

From Green-Bond Valuation and Climate-Risk Integration to Investor Stewardship and ESG Credibility

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Abstract

This paper examines the development of sustainable finance through three interconnected dimensions: green bonds, climate-related financial mechanisms, and responsible investment. The literature shows that green bonds have evolved from a specialised financing instrument into a broader mechanism for mobilising capital, signalling environmental commitments, and supporting corporate and public sustainability strategies. However, their financial characteristics remain conditional on market liquidity, issuer credibility, certification, institutional arrangements, and investor preferences. Sustainable finance also extends beyond labelled securities because climate-related physical and transition risks increasingly affect conventional asset prices, banking systems, financial stability, and corporate financing decisions. At the investor level, environmental, social, and governance considerations influence portfolio construction through screening, ESG integration, engagement, stewardship, and impact objectives. Nevertheless, the effectiveness of these strategies is complicated by substantial disagreement among ESG rating providers and by differences in investor objectives. The literature therefore suggests that sustainable finance cannot be assessed exclusively through issuance volumes, ESG scores, or short-term financial performance. Its development depends on the interaction between credible environmental information, financial institutions, corporate behaviour, investor preferences, and regulatory frameworks capable of improving comparability and limiting greenwashing.

Keywords: Green bonds; Sustainable finance; ESG; Responsible investment; Climate risk

JEL classification: G11; G12; G23; Q54; Q56

Introduction

The expansion of sustainable finance has progressively altered the relationship between financial decision-making and environmental objectives. Green bonds have become one of the most visible instruments associated with this development because they enable governments, corporations, municipalities, and financial institutions to finance projects presented as environmentally beneficial. Yet the significance of green bonds extends beyond the allocation of proceeds. The literature shows that their development depends on institutional credibility, regulatory frameworks, investor demand, certification, transparency, and the capacity of issuers to demonstrate that financed activities correspond to identifiable environmental objectives. Questions



concerning the existence and magnitude of a green-bond premium further indicate that sustainability characteristics interact with conventional determinants of fixed-income valuation rather than replacing them. Liquidity, credit quality, issuer type, maturity, macroeconomic conditions, and market development continue to influence yields and diversification opportunities. Research has consequently moved from documenting the emergence of green securities toward examining their pricing, market integration, credibility, and real environmental effects. This evolution has created a broader research agenda in which environmental finance is evaluated not only according to the volume of sustainable securities issued but also according to the extent to which such instruments modify corporate behaviour, financing conditions, investor composition, and environmental outcomes.

At the same time, sustainable finance has become increasingly connected with questions of climate risk, financial stability, corporate sustainability, and responsible investment. Climate change creates physical and transition risks capable of affecting firms, banks, sovereign borrowers, asset prices, and public finances. Sustainable finance therefore encompasses both the mobilisation of capital toward environmentally compatible activities and the management of risks generated by existing exposure to carbon-intensive sectors. This broader perspective has also strengthened the role of institutional investors, whose decisions increasingly incorporate ESG information through portfolio selection, engagement, stewardship, and risk-management processes. Yet the growing importance of ESG information has revealed substantial measurement difficulties. Sustainability ratings frequently differ because providers use different definitions, indicators, scopes, and weighting procedures, while investors themselves may pursue different combinations of financial performance, sustainability preferences, and impact objectives. The resulting literature presents sustainable finance as an institutional and financial architecture rather than a distinct collection of green products. Green securities, climate-risk pricing, corporate sustainability, investor preferences, and ESG measurement are closely connected components of a financial system in which environmental considerations increasingly influence both capital allocation and conventional assessments of risk and value.

1. Green Bonds: Market Development, Pricing and Financial Effects

1.1. Green-bond market formation, institutions and development

Maltais and Nykvist (2021) imply that green bonds should be understood not only as financing instruments but also as organisational mechanisms through which issuers can structure sustainability objectives, communicate environmental commitments, and deepen relationships with environmentally oriented investors. This perspective connects with Tolliver et al. (2020), who show that green-bond market expansion depends partly on credible national climate commitments and broader institutional conditions. Their findings suggest that public policy can create the environment in which labelled sustainable debt becomes scalable by supporting a credible pipeline of green investment. Tu et al. (2020) reinforce this institutional dimension in the Vietnamese context by showing that legal frameworks, policy incentives, and supportive financial conditions are important for developing a viable green-bond market. Cheong and Choi (2020) add that market expansion has involved a wide range of issuers, including governments, corporations, municipalities, and financial institutions, while transparency and standardisation remain necessary for further development. Taken together, these contributions imply that green-bond growth depends on interactions between issuer strategy, investor demand, public climate commitments, and institutional infrastructure. Environmental preferences alone are insufficient to sustain market development unless credible policies and regulatory conditions allow green projects to be converted into transparent and investable financial instruments.



MacAskill et al. (2021) imply that the existence of a green-bond premium is conditional rather than universal, since evidence of a greenium varies according to methodology, issuer characteristics, certification, security features, and market conditions. Liaw (2020) provides a related implication by showing that green bonds can trade at somewhat lower yields in certain markets, while investor demand may also reflect environmental mandates and sustainability objectives that extend beyond conventional risk-adjusted returns. Gilchrist et al. (2021) add that such pricing effects cannot be separated from market credibility because taxonomy problems, information asymmetry, verification requirements, and greenwashing risks influence how investors interpret green labels. Bhutta et al. (2022) reinforce this qualification by showing that certification, pricing, investor demand, and environmental impact remain central areas of debate in the green-bond literature. Together, these contributions imply that the financial value attached to a green label depends on the reliability of the institutional mechanisms supporting it. Investors may accept modestly lower yields when environmental attributes correspond to their preferences or mandates, but the persistence of such pricing differences depends on credible verification, transparent project classification, and confidence that labelled securities finance genuinely environmental activities rather than merely repackage conventional investment.

Cortellini and Panetta (2021) imply that the rapid growth of green-bond research has not eliminated uncertainty about the environmental effectiveness of labelled debt because definitions, methodologies, and measures of additionality remain fragmented. This implication connects with Bhutta et al. (2022), who distinguish the expansion of green-bond issuance from the more demanding question of whether financed activities actually generate additional environmental benefits. Gilchrist et al. (2021) similarly show that taxonomies, verification, disclosure, and protection against greenwashing are central to determining whether green finance produces substantive environmental outcomes. MacAskill et al. (2021) add that certification and institutional credibility also help explain variation in the green-bond premium, indicating that environmental integrity can have financial consequences for investors and issuers. Considered together, these contributions imply that the maturity of the green-bond market should not be evaluated solely by issuance volumes or pricing patterns. A credible sustainable-finance market requires evidence that proceeds are directed toward meaningful environmental projects, that external labels and verification mechanisms are reliable, and that reported outcomes can be compared across issuers. Financial expansion and environmental effectiveness therefore remain related but distinct dimensions of green-bond development.

1.2. Green-bond pricing, yield differentials and the greenium

Larcker and Watts (2020) imply that the existence of a greenium cannot be assumed independently of empirical design, since their comparison of closely matched municipal securities produces an effectively zero pricing premium. This finding provides an important qualification to Zerbib (2019), who identifies a small but statistically significant negative yield differential between green bonds and comparable conventional securities, suggesting that environmental preferences can influence fixed-income prices without radically changing traditional bond valuation. Hachenberg and Schiereck (2018) further reinforce the heterogeneous nature of this relationship by showing that pricing differences vary across issuer categories and credit-quality segments rather than reflecting a uniform environmental premium. Karpf and Mandel (2018) add a temporal dimension by demonstrating that the value associated with green labels changes over time as market conditions, investor participation, liquidity, and labelling practices evolve. Taken together, these contributions imply that green-bond pricing should be interpreted as a conditional market outcome rather than a permanent characteristic of sustainable debt. Inves-



tor preferences can generate yield differences, but their magnitude depends on security matching, conventional credit characteristics, issuer type, and the stage of market development. Estimates obtained in one market, period, or institutional setting should therefore not be generalized as evidence of a universal green financing advantage.

Hyun et al. (2020) imply that the pricing consequences of green bonds depend partly on the credibility of environmental claims, since external reviews and certification strengthen the premium investors attach to labelled securities. This implication connects with Bachelet et al. (2019), who show that pricing differences vary according to issuer characteristics and third-party verification, indicating that investors distinguish between environmental claims supported by credible institutional mechanisms and those receiving weaker external assurance. Fatica et al. (2021) broaden this argument by demonstrating that issuer type also conditions green-bond pricing, particularly among financial institutions, suggesting that reputation and the capacity to originate credible environmental assets influence how the market evaluates green debt. Gianfrate and Peri (2019) complement these findings from the issuer perspective by showing that issuing green rather than conventional bonds can reduce financing costs. Together, these contributions imply that the green label acquires financial value when investors have sufficient confidence that proceeds are genuinely associated with environmental activities. Certification, external verification, issuer reputation, and institutional characteristics can therefore reduce information asymmetry and increase investors' willingness to accept lower yields, while less credible labelling may provide a weaker financing advantage. Greenium formation consequently depends on governance mechanisms that transform environmental claims into verifiable characteristics of the security.

Nanayakkara and Colombage (2019) imply that investor demand for environmentally labelled securities can influence bond prices across international markets, since their evidence identifies a pricing advantage for green bonds after controlling for conventional security characteristics. Zerbib (2019) provides a related explanation by directly linking the negative yield differential of green securities to investors' pro-environmental preferences, while emphasizing that the resulting premium remains economically modest and varies across bond characteristics. Gianfrate and Peri (2019) extend this demand-side mechanism to corporate financing by showing that lower investor-required yields can translate into reduced borrowing costs for green issuers. Fatica et al. (2021), however, demonstrate that this financing advantage is not uniform across issuer categories, indicating that the market combines environmental attributes with traditional assessments of institutional quality and issuer characteristics. Considered together, these contributions imply that sustainability-oriented investor preferences can affect the cost of debt, but the resulting greenium remains embedded within conventional fixed-income valuation. Environmental demand may increase willingness to hold green securities at lower yields, yet issuer quality, security characteristics, institutional credibility, and market composition continue to determine the size of that effect. Green-bond pricing therefore represents an interaction between sustainability preferences and traditional credit-market fundamentals rather than a separate valuation system.

1.3. Liquidity, spillovers, shareholder value and environmental effects

Reboredo and Ugolini (2020) imply that green bonds should be considered part of an interconnected financial system rather than an isolated sustainable asset class, since their prices respond to developments in conventional fixed-income and currency markets. This perspective connects with Reboredo (2018), who shows that green bonds are strongly linked to traditional bond markets while displaying weaker relationships with some other asset classes, making diversification benefits conditional on the assets included in the portfolio and prevailing market



conditions. Broadstock and Cheng (2019) reinforce this interpretation by demonstrating that the relationship between green and conventional bond benchmarks varies over time and is influenced by macroeconomic conditions. Febi et al. (2018) add a market-microstructure dimension by showing that liquidity risk helps explain green-bond yield spreads and should therefore be distinguished from pricing effects attributed to environmental preferences. Taken together, these contributions imply that green-bond valuation and diversification cannot be understood through environmental characteristics alone. Interest-rate conditions, liquidity, macroeconomic developments, and cross-market transmission remain important determinants of performance. Apparent green premiums may partly reflect conventional market frictions, while diversification opportunities may weaken or strengthen as broader financial conditions change. Sustainable fixed-income investment therefore remains embedded within the same macro-financial and liquidity mechanisms influencing conventional debt markets.

Flammer (2021) implies that corporate green bonds can influence firm value and environmental performance simultaneously, since issuance announcements are associated with positive stock-market responses and are followed by improved environmental outcomes, particularly for first-time issuers and independently certified securities. Tang and Zhang (2020) provide a related shareholder perspective by showing that green-bond issuance generates favorable market reactions and can alter the investor base and corporate visibility rather than producing benefits solely through lower borrowing costs. Baulkaran (2019) reinforces this signaling mechanism by documenting positive shareholder responses to green-bond announcements, suggesting that investors may interpret labelled financing as evidence of environmental commitment, reputational improvement, or access to sustainability-oriented capital. Benlemlih et al. (2023) extend the argument to real corporate behavior by associating green-bond financing with improvements in energy-related environmental outcomes. Together, these contributions imply that the economic significance of green issuance extends beyond bond pricing. Green bonds can communicate environmental commitments to shareholders, attract sustainability-oriented investors, and support changes in corporate environmental trajectories. Their contribution to value is therefore more credible when market signals are accompanied by observable improvements in energy use, emissions, or broader environmental performance rather than remaining confined to the financing label itself.

Pham (2016) implies that the financial characteristics of green bonds should be evaluated through volatility as well as yields and average returns, since risk dynamics differ across market segments and evolve over time. This temporal perspective complements Broadstock and Cheng (2019), who show that relationships between green and conventional bond markets are not stable but respond to changing macroeconomic conditions. Reboredo (2018) further demonstrates that green-bond diversification benefits depend on the strength of co-movement with conventional financial assets, meaning that portfolio advantages can vary as market relationships change. Febi et al. (2018) add that differences in liquidity contribute to yield spreads, reinforcing the need to distinguish environmental pricing from conventional sources of financial risk. Considered together, these contributions imply that green bonds should be assessed as evolving financial assets whose risk-return properties depend on liquidity conditions, volatility regimes, macroeconomic developments, and integration with traditional markets. Environmental labelling does not remove exposure to ordinary financial risks, and observed differences from conventional bonds may change as the green market matures. Investors therefore need to evaluate sustainable fixed-income allocations dynamically, accounting for market depth, volatility transmission, and shifting cross-market relationships rather than assuming stable diversification or pricing advantages.



2. Sustainable Finance: Financial Architecture, Climate Risk and Corporate Sustainability

2.1. Green financial architecture, central banks and financial stability

Battiston et al. (2017) imply that sustainable finance must address not only the mobilisation of capital toward low-carbon activities but also the financial vulnerabilities created by existing exposures to carbon-intensive sectors. Their climate stress-testing framework shows that abrupt policy changes can generate asset revaluations and transmit losses through interconnected institutions. Dafermos et al. (2018) extend this implication by demonstrating within a macro-financial framework that climate-related damages can weaken firms and banks, affect credit creation, and ultimately influence wider economic performance. Lamperti et al. (2019) add a public-finance dimension by showing that climate-induced banking distress can generate fiscal costs when governments are required to support the financial system. Campiglio et al. (2018) place these mechanisms within the responsibilities of central banks and regulators by emphasizing that physical and transition risks can threaten financial stability even when environmental policy lies outside their primary mandates. Taken together, these contributions imply that climate change enters financial policy through several interconnected channels. Environmental shocks can alter asset values, weaken borrower balance sheets, affect bank resilience, and generate public intervention costs. Sustainable finance therefore requires forward-looking risk assessment capable of linking sectoral exposures, financial interconnectedness, credit dynamics, and macroeconomic consequences rather than treating climate considerations exclusively as questions of green investment allocation.

Campiglio (2016) implies that financing the low-carbon transition requires attention to the structure of banking and monetary systems because bank credit creation substantially influences which technologies and productive activities receive financing. This perspective connects with Wang and Zhi (2016), who argue that environmental externalities and information problems prevent private financial markets from directing capital efficiently toward green activities without appropriate public incentives and institutional frameworks. D'Orazio and Popoyan (2019) extend the argument toward macroprudential regulation by examining whether capital requirements and related tools can simultaneously address climate-related financial risks and influence green credit allocation. Their findings highlight the tension between maintaining risk-based prudential principles and using regulation to redirect financing. Dikau and Volz (2021) provide the institutional qualification by showing that central banks differ considerably in their sustainability mandates and that climate-related actions must be distinguished between measures justified by core price- and financial-stability objectives and more proactive environmental policies requiring broader political authorization. Together, these contributions imply that the transition toward sustainable finance cannot rely on market demand alone. Credit allocation, public policy, prudential regulation, and institutional mandates jointly determine the extent to which financial systems support low-carbon investment while preserving financial stability and respecting the boundaries of monetary and supervisory authority.

Monasterolo and Raberto (2018) imply that sovereign green bonds should be evaluated within a broader macro-financial policy framework because their effects depend on interactions among households, firms, banks, government, and financial markets. Their model suggests that labelled sovereign debt can support environmentally oriented public expenditure while simultaneously affecting investment, public debt, and wider macroeconomic conditions. Wang and Zhi (2016) provide a complementary institutional interpretation by arguing that green finance requires coordinated market incentives, government guidance, and policy frameworks capable



of overcoming environmental externalities and information problems. Campiglio (2016) further shows that securities-based financing alone is insufficient because bank lending, collateral structures, and monetary conditions continue to shape the availability of capital for low-carbon activities. Dikau and Volz (2021) add that the role of central banks in supporting this transition depends on formal mandates and on whether climate considerations can be linked to existing responsibilities for financial and price stability. Considered together, these contributions imply that green bonds form only one component of a wider sustainable-finance architecture. Their capacity to support the transition depends on how labelled debt interacts with fiscal policy, bank credit, monetary arrangements, regulatory institutions, and public sustainability objectives rather than on issuance volumes considered independently.

2.2. Climate risk, asset pricing and investor exposure

Bolton and Kacperczyk (2021) imply that climate exposure is already embedded in conventional asset pricing, since firms with higher carbon emissions earn higher returns after controlling for standard risk factors, consistent with investors requiring compensation for carbon-related risk. Painter (2020) extends this implication to fixed-income markets by showing that U.S. municipal issuers facing greater climate exposure incur higher borrowing costs, particularly at longer maturities where future environmental damages become more relevant. Ilhan et al. (2021) add a downside-risk perspective by demonstrating that carbon-intensive firms exhibit greater option-implied tail risk when climate-policy uncertainty becomes salient, indicating that transition concerns affect not only average expected returns but also the perceived probability of severe losses. Hong et al. (2020) place these mechanisms within the broader field of climate finance, emphasizing that climate risk affects equities, bonds, corporate decisions, and financial institutions rather than only explicitly labelled green assets. Taken together, these contributions imply that climate change modifies financial valuation through several channels simultaneously. Carbon intensity, physical exposure, policy uncertainty, and long-horizon environmental vulnerability can influence required returns, borrowing costs, and downside protection, meaning that climate considerations increasingly affect the pricing of ordinary financial assets as well as dedicated sustainable investments.

Pástor et al. (2021) imply that sustainable asset prices reflect both financial risk and investor preferences because investors may accept lower expected returns on greener assets when they derive utility from their environmental characteristics. Their framework also explains why green assets can experience strong realised performance when environmental preferences increase unexpectedly. Krueger et al. (2020) provide direct evidence that institutional investors increasingly view climate risk as financially material and incorporate it into risk management, engagement, and investment decisions, suggesting that sustainable demand cannot be reduced to ethical preferences alone. Choi et al. (2020) add a behavioural dimension by showing that unusually warm local weather increases investor attention to global warming and affects trading and pricing in climate-relevant firms. Engle et al. (2020) further demonstrate that climate-related news can be translated into market-based hedging strategies through portfolios whose returns respond to innovations in textual climate information. Together, these contributions imply that climate-related asset pricing emerges from interactions between preferences, perceived financial materiality, investor attention, and changing information. Investor demand for sustainable assets can therefore vary even when underlying corporate fundamentals remain unchanged, while climate news and salient experiences can alter both portfolio positioning and the market prices assigned to environmental exposure.

Giglio et al. (2021) imply that climate finance should be understood as an extension of mainstream financial economics because physical and transition risks affect asset pricing, hedging,



corporate finance, real estate, and institutional investment across multiple markets. Their synthesis emphasizes that long horizons, evolving regulation, and limited historical experience make climate-risk measurement particularly difficult. Engle et al. (2020) address part of this challenge by constructing climate-news measures and identifying portfolios capable of hedging innovations in climate information, suggesting that investors can infer relevant exposures from market data rather than relying exclusively on static sector classifications. Hong et al. (2020) similarly emphasize that climate finance concerns the response of conventional financial assets and institutions to environmental risks as much as the development of explicitly green securities. Krueger et al. (2020) add that institutional investors already incorporate these risks into practical decision-making, although insufficient disclosure and regulatory uncertainty remain important obstacles. Considered together, these contributions imply that effective climate-risk management requires forward-looking information, adaptable measurement techniques, and institutional capacity to incorporate uncertain environmental developments into existing financial processes. Sustainable finance therefore involves not only allocating capital toward green activities but also identifying, pricing, and managing climate exposure throughout conventional portfolios.

2.3. Corporate sustainability, ESG and financial outcomes

Khan et al. (2016) imply that the financial relevance of sustainability depends primarily on materiality rather than on the indiscriminate accumulation of ESG activities, since firms performing strongly on financially material sustainability issues subsequently achieve better accounting and market outcomes, while performance on immaterial issues has weaker effects. This implication connects with Friede et al. (2015), whose synthesis of more than 2,000 empirical studies shows that most documented ESG–financial-performance relationships are non-negative, although the heterogeneity of sustainability dimensions prevents a universal interpretation. Flammer (2015) strengthens the value-creation argument by showing through close shareholder votes that narrowly approved CSR proposals can improve firm value and operating performance, particularly where prior CSR engagement is relatively weak. Ferrell et al. (2016) add a governance mechanism by demonstrating that better-governed firms tend to exhibit stronger CSR and that responsible behavior is positively associated with firm value. Taken together, these contributions imply that sustainability can support financial performance when ESG investments address economically relevant stakeholder and operational issues and are implemented within governance structures capable of limiting managerial overinvestment. The economic case for responsible investment therefore rests on the strategic selection, governance, and materiality of sustainability initiatives rather than on the assumption that every ESG expenditure generates equivalent shareholder benefits.

Albuquerque et al. (2019) imply that CSR can create financial value through a risk channel because responsible firms may develop stronger customer loyalty and greater product differentiation, reducing the sensitivity of cash flows to aggregate economic fluctuations. Lins et al. (2017) provide related evidence during the global financial crisis by showing that firms with stronger pre-crisis CSR experienced better stock returns, profitability, and sales growth when trust became particularly scarce. Their findings suggest that stakeholder capital accumulated before a shock can support resilience when ordinary confidence mechanisms weaken. Dyck et al. (2019) extend this relationship toward institutional ownership by demonstrating that investors, especially those originating from countries with stronger environmental and social norms, can encourage portfolio companies to improve sustainability performance. Touil et al. (2024) provide an operational complement by showing among Moroccan companies that sustainable



contracting, green technologies, sourcing management, transparency, and traceability are associated with stronger financial performance. Together, these contributions imply that sustainable finance can affect corporate value through several linked mechanisms: stakeholder trust can reduce vulnerability during crises, institutional investors can influence managerial behavior, and sustainability-oriented operating practices can improve efficiency and transaction management. ESG-related capital therefore becomes economically meaningful when it supports organizational changes that strengthen cash flows and resilience.

Touil et al. (2023) imply that the translation of sustainable capital into environmental action depends on firm-level incentives and stakeholder conditions, since economic and energy efficiency, stakeholder pressure, and profitability encourage green-supply-chain adoption among Moroccan SMEs, while government incentives become relevant through their interaction with stakeholder pressure. This real-economy perspective connects with Dyck et al. (2019), who show that institutional investors can transmit environmental and social expectations to portfolio companies and thereby encourage changes in corporate sustainability practices. Ferrell et al. (2016) add that stronger governance is associated with greater CSR and higher firm value, suggesting that sustainability-oriented capital is more likely to generate economic benefits when managerial decisions are effectively monitored. Friede et al. (2015) provide the broader empirical context by showing that ESG integration is generally compatible with financial performance, while cautioning against interpreting this pattern as evidence that every sustainability intervention produces gains. Considered together, these contributions imply that the financial system influences sustainability not only through the pricing of labelled securities but also through the conditions under which firms adopt greener operating practices. Stakeholder pressure, governance, efficiency incentives, and active ownership determine whether capital directed toward sustainability is converted into substantive corporate change with potential financial consequences.

3. Responsible Investment: Investor Preferences, Stewardship and ESG Measurement

3.1. SRI, investor preferences and investment performance

Riedl and Smeets (2017) imply that responsible investment demand cannot be explained solely through conventional risk–return optimization, since investors may deliberately hold socially responsible funds even without expecting superior financial performance. Bauer et al. (2021) reinforce this preference-based interpretation by showing that pension participants support more sustainable investment policies when they are given an opportunity to express and implement those preferences in a setting with real financial implications. Barber et al. (2021) extend this mechanism to private-market impact investing, where mission-oriented investors may accept lower expected financial returns in exchange for social or environmental outcomes they value. Gutsche and Ziegler (2019) add that willingness to accept such financial trade-offs varies substantially across individuals, reflecting heterogeneous preferences and personal characteristics. Taken together, these contributions imply that sustainable investment markets contain investors with different utility functions rather than a homogeneous group seeking identical financial outcomes. Environmental and social attributes can therefore enter portfolio choice as objectives in their own right, while the willingness to sacrifice conventional financial performance differs across investors. This heterogeneity helps explain why sustainable and conventional products coexist and why growing demand for responsible assets does not necessarily generate a uniform pricing effect or identical investment strategy across market participants.



Hartzmark and Sussman (2019) imply that sustainability information can redirect capital when it becomes sufficiently visible and easy for investors to interpret, since the introduction of Morningstar sustainability ratings generated substantial flows toward highly rated funds and withdrawals from poorly rated alternatives. Halbritter and Dorfleitner (2015), however, show that ESG measurement is not neutral, because financial conclusions vary according to the rating dataset and methodology employed. This creates an important qualification for information-based capital allocation: investors may respond strongly to sustainability scores even though alternative providers can classify the same underlying firms differently. Auer and Schuhmacher (2016) reinforce the need for caution by finding limited evidence that ESG-based investment strategies consistently generate abnormal returns after conventional market risks are considered, with results varying across regions and ESG dimensions. Revelli and Viviani (2015) provide a broader synthesis showing that socially responsible investment does not produce a universal performance premium or penalty and that outcomes depend on methodology, geography, screening design, and performance measurement. Together, these studies imply that ESG information can meaningfully influence investor demand without guaranteeing superior portfolio returns. Sustainable-investment outcomes therefore depend on the quality and construction of ESG metrics, the way sustainability information is communicated, and the specific portfolio rules through which investors translate those signals into asset allocation.

Henke (2016) implies that responsible screening can have financial relevance in fixed-income portfolios because socially responsible bond funds may outperform conventional counterparts when exclusion criteria help identify issuers exposed to risks not fully captured by standard credit measures. This result contrasts usefully with Auer and Schuhmacher (2016), who find limited evidence that ESG-based selection consistently produces abnormal performance across international investment strategies, suggesting that the financial usefulness of sustainability information depends on asset class, region, and ESG dimension. Revelli and Viviani (2015) reinforce this conditional interpretation by showing through meta-analysis that responsible investment has neither a universal advantage nor an inevitable cost, with performance varying according to screening methodology and empirical design. Barber et al. (2021) add that some investors intentionally accept financial concessions when pursuing measurable environmental or social impact, meaning that observed responsible-investment performance should not always be judged against an objective of return maximization alone. Considered together, these contributions imply that sustainable portfolio performance reflects several distinct investment motives. ESG information can support risk identification and security selection in some settings, while other strategies primarily satisfy investor preferences or impact objectives. The financial consequences of responsible investment therefore depend on whether sustainability is used as a risk-management signal, a screening criterion, or an explicit non-financial objective.

3.2. Institutional ownership, engagement and stewardship

Amel-Zadeh and Serafeim (2018) imply that ESG information has become embedded in mainstream investment practice because professional investors increasingly use sustainability data to assess financial materiality, risk, and corporate quality rather than treating it solely as an ethical consideration. van Duuren et al. (2016) reinforce this interpretation by showing that asset managers often incorporate ESG information into conventional fundamental investment processes, using it to refine valuation and identify risks. Dimson et al. (2015) extend the implication from information use to active ownership by demonstrating that successful ESG engagements are followed by improvements in operating performance, profitability, governance, and abnormal returns. Hoepner et al. (2024) further show that successful shareholder engagement,



particularly on environmental issues, can reduce downside risk. Taken together, these contributions imply that responsible investment can operate through both security analysis and post-investment stewardship. ESG information can improve the assessment of firm-specific risks and management quality, while engagement can alter corporate practices after investors acquire ownership positions. The financial relevance of responsible investment therefore does not depend exclusively on screening firms into or out of portfolios; it can also arise when investors use sustainability information to strengthen valuation decisions and subsequently exercise ownership rights to improve governance, reduce downside exposure, and support changes with potential financial consequences.

Azar et al. (2021) imply that large diversified institutional investors can influence corporate environmental outcomes because stronger ownership by major asset managers is associated with subsequent reductions in carbon emissions, particularly when incentives for engagement are greater. Chen et al. (2020) provide a broader governance mechanism by showing that institutional ownership can causally improve corporate social responsibility, supporting the view that shareholders influence sustainability through monitoring rather than merely selecting firms that already perform well. Barko et al. (2022) reinforce this implication by demonstrating that targeted ESG engagement can improve corporate sustainability performance when investors concentrate efforts on firms and issues where intervention has a realistic probability of success. Dimson et al. (2015) similarly show that coordinated shareholder engagement is more likely to succeed and can be followed by favorable operating and market outcomes. Together, these contributions imply that institutional investors can affect sustainability through governance channels that extend beyond portfolio reallocation. Ownership creates opportunities to influence management, coordinate with other shareholders, and target specific environmental or social deficiencies. Responsible investment can therefore alter corporate behavior without requiring immediate divestment, while the effectiveness of engagement depends on investor incentives, coordination, target selection, and the capacity of firms to implement change.

Gibson Brandon et al. (2022) imply that public commitments to responsible investment should be distinguished from actual portfolio behavior, since institutional investors vary considerably in the extent to which their holdings correspond with their stated sustainability principles. This credibility issue connects with Amel-Zadeh and Serafeim (2018), who show that investment professionals regard inconsistent ESG information and limited comparability as major obstacles to effective integration. Reliable stewardship therefore requires both credible investor behavior and sufficiently decision-relevant sustainability information. Barko et al. (2022) add that engagement provides observable evidence of responsible ownership when investors actively intervene to improve environmental, social, or governance outcomes rather than relying only on public commitments. Hoepner et al. (2024) further demonstrate that successful engagement can reduce downside risk, indicating that stewardship can produce financially relevant consequences rather than merely symbolic improvements in ESG indicators. Considered together, these contributions imply that the credibility of responsible investment depends on consistency between declared principles, portfolio allocation, information use, and active ownership practices. Institutional investors strengthen the economic legitimacy of ESG integration when sustainability commitments are reflected in actual investment decisions and engagement activities that generate measurable corporate or risk-related outcomes.

3.3. ESG ratings, measurement uncertainty and portfolio consequences

Avramov et al. (2022) imply that uncertainty surrounding firms' ESG profiles has direct consequences for portfolio allocation and asset pricing because disagreement among rating providers



can increase required market premia, reduce investor demand, and alter the relationship between sustainability characteristics and expected performance. This perspective connects with Gibson Brandon et al. (2021), who show that ESG rating disagreement is itself associated with stock returns, transforming measurement inconsistency from a purely technical problem into an economically relevant source of uncertainty. Berg et al. (2022) provide the underlying explanation by demonstrating that divergence among major rating agencies arises from differences in measurement, scope, and weighting, with measurement choices accounting for a particularly important share of disagreement. Dorfleitner et al. (2015) offer earlier evidence of this problem by documenting limited convergence across alternative ESG rating methodologies applied to the same companies. Taken together, these contributions imply that sustainable investment decisions cannot rely on ESG scores as if they represented objectively observed corporate characteristics. Rating architecture influences how firms are classified, how investors perceive sustainability risk, and how securities are incorporated into portfolios. Measurement uncertainty can therefore affect both required returns and capital allocation, making methodological transparency and comparability central to the financial functioning of ESG markets.

Christensen et al. (2022) imply that increasing corporate sustainability disclosure does not necessarily resolve ESG measurement disagreement because rating agencies can interpret, classify, and weight additional information differently. Their findings suggest that comparability requires standardization of definitions and materiality judgments rather than disclosure volume alone. Widyawati (2020) reinforces this implication by documenting substantial heterogeneity in ESG concepts, data sources, and measurement methods across responsible-investment research, which can partly explain contradictory empirical findings concerning financial performance. Daugaard (2020) places this fragmentation within the broader evolution of sustainable investing, showing that the field has expanded from ethical screening toward climate risk, ESG integration, active ownership, and impact investing while retaining important differences in motives and methodologies. Pedersen et al. (2021) provide a portfolio interpretation by demonstrating that investors can rationally choose different ESG exposures according to expected returns, risk, sustainability preferences, and the informational content they assign to ESG characteristics. Together, these contributions imply that heterogeneity in sustainable investing reflects both measurement limitations and legitimate differences in investor objectives. Greater standardization can improve comparability, but it cannot eliminate variation arising from different financial beliefs, sustainability preferences, and interpretations of material ESG information within portfolio construction.

Broadstock et al. (2021) imply that ESG characteristics can become particularly relevant during periods of market stress, since stronger ESG performance among Chinese firms was associated with greater stock-price resilience during the COVID-19 crisis. This resilience mechanism connects with Pedersen et al. (2021), whose ESG-efficient-frontier framework shows that sustainability characteristics can enter portfolio decisions either as investor preferences or as signals containing information about fundamentals and risk. Gibson Brandon et al. (2021), however, demonstrate that the interpretation of those characteristics becomes more uncertain when rating providers disagree substantially, potentially affecting the returns investors require for holding securities. Avramov et al. (2022) formalize this relationship by showing that ESG uncertainty can reduce investor demand and modify expected premia, portfolio choice, and the financial consequences of sustainable investing. Considered together, these contributions imply that the portfolio value of ESG depends not only on underlying corporate sustainability but also on investors' confidence in how that sustainability is measured. ESG may provide information relevant to downside resilience, particularly during systemic shocks, yet disagreement over corporate classifications can weaken the ability of investors to identify and price those attributes



consistently. Sustainable portfolio construction therefore requires simultaneous consideration of ESG performance, financial risk, investor preferences, and uncertainty surrounding sustainability measurement.

4. Discussion

The literature first demonstrates that green bonds have acquired financial significance without becoming economically detached from conventional bond-market mechanisms. Zerbib (2019), Gianfrate and Peri (2019), Nanayakkara and Colombage (2019), and MacAskill et al. (2021) provide evidence consistent with the existence of a greenium in at least some market segments, suggesting that sustainability-oriented demand can reduce the yield required by investors. However, Larcker and Watts (2020) find an essentially zero premium when green and conventional municipal bonds are closely matched, while Hachenberg and Schiereck (2018) show that pricing differences vary across issuer categories and credit-quality segments. These results indicate that environmental preferences alone cannot explain green-bond valuation. Certification and external verification also matter, as shown by Hyun et al. (2020) and Bachelet et al. (2019), because credible assurance reduces uncertainty concerning the environmental use of proceeds. The market consequences of green issuance also extend beyond borrowing costs. Flammer (2021), Tang and Zhang (2020), and Baulkaran (2019) document favourable shareholder reactions, while Flammer (2021) and Benlemlih et al. (2023) connect issuance with subsequent environmental improvements. Green bonds can therefore function simultaneously as financing instruments, market signals, and mechanisms for supporting environmental changes, although their contribution depends on credible verification and observable environmental outcomes.

A second finding concerns the extension of sustainable finance from specialised green instruments toward the management and pricing of climate-related financial risk. Battiston et al. (2017), Dafermos et al. (2018), and Lamperti et al. (2019) demonstrate that climate shocks and transition policies can affect firms, banks, interconnected financial institutions, and public finances, which explains why Campiglio et al. (2018) place climate considerations within the responsibilities of financial regulators. The asset-pricing literature reaches a related conclusion. Bolton and Kacperczyk (2021) show that firms with higher carbon emissions command higher expected returns, while Painter (2020) finds that climate exposure influences municipal borrowing costs. Ilhan et al. (2021) further show that transition risk affects option-implied downside risk. These findings are consistent with Pástor et al. (2021), who demonstrate theoretically that sustainable asset prices reflect an interaction between risk and investor preferences. Krueger et al. (2020) confirm that institutional investors increasingly perceive climate change as financially material and incorporate it into investment practices. Sustainable finance must therefore be interpreted in two directions: capital can be redirected toward greener economic activities, but investors and financial institutions must simultaneously identify and manage the risks attached to carbon exposure, climate policy, environmental damage, and changing investor preferences.

The third major result is that responsible investment increasingly operates through information use, portfolio construction, and active ownership, but its effectiveness remains constrained by ESG measurement uncertainty. Riedl and Smeets (2017), Bauer et al. (2021), and Barber et al. (2021) demonstrate that investors can value environmental and social characteristics independently of expected financial returns, while Hartzmark and Sussman (2019) show that visible sustainability information can materially redirect investment flows. Institutional investors also influence corporate behaviour after investment. Dimson et al. (2015), Chen et al. (2020), Azar



et al. (2021), Barko et al. (2022), and Hoepner et al. (2024) show that engagement and ownership can improve sustainability outcomes, corporate practices, and in some circumstances downside-risk characteristics. Nevertheless, these mechanisms rely heavily on the quality of ESG information. Berg et al. (2022) document substantial disagreement among rating agencies, while Christensen et al. (2022) show that greater disclosure does not automatically produce greater comparability. Avramov et al. (2022) and Gibson Brandon et al. (2021) further demonstrate that ESG disagreement has portfolio and asset-pricing consequences. The literature therefore suggests that responsible investment requires more than growing demand for sustainable assets. Its financial and environmental credibility depends on consistent measurement, transparent methodologies, credible stewardship, and observable correspondence between declared sustainability principles and actual investment behaviour.

Conclusion

The literature reviewed in this paper indicates that sustainable finance has developed into a multidimensional component of contemporary financial markets. Green bonds illustrate this transformation particularly clearly. Their expansion demonstrates that environmental objectives can be incorporated into conventional debt financing, but their pricing and economic consequences depend on the same market forces that influence traditional securities, including liquidity, credit quality, macroeconomic conditions, issuer characteristics, and investor demand. Environmental certification and external verification add another dimension because the financial value of a green label depends heavily on investor confidence in the underlying environmental claims. Evidence of positive shareholder reactions and subsequent environmental improvements also suggests that green-bond issuance can influence corporate behaviour beyond the immediate financing transaction. Nevertheless, issuance volume alone does not provide sufficient evidence of environmental effectiveness. The literature consistently distinguishes between the growth of labelled finance and its environmental additionality. A mature green-finance market therefore requires reliable taxonomies, transparent allocation of proceeds, credible verification mechanisms, and comparable reporting of environmental outcomes. These conditions allow investors to distinguish substantive environmental financing from symbolic labelling and determine whether sustainable securities generate measurable changes in corporate investment, environmental performance, and financing conditions.

More broadly, sustainable finance increasingly integrates climate risk, corporate sustainability, institutional ownership, and ESG measurement into mainstream financial decision-making. Climate exposure affects expected returns, borrowing costs, downside risk, bank stability, and portfolio management, while corporate sustainability can contribute to financial performance through materiality, stakeholder trust, governance, and operational improvements. Responsible investment extends these mechanisms by allowing investors to use ESG information both before investment and through subsequent engagement with portfolio companies. However, the literature also identifies a major limitation: sustainability information remains heterogeneous, and ESG ratings can differ considerably across providers. This disagreement can affect capital allocation, security valuation, portfolio construction, and conclusions regarding sustainable-investment performance. Future development of sustainable finance consequently depends not only on increasing the supply of green securities or the quantity of corporate disclosure, but also on improving the consistency and financial relevance of sustainability information. Greater comparability must coexist with recognition that investors legitimately differ in their preferences, return requirements, and impact objectives. Sustainable finance is therefore most appropriately understood as an evolving integration of environmental objectives into traditional financial institutions, valuation mechanisms, governance practices, and investment decisions.



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