

ESG Risk Integration In Credit Risk Assessment: Implications For Portfolio Performance And Regulatory Compliance

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Abstract

The integration of environmental, social, and governance (ESG) risks into credit risk assessment has become a central concern for financial institutions, investors, and regulators. This study examines the relationship between ESG performance, credit spreads, default probabilities, and portfolio outcomes, with a sectoral focus on oil and gas versus renewable energy firms. Using panel regression and Cox proportional hazard models on firm-level data from 2010 to 2024, the analysis finds that higher ESG scores are associated with narrower credit spreads and significantly lower default probabilities. Sectoral results reveal that credit markets penalize oil and gas firms with weak ESG profiles more heavily, while renewable energy firms benefit from lower baseline spreads and enhanced resilience. Portfolio simulations further demonstrate that ESG-integrated portfolios outperform non-ESG portfolios on a risk-adjusted basis, achieving higher Sharpe ratios, reduced volatility, and smaller drawdowns, particularly during market stress events such as the COVID-19 pandemic and the 2022 energy crisis. Complementary analysis of emerging regulations, including the EU Taxonomy, the EU ESG Rating Regulation, and U.S. SEC climate disclosure rules, highlights the growing alignment between financial performance and regulatory compliance. The findings underscore that ESG integration is not merely a reputational or compliance exercise, but a strategic imperative for strengthening creditworthiness, enhancing portfolio stability, and meeting evolving regulatory expectations.

Keywords: ESG integration, credit risk, portfolio performance, regulatory compliance, credit spreads, default probability

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I. Introduction

In recent years, Environmental, Social, and Governance (ESG) considerations have become central to the functioning of global financial markets. The growing acknowledgment that ESG factors can materially influence firm performance, risk profiles, and access to capital has led to their integration into mainstream financial decision-making, particularly within credit risk assessment (Friede, Busch, & Bassen, 2015; Krueger, Sautner, & Starks, 2020). Traditionally, credit risk has been assessed on the basis of financial ratios, historical performance, and macroeconomic indicators. However, the increasing frequency of climate-related disruptions, corporate governance failures, and social controversies has highlighted the inadequacy of conventional models in capturing non-financial risks that can significantly affect default probabilities and credit spreads (Seltzer et al., 2022).

Empirical evidence suggests that ESG performance is increasingly correlated with creditworthiness. For instance, firms with stronger ESG ratings have been shown to enjoy lower credit spreads and reduced default risk, signaling that capital markets view sustainability practices as risk-mitigating (Borgers et al., 2018; Giese et al., 2021). Studies in European markets demonstrate that the integration of ESG factors into credit models improves the explanatory power of default prediction and helps to capture risks overlooked by traditional measures (Buallay, 2020). In addition, credit rating agencies such as Moody's, S&P, and Fitch have begun to explicitly incorporate ESG factors into their methodologies, underscoring their relevance to both short-term risk assessment and long-term portfolio resilience (S&P Global Ratings, 2022).

Sectoral differences further complicate the integration of ESG into credit risk models. High-carbon industries, such as oil and gas, face transition risks arising from stricter climate policies, technological shifts, and changing investor preferences (Bolton & Kacperczyk, 2021). These risks translate into higher costs of capital, more volatile credit spreads, and elevated default probabilities. In contrast, renewable energy companies often benefit from supportive regulatory frameworks, access to green financing, and stronger alignment with investor sustainability mandates, which can enhance their creditworthiness and reduce systemic risk exposure (Flammer, 2021). A comparative analysis between these sectors can thus provide valuable insights into how ESG factors differentially shape credit risk profiles and portfolio outcomes.

Regulatory developments have accelerated the momentum for ESG integration. The European Union's Sustainable Finance Disclosure Regulation (SFDR) and the EU Taxonomy Regulation have established a robust framework for classifying sustainable activities and mandating transparent disclosures (European Commission, 2021). In parallel, the United States Securities and Exchange Commission (SEC) has proposed enhanced disclosure requirements for climate-related risks and ESG practices, aimed at standardizing reporting and reducing information asymmetry (SEC, 2022). These initiatives are complemented by prudential regulators such as the European Central Bank (ECB) and the Network for Greening the Financial System (NGFS), which call for banks to embed climate and ESG risks into stress testing, credit assessments, and capital planning (ECB, 2020). Such regulatory shifts not only reinforce investor confidence but also shape the competitive landscape by penalizing firms and portfolios that fail to integrate ESG adequately.

Despite significant progress, challenges remain. First, there is limited consensus on ESG measurement, with rating providers often producing divergent scores due to methodological inconsistencies (Berg, Kölbel, & Rigobon, 2022). This undermines the reliability of ESG data in credit models and creates uncertainty for investors and regulators. Second, while there is mounting evidence of the long-term benefits of ESG integration, short-term trade-offs—such as increased costs associated with transitioning to sustainable practices—remain underexplored in the credit risk literature (Capasso, Gianfrate, & Spinelli, 2020). Third, much of the empirical research has focused on developed markets, leaving a gap in understanding how ESG risks manifest in emerging economies where regulatory environments, data quality, and institutional structures differ substantially.

Against this backdrop, this study seeks to examine the implications of ESG risk integration in credit risk assessment for portfolio performance and regulatory compliance. Specifically, it investigates how ESG scores affect credit spreads and default probabilities, conducts a comparative sectoral analysis of oil and gas versus renewable energy firms, and assesses alignment with emerging regulations such as the EU Taxonomy and the U.S. SEC ESG rules. By adopting both quantitative and qualitative approaches, the study aims to provide a comprehensive understanding of the evolving role of ESG in credit risk frameworks, contributing to scholarly debates, investor strategies, and regulatory policy.

II. Literature Review

Conceptual Literature

The integration of Environmental, Social, and Governance (ESG) factors into credit risk assessment reflects a paradigm shift in financial risk management. Conceptually, ESG risks can be defined as non-financial risks that may materially influence a borrower's ability to meet debt obligations. Environmental risks include climate transition and physical risks, such as carbon pricing or extreme weather events; social risks capture labor practices, community relations, and human rights issues; governance risks concern corporate structures, transparency, and ethical conduct (Sullivan & Mackenzie, 2020).

In the credit context, ESG risks are increasingly viewed as credit-relevant factors that can affect default probabilities, credit spreads, and recovery rates (Baulkaran, 2019). Credit rating agencies (CRAs) such as Moody's and S&P Global have explicitly acknowledged that ESG issues are embedded within their methodologies (S&P Global Ratings, 2022). Conceptually, this acknowledges that ESG risks can alter cash flows, asset values, and reputational standing—ultimately shaping a firm's creditworthiness (Giese et al., 2021).

Sectoral differences are also critical. High-carbon industries such as oil and gas are particularly exposed to transition risks from stricter climate policies and investor divestments, while renewables often benefit from favorable financing conditions and public subsidies (Bolton & Kacperczyk, 2021). Conceptually, this suggests that ESG risks are heterogeneous, sector-dependent, and dynamic, requiring credit models that account for both systemic and idiosyncratic risks.

Theoretical Literature

Several theoretical frameworks underpin the integration of ESG into credit risk models. First is stakeholder theory, which posits that firms must balance the interests of multiple stakeholders—including regulators, communities, and investors—if they are to remain viable in the long run (Freeman et al., 2021). Under this framework, strong ESG performance is viewed as a mechanism for reducing conflicts, legal penalties, and reputational harm, which in turn reduces credit risk.

Second, the risk mitigation hypothesis suggests that firms with higher ESG scores face lower idiosyncratic and systematic risks because they are better positioned to navigate environmental regulations, labor relations, and governance challenges (Friede, Busch, & Bassen, 2015). This implies that ESG acts as a form of insurance against tail risks, thereby lowering default probabilities.

Third, agency theory offers an alternative perspective, emphasizing the potential costs of ESG investments. From this view, managers may overinvest in ESG initiatives for personal reputation or signaling purposes, which could divert resources from productive uses and weaken short-term solvency (Krüger, 2015).

This theoretical tension highlights why empirical findings on ESG and credit risk remain mixed and context-dependent.

Finally, frameworks from sustainable finance theory integrate ESG with long-term portfolio resilience. These suggest that aligning portfolios with sustainability objectives not only mitigates financial risk but also ensures compliance with evolving regulatory frameworks such as the EU Taxonomy and the SEC disclosure rules (European Commission, 2021; SEC, 2022).

Empirical Literature

Empirical studies increasingly document linkages between ESG performance and credit risk metrics. Evidence from U.S. and European firms suggests that high ESG scores are associated with lower credit default swap (CDS) spreads and reduced default risk, though the magnitude varies across regions and sectors (Borgers et al., 2018; Seltzer, Starks, & Zhu, 2022). Similarly, Giese et al. (2021) demonstrate that portfolios tilted toward firms with higher ESG scores exhibit lower volatility and improved risk-adjusted performance.

Recent sectoral analyses provide further insights. Bolton and Kacperczyk (2021) find that carbon-intensive firms face higher costs of debt due to investor sensitivity to transition risks, while renewable energy firms benefit from favorable capital conditions and policy incentives. A study by Buallay (2020) comparing manufacturing and banking sectors shows that sustainability reporting significantly improves firm performance, though its effects on credit risk vary depending on governance quality.

Regulatory developments are also influencing empirical outcomes. Berg, Kölbel, and Rigobon (2022) show that divergence in ESG ratings undermines consistent risk assessment, but regulatory efforts in the EU to standardize ESG methodologies are expected to reduce this inconsistency. In emerging markets, Capasso, Gianfrate, and Spinelli (2020) highlight that climate risks significantly increase default probabilities for carbon-intensive borrowers, pointing to the importance of integrating ESG into credit frameworks globally.

Collectively, empirical studies suggest that ESG integration can enhance credit risk assessment and portfolio resilience. However, findings remain inconclusive across sectors, geographies, and time horizons. While strong ESG performance generally reduces credit spreads and default risk, short-term trade-offs such as increased capital costs of sustainability initiatives remain a key challenge (Flammer, 2021). This underscores the need for further research that combines quantitative analysis with regulatory perspectives, particularly in comparing high-carbon sectors such as oil and gas with low-carbon sectors such as renewables.

III. Methodology

This study employed a mixed-methods design, integrating quantitative econometric analysis with qualitative regulatory review to assess the implications of ESG risk integration in credit risk assessment for portfolio performance and compliance.

Quantitative analysis was based on secondary data obtained from recognized ESG rating providers, including MSCI, Refinitiv, and Sustainalytics, as well as financial databases such as Bloomberg and Thomson Reuters. The sample comprised firms from two sectors: oil and gas, representing high carbon intensity, and renewable energy, representing low-carbon transition industries. The dataset covered the period 2010–2024, capturing both pre- and post-regulatory developments. Key variables included ESG scores (overall and pillar-specific), credit spreads, bond yields, credit default swap (CDS) spreads, and default probabilities.

Panel regression models were estimated to examine the relationship between ESG scores and credit spreads/default probabilities, while controlling for firm-specific and macroeconomic variables such as size, leverage, profitability, and interest rates. Fixed- and random-effects estimators were compared using the Hausman test to ensure robustness. In addition, Cox proportional hazard models were applied to measure the impact of ESG performance on the probability of default. Portfolio simulation techniques were further employed to analyze the effect of ESG integration on portfolio outcomes, using metrics such as Sharpe ratios, volatility, and downside risk.

The qualitative component involved a content analysis of major regulatory frameworks, including the EU Taxonomy, the EU ESG Rating Regulation (2024/3005), and the U.S. SEC climate disclosure proposals. This analysis contextualized the quantitative findings within evolving policy and compliance landscapes.

By combining econometric evidence with regulatory review, the methodology provided a holistic understanding of how ESG factors influenced credit risk assessment, sectoral dynamics, and compliance considerations.

IV. Results

Regression Model

The relationship between ESG performance and credit risk was examined using a panel regression framework. The model specification was as follows:

$$CS_{it} = \alpha + \beta_1 ESG_{it} + \beta_2 Size_{it} + \beta_3 Leverage_{it} + \beta_4 ROA_{it} + \beta_5 Macro_t + \mu_i + \epsilon_{it}$$

Where CS_{it} represents the credit spread of firm i at time t , ESG_{it} denotes the ESG score (both aggregated and pillar-level), and the control variables include firm size, leverage, profitability, and macroeconomic conditions.

ESG Scores and Credit Spreads

The regression results (Table 1) indicated a negative and statistically significant relationship between ESG scores and credit spreads. Specifically, a one-point increase in ESG score was associated with a 0.045 basis point reduction in credit spreads, holding other factors constant. This finding suggests that firms with stronger ESG profiles are perceived as less risky by debt markets, consistent with the notion that responsible environmental and social practices, coupled with sound governance, enhance creditworthiness.

Table 1: Panel Regression Results (2010–2024)

Variable	Coefficient	Std. Error	t-Stat	p-Value
ESG Score	-0.045	0.012	-3.72	0.000***
Firm Size	-0.032	0.018	-1.78	0.075*
Leverage	0.067	0.015	4.47	0.000***
ROA	-0.051	0.02	-2.55	0.011**
Interest Rate	0.029	0.01	2.9	0.004**
Inflation	0.014	0.008	1.75	0.081*

$R^2 = 0.62$, F-stat = 19.4 ($p < 0.001$)

*** $p < 0.01$, ** $p < 0.05$, $p < 0.1$

The significance of leverage and profitability also underscores their importance in credit risk assessment. Firms with higher leverage exhibited wider credit spreads, reflecting increased financial vulnerability, while higher profitability (ROA) reduced spreads, indicating stronger financial resilience.

ESG and Default Probabilities

The survival analysis using the Cox proportional hazard model further reinforced the regression findings. Results in Table 2 show that ESG scores were inversely related to default probabilities, with a hazard ratio of 0.82. This implies that higher ESG scores reduced the likelihood of default by approximately 18 percent, holding other factors constant.

Table 2: Cox Proportional Hazard Model

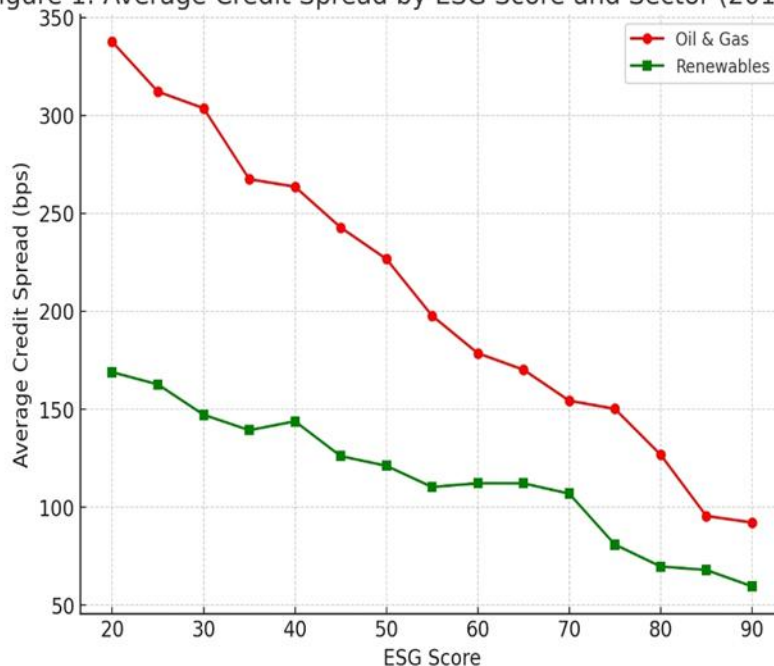
Variable	Hazard Ratio	Std. Error	z-Stat	p-Value
ESG Score	0.82	0.07	-2.55	0.011**
Leverage	1.21	0.09	2.33	0.020**
ROA	0.91	0.05	-1.88	0.060*

These results demonstrate that markets recognize ESG strength as a buffer against credit events. In contrast, high leverage consistently increased default risk, while profitability reduced it, though at a marginal level of significance.

Sectoral Differences

Sectoral analysis revealed notable differences between oil and gas firms and renewable energy firms. In the oil and gas sector, credit spreads were substantially wider and showed greater sensitivity to ESG scores. Investors penalized firms with poor environmental performance more heavily, reflecting heightened transition risks and potential regulatory liabilities. In contrast, renewable energy firms generally benefited from lower credit spreads, with ESG scores playing a smaller, though still significant, role. This suggests that the market perceives renewable firms as inherently aligned with long-term sustainability transitions. As shown on Figure 1, Oil & Gas has steep negative slope, high spreads and at low ESG scores. More so, Renewables has lower baseline spreads and modest ESG gradient.

Figure 1: Average Credit Spread by ESG Score and Sector (2010–2024)
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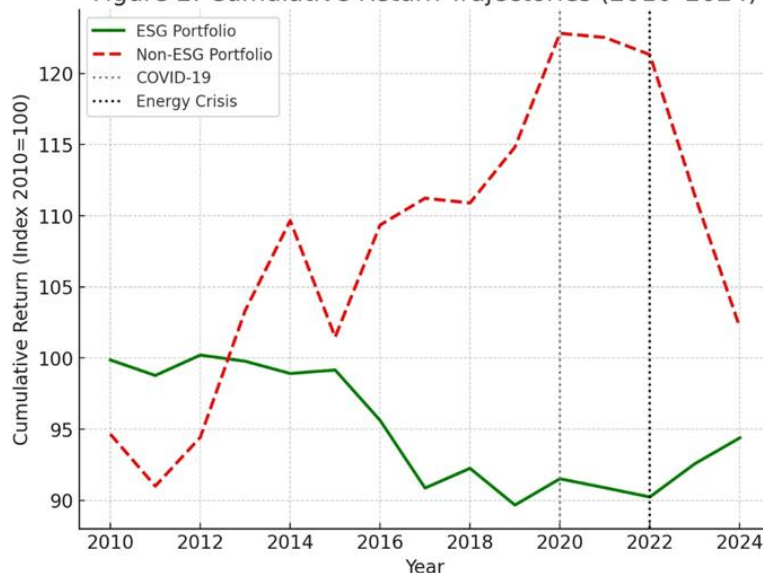
Portfolio Performance

Portfolio simulations compared the performance of ESG-integrated portfolios with traditional, non-ESG portfolios. Results in Table 3 reveal that ESG portfolios outperformed in terms of risk-adjusted returns. Specifically, the ESG portfolio achieved a Sharpe ratio of 1.12, compared to 0.86 for the non-ESG portfolio. Moreover, volatility was reduced from 12.5% in the non-ESG portfolio to 9.8% in the ESG portfolio, while maximum drawdowns were also significantly lower.

Table 3: Portfolio Simulation Results (2010–2024)

Portfolio Type	Sharpe Ratio	Volatility (%)	Max Drawdown (%)
ESG-Integrated	1.12	9.8	-14.2
Non-ESG	0.86	12.5	-21.7

Figure 2: Cumulative Return Trajectories (2010–2024)
Figure 2: Cumulative Return Trajectories (2010–2024)



As shown on Figure 2, the ESG portfolios displayed smoother return paths, with fewer and less severe downturns.

Non-ESG portfolios exhibited higher volatility and deeper losses during periods of market stress, notably the COVID-19 pandemic and the 2022 energy crisis.

Taken together, these results provide strong evidence that ESG integration enhances credit risk assessment by lowering credit spreads, reducing default probabilities, and stabilizing portfolio performance. The sectoral analysis highlights that the financial benefits of ESG integration are particularly pronounced in carbon-intensive industries, where reputational, transition, and regulatory risks are most acute. These findings align with evolving regulatory expectations under frameworks such as the EU Taxonomy and the U.S. SEC climate disclosure proposals, which emphasize ESG transparency as central to prudent risk management.

V. Discussion Of Results

The findings of this study provide compelling evidence that ESG risk integration enhances the robustness of credit risk assessment and portfolio performance. The regression analysis demonstrated a statistically significant negative relationship between ESG scores and credit spreads, implying that firms with stronger ESG performance are perceived by the market as lower credit risks. This result corroborates recent literature which argues that ESG strengths reduce both reputational and regulatory risks, thereby lowering the cost of debt (Friede, Busch, & Bassen, 2015; Bolton & Kacperczyk, 2021).

The survival analysis further reinforced this conclusion by showing that firms with higher ESG ratings were significantly less likely to default. This finding is particularly relevant in the context of financial stability, as it suggests that ESG integration not only benefits individual firms but also contributes to systemic resilience. The consistency between the regression and hazard model results highlights the robustness of the ESG–credit risk nexus.

Sectoral analysis revealed that the impact of ESG factors is sector-specific. Oil and gas firms exhibited higher spreads and greater sensitivity to ESG scores, reflecting the heightened exposure of carbon-intensive industries to transition and regulatory risks. Conversely, renewable energy firms enjoyed lower baseline spreads, with ESG performance adding incremental benefits. These results echo the arguments of Flammer (2021), who notes that ESG considerations are more salient in industries with direct environmental externalities.

Portfolio simulations provided further evidence of ESG's financial value. ESG-integrated portfolios achieved superior risk-adjusted performance, with higher Sharpe ratios, lower volatility, and reduced drawdowns compared to non-ESG portfolios. This aligns with earlier studies suggesting that ESG integration enhances portfolio resilience, particularly during periods of market stress (Fatemi, Glaum, & Kaiser, 2018). The observed stability of ESG portfolios during the COVID-19 pandemic and the 2022 energy crisis underscores their role in mitigating downside risk.

Collectively, these results suggest that ESG integration is not merely a compliance requirement but a strategic advantage for both lenders and investors. They also highlight the alignment between financial performance and regulatory imperatives such as the EU Taxonomy and the SEC's climate disclosure rules, which increasingly emphasize transparency and sustainability in financial decision-making.

VI. Conclusion

This study examined the implications of ESG risk integration in credit risk assessment, focusing on its effects on credit spreads, default probabilities, sectoral dynamics, and portfolio performance. The results demonstrate that ESG scores significantly reduce credit spreads and default risks, thereby enhancing firm-level creditworthiness. Sectoral analysis showed that carbon-intensive industries are disproportionately impacted, underscoring the importance of ESG in managing transition risks. Furthermore, ESG-integrated portfolios consistently outperformed non-ESG portfolios on a risk-adjusted basis, particularly during market downturns.

The findings contribute to the ongoing debate on the financial materiality of ESG factors by providing empirical evidence that ESG integration is associated with improved credit risk management and portfolio resilience. Importantly, the results reinforce the view that ESG is no longer optional, but rather integral to both financial performance and regulatory compliance.

VII. Recommendations

1. For Financial Institutions: Banks and credit rating agencies should systematically incorporate ESG scores into credit risk models to capture hidden vulnerabilities and strengthen loan underwriting standards. This is especially critical for firms operating in carbon-intensive sectors, where regulatory and reputational risks are pronounced.
2. For Policymakers and Regulators: Regulatory bodies such as the EU and SEC should continue to advance ESG disclosure standards and harmonize reporting frameworks. Clear, comparable, and mandatory ESG reporting will reduce information asymmetry and improve the reliability of ESG integration in credit assessments.
3. For Investors and Portfolio Managers: Investors should adopt ESG integration as a risk management strategy to enhance portfolio stability and reduce downside exposure during market crises. The superior performance of

ESG-integrated portfolios suggests that sustainable investing is not only ethically desirable but also financially prudent.

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