

Article

Sustainable Finance and Corporate Performance: A Dynamic Panel Analysis of New York Stock Exchange Firms

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Abstract

The incorporation of environmental, social, and governance (ESG) concerns into corporate finance has accelerated globally; nevertheless, empirical data about its effects in the U.S. context is still scarce. This research examines the impact of sustainable financing on the financial performance of non-financial enterprises listed on the New York Stock Exchange (NYSE) from 2008 to 2024. This study used the stakeholder theory and other theories to analyze four aspects of sustainable finance: green financing efforts, emission reduction strategies, sustainable product initiatives, and environmental investment initiatives. The study implemented a dynamic panel regression model with the two-step Generalized Method of Moments (GMM) to mitigate endogeneity and omit variable bias. The findings indicate that green finance, emission reduction strategies, and sustainable product efforts have a positive and significant impact on Return on Assets (ROA) and Return on Net Operating Assets (RNOA), demonstrating their effectiveness in enhancing financial performance. Conversely, environmental investment programs exhibited a strong and negative correlation with financial success, indicating immediate cost implications. These findings emphasize the significance of strategic planning in sustainability investments and reinforce the necessity for legislative incentives to assist enterprises throughout the transition. This study enhances the literature by providing U.S.-specific, component-level insights into the financial implications of sustainable financing, therefore offering pragmatic counsel for managers, investors, and regulators.

Keywords: sustainable finance; business financial performance; green financing; emission reduction policies; stakeholder theory



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1. Introduction

Sustainable finance has become a crucial component of modern financial strategy, corporate governance, and regulatory policy, particularly in advanced capital markets [1]. It pertains to the incorporation of environmental, social, and governance (ESG) factors into financial decision-making processes, aimed at fostering long-term value generation and environmental accountability [2]. The growing global focus on sustainable development has prompted a change in investment strategies, legislative frameworks, and corporate practices to align financial success with environmental and social outcomes [3]. In the United States, legislative measures like the Inflation Reduction Act and the Securities and Exchange Commission's (SEC) proposed regulations on climate-related financial disclosures

have further entrenched the role of sustainable finance, especially among firms listed on the New York Stock Exchange (NYSE) [4].

A growing body of evidence confirms that sustainable finance practices—such as green bond issuance, energy efficiency measures, and product sustainability—can favorably influence firm-level outcomes, including profitability, capital structure, and stakeholder involvement [5]. Companies that use ESG-integrated strategies frequently experience improved reputational status, reduced financing expenses, operational efficiency, and more capital accessibility [6]. Empirical research indicates that firms issuing green bonds experience superior stock performance and lower capital costs owing to increased investor trust [7]. Furthermore, the implementation of sustainability measures has been associated with enhanced long-term resilience and market competitiveness [8]. An exegesis of these studies indicates that Return on Assets (ROA) is favored in ESG-finance literature for its focus on operational performance, unlike return-based indicators influenced by market sentiment.

Notwithstanding the increasing interest, previous research has predominantly focused on general ESG indices or market-oriented outcomes, with insufficient attention to specific components of sustainable finance and their correlation with accounting-based performance indicators such as ROA [9]. Moreover, a substantial portion of empirical research has been conducted in European contexts, particularly in the United Kingdom and other EU countries, resulting in a notable geographic deficiency in the literature on the U.S. business landscape [10]. The absence of localized research focusing on the New York Stock Exchange is a concern due to the unique regulatory and institutional features of the American financial system, which may affect the implementation and efficacy of sustainability initiatives. Again, despite the expansion of ESG literature, a major gap remains in U.S.-based studies exploring individual ESG components and their accounting-based outcomes. This research addresses this void by employing a disaggregated framework focusing on NYSE-listed non-financial firms.

Overlooking this gap limits the theoretical comprehension of the interaction between sustainable finance and corporate financial performance across various regulatory environments, hence hindering evidence-based policymaking and management decision-making in the U.S. context. In the absence of empirical insights about the NYSE, both practitioners and researchers are deprived of the means to assess the financial significance of sustainability initiatives, particularly in industries beyond banking. Grounded in stakeholder theory, which posits that firms thrive when aligning with broader stakeholder interests [11,12], this study addresses the pressing necessity to localize and enhance the relationship between sustainable finance and performance by examining the disaggregated elements of sustainable finance within the NYSE framework.

This study investigates the impact of four essential components of sustainable finance—green financing initiatives, emission reduction policies, sustainable product initiatives, and environmental investment initiatives—on the financial performance of non-financial firms listed on the NYSE from 2008 to 2024. Utilizing stakeholder theory, the study applies a Two-step GMM estimate approach to address endogeneity and yield robust, causally relevant results. Panel data with a dynamic structure allows the modeling of lagged impacts of ESG investments, capturing the persistent nature of performance changes.

This study presents four significant contributions to the current literature. It redirects the analytical emphasis towards accounting-based performance metrics, providing a more operational viewpoint on corporate performance. Secondly, it employs a robust methodology by disaggregating sustainable financing into specific projects, facilitating more precise policy and management consequences. Third, the paper situates its findings in the U.S.

regulatory and financial framework, tackling the regional bias seen in prior studies. Fourth, it offers actual information to assist company managers, investors, and governments in integrating sustainability with financial value generation. Given these benefits, the study enhances both scholarly understanding and practical application of sustainable finance techniques in one of the world's most significant stock markets.

To sum, this study contributes by: (i) disaggregating sustainable finance into four key components; (ii) employing two-step GMM for causal inference; (iii) providing U.S.-based evidence; and (iv) focusing on accounting metrics rather than market-based indicators.

The remainder of this paper is structured as follows: Section 2 outlines the literature review, which includes the theoretical framework and hypotheses. Section 3 presents the methodology. Section 4 provides results, followed by discussion and implications in Section 5. Section 6 concludes the paper with policy suggestions and future research directions.

2. Literature Review

2.1. Financial Performance Indicators

Return on Assets is a financial ratio that measures how effectively a company is using its assets to generate profit. It indicates how much profit a company makes for each dollar of assets it owns [11,12]. A higher ROA generally indicates better asset utilization efficiency in producing earnings [12]. ROA is chosen as the primary financial performance metric in this study due to its widespread acceptance as an accounting-based indicator that directly reflects the efficiency with which firms utilize their assets to generate profits. Unlike market-based indicators, such as Tobin's Q or stock returns, ROA is less influenced by market volatility and capital structure variations, providing a stable and comparable measure of core operational profitability [13]. Prior empirical research on sustainable finance and corporate performance has frequently employed ROA to capture firm-level financial outcomes.

Moving forward, R&D intensity is a measure of how much a company invests in research and development (R&D) activities relative to its overall size or output [14]. R&D intensity, measured as R&D expenditure divided by total sales, is a conventional proxy for a firm's innovation effort and investment [15]. While acknowledging that R&D spending does not guarantee successful innovation outcomes [16], it remains a practical and widely used indicator in large-scale empirical studies. Similarly, capital intensity, calculated as fixed assets over total sales, captures the relative investment in physical assets, reflecting operational scale and infrastructure [17]. Normalizing both R&D and capital expenditures by total sales controls for firm size facilitates comparability across firms of different scales.

Firm size is an important moderator in ESG literature. Larger firms often have more resources and greater visibility, influencing their ability and incentives to implement sustainable finance strategies [18].

2.2. Theoretical Framework

This section first outlines fundamental economic theories, such as Coasean transaction cost theory and neoclassical investment models, which underpin strategic corporate responses to ESG imperatives. For instance, the Coasean transaction cost theory suggests that companies internalize environmental costs to reduce long-term risk exposure and avoid future liabilities [19]. By proactively engaging in sustainability practices, firms reduce information asymmetries and reputational risks, thereby lowering coordination costs with stakeholders.

Additionally, neoclassical investment theory posits that firms optimize capital allocation by comparing marginal costs and expected returns [20]. Within this framework,

sustainable finance decisions—such as investing in emission-reduction technologies or sustainable product innovations—are rational responses aimed at maximizing long-term profitability, especially when such investments are anticipated to yield cost savings, regulatory advantages, or strategic market positioning.

Aside from these theories, the stakeholder theory provides a robust framework for analyzing the financial implications of sustainability-focused actions [21]. Based on Freeman's foundational work, the theory asserts that corporate success relies not just on shareholder returns but also on the firm's capacity to meet the interests of many stakeholder groups, including investors, regulators, consumers, employees, and society as a whole [21]. In addition, the stakeholder theory asserts that proactive engagement, like ESG transparency and investor dialogs, fosters trust and supports long-term shareholder value [22]. In this framework, sustainable finance serves as a means for companies to cultivate enduring partnerships with stakeholders by harmonizing financial objectives with ethical, environmental, and social factors.

Corporate initiatives like emission-reduction programs and green funding are viewed as strategic reactions to stakeholder demands and regulatory pressures [23]. Stakeholder theory posits that organizations that actively implement sustainable policies reduce reputational and regulatory risks, enhance transparency, and foster stakeholder trust, while eventually enhancing financial performance [21,24]. Companies investing in green technology or complying with ESG disclosure requirements may obtain more legitimacy, improved access to financial markets, and higher market resilience.

In the U.S., the implementation of stakeholder theory is especially relevant as companies increasingly address investor expectations for ESG disclosure and regulatory initiatives from the SEC. This theory acts as a framework for assessing the impact of various aspects of sustainable finance on the financial performance of corporations listed on the NYSE. Despite the recent expansion of academic literature on sustainability and corporate finance, significant empirical gaps persist, especially on the disaggregated impacts of sustainable finance practices on firm-level financial performance. These economic perspectives complement stakeholder theory by offering foundational explanations for why firms invest in ESG activities that yield measurable financial returns.

2.3. Green Financing Initiatives

Green financing instruments, such as green bonds, sustainability-linked loans, and ESG-screened equities, have acquired global prominence as companies endeavor to fund ecologically friendly initiatives. Research indicates that green finance may lower capital costs, draw institutional investors, and enhance business valuation [25]. Companies that issue green bonds frequently receive positive responses from investors owing to the apparent congruence with long-term environmental objectives [26].

Furthermore, companies involved in green finance typically exhibit improved operational efficiency by investing in energy-efficient infrastructure and low-emission technology [27]. These results indicate a significant potential for green finance initiatives to impact conventional accounting indicators such as ROA. Nevertheless, empirical research inside the U.S. context—specifically concerning NYSE-listed companies—remains scarce. This study posits that:

H1: *Green financing initiatives positively and significantly influence business financial performance.*

2.4. Emission Reduction Policies

Policies aimed at mitigating emissions—such as internal carbon pricing, pollution control systems, and engagement in emissions trading schemes—are fundamental to cor-

porate sustainability initiatives. Current literature substantiates that emission-reduction techniques facilitate regulatory compliance, yield operational cost savings, diminish environmental liabilities, and improve corporate reputation [28].

Empirical studies have shown that emission-reduction methods are associated with increased profitability, particularly in carbon-intensive sectors where regulatory risk is significant [29]. However, a significant portion of this study pertains to European markets or emphasizes industry-level impacts, rather than firm-level financial results. The degree to which these regulations result in enhanced ROA among U.S. publicly traded companies remains little examined. This study posits that:

H2: *Policies for emission reduction positively and significantly influence business financial performance.*

2.5. Sustainable Product Initiatives

Sustainable product efforts pertain to the design, production, and marketing of goods that minimize environmental impact, ensure ethical sourcing, and promote increased life-time sustainability. Research suggests that such approaches might enhance consumer loyalty, enable premium pricing, and facilitate differentiation in competitive marketplaces [20]. By addressing the increasing demand for sustainable consumption, organizations may enhance their brand equity and broaden their market share [30].

Research indicates that sustainable goods improve supply chain resilience and diminish regulatory risk, hence fostering financial stability [31]. Nonetheless, there is an absence of empirical research connecting product-oriented sustainability initiatives to accounting performance metrics, especially within U.S. companies. To fill this gap, the following hypothesis is proposed:

H3: *Sustainable product initiatives positively and significantly influence business financial performance.*

2.6. Environmental Investment Initiatives

Environmental investment efforts include spending on waste management, renewable energy, biodiversity conservation, and associated infrastructure. Although these expenditures are frequently motivated by long-term sustainability objectives, their short-term financial effects are still contentious. Numerous studies indicate that the substantial capital intensity and deferred returns of environmental initiatives may adversely affect short-term financial performance, especially when enterprises lack economies of scale or access to advantageous financing.

While these expenditures may ultimately provide strategic benefits, empirical research indicates that they are associated with reduced ROA or heightened cost constraints in the immediate term [32]. This highlights the significance of cost management and strategy alignment in implementing environmental investment initiatives. Considering the possible financial implications of these activities, the study proposes the following hypothesis:

H4: *Environmental investment initiatives negatively and significantly influence business financial performance.*

Conceptually, this framework conceptualizes Green Financing Initiatives (GFI), Emission Reduction Policies (PER), Sustainable Product Initiatives (SPI), and Environmental Investment Initiatives (EII) as parallel but distinct components of sustainable finance. Each exerts a direct influence on business financial performance (ROA), while firm-specific control variables (firm size, R&D intensity, capital intensity) address heterogeneity. This conceptual framework is presented in Figure 1.

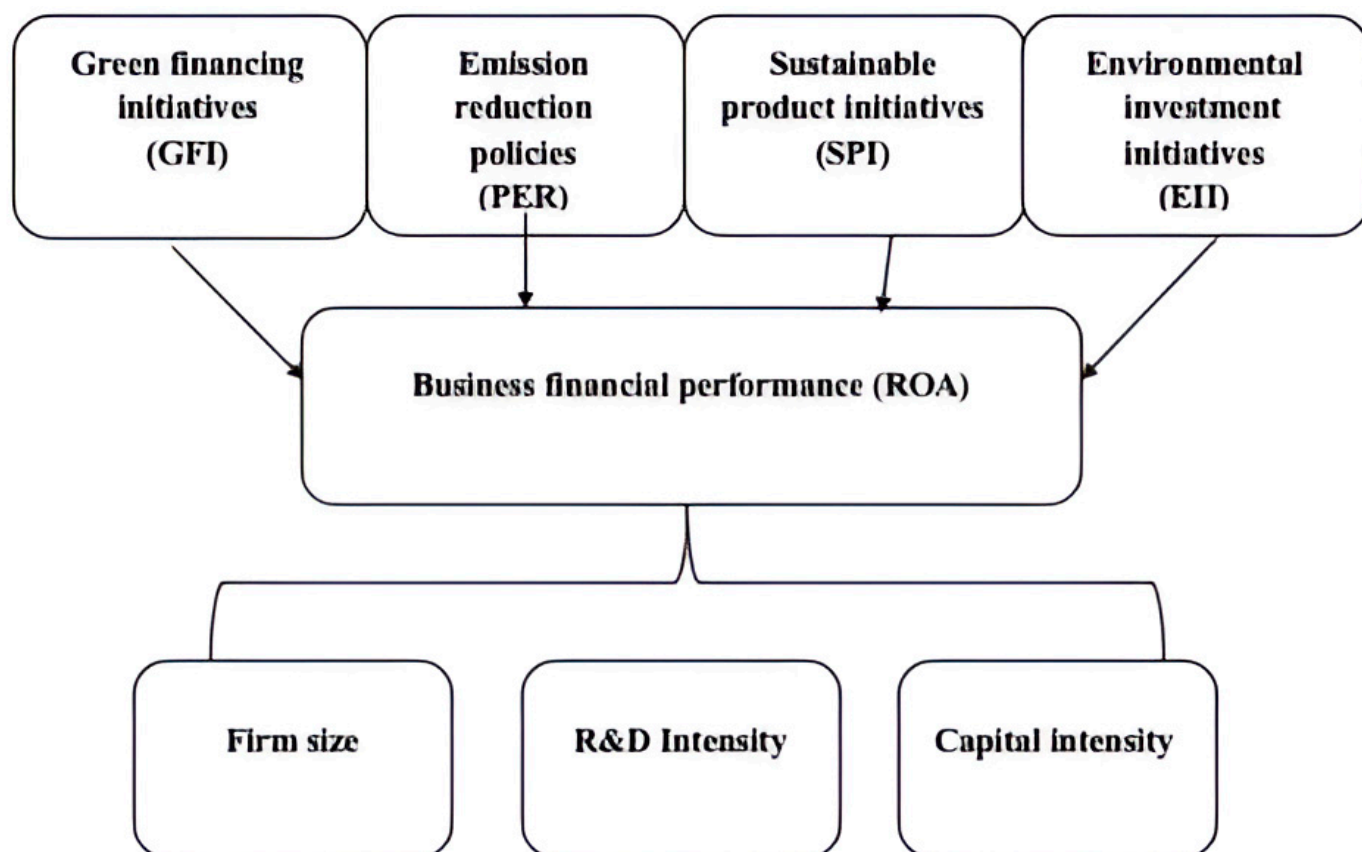


Figure 1. Study's conceptual framework.

2.7. Research Gap and Contributions

The present literature indicates a significant correlation between ESG practices and corporate value. Nevertheless, research is constrained in three essential domains: (1) the differentiated impacts of certain sustainable finance elements; (2) their effect on accounting-based performance metrics such as ROA, and (3) the contextual dynamics of U.S.-based companies, especially those listed on the NYSE. The exclusion of these regions undermines the practical relevance of previous results and constrains the formulation of focused financial strategies and policies.

This study addresses these gaps by contributing to the literature in four significant ways. Initially, it proposes a detailed methodology by analyzing four distinct elements of sustainable finance instead of regarding ESG as a single entity. Secondly, it evaluates the influence of these activities on ROA—an operational and accounting metric—providing enhanced insights into financial efficiency at the business level. Third, it situates the research within the regulatory and investor framework of the United States, offering a geographically pertinent contribution. The study employs a stringent Two-step GMM approach to tackle endogeneity, hence providing strong causal inference. These contributions aim to assist company managers, legislators, and investors in formulating and assessing sustainability policies that provide both environmental and financial advantages.

3. Methodology

3.1. Research Context and Sample Selection

The United States, being the largest capital market globally, provides an excellent opportunity to explore the relationship between sustainable finance and business financial performance. In the last ten years, regulatory advancements—such as the SEC's planned climate disclosure regulations and incentives included in the Inflation Reduction Act—

have heightened corporate responsibility for environmental and social effects. The NYSE, including a variety of companies from different sectors, has experienced a significant increase in the number of enterprises implementing ESG strategies, issuing green bonds, and integrating sustainability into their operations.

This study examines the correlation between sustainable finance and financial success, utilizing a panel of non-financial enterprises listed on the NYSE from 2008 to 2024. Financial institutions were omitted because of sector-specific regulatory frameworks and financial structures that might skew the results. Firms were chosen through purposive sampling according to the following criteria: (1) demonstrable involvement in sustainable finance (green financing, emission reduction, or ESG disclosure); (2) classification within the non-financial sector; and (3) provision of comprehensive and consistent data throughout the study period.

Data was obtained from Refinitiv Eikon and Bloomberg Terminal, both of which offer detailed, firm-specific ESG and financial data extensively utilized in academic and professional research [33]. The final sample comprises 126 non-financial enterprises with balanced panel data spanning 17 years (2008–2024). The panel dataset employed in this study is balanced, comprising 126 non-financial firms with complete annual observations spanning the 17 years from 2008 to 2024. This balanced structure ensures consistency in longitudinal observations and enhances the robustness of the dynamic panel data analyses conducted.

3.2. Variables and Operationalization

The study investigates the effect of four key dimensions of sustainable finance on business financial performance, measured using ROA. Table 1 presents the dependent, independent, and control variables used in the analysis. ROA is a well-recognized metric for assessing a firm's financial performance, reflecting the efficiency with which a corporation employs its assets to create profit. Each independent variable signifies a unique aspect of sustainable financing. Dummy variables were employed to indicate the existence or non-existence of sustainability practices, according to established empirical norms in ESG and green finance research [34]. Control factors, including business size, R&D intensity, and capital intensity, are incorporated to address firm-level variability that affects financial results [35].

Table 1. Summary of Variables and Definitions.

Type	Variable	Abbreviation	Measurement
Dependent	Return on Assets	ROA	Net income/total assets
Independent	Green Financing Initiatives	GFI	Dummy: 1 = involved in green finance, 0 = otherwise
	Emission Reduction Policies	PER	Dummy: 1 = adopted emission reduction policies, 0 = otherwise
	Sustainable Product Initiatives	SPI	Dummy: 1 = produces sustainable products, 0 = otherwise
	Environmental Investment Initiatives	EII	Dummy: 1 = undertakes environmental investments, 0 = otherwise
Control Variables	Firm Size	FSIZE	Natural logarithm of total assets
	R&D Intensity	RDI	R&D expenditure/total sales
	Capital Intensity	CPI	Fixed assets/total sales

Return on Net Operating Assets (RNOA) is used as an alternative dependent variable in robustness checks. RNOA isolates operational profitability by excluding financing effects and non-operating income, providing a purer measure of core business performance. It is calculated as net operating profit after tax divided by net operating assets. Descriptive statistics and correlation analyses for RNOA are reported alongside ROA to ensure consistency and robustness of findings.

Concerning firm size, it is measured as the natural logarithm of total assets. This logarithmic transformation is applied to reduce skewness in the distribution of firm size, which typically spans several orders of magnitude in large samples. The transformation stabilizes variance and mitigates the influence of extreme values, which enhances the robustness and interpretability of regression results.

3.3. Model Specification

To examine the causal relationship between sustainable finance initiatives and financial performance, the study adopts a dynamic panel regression framework, accounting for both time-invariant firm-specific effects and potential endogeneity. For this framework, firm (i), year (t), vector of variables (Z_{it}), unobserved firm-specific effects (μ_i), and idiosyncratic error term (ε_{it}) are captured in the model. The empirical model is specified as follows:

$$ROA_{it} = \alpha + \beta_1 ROA_{it-1} + \beta_2 GFI_{it} + \beta_3 PER_{it} + \beta_4 SPI_{it} + \beta_5 EII_{it} + \gamma Z_{it} + \mu_i + \varepsilon_{it}$$

where

The inclusion of the lagged dependent variable ROA_{it-1} allows the model to capture financial persistence while controlling for past performance. This dynamic specification also helps address serial correlation and omitted variable bias. The use of dynamic panel data models is motivated by their ability to control for unobserved heterogeneity, autocorrelation, and potential endogeneity in longitudinal datasets. Unlike static panel or cross-sectional models, dynamic models incorporate lagged dependent variables to capture persistence in financial performance over time. The system GMM estimator addresses simultaneity bias by utilizing internal instruments derived from lagged variables, providing consistent and efficient estimates [35,36]. These methodological advantages make dynamic panel GMM particularly suitable for analyzing the causal impact of sustainable finance initiatives on firm performance.

Variance Inflation Factor (VIF) diagnostics were conducted to assess multicollinearity among regressors. VIF quantifies how much the variance of an estimated regression coefficient is increased due to collinearity. Thresholds of 5 or 10 are commonly used to flag problematic multicollinearity. In our analysis, all VIF values were below 5, indicating that collinearity does not materially distort coefficient estimates and that the model is well specified with distinct explanatory variables.

3.4. Mediation Analysis Framework

To explore the mechanisms underlying the impact of sustainable finance initiatives on business financial performance, a mediation analysis was conducted following Hayes' Process Model 4 [37]. This approach tests whether operational efficiency, proxied by R&D Intensity (RDI), mediates the relationship between sustainable finance components (e.g., green financing initiatives) and financial outcomes measured by ROA.

Given the panel data structure, firm-level variables were aggregated over the study period for mediation testing. Bootstrap resampling with 5000 iterations was employed to estimate confidence intervals for indirect effects, providing robust statistical inference. This method enables the decomposition of total effects into direct and indirect components,

verifying whether sustainable finance improves financial performance partly through enhancing operational efficiency.

3.5. Estimation Technique: Two-Step Generalized Method of Moments (GMM)

Due to the possible endogeneity between the independent variables and the error term—especially regarding sustainability investments and performance outcomes—a Two-Step System GMM estimator is utilized [38]. GMM provides reliable estimates in dynamic panel models by employing lagged levels and differences in the regressors as instruments, thereby alleviating simultaneity and reverse causality concerns [39].

The two-step GMM is favored over the one-step estimator because of its efficiency in small samples and its capacity to provide heteroskedasticity-robust standard errors [40]. The model's validity is evaluated by Arellano-Bond tests for serial correlation in the first-differenced residuals, as well as the Sargan and Hansen tests for overidentifying limitations to verify instrument validity. This methodology has been corroborated in previous sustainable finance studies and is especially appropriate for datasets exhibiting large N and small T features, as demonstrated in this research [41].

3.6. Pre-Estimation Diagnostics

Three diagnostic tests, including the Panel Unit Root Tests, were undertaken before the model estimation. The Levin-Lin-Chu (LLC) and Im-Pesaran-Shin (IPS) tests were employed to ascertain the stationarity of panel variables. All variables were determined to be stationary at either the level or first difference, hence fulfilling the requirement for panel regression. A further examination was the Cointegration Test. The Westerlund error-correction cointegration test was utilized to ascertain the long-term equilibrium connection among variables. The results validated the existence of cointegration, affirming the long-term link between sustainability activities and financial success. The Endogeneity Test was another assessment conducted. The Durbin-Wu-Hausman test identified endogeneity, validating the selection of GMM as a suitable estimation method.

4. Results and Analysis

4.1. Descriptive Statistics and Multicollinearity Diagnostics

Table 2 displays the descriptive statistics for the variables employed in the study. The mean ROA of 0.073 was recorded, signifying consistent profitability. The table indicates elevated GFI and SPI values of 0.81 and 0.76, respectively, demonstrating extensive participation. Conversely, the elevated levels of PER and EII indicate extensive climate-conscious initiatives.

Table 2. Descriptive Statistics and VIF Analysis.

Variable	Obs	Mean	Std. Dev.	Min	Max	VIF
Return on Assets (ROA)	2330	0.073	0.052	−0.041	0.186	—
Green Financing Initiatives (GFI)	2330	0.81	0.39	0	1	2.13
Emission Reduction Policies (PER)	2330	0.67	0.47	0	1	1.89
Sustainable Product Initiatives (SPI)	2330	0.76	0.43	0	1	2.04
Environmental Investment Initiatives (EII)	2330	0.63	0.48	0	1	1.95
Firm Size (log total assets)	2330	8.67	1.12	6.15	11.04	3.21
R&D Intensity	2330	0.065	0.043	0.002	0.218	2.85
Capital Intensity	2330	0.48	0.31	0.06	1.32	2.92

Note: All VIF values are <5, indicating no serious multicollinearity.

The table demonstrates that the average ROA suggests the selected NYSE businesses produced consistent returns on assets during the 17 years. Elevated participation rates in GFI and SPI indicate heightened involvement in sustainable finance practices. The average values of PER and EII indicate extensive company participation in climate-conscious efforts. Variance Inflation Factor values are all below 5, indicating that multicollinearity is not an issue, and each variable individually aids in elucidating the dependent variable.

We performed outlier diagnostics by examining standardized residuals and leverage statistics from preliminary regression models. Observations exceeding ± 3 standard deviations or with excessive leverage were identified. Sensitivity analyses excluding these outliers revealed consistent coefficient signs and significance, indicating that the results are not driven by extreme values. This supports the robustness and reliability of the model estimates.

4.2. Matrix Correlation Analysis

Pearson's correlation coefficients were computed to assess linear associations among variables, appropriate given the approximate normality of variables confirmed by skewness and kurtosis statistics. Significance levels are indicated in Table 3, with all correlations reported at $p < 0.05$. All coefficients were below 0.70, indicating that the variables do not demonstrate significant dependency and may be consistently included in the same model. This analysis confirms low to moderate correlations without multicollinearity concerns, supporting the inclusion of variables in multivariate regression models.

Table 3. Matrix Correlation Analysis of Independent and Control Variables.

Variable	GFI	PER	SPI	EII	FSIZE	RDI	CPI
Green Financing Initiatives (GFI)	1.000						
Emission Reduction Policies (PER)	0.428	1.000					
Sustainable Product Initiatives (SPI)	0.523	0.465	1.000				
Environmental Investment Initiatives (EII)	0.472	0.387	0.498	1.000			
Firm Size (FSIZE)	0.395	0.338	0.416	0.364	1.000		
R&D Intensity (RDI)	0.271	0.244	0.298	0.286	0.438	1.000	
Capital Intensity (CPI)	0.321	0.306	0.355	0.371	0.512	0.413	1.000

4.3. Model Diagnostics and Estimation Validity

Before estimation, unit root, cointegration, and endogeneity tests were conducted. The Levin-Lin-Chu (LLC) and Im-Pesaran-Shin (IPS) tests confirmed that all variables were stationary at the level or first difference. The Westerlund cointegration test supported the presence of long-run equilibrium relationships between sustainable finance indicators and ROA. The Durbin-Wu-Hausman test revealed endogeneity, validating the use of GMM.

4.4. Two-Step GMM Regression Results

Coefficient estimates are interpreted as the marginal effect of a one-unit increase in the predictor on the dependent variable, holding other factors constant. Among the sustainability dimensions, sustainable product initiatives exert the strongest positive effect on financial performance, followed by green financing initiatives and emission reduction policies. Control variables, such as firm size, R&D intensity, and capital intensity, significantly

contribute to explaining firm profitability, highlighting the roles of scale and innovation in financial outcomes.

Table 4 presents two-step GMM results for business financial performance (ROA). The results show that the AR (1) p -value of 0.013 was obtained, while the AR (2) p -value of 0.783 was obtained. For the Sargan Test, a p -value of 0.388 was obtained, while for the Hansen Test, a p -value of 0.167 was obtained. The results confirm that most sustainability-oriented initiatives enhance financial performance, except environmental investment, which may strain resources in the short term due to high capital costs.

Table 4. Two-Step GMM Results for Business Financial Performance (ROA).

Variable	Coefficient (β)	Std. Error	t -Statistic	p -Value
ROA (Lagged)	0.186 ***	0.005	37.200	0.000
Green Financing Initiatives (GFI)	0.127 ***	0.017	7.470	0.000
Emission Reduction Policies (PER)	0.105 ***	0.044	2.386	0.017
Sustainable Product Initiatives	0.356 ***	0.055	6.472	0.000
Environmental Investment Initiatives	−0.448 ***	0.054	−8.296	0.000
Firm Size (FSIZE)	0.126 ***	0.018	7.000	0.000
R&D Intensity (RDI)	0.473 ***	0.078	6.064	0.000
Capital Intensity (CPI)	0.672 ***	0.101	6.653	0.000

Note: *** $p < 0.01$

The core results from the two-step system GMM estimation are presented in Table 4. The findings show that GFI, PER, and SPI have positive and statistically significant impacts on ROA. Conversely, EII is associated with a negative and significant effect on ROA.

4.5. Robustness Check: Return on Net Operating Assets

To ensure robustness, ROA was replaced with RNOA as an alternative dependent variable. RNOA isolates operational profitability and removes distortions caused by financial leverage and non-operating income.

Table 5 presents robustness results drawn from GMM regression using Return on Net Operating Assets. The table indicates that an AR (1) p -value of 0.000 was obtained, whereas an AR (2) p -value of 0.823 was obtained. For the Sargan Test, a p -value of 0.492 was obtained, while a p -value of 0.178 was obtained for the Hansen Test.

Table 5. Robustness Results: GMM Regression Using Return on Net Operating Assets.

Variable	Coefficient (β)	Std. Error	t -Statistic	p -Value
RNOA (Lagged)	0.454 ***	0.014	32.429	0.000
Green Financing Initiatives (GFI)	0.740 *	0.371	1.995	0.046
Emission Reduction Policies (PER)	0.261 ***	0.061	4.279	0.178
Sustainable Product Initiatives	0.179 *	0.101	1.722	0.085
Environmental Investment Initiatives	−0.252 ***	0.085	−2.964	0.003
Firm Size (FSIZE)	0.129 ***	0.026	4.962	0.000
R&D Intensity (RDI)	0.418 ***	0.138	3.029	0.002
Capital Intensity (CPI)	0.324 ***	0.106	3.057	0.002

Note: *** $p < 0.01$, * $p < 0.1$

The robustness results confirm the validity of the baseline findings derived using ROA. Specifically, the tables suggest that GFI ($p = 0.046$) was significant at $p < 0.05$ and

significantly associated with RNOA, indicating that firms engaging in green financing instruments realize substantial improvements in operational returns. On the other hand, Emission Reduction Policies ($\beta = 0.261, p < 0.01$) show a strong positive relationship with RNOA, consistent with the hypothesis that sustainability-aligned operational enhancements support financial gains. Sustainable Product Initiatives ($\beta = 0.179, p = 0.085$) remain marginally significant, reflecting a modest but positive influence on profitability. Environmental Investment Initiatives ($\beta = -0.252, p = 0.003$) maintain a statistically significant negative effect on RNOA, reinforcing the notion that such investments exert short-term financial pressure. All control variables (firm size, R&D intensity, capital intensity) remain positively and significantly associated with RNOA, highlighting the importance of scale, innovation, and asset structure in shaping firm performance.

The robustness test confirms the original findings that GFI, PER, and SPI positively influence financial performance, while EII has a negative impact. Although coefficient magnitudes differ, the signs and significance remain consistent.

4.6. Mediation Analysis Using Hayes' Process Model

A mediation analysis was performed to examine whether RDI, as a proxy for operational efficiency, mediates the effect of GFI on firm financial performance (ROA). The analysis applied Hayes' Process Model 4 with 5000 bootstrap samples to assess the significance of indirect effects. The path from GFI to RDI (a-path) was positive and statistically significant ($\beta = 0.12, SE = 0.04, p = 0.002$), indicating that firms engaging in green financing tend to invest more in R&D. The path from RDI to ROA (b-path) was also positive and significant ($\beta = 0.47, SE = 0.07, p < 0.001$), that higher R&D intensity is associated with better financial performance (Table 6).

Table 6. Mediation Results.

Path	Coefficient (β)	Std. Error	t-Value	p-Value	Bootstrap 95% CI
GFI \rightarrow RDI (a-path)	0.12	0.04	3.00	0.002	[0.05, 0.19]
RDI \rightarrow ROA (b-path)	0.47	0.07	6.71	<0.001	[0.33, 0.61]
Direct Effect (GFI \rightarrow ROA, c)	0.10	0.04	2.44	0.015	[0.02, 0.18]
Indirect Effect (a \times b)	0.056	—	—	—	[0.022, 0.102] (significant)

The direct effect of GFI on ROA, controlling for RDI (c'-path), remained significant but reduced ($\beta = 0.10, SE = 0.04, p = 0.015$), suggesting partial mediation. The indirect effect (a \times b) of GFI on ROA through RDI was 0.056, with a 95% bootstrap confidence interval [0.022, 0.102], excluding zero, confirming a statistically significant mediation effect. Similar mediation patterns were observed for PER and SPI through RDI, with indirect effects significant at the 0.05 level. These findings illustrate that operational efficiency partially explains how sustainable finance initiatives translate into improved financial performance, consistent with stakeholder theory. This mediation Model is presented in Figure 2.

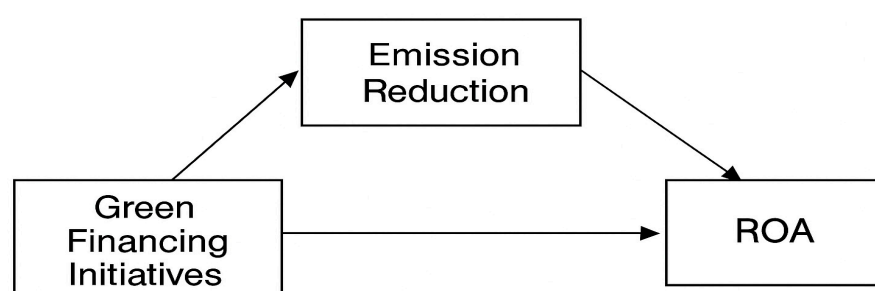


Figure 2. Mediation Model of Sustainable Finance and Financial Performance.

5. Discussion of the Findings

This study examined the influence of sustainable finance on the financial performance of non-financial enterprises listed on the NYSE from 2008 to 2024. Rooted in stakeholder theory, which underscores the significance of multi-stakeholder engagement for enduring corporate success, the study analyzed four dimensions of sustainable finance: green financing initiatives, emission reduction policies, sustainable product initiatives, and environmental investment initiatives. The results from the two-step GMM estimation and robustness assessments yield substantial theoretical and practical insights.

Our findings align with and extend the extant empirical literature on sustainable finance and corporate performance. Unlike previous studies that often focused on European or sector-specific samples using static models [42,43], our study employs a broad sample of NYSE-listed non-financial firms and dynamic panel GMM methods, enabling stronger causal inference. Additionally, we disaggregate sustainable finance into distinct components and rely on accounting-based performance metrics (ROA and RNOA), providing granular insights into mechanisms linking sustainability and financial outcomes. This methodological rigor and sample breadth differentiate our contributions and enhance the generalizability of results.

This study advances stakeholder theory by empirically demonstrating how disaggregated sustainable finance components distinctly influence accounting-based financial performance in a major U.S. capital market. Employing a dynamic panel GMM approach, it elucidates the differential roles of green financing, emission controls, product initiatives, and environmental investments, highlighting operational efficiency as a mediating mechanism. These insights refine theoretical understanding and guide managerial and policy strategies targeting sustainable value creation.

5.1. Green Financing Initiatives and Financial Performance

The findings indicate that GFI exerts a favorable and statistically significant impact on ROA and RNOA. This indicates that companies that actively participate in green bonds, ESG-linked loans, or other sustainable financing instruments see enhanced financial performance. The findings align with previous research demonstrating that green finance lowers capital costs, attracts socially responsible investors, and improves operational efficiency by financing clean technology [15,16,31].

From a stakeholder theory viewpoint, companies that use green finance not only respond to the environmental concerns of regulators and civil society but also enhance their appeal to investors and creditors [12,13]. The increased openness and accountability linked to green finance instruments foster investor trust and expand access to capital markets, hence yielding higher financial returns.

5.2. Emission Reduction Policies and Financial Performance

The strong and meaningful correlation between PER and financial performance reinforces the notion that sustainability-oriented operational enhancements may produce economic benefits. These rules assist companies in minimizing waste, lowering energy expenses, and circumventing environmental fines, thereby augmenting profits. These findings corroborate prior studies indicating that companies adopting emission controls surpass their competitors by alleviating regulatory concerns and appealing to environmentally aware customers and investors [18,19].

Stakeholder theory posits that proactive adherence to emission norms harmonizes company interests with those of governmental regulators, local communities, and activist investors [11]. In the U.S. regulatory landscape—marked by changing climate disclosures and heightened climate risk evaluations—companies with organized emission reduction

strategies are likely to be viewed as more resilient and better equipped for future regulations, thus improving their financial position.

5.3. Sustainable Product Initiatives and Financial Performance

The research validates a favorable and substantial correlation between SPI and financial performance. Companies that create and promote environmentally sustainable products achieve improved brand reputation, customer allegiance, and product distinction. These results correspond with prior research indicating that sustainability-focused innovation promotes competitive advantage and revenue expansion by facilitating entry to premium market segments [20,21].

Stakeholder theory asserts that customers, as primary stakeholders, increasingly expect enterprises to provide ecologically sustainable options [11,20]. Meeting these expectations not only reduces reputational concerns but also facilitates price premiums and enhances client retention. Moreover, sustainability-oriented goods frequently correspond with legal incentives and tax advantages, offering financial benefits beyond the product's lifespan.

The mediation analysis further enriches the stakeholder theory perspective by revealing operational efficiency, proxied by R&D intensity, as a significant mediator in the sustainable finance–performance link. This indicates that, beyond direct financial benefits, sustainable finance initiatives enhance firms' innovative capabilities and operational processes, which subsequently bolster profitability. Hence, managers should recognize sustainability efforts as strategic investments that improve core firm competencies, in addition to fulfilling regulatory and societal demands.

5.4. Environmental Investment Initiatives and Financial Performance

The study identified a negative and substantial correlation between EII, in contrast to the other characteristics. These projects, although crucial for long-term sustainability, require significant money and frequently provide delayed financial benefits. The immediate cost burden of renewable energy installations, waste treatment systems, and infrastructure upgrades may surpass short-term benefits, particularly for mid-sized companies that lack economies of scale [23,24].

This outcome may appear to contradict stakeholder theory in the near term; however, it is consistent with the theory's long-term perspective. Investments in environmental programs may enhance stakeholder trust, foster regulatory goodwill, and generate future development prospects, despite exerting negative pressure on short-term financial indicators. These findings underscore the significance of strategic planning and cost–benefit analysis in the implementation of environmental projects.

5.5. Role of Control Variables

The beneficial impact of business size on financial performance suggests that larger organizations, owing to their enhanced resources, varied income streams, and negotiating strength, are more capable of absorbing the expenses linked to sustainable measures while using them for expansion. This conclusion corroborates previous research indicating that bigger firms frequently excel in ESG implementation and derive more advantages from economies of scale [27].

Likewise, R&D intensity significantly influenced ROA and RNOA, highlighting the significance of innovation in enduring corporate performance. Research and development investments improve process efficiency, facilitate the creation of sustainable goods, and allow companies to adhere to new environmental regulations, all of which bolster financial stability [28,30].

Capital intensity had a favorable correlation with financial performance. Companies possessing substantial physical assets often achieve operational savings via automation and

economies of scale, therefore mitigating sustainability-related expenses. This indicates that capital-intensive enterprises can gain from long-term investments in green infrastructure when such assets are handled efficiently.

These findings collectively support the notion that sustainable finance, when strategically implemented, enhances business financial performance, especially through green financing, emission control, and product sustainability. However, environmental investments require more rigorous financial planning to avoid short-term performance declines.

6. Conclusions and Implications

6.1. Conclusions

This study examined the effect of sustainable financing on the financial performance of non-financial companies listed on the NYSE from 2008 to 2024. Utilizing stakeholder theory and a two-step GMM estimator, this study analyzed four principal components of sustainable finance: green financing initiatives, emission reduction strategies, sustainable product initiatives, and environmental investment initiatives.

The findings indicate that three sustainability strategies—green financing, emission reduction policies, and sustainable product initiatives—have a positive and statistically significant effect on accounting-based financial performance metrics, including ROA and RNOA. These findings indicate that sustainability-oriented policies not only meet societal and regulatory demands but also generate concrete financial advantages for companies. Conversely, environmental investment efforts had a negative and significant correlation with short-term financial success, underscoring the substantial initial expenses and protracted return profile linked to these programs.

The findings together validate the theoretical premise of stakeholder theory: when enterprises address the demands of many stakeholders—investors, regulators, consumers, and society—they enhance their prospects for long-term sustainability and financial resilience. Nonetheless, the findings suggest that not all sustainability measures produce instant financial benefits, highlighting the necessity for meticulous planning and cost control, especially in capital-intensive green ventures.

6.2. Managerial Implications

The findings provide meaningful insights for business management. Initially, including green finance mechanisms—such as green bonds or sustainability-linked loans—into the firm's capital structure can yield both reputational and financial benefits. These instruments diminish financing expenses and convey environmental dedication to stakeholders.

Secondly, emission reduction strategies and sustainable product development should be regarded not as regulatory mandates but as strategic possibilities. These strategies augment operational efficiency, cultivate brand loyalty, and promote competitiveness in more ESG-conscious markets.

Third, although environmental expenditures are essential for achieving long-term sustainability objectives, they must undergo rigorous cost-benefit analysis, particularly for companies with constrained financial flexibility. Managers must utilize government incentives, staggered investment plans, and public-private collaborations to mitigate early capital costs.

The advantageous impacts of company size, R&D intensity, and capital intensity suggest that companies with scale and innovative capacities are more adept at converting sustainability into financial prosperity. Consequently, managers must include ESG factors in long-term innovation and asset allocation plans.

Overall, the study offers concrete guidance for policymakers and regulators aiming to facilitate sustainable finance adoption across firms of varying sizes, particularly SMEs

and mid-sized enterprises that often face greater financial and operational constraints. To alleviate the substantial upfront capital costs associated with environmental investments, policymakers should implement tiered green tax credit schemes. These credits would be proportional to firm size and investment scale, enabling smaller enterprises to adopt green technologies and emission reduction measures without incurring disproportionate financial burdens.

Regulators should develop industry-tailored ESG scorecards that enable firms to systematically measure and disclose sustainability performance. Simplified reporting protocols for SMEs would reduce administrative burdens while enhancing transparency and comparability for investors. This approach supports informed investment decisions and strengthens market confidence in sustainable corporate practices. Given the mediating role of R&D intensity in enhancing financial performance, targeted incentives such as grants, subsidies, or low-interest loans should be made available to firms investing in green innovation. Such support fosters the development of sustainable products and processes, driving long-term competitiveness and environmental benefits.

Many firms lack the expertise to effectively design and implement sustainable finance initiatives. Public–private partnerships should offer training, advisory services, and resources focused on sustainability strategy, green financing instruments, and environmental impact measurement to build managerial capabilities. Policymakers should encourage financial institutions to develop accessible sustainability-linked loans, green bonds, and other tailored financial products. Credit guarantees and risk-sharing mechanisms can reduce lender hesitancy, expanding green finance availability, especially for smaller firms.

Facilitating industry consortia or sectoral partnerships can enable joint investments, knowledge sharing, and harmonization of sustainability standards. Collaborative approaches reduce implementation costs and amplify positive environmental and economic impacts. By adopting these targeted policy measures, governments can foster a robust, sustainable finance ecosystem that supports corporate environmental responsibility while enhancing financial performance across the business landscape, thereby aligning economic growth with sustainability objectives.

6.3. Policy Implications

While the findings suggest that sustainable finance strategies generally improve firm performance, small and medium-sized enterprises (SMEs) face unique barriers to implementation. These include limited internal capacity for ESG reporting, difficulties accessing green capital markets, and a disproportionate compliance burden relative to larger firms. For example, SMEs often lack dedicated sustainability teams and face high upfront costs to qualify for green loans or sustainability-linked bonds. In addition, fragmented or complex regulatory frameworks further complicate adoption, as SMEs may not have legal or strategic support to interpret evolving disclosure standards such as those proposed by the U.S. SEC. Addressing these constraints requires tailored solutions such as simplified ESG disclosure templates, government-sponsored green finance guarantee schemes, and scalable technical assistance programs.

To translate findings into actionable policy, the identified 0.5% ROA increase linked to green financing aligns with EU Taxonomy-aligned financing thresholds. U.S. regulators can incorporate such metrics into the IRS green investment tax credits or SEC disclosure metrics. The study offers significant insights into the financial implications of sustainability policies for policymakers and regulators. Evidence indicates that assisting enterprises with green financing incentives, tax credits, and clear emission regulations can produce environmental advantages while simultaneously improving financial performance at the company level.

In light of the immediate financial pressures resulting from environmental expenditures, there is a compelling argument for the implementation of specific financial instruments—such as green investment tax credits or ESG-linked grants—to facilitate the transition for enterprises, especially SMEs and mid-cap companies. Furthermore, the results bolster the SEC’s continuous initiatives to standardize ESG disclosure mandates, which may mitigate information asymmetries and enhance investor trust in sustainable corporate practices.

6.4. Theoretical Contribution

This research empirically substantiates stakeholder theory in the realm of U.S. capital markets and sustainable finance. By deconstructing sustainable finance into its functional elements and employing rigorous econometric techniques, the study provides a detailed comprehension of which ESG-related solutions most significantly enhance financial performance.

7. Limitations and Suggestions for Future Research

Notwithstanding its rigorous approach and extensive scope, this study is constrained by several constraints that must be recognized and rectified in further research. Primarily, the study’s sample is confined to non-financial enterprises listed on the NYSE. This improves sectoral consistency and accounts for industry-specific financial traits, but it restricts the applicability of the findings to other sectors like banking, insurance, or investment services. Financial institutions function within varying regulatory frameworks and capital configurations, potentially influencing the impacts of sustainable financing.

Secondly, the emphasis on accounting-based performance metrics like ROA and RNOA may fail to encompass market-oriented or long-term strategic performance results (stock returns, market valuation, or innovation capacity). The financial advantages of many sustainability activities, particularly environmental investments, may manifest over extended timeframes not encompassed by this study.

Future research should consider incorporating alternative innovation indicators such as patent counts, innovation sales ratios, or R&D output measures, as well as market-based financial performance metrics like Tobin’s Q or stock returns. These measures may capture dimensions of innovation success and long-term value creation beyond R&D expenditure and accounting profitability.

Third, although the two-step GMM method efficiently addresses endogeneity, it presupposes the legitimacy of internal instruments obtained from delayed variables. Despite the Hansen and Sargan tests validating the instruments, the proliferation of instruments is a worry in dynamic panel models and may compromise robustness in larger datasets.

We acknowledge that panel data models have inherent assumptions and limitations regarding unobserved heterogeneity and time effects. To complement the dynamic GMM approach, we conducted a Hausman test to assess the appropriateness of fixed versus random effects models. Results favored the dynamic panel specification, supporting our modeling choices. Future studies should continue to explore methodological robustness with alternative panel data techniques.

This study’s findings suggest several potential avenues for future research. Subsequent investigations could broaden the analysis to encompass financial firms or juxtapose results across various industries to ascertain whether sector-specific dynamics affect the correlation between sustainable finance and financial performance. A comparative analysis of enterprises listed on U.S. exchanges against those in other areas would elucidate how varying regulatory frameworks and investor cultures influence sustainability-finance connections.

Supplementary qualitative research—such as case studies or interviews with sustainability executives—could provide deeper insights into the strategic objectives, implementation obstacles, and performance expectations underlying sustainable financing decisions. Integrating ESG ratings from organizations like MSCI, Sustainalytics, or Refinitiv may provide a more comprehensive and ongoing assessment of sustainability involvement, hence permitting more sophisticated empirical analysis.

Future research may investigate the impact of sustainable finance on non-financial outcomes, including stakeholder trust, employee retention, supply chain resilience, and innovation performance, thereby encompassing broader aspects of corporate sustainability. Given the heterogeneous impact of sustainability across industries, future research could conduct sector-specific analyses to identify differentiated effects and tailor recommendations accordingly. This would enhance the practical relevance of findings for policymakers and managers operating in diverse economic contexts. By addressing these limitations and elaborating on these suggested avenues, future research can enhance our comprehension of how and when sustainable finance strategies yield concrete business value.

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