects on profitability and capital adequacy follow the same pattern.

Similarly, Bejarano and Rodríguez (2025) analyze the macroeconomic and monetary policy impacts of transition shocks—specifically anticipated declines in productivity and carbon tax increases—in Colombia, which has a small open economy. The findings suggest that climate change gradually reduces potential output and increases production costs over the long run, while in the short run both inflation and the natural interest rate decline. From a policy perspective, these findings highlight the importance of an orderly transition toward a low-carbon economy. Delayed or absent transition policies may increase financial vulnerabilities, while the results underscore the value of incorporating climate-related scenarios into financial stability monitoring and stress-testing exercises.

4.2.3 Physical Risk Analysis

Recent work has incorporated physical risks into financial stability assessments using granular borrower-level information. Employing loan portfolio data at the institutional and municipal levels, an exposure map linking credit institutions to precipitation risk revealed substantial heterogeneity in precipitation patterns across Colombia and, thus, in the distribution of credit exposures. Aggregate exposure to below-average precipitation municipalities appears limited. But lending activity in several of these municipalities is concentrated among a small number of institutions, making them disproportionately vulnerable to persistent drought conditions.

Building on this work, a climate-credit-risk satellite model was developed to assess how municipal-level precipitation shocks affect loan portfolio quality. This framework captures differences in exposure across institutions arising from the territorial distribution of their lending activities and allows climate-related shocks to be incorporated into the SYSMO stress-testing framework. The results indicate that severe drought scenarios generate an additional deterioration in credit quality beyond that implied by adverse macroeconomic conditions alone. On average, precipitation shocks increase the Quality Risk Indicator by approximately 1.5 p.p. relative to the baseline stress scenario, with the largest effects observed in microcredit and housing loan portfolios, accounting for 3% and 28% of total loans, respectively. Higher credit risk reduces both profitability and capital positions. Although the financial system remains resilient, the findings highlight that incorporating geographically

granular climate information into credit risk assessments is key, as aggregate indicators hide vulnerabilities concentrated in specific institutions and regions.

Another study examines sectoral firm-level transmission channels through Colombia's hydropower sector, which accounts for approximately 60% of the country's electricity production. By linking precipitation patterns, hydropower generation data, firms' financial statements, and firm-bank credit exposures, the analysis evaluates how drought conditions affect firms' financial performance and, ultimately, the credit risk faced by financial institutions. The results suggest that severe droughts can significantly reduce hydropower generation, weaken firms' financial positions, and increase credit risk for institutions with greater exposure to affected firms. They illustrate how physical risks can be transmitted through sectoral concentration channels and reinforce the value of incorporating physical risks into financial stability assessments and stress-testing frameworks.

4.2.4 Policy Implications

These research efforts demonstrate how physical and transition risks can be incorporated into existing stress-testing frameworks. Taken together, the studies have strengthened the Central Bank's stress-testing framework by enabling the evaluation of adverse macroeconomic scenarios alongside physical and transition risk scenarios. This allows for a more comprehensive assessment of how weather-related shocks and transition pathways may affect not only macroeconomic variables such as economic growth and inflation, but also specific borrowers, economic sectors, and credit institutions. More broadly, these exercises demonstrate that physical and transition risks can affect financial stability through multiple channels and over different time horizons. Incorporating these risks into existing analytical frameworks can help strengthen the financial system's capacity to anticipate, monitor, and manage emerging vulnerabilities.

Looking ahead, continued development of climate-related analytical tools will be important. Future work should deepen the analysis of sectoral vulnerabilities, recognizing that physical and transition risks are unlikely to affect all sectors equally, and further explore the interaction between environmental shocks, transition policies, and asset valuations. Progress will also depend on the availability of granular data. This is essential for improving the identification of transmission channels and the assessment of financial risk exposures. Additional efforts are particularly needed to better evaluate transition risks. As noted by Monnin (2018), environmental risks are often excluded from traditional financial risk assessments because they are perceived to materialize beyond the standard analytical horizon of one to three years. This challenge is especially relevant for transition risks, whose economic and financial consequences may unfold gradually over time.

4.3 Ecuador: Physical Risks and Inflation Dynamics

4.3.1 Context

A growing body of evidence shows that climate shocks have become a persistent source of inflationary pressure worldwide. Drawing on consumer price data from 121 countries, Kotz et al. (2024) find that adverse climate conditions raise both food and headline inflation, with effects that persist for at least 12 months and are particularly pronounced in warmer regions such as South America. Earlier work by Faccia et al. (2021) similarly documents that extreme temperatures pose measurable risks to price stability, while Ciccarelli et al. (2023) show that the inflationary effects of weather shocks are asymmetric in nature.

These pressures are particularly relevant for small, agriculturally dependent economies. In Ecuador, extreme weather events affect agricultural production and disrupt supply chains (Vos et al., 1999). This issue is particularly important in a fully dollarized economy, where the instruments available to offset supply-driven inflation are considerably more limited. The Central Bank of Ecuador is researching the magnitude and persistence of climate-related inflationary shocks and evaluating the extent to which these effects propagate across regions through national supply networks.

4.3.2 Methodology

The analysis constructs regional indicators of floods and droughts based on extreme rainfall conditions. Precipitation anomalies are first standardized at the parish level relative to historical monthly patterns (i.e., a parish is classified as affected by flooding when rainfall is above its historical norm and by drought when rainfall is below it) and then aggregated to the canton level and grouped into Ecuador's Coast and Highlands regions. The index weights each canton according to its share in regional agricultural output, capturing not only where climate events occur, but also whether they affect areas that are vital for food supply and, consequently, for inflation dynamics.

The study applies the Local Projections methodology developed by Jordà (2005). This approach traces impulse-response functions that show how food prices evolve month by month over the year following a climate event. Unlike a single average effect, local projections capture both the immediate impact of floods and droughts and the persistence of their effects over time. The estimations control for regular seasonal price patterns and recent inflation dynamics, allowing the responses to be more clearly attributed to the climate shock itself. This approach isolates the effect of each type of climate event by region. For example, when estimating the impact of floods in the Coast region, the specification simultaneously controls for droughts in the Coast and for both floods and droughts in the Highlands. This

reduces the risk of attributing inflationary effects to the wrong climate event when multiple shocks occur simultaneously in different parts of the country.

4.3.3 Main Findings

The findings point to three main conclusions, organized by geographic scope.

Local Direct Impacts. Weather shocks have significant direct effects on local food prices. Floods in the Coast region generate the strongest impact, increasing regional food inflation during the five months following the event before gradually easing. Droughts in the Highlands, by contrast, produce a less immediate but considerably more persistent effect, with inflation building gradually and remaining elevated for much of the following year.

Interregional Spillover Effects. Weather shock effects extend beyond the regions in which they originate. Floods in the Coast region increase food prices not only locally but also in the Highlands, with effects of similar magnitude to the direct regional impact. Likewise, droughts in the Highlands contribute to higher food prices in the Coast region. These spillovers reflect the strong integration of Ecuador's food distribution system and indicate that climate-related inflation risks are national in scope even when the underlying shock is regional.

National Level Effects. Both Coastal floods and Highland droughts increase food inflation at the national level. However, only droughts in the Highlands exert a clear effect on headline inflation. This appears to reflect the greater persistence of drought-related shocks and the longer time required for higher food prices to pass through from food prices to the broader consumption basket.

4.3.4 Policy Implications

These findings highlight the importance of incorporating physical risks into inflation analysis and forecasting frameworks. Even when shocks originate in specific regions, their effects can spread through supply chains and affect inflation at the national level. A central question is how monetary policy should respond to climate-driven inflationary shocks. While the answer depends on the monetary policy regime, the analysis points to a common requirement: strengthening the ability to anticipate, measure, and communicate climate-related risks to prices.

In economies with active monetary policy frameworks, this evidence can help central banks assess whether weather-related inflationary pressures are likely to be short-lived or persistent and adjust their policy stance accordingly. In a fully dollarized economy such as that of Ecuador, where conventional instruments such as interest rates and

exchange-rate adjustments are unavailable, the ability to anticipate and communicate inflationary risks becomes particularly important. In this context, the central bank's role is primarily to support the timely assessment and clear communication of inflation risks, helping to anchor expectations and inform broader policy coordination.

Three policy priorities emerge from the analysis. First, weather indicators can be incorporated more systematically into inflation monitoring and short-term forecasting exercises. Tracking extreme weather events, identifying their geographic concentration, and linking them to key food supply chains can improve early-warning systems and help policymakers detect emerging supply pressures before they are fully reflected in prices. Second, inflation forecasting frameworks can be strengthened by accounting for differences in the timing and persistence of floods and droughts. Distinguishing between temporary disruptions and more persistent supply shocks is essential for understanding inflation dynamics. Third, communication strategies regarding weather-related inflation risks, their expected duration, and their potential impact on prices can help households, firms, and policymakers form more accurate expectations. Over time, incorporating these risks into regular monitoring and communication frameworks may improve the assessment of inflationary pressures, strengthen credibility, and support more effective policy coordination.

4.4 Lessons for Central Banks in Latin America and the Caribbean

Despite addressing different questions, the three case studies reveal several common themes. First, environmental risks affect central bank objectives through multiple channels, including credit risk, financial stability, and inflation. Second, the transmission of these shocks is highly country-specific, reflecting differences in economic structure, financial development, and exposure to weather events. Third, granular data substantially improve the assessment of vulnerabilities, whether through firm-level credit registries, geographically disaggregated loan portfolios, or regional inflation indicators. Finally, the studies illustrate that existing central bank tools—including stress testing, credit-risk models, and inflation forecasting frameworks—can be adapted to incorporate physical and transition risks without requiring entirely new analytical frameworks.

Together, these experiences demonstrate how central banks in Latin America and the Caribbean are moving beyond conceptual discussions toward practical measurement and monitoring of environmental risks. While the approaches differ across countries, they provide useful examples of how climate-related considerations can be integrated into existing mandates focused on financial stability and price stability.

5

Conclusions and Policy Recommendations

Physical and transition risks are becoming increasingly relevant for central banks because they can affect inflation, financial stability, and credit markets. Evidence shows that these risks can influence loan performance, credit supply, and bank balance sheets through multiple transmission channels, and physical risks are already affecting households, firms, financial institutions, and governments across Latin America and the Caribbean. These challenges are particularly important in the region, where frequent weather-related shocks interact with structural vulnerabilities—including high inequality, limited fiscal space, and dependence on weather-sensitive sectors—that may magnify their economic and financial effects. International experience shows that central banks can incorporate these risks into existing policy frameworks through stress testing, scenario analysis, and disclosure.

The country case studies illustrate how central banks in the region are already adapting their analytical frameworks. In Argentina, severe droughts affected firms' financing and repayment capacity without generating systemic banking instability. In Colombia, physical and transition risks were incorporated into stress-testing frameworks, highlighting the importance of granular data for identifying vulnerabilities. In Ecuador, droughts and floods affected inflation through food supply chains and interregional spillovers. Together, these experiences demonstrate that physical and transition risks can affect both financial stability and price dynamics.

Three priorities emerge. First, central banks should continue strengthening the measurement and monitoring of environmental risks through improved data collection, exposure mapping, and financial surveillance. Second, these risks should increasingly be incorporated into financial stability analysis and stress-testing to better assess vulnerabilities and resilience across institutions and sectors. Third, central banks should deepen their understanding of how weather-related shocks and transition pathways affect inflation and macroeconomic performance, particularly where food, energy, and commodity sectors are key.

The broader lesson is that central banks do not require entirely new policy frameworks to address these challenges. It is possible to adapt existing tools—including stress testing, exposure mapping, and inflation forecasting—to incorporate physical and transition risks while remaining aligned with traditional mandates focused on price stability and financial stability. A pragmatic approach centered on better data, stronger analytical capacity, and the gradual integration of these risks into existing frameworks offers a credible path forward for central banks in Latin America and the Caribbean.

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