


The Impact of Climate Risks on Green Finance and Financial Stability


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Կլիմայական ռիսկերի ազդեցությունը կանաչ ֆինանսների ու ֆինանսական կայունության վրա **Սահակյան Ռուզան Ա.**

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Ամփոփագիր. Կլիմայական փոփոխության ազդեցության ուժգնացումը պահանջում է ֆինանսական հաստատություններից կայունության սկզբունքների ինտեգրում իրենց հիմնական գործունեությանը՝ պահպանելով տնտեսական և ֆինանսական կայունություն: Կլիմայական ռիսկերը ճանաչվում են որպես նշանակալի գործոններ, որոնք ազդում են մակրոտնտեսական ցուցանիշների և ֆինանսական համակարգերի վրա, հատկապես Փարիզի համաձայնագրից հետո, որը սահմանեց ազգային տնտեսությունների ածխաջրածնի նվազեցման ուղիներ: Կանաչ ֆինանսավորումը ծառայում է որպես հիմնական մեխանիզմ՝ ֆինանսական որոշումների կայացման մեջ շրջակա միջավայրի նկատառումները ներառելու և ցածր ածխաջրածնային տնտեսությունների զարգացումը խթանելու համար: Այն ընդգրկում է տարբեր գործիքներ, ինչպիսիք են կանաչ պարտատոմսերը, կայունության հետ կապված վարկերը և վերականգնվող էներգիայի նախագծերը: Միևնույն ժամանակ, կանաչ ֆինանսավորման արդյունավետ կիրառումը սահմանափակվում է կառավարչական դժվարություններով, չափանիշների համընդհանուր նպատակադրմամբ և տվյալների հասանելիության խնդիրներով, ինչպես նաև բանկերի ռազմավարական և գործառնական մարտահրավերներով: Ներդրողների և քաղաքական որոշում կայացնողների համար կարևոր է հասկանալ կանաչ ֆինանսավորման ամբողջական ներուժը՝ ոչ միայն որպես ռիսկերի նվազեցման գործիք, այլ նաև որպես տնտեսության երկարաժամկետ դիմակայունակության ապահովման միջոց: Աշխատանքի նպատակն է համապարփակ վերլուծություն կատարել՝ պարզելու, թե ինչպես կանաչ ֆինանսավորումը կարող է նվազեցնել կլիմայական ռիսկերից բխող ֆինանսական սպառնալիքները, խթանել տնտեսական և ֆինանսական կայունությունը: Արդյունքները կարող են ծառայել որպես հիմք կայուն ֆինանսական քաղաքականության և երկարաժամկետ ներդրումային ռազմավարությունների մշակման համար:

Հանգուցաբառեր և բառակապակցություններ՝ կլիմայական ռիսկեր, կանաչ ֆինանսավորում, ֆինանսական կայունություն, բանկային համակարգ, ESG, տնտեսական դիմակայունություն, կայուն զարգացում, կանաչ ներդրումներ, կլիմայական քաղաքականություն

Влияние климатических рисков на зеленое финансирование и финансовую стабильность

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Аннотация. Усиление воздействия изменения климата требует от финансовых учреждений интеграции принципов устойчивого развития в свою основную деятельность при обеспечении экономической и финансовой стабильности. Климатические риски признаются значимыми факторами, влияющими на макроэкономические показатели и финансовые системы, особенно после Парижского соглашения, которое установило пути декарбонизации для национальных экономик. Зеленое финансирование выступает в качестве ключевого механизма для учета экологических факторов при принятии финансовых решений и стимулирования развития низкоуглеродных экономик. Оно охватывает различные инструменты, такие как зеленые облигации, кредиты, связанные с устойчивостью, и проекты в области возобновляемой энергии.

В то же время эффективное внедрение зеленого финансирования ограничено административными трудностями, отсутствием унифицированных стандартов и проблемами с доступностью данных, а также стратегическими и операционными вызовами для банков. Для инвесторов и политиков важно понимать полный потенциал зеленого финансирования не только как инструмента снижения рисков, но и как средства обеспечения долгосрочной устойчивости экономики. Цель данной работы — провести комплексный анализ того, как зеленое финансирование может снижать финансовые риски, связанные с климатическими изменениями, и способствовать экономической и финансовой стабильности. Результаты исследования могут служить основой для разработки устойчивой финансовой политики и долгосрочных инвестиционных стратегий.

Ключевые слова и словосочетания: климатические риски, зеленое финансирование, финансовая стабильность, банковская система, ESG, экономическая устойчивость, устойчивое развитие, зеленые инвестиции, климатическая политика

Introduction

The intensifying impacts of climate change have heightened the urgency for financial institutions to integrate sustainability considerations into their core activities while preserving economic and financial stability. Climate-related risks are increasingly recognised as material sources of risk for macroeconomic performance and financial systems, particularly in the aftermath of the Paris Agreement, which established clear decarbonisation pathways for national economies. As key intermediaries within the global financial system, banks play a critical role in mobilising and allocating capital toward climate-resilient and environmentally sustainable investments.

In this context, green finance has emerged as an essential mechanism for embedding environmental considerations into financial decision-making and supporting the transition to low-carbon economies. This paradigm shift is closely aligned with international sustainability frameworks, including the Paris Agreement and the United Nations Sustainable Development Goals [31]. Green finance encompasses a wide range of financial instruments and activities, such as green bonds, sustainability-linked loans, and investments in renewable energy and energy efficiency projects, through which financial institutions can actively contribute to sustainable development while mitigating climate-related financial risks. Despite its growing relevance, the effective adoption of green finance

remains constrained by several structural and operational challenges. These include fragmented regulatory frameworks, the absence of harmonised definitions and metrics, and the limited availability of reliable and comparable environmental data [8]. Moreover, banks face strategic and operational difficulties in integrating sustainability into traditional business models, which often requires substantial investments in specialised expertise, data infrastructure, and technological innovation [26]. These challenges underscore the need for a more integrated analytical and policy-oriented approach to understanding the role of green finance in mitigating climate risks and supporting long-term financial and economic resilience.

Research methodology

This study employs a mixed-methods approach, combining both quantitative and qualitative techniques to analyze the impact of climate risks on sovereign debt, financial stability, and economic performance. Data is gathered from sources such as climate vulnerability indices (e.g., ND-GAIN), government reports, and financial databases, covering over 170 countries. A composite risk score is developed by weighting key factors, including physical and transition risks, and adaptive capacity, based on existing literature and econometric analysis. Econometric methods, such as regression and panel data modeling, are used to assess the relationship between climate risks and financial outcomes like sovereign debt, credit ratings, and

GDP growth. Case studies of specific countries and sectors, such as energy, are also included to illustrate real-world impacts. In addition, qualitative interviews with policymakers and industry experts offer further insights into climate risk management practices. This methodology provides a robust framework for understanding the economic implications of climate change.

Literature review

Interest in climate risks at the country level, particularly in the context of the Paris Agreement [35], has increased significantly in recent years. The Agreement set clear pathways for decarbonization for each nation, further intensifying the focus on quantifying and assessing climate risks. Investors, especially those with a long-term outlook, are becoming increasingly aware of the financial risks associated with climate change. Exposure to physical climate risks can have profound implications for sovereign debt [37; 7], and this has become even more evident after the Paris Agreement [11]. The consequences of climate-related risks include rising costs of debt [6, pp. 920-936; 9], deteriorating sovereign ratings [2], and threats to fiscal sustainability [1]. Climate change risks also influence financial stability [23, pp. 320-337], international trade [24], and even political stability [27; 14]. The potential effects of climate risks are particularly pronounced for smaller economies and those with limited capacity to manage the costs of climate change [25]. However, even advanced economies are not immune to challenges related to debt sustainability arising from climate events [17]. The impact of climate risks is often non-linear, as highlighted by studies examining the effect of rising temperatures on national productivity [10, pp. 235-239], and it is expected to vary in severity depending on the specific vulnerability of each country [15, pp. 423-424]. In light of these findings, it is clear that addressing climate risks is crucial for ensuring long-term economic stability and sustainability at the country level.

In 2023, the Intergovernmental Panel on Climate Change reported that the global average temperature had risen by 1.4°C compared to pre-industrial levels, drawing closer to the critical threshold of 1.5°C set by the "Paris Agreement." This rising temperature is directly linked to more frequent and intense extreme weather events, such as floods, droughts, heatwaves, and storms, which are increasingly disrupting industries and economic systems. For traditional industries, which rely heavily on stable environmental conditions, the consequences of climate-induced disruptions are especially severe. In 2021, a devastating rainstorm in Zhengzhou, China, disrupted production lines,

leading to widespread industrial breakdowns and a significant decline in stock market performance for the affected companies [34]. This incident exemplifies how the physical and operational resilience of businesses can be compromised by extreme weather events, resulting in cascading disruptions throughout the industrial supply chain. Moreover, research has demonstrated that climate change affects multiple facets of business operations. For instance, energy supply chains are increasingly vulnerable to climate-related disruptions, as extreme weather can damage infrastructure or hinder the delivery of essential resources. The energy-intensive nature of many industries amplifies these vulnerabilities.

Bauri, Mondal, and Fatma (2024) examine the impact of climate risk on the financial performance of 48 energy companies from G-20 countries, covering the period 2017-2021 [5, pp. 241-268]. Using the ND-GAIN climate vulnerability score to measure physical climate risks, the study finds that climate risks negatively affect companies' financial performance, as reflected in indicators like return on assets and equity. The authors highlight that firms in countries with lower climate risks perform better financially. The research provides valuable insights for policymakers, investors, and stakeholders in managing climate risks within the energy sector, contributing to the growing body of literature on climate-related financial impacts.

Gallas and Chouchene (2026) explore the relationship between ESG commitment and financial performance in China's fossil fuel industry, considering the mediating role of the Climate Change Performance Index [18, pp. 1-22]. The study uses panel data from publicly listed Chinese energy firms between 2009 and 2021 and applies autoregressive distributed lag techniques to account for firm-level heterogeneity. The findings show a positive link between ESG efforts and financial performance, with national climate policies, reflected in the CCPI, enhancing the ESG-finance connection. The research highlights the reciprocal effect between corporate ESG practices and financial success, emphasizing the role of strong climate policies.

Nour and Arbussa (2025) explore the role of business model innovation and cross-sector collaboration in accelerating green hydrogen adoption, especially in industrial and transportation sectors, contributing to global decarbonization [30, pp. 1-24]. Their qualitative research, combining expert interviews and document analysis, identifies emerging models like green hydrogen-as-a-service and hydrogen power purchase agreements as key drivers for enhancing financial viability and mitigating adoption risks. They emphasize the

importance of collaboration across sectors to overcome economic, infrastructural, and policy challenges. The study offers valuable insights for policymakers, industry stakeholders, and investors to design scalable models and facilitate market development.

Additionally, climate-induced disruptions can directly impact labor health, with extreme temperatures and poor working conditions leading to lower productivity, increased absenteeism, and even long-term health problems for workers [32; 13]. Infrastructure, particularly in regions prone to flooding or heatwaves, is also at greater risk of degradation, which further limits the capacity of firms to maintain continuous operations. The compounding effect of these factors makes it imperative for firms to reassess their risk management strategies and invest in adaptive measures to mitigate the adverse effects of climate change. Firms must integrate climate resilience into their long-term strategic planning, including diversifying supply chains, investing in energy-efficient technologies, and adopting flexible workforce management practices. Furthermore, governments and financial institutions play a crucial role in incentivizing businesses to adopt sustainable practices and fostering innovations that reduce climate-related risks. As the impacts of climate change become more pronounced, the business landscape will continue to evolve, requiring both policy-makers and industry leaders to develop more robust, forward-thinking approaches to climate risk management. By addressing these challenges head-on, firms can not only ensure their own resilience but also contribute to the broader effort of mitigating climate change's disruptive effects on the global economy.

Green finance includes various financial tools and policies aimed at promoting environmentally sustainable projects, including green loans, green bonds, and investments in renewable energy [29]. Previous studies based on economic theory agree that green finance reduces environmental risks, climate-related financial risks, and potential systemic shocks, leading to greater country-wide financial stability [16; 21]. Furthermore, green finance development helps firms enhance their ESG activities, thereby helping firms avoid non-systemic risks. This further contributes to the stability of the financial system [22]. Green finance aligns with financial intermediation theory, which states that financial institutions can reduce risks by efficiently allocating capital and managing liquidity, channeling funds into sustainable industries, and preventing financial instability caused by climate risks, regulatory shifts, and stranded assets in fossil fuel industries [12, pp. 20-50].

Bala, Singh, and Jakada (2026) examine the relationship between energy consumption, CO₂ emissions, and economic growth in Central European and Baltic countries, with a focus on renewable energy's role in emission reduction [3, pp. 1-27]. Using panel data from 11 countries (1990-2020), they find that renewable energy consumption significantly reduces CO₂ emissions, while nonrenewable energy use increases them. The study highlights the limited role of aggregate output, trade openness, and urbanization in emission reduction. The authors suggest that policymakers focus on expanding renewable energy infrastructure through tax incentives and public-private partnerships to foster low-carbon economies.

In their study, He and Ren (2022) examine the impact of financial constraints on the risk of stock price crashes [20, pp. 612-637]. They find that financial constraints significantly increase the likelihood of future stock price crashes, a result that holds up even when using quasi-natural experiments to control for potential endogeneity. The authors suggest that bad news hoarding and default risk play a crucial role in explaining this heightened crash risk. Furthermore, their findings indicate that this relationship is more pronounced in firms with weaker corporate governance. The study emphasizes the importance of understanding financial constraints for investors and stakeholders concerned with firm creditworthiness and stability.

Analysis

According to the Bank for International Settlements (BIS, 2024), financial authorities globally recognize that both the physical impacts of climate change and the transition to a low-carbon economy present significant financial risks [4]. The physical impacts of climate change are categorized as either acute or chronic risks. Acute physical risks result from the increasing severity and frequency of extreme weather events associated with climate change, such as heatwaves, droughts, landslides, floods, wildfires, and storms. Chronic risks refer to longer-term, progressive shifts in climate patterns, including ocean acidification, rising sea levels, and increasing average temperatures. Although the frequency and intensity of climate events vary by geography and are difficult to model or predict, the overall losses resulting from global natural disasters between 1980 and 2018 were estimated to exceed \$5 trillion (BIS, 2024).

In their report on Europe's green investment needs, Nerlich et al. (2025) highlight a significant public funding gap for green investments by 2030 [28]. Despite substantial EU funds being available, especially through the Recovery and Resilience Facility of NextGenerationEU, there remains a backlog in absorbing RRF funds. They also note

that green funding from the EU budget is progressing well, but after the RRF expires in 2026, an estimated €54 billion shortfall may arise by 2030. The authors suggest that an EU fiscal capacity for climate could help close this funding gap, emphasizing the importance of financing in determining the scope and viability of cross-border green projects. They also note that the reformed EU fiscal governance framework may encourage further green investments by national governments.

According to the same report, Nerlich et al. (2025) highlight that Europe will need to invest substantial amounts until 2030 to meet its green transition goals. The total green investment required is estimated to reach up to €1.2 trillion per year, in line with the EU's target of a 55% reduction in greenhouse gas emissions. The European Commission's analysis reveals that, on average, €764 billion per year was invested in the EU from 2010 to 2020 for reducing GHG emissions, which corresponds to 5.1% of the EU's GDP in 2023 and approximately 24% of total real investment. To meet the 2030 target, an additional €477 billion per year (3.2% of GDP) will be needed. This would bring the total annual green investment to €1.2 trillion, or 8.3% of the 2023 EU GDP. A significant portion of the additional investment will be required for greening the transport sector and improving energy efficiency in residential buildings, presenting a major challenge in the transition.

In *Recent Developments in Green Finance, Green Growth and Carbon Neutrality* (Shahbaz, Dong, & Gedikli, 2023), the editors present a comprehensive framework for achieving a carbon-neutral society [33]. The book explores the role of green finance and green growth in transforming the global economy towards carbon neutrality. The authors delve into the theoretical and empirical relationship between these concepts, emphasizing the synergy between green finance policies, green

growth strategies, and carbon neutrality. In particular, the book highlights the importance of incorporating energy economics and financial innovations to design a feasible path for a low-carbon transition. Chapters dedicated to the United Nations Sustainable Development Goals 7 and 13 further underscore the significance of green finance in advancing sustainable global development.

According to Welsby et al. (2021), in order to limit global warming to 1.5°C, a substantial portion of fossil fuel reserves must remain unextracted [36, pp. 230-234]. Their analysis, using a global energy systems model, reveals that by 2050, nearly 60% of oil and fossil methane gas, and 90% of coal must be left in the ground. This is a significant increase compared to previous estimates for a 2°C carbon budget, especially for oil, where an additional 25% of reserves need to remain unextracted. They further argue that oil and gas production must decline globally by 3% per year until 2050, which implies that many existing and planned fossil fuel projects will become economically unviable. These findings underscore the urgency of transitioning away from fossil fuels to meet the 1.5°C target, and they also highlight the risks and uncertainties regarding the deployment of negative emission technologies at scale.

As shown in Figure 1. of the report how the costs of green technologies, such as electric vehicles and solar panels, have fallen significantly over the last decade as these technologies matured. This decline in production costs may partly explain why the European Commission's historical green investment estimates are higher than those in other studies. Additionally, differences in the assumptions regarding production costs and the scope of investments considered (such as including full costs versus just the difference from old technologies) contribute to the varying estimates of investment needs.

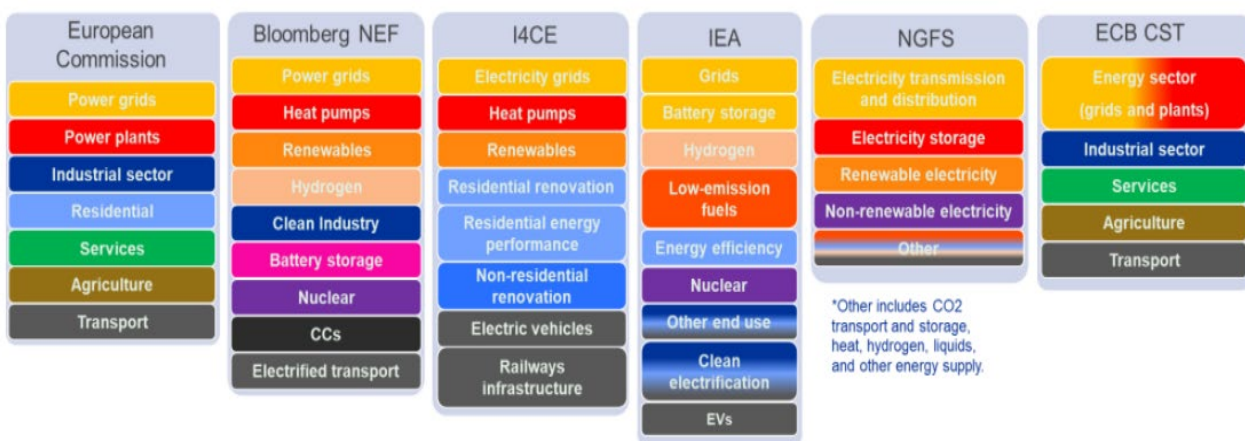


Figure 1. Sectors included in the estimates of green investment needs: comparison across institutions (ECB, 2025)

The report also highlights sector-specific discrepancies in investment calculations, particularly in the transport sector, where methodologies and sectoral components differ between studies.

According to the second ECB economy-wide climate stress test, investment shortfalls relative to

the 2030 target would lead to higher overall green investment needs. The stress test estimates granular firm-level investment requirements for euro area corporates, considering two types of investments: carbon mitigation and renewable energy capacity expansion.

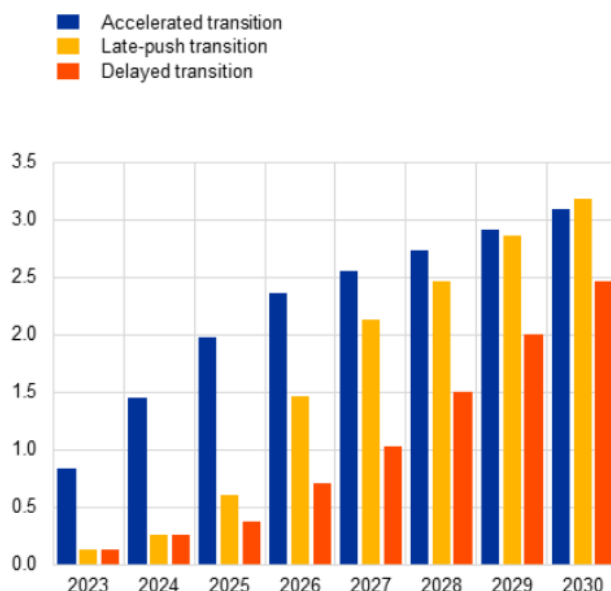


Figure 2. Composition of Additional Green Investment Needs in ECB Climate Stress Test (EUR trillions)

The investments in carbon mitigation are tied to firms' projected GHG reductions from 2023 to 2030, while investments in renewable energy focus primarily on the electricity sector to meet the increased demand for green energy. Three scenarios are examined, with the "late-push transition" scenario resulting in higher investment costs and, consequently, greater green investments from 2026

onwards, as the transition accelerates (see Figure 2.).

According to the World Bank's report, 48% of the financing from the World Bank Group in fiscal year (FY) 2025 had climate co-benefits, compared to 44% in FY2024. The actual climate finance in dollar amounts from IBRD/IDA increased from \$31.0 billion in FY2024 to \$39.2 billion in FY2025 (Figure 3.).

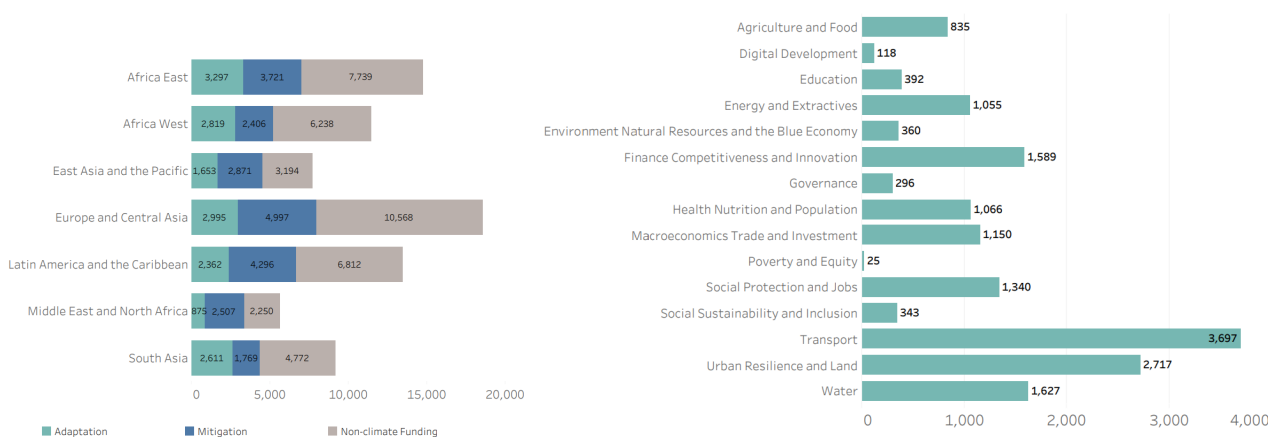


Figure 3. IBRD & IDA Climate Finance Distribution by Region and Adaptation Efforts (in USD millions)

The green investment needed in Europe by 2030 is substantial, with estimates of additional investment requirements ranging from €403 billion to €558 billion per year, equivalent to about 2.7% to

3.7% of EU GDP. These figures vary due to differing sectoral coverage, methodologies, and assumptions. Current investments fall significantly short, adding to future annual investment needs. The

global challenges are even greater. Banks play a crucial role in financing the green transition, with euro area banks increasingly factoring climate risks into loan decisions, although the role of capital markets remains limited, especially for venture capital. Despite this, the growth of green market segments is gaining momentum. However, financing costs are a barrier for many firms, especially SMEs. While the private sector must contribute most of the green financing, the public sector is critical in leveraging private investment. The EU has allocated significant public funds through the Recovery and Resilience Facility, but a green financing gap may arise post-2026. National funding availability will be constrained by fiscal space, particularly in some countries. Though green public investment carries potential fiscal risks, such as inflationary pressures, a lack of investment poses even greater long-term risks, including economic instability and climate tipping points. Future analyses should consider the long-term benefits of green investments for both climate sustainability and economic resilience.

Conclusions

The growing recognition of climate risks at the country level, particularly after the Paris Agreement, has brought significant attention to the potential economic implications of climate change. Physical climate risks, such as extreme weather events, rising temperatures, and sea-level rise, pose considerable challenges, particularly for emerging economies with limited adaptation capacities. Conversely, transition risks affect wealthier, fossil fuel-dependent nations as they strive to decarbonize rapidly. These risks threaten sovereign debt sustainability, financial stability, and economic growth, with non-linear impacts on productivity, health, and infrastructure resilience. Climate change-induced disruptions extend beyond environmental concerns, directly influencing labor productivity, industrial operations, and supply chains, with profound financial consequences for businesses. Green finance plays a critical role in mitigating these risks, fostering low-carbon transitions, and ensuring financial stability. However, the substantial investments required to meet climate goals, especially in sectors like transport and energy, pose significant challenges. Public and private sector collaboration is essential to bridge the green finance gap, with financial institutions increasingly integrating climate risks into their decision-making processes. The urgency of addressing these challenges underscores the need for coordinated global efforts to drive sustainable investment, minimize financial risks, and build resilience against climate-related disruptions.

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