EXECUTIVE SUMMARY

Sustainability-Linked Bonds: Modelling for Sustainability Performance

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Oxford Sustainable Finance Group
Smith School of Enterprise and the Environment

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Abstract

We propose and test a valuation model for sustainability-linked bonds (SLBs)—debt instruments tying the cost of borrowing with corporate sustainability performance—considering the potential stochastic volatility nature of sustainability performance metrics. The model simulates multiple performance pathways to derived probabilities of them to meet their SLB targets and integrate these into the valuation of SLBs. Moreover, it incorporates the influence of issuers' transition plans on these probabilities. Our empirical application validates the model's effectiveness in providing investors with a dynamic tool to evaluate the sustainability commitments of issuers over time. This research enhances the understanding of bond valuation in the context of sustainability outcomes and informs decision-makers with a tool to identify potential misalignments in SLB pricing, offering an additional method of assessing the associated sustainability risks and opportunities.

Full working paper available on:

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The views expressed in this paper are solely the responsibility of the authors and do not necessarily reflect the opinions of the acknowledged individuals.

Introduction

As we advance climate transition efforts, the unpredictable nature of this journey requires innovative financial models to price the risks and outcomes accounting for such uncertainty. In this paper, we examine the case of sustainability-linked bonds (SLBs), which have emerged as a promising tool to drive corporate accountability and align financial interests with global sustainability goals. SLBs are financial instruments where the issuer commits to achieving specific sustainability performance targets (SPTs), with bond terms potentially adjusting if these targets are not met.

Since its inception in 2019, the SLB market has experienced significant growth, with cumulative issuances exceeding USD 250 billion as of July 2024 (Bloomberg L.P., 2024). However, this market has faced significant challenges in recent months, including a decline in issuance due to investor scepticism about the credibility of targets and KPIs, compounded by adverse global market conditions. The accurate valuation of SLBs remains a critical issue, as existing models often fall short to capture the dynamic nature of sustainability performance indicators, leading to inaccuracies and suboptimal strategies for both issuers and investors.

We adopt a framework that treats SLBs as tools to hedge against sustainability-related risks when they arise, while directly incentivising short-term sustainability outcomes, such as decarbonisation. SLBs adjust yield spreads to reflect not only perceived sustainability risks but also investor willingness to support issuers' sustainability alignment. This adjustment functions similarly to option pricing, where the yield spread parallels volatility and strike price, aligning financial incentives with sustainability performance. This dual approach enhances SLBs' appeal to investors seeking both returns and impact.

Methods

Our methodology consists of two key steps. First, we set up the theoretical valuation model, distinguishing between the option premium—related to the uncertainty of meeting sustainability targets—and the non-pecuniary "greenium," or ESG premium, which reflects the lower yield investors accept due to their preference for sustainable investments. Within this step, we integrate an adapted Heston model into the valuation framework, particularly within the option-like component (Heston, 1993).

This adaptation uses stochastic differential equations to simulate the sustainability performance of issuers, capturing the inherent uncertainty and variable volatility in meeting SPTs. To account for transition plans, we adjust initial volatility and drift based on the issuer's transition plan score and peer ranking. A higher transition plan score reduces volatility, while a higher peer ranking lowers the drift adjustment, reflecting greater stability and reduced risk from effective sustainability management.

Second, we apply this framework empirically by estimating the probability of issuers meeting their targets. To achieve this, we employ a Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model to estimate the mean reversion parameters for the Heston model and use Monte Carlo simulations to project possible outcomes. The probabilities are derived by calculating the percentage of simulated pathways in which issuers meet or exceed the targets. We validate the model through Backtesting and convergence analysis, ensuring robust and reliable valuation outcomes. This empirical analysis focuses on two pioneering SLB transactions—Enel at the corporate level and the Republic of Chile at the sovereign level—chosen for their innovative nature and time series data that deviate from a geometric Brownian Motion (GBM) process that exhibit non-constant volatility.

Takeaways

Sustainability performance of issuers does not necessarily exhibit non-constant volatility due to inherent market and regulatory dynamics.

Our analysis reveals that sustainability metrics like Enel's renewable energy capacity (REC) and Chile's non-conventional renewable energy (NCRE) show significant time-varying volatility, influenced by factors like regulatory changes. The original data for these metrics was non-stationary, but after transformations, it became stationary, challenging the assumption of constant volatility. The GARCH model found that recent market shocks have a lasting impact on volatility, with Enel REC showing a strong persistence. Bootstrapping confirmed stable mean reversion, though Chile's GHG emissions exhibited higher variability. These findings suggest that models accounting for changing volatility (i.e., Heston) are more appropriate for these metrics.

Our model enhances accuracy and reliability, especially in scenarios involving disruptive changes in sustainability performance.

Backtesting confirmed its robustness against historical data. For example, integrating a transition plan increased the probability of Enel achieving its 80% Renewable Energy Capacity (REC) target from 43% to 53%, reducing the bond's imputed present value and lowering the imputed PV of the coupon step-up from 111.89 bps to 91.81 bps. The model also better captured Enel's renewable energy expansion and Chile's rapid deployment of Non-Conventional Renewable Energy (NCRE) and GHG reductions, reflecting their climate policies accurately. Backtesting confirmed its robustness against historical data, as seen in Figure 1 where the Transition Plan Model more accurately predicted Chile's GHG emissions by accounting for updated climate policies, nearly matching actual GHG levels by 2020.

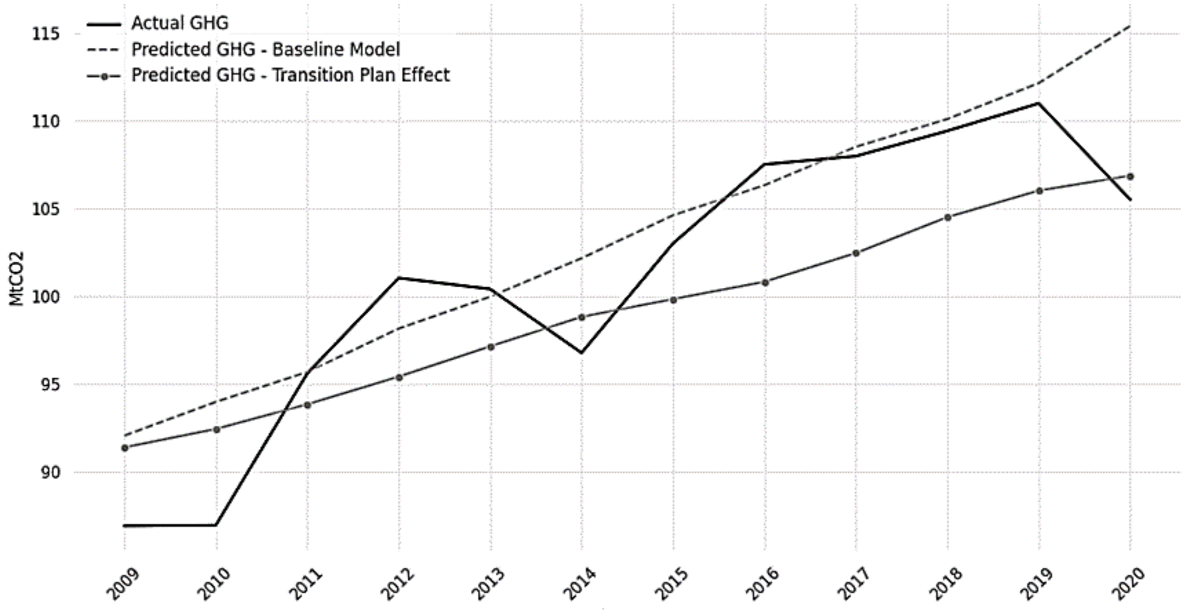

Figure 1. Longitudinal Analysis of Predicted vs. Actual Chile's GHG: Assessing Stochastic Model Efficacy

The stochastic model reveals relevant considerations for the valuation of SLBs, offering valuable insights for practitioners.

It serves as a benchmark for spread analysis, uncovering discrepancies in market-implied premiums and highlighting potential underestimations of risk, as demonstrated in the cases of Enel and Chile. The model's application suggests that it can enhance the accuracy of SLB valuations by better assessing issuers' capabilities to meet sustainability targets.

Recommendations

Investors and market practitioners should request more frequent data in sustainability performance metrics to refine probabilistic estimations.

Investors and market practitioners can significantly enhance the accuracy of SLB valuations by requesting more frequent reporting of sustainability performance metrics. Quarterly data would provide a richer dataset, allowing for better calibration of stochastic models like the GARCH model used in the analysis. Increased data frequency helps capture short-term fluctuations and trends, leading to more precise probabilistic estimations of an issuer's likelihood of meeting sustainability targets. This refined data granularity can reduce uncertainty and improve investor confidence in the financial instruments. Issuers should communicate how their corporate strategies inform the calibration of sustainability targets.

Issuers of SLBs should provide detailed explanations of how their corporate strategies underpin the calibration of sustainability targets.

By clearly outlining the strategic initiatives, transition plans, and operational changes driving their sustainability goals, issuers can offer greater transparency and credibility to investors. This information allows investors to better understand the context and feasibility of the targets, facilitating more accurate risk assessments and valuations. Such transparency ensures that the sustainability performance metrics are not only ambitious but also realistically aligned with the company's overall strategic direction, enhancing the integrity and attractiveness of the SLBs.

Future Work

Future research should delve into the intricate interplay between sustainability risks, sustainability outcomes, and conventional credit risks to better understand their combined impact on the valuation and performance of SLBs. Investigating how these elements interact can provide deeper insights into how sustainability risks might amplify or mitigate conventional credit risks, thereby affecting an issuer's overall risk profile.

Lastly, it is crucial to explore the trade-off between setting ambitious sustainability targets and the potential credit risk increase due to the significant financial resources required. Setting highly ambitious targets can drive significant positive sustainability outcomes but may also elevate the default risk if the targets are perceived as unattainable or overly burdensome. Balancing these aspects will be vital for developing SLB frameworks that optimize both financial and sustainability performance, ensuring that bonds are both attractive to investors and effective in driving meaningful progress towards sustainability goals.

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