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Green Finance: A Pathway to Climate Risk Mitigation

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Abstract: Against the backdrop of escalating climate crises, economic losses from extreme weather pose challenges to the financial system, with traditional finance struggling to price climate risks effectively. This article explores how green finance, by integrating environmental considerations into investment and risk management, serves as a key pathway to address climate risks. The study distinguishes between transition and physical risks, analyzes the role of green finance in guiding low-carbon capital allocation, enhancing risk pricing transparency, and strengthening systemic resilience, while identifying challenges such as fragmented disclosure mechanisms and liquidity constraints. It proposes recommendations like improving infrastructure and promoting product innovation to foster the collaborative development of financial stability and climate resilience.

Keywords: green finance; climate risks; risk mitigation

1. Introduction

In an era marked by escalating climate emergencies, from record-breaking heatwaves and catastrophic wildfires to devastating floods, the financial implications of environmental degradation have become impossible to ignore. According to Munich Re, the global economic losses from natural disasters surged to $329 billion in 2023, with only a fraction covered by insurance. However, traditional financial systems often fail to adequately price climate risks, leaving both public and private sectors exposed to unmanageable volatility. Green finance, by integrating environmental considerations into investment and risk management, emerges as a critical solution.

Green finance, which centers around environmentally friendly investments and practices, has emerged as a pivotal instrument in achieving sustainable and environmentally friendly economic growth [1]. By integrating environmental considerations into financial decision-making, green finance not only addresses the estimated $5.8 trillion annual funding gap for climate solutions according to UNEP, but also mitigates systemic risks threatening financial stability. Central banks, including the People's Bank of China and the European Central Bank, have increasingly recognized this potential, incorporating climate stress tests into regulatory frameworks.

However, despite its promise, green finance faces significant hurdles such as identifying the right projects; developing complex plans that involve both the public and private sectors (and often more than one country); and structuring the financing [2]. This article aims to provide a comprehensive understanding of climate risks and green finance, analyze the preventive function of green finance against climate risks and the possible challenges it may encounter, and put forward policy suggestions.

2. Climate Risks and Green Finance

This section mainly describes the financial implications of climate risks and the meaning and main classifications of green finance.

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2.1. Climate Risks in Finance

Climate risks can be categorized into two main types based on their characteristics and transmission mechanisms: transition risks and physical risks. Transition risks refer to the policy, cost, and market operational risks that arise as financial institutions navigate the societal and economic transition toward a low-carbon and net-zero emissions economy. Physical risks, conversely, involve the risk of physical damage to assets and collateral in financial transactions, caused by extreme weather events and natural disasters stemming from climate change. These include acute physical risks triggered by sudden catastrophes such as heatwaves, floods, and wildfires, as well as chronic physical risks — long-term, gradual risks resulting from phenomena like sea-level rise and droughts exacerbated by the greenhouse effect.

2.2. What Is Green Finance?

Green finance refers to financial activities that promote environmental sustainability by channeling capital toward projects that mitigate climate change, protect ecosystems, and support sustainable development. It operates at the intersection of finance and environmental stewardship, addressing both the urgent need for climate action and the opportunities for long-term, resilient investment. Its framework encompasses a range of innovative instruments and strategies designed to align financial markets with ecological goals, while also managing risks posed by environmental degradation to the financial system itself. The key instruments of green finance include green bonds, green banks, carbon market instruments, fiscal policy, green central banking, financial technologies, and community-based green funds, among others. The following is a detailed description of several instruments' functions.

1) Green Bonds

Green bonds are fixed-income financial instruments designed exclusively to finance environmentally sustainable projects. These include initiatives like renewable energy installations, energy-efficient infrastructure upgrades, and sustainable agricultural practices. What sets them apart from traditional bonds is the requirement for clear, detailed reporting on how the raised funds are utilized. This transparency ensures investors can track the environmental impact of their investments, fostering accountability in achieving ecological goals. By 2023, cumulative global green bond issuances surpassed $1 trillion, reflecting a surging investor demand for assets that balance financial returns with tangible environmental benefits.

2) ESG Investing

Short for Environmental, Social, and Governance investing, this approach goes beyond conventional financial metrics to evaluate companies. Specifically, it assesses three key dimensions: Environmental practices such as carbon emissions management, resource efficiency, and waste reduction, social impacts including labor standards, community engagement, and product safety, and Governance quality covering board diversity, ethical leadership, and transparency in decision-making. ESG-focused funds use these criteria to identify businesses with robust sustainable practices, thereby minimizing exposure to entities vulnerable to regulatory fines, reputational harm, or environmental liabilities. This strategy aligns investment portfolios with long-term societal and environmental goals.

3) Climate Insurance

Climate insurance encompasses specialized insurance products tailored to help individuals, businesses, and governments manage risks posed by climate-related disasters. These include events like floods, wildfires, droughts, or extreme weather events that damage property, disrupt livelihoods, or impact economic activities. By pooling risks across regions or populations, climate insurance provides financial protection against losses, enhancing resilience in vulnerable areas. A notable example is parametric insurance, which

triggers payouts based on predefined climate indicators (e.g., rainfall thresholds, temperature spikes, or wind speeds). This model enables rapid, objective compensation for affected parties, reducing reliance on slow, claims-intensive processes and encouraging proactive measures to adapt to climate risks [3].

4) Carbon Markets

Carbon markets are trading systems where carbon credits — units representing the right to emit a specific amount of greenhouse gases — are bought and sold. There are two primary types: mandatory cap-and-trade schemes, which set a legal limit on total emissions for regulated entities. Companies that cut emissions below their allocated quota can sell unused credits to those exceeding theirs, creating a financial incentive for emission reductions. Voluntary carbon markets, meanwhile, allow organizations or individuals to offset their emissions by investing in external projects that reduce or remove carbon, such as reforestation, renewable energy installations, or energy efficiency initiatives. By assigning a monetary value to carbon emissions, these markets internalize environmental costs, driving industries to adopt low-carbon technologies and accelerate the transition to a net-zero economy [4].

3. How Green Finance Mitigates Climate Risks

Green finance serves as a critical mechanism linking climate resilience and financial stability, leveraging regulatory design, market mechanisms, and policy synergies to address both physical and transitional climate risks. Below are the core pathways through which it operates, rooted in theoretical insights and empirical evidence from economic modeling and global policy.

3.1. Regulatory Incentives for Low-Carbon Capital Allocation

Financial regulations such as green Basel-type capital requirements reshape banks' risk-return calculus, channeling funds toward sustainable projects while curbing exposure to high-carbon assets. By assigning lower risk weights to green loans or excluding them from strict capital buffers, regulators reduce the cost of financing for renewable energy projects, energy-efficient infrastructure, and other low-carbon initiatives. For example, a bank financing a wind farm might face a 20% risk weight on such assets compared to 100% for a coal mine, making green investments more attractive on balance sheets. This mechanism not only accelerates the deployment of climate-friendly technologies but also mitigates transition risks — such as stranded fossil fuel assets due to policy shifts or technological obsolescence — by discouraging locking capital in unsustainable sectors. Model simulations by Lamperti et al. show that such policies can increase green credit supply by over 20%, thereby driving productivity gains in sustainable industries and simultaneously reducing the volatility of bank profits, as portfolios become less exposed to climate-related regulatory or market shocks [3].

3.2. Market-Driven Risk Pricing and Transparency

Green finance enhances risk management by integrating climate factors into financial valuation and disclosure frameworks. Carbon-risk adjustment in credit ratings, for instance, incorporates metrics like emission intensity, climate policy exposure, and physical risk vulnerability into creditworthiness assessments. A manufacturing firm with high carbon emissions may face higher borrowing costs due to perceived transition risks including future carbon taxes and consumer boycotts, while a low-carbon innovator benefits from preferential terms. This creates market discipline, incentivizing firms to reduce their carbon footprints in order to secure continued access to affordable capital. Complemented by mandatory climate disclosures such as TCFD guidelines, these practices reduce information asymmetry, allowing investors to price risks such as flood vulnerabilities for coastal real estate or heatwave impacts on agriculture. Empirical studies link such transparency to lower default rates in green portfolios, as better risk visibility enables proactive

mitigation strategies, such as diversifying into climate-resilient assets or hedging via parametric insurance for extreme weather events.

3.3. Policy Synergies for Systemic Resilience

The true power of green finance emerges from combining regulatory tools with public risk-sharing mechanisms, creating a virtuous cycle of decarbonization and financial stability. Green public guarantees, for example, act as a safety net for banks' lending to nascent green sectors covering green hydrogen and carbon capture, these sectors often involve high upfront costs and technical uncertainties, which deter private investment. By guaranteeing a portion of these loans, governments de-risk projects, attracting private capital while preserving bank solvency — simulations show this can double the share of green firms accessing credit without compromising financial stability. When paired with green Basel requirements, which expand credit supply, and carbon-risk adjustment, which ensures environmental criteria are embedded in lending, these policies reinforce each other: expanded green investment lowers long-term physical risks, while risk-adjusted pricing prevents excessive leverage in unsustainable sectors. This policy mix, as modeled by Lamperti et al., can achieve a 15-20% reduction in emissions growth alongside a 10-15% boost in GDP growth, demonstrating that climate mitigation and economic resilience are not mutually exclusive but reinforcing objectives [3].

4. Challenges in Aligning Green Finance with Risk Mitigation

4.1. Inadequate and Fragmented Green Finance Disclosure and Risk Management Mechanisms

Although green finance has achieved notable progress in many countries and regions, its policy and regulatory frameworks remain incomplete, particularly in developing nations where the regulatory systems for green finance are still in their infancy. Due to the lack of clear policy guidance and regulatory support, many green finance projects lack unified information disclosure standards and mechanisms, leading to non-standard market practices and even "greenwashing" — where some projects label themselves "green" without meeting clearly defined low-carbon benchmarks or environmental performance standards. Additionally, some financial institutions lack professional capabilities in identifying and assessing environmental risks, which not only negatively impacts enterprises' financial performance but also exacerbates the institutions' own asset risks. These challenges manifest as regional fragmentation, necessitating tailored solutions and international support.

4.2. Liquidity Constraints and Market Risks

Green finance projects typically feature long-term returns and investment cycles, which dampens investors' interest in such projects. The green finance market is not yet fully mature, with low liquidity in green financial products such as green bonds and green funds. These liquidity constraints make green projects vulnerable to capital market fluctuations during financing, increasing project uncertainty and investment risks. Market risk is another critical challenge: low-carbon projects often involve emerging technologies and underdeveloped market sectors, making their market risks higher than those of traditional projects. When technologies are immature or market acceptance is low, some green projects may face operational difficulties, affecting the overall returns of green finance.

4.3. Insufficient Public Awareness and Corporate Social Responsibility

Many members of the public lack systematic and accurate understanding of how green finance mitigates climate risks, often perceiving it as a high-risk investment. This awareness gap hinders the promotion of green financial products. In parallel, insufficient corporate social responsibility limits the advantages of green finance. Some enterprises pursue policy subsidies in green projects but lack long-term commitment to low-carbon

transformation; worse still, some merely masquerade as green projects through superficial measures, achieving limited environmental outcomes [4].

5. Policy Solutions for Effective Risk Mitigation

Climate change shocks adversely affect the economy, contributing to firm and bank bankruptcies, while the behavior of economic agents, in turn, influences the pace and severity of climate change.

5.1. Enhancing the Application of Insurance Products

Internationally, typical insurance products include catastrophic insurance and weather index insurance. Catastrophic insurance covers risks such as flood and hurricane insurance; for example, the World Bank's Pacific Catastrophe Risk Insurance Program provides typhoon and earthquake risk protection for island nations like Tonga and Samoa through bond financing. Unlike traditional insurance, weather index insurance does not indemnify based on actual losses incurred but rather on pre-determined trigger factors (e.g., wind speed or rainfall levels). These index-based products have been adopted by agricultural lenders and microfinance institutions to facilitate rapid financial recovery for clients following climate-induced disasters, reducing widespread loan defaults and financial risks. In China, for instance, in 2024, Anxin Agricultural Insurance and Zheshang Futures launched a "rice high-temperature weather index insurance + derivatives" pilot project in Shanghai's Songjiang District. By linking to the "CMA-DCE Temperature Index", the project protected over 4000 mu of local rice crops from production losses caused by extreme heat.

5.2. Strengthening Green Financial Infrastructure

At the policy level, harmonizing green classification standards is critical. By drawing on frameworks like the EU's Sustainable Finance Disclosure Regulation (SFDR) and China's Green Bond Endorsed Project Catalogue, countries can establish cross-regional, mutually recognized definitions for green projects to combat "greenwashing". Mandatory climate-related disclosures are also essential: financial institutions and enterprises should be required to disclose climate risk exposures following the Task Force on Climate-related Financial Disclosure (TCFD) framework. For example, Hong Kong's Securities and Futures Commission will mandate listed companies to disclose climate scenario analyses starting in 2025, enhancing market transparency.

In terms of data infrastructure, supporting the development of meteorological databases and models can foster synergy between climate science and finance. National-level green finance information-sharing platforms should be established to break down data silos among enterprises, financial institutions, and regulators, thereby enhancing climate risk assessment accuracy and improving the efficiency of green capital allocation. China's "Green Finance Reform and Innovation Pilot Zones", for instance, have built regional data platforms that have reduced the non-performing loan ratio of green credit by 1.2 percentage points compared to traditional credit, demonstrating improved risk management through data integration.

5.3. Promoting Innovation in Green Financial Products

From an investment strategy perspective, financial institutions like commercial banks can adopt climate risk resilience measures, such as conducting scenario analysis and stress testing, integrating climate data into lending and investment decisions, diversifying portfolios across regions and industries, and expanding green financing. A key innovation is the development of climate-themed green bonds, which focus on projects addressing climate change, such as clean energy R&D and urban flood control infrastructure. Issuers specify fund allocations and expected climate benefits, attracting investors

with strong environmental awareness and a focus on long-term stable returns. For example, some cities have issued such bonds to upgrade drainage systems and build stormwater storage facilities, enhancing urban climate resilience while offering investors stable and risk-adjusted returns. These bonds exemplify how financial products can align profit motives with climate action, driving both resilience and sustainable investment.

6. Conclusion

Climate risks are impacting global financial stability and sustainable development with unprecedented intensity, and green finance, as a key link between environmental protection and the financial system, provides a systematic approach to addressing both transition and physical climate risks by embedding environmental factors into capital allocation, risk assessment, and policy design. In practice, tools such as green bonds and carbon markets have achieved notable results in guiding funds to low-carbon sectors and internalizing environmental costs, while the synergy of regulatory incentives and market mechanisms has enhanced the financial system's resilience to climate shocks. However, challenges like fragmented disclosure standards, mismatched investment horizons, and weak environmental awareness still hinder its full potential.

The path forward lies in elevating green finance from a technical toolset to a guiding paradigm — one that integrates environmental priorities into institutional structures, regulatory strategies, and long-term financial planning: Build unified regulatory frameworks to ensure transparency, innovate financial products to bridge long-term climate goals with market incentives, and embed environmental responsibility into the DNA of financial institutions — both through policy mandates and cultural shifts. Internationally, fostering cross-border collaboration to share standards and pool risks is essential, turning climate action from a regional endeavor into a global collective effort. When finance aligns with planetary boundaries, it ceases to be a passive responder to crises and becomes an active architect of resilience. This transformation is not just about mitigating risks, but about redefining prosperity — one where financial and ecological health is inseparable, paving the way for a future in which human progress aligns with planetary stability.

References

1. C. Fu, L. Lu, and M. Pirabi, "Advancing green finance: a review of sustainable development," *Digit. Econ. Sustain. Dev.*, vol. 1, no. 1, p. 20, 2023, doi: 10.1007/s44265-023-00020-3.
2. J. D. Sachs, W. T. Woo, N. Yoshino, and F. Taghizadeh-Hesary, "Why is green finance important?," *SSRN Electron. J.*, 2019, doi: 10.2139/ssrn.3327149.
3. F. Lamperti, V. Bosetti, A. Roventini, M. Tavoni, and T. Treibich, "Three green financial policies to address climate risks," *J. Financ. Stab.*, vol. 54, p. 100875, 2021, doi: 10.1016/j.jfs.2021.100875.
4. M. Hu, Z. Sima, S. Chen, and M. Huang, "Does green finance promote low-carbon economic transition?," *J. Clean. Prod.*, vol. 427, p. 139231, 2023, doi: 10.1016/j.jclepro.2023.139231.