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The Performance of Green Financial Instruments and Their Supporting Role in Sustainable Investment

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Abstract. As global sustainable development strategies continue to evolve, green financial instruments have become a key means of directing capital towards environmental projects. In contrast to traditional financial tools, innovative mechanisms like green bonds and green investment funds serve dual purposes, both advancing environmental goals and fulfilling fiscal functions. This enables them to fill institutional gaps in traditional financial markets, particularly in the area of ecological governance. This paper investigates the performance of green financial instruments in sustainable investment and their role in driving the green transition. Despite rapid growth, debates persist over their effectiveness, especially around "greenium," risk diversification, and policy limits. By combining literature review and case analysis, it aims to clarify the issues in assessing green finance performance. The results show that green financial instruments are effective in mobilizing private capital, enhancing environmental transparency, and lowering climate risks. However, they also face challenges like insufficient standardization, market fragmentation, as well as difficulties in assessing environmental impact. Despite these issues, green finance supports sustainable investment, with its effectiveness relying on a solid policy framework, clear definitions, and accurate assessment methods.

Keywords: Green finance, Sustainable investment, ESG performance, Financial risk, Policy incentives

1. Introduction

By directing capital into projects like clean energy, green transportation, and eco-friendly buildings, green finance aims to balance economic growth with environmental protection. As climate change intensifies, green finance has become a crucial driver in transforming the global financial system. Following the signing of the Paris Agreement, the rapid growth of tools such as green bonds, green funds, and Environmental, Social, and Governance (ESG) investments has propelled the continuous growth of the green finance market. As a leading advocate of green finance, China has established a comprehensive policy framework since 2016, offering diverse financial support for green projects while continuously refining related mechanisms to meet its dual carbon goals of peak emissions and carbon neutrality. However, whether green financial instruments have genuinely boosted the overall performance of sustainable investment remains a debated issue. Existing studies explored indicators such as returns or risks, ignoring the connection between environmental impact, social benefits, and

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financial performance. Therefore, this paper adopts literature review and case analysis as its main research methods. From a multi-dimensional performance perspective, it examines the development logic and classification of green financial instruments. In addition, it further develops an evaluation framework covering financial returns, environmental impact, and social contribution, and analyzes the actual effectiveness of green finance in supporting sustainable investment.

2. The types and market structure of green financial instruments

2.1. Main types and characteristics of green financial instruments

The expansion of the green finance market has led to the widespread adoption of green financial instruments to support projects focused on environmental sustainability. Based on their financing structure, these instruments are usually divided into three types, including debt-based, equity-based, and market-based instruments. Though each green financial instrument varies in form, all align with sustainable development goals, provide distinct advantages to different user groups, and play a key role in the global transition to a green economy [1].

In particular, debt-based instruments like green bonds and green loans drive sustainable finance. Green bonds are typically issued by governments, financial institutions, or large corporations, with the funds directed towards projects like renewable energy, energy-efficient buildings, and clean transportation [2]. For instance, over $2.5 trillion worth of green bonds have been issued globally, playing a crucial role in climate finance. In comparison, green loans offer more flexibility, making them well-suited for small and medium-sized businesses (SMEs) or local governments, with terms tailored to individual project needs. Besides, equity-based instruments like green funds pool capital to invest in sustainable assets. These funds select investments based on environmental, social, and governance (ESG) criteria, aiming to balance financial returns with ecological benefits. The market for green funds has grown rapidly, especially in green exchange-traded funds (ETFs) and mutual funds. However, green funds face challenges, such as the inconsistency in ESG ratings and the issue of greenwashing, which could undermine investor trust. In addition, market-based instruments, such as carbon credits and emission trading systems (ETS), incentivize companies to cut emissions via tradable environmental rights. For example, the European Union's ETS allows businesses to trade carbon emission allowances on the market, promoting the adoption of low-carbon technologies. In 2023, the global carbon market reached a value of $950 billion, highlighting the important role this mechanism plays in global emission reductions.

2.2. The evolution path and mechanism of the green financial market

The green finance market has undergone structured expansion and gradual institutionalization since the first issuance of green bonds in 2007, becoming an important component of the global capital markets. Its development is closely linked to international agreements and policies, as well as the dynamic impact of market mechanisms and diverse stakeholders [3].

First, the promotion of international policies has been a key driver of the green finance market's expansion. The adoption of the Paris Agreement in 2015 laid the foundation for the global carbon neutrality goal, driving capital flows and market participation worldwide. The active involvement of emerging economies, especially China and Southeast Asia, has further promoted the geographical diversification of capital flows. Second, the participants in the green finance market have gradually expanded from initial multilateral development banks and sovereign entities to include commercial banks, corporations, and asset management firms. This shift has not only enhanced market liquidity

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and depth but also made risk assessment and reporting mechanisms more complex and diversified, posing new challenges. Additionally, the maturity of the green finance market is closely linked to the establishment of key mechanisms. International standards like the Green Bond Principles (GBP) and Climate Bonds Standard, along with mandatory disclosures and third-party verification, have boosted market transparency and credibility. These mechanisms help curb greenwashing, reduce information gaps, and ensure green financial products achieve their environmental goals. Therefore, the growth of the green finance market is driven by policy support, diverse market players, and key mechanisms. With further improvements in standardized tools and regulatory frameworks, green finance will play an even greater role in driving global sustainable development.

3. The performance measurement and mechanism of green financial instruments

3.1. Performance and market response

The financial performance of green financial instruments has become a critical consideration for investors aiming to achieve both environmental influence and financial returns. In terms of return, green bonds often show a "greenium," with slightly lower yields than conventional bonds, thereby reflecting investors' willingness to accept modestly reduced returns for environmental benefits and reputational value. For example, Karpf and Mandel noted a consistent yield gap in the United States (U.S.) municipal bond market, where green-labeled bonds traded at marginally lower yields than traditional bonds, demonstrating a measurable greenium driven by investor demand [4]. From a risk perspective, ESG-integrated assets typically show lower long-term volatility, better credit quality, and greater resilience to market downturns. In fact, a meta-analysis by Friede et al. found that most ESG-aligned portfolios either outperform or match traditional investments when adjusted for risk [5]. Nevertheless, liquidity remains a challenge, as green instruments often experience lower trading volumes and limited secondary market depth, particularly in emerging markets or niche sectors. As a result, these constraints can lead to wider bid-ask spreads and slower price discovery. However, for example, with over USD 4 billion issued since 2016, Apple's green bond program acts as a key example of increasing investor confidence and the mainstreaming of green finance [1]. Inclusion in major indices, such as the MSCI ESG Leaders Index, significantly enhances the market visibility and access of green assets. Consequently, green financial instruments are increasingly valued for their environmental utility and their ability to support effective capital deployment in line with long-term sustainability goals

3.2. Environmental benefits and sustainable value

In driving carbon reduction, ecological investment, and sustainable transformation, green financial instruments play a vital role. Besides, the evaluation of their environmental impact relies on capital allocation, project structure, as well as standardized third-party criteria and indicator systems. In the field of green bonds, the French utility company EDF has issued bonds to finance renewable energy projects like wind and hydropower [2]. Based on public disclosures, an estimated annual reduction of 2 million tons of CO_2 is achieved for every €1 billion in financing, demonstrating significant environmental returns. In China, the Industrial Bank has released green financial bonds that support sectors such as clean energy and energy efficiency retrofits. The financed activities, according to project-level reporting, are anticipated to reduce about 1.5 million tons of CO_2 emissions each year, thus contributing measurably to regional carbon peaking and air pollution control [3]. By excluding high-emission enterprises and focusing on renewable energy projects, Norway's Sovereign Wealth

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Fund (NBIM) has become a global model for green funds [6]. Its green investment portfolio has topped USD 100 billion, effectively combining financial returns with environmental responsibility. These cases indicate that green financial tools guide capital flows toward environmentally friendly projects and establish measurable, traceable performance mechanisms, providing valuable financial support for achieving carbon neutrality goals.

3.3. Synergistic logic and structural tension

At the intersection of financial returns and environmental influences, green financial instruments generate both synergies and inherent tensions. In this context, a key challenge is the green premium, where green bonds generally yield less than conventional bonds. This reflects investor preferences for environmental responsibility while also raising questions about balancing financial performance with sustainability objectives. For example, Zerbib empirically analyzes this yield difference across various markets and confirms that green bonds typically provide slightly lower returns, particularly during periods of stable monetary policy, underscoring the trade-off between impact and profit [7]. Beyond fixed-income products, ESG strategies in equity markets reveal complex relationships with long-term market value. For example, Lins, Servaes, and Tamayo highlight that during the 2008 financial crisis, firms with strong CSR performance experienced smaller stock price declines and a quicker recovery afterward, in contrast to companies with poor CSR records [8]. This suggests that ESG strategies could act as a form of "crisis insurance," offering resilience during periods of market volatility. However, the benefits are often context-dependent and may not be immediately evident in short-term financial metrics. In addition, traditional evaluation systems prioritize static financial and environmental indicators, often neglecting the dynamic, long-term value that ESG factors can bring to a company's resilience and adaptability during crises. In order to fully capture the systemic value of green finance, future frameworks should incorporate time-sensitive metrics, stakeholder trust dynamics, and risk-adjusted ESG impact assessments.

4. Structural bottlenecks and transformation paths

4.1. Disagreements on standards and information barriers

The persistent structural challenges in green financial markets, including inconsistent standards and information asymmetry, continue to undermine market efficiency and environmental effectiveness. As such, investors often struggle to identify credible sustainable assets due to fragmented disclosure frameworks and the absence of standardized evaluation metrics. For example, Flammer argues that while green bonds have the potential to boost long-term firm value, their success largely depends on credible commitments and strong governance structures [9]. Meanwhile, Albuquerque et al. show that firms with high ESG ratings exhibited significant resilience during periods of systemic stress, although these long-term benefits are often overlooked in short-term focused markets [10]. The underlying causes include underdeveloped institutional frameworks, asymmetrical capacity among market participants, and regulatory delays. These issues result in tangible market impacts, such as widespread mispricing, diminished investor confidence, and higher funding costs for high-quality green projects. To support the healthy development of sustainable finance, it is crucial to establish a standards and disclosure system that is dynamically adjusted, transparent, and widely accepted.

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4.2. Regulatory innovation and market practice

As green finance moves from theoretical support to practical application, regulatory innovation has become a key tool for improving market efficiency and directing sustainable capital flows. In this context, a multi-level regulatory framework is emerging, encompassing national frameworks, local implementation guidelines, broad classification systems, and targeted incentive mechanisms. This evolving structure is gradually forming a policy loop that links regulation to market response. For example, China's Green Bond Endorsed Project Catalogue and interest subsidy schemes for green credit have clarified eligibility standards, reduced financing costs, and boosted the competitiveness of green projects in carbon-intensive sectors [11]. At the market level, mechanisms such as green certification systems, third-party verification, interest subsidies, and guarantee instruments have enhanced the visibility and bankability of green assets. These measures attract more investors and expand credit access for projects with longer payback horizons. In parallel, strengthened disclosure requirements, such as mandatory ESG reporting and environmental risk stress testing, have raised transparency, thus enabling more accurate risk pricing and more effective supervisory oversight [12]. By standardizing product definitions, boosting cross-border comparability, and acting as a reference for investment screening and credit rating adjustments, the EU's Sustainable Finance Taxonomy drives technical standardization and regulatory integration. While the EU framework offers greater consistency and auditability than China's system, it sacrifices flexibility in fast-evolving sectors. Thus, regulatory innovation must balance stability and adaptability to match market changes [13].

4.3. Performance mechanisms and policy effects

The assessment of green financial instruments reflects both environmental and economic impact and serves as a crucial indicator of policy effectiveness. For example, green bonds green credit have effectively channeled capital into low-carbon infrastructure, renewable energy, and pollution control. Flammer highlights that green bond issuers can attain superior emissions reductions and long-term performance while reaping reputational advantages [14]. However, there are substantial disparities across regions and sectors, and certain projects continue to grapple with balancing environmental gains and efficiency [15]. Besides, regional differences arise from structural and institutional gaps. Developed economies benefit from mature regulatory frameworks, higher investor ESG awareness, and standardized impact assessment methods, which make green investment returns more reliable. In contrast, developing markets often lack unified standards, transparent disclosure mechanisms, and regulatory enforcement, leading to the misallocation of green capital and higher perceived risks. Sectoral differences are also significant. Renewable energy and clean technology projects typically have clearer financial returns and scalability, attracting more investment. However, industries like green buildings and industrial decarbonization require larger upfront investments and face longer payback periods. This makes them more reliant on policy incentives and susceptible to economic swings. Moreover, differences in technological maturity, market demand, and regulatory sensitivity amplify the performance heterogeneity across industries. Policy incentives, including subsidies, tax breaks, and financial support, reduce financing costs and stimulate early market growth [16]. As markets mature and investor preferences evolve, the marginal utility of these policies is diminishing. In developed markets, over-reliance on incentives may hinder innovation and efficiency. Thus, an integrated dynamic assessment framework combining environmental, economic, and social metrics should be established. The application of big data and machine learning can improve risk-return

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analysis and the causal links between policy interventions and market outcomes, backing more adaptive, evidence-based global green finance policies [17].

5. Conclusion

Green financial instruments provide funding for low-carbon and ecological projects through various mechanisms such as green bonds, loans, funds, and environmental rights instruments, shaping a transparent green finance ecosystem. Meanwhile, their dual functions fill institutional gaps, enhance market efficiency, and bolster investment resilience. The results demonstrate that a comprehensive evaluation of financial returns, environmental impacts, and social benefits can yield a more precise assessment of green finance effectiveness, and that standardised governance and reliable disclosure can stimulate innovation, boost confidence, reduce risks, and reinforce their roles as market drivers and sustainability enablers. In the future, the ongoing progress of green finance hinges on policy fine-tuning and methodological innovation. On the policy front, it is crucial to align classification standards, streamline verification procedures, and gradually shift from direct incentives to nurturing self-sustaining market mechanisms. Methodologically, it is vital to integrate real-time, data-driven performance checks, using timely metrics and risk-tied ESG factors, to truly gauge the long-term worth of green finance. As analytical tools like big data and machine learning continue to evolve, they will boost the accuracy and comparability of performance evaluations, enabling more precise policy adjustments. The future of green financial instruments depends on balancing flexibility and standardization to sustain the global green transition.

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