



# SAFE HAVEN OR SELECTIVE SHIELD? INSTITUTIONAL INVESTOR HETEROGENEITY, GEOPOLITICAL RISK, AND THE CRISIS RESILIENCE OF GREEN BONDS

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Article history:	Abstract:
<p><b>Received:</b> 30<sup>th</sup> March 2026 <b>Accepted:</b> 28<sup>th</sup> April 2026</p>	<p><i>The rapid expansion of green bonds positions sustainable finance at the core of climate mitigation strategies. However, empirical evidence on their crisis resilience and corporate value effects remains contradictory. This study synthesizes 73 peer-reviewed articles using meta-analytical methods (random-effects models, FAT-PET, PEESE) to resolve these discrepancies. We propose and test the Asymmetric Shock Resilience Hypothesis: green bonds exhibit diametrically opposite behaviors depending on shock origin. During financial or health crises (e.g., COVID-19), they act as safe havens, shielded by concentrated institutional ownership (Herfindahl-Hirschman Index = 0.28 vs. 0.15 for conventional bonds). Conversely, during geopolitical risk (GPR) episodes (e.g., Ukraine war), green bonds demonstrate severe vulnerability, with negative return shocks absent in conventional markets. At the corporate level, global average financial effects are negligible <math>\mu = -0.005</math>, <math>p = 0.225</math>, but this masks strong moderation: developed markets exhibit a significant "greenium" (lower cost of capital), while emerging markets (e.g., China) show negative post-issuance effects <math>\mu = -0.041</math>) due to prohibitive certification costs. Weighted least squares (WLS) meta-regression on 240 effect sizes confirms that investor type (mutual funds vs. insurers), shock typology, and third-party verification jointly explain 67% of between-study heterogeneity. We conclude that the greenium is not a static advantage but a contingent premium dependent on systemic stability, investor mandate rigidity, and market maturity.</i></p>

**Keywords:** Green Bonds; Geopolitical Risk; Asymmetric Resilience; Corporate Value; Meta-Analysis; Institutional Investors.

**JEL Classification:** G11, G23, G01, Q56, G15.

## 1. INTRODUCTION

The global green bond market reached USD 2 trillion in outstanding issuance by late 2022, having grown at a compound annual rate exceeding 50% since its inception in 2007. This unprecedented capital mobilization has run parallel to a succession of severe exogenous shocks — including the COVID-19 pandemic, the Russia-Ukraine conflict, and accelerating global geopolitical fragmentation. These events have subjected financial ecosystems to high-volatility regimes that fundamentally contrast with the tranquil market conditions of the previous decade. Evaluating how green debt instruments perform under structural duress, and identifying the exact economic transmission

channels of these shocks, represents one of the most critical open inquiries in sustainable finance.

To date, the empirical literature presents two starkly conflicting stylised facts. On one hand, asset-pricing studies focusing on health and financial crises suggest that green bonds possess superior resilience. During market-wide sell-offs, sustainability-oriented institutional investors appear to shield their green holdings, resulting in lower net sales and a widening "greenium" precisely when conventional credit spreads expand. On the other hand, macro-finance studies incorporating geopolitical risk (GPR) indicate that green bonds exhibit acute vulnerability during structural international crises. In high-volatility regimes,



geopolitical threats exert significant destabilizing pressure on green bond returns, inducing intense cross-market contagion effects that bypass conventional sovereign and corporate debt instruments.

A third empirical paradox complicates this landscape: aggregate meta-analytic evidence across financial performance outcomes yields a summary effect size statistically indistinguishable from zero ( $\mu = -0.005$ ,  $p = 0.225$ ), while environmental outcomes demonstrate a robust positive impact ( $\mu = 0.043$ ,  $p < 0.001$ ). This severe heterogeneity ( $I^2 = 86.7\%$  for financial metrics) remains unexplained. It strongly implies that contextual factors — such as geographic location, certification rigor, investor mandate type, and the specific nature of the macroeconomic shock — are driving the divergent results.

This paper resolves these interconnected puzzles by developing a unified demand-side asset-pricing framework where investor heterogeneity is the primary transmission mechanism rather than an econometric nuisance. We transition beyond qualitative literature synthesis by executing a formal, weighted least squares (WLS) meta-regression analysis on 240 extracted effect sizes. This allows us to empirically decompose market heterogeneity and map how specific investor mandates interact with distinct shock typologies.

## 2. LITERATURE REVIEW

### 2.1 The Greenium and Normal-Market Pricing

In tranquil market regimes, a broad consensus confirms the existence of a negative yield premium — the greenium — whereby green bond issuers benefit from a lower cost of capital relative to identical conventional bonds, ranging from 2 to 13 basis points (Zerbib, 2019). Traditional asset-pricing models fail to explain this spread, as the cash-flow risks of the two instruments are frequently identical. Consequently, modern literature relies on the investor-tastes framework of Fama and French (2007) and the demand-system asset-pricing methodology of Kojen and Yogo (2019), which posit that agents derive non-pecuniary utility from holding assets aligned with environmental values.

Crucially, the greenium is deeply contingent on governance quality and signaling mechanisms. Costly third-party verification separates genuine green projects from greenwashing entities, operating as a credible signal under asymmetric information (Flammer, 2021). Khan and Vismara (2025) note that while market-based proxies (Tobin's Q) respond favorably to green issuance signals, long-term operational metrics (ROA) show negligible immediate improvement. This supports the premise that if the greenium is a product

of sticky, non-pecuniary institutional demand, green holdings should remain highly resilient under stress, as value-driven investors face lower behavioral incentives to liquidate assets.

### 2.2 Crisis Resilience: COVID-19 and Institutional Response

The COVID-19 pandemic served as a major natural experiment to test asset resilience. Utilizing quarterly bond-level holdings data, Fatica and Panzica (2024) deployed a difference-in-differences (DiD) framework on propensity-score-matched bond pairs. They demonstrated that institutional investors maintained green bond holdings at a level approximately 4% higher than conventional counterparts during the Q1 2020 crash, driving a substantial reduction in green net sales. Importantly, this buffering effect varies significantly across investor classes. Open-ended mutual funds, despite facing intense redemption pressure, actively minimized green bond liquidations. Conversely, insurance companies — characterized by long-duration liabilities and structural buy-and-hold strategies — displayed identical selling patterns across both green and conventional debt (Becker & Ivashina, 2015; Fatica & Panzica, 2024). Robustness checks tracking same-issuer bond pairs confirm that the green label itself, rather than unobserved firm-level credit health, governs this defensive market behavior (Arat et al., 2023; Fatica & Panzica, 2024).

### 2.3 Geopolitical Risk and Regime-Dependent Transmission

Parallel literature mapping macro-level shocks introduces a major contradiction. Utilizing Markov-switching vector autoregressions (MS-VAR), Sheenan (2023) identified that under high-volatility regimes, geopolitical risk (GPR) acts as a severe negative driver of green bond returns. This disruptive transmission channel is entirely absent in conventional corporate and sovereign bond markets during identical periods. Furthermore, cross-market Granger-causality spikes dramatically from conventional credit markets to green indices during periods of heightened international tension, signaling severe market contagion (Forbes & Rigobon, 2002; Sheenan, 2023).

This divergence implies that the safe-haven properties of green bonds are highly conditional on the shock typology. While a public health crisis (COVID-19) reinforces sustainable sentiment and activates protective regulatory policy (Arat et al., 2023), geopolitical crises measured via international indices (Caldara & Iacoviello, 2022) disrupt international policy alignment, threaten cross-border critical mineral supply



chains, and prompt a structural flight-to-safety toward hyper-liquid conventional assets like US Treasuries.

### 3. METHODOLOGY

#### 3.1 Research Design

This study employs a quantitative meta-analytical framework to reconcile conflicting empirical findings regarding the crisis resilience and corporate value implications of green bonds. Given the substantial divergence in reported results across market environments, investor structures, and shock regimes, a meta-analysis allows the aggregation of heterogeneous evidence into a unified empirical structure while explicitly modeling between-study variation. The empirical strategy combines random-effects meta-analysis, heterogeneity diagnostics, weighted least squares (WLS) meta-regression, and publication-bias diagnostics using FAT-PET and PEESE procedures.

#### 3.2 Literature Search Strategy and PRISMA Logic

The literature search was conducted using multiple academic databases (Scopus, Web of Science, ScienceDirect, SSRN, Google Scholar) covering January 2015 through February 2026. The search syntax combined green finance terminology with crisis and institutional-investor keywords. Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework, the initial 412 records were screened down to 73 primary empirical studies

that satisfied all inclusion criteria and reported convertible statistical estimates (Hedge's  $g$ ).

#### 3.3 Statistical Modeling

To account for within-study dependence caused by multiple reported specifications, standard errors in the WLS meta-regression were clustered at the study level. Given the substantial diversity across jurisdictions, random-effects estimators were preferred to model between-study variance ( $\tau^2$ ) and Cochran's Q tests. To identify the drivers of heterogeneity, a WLS meta-regression model was fitted on 240 extracted effect sizes:

$$\text{Hedge's } g_i = \beta_0 + \beta_1 \text{GPR}_i + \beta_2 \text{ESG\_Fund}_i + \beta_3 \text{Insurer}_i + \beta_4 \text{Verification}_i + \epsilon_i$$

Observations were weighted using inverse-variance weights to assign greater influence to more precise estimates.

### 4. RESULTS

#### 4.1 Asymmetric Shock Resilience: Quantitative Synthesis

Table 1 summarizes the extracted effect sizes across 73 studies. Green bonds exhibit a statistically significant positive resilience coefficient during COVID-19 (aggregate Hedge's  $g = 0.42$ , 95% CI [0.28, 0.56],  $p < 0.001$ ), indicating lower net selling pressure compared to conventional bonds. This directly aggregates findings from asset-holding studies such as Fatica and Panzica (2024).

Table 1. Meta-Analytic Effect Sizes by Shock Type

Shock Typology	k (studies)	Hedge's $g$	95% Confidence Interval	p-value	Heterogeneity (I <sup>2</sup> )	Primary Literature Base
COVID-19 (Health/Financial)	31	0.42	[0.28, 0.56]	< 0.001	68%	Arat et al. (2023); Fatica & Panzica (2024)
GPR (Geopolitical Risk)	28	-0.57	[-0.74, -0.40]	< 0.001	72%	Caldara & Iacoviello (2022); Sheenan (2023)
Conventional Crises	14	-0.11	[-0.27, 0.05]	0.184	45%	Becker & Ivashina (2015); Forbes & Rigobon (2002)

Note: Positive  $g$  indicates green bonds outperform conventional bonds; negative  $g$  indicates underperformance.

Conversely, during GPR episodes, the same asset class shows a negative cumulative abnormal return differential ( $g = -0.57$ , 95% CI [-0.74, -0.40],  $p < 0.001$ ) relative to conventional credit instruments, aggregating the return-volatility shocks identified by

Sheenan (2023). A formal test of interaction confirms shock-type asymmetry ( $F(1, 69) = 34.2$ ,  $p < 0.001$ ).

#### 4.2 Ownership Concentration and Macro-Transmission Channels



Contrary to the hypothesized direct causal chain of illiquidity, meta-regression reveals that ownership concentration (HHI = 0.28) alone explains only 12% of the variance in GPR vulnerability (adjusted  $R^2 = 0.12$ ,  $p = 0.09$ ). When energy price volatility indicators (EPU index for oil & gas) are added to the framework, explanatory power rises significantly to 54% ( $R^2 = 0.54$ ,  $p < 0.001$ ). This empirical pattern demonstrates that the primary transmission channel for GPR is input cost shock (rare earth metals, fossil fuel substitution risk) as argued in macro-regime studies, rather than localized trading illiquidity per se; high institutional concentration operates as a correlate rather than a root cause.

### 4.3 Corporate Value Creation: Heterogeneity by Moderators

A naive global random-effects meta-analysis of 42 studies on financial performance (ROA, ROE, Tobin's Q) yields a summary effect indistinguishable from zero ( $\mu = -0.005$ ,  $p = 0.225$ ), reflecting the high friction highlighted by Khan and Vismara (2025). However, this aggregate masks strong, theoretically meaningful moderation.

Table 2. Moderators of Corporate Financial Performance Post-Issuance

Moderator	Subgroup	k	Effect Size (g)	95% CI	p (within)	p (between)	Primary Literature Base
Market Maturity	Developed (DM)	24	0.18	[0.09, 0.27]	0.002	< 0.001	Flammer (2021)
	Emerging (EM)	18	-0.041	[-0.078, -0.004]	0.031		Khan & Vismara (2025)
Metric Type	Market (Tobin's Q)	27	0.22	[0.11, 0.33]	0.001	< 0.001	Negi et al. (2025)
	Accounting (ROA)	33	-0.03	[-0.09, 0.03]	0.342		Khan & Vismara (2025)
Bond Maturity	Short (\le 5years)	15	-0.08	[-0.15, -0.01]	0.042	0.008	Zerbib (2019)
	Long (> 10years)	19	0.09	[0.02, 0.16]	0.018		Abhilash et al. (2022)

Environmental performance metrics (ESG scores, carbon intensity) are consistently positive across all subgroups (global  $g = 0.51$ , 95% CI [0.38, 0.64]), confirming that green bonds achieve their environmental mandate even when immediate financial accounting outcomes lag.

### 4.4 Weighted Least Squares (WLS) Meta-Regression

To jointly test the empirical implications of investor mandates and shock types, we estimate a WLS meta-regression with 240 effect sizes extracted from the 73 primary studies.

Table 3. WLS Meta-Regression Results (Dependent Variable: Hedge's g)

Predictor Variable	Coefficient	Robust SE	t-statistic	p-value	95% Confidence Interval
Intercept	0.38	0.09	4.22	< 0.001	[0.20, 0.56]
GPR Shock (vs. COVID-19)	-0.94	0.11	-8.55	< 0.001	[-1.16, -0.72]
% ESG-Mandated Funds	0.67	0.18	3.72	< 0.001	[0.31, 1.03]
Insurer Dominance	-0.08	0.14	-0.57	0.569	[-0.36, 0.20]
Third-Party Verification	0.41	0.15	2.73	0.007	[0.11, 0.71]
Emerging Market (EM)	-0.52	0.13	-4.00	< 0.001	[-0.78, -0.26]
Publication Year	0.01	0.02	0.50	0.617	[-0.03, 0.05]



Model Fit:  $R^2 = 0.67$ , Adjusted  $R^2 = 0.64$ ,  $N$  (effect sizes) = 240,  $k$  (studies) = 73. Standard errors clustered at the study level.

## 5. DISCUSSION

### 5.1 Interpretation of Key Findings

Our results resolve three long-standing disputes in the green bond literature. First, the asymmetric resilience puzzle is explained. The WLS meta-regression (Table 3) demonstrates that this is not an artifact of sample selection. The GPR coefficient ( $-0.94$ ,  $p < 0.001$ ) remains large and highly significant even after controlling for investor composition and verification status. This supports the theoretical premise that geopolitical shocks erode the non-pecuniary utility weight derived from environmental holdings by shifting macro policy focus toward traditional energy security and fracturing international climate consensus (Sheenan, 2023). In practical terms, when oil prices spike due to military conflict, renewable infrastructure becomes relatively less attractive, and capital flees to conventional safe havens.

Second, regarding investor heterogeneity, the meta-regression confirms that not all institutional investors behave identically under structural duress. ESG-mandated mutual funds provide a genuine protective shield (coefficient  $0.67$ ,  $p < 0.001$ ), consistent with binding mandate penalties that raise the behavioral cost of liquidating green holdings (Fatica & Panzica, 2024). Conversely, insurance companies — characterized by long-duration liabilities and buy-and-hold strategies — show no differential behavior (coefficient  $-0.08$ , statistically insignificant). This explains why studies that aggregate across all institutional investors find weaker or mixed resilience effects: the protective effect is concentrated in mandate-bound funds, not universal institutional asset structures (Becker & Ivashina, 2015; Fatica & Panzica, 2024).

Third, the corporate value paradox is resolved. Table 2 shows that the global average financial effect of green bond issuance is zero only because positive effects in developed markets ( $g = 0.18$ ) cancel negative effects in emerging markets ( $g = -0.041$ , Flammer, 2021). Similarly, market-based metrics (Tobin's  $Q$ ) capture immediate signaling benefits ( $g = 0.22$ ), while accounting-based metrics (ROA/ROE) show delayed or absent operational effects ( $g = -0.03$ , Khan & Vismara, 2025).

### 5.2 Comparison with Prior Literature

Our findings reconcile the conflicting paradigms identified in the literature review. Fatica and Panzica (2024) documented robust COVID-19 resilience — we confirm this ( $g = 0.42$ ) but show it is conditional on

investor mandate intensity. Sheenan (2023) documented severe GPR vulnerability — we confirm this ( $g = -0.57$ ) and identify the transmission channel through input cost shocks. Khan and Vismara (2025) found negligible average financial effects — we show this masks strong moderation by market maturity and metric type. Importantly, our WLS meta-regression explains 67% of between-study heterogeneity ( $R^2 = 0.67$ ), which is exceptionally high for meta-analyses in finance, proving that the primary sources of disagreement in the literature have been successfully captured.

### 5.3 Why Not a True "Safe Haven"?

Based on these findings, we propose that the unconditional use of the term "safe haven" should be abandoned in regulatory and academic discourse regarding sustainable fixed income. Green bonds are more accurately defined as **ESG-sentiment-conditional safe havens** — assets that deliver strong portfolio defense only when an exogenous crisis reinforces sustainable sentiment and regulatory trajectory (Arat et al., 2023; Fatica & Panzica, 2024), but remain highly exposed to systemic credit contagion when geopolitical shocks destabilize the international policy consensus (Sheenan, 2023).

### 5.4 Explicit Empirical Limitations

First, our FAT-PET test indicates residual publication bias (Egger's intercept =  $1.8$ ,  $p = 0.04$ ); null results for green bond financial underperformance are likely underreported in mainstream sustainability literature. Second, the primary studies exhibit moderate-to-high heterogeneity ( $I^2 = 68\% - 72\%$  in Table 1), typical for meta-analyses in finance but limiting point estimate precision. Third, we could not control for explicit bond credit ratings (AAA vs. high-yield) due to inconsistent reporting in primary studies. Fourth, our demand-system preference parameters are not structurally estimated; we test only their observable empirical implications across markets. Fifth, the causal link from macro GPR to corporate ROA is inferred from market-level bond returns rather than firm-level panel data.

## 6. POLICY AND REGULATORY IMPLICATIONS

### 6.1 Taxonomy and Standard Harmonization

Third-party certification emerges as a significant positive moderator in our framework (Table 3: coefficient  $0.41$ ,  $p = 0.007$ ). However, external



certification costs in emerging markets (averaging USD 180k–320k per issuance) currently erode post-issuance financial benefits, driving the negative EM effect size ( $g = -0.041$  in Table 2) (Khan & Vismara, 2025). Standardizing frameworks globally — such as aligning international regional rules with the EU Green Bond Standard — is essential to reduce validation friction that financially penalizes EM corporate entities.

### 6.2 Central Bank Haircut Frameworks

Central bank collateral programs (e.g., the European Central Bank's asset purchase frameworks) currently treat green and conventional bonds symmetrically. Our findings suggest this layout is suboptimal. Green bonds exhibit distinct volatility profiles under different crisis regimes: lower volatility during health crises ( $g = 0.42$ ) but higher vulnerability during GPR episodes ( $g = -0.57$ ). During geopolitically induced market turmoil, central banks should implement dynamic, asset-class-specific haircuts to safeguard monetary reserves against cross-market contagion.

### 6.3 Disclosure Requirements and Mandate Design

Regulatory instruments like the EU Sustainable Finance Disclosure Regulation (SFDR) increase the density of mandate-bound institutional capital. However, standard-setters must ensure these rules incentivize genuine non-pecuniary environmental preferences rather than superficial compliance. Our meta-regression shows that the protective effect is real (coefficient 0.67 for ESG mandate share) but operates only when mandates are strictly binding. If green bond demand is driven by superficial compliance rather than deep intrinsic preferences, the protective safe-haven shield will fail during major risk-off liquidations.

## 7. CONCLUSION

By integrating micro-level institutional holdings data, macro regime-switching VAR models, and a formal WLS meta-regression analysis of 240 effect sizes, this paper delivers a comprehensive assessment of green bond crisis dynamics. We demonstrate that green bond market resilience is strictly investor-class-specific, shock-type-conditional, and credibility-moderated. Mandate-driven mutual funds provide a robust defense during sentiment-aligned crises, whereas geopolitical shocks severely destabilize green returns by triggering credit market contagion and fracturing global supply chains.

Furthermore, our meta-regression demonstrates that while the greenium systematically lowers corporate cost of capital, it does not improve operational profitability

metrics like ROA in emerging markets. The global average financial effect is zero only because positive effects in developed markets ( $\mu = 0.18$ ) cancel negative effects in emerging markets ( $\mu = -0.041$ ). For policymakers, harmonized certification standards are the single most impactful intervention to eliminate emerging market friction. For investors, treating green bonds as a uniform asset class is a strategic error; hedging GPR exposure requires explicit commodity price hedging or diversification across DM issuers with vertically integrated supply chains

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