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The Optimal Design of Green Debt

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Executive summary

Financial markets are playing an increasingly important role in the fight against climate change. The sustainable debt market has grown exponentially over the past decade, surpassing $7.5 trillion as of 2023. This growth has been accompanied by a proliferation of security types, and heightened concerns about greenwashing and the limited environmental impact of these securities. In "The Optimal Design of Green Debt", Adelina Barbalau and Federica Zeni develop a theoretical framework for understanding how to structure debt contracts to curb greenwashing while maximizing environmental outcomes.

This Policy Brief is based on the E-Axes Research Prize winner paper by Barbalau and Zeni and on the webinar of the 30th of October 2024 with Barbalau and Zeni, discussed by Stephen Cecchetti (Brandeis International Business School) entitled "The Optimal Design of Green Debt".

Policy Brief

Understanding the Sustainable Debt Landscape The authors start by noting that despite the rapid expansion of security types, a distinction can be made between two contract designs: • project-based designs, such as green bonds (GBs), which allocate funds to specific projects but do not require issuers to achieve concrete environmental outcomes • outcome-based designs, such as sustainability-linked bonds (SLBs), which link financing costs to the achievement of environmental targets but do not impose restrictions on the use of proceeds While GBs ensure proceeds go toward environmentally friendly projects, they do not guarantee actual emissions reductions or measurable environmental benefits. On the other hand, SLBs encourage firms to meet climate targets, but their effectiveness is limited by the potential for manipulating reported green outcomes and the lack of transparency regarding the use of proceeds. Designing Green Debt Optimally The paper formally identifies the trade-offs and inefficiencies involved in issuing GBs or SLBs and, importantly, studies how securities aimed at financing the provision of green outcomes should be optimally designed. It considers a setup where green outcomes can be obtained through the implementation of tangible green projects (e.g., solar panels) and/or intangible effort-based strategies (e.g., reducing energy

consumption) and which allows for greenwashing, defined as the possibility to manipulate reported outcomes. These features are incorporated into a principal-agent problem where an investor with pro-environmental preferences provides debt financing to a profit-maximizing firm. The model delivers the following main results:

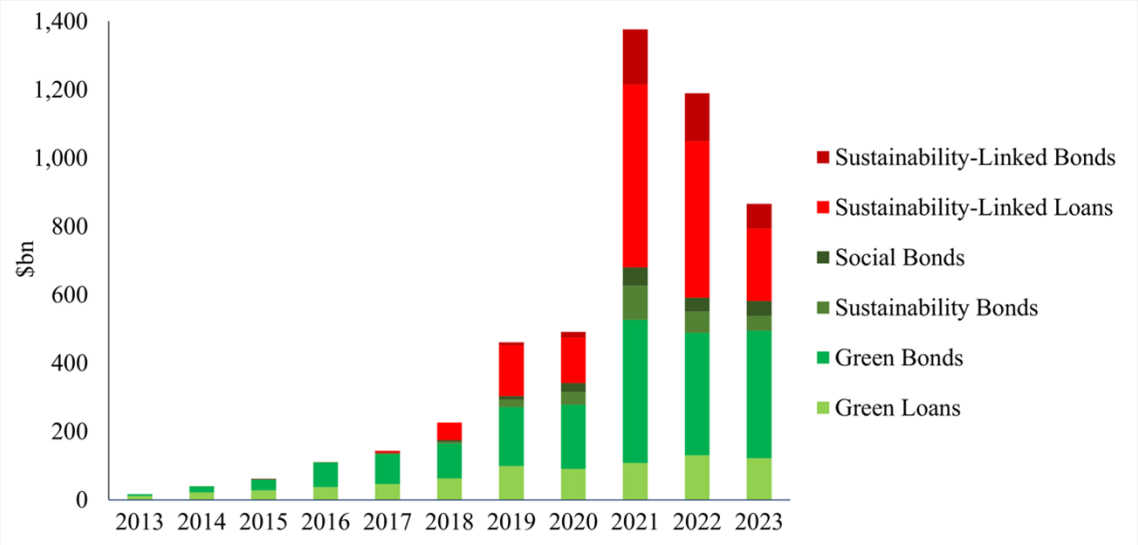
- **When greenwashing is not a concern**: If environmental outcomes are accurately measurable, outcome-based instruments like SLBs are optimal. They incentivize firms to pursue both tangible projects and effort-based, achieving efficient outcomes.
- **When greenwashing is highly likely:** If green outcomes can be easily manipulated, the optimal contract takes the form of a project-based instrument like a GB. Since reported outcomes cannot be trusted, the only reliable solution is funding tangible projects with environmental potential.
- **When greenwashing is possible but costly:** When manipulation is possible at a cost, the optimal contract is a hybrid combining both project- and outcome-based features. Specifically, it includes a payoff component that depends on the environmental outcomes achieved (which incentivizes effort-based strategies while controlling for manipulation), and a payoff component that depends on the implementation of green projects (which ensure that proceeds are allocated to the right projects).

Empirical Relevance and Market Implications

In practice, the theoretically optimal hybrid contract—combining pay-for-performance with dedicated use-of-proceeds—is rarely observed, but several issuances align with this design. For instance, the Austrian utility company Verbund issued a green and sustainability-linked bond in 2021 that integrates periodic reporting on performance targets with updates on projects funded by the proceeds (Verbund, 2012). Importantly, ICMA recently released guidelines for the issuance of hybrid instruments that combine use-of-proceeds features with sustainability targets, signaling a market shift toward hybrid structures that reflect the optimal theoretical design.

The limited adoption of hybrid contracts can be attributed to the complexity of structuring and monitoring both use-of-proceeds and performance-based components, which may make simpler instruments like GBs and SLBs the dominant options. The paper formally characterizes the inefficiencies associated with these two contracts, pins down the sources of such inefficiencies, and rationalizes issuance patterns across industries. For instance, through the lens of the model, financial institutions primarily issue GBs because the green outcomes they can deliver, e.g., Scope 3 emission reductions, are highly imprecise and prone to manipulation. Utilities, on the other hand, favor GBs due to their access to tangible projects and limited scope to improve their environmental performance through effort-based strategies.

Figure 1: Global Sustainable Market Debt



Policy Implications

The effectiveness of financial market solutions for combating climate change depends on well-designed contracts that align incentives, foster accountability, and curb manipulation. This paper highlights that when greenwashing is possible, the security designs prevalent on the market (GBs, SLBS) are likely to be inefficient, and a hybrid design that combines transparency about use of proceeds with accountability to outcomes is best. Improvements in measurement systems, green lending policies as well as the development of more rigorous reporting and verification standards play a crucial role in ensuring the integrity and growth of the market. Policymakers, investors, and firms must ultimately work together to ensure that sustainable finance lives up to its promise of driving meaningful environmental change.

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