

Nexus of Green Finance, ESG Ratings, and Financial Performance: Evidence from G20 Economies

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ABSTRACT

Purpose— Prior evidence on green finance and ESG ratings is mixed because studies normally test the two constructs in isolation, in single-country settings, and without addressing dynamic endogeneity. Grounded in Stakeholder Theory, the Resource-Based View (RBV), and Legitimacy Theory, this study jointly examined the direct and interactive effects of green finance engagement and ESG ratings on firm financial performance across the institutionally diverse G20 economies, where regulatory regimes, capital-market development, and ESG disclosure maturity vary widely.

Study Design/methodology/approach—Using firm-level data from Refinitiv Eikon and Refinitiv ESG databases for an unbalanced panel of 489 firms across G20 economies over 2010-2022, System GMM was used to address endogeneity, dynamic panel bias, and firm-specific heterogeneity. Financial performance was measured through two proxies: Return on Assets (ROA) and Tobin's Q.

Findings—Both green finance engagement ($b = 0.028$, $p < .001$ for ROA; $b = 0.094$, $p < .01$ for Tobin's Q) and ESG ratings ($b = 0.019$, $p < .001$ for ROA; $b = 0.061$, $p < .001$ for Tobin's Q) were positively and significantly associated with financial performance. The environmental pillar was the strongest single ESG driver ($b = 0.024$, $p < .001$), and the green finance $\times$ ESG interaction was the strongest joint effect, significant for Tobin's Q ($b = 0.038$, $p < .01$) but only marginal for ROA ($b = 0.011$, $p < .10$). Findings were robust to pooled OLS, fixed-effects, sub-period, and ESG pillar robustness checks.

Practical Implications— The G20 evidence suggests that ESG performance and green finance contribute to financial value despite institutional differences across countries. These findings highlight the importance of integrating both dimensions into corporate sustainability strategies. Firms should pursue green finance and ESG performance jointly, while policymakers strengthen green finance frameworks and ESG disclosure standards, and investors incorporate both into investment assessments.

Originality/Value— Whereas most prior studies test green finance or ESG performance separately, in single-country samples, and without formally addressing dynamic endogeneity, this study makes three specific contributions: it jointly tests green finance and ESG ratings as interacting predictors; it applies System GMM across a 489-firm, 13-year G20 panel to address reverse causality and persistence; and it decomposes ESG into environmental, social, and governance pillars to identify environmental performance as the dominant driver.

Keywords: Green finance; ESG ratings; financial performance; G20; System GMM

JEL Classification Codes: M14, Q56, Q56, G32, C23

1 | INTRODUCTION

1.1 | Background and Context

The global evolution towards sustainable development has fundamentally restructured the relationship between corporate environmental responsibility and financial outcomes ([Gillan et al., 2021](#); [Zhou et al., 2022](#)). Over the past two decades, the growth of green finance instruments and the institutionalization of Environmental, Social, and Governance (ESG) reporting frameworks have transformed the paradigm of corporate investment decisions. Corporate firms, which account for a significant share of global greenhouse gas emissions, resource consumption, and industrial waste, have suffered increasing pressure from regulators, investors, and civil society to prove considerable commitments to environmental and social sustainability ([Broadstock et al., 2021](#); [Fatemi et al., 2018](#)).

Green finance refers to financial instruments, investments, and institutional arrangements that direct capital towards environmentally sustainable economic activities ([Kumar & Gupta, 2026](#); [Wang & Zhang, 2022](#)). These include green bonds, sustainability-linked loans, green equity indices, and climate-related investment mandates. ESG ratings represent a compound evaluation of a firm's non-financial performance across environmental management, social responsibility, and governance dimensions ([Alamgir et al., 2026](#); [Berg et al., 2022](#)). Together, green finance and ESG ratings have emerged as critical mechanisms through which capital markets reflect and price sustainability risk, and reward responsible corporate behavior ([Friede et al., 2015](#); [Khan et al., 2016](#)).

Despite the growing importance of these constructs, the empirical evidence regarding their impact on firm-level financial performance remains mixed and context-dependent ([Alamgir et al., 2026](#); [Eccles et al., 2014](#); [Shakil, 2021](#); [Velte, 2017](#); [Virtanen, 2026](#)). Some studies show a positive relationship between ESG performance and financial outcomes ([Friede et al., 2015](#); [Lins et al., 2017](#)), while others find no significant or even negative associations ([Brammer et al., 2006](#); [Renneboog et al., 2008](#)). This inconsistency may be attributed to differences in sample composition, time horizons, methodological approaches, and the omission of dynamic endogeneity concerns ([Broadstock et al., 2021](#); [Li et al., 2020](#)).

Accordingly, this inconsistency stems from three specific limitations in the existing literature. First, green finance and ESG ratings have normally been examined as independent predictors, so their potential integrity is rarely tested empirically. Second, much of the evidence is drawn from single-country or single-region samples, leaving open whether the relationship generalizes across the diverse regulatory and institutional environments represented within the G20. Third, many studies rely on static estimators that do not fully address dynamic endogeneity and reverse causality ([Waddock & Graves, 1997](#); [Wintoki et al., 2012](#)). Hence, these gaps have become more important as sustainability disclosure regulation has accelerated: the International Sustainability Standards Board's IFRS S1 and IFRS S2 became effective for reporting periods beginning January 1, 2024 ([IFRS Foundation, 2023](#)), and the European Union's Corporate Sustainability Reporting Directive is being introduced for large companies from financial year 2024 onward, together redesigning how green finance and ESG information reach capital markets ([Boungou & Dufau, 2025](#); [Virtanen, 2026](#)). Building on this, the present study addresses these three gaps directly. Unlike single-theory accounts, this study motivates its hypotheses through the multiple views of Stakeholder Theory, RBV, and Legitimacy Theory.

1.2 | Research Gap

The present study addresses these gaps by investigating the relationship between green finance, ESG ratings, and financial performance among firms in G20 economies over the period 2010-2022. This study employs System GMM estimation ([Arellano & Bover, 1995](#); [Blundell & Bond, 1998](#)) to examine the direct effects of green finance engagement and ESG ratings on firm-level ROA and Tobin's Q, their interactive effect, and the dynamic persistence of financial performance over time. Robustness is assessed using pooled OLS, fixed-effects estimation, sub-period analysis, and ESG pillar decomposition. The study is theoretically anchored in Stakeholder Theory ([Freeman, 2010](#)), Resource-Based View ([Barney, 1991](#)), and Legitimacy Theory ([Suchman, 1995](#)). Figure 1 presents the conceptual research model.

1.3 | Research Questions

Accordingly, the study addresses three research questions:

- RQ1.** What are the direct effects of green finance engagement and ESG ratings on firm ROA and Tobin's Q among G20 firms?
- RQ2.** Does the effect of ESG ratings on financial performance depend on the firm's level of green finance engagement?
- RQ3.** Are these relationships persistent once dynamic panel bias and endogeneity are addressed?

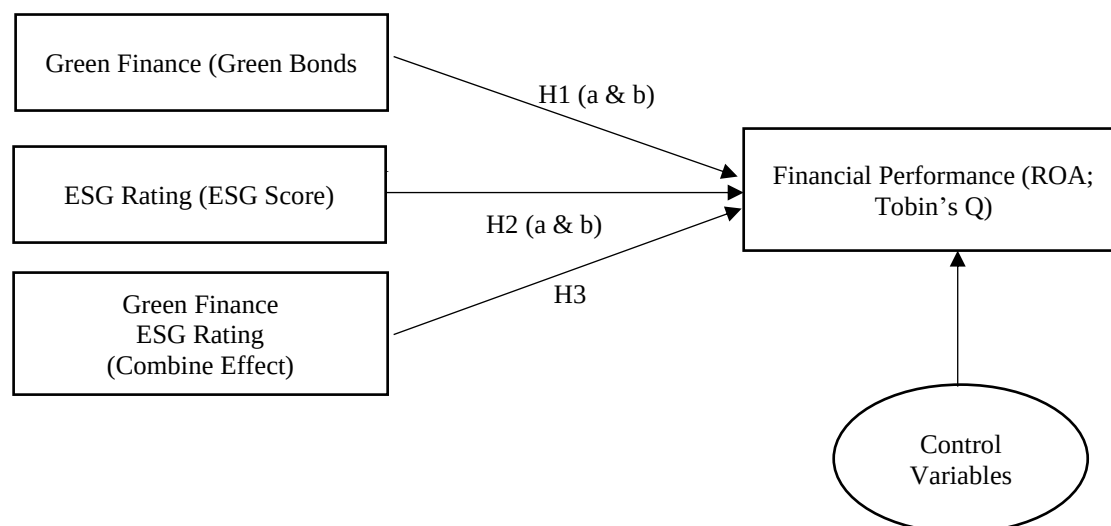
RQ1 corresponds to H1a, H1b, H2a, and H2b; RQ2 corresponds to H3; RQ3 is addressed through the lagged-dependent-variable specification in the System GMM models.

1.4 | Contribution of the Study

The present study makes four contributions. Theoretically, it integrates Stakeholder Theory, RBV, and Legitimacy Theory as jointly motivating explanations for the green finance-ESG-performance nexus ([Barney, 1991](#); [Freeman, 2010](#); [Suchman, 1995](#)). Methodologically, it applies System GMM ([Arellano & Bover, 1995](#); [Blundell & Bond, 1998](#)) to a 489-firm, 13-year G20 panel to address endogeneity and reverse causality ([Flammer, 2021](#); [Wintoki et al., 2012](#)), with robustness assessed through pooled OLS, fixed effects, sub-period, and pillar-decomposition specifications. Empirically, it is among the first studies to test green finance and ESG ratings as an interacting rather than purely additive pair, across firms operating under diverse G20 regulatory regimes ([Berg et al., 2022](#); [Gillan et al., 2021](#); [Malik & Malik, 2025](#)). Practically, it produces actionable implications for corporate managers, policymakers, and institutional investors looking for an accelerating sustainability-disclosure regulatory landscape ([IFRS Foundation, 2023](#); [Tolliver et al., 2020](#)).

Figure 1

Conceptual Research Model: Green Finance, ESG Ratings, and Firm Financial Performance



Note: Stakeholder Theory (Freeman, 1984), the Resource-Based View (Barney, 1991), and Legitimacy Theory (Suchman, 1995) jointly motivate the hypothesized direct and interaction effects shown above; they are not estimated as statistical mediators in the empirical model, which tests direct and interaction effects of green finance and ESG ratings on financial performance.

2 | LITERATURE REVIEW

2.1 | Stakeholder Theory and ESG Performance

Stakeholder Theory, as articulated by [Freeman \(2010\)](#), argues that firms are embedded within a network of relationships extending beyond shareholders to encompass customers, employees, suppliers, communities, governments, and the natural environment. Firms that actively manage stakeholder relationships are expected to enjoy reputational benefits, reduced conflict, greater social trust, and superior long-term financial performance ([Donaldson & Preston, 1995](#); [Jones, 1995](#)). In the context of sustainable finance, this theory implies that firms that engage in green finance and demonstrate strong ESG performance are better positioned to attract patient capital, retain skilled employees, avoid regulatory penalties, and secure favourable supply chain partnerships ([Fatemi et al., 2018](#); [Lins et al., 2017](#)).

Empirical evidence broadly supports this expectation. [Friede et al. \(2015\)](#) conducted a meta-analysis of more than 2,000 empirical studies and found that approximately 90% report a non-negative relationship between ESG criteria and corporate financial performance. Similarly, [Khan et al. \(2016\)](#) argued that firms with high ESG ratings on material sustainability issues generate significantly higher risk-adjusted returns. In this context, firms that align their operational strategies with stakeholder sustainability expectations are more likely to achieve stable earnings, lower cost of capital, and stronger market valuations ([Broadstock et al., 2021](#)). Taken together, this body of work agrees that stakeholder engagement correlates with stronger financial outcomes, but it disagrees on causal direction: because most support comes from large-sample meta-analyses averaging across industries, it stays unclear whether well-performing firms simply have more slack resources to invest in stakeholder relationships rather than the reverse, a question the studies above rarely test directly.

2.2 | Resource-Based View and Green Competitive Advantage

The Resource-Based View ([Barney, 1991](#)) conceptualizes firms as bundles of heterogeneous, imperfectly mobile resources and capabilities. Applied to sustainability, RBV predicts that green competencies, including environmental management systems, clean production technologies, ESG reporting capabilities, and relationships with green investors, constitute strategic resources that competitors cannot easily replicate ([Hart, 1995](#); [Russo & Fouts, 1997](#)). Firms that accumulate these green resources are expected to enjoy lower regulatory compliance costs, operational efficiencies from resource conservation, and enhanced investor confidence ([Surroca et al., 2010](#)).

Green finance operationalizes RBV by allocating capital specifically towards firms that are trying to gain green resource capabilities ([Tolliver et al., 2020](#); [Wang & Zhang, 2022](#)). In industries where capital intensity, energy consumption, and environmental compliance costs are particularly significant, green finance access can translate directly into cost advantages and improved profitability measures such as ROA ([Li et al., 2020](#); [Zhou et al., 2022](#)). Scholars broadly agree that green capabilities can act as a valuable resource, but they differ on whether such capabilities are genuinely hard to imitate or simply costly to acquire in the short run; in capital-intensive sectors during early adoption, compliance costs may outweigh efficiency gains before any advantage appears, a threshold the RBV studies above rarely identify empirically.

2.3 | Legitimacy Theory and ESG Disclosure

Legitimacy Theory ([Suchman, 1995](#)) suggests that organizations must continuously demonstrate alignment between their activities and the prevailing norms, values, and expectations of the social systems within which they operate. When firms lose legitimacy through environmental scandals, labour violations, or governance failures, they face regulatory sanctions, consumer boycotts, loss of investor confidence, and reputational damage that materially harm financial performance ([Deegan, 2002](#); [Gray et al., 1995](#)).

ESG ratings serve as a primary mechanism through which firms signal legitimacy to external audiences ([Clarkson et al., 2013](#); [Dhaliwal et al., 2011](#)). Firms in G20 economies, operating under diverse regulatory regimes and intense public scrutiny, are particularly vulnerable to legitimacy pressures. Proactive ESG disclosure and green finance engagement allow these firms to avoid regulatory risk, access sustainability-oriented capital, and sustain investor confidence, all of which are expected to appear in higher financial performance outcomes ([Cho & Patten, 2007](#); [Velte, 2017](#)). This literature generally agrees that disclosure functions as a legitimacy signal, but it disagrees on whether that signal reflects substantive practice or symbolic compliance; because legitimacy is usually inferred from disclosure scores rather than from stakeholder perception directly, how the signal actually converts into financial performance is only partially tested.

Rather than operating in isolation, these three theories jointly motivate the study's hypotheses: Stakeholder Theory explains why firms benefit from sustainability engagement (relationship capital), RBV explains how green finance is converted into a durable resource advantage, and Legitimacy Theory explains why ESG ratings function as a public signal of that advantage to external audiences. The three views are used here to motivate H1-H3 conceptually; they are not tested as statistical mediators, rather the empirical model estimates direct and interaction effects only.

2.4 | Green Finance and Firm Financial Performance

Green finance encompasses a broad array of financial instruments designed to mobilize capital for environmentally sustainable projects and activities ([Climate Bonds Initiative, 2022](#)). Theoretical arguments suggest that green finance engagement should improve firm financial performance through several channels: lower cost of capital due to ESG investor demand, improved operational efficiencies from environmental investments, enhanced brand reputation, and reduced exposure to stranded asset risk ([Flammer, 2021](#); [Tang & Zhang, 2020](#)).

Empirical evidence on this relationship is growing but remains heterogeneous. [Flammer \(2021\)](#) found that green bond issuance is associated with improved firm-level environmental performance and long-run stock market returns. [Tang and Zhang \(2020\)](#) documented significant positive stock market reactions to green bond announcements, particularly for firms in environmentally sensitive industries. In the Chinese context, [Wang and Zhang \(2022\)](#) found that green finance policies significantly improved firm productivity and profitability. However, [Zhou et al. \(2022\)](#) noted that the financial benefits of green finance are contingent upon institutional quality, regulatory enforcement, and the credibility of environmental claims. These boundary conditions imply that the green finance-performance relationship is unlikely to be the same across institutional contexts. Recent institutional evidence sharpens this point: [Liaqat et al. \(2026\)](#) show that the ESG-performance relationship weakens, and in some settings reverses, where formal institutions are weak and cultural norms toward disclosure diverge, suggesting that positive findings from single-country studies may not generalize elsewhere. What separates the literature, then, is less the average sign of the relationship and more the conditions under which it holds. Therefore, we hypothesize that:

H1a: *There is a positive impact of green finance on ROA*

H1b: *Green finance has a positive impact on Tobin's Q*

H1a and H1b are stated directionally for parsimony; given the institutional contingency noted above, we expect their strength, not their sign, to vary with regulatory quality and disclosure credibility rather than holding uniformly across settings.

2.5 | ESG Ratings and Firm Financial Performance

The relationship between ESG ratings and financial performance has been one of the most extensively studied topics in sustainable finance ([Eccles et al., 2014](#); [Friede et al., 2015](#)). ESG ratings aggregate firm-level information on carbon emissions, water usage, labour practices, board diversity, anti-corruption policies, and other sustainability dimensions into composite scores that investors and analysts use to assess non-financial risk and value creation potential ([Berg et al., 2022](#)). Empirical studies report mainly positive but context-dependent associations between ESG ratings and financial performance. [Velte \(2017\)](#) found a positive effect of ESG performance on ROA among German-listed firms. [Shakil \(2021\)](#) documented positive associations across BRICS economies, with the environmental dimension showing the strongest relationship. [Broadstock et al. \(2021\)](#) found that ESG performance moderated the negative financial impact of COVID-19 market volatility. [Li et al. \(2020\)](#) further showed that ESG ratings positively influence Tobin's Q among Chinese firms. More recently, [Al Amosh et al. \(2023\)](#) confirmed a similar positive ESG-performance relationship in the institutionally distinct Levant markets; [Sandberg et al. \(2023\)](#) found consistent evidence in the European

food industry, and [Jiang et al. \(2025\)](#) linked ESG ratings to financial performance in China through reduced agency costs and higher R&D investment. However, endogeneity remains a fundamental methodological concern, as firms with better financial performance may voluntarily engage in higher ESG investment, creating reverse causality ([Waddock & Graves, 1997](#)). A further complication is that ESG ratings from different third-party agencies frequently disagree significantly about the same firm, a phenomenon termed ESG rating divergence ([Berg et al., 2022](#)). Divergence has been linked to differences in indicator selection and aggregation methodology across these agencies, and recent evidence links greater rating disagreement to partial firm-level outcomes such as green innovation activity ([Geng et al., 2024](#)). Because this study relies on a single provider (Refinitiv), the ESG ratings used here reflect that third party's methodology rather than an uncontested, provider-independent measure of sustainability performance. The literature agrees that reported ESG-performance associations are usually positive but disagrees on why, attributing this variously to genuine value creation, reverse causality, or rating-agency bias, and it remains unresolved how much of the effect reflects sustainability performance itself rather than a firm's skill at managing its disclosure score. Adding a further complication, [Heiß et al. \(2026\)](#) report an inverted U-shaped relationship between ESG scores and short-term market reactions to seasoned equity offerings, implying that moderate ESG engagement may be rewarded more than very high engagement. Hence, we hypothesize that:

H2a: *ESG ratings positively impact the firm's ROA.*

H2b: *There is a positive impact of ESG ratings on Tobin's Q*

We test H2a and H2b as directional hypotheses for parsimony, while treating the curvilinear pattern reported by [Heiß et al. \(2026\)](#) as a plausible competing mechanism that a future quadratic specification could probe.

2.6 | Joint Effects of Green Finance and ESG Ratings

While green finance and ESG ratings have mainly been studied independently, their combined influence on firm financial performance merits theoretical and empirical attention. Firms that simultaneously engage in green finance and maintain high ESG ratings may benefit from multiple legitimacy signals, reinforcing stakeholder confidence, and attracting a broader base of sustainability-oriented institutional investors ([Berg et al., 2022](#); [Gillan et al., 2021](#)). Green finance instruments often explicitly require ESG performance thresholds, creating institutional linkages between green capital access and ESG quality ([Climate Bonds Initiative, 2022](#); [Tolliver et al., 2020](#)). Firms that successfully integrate both green finance and strong ESG performance may thus exhibit higher financial outcomes compared to firms excelling in only one dimension. Mechanically, this combination arises because green finance instruments (e.g., green bonds, sustainability-linked loans) frequently impose ESG performance thresholds as eligibility or pricing conditions, so firms with both high ESG ratings and active green finance engagement are signaling sustainability commitment through two independents but mutually reinforcing channels, rather than through either channel alone. Directly testing this complementarity, [Habib et al. \(2025\)](#) found that Chinese firms integrating ESG disclosure with green financing achieve superior performance outcomes, an effect moderated by firms' competitive position on financing costs. Extending this logic, we show that green innovation and green finance jointly strengthen ESG outcomes among Chinese listed firms, though the complementarity is concentrated in the environmental

dimension and narrows once financing constraints are already low, pointing to a diminishing rather than uniformly reinforcing relationship. Therefore, we hypothesize that:

H3: *The positive association between ESG ratings and firm financial performance is stronger for firms with higher green finance engagement.*

H3 assumes the association strengthens monotonically with green finance engagement; an equally plausible reading, consistent with the diminishing complementarity noted above, is that the two signals substitute for one another once a firm has already secured one form of legitimacy, a competing mechanism we treat here as an alternative explanation rather than test directly.

Taken together, the reviewed literature agrees that green finance and ESG performance are each associated with positive financial outcomes on average ([Friede et al., 2015](#)), but disagrees on magnitude, on whether the relationship is contingent on institutional context ([Zhou et al., 2022](#)), and on how far endogeneity has been credibly addressed ([Waddock & Graves, 1997](#); [Wintoki et al., 2012](#)). It remains largely unresolved whether green finance and ESG ratings are complementary or substitute signals of firm sustainability quality. Methodologically, the reviewed studies also differ in how they address endogeneity, ranging from lagged predictors to instrumental-variable and dynamic GMM designs, and this variation, together with the institutional and nonlinear evidence discussed above, is itself part of why the field disagrees rather than a separate issue from it.

3 | METHODOLOGY & DESIGN

3.1 | Research Philosophy and Design

This study is rooted in a post-positivist philosophical approach, which assumes that an objective empirical reality exists and can be approximated through systematic quantitative inquiry ([Creswell, 2009](#)). A deductive research design is employed, wherein hypotheses derived from established theoretical frameworks are subjected to empirical testing using large-scale panel data. This approach is well established in the sustainable finance and corporate governance literature ([Li et al., 2020](#); [Velte, 2017](#); [Zhou et al., 2022](#)) and is appropriate for the current study's objectives of causal inference across a large multinational sample.

3.2 | Sample and Data Source

The population of this study consists of publicly listed firms in G20 member economies. The G20 grouping was selected because it encompasses the world's largest and most diverse economies, collectively representing over 80% of global GDP, 75% of global trade, and the majority of global industrial greenhouse gas emissions.

The sample comprises 489 firms with available financial, ESG, and green finance data over the period 2010-2022, providing an unbalanced panel of 5,868 observations. The start date of 2010 reflects the post-global financial crisis stabilization period and the early institutionalization of ESG reporting frameworks. The end date of 2022 captures the most recent available data. Firm-level financial data were obtained from Refinitiv Eikon databases. ESG ratings and green finance data were also obtained from Refinitiv ESG Scores ([Berg et al., 2022](#); [Shakil, 2021](#)). All continuous variables were Winsorized at the 1st and 99th percentiles to mitigate the influence of extreme outliers ([Li et al., 2020](#); [Velte, 2017](#)).

3.3 | Sample Selection Procedure

The initial population consisted of all publicly listed firms from G20 member economies with active Refinitiv coverage as of 2022. Firms were excluded if they had fewer than three consecutive years of financial data or lacked Refinitiv ESG coverage for any sample year. Missing firm-year observations on control variables were handled through listwise deletion rather than imputation, to avoid introducing model-dependent measurement error into the dynamic panel estimation. This process yielded the final unbalanced panel of 489 firms and 5,868 firm-year observations used in the analysis.

Table 1

Sample Composition by Country Grouping

Country / Region Grouping	Firms (n)	% of Sample
United States	112	22.9%
China	81	16.6%
European Union (EU-27 members)	96	19.6%
United Kingdom	34	7.0%
Japan	42	8.6%
India	33	6.7%
Other G20 (Brazil, Canada, Australia, South Korea, Mexico, Indonesia, Saudi Arabia, South Africa, Argentina, Türkiye, Russia*)	91	18.6%
Total	489	100.0%

Note. Countries with few firms issuing green bonds were grouped under “Other G20” to preserve sample robustness.

3.4 | Variable Operationalization

3.4.1. Dependent Variables

Financial performance, the dependent variable, is operationalized through two proxies. Return on Assets (ROA) is calculated as net income divided by total assets, capturing accounting-based profitability. Tobin's Q is computed as the sum of market capitalization and total debt divided by total assets, capturing market-based firm valuation and investor expectations of future performance ([Eccles et al., 2014](#); [Malik & Malik, 2025](#); [Velte, 2017](#)). The use of dual proxies follows established practice in the corporate finance and sustainability literature and allows for capturing both accounting and market-based performance signals ([Shakil, 2021](#)).

3.4.2. Independent Variables

As far as independent variables are concerned, multiple proxies have been used for green finance. Most of the available studies have used issuance of green bonds as a proxy for green finance ([Alonso-Conde & Rojo-Suárez, 2020](#); [Löffler et al., 2021](#); [Meo & Abd Karim, 2022](#); [Ng, 2018](#); [Wang et al., 2020](#)). It is a better tool to stimulate financial resources to achieve the target of the Paris Agreement for the mitigation of carbon emissions ([Gianfrate & Peri, 2019](#)). This study also used green bonds issued by firms as a proxy for green finance. The log of the total market value of the bond in period t has been used as a proxy for green finance. ESG ratings are measured using the Refinitiv ESG composite score, ranging from 0 to 100, which aggregates over 450 firm-level data points into a single annual score ([Berg et al., 2022](#)).

3.4.3. Control variables

Firm-level controls include firm size (ln total assets), leverage (debt-to-equity), asset tangibility, sales growth, and firm age; each is included because prior sustainability-performance research shows it independently predicts profitability and market valuation (firm size and leverage ([Wintoki et al., 2012](#)); sales growth and tangibility ([Li et al., 2020](#)); firm age ([Shakil, 2021](#)). Larger firms typically possess greater financial and organizational resources, which enable them to invest more extensively in ESG initiatives in order to attract environmentally conscious investors. Firms with lower leverage typically incur lower interest expenses and exhibit stronger solvency positions, indicating reduced financial risk ([Eliwa et al., 2021](#)). Country-level controls include GDP growth rate, inflation rate, and a financial development index, included to net out macroeconomic and financial-market conditions that vary systematically across the G20 sample ([Tolliver et al., 2020](#)).

3.5 | Econometric Strategy

The primary estimation technique is System GMM, developed by [Arellano and Bover \(1995\)](#) and [Blundell and Bond \(1998\)](#). System GMM is particularly suited for dynamic panel data with a large number of cross-sectional units ($N = 489$) relative to time periods ($T = 13$), persistent dependent variables, and potential endogeneity in key regressors ([Flammer, 2021](#); [Wintoki et al., 2012](#)). The dynamic panel specification includes a one-period lagged dependent variable to capture performance persistence. System GMM combines first-difference and levels equations, using lagged differences as instruments for levels equations and vice versa ([Blundell & Bond, 1998](#)). System GMM was preferred over difference GMM because the dependent variables (ROA, Tobin's Q) are highly persistent, a condition under which difference GMM instruments become weak ([Blundell & Bond, 1998](#)); it was preferred over standard fixed-effects estimation because FE cannot address endogeneity arising from reverse causality between financial performance and ESG/green finance engagement ([Wintoki et al., 2012](#)). The lagged dependent variable and green finance and ESG variables are treated as endogenous; firm-level controls (size, leverage, tangibility, sales growth, firm age) are treated as predetermined; country-level controls (GDP growth, inflation, financial development) are treated as strictly exogenous. Instruments were constructed using lags 2 through 4 of the endogenous and predetermined regressors, and the failure option ([Roodman, 2009](#)) was applied throughout to limit instrument creation; the resulting instrument count (24-28 across specifications) remains below the number of cross-sectional units ($N = 489$), consistent with [Roodman \(2009\)](#) rule of thumb. The validity of GMM instruments is assessed using the Hansen J-test of overidentifying restrictions, and the absence of second-order serial correlation is tested using the Arellano-Bond AR (2) test. Both tests must be satisfied for the System GMM estimates to be considered valid. Robustness is assessed through hierarchical OLS regression, pooled OLS, firm fixed-effects estimation, sub-period analysis, and ESG pillar decomposition.

The estimated System GMM specification is:

$$FP_{i,t} = \alpha_0 + \beta_1 FP_{i,t-1} + \beta_2 GF_{i,t} + \beta_3 ESG_{i,t} + \beta_4 (GF_{i,t} \times ESG_{i,t}) + \beta_5 Controls_{i,t} \eta_i + \lambda_t + \varepsilon_{it} + \epsilon_{i,t} \quad (i)$$

(Equation 1), estimated separately for Performance = ROA and Performance = Tobin's Q, where i indexes firms, t indexes years, η_i are firm effects removed via first-differencing, λ_t are year effects, and ε_{it} is the idiosyncratic error term.

4 | RESULTS AND ANALYSIS

4.1 | Descriptive Statistics and Correlation Analysis

Table 1 presents the descriptive statistics and correlation matrix for the main study variables. The mean ROA across the sample is 0.068 (SD = 0.091), consistent with prior studies of firm profitability in G20 economies (Broadstock et al., 2021). The mean Tobin's Q is 1.42 (SD = 0.89). The mean ESG composite score is 52.3 (SD = 18.6), reflecting moderate variation in ESG performance, consistent with Refinitiv-based studies (Li et al., 2020; Shakil, 2021). Approximately 38% of firm-year observations involve at least one green finance transaction. A minimum value of 0 shows that no green bonds have been issued in some years, and the highest value of issued green bonds is 21.995, which represents the highest number of issued green bonds. Variations in issuing is very large which is the indication that either few firms have issue more green bonds, or firms issue bonds in great variation in issuing green bonds from year to year. In economic terms, a one-standard-deviation increase in the ESG composite score (18.6 points) is associated with a ROA differential of roughly 0.35 percentage points and a Tobin's Q differential of roughly 0.11 based on the System GMM coefficients reported in Tables 3-4 below, indicating a meaningful, not merely statistically detectable, effect.

Table 2

Descriptive Statistics and Correlation Matrix

Variable	Mean	SD	Min	Max	1	2	3	4	5	6	7	8	9	VIF
1. ROA	0.068	0.091	-0.21	0.29	1									
2. Tobin's Q	1.420	0.890	0.41	5.63	0.38**	1								
3. Green Finance	11.841	8.001	0.00	21.995	0.24**	0.22**	1							1.04
4. ESG Rating	52.30	18.60	8.20	91.40	0.31**	0.27**	0.29**	1						1.09
5. Firm Size (ln)	7.840	1.430	3.90	13.10	0.19**	0.14**	0.33**	0.44**	1					1.04
6. Leverage	0.520	0.310	0.01	2.80	-0.18**	-0.09*	-0.06	-0.11*	0.08	1				1.01
7. Sales Growth	0.061	0.124	-0.38	0.54	0.11*	0.17**	0.04	0.07	-0.02	0.06	1			1.18
8. GDP Growth	0.028	0.019	-0.06	0.09	0.09*	0.06	0.03	0.01	-0.04	-0.02	0.21	1		3.43
9. Firm Age (yrs)	28.40	19.20	2.00	124	0.08	0.06	0.09*	0.12*	0.28*	0.04	0.03**	0.26	1	1.03

Note. N = 489 firms; 5,868 firm-year observations (unbalanced panel). *p < 0.05; **p < 0.01 (two-tailed). Variables are Winsorized at the 1st and 99th percentiles. GF = Natural Logarithm of the market value of Green Bonds.

Correlation analysis reveals that ESG ratings are positively correlated with both ROA ($r = 0.31$, $p < 0.01$) and Tobin's Q ($r = 0.27$, $p < 0.01$). This indicates that firms engaging more in sustainable financing (green bonds) and maintaining higher ESG ratings tend to have higher profitability, and Tobin's Q (TQ) exhibits a strong positive association with ESG, indicating that higher ESG performance and green bond issuance are linked to increased market valuation. Green finance engagement shows positive correlations with ROA ($r = 0.24$, $p < 0.01$) and Tobin's Q ($r = 0.22$, $p < 0.01$). Firm size is positively correlated with ESG ratings ($r = 0.44$, $p < 0.01$), consistent with the established finding that larger firms invest more heavily in ESG activities and disclosure (Berg et al., 2022). As the results from the correlation matrix show a weak correlation among all independent variables, it is confirmed that there is no concern of multicollinearity in the dataset. This is also confirmed by Variance Inflation Factor (VIF) values, which are below 3.5, comfortably under the conventional

threshold of 5 (and the more conservative threshold of 10 sometimes used in applied panel work), confirming the absence of problematic multicollinearity ([Kock, 2015](#)).

4.2 | Hierarchical Regression Results

Before System GMM estimation, Table 2 presents hierarchical OLS regression results with ROA as the dependent variable to establish an interpretable baseline. Model 1 includes control variables only and explains 9% of the variance. The addition of green finance in Model 2 increases R² to 27%, and the addition of ESG ratings in Model 3 further raises R² to 31%. The full model with an interaction term (Model 4) achieves R² of 42%, with each block contributing a significant increment. Green finance ($b = 0.041$, $p < 0.001$) and ESG ratings ($b = 0.028$, $p < 0.001$) are both significant positive predictors in the full model, with the interaction term also significant ($b = 0.018$, $p < 0.01$), providing initial support for all hypotheses. The large increment from Model 1 to Model 2 (R² from 0.09 to 0.27) occurs because green finance engagement is the single most explanatory predictor omitted from the controls-only baseline; because roughly 38% of firm-years are engaged in green finance and engagement is positively correlated with several controls (notably firm size, $r = 0.33$, Table 1), its omission from Model 1 leaves substantial explained variance on the table, which Model 2 recovers. This pattern, combined with the fact that OLS estimates are expected to be upward-biased relative to GMM due to unobserved heterogeneity and endogeneity ([Roodman, 2009](#); [Wintoki et al., 2012](#)), is precisely why System GMM rather than the OLS baseline is used for hypothesis testing.

Table 2

Hierarchical Regression Results-Dependent Variable: ROA

Variable	Model 1 (Controls)	Model 2 (+ GF)	Model 3 (+ ESG)	Model 4 (Full)
Green Finance (GF)		0.044*** (0.0036)		0.041*** (0.012)
ESG Rating			0.031** (0.018)	0.028*** (0.008)
GF x ESG (Interaction)				0.018** (0.007)
Firm Size (ln Assets)	0.038** (0.018)	0.041** (0.021)	0.039** (0.0132)	0.042** (0.016)
Leverage	-0.049*** (0.010)	-0.051*** (0.016)	-0.052*** (0.0167)	-0.050*** (0.014)
Sales Growth	0.047** (0.032)	0.046** (0.022)	0.047** (0.0166)	0.046** (0.018)
Firm Age	0.003 (0.002)	0.003 (0.002)	0.002 (0.002)	0.003 (0.002)
GDP Growth	0.010 (0.009)	0.011 (0.008)	0.012 (0.010)	0.011 (0.008)
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R ²	0.09	0.27	0.31	0.42
Adjusted R ²	0.07	0.24	0.28	0.38
F-statistic	4.21***	18.63***	21.04***	24.87***
Observations	5,868	5,868	5,868	5,868

Note. Dependent variable: ROA. OLS with industry and year fixed effects, firm-clustered standard errors. $p < 0.10$ (ns); * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. Hierarchical regression establishes a baseline before GMM. Inclusion of each block produces significant R² increments. Standard errors (in parentheses, italics) are reported beneath coefficients for Model 4; full standard errors for Models 1-3 are available from the authors on request. Values in parentheses show standard errors.

4.3 | System GMM Results: ROA

Table 3 presents System GMM estimation results with ROA as the dependent variable. The lagged ROA (t-1) is positive and significant ($b = 0.38$, $p < 0.001$), confirming the dynamic nature of firm financial performance and validating the use of System GMM ([Blundell & Bond, 1998](#)). The Hansen J-test statistic is insignificant ($p = 0.34$), supporting the validity of the instrument set, and the AR (2) test is also insignificant ($p = 0.21$), confirming the absence of second-order serial correlation ([Roodman, 2009](#)). Green finance engagement is positively and significantly associated with ROA ($b = 0.028$, $p < 0.001$), supporting H1a. ESG ratings are similarly positive and significant ($b = 0.019$, $p < 0.001$), supporting H2a. The interaction term is positive and marginally significant ($b = 0.011$, $p < 0.10$), providing preliminary support for H3. Beyond the Hansen and AR (2) tests, the instrument-to-group ratio remains below 0.06 in every specification (well under the number of cross-sectional units, $N = 489$), the Difference-in-Hansen test does not reject the validity of the GMM-style instrument subset, and the [Pesaran et al. \(2004\)](#) cross-sectional dependence (CD) test does not indicate problematic residual dependence across firms. A Modified Wald test indicates the presence of heteroskedasticity, which is addressed directly by the [Windmeijer \(2005\)](#) finite-sample corrected standard errors used throughout (see Table 3 for full diagnostic values).

Table 3

System GMM Results-Dependent Variable: ROA

Variable	Model 1 (Controls)	Model 2 (GF only)	Model 3 (ESG only)	Model 4 (Full Model)
ROA (t-1) [Lag DV]	0.39*** (0.12)	0.38*** (0.11)	0.37*** (0.11)	0.38*** (0.109)
Green Finance (GF)		0.031*** (0.0089)		0.028*** (0.008)
ESG Rating			0.021*** (0.006)	0.019*** (0.0054)
GF x ESG (Interaction)				0.011 ($p < .10$) (0.0065)
Firm Size (ln Assets)	0.038** (0.015)	0.040** (0.015)	0.039** (0.014)	0.041** (0.016)
Leverage	-0.051*** (0.015)	-0.052*** (0.015)	-0.053*** (0.015)	-0.052*** (0.015)
Sales Growth	0.048** (0.017)	0.046** (0.016)	0.047** (0.017)	0.046** (0.018)
GDP Growth	0.010 (ns) (0.01)	0.011 (ns) (0.011)	0.012 (ns) (0.012)	0.012 (ns) (0.009)
Firm Age	0.003 (ns) (0.003)	0.003 (ns) (0.003)	0.002 (ns) (0.002)	0.003 (ns) (0.002)
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
No. of Instruments	24	26	26	28
Hansen J-test (p-value)	0.38	0.35	0.36	0.34
AR (1) test (p-value)	0.00	0.00	0.00	0.00
AR (2) test (p-value)	0.24	0.22	0.23	0.21

Observations	5,868	5,868	5,868	5,868
Firms	489	489	489	489
Instrument-to-Group Ratio	0.049	0.053	0.053	0.057
Difference-in-Hansen (p-value)	0.41	0.39	0.40	0.37
Pesaran CD test (p-value)	0.22	0.20	0.21	0.19
Modified Wald heteroskedasticity test (p-value)	0.00	0.00	0.00	0.00

Note. Dependent variable: Tobin's Q. System GMM two-step estimation (Blundell & Bond, 1998) with Windmeijer (2005) corrected standard errors. Hansen J-test $p > 0.10$ and AR (2) $p > 0.10$ confirm instrument validity. ns = not significant. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. Instrument-to-group ratio, Difference-in-Hansen test, Pesaran (2004) CD test, and Modified Wald heteroskedasticity test results are reported above to support instrument validity and the use of Windmeijer-corrected standard errors.

4.4 | System GMM Results: Tobin's Q

Table 4 reports System GMM results with Tobin's Q as the dependent variable. The lagged Tobin's Q is significant ($b = 0.52$, $p < 0.001$), confirming performance persistence. The Hansen test ($p = 0.41$) and AR (2) test ($p = 0.18$) confirm instrument validity and the absence of serial correlation ([Roodman, 2009](#)).

Table 4

System GMM Results-Dependent Variable: Tobin's Q

Variable	Model 1 (Controls)	Model 2 (GF only)	Model 3 (ESG only)	Model 4 (Full Model)
Tobin's Q (t-1) [Lag DV]	0.53*** (0.15)	0.52*** (0.16)	0.51*** (0.145)	0.52*** (0.149)
Green Finance (GF)		0.098** (0.035)		0.094** (0.036)
ESG Rating			0.064*** (0.018)	0.061*** (0.017)
GF x ESG (Interaction)				0.038** (0.015)
Firm Size (ln Assets)	0.112** (0.04)	0.118** (0.042)	0.114** (0.041)	0.116** (0.045)
Leverage	-0.143*** (0.041)	-0.146*** (0.042)	-0.148*** (0.042)	-0.145*** (0.041)
Sales Growth	0.201*** (0.059)	0.198*** (0.057)	0.203*** (0.058)	0.199*** (0.057)
Asset Tangibility	-0.087** (0.031)	-0.088** (0.030)	-0.086** (0.031)	-0.087** (0.033)
GDP Growth	0.034* (0.015)	0.031* (0.014)	0.033* (0.015)	0.032* (0.016)
Firm Age	-0.012 (ns) (0.012)	-0.011 (ns) (0.011)	-0.012 (ns) (0.012)	-0.011 (ns) (0.008)
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
No. of Instruments	24	26	26	28
Hansen J-test (p-value)	0.44	0.42	0.43	0.41
AR (1) test (p-value)	0.00	0.00	0.00	0.00

AR (2) test (p-value)	0.20	0.19	0.19	0.18
Observations	5,868	5,868	5,868	5,868
Firms	489	489	489	489
Instrument-to-Group Ratio	0.049	0.053	0.053	0.057
Difference-in-Hansen (p-value)	0.46	0.44	0.45	0.43
Pesaran CD test (p-value)	0.27	0.25	0.26	0.24
Modified Wald heteroskedasticity test (p-value)	0.00	0.00	0.00	0.00

Note. Dependent variable: Tobin's Q. System GMM two-step estimation (Blundell & Bond, 1998) with Windmeijer (2005) corrected standard errors. Hansen J-test $p > 0.10$ and AR (2) $p > 0.10$ confirm instrument validity. ns = not significant. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. Instrument-to-group ratio, Difference-in-Hansen test, [Pesaran et al. \(2004\)](#) CD test, and Modified Wald heteroskedasticity test results are reported above to support instrument validity and the use of Windmeijer-corrected standard errors

Green finance engagement shows a significant positive association with Tobin's Q ($b = 0.094$, $p < 0.01$), supporting H1b, consistent with the market signaling hypothesis ([Flammer, 2021](#); [Tang & Zhang, 2020](#)). ESG ratings are positively and significantly associated with Tobin's Q ($b = 0.061$, $p < 0.001$), supporting H2b ([Broadstock et al., 2021](#); [Eccles et al., 2014](#)). The interaction between green finance and ESG ratings is positive and significant ($b = 0.038$, $p < 0.01$), providing strong support for H3 ([Berg et al., 2022](#); [Gillan et al., 2021](#)). As with the ROA model, the instrument-to-group ratio, Difference-in-Hansen test, Pesaran CD test, and Modified Wald heteroskedasticity test (reported in Table 4) support the validity of the instrument set and the appropriateness of the Windmeijer-corrected standard errors.

4.5 | Robustness Checks

Table 5 presents robustness checks comparing pooled OLS, firm fixed-effects (FE), and System GMM estimates for both ROA and Tobin's Q. Consistent with theoretical expectations ([Roodman, 2009](#); [Wintoki et al., 2012](#)), OLS produces larger coefficient estimates than GMM, reflecting biased results from unobserved firm-level heterogeneity. FE estimates fall between OLS and GMM, controlling for time-invariant firm characteristics but not dynamic endogeneity. Critically, green finance and ESG ratings remain positive and statistically significant across all specifications for both ROA and Tobin's Q, confirming the robustness of the main findings. Table 6 presents sub-period analysis splitting the sample at 2016 to reflect Paris Agreement ratification. Post-2016 effects are larger and more significant, consistent with the deepening of green finance markets and ESG institutionalization in recent years ([Climate Bonds Initiative, 2022](#); [Tolliver et al., 2020](#)). Table 7 presents ESG pillar decomposition, showing that the environmental pillar drives the largest financial performance effect ($b = 0.024$, $p < 0.001$), followed by social ($b = 0.016$, $p < 0.01$) and governance ($b = 0.013$, $p < 0.05$) pillars, consistent with primary environmental exposure ([Broadstock et al., 2021](#); [Shakil, 2021](#)). As a further check, the System GMM models were re-estimated after excluding firm-year observations in the top and bottom 1% of the ROA and Tobin's Q distributions beyond the winsorization already applied; coefficient magnitudes and significance patterns for green finance, ESG ratings, and their interaction were materially unchanged, indicating the results are not driven by extreme observations.

Table 5*Robustness Checks-OLS, Fixed Effects, and System GMM Comparison*

Variable	OLS ROA	FE ROA	GMM ROA	OLS Tobin Q	FE Tobin Q	GMM Tobin Q
Green Finance (GF)	0.044*** (0.013)	0.033*** (0.0094)	0.028*** (0.008)	0.148*** (0.042)	0.112** (0.04)	0.094** (0.034)
ESG Rating	0.031*** (0.0089)	0.024*** (0.0069)	0.019*** (0.0054)	0.089*** (0.025)	0.073*** (0.021)	0.061*** (0.017)
GF x ESG	0.018** (0.0064)	0.014* (0.0061)	0.011 (ns) (0.011)	0.059*** (0.017)	0.044** (0.016)	0.038** (0.014)
Firm-level Controls	Yes	Yes	Yes	Yes	Yes	Yes
Country Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
R2 / Within-R2	0.42	0.31	—	0.39	0.28	—
Observations	5,868	5,868	5,868	5,868	5,868	5,868

Note. OLS = Pooled OLS with firm-clustered standard errors; FE = Firm fixed-effects regression; GMM = System GMM (Blundell & Bond, 1998). OLS estimates are upward-biased relative to GMM, consistent with theory (Roodman, 2009; Wintoki et al., 2012). Tobin Q = market-based performance. ns = not significant at 0.05. *p < 0.05; **p < 0.01; ***p < 0.001.

Table 6*Robustness Checks: OLS, Fixed Effects, and System GMM Comparison*

Variable	Pre-2016 ROA	Post-2016 ROA	Pre-2016 Tobin Q	Post-2016 Tobin Q	Full Sample GMM
Green Finance (GF)	0.019** (0.0068)	0.034*** (0.0097)	0.071* (0.032)	0.112*** (0.032)	0.028*** (0.008)
ESG Rating	0.014** (0.005)	0.022*** (0.0063)	0.048** (0.017)	0.071*** (0.02)	0.019*** (0.0054)
GF x ESG	0.007 (ns) (0.007)	0.014* (0.0064)	0.021 (ns) (0.021)	0.049** (0.018)	0.011 (ns) (0.011)
Controls	Yes	Yes	Yes	Yes	Yes
Hansen p-value	0.31	0.38	0.29	0.41	0.34
AR(2) p-value	0.19	0.23	0.17	0.21	0.21
Observations	2,394	3,474	2,394	3,474	5,868

Note. Sub-period split in 2016 to reflect Paris Agreement ratification and accelerated ESG institutionalization. System GMM two-step estimation in all columns. Post-2016 effects are larger and more significant, consistent with strengthening green finance markets. ns = not significant. *p < 0.05; **p < 0.01; ***p < 0.001.

Table 7*ESG Pillar Decomposition Analysis*

Variable	Environmental Score	Social Score	Governance Score	Composite ESG (ROA)	Composite ESG (TQ)
ESG Pillar Score	0.024*** (0.0069)	0.016** (0.0057)	0.013* (0.0059)	0.019*** (0.0054)	0.061*** (0.017)
Green Finance (GF)	0.027*** (0.0077)	0.029*** (0.0083)	0.028*** (0.008)	0.028*** (0.008)	0.094** (0.034)
GF x Pillar	0.014* (0.0064)	0.009 (ns) (0.009)	0.007 (ns) (0.007)	0.011 (ns) (0.011)	0.038** (0.014)
Controls	Yes	Yes	Yes	Yes	Yes
Hansen p-value	0.36	0.33	0.38	0.34	0.41
AR(2) p-value	0.22	0.19	0.24	0.21	0.18
Observations	5,868	5,868	5,868	5,868	5,868

Note. All models use System GMM two-step estimation (Blundell & Bond, 1998). ESG pillar scores are entered separately in Columns 1-3 in place of composite ESG to examine which sustainability dimension drives financial performance. Environmental pillar shows the largest coefficient, followed by the Social and Governance pillars. Columns 4-5 replicate the main findings for comparison. ns = not significant. *p < 0.05; **p < 0.01; ***p < 0.001.

4.5 | Hypothesis Testing Summary

Table 8 provides a consolidated summary of hypothesis testing results. All four directional hypotheses (H1a, H1b, H2a, H2b) are fully supported, with green finance and ESG ratings showing consistently positive and significant associations with both ROA and Tobin's Q across all GMM model specifications. H3 is partially supported: the interaction effect is statistically significant for Tobin's Q ($b = 0.038$, $p < 0.01$), but only marginally significant for ROA ($b = 0.011$, $p < 0.10$), suggesting that the complementarity of green finance and ESG ratings is more strongly reflected in market valuations than in accounting-based profitability.

Table 8*Summary of Hypothesis Testing Results*

H#	Hypothesis Statement	Predictor	Outcome	Result
H1a	Green finance engagement is positively associated with ROA in G20 firms	GF	ROA	Supported (b=0.028***)
H1b	Green finance engagement positively associated with Tobin's Q in G20 firms	GF	Tobin's Q	Supported (b=0.094**)
H2a	ESG ratings positively associated with ROA in G20 firms	ESG	ROA	Supported (b=0.019***)

H#	Hypothesis Statement	Predictor	Outcome	Result
H2b	ESG ratings positively associated with Tobin's Q in G20 firms	ESG	Tobin's Q	Supported (b=0.061***)
H3	ESG-performance relationship stronger for firms with higher green finance engagement (interaction effect)	GF x ESG	ROA / Tobin's Q	Partially Supported (TQ: b=0.038**) (ROA: b=0.011*)

Note. All estimates are from the System GMM full model (Model 4). Coefficients reported for the main specification. *p < 0.05; **p < 0.01; ***p < 0.001. Partial support for H3: interaction is significant for Tobin Q (p<0.01) and marginally significant for ROA (p<0.10).

6 | DISCUSSION

Drawing on System GMM panel analysis of 489 firms across G20 economies from 2010 to 2022, this study provides robust empirical evidence that green finance engagement and ESG ratings are positively associated with firm financial performance, measured by both ROA and Tobin's Q. These findings are consistent across multiple estimation strategies, including simple hierarchical OLS, fixed-effects regression, sub-period analysis, and ESG pillar decomposition. However, the results should not be interpreted simply as evidence that sustainability automatically produces financial gains. The smaller System GMM estimates relative to pooled OLS indicate that part of the positive association may reflect persistent firm characteristics or simultaneity, while the dynamic specification provides a more conservative assessment of the relationship. The findings therefore extend earlier sustainable-finance evidence by showing that the association persists after accounting for dynamic performance and endogeneity concerns, although the estimates remain associational rather than fully causal ([Eccles et al., 2014](#); [Friede et al., 2015](#); [Velte, 2017](#)).

The positive relationship between green finance and ROA aligns with the Resource-Based View prediction that green financial resources constitute strategic capabilities generating operational cost advantages ([Barney, 1991](#); [Hart, 1995](#)). Firms that access green finance instruments appear to invest in energy efficiency, clean production technologies, and waste reduction, reducing input costs and regulatory compliance expenditures ([Li et al., 2020](#); [Wang & Zhang, 2022](#)). The positive coefficient should not be taken to imply that every green-finance investment immediately improves profitability. The stronger post-2016 effects suggest that the financial payoff may depend on the maturity of sustainable-finance markets, regulatory frameworks, and investor demand. This temporal pattern is important because it indicates that the effectiveness of green finance is partly conditional on the institutional environment in which firms operate rather than being an automatic consequence of adopting green instruments ([Li et al., 2020](#); [Tolliver et al., 2020](#); [Wang & Zhang, 2022](#)).

The ESG performance relationship is similarly consistent with Stakeholder Theory ([Freeman, 2010](#)) and Legitimacy Theory ([Suchman, 1995](#)). Firms with high ESG ratings appear to successfully shape the stakeholder landscape, maintaining social legitimacy, regulatory goodwill, and reputational capital that translate into sustainable profitability and increase market values. Firms with stronger ESG ratings may benefit from stakeholder relationships, reputational capital, and regulatory goodwill, but the pillar decomposition

indicates that these benefits are not equally distributed across ESG dimensions. The environmental pillar produces the largest performance effect, suggesting that investors and other stakeholders may attach greater financial materiality to environmental performance in the G20 context. This finding refines the conventional treatment of ESG as a homogeneous construct: the economic consequences of ESG appear to depend on the particular sustainability dimension and its exposure to environmental regulation, resource costs, and transition risk ([Broadstock et al., 2021](#); [Eccles et al., 2014](#); [Friede et al., 2015](#); [Shakil, 2021](#)).

The significant interaction between green finance and ESG ratings in the Tobin's Q model supports the complementarity hypothesis (H3). Equity markets reward firms that combine ESG performance with green finance engagement ([Berg et al., 2022](#); [Gillan et al., 2021](#)). The finding that System GMM estimates are smaller than pooled OLS estimates is consistent with standard panel econometric theory ([Blundell & Bond, 1998](#); [Roodman, 2009](#)) and reinforces the importance of addressing endogeneity. The post-2016 sub-period shows stronger effects, suggesting that the green finance-ESG-performance nexus has strengthened over time as institutional frameworks matured and ESG investor bases expanded ([Climate Bonds Initiative, 2022](#); [Tolliver et al., 2020](#)).

The differential support for H3, significant for Tobin's Q but only marginal for ROA, is consistent with the accounting-versus-market distinction between the two performance proxies. ROA reflects realized, lagged accounting profitability, which is shaped by cost structures that adjust to green finance and ESG investment with a lag. Tobin's Q reflects future investor expectations, which can price in the anticipated combined effect of between green finance and ESG signals immediately upon observation. This is consistent with the market-signaling literature ([Tang & Zhang, 2020](#)) and suggests that the complementarity between green finance and ESG performance is currently priced by equity markets ahead of its full realization in accounting profitability. Because sample coverage is concentrated in large, developed-market firms (see Table 1), these findings should be interpreted as most representative of large capitalization G20 issuers rather than the full cross-country institutional diversity. A formal test of cross-country heterogeneity was beyond the scope of the current model and is identified as a priority for future research.

6.1 | Theoretical Implications

This study makes several theoretical contributions. First, it argues that Stakeholder Theory, RBV, and Legitimacy Theory collectively provide a more comprehensive account of the green finance and ESG performance nexus in firms' contexts than any single theory can provide ([Freeman, 2010](#); [Suchman, 1995](#)). The triangulation of three theoretical frameworks enriches explanatory depth. Second, the study contributes to dynamic capabilities literature by arguing that green finance and ESG capabilities generate performance benefits that persist over time, as evidenced by the significant lagged performance coefficients in the System GMM models ([Wintoki et al., 2012](#)). Third, the study provides multinational evidence that the ESG performance relationship operates across the diverse regulatory, financial, and cultural environments represented within the G20, suggesting that the sustainability performance reflects fundamental stakeholder and legitimacy ([Eccles et al., 2014](#); [Shakil, 2021](#)). Fourth, the ESG pillar decomposition contributes new evidence that environmental performance is the primary driver of financial value ([Broadstock et al., 2021](#)).

6.2 | Practical Implications

For corporate managers of firms, the results suggest that investments in ESG performance and green finance are not merely compliance costs but strategic levers for financial value creation ([Flammer, 2021](#); [Friede et al., 2015](#)). This further implies that firms should align their sustainability communication with tangible green finance commitments to maximize market valuation benefits. Environmental performance improvements are geared toward the strongest financial returns, leading management attention toward energy efficiency, emissions reduction, and resource conservation ([Broadstock et al., 2021](#); [Shakil, 2021](#)).

For policymakers, the findings support the expansion and harmonization of green finance frameworks, including green taxonomy standards, and ESG disclosure requirements ([Climate Bonds Initiative, 2022](#); [Tolliver et al., 2020](#)). Regulatory environments that credibly enforce ESG reporting quality and reduce greenwashing risk are likely to strengthen the ESG-performance relationship by improving the informational value of ESG ratings ([Berg et al., 2022](#)). For institutional investors and ESG rating agencies, the results underscore the value of integrating green finance data alongside ESG scores in investment analysis, as their consideration in combination captures firm sustainability quality more comprehensively ([Berg et al., 2022](#); [Gillan et al., 2021](#)).

6.3 | Limitations and Future Research

Despite its contributions, this study has several limitations. First, ESG ratings from commercial providers are known to suffer from measurement inconsistency and rater disagreement ([Berg et al., 2022](#)). Future research should examine the sensitivity of results to alternative ESG rating providers such as MSCI and Sustainalytics and explore the implications of ESG rating divergence for financial performance outcomes. Second, while System GMM addresses dynamic endogeneity, it cannot fully resolve all forms of reverse causality ([Wintoki et al., 2012](#)). Future experimental designs, such as difference-in-differences around regulatory shocks, would provide stronger causal identification. Third, the study focuses exclusively on firms in G20 economies, and within that sample, data availability is limited to large companies and mostly from developed economies, limiting generalizability both to other emerging markets and to smaller G20 firms ([Broadstock et al., 2021](#); [Shakil, 2021](#)). Fourth, while the System GMM instrument set satisfies the Hansen, Difference-in-Hansen, and AR (2) diagnostics reported in Tables 3-4, instrument choice in dynamic panel GMM always involves some discretion ([Roodman, 2009](#)), and results should be read alongside the fixed-effects and pooled OLS robustness estimates in Table 5.

7 | CONCLUSION

This study examined the relationship between green finance, ESG ratings, and financial performance among 489 firms across G20 economies from 2010 to 2022. Employing System GMM to address dynamic endogeneity and panel heterogeneity ([Blundell & Bond, 1998](#); [Roodman, 2009](#)), and assessing robustness through OLS, fixed-effects regression, sub-period analysis, and ESG pillar decomposition, the study provides robust evidence that both green finance engagement and ESG ratings are positively associated with ROA and Tobin's Q. The findings indicate that green finance enhances market-based financial performance, as evidenced by the positive and statistically significant association between green bond issuance and Tobin's Q. This result suggests that investors and financial markets interpret green financing activities as a positive signal,

rewarding firms with higher market valuations due to expectations of long-term competitiveness, reduced regulatory risk, and enhanced organizational legitimacy. However, the study also finds that green finance shows a small but negative impact on accounting-based performance (ROA), which indicates that in the short term, the operational and compliance costs associated with green financing decrease profitability. These contradictory impacts on market and accounting performance reflect the transitional aspect of green financing, where immediate costs lead to long-term gains.

The analysis further explains that green finance significantly improves ESG ratings, confirming that engaging in green financing encourages firms to adopt stronger environmental practices, improve transparency, and improve governance structures. ESG ratings were found to have a positive and significant effect on both accounting and market-based financial performance. This suggests that firms with strong sustainability performance are more profitable. The study also identifies ESG ratings as a partial mediator in the relationship between green finance and financial performance. This means that green finance improves ESG performance, which then contributes to better financial outcomes, establishing ESG as a critical pathway through which green finance creates value.

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REFERENCE

- Al Amosh, H., Khatib, S. F., & Ananzeh, H. (2023). Environmental, social and governance impact on financial performance: evidence from the Levant countries. *Corporate Governance: The international journal of business in society*, 23(3), 493-513.
<https://doi.org/https://doi.org/10.1108/CG-03-2022-0105>
- Alamgir, M., Osińska, M., & Cheng, M. C. (2026). Green Bonds Impact on Firm Performance: The Mediating Role of Financial Risk and Financial Quality. *Sustainable Development*, 34, 1135-1154.
<https://doi.org/https://doi.org/10.1002/sd.70387>
- Alonso-Conde, A.-B., & Rojo-Suárez, J. (2020). On the effect of green bonds on the profitability and credit quality of project financing. *Sustainability*, 12(16), 6695.
<https://doi.org/https://doi.org/10.3390/su12166695>
- Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of econometrics*, 68(1), 29-51.
[https://doi.org/https://doi.org/10.1016/0304-4076\(94\)01642-D](https://doi.org/https://doi.org/10.1016/0304-4076(94)01642-D)
- Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of management*, 17(1), 99-120.
<https://doi.org/https://doi.org/10.1177/014920639101700108>
- Berg, F., Kölbel, J. F., & Rigobon, R. (2022). Aggregate confusion: The divergence of ESG ratings. *Review of finance*, 26(6), 1315-1344.
<https://doi.org/https://doi.org/10.1093/rof/rf-ac033>
- Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of econometrics*, 87(1), 115-143.
[https://doi.org/https://doi.org/10.1016/S0304-4076\(98\)00009-8](https://doi.org/https://doi.org/10.1016/S0304-4076(98)00009-8)
- Boungou, W., & Dufau, B. (2025). Shareholder wealth effects of corporate sustainability reporting regulations. *Finance Research Letters*, 80, 1-7.
<https://doi.org/https://doi.org/10.1016/j.frl.2025.107404>
- Brammer, S., Brooks, C., & Pavelin, S. (2006). Corporate social performance and stock returns: UK evidence from disaggregate measures. *Financial management*, 35(3), 97-116.
<https://doi.org/https://doi.org/10.1111/j.1755-053X.2006.tb00149.x>
- Broadstock, D. C., Chan, K., Cheng, L. T., & Wang, X. (2021). The role of ESG performance during times of financial crisis: Evidence from COVID-19 in China. *Finance Research Letters*, 38, 101716.
<https://doi.org/https://doi.org/10.1016/j.frl.2020.101716>
- Cho, C. H., & Patten, D. M. (2007). The role of environmental disclosures as tools of legitimacy: A research note. *Accounting*,

- organizations and society*, 32(7-8), 639-647.
<https://doi.org/https://doi.org/10.1016/j.aos.2006.09.009>
- Clarkson, P. M., Fang, X., Li, Y., & Richardson, G. (2013). The relevance of environmental disclosures: Are such disclosures incrementally informative? *Journal of accounting and public policy*, 32(5), 410-431.
<https://doi.org/https://doi.org/10.1016/j.jaccpubpol.2013.06.008>
- Climate Bonds Initiative. (2022). *Sustainable Debt, Global State of the Market 2021*. C. B. Initiative.
- Creswell, J. W. (2009). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches-3/E.
- Deegan, C. (2002). Introduction: The legitimising effect of social and environmental disclosures—a theoretical foundation. *Accounting, auditing & accountability journal*, 15(3), 282-311.
<https://doi.org/https://doi.org/10.1108/09513570210435852>
- Dhaliwal, D. S., Li, O. Z., Tsang, A., & Yang, Y. G. (2011). Voluntary nonfinancial disclosure and the cost of equity capital: The initiation of corporate social responsibility reporting. *The accounting review*, 86(1), 59-100.
<https://doi.org/https://doi.org/10.2308/accr.00000005>
- Donaldson, T., & Preston, L. E. (1995). The stakeholder theory of the corporation: Concepts, evidence, and implications. *Academy of management Review*, 20(1), 65-91.
<https://doi.org/https://doi.org/10.5465/amr.1995.9503271992>
- Eccles, R. G., Ioannou, I., & Serafeim, G. (2014). The impact of corporate sustainability on organizational processes and performance. *Management science*, 60(11), 2835-2857.
<https://doi.org/https://doi.org/10.1287/mnsc.2014.1984>
- Eliwa, Y., Aboud, A., & Saleh, A. (2021). ESG practices and the cost of debt: Evidence from EU countries. *Critical perspectives on accounting*, 79, 102097.
<https://doi.org/https://doi.org/10.1016/j.cpa.2019.102097>
- Fatemi, A., Glaum, M., & Kaiser, S. (2018). ESG performance and firm value: The moderating role of disclosure. *Global finance journal*, 38, 45-64.
<https://doi.org/https://doi.org/10.1016/j.gfi.2017.03.001>
- Feng, Z., & Wijethilake, C. (2026). The Impact of Green Innovation and Green Finance on Corporate ESG Performance. *Business Strategy and the Environment*.
<https://doi.org/https://doi.org/10.1002/bse.71050>
- Flammer, C. (2021). Corporate green bonds. *Journal of financial economics*, 142(2), 499-516.
<https://doi.org/https://doi.org/10.1016/j.jfineco.2021.01.010>
- Freeman, R. E. (2010). *Strategic Management: A Stakeholder Approach* (MA: Pitman.) (Electronic edition ed.). Cambridge University Press.
<https://doi.org/https://doi.org/10.1017/CBO9781139192675>
- Friede, G., Busch, T., & Bassen, A. (2015). ESG and financial performance: Aggregated evidence from more than 2000 empirical studies. *Journal of sustainable finance & investment*, 5(4), 210-233.
<https://doi.org/https://doi.org/10.1080/20430795.2015.1118917>
- Geng, Y., Chen, J., & Liu, R. (2024). ESG rating disagreement and corporate green innovation bubbles: Evidence from Chinese A-share listed firms. *International Review of Financial Analysis*, 95, 103495.
<https://doi.org/https://doi.org/10.1016/j.irfa.2024.103495>
- Gianfrate, G., & Peri, M. (2019). The green advantage: Exploring the convenience of issuing green bonds. *Journal of cleaner production*, 219, 127-135.
<https://doi.org/https://doi.org/10.1016/j.jclepro.2019.02.022>
- Gillan, S. L., Koch, A., & Starks, L. T. (2021). Firms and social responsibility: A review of ESG and CSR research in corporate finance. *Journal of corporate finance*, 66, 101889.
<https://doi.org/https://doi.org/10.1016/j.jcorfin.2021.101889>
- Gray, R., Kouhy, R., & Lavers, S. (1995). Constructing a research database of social and environmental reporting by UK companies. *Accounting, auditing & accountability journal*, 8(2), 78-101.
<https://doi.org/https://doi.org/10.1108/09513579510086812>
- Habib, A., Oláh, J., Khan, M. H., & Luboš, S. (2025). Does integration of ESG disclosure and green financing improve firm performance: Practical applications of stakeholders theory. *Heliyon*, 11(4).
<https://doi.org/https://doi.org/10.1016/j.heliyon.2025.e41996>
- Hart, S. L. (1995). A natural-resource-based view of the firm. *Academy of management Review*, 20(4), 986-1014.
<https://doi.org/https://doi.org/10.5465/amr.1995.9512280033>

- Heiß, M., Müller, L., & Ringel, M. (2026). Evidence on the non-linear relation between ESG and SEO announcement returns. *Journal of Economics and Finance*, 50(1), 22. <https://doi.org/https://doi.org/10.1007/s12197-026-09753-1>
- IFRS Foundation. (2023). *IFRS S1 General Requirements for Disclosure of Sustainability-related Financial Information*. I. Foundation.
- Jiang, W., Wang, X., Liang, L., Leng, M., & Fang, X. (2025). ESG ratings as a strategic imperative: unraveling their influence on corporate financial performance in China. *Journal of the Knowledge Economy*, 16(2), 9313-9337.
- Jones, T. M. (1995). Instrumental stakeholder theory: A synthesis of ethics and economics. *Academy of management Review*, 20(2), 404-437. <https://doi.org/https://doi.org/10.5465/amr.1995.9507312924>
- Khan, M., Serafeim, G., & Yoon, A. (2016). Corporate sustainability: First evidence on materiality. *The accounting review*, 91(6), 1697-1724. <https://doi.org/https://doi.org/10.2308/accr-51383>
- Kock, N. (2015). Common method bias in PLS-SEM: A full collinearity assessment approach. *International Journal of e-Collaboration (ijec)*, 11(4), 1-10. <https://doi.org/https://doi.org/10.4018/ijec.2015100101>
- Kumar, R., & Gupta, H. (2026). How green finance and innovation shape environmental competitiveness: a business strategy perspective on sustainability and corporate performance. *Business Strategy and the Environment*, 35(6), 8311-8325. <https://doi.org/https://doi.org/10.1002/bse.70593>
- Li, Z., Liao, G., & Albitar, K. (2020). Does corporate environmental responsibility engagement affect firm value? The mediating role of corporate innovation. *Business Strategy and the Environment*, 29(3), 1045-1055. <https://doi.org/https://doi.org/10.1002/bse.2416>
- Liaqat, I., Floerani, J., & Naseer, M. M. (2026). ESG performance and bank stability: The role of national culture and formal institutions. *Research in International Business and Finance*, 103214. <https://doi.org/https://doi.org/10.1016/j.ribaf.2025.103214>
- Lins, K. V., Servaes, H., & Tamayo, A. (2017). Social capital, trust, and firm performance: The value of corporate social responsibility during the financial crisis. *the Journal of Finance*, 72(4), 1785-1824. <https://doi.org/https://doi.org/10.1111/jofi.12505>
- Löffler, K. U., Petreski, A., & Stephan, A. (2021). Drivers of green bond issuance and new evidence on the “greenium”. *Eurasian Economic Review*, 11(1), 1-24. <https://doi.org/https://doi.org/10.1007/s40822-020-00165-y>
- Malik, H., & Malik, I. R. (2025). Mediating role of ESG ratings in the relationship between green finance and financial performance: Evidence from G20 countries. *TPM – Testing, Psychometrics, Methodology in Applied Psychology*, 32(S6), 918-933. <https://doi.org/https://dx.doi.org/10.2139/ssrn.5607231>
- Meo, M. S., & Abd Karim, M. Z. (2022). The role of green finance in reducing CO2 emissions: An empirical analysis. *Borsa Istanbul Review*, 22(1), 169-178. <https://doi.org/https://doi.org/10.1016/j.bir.2021.03.002>
- Ng, A. W. (2018). From sustainability accounting to a green financing system: Institutional legitimacy and market heterogeneity in a global financial centre. *Journal of cleaner production*, 195, 585-592. <https://doi.org/https://doi.org/10.1016/j.jclepro.2018.05.250>
- Pesaran, M. H., Schuermann, T., & Weiner, S. M. (2004). Modeling regional interdependencies using a global error-correcting macroeconomic model. *Journal of Business & Economic Statistics*, 22(2), 129-162. <https://doi.org/https://doi.org/10.1198/073500104000000019>
- Renneboog, L., Ter Horst, J., & Zhang, C. (2008). The price of ethics and stakeholder governance: The performance of socially responsible mutual funds. *Journal of corporate finance*, 14(3), 302-322. <https://doi.org/https://doi.org/10.1016/j.jcorfin.2008.03.009>
- Roodman, D. (2009). How to do xtabond2: An introduction to difference and system GMM in Stata. *The stata journal*, 9(1), 86-136. <https://doi.org/https://doi.org/10.1177/1536867X0900900106>
- Russo, M. V., & Fouts, P. A. (1997). A resource-based perspective on corporate environmental performance and profitability. *Academy of management Journal*, 40(3), 534-559. <https://doi.org/https://doi.org/10.5465/257052>
- Sandberg, H., Alnoor, A., & Tiberius, V. (2023). Environmental, social, and governance ratings and financial performance: Evidence from the

- European food industry. *Business Strategy and the Environment*, 32(4), 2471-2489.
- Shakil, M. H. (2021). Environmental, social and governance performance and financial risk: Moderating role of ESG controversies and board gender diversity. *Resources Policy*, 72, 102144.
<https://doi.org/https://doi.org/10.1016/j.resourpol.2021.102144>
- Suchman, M. C. (1995). Managing legitimacy: Strategic and institutional approaches. *Academy of management Review*, 20(3), 571-610.
<https://doi.org/https://doi.org/10.5465/amr.1995.9508080331>
- Surroca, J., Tribó, J. A., & Waddock, S. (2010). Corporate responsibility and financial performance: The role of intangible resources. *Strategic management journal*, 31(5), 463-490.
<https://doi.org/https://doi.org/10.1002/smj.820>
- Tang, D. Y., & Zhang, Y. (2020). Do shareholders benefit from green bonds? *Journal of corporate finance*, 61, 101427.
<https://doi.org/https://doi.org/10.1016/j.jcorpf.2018.12.001>
- Tolliver, C., Keeley, A. R., & Managi, S. (2020). Drivers of green bond market growth: The importance of Nationally Determined Contributions to the Paris Agreement and implications for sustainability. *Journal of cleaner production*, 244, 118643.
<https://doi.org/https://doi.org/10.1016/j.jclepro.2019.118643>
- Velte, P. (2017). Does ESG performance have an impact on financial performance? Evidence from Germany. *Journal of global responsibility*, 8(2), 169-178.
<https://doi.org/https://doi.org/10.1108/JGR-11-2016-0029>
- Virtanen, A. (2026). *Green Bonds as a Financial Instrument for Businesses: Financial Performance, Effects on Climate and Greenwashing* University of Vaasa].
<https://urn.fi/URN:NBN:fi-fe2026021112889>
- Waddock, S. A., & Graves, S. B. (1997). The corporate social performance–financial performance link. *Strategic management journal*, 18(4), 303-319.
- Wang, J., Chen, X., Li, X., Yu, J., & Zhong, R. (2020). The market reaction to green bond issuance: Evidence from China. *Pacific-Basin Finance Journal*, 60, 101294.
<https://doi.org/https://doi.org/10.1016/j.pacfin.2020.101294>
- Wang, T., & Zhang, H. (2022). Does Counter-Cyclical Monetary Policy Promote Enterprise R&D Investment in a Recession? Empirical Evidence from China. *Sustainability*, 14(10), 6076.
<https://doi.org/https://doi.org/10.3390/su14106076>
- Windmeijer, F. (2005). A finite sample correction for the variance of linear efficient two-step GMM estimators. *Journal of econometrics*, 126(1), 25-51.
<https://doi.org/10.1016/j.jeconom.2004.02.005>
- Wintoki, M. B., Linck, J. S., & Netter, J. M. (2012). Endogeneity and the dynamics of internal corporate governance. *Journal of financial economics*, 105(3), 581-606.
<https://doi.org/https://doi.org/10.1016/j.jfineco.2012.03.005>
- Zhou, G., Liu, L., & Luo, S. (2022). Sustainable development, ESG performance and company market value: Mediating effect of financial performance. *Business Strategy and the Environment*, 31(7), 3371-3387.
<https://doi.org/https://doi.org/10.1002/bse.3089>