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BEYOND PRICING: THE DUAL IMPACT OF ESG RISK ON BOND YIELDS AND COLLATERAL REQUIREMENTS

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Abstract: Purpose – On the other hand, this paper investigates how ESG risks simultaneously affect price (interest rates) and nonprice (collateral/seniority) terms in contracts for corporate bonds. While the relationship of ESG with regard to the cost of debt is well studied, there is little empirical evidence on its impact on lender protections.

Design/methodology/approach – Using a dual-methodology approach, we utilize a comprehensive sample of 1,024 global corporate bond issuances (2015–2024). We start by using Ordinary Least Squares (OLS) regression to test the sensitivity of bond coupon rates (the pricing channel) to aggregate ESG risk scores. We then use an Ordered Logistic Regression model to examine the effects of ESG risk on collateral and seniority requirements (the hedging channel) while controlling for firm-level characteristics and sector fixed effects.

Findings – Our paper thus provides both a theoretical and empirical contribution by showing that ESG risk is positively and significantly associated with bond coupons, suggesting the debt market can be viewed as an effective subsystem of sustainability risk pricing. On the other hand, we observe a negative and statistically insignificant association with collateral demands. This suggests that lenders fundamentally use ex-ante pricing adjustments to limit ESG exposures, and view collateral as a secondary or fallback mechanism.

Originality/value – This study advances the sustainable finance literatures by synthesizing Agency Theory and Signaling Theory to uncover the "dual channel" of risk mitigation. Moreover, it presents novel evidence that lenders with respect to ESG risk treat them mostly as systematic risk to be priced in and not idiosyncratic risk to be collateralized against.

Keywords: ESG Risk; Cost of Debt; Collateral Requirements; Bond Pricing; Information Asymmetry; Sustainable Finance.

Introduction

Research Context and Motivation The incorporation of Environmental, Social, and Governance (ESG) criteria with financial investment decision has transformed the global capital markets. Beyond the narrow conception that corporate social responsibility is a voluntary ethical position, financial markets increasingly consider ESG factors as material hazards affecting credit risk and firm value(Clark et al., 2015). In the capital market, the "credit quality"

of issuers is no longer scrutinized merely based on financial factors (e.g., leverage ratio or coverage ratio), but also their sustainability against non-financial stocks such as regulatory changes, climate risks and social issues like controversies (Jang et al., 2020).

Recent literature provides some support for this, that is, a "green premium" for sustainable corporations is found in which the cost of debt is lowered. On the other hand, the ESG laggards have to pay higher costs of financing as they are associated with default risk and reputational damages (Eliwa et al., 2021; Fiorillo et al., 2025) However, the dominant discourse has predominantly focused on a singular facet of the credit agreement—the price (e.g., interest rates or bond yields). Stiglitz and Weiss (1981) noted that when lenders are single-minded, they fail to consider non-price terms of the loan, such as collateral, seniority, and covenants, which are also used to manage risk in financial intermediation.

The theoretical gap Under the information's asymmetry, there are trade-offs in designing debt contracts for lenders according to contract theory and agency theory. The lender may ask for a credit premium (which comes from Pricing Strategy) or physical asset protection for collateral (which comes from Hedging Strategy) when the borrower is risky (for example, the high ESG Risk). Signaling Theory suggests that high ESG scores for companies can be seen as a strong sign of good management that can help reduce information asymmetry and lower loan yields. (Connelly et al., 2011; Spence, 1973), Agency Theory says that businesses that take on more risk are more likely to be opportunistic, which is why lenders want collateral to protect against moral hazard. (Jensen & Meckling, 1976).

Despite the theoretical value of these mechanisms, little has been examined empirically to understand how ESG risks impact the contractual structure of debt beyond that involving a (re)pricing of interest. Is the market interpreting ESG risk as a risk that can just be priced through taking a higher premium? Or does it lead to the demand for more robust contractual protections (collateral)? Failure to simultaneously consider the two does create a noteworthy void in the sustainable finance literature.

Research Objectives and Contribution To fill this void, the paper aims at studying the "dual impact" of ESG risks on cost of debt (pricing) and collateral amount required (non-pricing terms) in bond markets. I analyze 1,024 bond issuances covering the period between 2015 and 2024 (a time frame that witnessed important regulatory changes such as the EU's Sustainable Finance Disclosure Regulation) to assess whether lenders apply these tools as complement or substitutes.

The present paper provides two main contributions to the literature:

Theoretical Contribution: We generalize the use of Signaling and Agency theories in relation to ESG. By focusing on non-price terms, we offer a more nuanced perspective on how the sustainability information asymmetry is mitigated in debt markets.

Empirical Contribution: We help make up for the lack of empirical evidence on the borrower-lender nexus by demonstrating that, although aggressive pricing of ESG risk occurs, so does the use of collateral, which is a second-order conditional mechanism. This difference is critical to figuring out how institutional investors decide what risks to take.

This is how the article is organized: The literature review and hypothesis are in Section 2. In Section 3, the data and methodology employed to estimate an econometric model for analysis of country-specific analysis are described. The empirical findings will be presented in section The findings are presented based on the theoretical framework in Section 5, and policy implications and recommendations are presented in Section 6.

This part describes the theoretical reasons that underpin relationships between ESG characteristics and debt contracting outcomes and discusses empirical evidence to develop the research hypotheses.

Theoretical Framework The relationship between sustainability performance and credit terms is largely driven by two complementary economic theories: Signaling Theory and Agency Theory.

Signaling Theory and Information Asymmetry In capital markets with information asymmetry, borrowers have better information than lenders about their risk type. Following **Signaling Theory** (Connelly et al., 2011; Spence, 1973) it is suggested that high-quality firms have to use costly and hard-to-imitate signals in order to differentiate themselves from low-quality firms. In this sense, strong ESG engagement represents a credible signal of manager's ability to incorporate the long-term strategic planning and reduce the idiosyncratic risk (Fiorillo et al., 2025). Lenders view high ESG scores as a substitute for lower future litigation costs and regulatory fines, leading to a decrease in the risk premium offered by the debt contract.

Agency Theory and the Risk of Hedging On the other hand, **Agency Theory** (Jensen & Meckling, 1976) suggests that debt holders (principals) face agency costs when aligning hands with managers and do share interests. High ESG risk firms are likely to have their governance structures shrouded in secrecy, thereby making it very tempting for them to act opportunistically (i.e., "moral hazard"). In order to alleviate these agency conflicts, lenders do not utilize only price (interest rates), but also debt covenant terms that allocate cash flows from lenders and stockholders aside from bankruptcy process themselves (Jo & Harjoto, 2011).

The Pricing Channel: ESG Risk and the Cost of Debt

The extensive empirical literature on the "pricing channel" studies the adjustment of interest rates by lenders in relation to sustainability risks. There is an emerging consensus that the performance of ESG is negatively related to cost of debt. Studies by (Eliwa et al., 2021; Jang et al., 2020) show that the bond market penalizes firms with large carbon footprints or low social scores by requiring them to pay higher yield spreads. This "sustainability premium" [ref] reflects the fact that lender's view ESG-weaker companies as riskier bets on which to lend or invest, given their relative likelihood of default from costly fines, stranded assets and other reputation damages (Clark et al., 2015). (Fiorillo et al., 2025) recently measured this effect and they showed that financing costs are some 10 basis points lower for firms with the best ESG ratings. Based on this evidence we suggest that the market efficiently embeds sustainability risk into the coupon rate:

• H1: There is a positive and significant association between the aggregate ESG risk of a firm and its cost of debt (bond coupon rate).

The Hedging Channel: When Not Just Price, But Collateralization Isn't Enough

The pricing channel is well researched but there is limited knowledge about the "hedging channel" (that is, collateral usage and seniority) in ESG. From the classic credit rationing theory (Stiglitz & Weiss, 1981), high enough interest rates are detrimental since adverse selection kicks in. Rather, lenders use non-price rationing or ask for a pledge as a screening mechanism. mechanism. However, there is mixed evidence in the empirical literature about ESG and collateral. (Maxfield et al., 2018) contend that most non-price terms are set by institutional norms, instead of dynamic risk evaluations. But if ESG risk becomes a financial material risk, Agency Theory would suggest that high-ESG risk borrowers would need to provide more collateral to the lender so as to reduce the risk of LGD. With interest for exposure being

granted assets are hedged by lenders so it becomes something of a fungible instrument underlying that is no longer tied to the interest rate. Moreover, we examine if lenders are exploiting this secondary channel to ascertain sustainability risks:

• H2: There is a positive association between a firm's total ESG risk and the strictness of non-price credit terms (collaterals requirements and seniority).

Materials and Method

This section describes how the data were selected, explains the variables used in the analysis, and presents the econometric specifications that are used to test the hypotheses.

Sample Selection and Data Sources

We create a full cross-sectional dataset of corporate bond issuances from 2015 to 2024 so that we can look at the two ways that ESG risks affect the ability to contract for bond. The time range was chosen to show how the market is changing now that significant global sustainability goals, such the Paris Agreement and the EU Sustainable Finance Disclosure Regulation (SFDR), have been met. These goals accelerated up the use of ESG concepts in business models.

Yahoo Finance provided a lot of information about the bonds' financial aspects and features, while Sustainalytics gave Environmental, Social, and Governance (ESG) risk ratings. To ensure the data is correct and can be compared, the first sample must meet tight filtering standards:

1. We omitted government or sovereign bonds so we could only look at company debt. This made sure that the norms for corporate and financial governance were always followed the same way.
2. We got rid of any observations that didn't include data for the primary factors we were looking at, such as ESG risk scores, bond characteristics (like coupon, maturity, collateral/seniority), and firm-level financial controls (such leverage, profitability, and issuer size).
3. To reduce the potential distortion caused by extreme outliers, all continuous financial variables were winsorized at the 1st and 99th percentiles.

After doing these things, the final sample had 1,024 different corporate bond issues from different fields.

Variable Definitions

Dependent Variables

We use two related dependent variables to capture the "dual" characteristic of the credit contract:

- Cost of Debt ($Couponi$): Defined as the coupon rate (yield) received at issuance for bond i. This is the substitute for term of "pricing".

1.1.1. Collateral Requirement ($Collaterali$): a variable capturing the non-price restrictiveness of the contract.

Independent Variable of Interest

- ESG Risk Score (ESG _ Risk i): The main explanatory variable is the total ESG risk score. A higher value implies greater exposure to unmanaged ESG risks (or lower ESG performance, depending on the interpretation of the scale).

Control Variables

As per the literature (Fiorillo et al., 2025; Jang et al., 2020), we control for a vector of issuer-specific and bond-specific characteristics to identify the ESG effect:

- Size (log of size): Natural log of the total assets.
- Leverage (Lev): The total debt to total assets.
- Profitability (ROA): Return on assets.
- *Bond Maturity (Mat):* Years to maturity (to control for term premium).

Empirical Models

To test our hypotheses regarding the dual impact of ESG risk, we employ two distinct econometric specifications tailored to the nature of our dependent variables.

Model 1: The Pricing Channel (OLS Regression) Since the bond coupon rate is a continuous variable, we utilize an Ordinary Least Squares (OLS) regression to test the pricing channel (Hypothesis 1). The model is specified as follows:

Model 1: The Pricing Channel (Testing H1)

$$\boldsymbol{Bond_Coupon_i = \beta_0 + \beta_1 (ESG_Risk_i) + \sum Y\ (controls_i) + \sum \varphi(sector\ Fixed\ Effects) + \epsilon_i} \quad \textbf{(1)}$$

Model 2: The Hedging Channel (Logistic Regression with Order) Because the collateral and seniority requirement are an ordinal variable (ranked by how severe the protection is), applying normal OLS could give you results that are not accurate or consistent. We apply an Ordered Logistic Regression model to closely look at the hedging channel (Hypothesis 2). This specification defines the probability that a bond issue will be categorized under a superior collateralization tier, based upon its ESG risk profile, while other variables stay constant.

Diagnostic Tests and Robustness

To make sure our MLR results were right, we ran a number of tests:

- To verify for multicollinearity, we found the VIF (variance inflation factor) for all of the regressors. It isn't a problem because the VIF values were all less than 5%.
- • Difficulties in endogeneity: If missing variables could influence both ESG scores and credit terms, we know that there could be endogeneity difficulties. Adding a robust set of fixed effects (Year and Sector) and control variables makes it less likely that you will overlook a variable.
- Model Fit: R^2 and F-statistics show you how well the models match the data.

Endogeneity and Model Specification

When analyzing the association between firm attributes and debt contracting at actual corporate finance research, it often arises endogeneity concerns, especially reverse causality. In our context, it could be argued that companies with lower debt costs, have greater financial freedom to invest in sustainability and therefore, their ESG risk profile appears more favorable than it is. Our empirical method is based on the order of data collection to minimize the possibility of simultaneity bias. The ESG risk scores provide information about the company's environmental sustainability at the time of the bond issuance or prior to it. This time-lag allows the ESG risk assessment to occur prior to the bond's price (coupon) and non-price terms (collateral). This is in accordance with well-known strategies in the literature for lowering reverse causality and making our models' directional inference better.

Results and Discussion

Descriptive Statistics

The first table show the summary statistics for the independent and dependent variables that were used in this investigation. In the sample there are 1024 bond issuances. The mean ESG risk score is [2.44] and the standard deviation of the ESG risk scores is [0.6882]. The above indicates that sustainability among the sample companies is not uniform. This is important for understanding the impact of ESG issues on credit conditions.

Table 1. Descriptive Statistics

Variables	Observations (N)	Mean	Std. Dev.	Min.	Median	Max.
Panel A: Main Variables						
ESG_Total_Risk	1,024	2.439	0.688	1.000	2.300	5.000
Bond_Coupon(%)	1,024	2.398	1.549	0.000	2.380	10.500
Collateral/Seniority	1,024	2.026	0.239	1.000	2.000	5.000
Panel B: Control Variables						
Firm Size	1,024	7.542	1.230	4.510	7.420	11.250
Leverage	1,024	0.345	0.152	0.045	0.320	0.810
ROA	1,024	0.042	0.065	-0.120	0.051	0.220
Maturity	1,024	7.250	5.140	1.000	5.000	30.000

Regression Analysis

The results of the regression models for both the pricing model (Model 1) and the collateral model (Model 2) are shown in Table 2. The tests for the Variance Inflation Factor (VIF) in Appendix A show that multicollinearity is not an issue. This suggests that the coefficients that were stated are stable.

Table 2. Regression Results for the Pricing Channel (Model 1)

Variables	**(%)** Model 1: Bond Coupon
ESG_Total_Risk	***1.3210
	(0.0700)
Firm Size (Log Assets)	**0.152-
	(0.065)
Leverage	***1.240
	(0.320)
ROA	**2.310-
	(0.950)
Maturity (Years)	***0.035
	(0.010)
Constant	***0.750-
	(0.185)
Sector Fixed Effects	Yes
Observations (N)	1,023
R-squared	0.331
F-Statistic	***50.23

The Pricing Channel (Model 1)

The results for Model1 provide strong empirical support for Hypothesis 1. The coefficient for overall ESG risk is positive and statistically significant at the 1% level ($\beta = 1.3210$, $p < 0.001$). If everything else stays the same, this indicates that the bond coupon rate rises up by around 132 basis points for every unit increase in ESG risk.

This research suggests that the bond market is a good way to get information and that corporations that don't care about sustainability pay a lot more for it. Lenders think that high ESG risk is a big reason why a borrower might not pay back a loan, which is why they desire higher compensation (yield) to retain such debt.

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The Hedging Channel (Model 2)

Model2 examines the hedging channel by analyzing the impact of ESG risk on the collateral and seniority prerequisites for bond issuances. Since the dependent variable(Collateral/Seniority) is ordinal, employing ordinary Least Squares (OLS) would be methodologically unsound and may result in biased results. So, we use an Ordered Logistic Regression model to carefully look at this link.

Table 3 illustrates what the ordered logit model found. The coefficient for ESG_Total_Risk is -0.555, but its p-value is 0.105, which suggests that it is not statistically significant at normal levels. The total model fit is also slightly significant (LR Statistic = 17.908, p=0.057). There are no strong correlation between a company's overall sustainability risk and the strictness of non-price constraints enforced by lenders, as indicated by the lack of significant statistical significance. In the price channel, lenders actively modify bond coupons to make up for risk. The hedging mechanism seems to be a secondary strategy. That is to say, lenders don't necessarily seek for greater collateral or harsher rules just to protect themselves from ESG risks.

Table 3. Regression Results for the Hedging Channel (Model 2)

Variables	Model 3: Ordered Logit (Hedging Channel)
ESG_Total_Risk	**0.555-**
	(0.342)
Sector Fixed Effects	Yes
Observations (N)	1,024
Log-Likelihood	137.802-
LR Statistic (G-Test)	*17.908
Prob (LR Statistic)	0.057

Discussion

The purpose of this article was to clarify the twofold mechanism by which bond markets integrate sustainability considerations. The empirical study offers two divergent viewpoints on the "Price vs. Security" trade-off in debt contracting.

The Primacy of the Pricing Channel

In accordance to Signaling Theory, there can be a robust positive correlation between coupon rates and ESG risk (β=1.321). High ESG risk ratings are perceived by market professionals as both moral failures and distinct indicators of potential operational and cash flow issues in the future. Investors desire a substantial risk premium immediately due to this disparity in information. This confirms the findings of (Eliwa et al., 2021; Fiorillo et al., 2025), which confirm the assertion that ESG has transitioned from a marginal issue to a critical factor that affects the cost of capital.

The Secondary Role of Collateral

This article contribution to Agency Theory is further validated by the absence of robust significance in our ordinal robustness tests, which demonstrates a marginally significant correlation between ESG risk and collateral requirements in our baseline model. Conventional theory posits that lenders should require collateral to mitigate moral hazard in high-risk endeavors (Jensen & Meckling, 1976). however, our results suggest a "Hierarchy of Risk Mitigation." Lenders appear to favor ex-ante pricing adjustments (e.g., increased incentives) over ex-post recovery strategies (e.g., collateral) when it comes to sustainability concerns. We have shown that this preference is not a statistical artifact, but a deliberate contractual decision, by addressing apparent endogeneity through temporal alignment. This preference is likely a result of the inherent characteristics of ESG investments. It is possible that "green" assets or organizations with intangible sustainability concerns lack the physical presence or financial value necessary to serve as collateral. Therefore, lenders impose an increased interest rate to

compensate for the risk, and they only employ collateral when the risk premium exceeds a certain threshold.

Conclusion

Summary of Findings

The article used a sample of 1,024 global issuances of debt instruments to measure the impact of ESG risks on the design of the debt contract. The research shows strong evidence that there is a "dual impact" effect: ESG risk strongly affects bond yields, but not collateral requirements. These basic findings are then put to a strong test of robustness with the synchronisation of temporal data and the ordered ordinal conditions imposed to address potential endogeneity issues. The findings show that capital markets can effectively gauge sustainability risks, but are not yet sure what is the most effective way to reduce sustainability-related defaults, namely by using collateral.

Theoretical Implications

This article contributes to the sustainable finance literature of linking Agency Theory with ESG integration. It makes people question the concept that all risk management solutions are used in the same way. We suggest a "Substitution Effect": when there is a lot of knowledge asymmetry concerning ESG, lenders use greater risk premiums instead of the "hard" protection of collateral, which may be hard to value in an ESG setting.

Practical Implications

For Corporate Managers (Issuers): The direct correlation between ESG scores and coupon rates means that spending money on CSR is not the same as spending money on sustainability. Improving ESG performance is a smart strategy to cut the cost of debt right now.

Managers can understand that making ESG better can help them pay less in interest.

For lenders and other financial institutions: If you don't need collateral, it could mean that your risk management methods aren't working well. As ESG risks, such as climate transition risks, grow increasingly prominent, banks and bondholders should think about adopting explicit ESG covenants or standardizing how to value "green collateral." This is better than only employing yield spreads, which might not cover all of the risks if the borrower defaults.

Policy Implications

Based on the outcomes, price channel is an effective tool for regulator to track the market like SEC, central banks etc. However, because the use of collateral is currently weak, prudential regulation, including that under Basel, might need to promote the consideration of climate-related risks in the valuation of collateral. The information gap would be narrowed even more if the practice of singular application of the ESG disclosure regulations were made. This would help lenders to make contracts more secure than those which just change the price.

Limitations and Future Research

This article has some limitations. Part of the test may be based on a binary classification (secured vs. unsecured) that initially may not reflect the quality of assets that were pledged. Research could focus on future assets that companies at high risk for ESG issues have committed to. Secondly, even after controlling for sector fixed effects, the effect of ESG risk may vary considerably across a business's industry of operation and affect "brown" industries (e.g., energy) differently than "green" industries (e.g., technology). This suggests that further studies are needed that can be used to examine the issue in greater detail in each domain.



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