

A Study on the Allocation of Funds within the Global Climate Governance Framework: Based on the Interaction Between Green Bonds and Carbon Markets

Yingying Chen *

College of Economy, Jinan University, Guangzhou 511443, Guangdong, China

*Corresponding Author: 18928870324@163.com

ABSTRACT

Amid the accelerated progress of global climate governance, bridging the significant climate finance gap is a core challenge in achieving temperature control goals. As two key market-based climate finance instruments, the synergistic development of green bonds and carbon markets holds significant potential for optimizing the efficiency of global climate finance allocation. This study focuses on the interplay between green bonds and carbon markets and the mechanisms that influence climate finance allocation. First, it systematically examines the current status and characteristics of the global climate governance finance gap and identifies the limitations of traditional funding sources. Second, it deeply analyzes the green bond market's role in providing low-cost, scalable financing for low-carbon projects and the carbon market's central role in guiding emission reduction investment flows through price signals. It focuses on theoretical pathways and empirical evidence for the interplay between the two markets in terms of price transmission, risk management, investor incentives, and information disclosure and sharing. For example, rising carbon prices boost the expected returns of green projects, thereby stimulating green bond issuance, and carbon credits generated by projects financed by green bonds can flow back into the carbon market. The study finds that current interplay faces obstacles such as policy fragmentation, diverging standards, varying market maturity, and insufficient cross-border coordination, significantly hindering the realization of synergistic effects. Based on this, we propose optimization paths, including strengthening top-level policy design to promote rule compatibility, promoting innovation in carbon financial derivatives, establishing a unified information disclosure and certification platform, exploring integrated products such as "carbon bonds," and deepening international coordination to facilitate cross-border capital flows. The research concludes that deepening the institutional linkage between green bonds and the carbon market is a key breakthrough for increasing the scale, efficiency, and precision of global climate finance flows, and has significant practical significance for achieving a just transition and global carbon neutrality.

KEYWORDS

Global climate governance; Capital allocation; Green bonds; Carbon market; Linkage effect; Climate finance; Carbon pricing; Green finance

1. INTRODUCTION

Addressing climate change has become one of the most pressing global issues. The Paris Agreement established the long-term goal of limiting global temperature rise to well below 2°C above pre-industrial levels, and pursuing efforts to limit it to 1.5°C. Achieving this ambitious goal requires an unprecedentedly deep transformation of the global economic system toward a low-carbon and zero-carbon future. The scale and speed of this transformation are highly dependent on sustained, sufficient,

and efficient climate finance investment. However, there is a significant gap between the current global climate finance supply and actual demand. According to estimates by the United Nations Environment Programme (UNEP) and other organizations, developing countries require hundreds of billions of dollars annually for climate adaptation and mitigation, a figure that continues to grow. However, existing public finance and international aid are far from sufficient to meet this demand. Traditional sources of climate finance, such as official development assistance (ODA) and loans from multilateral development banks (MDBs), while playing an important role, face constraints such as limited scale, complex procedures, and numerous conditionalities, making them unable to independently support the massive transformation needs.

Against this backdrop, effectively leveraging and directing massive amounts of private capital toward climate-friendly sectors has become crucial for addressing this funding gap. Green bond markets and carbon trading markets, as two important market-based climate financing mechanisms, have emerged and are rapidly developing. By clearly identifying the purpose of raised funds, green bonds provide dedicated financing channels for green projects such as renewable energy, energy efficiency improvements, and pollution control. Their market size has seen explosive growth in recent years. Carbon markets, by establishing scarcity and tradability of carbon emission rights, generate carbon price signals, internalize the external costs of carbon emissions, provide economic incentives for emission reductions, and direct capital toward low-carbon technologies and projects. These two markets do not operate in isolation; their internal mechanisms offer natural complementarity and potential synergies.

Therefore, in-depth research into how the linkage between green bonds and the carbon market influences the efficiency of capital allocation within the global climate governance framework is of great theoretical value and practical urgency. Understanding the underlying mechanisms of their interaction, identifying current barriers to linkage, and designing policy and market pathways that promote deep integration are crucial for fully unleashing the potential of both markets, optimizing the flow and effectiveness of limited global climate finance, and accelerating progress towards global carbon neutrality. This study aims to systematically analyze this linkage mechanism, assess its impact on optimizing climate finance allocation, and propose specific strategies to enhance synergies.

2. FINANCING NEEDS AND CHALLENGES WITHIN THE GLOBAL CLIMATE GOVERNANCE FRAMEWORK

Achieving the Paris Agreement's temperature control targets requires the global economy to achieve net-zero CO₂ emissions around mid-century. This transition involves multiple areas, including energy system restructuring, deep industrial decarbonization, electrification and energy efficiency improvements in transportation and buildings, and the large-scale application of nature-based solutions. Authoritative assessments indicate that the annual climate finance demand supporting this transition is in the trillions of dollars. Developing countries alone require hundreds of billions of dollars in annual financing to fulfill their NDCs and adapt to climate change. This funding gap is significant and persistent, particularly for adaptation financing and for the least developed countries and small island developing states.

Traditional climate finance primarily relies on public funds pledged by developed countries under the Convention and the Paris Agreement, concessional financing from multilateral development banks, and bilateral climate aid. This type of funding plays a pioneering and catalytic role in capacity building, technology transfer, and risk mitigation, but its scale is constrained by donor countries' fiscal capacity, political will, and the international negotiation process. Public funding has long approval cycles, comes with conditionalities that may be misaligned with developing countries' priorities, and tends to support public goods or high-risk projects, limiting its coverage of large-scale commercial emission reduction projects [1].

Therefore, effectively mobilizing and leveraging private capital, which far outstrips public funding, has become an inevitable option and a core challenge to fill this gap. While the private sector possesses vast capital, its investment decisions are strictly based on risk-return assessments. Climate projects, particularly those involving emerging technologies or infrastructure, often face obstacles such as policy uncertainty, technological risks, market acceptance challenges, and uncertain long-term returns, which dampen investment enthusiasm. Designing effective mechanisms and policy frameworks to reduce risks and barriers to entry for private capital in the climate sector, increase expected returns, and direct capital flows to sectors and regions most in need is key to optimizing the efficiency of global climate finance allocation. This creates an urgent need and broad space for the development of market-based instruments such as green bonds and carbon markets, as well as their synergistic impact.

3. FUNCTIONAL POSITIONING AND CURRENT DEVELOPMENT OF GREEN BONDS AND CARBON MARKETS

As debt instruments specifically used for qualified environmental benefit projects, green bonds' core function is to establish a transparent and traceable financing channel for green and low-carbon projects. By mandating disclosure of fund use, environmental impact assessments, and subsequent reporting, they enhance the credibility of the funds' green credentials and reduce investor identification costs. Their appeal lies in meeting growing ESG investment demand and attracting specific funds. Furthermore, as the market matures, some high-quality green bonds have demonstrated issuance cost advantages or at least interest rate parity, significantly reducing the financing costs of projects such as renewable energy, energy efficiency improvements, and green buildings, accelerating their deployment. The International Capital Market Association (ICMA)'s Green Bond Principles (GBP) and the Climate Bonds Initiative (CBI) standards constitute the primary global frameworks. The core function of the carbon market (including the mandatory Emissions Trading System (ETS) and the voluntary carbon market (VCM)) is to create a carbon price signal that reflects the marginal cost of emissions reduction by establishing scarcity and tradability of carbon emission rights. This signal internalizes the external costs of carbon emissions, increasing the costs of high-carbon activities while creating economic value for low-carbon technologies, energy efficiency improvements, and carbon sequestration projects. The mandatory ETS requires regulated enterprises to clear quotas equal to their emissions [2]. Excess emissions require them to purchase quotas or carbon credits, and the remaining balance can be sold for profit. The voluntary VCM allows enterprises or individuals to purchase certified carbon credits for purposes such as social responsibility and brand building. Through price discovery, the carbon market guides capital flows to areas with the lowest emission reduction costs, promoting the optimal allocation of emission reduction resources.

Currently, the green bond market is developing rapidly, with global annual issuance volumes jumping from sporadic to hundreds of billions of dollars. Issuer types and bond varieties are becoming increasingly diverse, with China becoming a major issuer. Global carbon market coverage continues to expand, with the EU ETS being the most mature and China's national carbon market covering the largest amount of emissions. While the voluntary carbon market faces integrity challenges, trading volume has seen significant growth driven by net-zero commitments. While the infrastructure of the two markets continues to improve, challenges persist, including regional imbalances, a lack of unified standards, and insufficient market depth and liquidity, posing challenges to their coordinated development.

4. ANALYSIS OF THE LINKAGE MECHANISMS BETWEEN GREEN BONDS AND THE CARBON MARKET

The green bond market and the carbon market complement each other, and their linkage is crucial for guiding climate finance flows and improving allocation efficiency. The core linkage mechanism lies in the impact of carbon price signals on project economics and the direct support of green finance for emission reduction projects.

Carbon Price-Driven Capital Flows: Effective and rising carbon prices directly increase the operating costs of high-carbon assets while increasing the relative value and expected returns of low-carbon projects. For example, when carbon prices are high, renewable energy projects can generate additional revenue from the sale of carbon credits, in addition to electricity sales. This expected incremental revenue enhances the financial viability of projects, in turn encouraging companies to issue green bonds to finance such projects. The low-cost capital provided by green bonds accelerates project implementation, resulting in actual emissions reductions, either supplying carbon credits to the carbon market or reducing allowance demand, creating a positive cycle [3]. **Synergy between Risk Management and Valuation:** The carbon market provides a key reference for investors to assess the long-term value of green bond-backed projects. Stable carbon price expectations help quantify the potential economic value of project environmental benefits, enabling a more accurate assessment of project risk and return. For issuers, participating in the carbon market can hedge carbon cost risks or generate new revenue, improving financial robustness and indirectly enhancing the creditworthiness of their green bonds. The development of carbon financial derivatives also provides green bond stakeholders with tools to manage carbon price risks.

Information and Certification Infrastructure: Information disclosure and certification systems are the cornerstones of the linkage between the two markets. Green bonds require disclosure of the use of funds and environmental benefits, while carbon credit projects undergo rigorous methodological validation, additionality demonstration, and Monitoring and Verification (MRV). There is a high degree of synergy between the two markets in terms of quantification, monitoring, reporting, and verification of greenhouse gas emission reductions at the project level. Promoting compatibility and mutual recognition between the two sectors in emission reduction accounting methods, data formats, and certification standards can significantly reduce project compliance costs, enhance information credibility and comparability, provide investors with a clear and consistent assessment basis, and promote the efficient flow of funds to real and effective emission reduction activities.

5. BARRIERS TO INTEROPERABILITY AND COLLABORATION BOTTLENECKS UNDER THE CURRENT FRAMEWORK

Despite the enormous potential for synergy between green bonds and the carbon market, multiple practical obstacles severely constrain their synergy and the optimal allocation of climate finance.

Institutional Barriers: Policy and Standards Divergence

Green bond regulation focuses on the identification and disclosure of funds' "green attributes" and is primarily led by the financial sector. Carbon market rules, on the other hand, focus on emissions control, allowance allocation, and verification (MRV), and are often formulated by environmental authorities. The two systems have distinct objectives, targets, and indicators, and lack top-level coordination, leading to difficulties in aligning and even conflicting key definitions, project boundaries, emission reduction accounting, and data reporting. Frequent policy changes further undermine market participants' confidence in long-term, coordinated investment. Furthermore, global green bond standards differ significantly from those in the carbon market and are fragmented. A project seeking both green bond financing and carbon credits must meet both broad "environmental

benefit" requirements and stringent technical requirements for "additionality" and "permanence." This dual compliance cost is high, hindering the model's widespread adoption.

Structural Bottlenecks: Market Maturity and Cross-Border Obstacles

The green bond market in developed economies is relatively mature and has good liquidity. Emerging market green bond markets are mostly in their early stages, with a small number of issuers, a weak investor base, insufficient liquidity, and limited financing cost advantages. Carbon markets are similarly uneven: while the EU ETS is mature and efficient, emerging market carbon pricing mechanisms are still underdeveloped, resulting in low and volatile prices. This difference in maturity makes linkage models that rely on stable carbon price expectations less viable in emerging markets. Furthermore, the credit quality of voluntary carbon markets (VCMs) has diminished their appeal as a stable source of revenue for projects [4].

Cross-border barriers exacerbate capital mismatches.

Developing countries with the largest climate finance gaps have weak local green finance and carbon market foundations and urgently need international capital inflows. However, cross-border investment faces inherent obstacles, compounded by additional hurdles in green finance and carbon markets: inconsistent definitions of "green" and carbon credit recognition standards hinder capital flows; slow progress in negotiations on the details of international carbon credit trading under Article 6 of the Paris Agreement restricts the development of a standardized market; and discrepancies in capital controls and taxation also dampen investment enthusiasm. In summary, fragmented policy standards, unbalanced market development, and cross-border barriers collectively constitute core obstacles, inhibiting the potential for synergy between the two markets and hindering the efficient and targeted flow of climate finance to key sectors.

6. EXPLORING PATHWAYS TO PROMOTE SYNERGY AND OPTIMIZE FUND ALLOCATION

To overcome existing obstacles to the linkage between green bonds and the carbon market and enhance the efficiency of global climate finance, policymakers, regulators, financial institutions, and market players must work together to promote the integration and innovation of systems, markets, products, and technologies.

Strengthening institutional synergy is fundamental. At the national level, it is urgent to establish a regular coordination mechanism between fiscal, financial regulatory, and ecological and environmental departments, focusing on standardizing key definitions, core environmental performance indicators, and information disclosure requirements. Exploring the inclusion of carbon price expectations or project carbon credit output potential within green bond assessment frameworks is crucial. Internationally, efforts should promote the mutual recognition of green finance standards and core carbon credit standards, accelerate the implementation of the international carbon credit mechanism under Article 6 of the Paris Agreement, and eliminate regulatory barriers to cross-border investment [5].

Deepening product innovation is crucial. Vigorously promote "Sustainability-Linked Bonds" (SLBs), directly and transparently linking their key performance indicators (KPIs) to Sustainable Development Goals (SDGs) through carbon market variables, such as the reduction in carbon intensity of regulated enterprises or the value of carbon credits generated by projects, so that bond terms can be dynamically adjusted based on carbon performance. Actively explore the issuance of "carbon bonds," with proceeds specifically allocated to projects that generate high-quality carbon credits. Future carbon credit income can be used as a source of debt repayment or credit enhancement, thus addressing upfront capital constraints. Simultaneously develop derivatives such as carbon futures and options to provide market participants with tools to manage the risk of carbon price fluctuations.

Building digital infrastructure is a guarantee. Promote the establishment of national or regional digital platforms, integrating green bond registration systems with carbon market registries to enable the secure and efficient sharing of project-level environmental benefit data. Apply distributed ledger technologies (DLT), such as blockchain, to enhance the traceability, transparency, and tamper-proofing of carbon credits throughout their lifecycle, and reliably link them to corresponding green bond information, providing investors with a comprehensive view of the "funding-emissions reduction" equation. Promote mutual recognition of third-party assessment and certification systems to reduce compliance costs.

Expanding international cooperation is supportive. Developed countries must earnestly fulfill their climate finance commitments and leverage private capital into developing countries' green bond markets and high-quality carbon credit projects through institutions such as the Multilateral Development Banks (MDBs) and the Green Climate Fund (GCF). They should leverage blended finance, guarantees, and technical assistance tools to leverage private capital into developing countries' green bond markets and high-quality carbon credit projects. Priority should be given to supporting developing countries in strengthening their capacity for green finance and carbon markets, encompassing policy development, regulatory frameworks, institutional development, and MRV systems. International organizations should establish platforms to facilitate cross-border experience exchange, standard convergence, and project matching. The establishment of fair and reasonable international carbon credit trading rules should be promoted to ensure that climate finance flows equitably to areas most in need.

7. CONCLUSION

Achieving the Paris Agreement's temperature control targets faces a significant climate finance gap, necessitating the efficient mobilization of private capital. Green bonds accelerate the deployment of green projects by reducing their financing costs, while carbon markets, through carbon price signals, guide capital flows toward efficient emission reduction projects. Their functions are naturally complementary.

This study reveals the core linkage mechanism between these two markets: rising carbon prices boost the expected returns of low-carbon projects, stimulating green bond issuance; the low-cost capital provided by green bonds accelerates the implementation of projects that generate carbon credits, creating a positive cycle of financing and emission reduction. The carbon market creates additional value channels for green bond projects and provides risk management tools. Green bond disclosure requirements and the Monitoring and Verification (MRV) system for carbon credits provide a foundation for integration of environmental benefit data, enhancing transparency and comparability. These synergies contribute to the expansion of climate finance, lower costs, and optimized flows.

However, coordinated development faces significant obstacles: fragmented policy and regulatory frameworks lead to incompatible rules; fragmented standards systems increase project compliance costs; the lack of maturity and liquidity in some markets undermines the effectiveness of carbon pricing guidance; and cross-border coordination barriers hinder capital flows. These factors hinder the full realization of synergy effects. To overcome these bottlenecks, the following recommendations are made: 1. Strengthen policy coordination: Promote compatibility between national green finance and carbon market rules in key definitions and environmental performance indicators; 2. Innovate market products: Develop sustainability-linked bonds (SLBs) linked to carbon prices and explore "carbon bonds" repaid with future carbon credit revenue; 3. Unify information infrastructure: Build a trusted platform integrating green bond and carbon credit data, leveraging blockchain and other technologies to ensure traceability; 4. Deepen international cooperation: Developed countries should fulfill their financial obligations and leverage private capital, support capacity building in developing countries, and promote fair cross-border carbon credit trading.

In summary, deepening the institutional linkage between green bonds and carbon markets is key to optimizing the efficiency of global climate finance allocation and driving cost-effective emission reduction actions, and is crucial to achieving global climate goals. Future efforts require continued focus on innovative linkage models, deepening policy coordination, and achieving effective international cooperation.

REFERENCES

- [1] Xie Canyang, Dong Wenjuan, Wang Can. From 100 billion to 100 trillion: the funding issue in global climate governance [J]. *Progress in Climate Change Research*, 2023, 19(05): 653-662.
- [2] She Qunzhi, Wu Xiaoli, Pan An. The impact of climate finance on carbon emissions in recipient countries [J]. *Resources Science*, 2020, 42(06): 1015-1026.
- [3] Fu Sha, Chai Qimin, Xu Huaqing. Analysis of the gap in global climate mitigation, finance and governance after the United States announced its withdrawal from the Paris Agreement [J]. *Progress in Climate Change Research*, 2017, 13(05):415-427.
- [4] Fu Sha, Chai Qimin, Xu Huaqing. Analysis of global climate mitigation, finance and governance gaps after the United States announced its withdrawal from the Paris Agreement [J]. *Progress in Climate Change Research*, 2017, 13(05):415-427.
- [5] Li Mengyuan. Research on spillover effects of green bonds, carbon trading and energy markets: considering the impact of climate change concerns [D]. Shanghai International Studies University, 2024. DOI:10.27316/d.cnki.gswyu.2024.000735.