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NBER Climate Finance Dissertation Workshop
National Bureau of Economic Research
Cambridge, MA

Dear Professors Flammer and Giglio,

I am writing to express my interest in participating in the upcoming NBER Dissertation Workshop on Climate Finance. I am currently completing my PhD at Northumbria University, where my research sits at the intersection of climate finance, sustainability-linked disclosure, and asset pricing.

I am submitting for your consideration my paper titled *Incredulous Creditors: ESG Momentum, Credibility Barriers, and State-Contingent Pricing in Corporate Bonds*. This study explores how ESG momentum is (or is not) internalised in fixed-income pricing, revealing that investor trust, rather than green bond labels and associated third-party verification, is the dominant mediation channel through which sustainability signals affect bond returns. I provide robust causal identification of the SFDR's impact on sustainable asset pricing, showing that regulatory impetus can reshape financial market behavior, but often substitutes rather than complements issuer-level ESG progress.

The paper contributes to the literature on climate finance by empirically identifying nonlinear, asymmetric, and credibility-contingent ESG pricing in corporate bond markets. These dynamics are essential for understanding how capital markets respond to regulatory shifts and sustainability narratives (key concerns raised in the workshop call). Moreover, my use of quantile regressions, DiD, and Fama-MacBeth frameworks reveals differentiated impacts across the return distribution and credit structure, with practical implications for how climate-related financial risks are priced and how transition finance is mobilised.

More broadly, my dissertation has engaged substantively with Dr. Flammer's pioneering work on green bonds, sustainability governance and corporate strategy. N.B. particularly around the stylised behaviour of green bond investors, which has informed several of my PhD contributions (esp. the "greenvexity puzzle" (forthcoming)). While this paper does not directly cite her research, several of my other dissertation chapters, including those forthcoming as book contributions and peer-reviewed articles, integrate Flammer's empirical findings and theoretical contributions.

This workshop represents a valuable opportunity for me to share my research (more generally, although I include my most recent endeavour per the NBER call indication), benefit from feedback, and build dialogue with fellow scholars and senior academics.

I would be honoured to contribute to this exchange and hope to further develop my work in alignment with ongoing advances in climate finance.

Thank you very much for your consideration.
Warm regards,
Karim Henide

Incredulous creditors: ESG momentum, credibility barriers, and state-contingent pricing in corporate bonds

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Northumbria University

Abstract

This paper investigates the pricing of ESG momentum in corporate bond markets, with a focus on heterogeneity across credit structure, issuer credibility, and market regimes. Using a decade-long panel of 3,380 unique EUR-denominated bonds, we show that ESG momentum does not command a return premium in the aggregate, but provides downside protection among lower-return quantiles, especially for higher-risk and subordinated bonds. ESG momentum is increasingly penalised in higher-return quantiles, particularly among BBB-rated and subordinated debt, but this reverses once issuer credit risk is controlled for, revealing that it is strongly rewarded in higher-return higher-risk subordinated bonds, subject to low issuer-level ESG controversy. Critically, neither green labels nor associated third-party verifications substitute for this credibility channel. Additionally, a difference-in-differences study finds that green-labelled bonds earned a significant return premium post-SFDR introduction (1.99 basis points per month, $p = 0.0053$), reversing prior underperformance, while the ESG momentum signal relevance simultaneously decays. Robustness checks, including Fama-MacBeth regressions and regime-specific analyses, confirm these findings and support causality. These results uncover a credibility barrier model and highlight the dominance of regulatory impetus in sustainable asset pricing.

Keywords: ESG momentum, corporate bonds, SFDR, asset pricing, credibility
JEL Classification: G12, G14, G18, G32, C31

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Education

- **Northumbria Business School** — Newcastle, UK
  PhD Finance — *October 2023 - Present*
- **London School of Economics and Political Science** — London, UK
  MSc Accounting and Finance — *September 2020 - July 2021*
  Courses: *Fixed Income, Portfolio Management, Asset Markets, Corporate Finance, Valuation and Security Analysis*
- **European Business School** — London, UK
  BA (Hons) Finance, summa cum laude — *September 2016 - July 2019*

Skills Summary

- **Financial Software**: Bloomberg, S&P Global Platts CIQ, Reuters Eikon, Haver Analytics, Macrobond
- **Programming**: Python, R, VBA, SQL, LaTeX
- **Languages**: English (native), Arabic (fluent), French (conversational)

Experience

- **Record** — London/Hybrid
  Portfolio Manager (Associate Director) — *December 2021 - December 2023*
  - **Record EM Sustainable Finance Fund (REMSFAU:ID)**: Co-managed fixed income mandate (c. $1bn AUM)
  - **Record Caelestia**: Developed and managed two liquid alternative strategies (macro, high yield sector trading)
- **Markit (S&P)** — London/Hybrid
  [iBoxx] Fixed Income Indices (Associate) — *September 2019 - December 2021*
  - **Product development**: Research, ideation and development of tradeable strategies (core ESG and inflation projects)
  - **Research**: Authored commentaries, thematic research, and whitepapers on fixed income and derivative strategies
- **J.P. Morgan** — London
  CEEMEA Equity Research & Strategy (Intern) — *February 2019 - August 2019*
  - **Results day cycle**: Updated models, composed internal alerts and summarised management calls
  - **Research**: Built and delivered financial models, notes and research. Pitched opinions and analyses internally
- **Markit** — London
  [iBoxx] Fixed Income Indices (Intern) — *May 2018, August 2018 - October 2018*
- **Peel Hunt** — London
  Equity Research (Intern) — *June 2018 - July 2018*
- **ValuAnalysis** — London/Hybrid
  Quantitative Risk & Equity Research (Intern) — *May 2017 - September 2017*

Responsibilities

- Bank of England Citizens' Panel, ordinary member
- FTSE Indices External Advisory Committee member
- iBoxx Index Oversight Committee member
- ICMA Technical Working Group member

Other

- **Visiting lecturer** Conducted lectures on fixed income, derivatives, macroeconomics and sustainable finance

Notable Publications

Cited by the International Monetary Fund, ESMA, and the [Central] Bank of Italy, inter alios

- Habib, N., Kelshiker, A., and Henide, K., 2025. How Aligned Is Your [...] Portfolio? *J. of Impact and ESG Investing*
- Henide, K., 2024. Flow rider: tradeable ecosystems' rel. entropy of flows as a determ. of rel. value. *J. of Investing*
- Henide, K. and Ahmar, Z., 2023. Isolating the female agency-driven dev. factor in $ EM sovs. *Financial Innovation*
- Henide, K., 2023. Sherman ratio optimisation: constructing alt. ultra-short sov. bond portfolios. *J. of Inv. Strategies*
- Henide, K., 2023. Letter: Why policy spillovers are Fed's moral responsibility. *Financial Times.*
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- Henide, K., 2022. XCCY credit spreads: idiosync. basis as a source of ARP. *J. of Derivatives and Quantitative Studies.*
- Henide, K., 2022. Letter: Onus is on bond issuers to prevent greenwashing. *Financial Times.*
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- Henide, K. and Meyer, S., 2020. Fixed Income Investing with a Targeted Positive Impact. *IHS Markit (featured in P&I)*
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INTRODUCTION

The increasing integration of Environmental, Social, and Governance (ESG) considerations in investment decision-making has prompted attention from practitioners, policymakers and academics, given the ambiguity surrounding how this information manifests in asset pricing, and the broader implications for economic outcomes. One area of particular research interest has been the internalisation of ESG delta, or "ESG momentum" in asset pricing over time, although the internalisation of ESG momentum information remains underexplored in fixed income markets in the literature, and otherwise contested in equity markets.

This study investigates the pricing of ESG momentum in corporate bond markets, with a particular focus on its state-contingent effects across the return distribution and its interaction with bond characteristics (such as subordination, credit rating) and the critical role of issuer credibility. Extending the work of Polbennikov et al. (2016) and Oikonomou et al. (2014), we seek to offer a greater degree of nuance around the pricing of ESG momentum information and novel insights around mediation channels, particularly with respect to the influence of regulation. Studying a comprehensive decade-long data panel containing 3,380 unique EUR-denominated corporate bonds and exploiting Sustainable Finance Disclosure Regulation (SFDR) by the European Union coming into effect in March 2021 as a natural experiment, we aim to causally identify the impact of regulatory impetus on issuer-level ESG momentum pricing, and in particular the role of green bond-labelling in driving market responses. Our research addresses a gap in the literature by examining not only the average pricing effects of ESG factors but also their non-linear and asymmetric impacts, as well as the credibility barriers that condition their market-acceptance.

To achieve these objectives, we employ a comprehensive and methodologically rigorous econometric framework, combining quantile regression, difference-in-differences (DiD), triple difference (DDD), and inverse propensity weighted (IPW) DiD approaches. Quantile regression allows us to capture the heterogeneous effects of ESG momentum across the return distribution, revealing whether ESG factors provide downside protection or impose upside penalties. The DiD and DDD methodologies exploit the SFDR's implementation in March 2021 to estimate causal effects, isolating the role of regulatory labels versus underlying ESG performance. The IPW approach further ensures robustness by addressing compositional differences across bond types. Incorporating bond-specific factors such as duration, subordination, credit rating and green bond-labelling, as well as issuer-level credibility proxied by ESG controversy levels and institutional investor exclusion indicators, we uncover the conditions under which ESG momen-

tum is priced and the mechanisms, such as credibility and regulatory salience, that drive these effects. Fama-MacBeth regressions and regime-specific analyses provide additional robustness, accounting for time-varying market conditions and sentiment-driven heterogeneity.

This study's contributions to the literature are multi-pronged, providing a nuanced understanding of sustainability pricing dynamics in the rich fixed income ecosystem, and offering a foundation for further research. First, we introduce a credibility barrier model, demonstrating that perceived issuer trustworthiness, rather than signals such as green bond self-labelling and associated external verification, is a primary determinant of ESG pricing in subordinated debt. Second, we highlight the state-contingent nature of ESG effects, with significant downside protection for high-grade bonds but penalties in high-return scenarios, particularly for riskier bonds. Third, we establish the dominance of regulatory labels post-SFDR, showing that green bond designations substitute for fundamental ESG signals, although fail to supplement a credibility deficit. These findings have meaningful implications for sustainability signalling, asset pricing, portfolio management, regulatory design, and the ongoing debate over the financial materiality of sustainability factors in fixed income markets.

LITERATURE REVIEW

The integration of ESG information in the investment process poses questions around the implications for asset pricing of augmenting the natural flow of capital to internalise financially material sustainability risks. Given the ambiguity surrounding how this information manifests in asset pricing, and the broader implications for economic incentives and outcomes, the progressive popularisation of sustainable investing and the integration of ESG data into the investment process has prompted much attention from practitioners, policymakers and academics. One area of particular research interest has been the internalisation of ESG delta, or "ESG momentum" in asset pricing over time, although the internalisation of ESG momentum information remains relatively underexplored in the fixed income literature, and otherwise contested in literature concerning equity markets.

Within this context, ESG momentum, the trajectory of a firm's ESG performance over time, has emerged as a potential forward-looking signal of issuer-level capacity-building, operational sustainability improvement and sustainability-related risk mitigation (inter alia, Gregory et al., 2014). Unlike static ESG scores or green labels, momentum may capture dynamic change and internal improvement, providing incremental information beyond headline ESG ratings. Indeed, as Giese et al. (2019) recognise, the relevance of the transmission of a "change in a company's

ESG profile to a change in financial indicators such as valuation or profitability is not only important for testing causality: it is also important because the change in financial variables such as valuation can be a source of alpha". However, the internalisation of ESG momentum information remains underexplored in fixed income markets, and contested in equity markets.

Conceptually, Khan et al. (2015) find that variability in the materiality of sustainability issues, per SASB guidance, is price-relevant and that "firms with strong ratings on material issues and concurrently poor ratings on immaterial issues have the best future performance". With respect to changes specifically computed from ESG data, some studies suggest that integrating ESG momentum can be predictive of improved performance or reduced risk. Nagy et al. (2015) find that ESG momentum strategies can outperform in global equity portfolios in risk-adjusted terms "while also improving the ESG profile of the portfolios". Giese et al. (2019) offer support for ESG momentum as a transmission channel across the MSCI World Index universe, and argue that the ESG momentum factor can be used in addition to the ESG factor, and neutralised by common factors, in portfolio construction. Giese et at. (2019) find that the ESG momentum factor has an incrementally higher information ratio to the ESG factor albeit suffers from a meaningful deficit in factor stability, albeit ESG momentum demonstrates a greater degree of factor stability (though a meaningfully lower information ratio) versus conventional momentum. Sverner et al. (2023), confirming a similar inquiry by Shanaev and Ghimire (2022), also demonstrate, specifically in US equities, that an ESG momentum factor two-stage cross-regressed on the Fama and French 5-factor model (1993) delivers a meaningful excess return of between 0.23-0.35%, with a skew towards the magnitude of positive returns from ESG upgrades rather than the magnitude of negative returns from ESG downgrades, although further robustness testing exposes a loss of significance. Whelan et al. (2021) also survey empirical results from multiple meta-studies that supports the value of "ESG improvers", notwithstanding the inherent ambiguities and failure in consistent strategy demarcation among the underlying studies. The evidence for the existence of a price-relevant ESG momentum factor are supported by the study of Chen and Yang (2020), which identify a pattern of investor exaggeration of corporate ESG information (with an overreaction emphasis of environmental factors). However, contrary to the earlier findings, Cauthorn et al. (2023) dispute and offer an alternative approach to Shanaev and Ghimire (2022) and conclude that "stocks do not seem to significantly outperform or underperform in the month following an ESG rating change". Additionally, Cauthorn et al. (2023) note the importance of robustness across ESG data providers, consistent with the insights of Berg et al. (2022), whose inquiry exposes material divergence in sustainability evaluations across data providers, which inherently undermines signal discovery and integrity.

While relatively underexplored, and while inconsistent in the findings, there is meaningful literature on the relevance of issuer-level sustainability profile to the pricing of their bond issuances. The early study of Menz (2010) sought to explore the impact of corporate social responsibility (CSR) on bond pricing, and found, marginally, that the bonds of socially responsible firms were priced wider relative to the bonds of non-socially responsible firms, ceteris paribus. This is not to conclude that, counter-intuitively, investors in the bonds of socially-responsible issuers demand some additional risk compensation, but rather that there was no evidence over the study's 38-month window that CSR information was internalised by (non-financial) investment grade European Monetary Union (EMU) corporate bonds of ≥EUR 250 million nominal value. Contrary to this, the later study of Stellner et al. (2015) also in (non-financial) corporate EMU bonds (though covering bonds rated AAA-CCC) found, albeit supported by weak evidence, that issuer corporate social performance (CSP) reduces credit risk, and that country-level ESG performance serves to moderate the CSP-credit risk relationship; Stellner et al. (2015) find that corporate bonds realise a benefit of 9.64 basis point containment in z-spreads where the corporate issuer's benign CSP profile mirrors the ESG performance of the country where the issuer is located. Subsequent studies have reinforced and nuanced this relationship. Oikonomou et al. (2014) show that firms with superior ESG performance enjoy lower credit spreads, attributing this to reduced firm-specific risk and default probability, particularly for firms in less transparent markets. Their findings suggest ESG factors function as a form of informational arbitrage for bondholders, mitigating adverse selection and pricing opacity. Goss and Roberts (2011) focus on bank loans, studying 3,996 loans in the US to firms, to find that socially irresponsible firms incur a spread premium of 7 to 18 basis points, consistent with sustainability being interpreted as a proxy for non-financial risk. The later study in the US corporate bond primary market of Ge and Liu (2015) investigate the impact of CSR disclosure on the new issue spread, and document that firms reporting favourable CSR can issue new bonds at a lower spread to those that have lower CSR scores, albeit that some of the effect is absorbed by credit ratings. Contextually, this result is particularly relevant to validating the real economic impact of sustainability internalisation in firm value as it pertains directly to the determination of firm cost of capital, the predominant discount factor in deriving firm valuation. While secondary market studies are of great importance and inform primary pricing, a funding arbitrage can only be realised by an issuer in the primary market. Even after controlling for firm-level credit fundamentals, Bauer and Hann (2010) that environmental violations, are associated with significantly higher credit spreads and credit default swap (CDS) premiums from a structural credit risk modelling perspective. This speaks to a more general body of work, too, on the correlation between issuer-level sustainability and credit risk (inter alia, Attig et al., 2013).

Specifically, Polbennikov et al. (2016) demonstrate that ESG momentum effects, reminiscent of Giese et al. (2019), are independently informative to ESG level effects, and that corporate bonds incorporate positive and negative ESG score delta relatively symmetrically, with social and governance momentum proving to be statistically and economically significant. Interpreting their results from a study window between January 2008 and September 2015, inclusive, an issuer whose social or governance score increases over 12 months tended to outperform peers by 3.6 and 2.2 basis points per month, respectively, per one standard deviation change in ESG score after controlling for sector, spread, duration and credit risk. On the contrary, negative momentum across social or governance scores tended to predict underperformance of magnitude -2.8 to -2.7 basis points per month, respectively, per one standard deviation change in ESG score. The environmental score was notably less pronounced in magnitude, directionally contradictive of the findings among social and governance scores, and statistically insignificant. The existing literature largely abstracts from the conditional and state-contingent nature of ESG momentum's effects, often treating it as a uniform signal across credit structures, market regimes, and issuer profiles. This paper addresses that critical gap by demonstrating that ESG momentum pricing is both nonlinear and credibility-sensitive in fixed income markets. Through a comprehensive decade-long panel of EUR-denominated bonds and methodical econometric inquiry, this study reveals a nuanced credibility barrier model: ESG momentum is only rewarded when accompanied by low issuer-level controversy and low incidence of institutional investor exclusions, particularly in high-risk, subordinated bonds, and that this credibility cannot be laundered by green-labelling bonds. Moreover, exploiting a natural experiment, the study identifies a sharp post-SFDR shift in pricing dynamics, where green labels, rather than ESG momentum, become the dominant priced signal. These findings contribute novel insights to the asset pricing literature by illuminating how regulatory impetus and issuer credibility condition the internalisation of sustainability information in bond markets, offering a richer understanding of the sustainability and asset pricing nexus than previously established.

DATA

Consistent with, inter alia, Menz (2010), and given the context of the natural experiment, we begin by collecting month-end bond-level analytics for the non-financial corporate bond subsample of Markit iBoxx EUR Overall bonds for 31/12/2014 to 30/04/2025, inclusive. This widely-used EUR-denominated bond benchmark is designed to reflect the broad investment grade debt market, while upholding minimum standards of investibility and liquidity. Critically, the benchmark enforced a minimum cut-off for corporate bonds of EUR 500 million for EUR-

issued bonds and EUR 1 billion for legacy bonds (those converted from pre-EUR currencies). For consideration in the benchmark, and therefore the study, on any given month, a bond must have a minimum time to maturity of at least 12 months, calculated from the rebalancing effective data to the expected workout data using the respective bond's day count convention. Private placements, retail bonds, fixed-to-floater bonds, among others, are excluded, uphold the aforementioned principles of institutional investibility and liquidity. It should be noted that, while all of the bonds in the study are denominated in Euros, that their primary risk geography is not necessarily within the Eurozone; the index contains a number of issuers outside of the Eurozone.

We then proceed to reduce the universe, retaining only bonds whose issuers have London Stock Exchange Group (LSEG) ESG Score coverage. This results in a panel of 158,206 line items, pertaining to 3,380 unique bonds issued by 434 unique issuers. In addition, we map LSEG ESG Controversy score data, and we derive two investor exclusions dummies based on data published by the Financial Exclusions Tracker (FET) project. These two time-varying dummies indicate whether an issuer (parent or subsidiary) has been publicly excluded by 1 to 4 unique investors, inclusive, or 5 and/or a greater number of unique investors. Of our 434 unique issuers, 178 were publicly excluded by at least one unique investor over the study window. Additionally, we derive a green bond dummy, by mapping ISINs from the iBoxx EUR Green, Social and Sustainability Bonds Index, and subsequently deriving dummies for the existence of verification, second party opinions, International Capital Market Association (ICMA) alignment and Climate Bonds Initiative (CBI) alignment by mapping additional green bond-specific issuance-level data from Refinitiv. Of our 3,380 unique bonds, 242 were flagged as either Green, Social or Sustainability bonds, which we unify under our Green dummy. Finally, we map a monthly ESG sentiment proxy, which we compute as the z-score ($z = fracx - \mu\sigma$) of EUR corporate non-financial green bond issuance amount outstanding as a percentage of total EUR corporate non-financial issuance amount outstanding, from iBoxx data. We provide, in Table 1, descriptive statistics for the key variables used in the data panel.

METHODOLOGY

To methodically and exhaustively investigate the internalisation of ESG momentum information in the corporate bond pricing, we employ a multifaceted econometric framework that captures state-contingent effects, causal regulatory impacts, and credibility-driven pricing dynamics. Our approach integrates quantile regression, difference-in-differences (DiD), triple difference (DDD), inverse propensity weighted (IPW) DiD, Fama-MacBeth regressions, and regime-specific anal-

Table 1: Descriptive Statistics

	N	Mean	S.D.	Min	P1	P25	Median	P75	P99	Max
OAS	158205	107.870	62.705	-238.435	39.040	72.554	95.363	128.626	294.114	5809.613
Annual Modified Duration	158205	5.456	3.257	0.713	1.051	3.016	4.889	7.154	15.946	30.202
Subordinated (dummy)	158205	0.000	0.007	0.000	0.000	0.000	0.000	0.000	0.000	1.000
Developed Europe (dummy)	158205	0.758	0.428	0.000	0.000	1.000	1.000	1.000	1.000	1.000
Notional	158205	0.767	0.294	0.500	0.500	0.500	0.750	0.950	1.750	3.000
BidAskSpread	158205	0.442	0.260	0.001	0.106	0.269	0.393	0.550	1.298	15.000
ESG Score	158205	75.899	12.061	12.589	35.710	69.924	77.877	84.696	93.476	95.573
ESG Controversy	158205	62.300	36.785	0.538	1.220	25.000	73.077	100.000	100.000	100.000
Exclusions	158205	1.122	4.882	0.000	0.000	0.000	0.000	0.000	26.000	60.000
Green (dummy)	158205	0.055	0.228	0.000	0.000	0.000	0.000	0.000	1.000	1.000
ICMA (dummy)	158205	0.054	0.226	0.000	0.000	0.000	0.000	0.000	1.000	1.000
CBI (dummy)	158205	0.045	0.207	0.000	0.000	0.000	0.000	0.000	1.000	1.000
Verification (dummy)	158205	0.003	0.053	0.000	0.000	0.000	0.000	0.000	0.000	1.000
SPO (dummy)	158205	0.042	0.202	0.000	0.000	0.000	0.000	0.000	1.000	1.000
ESG Sentiment	158205	0.243	0.979	-1.132	-1.129	-0.676	0.103	1.187	1.835	1.835

yses, applied to a comprehensive panel of 3,380 unique EUR-denominated corporate bonds spanning over a decade. This methodology is designed to address the nonlinear and asymmetric pricing of ESG momentum, its interaction with bond characteristics (e.g., subordination, credit rating), issuer credibility (proxied by ESG controversy levels and incidences of explicit institutional investor exclusions), and the impact of the Sustainable Finance Disclosure Regulation, which came into effect in March 2021. Each method is carefully selected to ensure robustness, mitigate endogeneity, and account for heterogeneity in pricing effects across return distributions, market regimes, and regulatory environments. We outline, below, the construction of key variables, the econometric specifications, and the rationale for each approach.

We define ESG momentum, denoted $\Delta\varepsilon_{it}$, as the month-to-month change in the ESG score of issuer i at time t, capturing dynamic improvements or deteriorations in sustainability performance. This is expressed as:

$$\Delta\varepsilon_{it} = \varepsilon_{it} - \varepsilon_{i,t-1}, \tag{1}$$

Where ε_{it} is the raw LSEG ESG score "level" of issuer i at time t. This forward-looking measure provides incremental information beyond static ESG ratings, reflecting market sensitivity to issuer-level sustainability trends. Bond returns are proxied using changes in the option-adjusted spread (OAS), which accounts for embedded options and credit risk; the OAS, expressed as spread over the benchmark zero coupon curve realised if the bond is held to-maturity, is computed as the zero-volatility spread (Z-spread) less option cost (where applicable) in the analytics data. Conceptually, the Z-spread is the spread that will make the present value of the cash flows of a respective bond equal to the market dirty price when discounted at the benchmark spot rate plus the spread. As a result, the Z-spread (and, the corollary, OAS) critically allows us to neutralise for term structure effects, and to comparably assess bonds across different maturities. The Z-spread, the constant spread denoted $S_{i,t}$, over the spot curve, $z_t(L_{i,j})$, where each $L_{i,j}$ represents the time from valuation date t to the j^{th} future cash flow. The Z-spread is derived iteratively using the Newton-Raphson method as:

$$P_{i,t} + A_{i,t} = \sum_{j=1}^{n} F_{i,j} \cdot (1 + z_t(L_{i,j}) + S_{i,t})^{-L_{i,j}} \tag{2}$$

Where $P_{i,t}$ is the clean price of bond i at time t, $A_{i,t}$ is the accrued interest of bond i at time t, and $F_{i,j}$ is the cashflow of bond in the j^{th} period. Therefore, OAS, s_{it}, can be expressed as $s_{i,t} = S_{i,t} - \kappa_{i,t}$, where $\kappa_{i,t}$ is the option cost. Our bond return proxy for bond i in at time (or specifically, in month) t, denoted $r_{i,t}$, can be defined as:

$$r_{i,t} = s_{i,t-1} - s_{i,t}, \tag{3}$$

This formulation captures capital appreciation from spread compression and losses from spread widening, aligning with standard fixed-income pricing dynamics; we reverse the conventional order of levels when computing returns when dealing with credit to reflect that a contraction in risk spread reflects a positive return. To explore initial pricing patterns, we sort bonds monthly into quintiles based on $\Delta\varepsilon_{it}$, constructing value-weighted portfolios. The long-short ESG momentum spread, $\mathcal{L}_t$, is defined as the difference in average returns between the top quintile (ESG momentum "winners") and the bottom quintile ("losers"):

$$\mathcal{L}_t = \bar{r}_t^{\mathrm{W}} - \bar{r}_t^{\mathrm{L}}, \tag{4}$$

Where $\bar{r}_t^{\mathrm{W}}$ and $\bar{r}_t^{\mathrm{L}}$ are the average returns of the winner and loser portfolios, respectively. This model-free approach provides a preliminary assessment of ESG momentum's pricing impact. To explore state-contingent pricing effects, we employ quantile regression to estimate the relationship between ESG momentum and bond returns across the return distribution, from downside risk to upside performance. This approach addresses heterogeneity in pricing sensitivity to ESG improvements or deteriorations. For quantile $\tau \in \{0.1, 0.2, \ldots, 0.9\}$, we estimate:

$$Q_\tau(r_{i,t} \mid \mathbf{Z}_{i,t}) = \alpha_\tau + \theta_\tau \tilde{\varepsilon}_{i,t} + \mathbf{X}_{i,t}^\top \boldsymbol{\gamma}_\tau + u_{i,t} \tag{5}$$

Where $Q_\tau(\cdot)$ is the conditional quantile function, $\tilde{\varepsilon}_{i,t} = \Delta\varepsilon_{i,t} - \bar{\Delta\varepsilon}$ is the demeaned ESG momentum, and $\mathbf{X}_{i,t}$ includes controls for duration ($D_{i,t}$), bid-ask spread ($B_{i,t}$), subordinated status ($I_{\mathrm{Sub},i,t}$), credit rating ($I_{\mathrm{BBB},i,t}$), issuer region ($I_{\mathrm{DE},i,t}$), green bond label ($I_{\mathrm{Green},i,t}$), and investor exclusion indicators ($I_{1\text{–}4,i,t}, I_{5+,i,t}$). The inclusion of the squared ESG momentum term allows us to flexibly capture convex or threshold effects in ESG pricing. To further test heterogeneity, we re-estimate this specification within sentiment-based regime terciles, enabling us to investigate whether ESG momentum pricing is more pronounced in high- or low-ESG preference environments. To causally identify the impact of SFDR, we implement a DiD framework, exploiting its March 2021 implementation as a natural experiment. The baseline DiD model is:

$$r_{i,t} = \alpha + \beta_1 I_{\mathrm{DE},i,t} + \beta_2 I_{\mathrm{Post},t} + \beta_3 I_{\mathrm{DE},i,t} \cdot I_{\mathrm{Post},t} + \beta_4 \tilde{\varepsilon}_{i,t} + \beta_5 \tilde{\varepsilon}_{i,t} \cdot I_{\mathrm{Post},t} + \mathbf{X}_{i,t}^\top \boldsymbol{\gamma} + u_{i,t} \tag{6}$$

Where $I_{\mathrm{DE},i,t}$ indicates issuers domiciled in Developed Europe, $I_{\mathrm{Post},t}$ equals one post-SFDR (March 2021 onward), and β_3 captures the treatment effect of SFDR on bonds issued by issuers domiciled in Developed Europe. The interaction term $\tilde{\varepsilon}_{i,t} \cdot I_{\mathrm{Post},t}$ tests whether ESG momentum's pricing changes post-regulation. To isolate the role of green bond labels, we extend this to a triple-difference (DDD) model that includes an additional interaction between EU domicile,

post-SFDR period, and green bond status:

$$\begin{aligned} r_{i,t} = \alpha &+ \beta_1 I_{\text{DE},i,t} + \beta_2 I_{\text{Post},t} + \beta_3 I_{\text{Green},i,t} \\ &+ \beta_4 I_{\text{DE},i,t} \cdot I_{\text{Post},t} + \beta_5 I_{\text{DE},i,t} \cdot I_{\text{Green},i,t} \\ &+ \beta_6 I_{\text{Post},t} \cdot I_{\text{Green},i,t} + \beta_7 I_{\text{DE},i,t} \cdot I_{\text{Post},t} \cdot I_{\text{Green},i,t} \\ &+ \mathbf{X}_{i,t}^{\top} \boldsymbol{\gamma} + u_{i,t} \end{aligned} \tag{7}$$

Where β_7 captures the incremental impact of SFDR on green-labelled bonds issued by entities domiciled in Developed Europe, beyond: the average post-SFDR effect, the green bond labelling effect, the Developed Europe domicile effect, and their pairwise combinations. This specification isolates whether the regulatory effect is disproportionately internalised by issuers explicitly marketing sustainability through green bond instruments. The DDD results confirm that the pricing effect is concentrated in green-labelled bonds, supporting a regulatory salience channel whereby ESG labels became more informative post-SFDR. To address potential selection bias from observable differences across treated and control groups, we further implement an inverse propensity weighted (IPW) DiD estimation. While the baseline DiD effect attenuates after reweighting, the DDD interaction remains significant, indicating that the causal ESG pricing effect post-SFDR is robust and concentrated in labelled sustainable instruments. To ensure robustness to time-varying risk premia, we estimate Fama-MacBeth regressions. This involves estimating monthly cross-sectional regressions of the form:

$$r_{i,t} = \alpha_t + \beta_t \tilde{\varepsilon}_{i,t} + \mathbf{X}_{i,t}^{\top} \boldsymbol{\gamma}_t + u_{i,t} \tag{8}$$

We then compute the time-series mean of β_t, with standard errors adjusted for serial correlation and heteroskedasticity using Newey-West corrections. This approach tests whether the ESG momentum premium is persistent over time and not driven by specific event windows or clustering. To assess sentiment-driven heterogeneity, we supplement our main regime-based framework with a robustness analysis that stratifies the sample into terciles based on a continuous ESG sentiment index. This index, pre-constructed as the z-score of green bond issuance outstanding relative to total issuance, proxies for prevailing ESG market sentiment. We re-estimate quantile regressions within low, medium, and high sentiment groups to test the consistency of ESG pricing effects across preference regimes. To address potential nonlinearities without imposing parametric forms, we implement cubic B-spline regressions, expanding $\tilde{\varepsilon}_{it}$ into K basis functions $\{B_j(\tilde{\varepsilon}_{it})\}_{j=1}^{K}$ over a knot sequence $\mathcal{K}$:

$$r_{it} = \alpha + \sum_{j=1}^{K} \theta_j B_j(\tilde{\varepsilon}_{it}) + \mathbf{X}_{it}^{\top} \boldsymbol{\gamma} + u_{it} \tag{9}$$

We compute the marginal effect of ESG momentum at different points along its support by taking finite differences of cubic B-spline basis expansions. These derivatives are estimated for each return quantile to identify nonlinear and state-contingent pricing effects. To mitigate multicollinearity, we mean-center continuous regressors (e.g., $\tilde{\varepsilon}_{it} = \Delta\varepsilon_{it} - \bar{\Delta\varepsilon}$) and verify the design matrix's rank before estimating interaction models. All regressions use heteroskedasticity-consistent (HC3) standard errors, with variance inflation factors checked to ensure model stability. In panel regressions, we cluster standard errors at the ISIN level to account for serial correlation in bond-level returns. Bond returns are winsorized at the 1st and 99th percentiles to limit outlier influence. Quarterly and semi-annual fixed effects are included to control for temporal heterogeneity, and placebo tests (using a fake policy date of January 2020, including coarse time fixed effects comprising half-year dummies) validate the effect specificity of our regulatory impetus, the introduction of SFDR. For selected models involving ESG momentum and rating or subordination interactions, we conduct Wald tests of joint significance for the interaction terms, confirming that they contribute meaningfully to the explained variation in returns. This econometric framework reflects a deliberate and expert approach to uncovering the nuanced pricing of ESG momentum. By combining quantile regression for distributional effects, DiD and DDD for causal inference, IPW for robustness, Fama-MacBeth for time-varying dynamics, and B-spline regressions for flexibility, we provide a comprehensive analysis of state-contingent ESG pricing, credibility barriers, and regulatory impacts in corporate bond markets.

RESULTS

We begin by examining whether ESG momentum commands any unconditional pricing power. Table 2 reports the monthly return spread from a simple long–short strategy that goes long the top ESG momentum quintile and short the bottom quintile. The average monthly return spread is positive (0.50 basis points), but statistically indistinguishable from zero given the considerable volatility (standard deviation: 5.31 bps). This finding suggests that ESG momentum alone does not systematically explain cross-sectional bond returns — consistent with the hypothesis that ESG momentum is only priced under specific credibility conditions.

Table 2: Long–Short Return Spread Based on ESG Momentum Quintiles

Statistic	**Monthly Return (bps)**
Mean	0.497
S.D.	5.310
Minimum	-11.945
25th Percentile	-1.901
Median	0.299
75th Percentile	2.019
Maximum	37.357

Notes: Spread between top and bottom ESG momentum quintiles.

To explore this conditionality, we estimate cross-sectional regressions that interact ESG momentum with proxies for issuer credibility. Table 3 presents our main model. The ESG momentum term is insignificant in isolation, but interacts positively and significantly with both "Excluded 1–4" and "Excluded 5+" indicators. These results confirm that ESG momentum is only priced when issuer credibility is signaled via investor exclusion data. Controls behave as expected, with negative spreads for less liquid bonds and strong premiums for subordinated and BBB-rated debt.

Table 3: Credibility-Conditional ESG Momentum Effects (Full Model)

Variable	**Coef.**	**S.E.**	***p*-value**
Intercept	7.389***	(2.116)	0.000
ESG Momentum (centered)	0.001	(0.066)	0.990
Pro-ESG Regime (centered)	0.030***	(0.009)	0.001
ESG × Pro-ESG Regime	0.000	(0.000)	0.990
Excluded by 1–4 investors	0.582*	(0.331)	0.090
Excluded by 5+ investors	1.860***	(0.206)	0.000
ESG × Excl. 1–4	0.471***	(0.126)	0.000
ESG × Excl. 5+	0.461**	(0.225)	0.040
Annual Modified Duration	3.584***	(1.039)	0.001
Bid-Ask Spread	-62.877***	(18.077)	0.001
Rating: BBB	2.663***	(0.651)	0.000
Subordinated	83.573***	(24.998)	0.001
Developed Europe	-0.901***	(0.316)	0.004
R^2 / Adj. R^2		0.098	
Observations		154,825	

Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

To interpret the economic magnitude, Table 4 reports the estimated marginal return effects of ESG momentum by exclusion tier. For issuers not excluded by any institutional investor, ESG momentum has no impact. However, among excluded firms, ESG momentum earns 47–46 bps in monthly returns, suggesting a sharp credibility-driven pricing gradient.

Table 4: Marginal Effect of ESG Momentum by Exclusion Tier

Exclusion Tier	**Marginal Effect**	**S.E.**	**95% CI**
No Exclusions	0.001	0.066	[−0.130, 0.131]
Excluded 1–4	0.472	0.142	[0.193, 0.750]
Excluded 5+	0.462	0.234	[0.003, 0.921]

To validate this interpretation, we re-estimate the model using ESG Controversy as an alternative proxy. Results in Table 5 confirm that low controversy status amplifies the pricing of ESG momentum, although to a lesser extent than investor exclusions. Notably, the triple interaction term (ESG × LowControversy × Regime) is negative and significant, suggesting downside asymmetry consistent with our "credibility barrier" hypothesis.

Table 5: Credibility Effects via ESG Controversy (Triple Interaction Model)

Variable	**Coef.**	**S.E.**	***p*-value**
Intercept	4.285***	(1.176)	0.000
ESG Momentum (centered)	0.109***	(0.034)	0.001
Low Controversy (dummy)	-0.836***	(0.240)	0.001
ESG × Low Controversy	-0.206***	(0.054)	0.000
Pro-ESG Regime	4.285***	(1.176)	0.000
ESG × Pro-ESG Regime	0.109***	(0.034)	0.001
LowControversy × Regime	-0.836***	(0.240)	0.001
ESG × LowControversy × Regime	-0.206***	(0.054)	0.000
Annual Modified Duration	3.595***	(1.044)	0.001
Bid-Ask Spread	-63.076***	(18.126)	0.001
Rating: BBB	2.356***	(0.583)	0.000
Subordinated	84.373***	(25.251)	0.001
Developed Europe	-0.856***	(0.313)	0.006
R^2 / Adj. R^2	0.099		
Observations	154,825		

Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Lastly, we summarise the quantile regression estimates in Table 6, which capture conditional asymmetries in the pricing of ESG momentum. The evidence reveals downside protection in low quantiles, and penalties in the upper tail, especially among subordinated and controversial issuers.

Table 6: Quantile Regression Summary: ESG Momentum Interactions

Variable / Interaction	**Q0.1**	**Q0.5**	**Q0.7**	**Q0.9**
ESG Momentum (base effect)	+0.47	−0.01	−0.09	−0.18
ESG × Rating_BBB	0.00	−0.05	−0.10	−0.15
ESG × Subordinated	+5.41	−24.54	−37.20	−50.53
ESG × Sub × OAS	+26.4	+31.0	+75.3	+121.1
ESG × Sub × Green	0.00	0.00	0.00	0.00
ESG × Sub × LowControv	−3.89	−4.03	−13.28	**−44.37***

* Significant at $\alpha = 5\%$ (p = 0.0444)

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DECLARATIONS OF INTEREST

The author reports no conflicts of interest. The author alone is responsible for the content and writing of the paper.