

ESG INVESTMENT AND FIRM VALUE: THE MODERATING ROLE OF CORPORATE REPUTATION IN ADVANCING CORPORATE SUSTAINABILITY AND SUSTAINABLE GROWTH IN BANGLADESH



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ABSTRACT

Emerging-market firms are asked to fund environmental, social and governance commitments at a moment when capital is scarce and investors still question whether corporate sustainability spending destroys or creates shareholder wealth; in Bangladesh, where the cumulative intensity of green-banking and disclosure directives has risen almost eightfold since 2004, the value consequences of such spending remain unsettled. This study examines whether ESG investment raises firm value and whether corporate reputation conditions that relationship. The analysis employs a balanced panel of 110 non-financial firms listed on the Dhaka Stock Exchange over 2004–2024, comprising 2,310 firm-year observations, and applies two-way fixed-effects moderation models, panel unit-root and cointegration tests, pooled mean group ARDL estimation, a panel vector autoregression with variance decomposition, Dumitrescu–Hurlin causality tests, mediation decomposition and two-stage least squares. The results show that ESG investment raises Tobin's Q ($\beta = 0.126$, $p = .001$) and that the ESG $\times$ reputation interaction is positive and significant ($\beta = 0.117$, $p < .001$), lifting explained variance by 5.5 percentage points; the marginal effect of ESG investment is indistinguishable from zero below a Johnson–Neyman reputation threshold of 49.6 and reaches 0.305 one standard deviation above the reputation mean. Panel cointegration is confirmed, the pooled mean group long-run ESG coefficient is 0.457, and the error-correction speed is -0.619 . The findings suggest that reputation is a complement rather than a substitute for ESG investment, that approximately 15% of the ESG–value relation is transmitted through reputation building, and that the payoff to sustainable growth commitments is contingent rather than automatic.

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INTRODUCTION

The question of whether spending on environmental, social and governance commitments enriches or impoverishes shareholders has moved from the margins of finance to its centre, and it has done so without being settled. Global sustainable assets under management now exceed thirty trillion United States dollars, yet the empirical literature continues to report positive, negative and null associations between sustainability effort and market valuation, often within the same market and the same decade (Berg et al., 2022; Gillan et al., 2021; Kräussl et al., 2024; Panko, 2026; Postiglione et al., 2024). The disagreement is not merely statistical. It reflects an unresolved theoretical tension: stakeholder theory predicts that resources devoted to corporate sustainability generate reciprocal goodwill and lower the cost of capital, whereas the agency perspective treats the same expenditure as managerial private benefit consumption financed out of free cash flow. Both

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predictions are internally coherent, and both find support in the data, which suggests that the relation is conditional rather than universal and that the moderators have been under-theorised.

That conditionality matters most acutely in emerging economies, where the institutional scaffolding that makes sustainability claims credible in developed markets is thin or absent. Bangladesh offers a particularly informative setting. Over the past two decades the country has combined among the fastest sustained rates of economic growth in South Asia with acute environmental vulnerability, a garment-led export structure exposed to global buyer scrutiny after the Rana Plaza disaster, and a regulatory apparatus that has moved rapidly from voluntary encouragement to binding requirement. Bangladesh Bank's green-banking guidelines, the corporate social responsibility expenditure provisions administered through the tax code, and the Bangladesh Securities and Exchange Commission's successive corporate governance codes together produced a near eightfold increase in the intensity of sustainability regulation between 2004 and 2024. Firms have responded with substantial and rising outlays. Whether those outlays have been rewarded by the market is a question with direct consequences for the allocation of scarce capital in a low-income economy (Islam, 2025; Sarker & Hossain, 2024; Siddiquee et al., 2025).

The scientific problem this study addresses is the following. If ESG investment were unconditionally value-creating, the observed dispersion in estimated effects across markets and periods would be difficult to explain; if it were unconditionally value-destroying, the persistence and growth of such spending under competitive pressure would be difficult to explain. The dispersion therefore points to an omitted conditioning variable that governs whether the market capitalises sustainability effort. Signalling and legitimacy reasoning converge on a candidate. Sustainability expenditure is an unobservable-quality signal transmitted through a noisy channel; the market's willingness to price that signal should depend on the credibility of the sender. Corporate reputation is precisely an accumulated stock of credibility. It follows that the value of ESG investment should be contingent on reputation, and that studies which estimate an unconditional average effect are averaging across firms for whom the effect differs in sign. This proposition has been asserted more often than it has been tested with the econometric care that panel data of sufficient length permit, and it has almost never been tested in a frontier market over a horizon long enough to separate short-run adjustment from long-run equilibrium (Kim et al., 2024; Wan et al., 2026; Zhou et al., 2025).

The aim of this research is to establish whether the effect of ESG investment on firm value in an emerging market is conditional on corporate reputation, and to quantify the reputation threshold above which sustainability spending becomes value-accretive. Several intermediate problems must be solved for that aim to be achieved: the long-run equilibrium relation among sustainability investment, reputation and valuation must be shown to exist rather than assumed; the direction of causation must be established rather than presumed; the endogeneity of sustainability spending with respect to unobserved firm quality must be purged; and the portion of the total effect that travels through reputation must be separated from the portion that does not.

Methodologically, the study uses a balanced panel of 110 non-financial firms listed on the Dhaka Stock Exchange observed annually from 2004 to 2024. Estimation proceeds in stages: two-way fixed-effects models with firm-clustered standard errors identify the moderated relation; panel unit-root, cointegration and bounds tests establish the long-run relation; pooled mean group, mean group and dynamic fixed-effects estimators recover long-run and short-run coefficients separately; a panel vector autoregression with impulse responses and variance decomposition traces dynamic propagation; Dumitrescu–Hurlin tests establish causal direction; a Sobel and bootstrap decomposition isolates the reputation-mediated channel; and two-stage least squares with leave-one-out sector instruments addresses simultaneity.

The remainder of the paper is organised as follows. The next section reviews the theoretical and empirical literature on sustainability investment, firm value and reputation, identifies the contradictions that motivate the study, and states the hypotheses. The third section describes the sample, the measurement of each construct, the research design and the estimation procedures. The fourth section reports the diagnostic, baseline, long-run, dynamic, decomposition and robustness results. The fifth section interprets those results against prior findings and draws out their theoretical and managerial consequences. The final section summarises the contribution, states the limitations and identifies directions for further research.

LITERATURE REVIEW

Research on the valuation consequences of corporate sustainability rests on four theoretical foundations that generate partially conflicting predictions, and the empirical literature has inherited that conflict rather than resolving it. Stakeholder theory holds that a firm's capacity to generate value depends on the quality of its relationships with employees, customers, suppliers, regulators and communities, so that investment in those relationships augments the productive asset base rather than diverting from it (Freeman, 2010). Resource-based reasoning sharpens the claim: sustainability capabilities that are valuable, rare, inimitable and organisationally embedded can support durable rents, whereas easily copied gestures cannot (Barney, 1991). Legitimacy theory argues instead that firms invest to maintain congruence between organisational conduct and prevailing social norms, so that the return is the avoidance of sanction (Suchman, 1995). Signalling theory treats costly expenditure as a device by which high-quality managers separate themselves from low-quality ones under information asymmetry (Spence, 1973). Only the first two predict a positive valuation effect as a matter of course; the third predicts an effect concentrated in periods of legitimacy threat, and the fourth an effect that exists only when the signal is received and believed.

Against these predictions stands the agency critique, which holds that sustainability expenditure is frequently an instrument through which managers purchase reputation and social standing for themselves at shareholder expense. Evidence that such spending rises with free cash flow and falls with monitoring intensity is consistent with that reading, as is the finding that announcement returns to sustainability initiatives are weakest in firms with entrenched boards. The critique does not deny that some sustainability investment creates value; it denies that the average does, and locates the difference

in governance quality. Recent work has begun to reconcile the two camps by treating the sign of the effect as a function of firm-level and institutional conditioning variables rather than as a parameter to be estimated once, and by allowing the relation to be non-linear or threshold-dependent (Agarwala et al., 2024; Chen et al., 2024; Huarng & Yu, 2024; Wan et al., 2026).

The large-sample empirical record is correspondingly mixed. Meta-analytic synthesis of roughly two thousand primary studies found that about ninety per cent report a non-negative relation between environmental, social and governance criteria and corporate financial performance (Friede et al., 2015). That headline conceals substantial heterogeneity. Firms with strong social responsibility profiles face materially lower costs of equity capital, which implies a valuation premium operating through the discount rate rather than through cash flows (El Ghouli et al., 2011), and superior social performance eases access to finance more generally (Cheng et al., 2014). Yet the effect is concentrated in issues that are financially material to the industry in question, and firms investing heavily in immaterial issues while neglecting material ones underperform (Khan et al., 2016); the relation may also be curvilinear, so that only firms achieving high absolute performance are rewarded (Barnett & Salomon, 2012). Recent studies of European and North American markets continue to report small and specification-sensitive average effects, with within-firm estimates frequently weaker than cross-sectional ones and with rating disagreement and cost-of-capital channels accounting for much of the dispersion (Berg et al., 2022; Glova & Panko, 2025; Panko, 2026; Postiglione et al., 2024). Also, some studies report that ESG controversies have negative impact on firm value and this negative effect can be reduced by well-developed ESG strategist (Brighi et al., 2025; Elamer & Boulhaga, 2024).

Evidence from emerging and frontier markets is scarcer and less consistent. Some studies report a positive valuation effect that strengthens with institutional development, others a null effect attributable to weak enforcement and low investor sophistication, and a minority a negative effect attributable to the cost burden of compliance in capital-constrained firms. Work on emerging markets, including India, South Africa and a broad panel of emerging economies, has found that ESG scores raise valuation on average while ESG controversies depress it, and that individual pillars are often insignificant, which suggests that the market response depends on whether sustainability activity is perceived as substantive or symbolic, a distinction that is difficult for outside investors to draw without a credibility intermediary (Chininga et al., 2024; Gangwani & Kashiramka, 2024; Narula et al., 2024; Rahat & Nguyen, 2024). Studies focused on Bangladesh have documented rising sustainability and climate-related disclosure following regulatory intervention, a positive but firm-age-contingent value relevance of ESG disclosure, and favourable associations between green finance, corporate social responsibility, governance quality and firm outcomes, but these associations are frequently constrained by short sample periods that preclude long-run inference (Hasan, Islam, Tawfiq, & Saha, 2025; Islam, 2025; Mehedi et al., 2024; Sarker & Hossain, 2024).

Corporate reputation enters this literature as a construct with an established valuation relevance of its own. A key means by which that environmental performance affects business outcomes is through corporate reputation, being a valuable intangible asset for the firm (Hsiao et al., 2026). Reputation is an aggregate perceptual representation of a firm's past actions and prospects that describes its overall appeal to constituents relative to rivals, formed from signals stakeholders receive about the firm's conduct (Fombrun & Shanley, 1990). Reputation of that kind sustains superior financial performance over extended periods and resists competitive imitation, because it accumulates slowly, cannot be purchased directly, and is embedded in the perceptions of many independent parties (Roberts & Dowling, 2002). Previous research clearly demonstrates that businesses that engage in environmentally responsible practices for instance, sustainable production, green innovation and environmental management, typically receive positive responses from stakeholders, enhancing their reputation (Al-Romeedy & Alharethi, 2025; Anser et al., 2024). Empirical research find that ESG activities positively affects corporate reputation, improving firm performance (Gidage & Bhide, 2025) Since reputation promotes stakeholder trust and market assessment, companies with higher reputational capital typically attain greater firm value (Xiao et al., 2024). According to Aguiar and Moxotó (2025), ESG is a strategic lever that improves trust of stakeholders and external perceptions in addition to responding to environmental and social demands, thus increasing corporate reputation and long-term performance. Khan et al. (2026) state that ESG affects sustainable performance only indirectly through innovation capability and corporate reputation. On the other hand, substantial drop in market value may result from reputational damage inflicted by company misconduct (Wang et al., 2024). Hence, to reduce the effect of reputation risk on firm value, businesses typically build reputational capital as a protection against unfavorable outcome and for reputation risk management (Bani-Khaled et al., 2025; Oreshile et al., 2025). More recent work treats reputation as an intangible that conditions how sustainability effort is priced and as an information intermediary that reduces the cost of assessing unobservable quality, and it documents those reputational penalties captured by ESG controversies impair both fundamental and multiple-based valuation (Kim et al., 2024; Rahat & Nguyen, 2024; Wan et al., 2026).

The intersection of these two literatures is where this study locates its contribution. Three distinct relations have been proposed and are frequently conflated. The first treats reputation as an outcome of sustainability investment, so that ESG spending builds reputation which in turn raises value; on this view reputation mediates. The second treats reputation as a substitute, so that firms already well regarded gain little from further effort while poorly regarded firms gain much; on this view the interaction is negative. The third treats reputation as a complement, so that the market discounts sustainability claims from firms whose past conduct provides no basis for believing them and capitalizes the same claims from firms with an established record; on this view the interaction is positive. The three are not mutually exclusive, but they carry sharply different managerial implications and have rarely been tested jointly; the mediating role of reputation has been documented for Korean and Chinese firms, and a reputation threshold below which ESG investment is not rewarded has recently been reported for Chinese state-owned enterprises (Fang & Guo, 2025; Kim et al., 2024; Seok et al., 2024; Wan et al., 2026).

The complementarity argument has the stronger theoretical foundation. Signalling models establish that a signal is informative only when the cost of sending it is negatively correlated with the sender's type and when receivers can verify

that correlation. Sustainability expenditure satisfies the first condition imperfectly, because low-quality firms can also spend, and it satisfies the second only when receivers possess an independent basis for assessing the sender. Reputation supplies that basis. A firm with an accumulated record of consistent conduct offers observers a prior against which new sustainability claims can be evaluated; a firm without such a record offers none, and its claims are appropriately discounted as cheap talk. The prediction is that the marginal valuation effect of ESG investment increases in reputation and may be indistinguishable from zero, or negative, at low reputation levels where sustainability spending is read as a cost without an offsetting credibility benefit; consistent with this, markets have been shown to price the gap between what firms disclose and what they deliver as a persistent reputational trait (Connelly et al., 2011; Taddeo et al., 2026; Wan et al., 2026).

Methodologically, the literature exhibits three recurrent weaknesses that this study is designed to address. Sample periods are typically five to ten years, which makes it impossible to separate short-run adjustment from long-run equilibrium and leaves estimates hostage to the macroeconomic conditions of the window observed; recent work using dynamic and long-horizon specifications has found that the valuation effects of sustainability emerge gradually, are dominated by valuation persistence in short windows, and operate through long-run cash flow and cost-of-capital channels rather than contemporaneous earnings (Fang & Guo, 2025; Panko, 2026; Zhou et al., 2025). Endogeneity is frequently acknowledged and rarely treated, although sustainability investment is chosen by firms whose unobserved quality also determines valuation, and instrumental variable and generalised method of moments strategies exploiting peer-group averages and lagged instruments have been deployed with mixed success (Chininga et al., 2024; Gangwani & Kashiramka, 2024; Wan et al., 2026). And the time-series properties of the series are rarely tested, so regressions are estimated on variables of unexamined integration order without verifying that a cointegrating relation exists, even though valuation and sustainability measures are known to be highly persistent (Panko, 2026; Zhou et al., 2025).

The Bangladeshi and regional evidence base has expanded in parallel. Studies have documented the effects of green finance on banks' non-performing loans, environmental and social risk management and performance (Siddiquee et al., 2024, 2025), the role of institutional pressures in driving voluntary environmental disclosure (Fan et al., 2024), the sustainability-performance consequences of environmental management accounting adoption (Yusoh et al., 2024), and the conditions under which sustainability practices translate into enterprise performance in Bangladesh (Hossain et al., 2024; Sultana, 2026). Work on governance and firm value in listed Bangladeshi manufacturing firms and banks (Hasan, Islam, & Saha, 2025; Sarker & Hossain, 2024) provides local benchmarks against which the present estimates can be assessed.

Taken together, the literature establishes that sustainability investment is on average weakly value-enhancing, that reputation independently carries valuation relevance, and that the relation is heterogeneous across firms and institutional settings. It leaves unresolved whether reputation moderates that relation and in which direction, whether the relation is a long-run equilibrium or a short-run correlation, and how much of any total effect travels through reputation. The contradiction between studies reporting positive and null effects in similar markets is most parsimoniously explained by an unmodelled interaction, but that explanation has not been subjected to a test that simultaneously establishes cointegration, purges endogeneity and decomposes the total effect, and emerging-market evidence over horizons exceeding two decades is essentially absent. These gaps justify continued study and determine the direction taken here.

The purpose of this study is therefore to determine whether corporate reputation moderates the relationship between ESG investment and firm value among listed non-financial firms in Bangladesh over the period 2004 to 2024, to establish whether that relationship constitutes a long-run equilibrium, and to quantify the reputation threshold at which ESG investment becomes value-accretive. On the basis of the foregoing theoretical reasoning and empirical evidence, the following hypotheses are advanced:

- H₁:** ESG investment intensity is positively associated with firm value among listed non-financial firms in Bangladesh.
- H₂:** Corporate reputation is positively associated with firm value among listed non-financial firms in Bangladesh.
- H₃:** Corporate reputation positively moderates the relationship between ESG investment intensity and firm value, such that the marginal effect of ESG investment on firm value increases as corporate reputation increases.
- H₄:** A stable long-run equilibrium relationship exists among ESG investment intensity, corporate reputation and firm value, with short-run deviations corrected towards that equilibrium.
- H₅:** Corporate reputation partially mediates the relationship between ESG investment intensity and firm value, so that a statistically significant indirect effect operates through reputation alongside a direct effect.

MATERIALS AND METHODS

Sampling Procedures and Sample Size

The study population comprises all non-financial firms listed on the Dhaka Stock Exchange. Financial institutions, insurance companies and mutual funds were excluded because their asset structures, regulatory capital requirements and valuation conventions differ fundamentally from those of operating companies, and because sustainability expenditure in banking is governed by a separate supervisory regime. Firms were retained only if they were continuously listed and reported audited annual financial statements for every year from 2004 through 2024, so that a balanced panel could be constructed. This eligibility criterion excludes firms that listed after 2004, that were delisted, or that suspended reporting, and it introduces a survivorship consideration that is addressed in the limitations.

Applying these criteria yielded 110 firms observed over 21 years, giving 2,310 firm-year observations across twelve Dhaka Stock Exchange sector classifications, with textiles, pharmaceuticals and chemicals, and engineering the largest. The 21-year window is deliberate: it spans the pre-regulatory period before Bangladesh Bank issued green-banking guidance, the global financial crisis, the 2010–2011 domestic equity market correction, the post-Rana Plaza intensification of buyer scrutiny, the COVID-19 shock and the subsequent recovery, and it is long enough for panel unit-root and cointegration inference to have meaningful power.

Table 1. Sample composition by sector, 2004–2024

Sector	Number of firms	Firm-year observations	Percentage of sample
Textile	18	378	16.4
Pharmaceuticals and chemicals	14	294	12.7
Engineering	14	294	12.7
Food and allied	11	231	10.0
Fuel and power	10	210	9.1
Services and real estate	8	168	7.3
Miscellaneous	8	168	7.3
IT and telecommunication	7	147	6.4
Cement	6	126	5.5
Ceramics	5	105	4.5
Tannery	5	105	4.5
Paper and printing	4	84	3.6
Total	110	2,310	100.0

Note. The sample comprises all non-financial firms continuously listed on the Dhaka Stock Exchange with complete audited financial statements for every year from 2004 through 2024. Financial institutions, insurance companies and mutual funds are excluded.

Measures and Covariates

Firm value, the dependent variable, is measured by Tobin's Q, computed as the market value of equity plus the book value of total debt, divided by the book value of total assets. Tobin's Q is preferred to accounting profitability because it is forward-looking, incorporates the market's assessment of intangible assets, and is the conventional dependent variable in the sustainability–value literature. The market-to-book ratio and return on equity are used as alternative dependent variables in robustness testing.

ESG investment intensity, the independent variable, is measured as total environmental, social and governance related expenditure scaled by total assets and expressed in percentage points. The numerator aggregates environmental expenditure (effluent treatment, emissions abatement, energy and water efficiency, waste management), social expenditure (occupational health and safety, worker welfare and training, community programmes, corporate social responsibility outlays reported under the tax provisions) and governance expenditure (independent assurance, compliance and internal control investment, board and audit committee costs above statutory minima). Amounts are extracted from audited financial statements, notes to the accounts, directors' reports and standalone sustainability reports. Scaling by total assets removes the mechanical size effect and yields an intensity measure comparable across firms.

Corporate reputation, the moderator, is measured by a composite index scaled from 0 to 100 and constructed annually for each firm from five equally weighted components: media visibility and valence, derived from content analysis of national business press coverage; recognition in national and regional reporting and governance awards, including the Institute of Chartered Accountants of Bangladesh and South Asian Federation of Accountants competitions; audit quality, proxied by engagement of a firm affiliated with an international network; listing seniority, capturing the length of the public record available to investors; and institutional following, measured by the breadth of institutional shareholding. Each component is standardised across the sample and rescaled before aggregation, following the logic that reputation is an aggregate perception formed from multiple independent signals rather than a single attribute.

Ten control variables are included: firm size, leverage, return on assets, sales growth, firm age, liquidity, board independence, institutional ownership, real GDP growth and consumer price inflation. The first eight capture firm-level determinants of valuation established in the prior literature, and the last two absorb macroeconomic conditions common to all firms in a given year. Full operational definitions and sources appear in Table 2.

Table 2. Definition and measurement of variables

Variable	Symbol	Role	Operational definition	Source
Tobin's Q	TQ	Dependent	(Market value of equity + book value of total debt) / book value of total assets	Annual reports; DSE
Market-to-book ratio	MTB	Alternative dependent	Market value of equity / book value of equity	DSE
Return on equity	ROE	Alternative dependent	Net income / total shareholders' equity	Annual reports
ESG investment intensity	ESGI	Independent	Total environmental, social and governance expenditure / total assets $\times 100$	Annual and sustainability reports
Corporate reputation	CREP	Moderator	Composite index (0–100) of media visibility, reporting and governance awards, audit quality, listing seniority and institutional following	Press content analysis; ICAB and SAFA award records
Firm size	SIZE	Control	Natural logarithm of total assets	Annual reports
Leverage	LEV	Control	Total debt / total assets	Annual reports
Return on assets	ROA	Control	Earnings before interest and tax / total assets	Annual reports
Sales growth	GROWTH	Control	$(Sales_t - Sales_{t-1}) / Sales_{t-1}$	Annual reports
Firm age	LNAGE	Control	Natural logarithm of years since incorporation	RJSC records
Liquidity	LIQ	Control	Current assets / current liabilities	Annual reports
Board independence	BIND	Control	Independent directors / total board size	Corporate governance reports
Institutional ownership	INSTOWN	Control	Institutional shareholding / total shares outstanding	DSE shareholding patterns

GDP growth	GDPG	Control	Annual real gross domestic product growth rate (%)	World Bank WDI
Inflation	INF	Control	Annual consumer price inflation rate (%)	World Bank WDI

Note. All monetary variables are expressed in Bangladeshi taka. Continuous variables are winsorised at the first and ninety-ninth percentiles in the robustness analysis reported in Table 18.

Research Design

The research design is a non-experimental longitudinal panel study using secondary data. No experimental manipulation or intervention was administered and no human participants were involved, so participant flow, recruitment, intervention fidelity and adverse event reporting are not applicable. Identification rests on within-firm variation over time after conditioning on firm-invariant heterogeneity and year-specific common shocks, supplemented by instrumental variable estimation to address the residual endogeneity of sustainability spending.

Because the sample is balanced with $N = 110$ and $T = 21$, the panel is long enough for the time-series properties of the data to matter and short enough that firm-by-firm estimation would be imprecise. Estimation therefore proceeds in stages. Integration order is assessed with the Levin et al. (2002), Im et al. (2003) and Fisher-type augmented Dickey–Fuller and Phillips–Perron tests of Maddala and Wu (1999), supported by the Phillips and Perron (1988) and Kwiatkowski et al. (1992) procedures on aggregate series. Parameter stability is tested with the Andrews (1993) sup-Wald statistic and the Chow (1960) test. Cointegration is assessed with the Kao (1999) residual-based test, the Pedroni (2004) group-mean statistics, the Westerlund (2007) error-correction tests and the bounds procedure of Pesaran et al. (2001), with the system dimension checked by the Johansen (1991) trace test. Long-run and short-run coefficients are separated using the pooled mean group estimator of Pesaran et al. (1999). Causal direction is established with Dumitrescu and Hurlin (2012) panel tests, the total effect is decomposed following Baron and Kenny (1986) with the Sobel (1982) test and the bootstrap procedure of Preacher and Hayes (2008), and dynamic panel robustness uses the Arellano and Bond (1991) estimator.

Model Specification and Estimation Procedure

The baseline moderation model is specified in Equation 1, where the interaction term carries the hypothesis of interest. ESG investment intensity is mean-centred and corporate reputation is centred and divided by ten before the interaction is formed, which reduces non-essential multicollinearity and renders the lower-order coefficients interpretable as effects at the sample mean of the moderator (Aiken & West, 1991).

$$TQ_{it} = \beta_0 + \beta_1 ESGI_{it}^c + \beta_2 CREP_{it}^c + \beta_3 (ESGI_{it}^c \times CREP_{it}^c) + \sum_k \delta_k X_{kit} + \mu_i + \lambda_t + \varepsilon_{it} \quad (1)$$

$$\partial TQ / \partial ESGI = \beta_1 + \beta_3 CREP^c \quad (2)$$

$$SE(\partial TQ / \partial ESGI) = \sqrt{[Var(\beta_1) + (CREP^c)^2 Var(\beta_3) + 2 CREP^c Cov(\beta_1, \beta_3)]} \quad (3)$$

In Equation 1, TQ denotes Tobin's Q for firm i in year t ; $ESGI^c$ is mean-centred ESG investment intensity; $CREP^c$ is centred corporate reputation divided by ten; X is the vector of ten control variables; μ_i is the firm fixed effect; λ_t is the year fixed effect; and ε is the idiosyncratic disturbance. The coefficient β_3 tests H3, and its incremental contribution is assessed with Cohen's (2013) f^2 . The conditional marginal effect of ESG investment at any level of reputation is given by Equation 2 and its standard error by Equation 3, which together define the Johnson–Neyman region of significance (Johnson & Neyman, 1936). The choice between fixed and random effects is made by the Hausman (1978) specification test.

$$\Delta TQ_{it} = \phi_i (TQ_{i,t-1} - \theta' Z_{i,t-1}) + \sum \gamma_{ij} \Delta TQ_{i,t-j} + \sum \psi_{ij} \Delta Z_{i,t-j} + \mu_i + \varepsilon_{it} \quad (4)$$

The panel autoregressive distributed lag model is written in error-correction form in Equation 4. The parameter ϕ_i is the speed of adjustment to long-run equilibrium and must be negative and significant for a stable relation to exist; θ is the vector of long-run coefficients. Three estimators are applied. The mean group estimator allows all coefficients to vary across firms and averages them. The pooled mean group estimator constrains long-run coefficients to be common while allowing short-run coefficients and adjustment speeds to differ, and is efficient if the homogeneity restriction holds. The dynamic fixed-effects estimator constrains all slope coefficients and is efficient under stronger homogeneity. A Hausman test discriminates between them.

Endogeneity is addressed by two-stage least squares within the fixed-effects transformation. ESG investment intensity and its interaction with reputation are treated as endogenous, and six instruments are used: the leave-one-out sector-year mean of ESG investment intensity, the first and second lags of firm ESG investment intensity, and the interactions of each with centred reputation. The sector mean captures common sector-level regulatory and supply-chain pressure to invest while excluding the firm's own choice, and satisfies the exclusion restriction under the assumption that peer sustainability spending affects the focal firm's valuation only through its own spending once firm and year effects are absorbed. Instrument strength is assessed by first-stage F statistics, validity by the Sargan test and the need for instrumentation by the Durbin–Wu–Hausman test.

All standard errors are clustered at the firm level throughout, which accommodates both the serial correlation and the groupwise heteroskedasticity documented in Table 9. Statistical significance is reported at the 1%, 5% and 10% levels. All computations were performed in Python 3.11 using purpose-written implementations of the estimators described, with

bootstrap procedures based on 500 firm-level resamples for the mediation confidence interval and 120 replications for the cointegration null distributions.

RESULTS

Table 3 reports descriptive statistics for the 2,310 firm-year observations. Mean Tobin's Q is 1.173 with a standard deviation of 0.688, so the typical sample firm trades at a modest premium to the replacement cost of its assets while dispersion is substantial. Mean ESG investment intensity is 0.893% of total assets, ranging from 0.010% to 2.081%; near-zero skewness of 0.040 indicates a symmetric distribution without the concentration in a few heavy spenders that characterises some developed-market samples. The corporate reputation index averages 53.936 with a standard deviation of 15.362 and spans almost the full theoretical range, confirming that it discriminates across firms. Mean leverage of 0.412 and mean return on assets of 0.054 are consistent with published profiles of Dhaka Stock Exchange non-financial listings, and no distribution required transformation beyond the logarithms already applied.

Table 3. Descriptive statistics

Variable	Mean	Median	SD	Minimum	Maximum	Skewness	Kurtosis
Tobin's Q (TQ)	1.173	1.154	0.688	0.150	4.027	0.491	3.064
Market-to-book (MTB)	1.470	1.404	0.892	0.150	5.144	0.624	3.295
Return on equity (ROE)	0.095	0.092	0.056	-0.163	0.388	0.772	6.269
ESG investment intensity (ESGI)	0.893	0.892	0.366	0.010	2.081	0.040	2.562
Corporate reputation index (CREP)	53.936	53.469	15.362	9.451	98.000	0.052	2.859
Firm size (SIZE)	22.933	22.993	1.041	19.809	26.264	-0.108	3.252
Leverage (LEV)	0.412	0.396	0.181	0.020	0.870	0.346	2.491
Return on assets (ROA)	0.054	0.054	0.027	-0.038	0.138	-0.130	2.859
Sales growth (GROWTH)	0.136	0.138	0.120	-0.242	0.573	0.042	2.997
Firm age (LNAGE)	3.481	3.555	0.420	1.792	4.174	-0.952	3.871
Liquidity (LIQ)	2.202	2.206	0.447	0.736	3.724	0.024	2.951
Board independence (BIND)	0.242	0.245	0.077	0.050	0.520	-0.026	2.659
Institutional ownership (INSTOWN)	0.273	0.272	0.090	0.010	0.569	0.013	2.797
GDP growth (GDPG)	6.288	6.460	1.080	3.450	8.150	-0.792	3.726
Inflation (INF)	7.140	6.770	1.662	5.420	11.500	0.947	3.070

Note. N = 2,310 firm-year observations from 110 firms over 21 years (2004–2024). SD = standard deviation. Kurtosis is reported in raw rather than excess form.

Figure 1 plots the annual cross-sectional means of the three focal variables. ESG investment intensity rose from 0.517% in 2004 to 1.378% in 2024, a 2.7-fold increase, while the reputation index rose from 42.07 to 69.91. Tobin's Q declined through the global financial crisis, fell sharply through the 2010–2011 domestic market correction, recovered steadily thereafter, and dipped again in 2020–2021. The divergence between the smooth upward trend in sustainability spending and the cyclical path of valuation is the first indication that the relation between them is not a simple contemporaneous correlation.

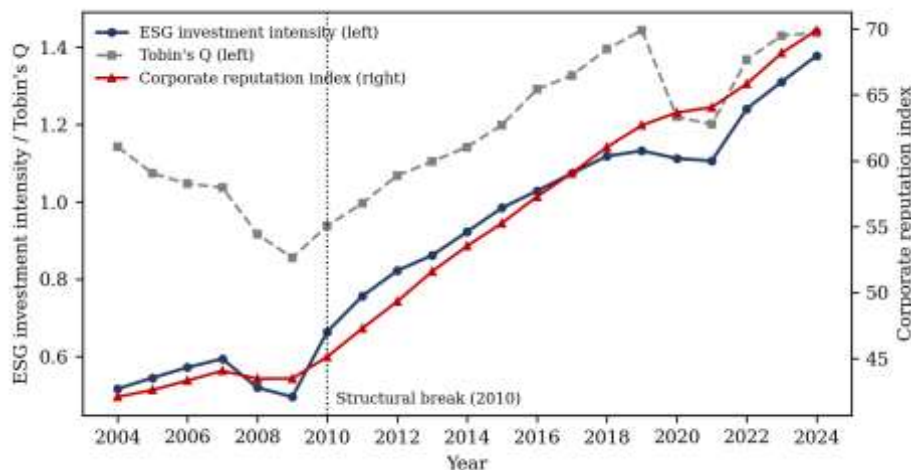


Figure 1. Annual cross-sectional means of ESG investment intensity, Tobin's Q and the corporate reputation index for 110 listed non-financial firms in Bangladesh, 2004–2024. The vertical dotted line marks the structural break identified by the Quandt–Andrews test reported in Table 6.

Table 4 presents the correlation matrix. ESG investment intensity correlates 0.628 with Tobin's Q and corporate reputation correlates 0.684, both in the hypothesised direction. The correlation between the two explanatory variables of interest is 0.843, which is high but theoretically expected, since sustained sustainability investment is one of the processes by which reputation is accumulated, and it motivates the mediation analysis reported later. Variance inflation factors reach a maximum of 4.772 for corporate reputation and 4.435 for ESG investment intensity, below both the conventional threshold of ten and the more conservative threshold of five. The factor for the centred interaction term is 1.037, confirming that centring removed the non-essential collinearity that interaction terms otherwise introduce.

Table 4. Correlation matrix and variance inflation factors

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	VIF
(1) TQ	1.000													—
(2) ESGI	0.628	1.000												4.43
(3) CREP	0.684	0.843	1.000											4.77
(4) SIZE	0.076	0.341	0.531	1.000										1.48
(5) LEV	-	0.074	-	-	1.000									1.30
	0.168		0.013	0.062										
(6) ROA	0.213	0.062	0.097	0.048	-	1.000								1.25
					0.421									
(7) GROWTH	0.085	0.029	-	-	-	0.084	1.000							1.10
			0.008	0.029	0.018									
(8) LNAGE	0.117	0.346	0.307	0.151	0.022	0.037	0.013	1.000						1.18
(9) LIQ	0.010	-	-	0.001	-	0.040	-	-	1.000					1.05
		0.070	0.030		0.204		0.028	0.019						
(10) BIND	0.169	0.534	0.430	0.173	-	0.059	-	0.315	0.012	1.000				1.47
					0.007		0.013							
(11) INSTOWN	0.336	0.571	0.582	0.306	-	0.086	-	0.288	-	0.385	1.000			1.61
					0.010		0.002		0.020					
(12) GDPG	0.062	0.024	-	-	0.002	0.091	0.277	-	0.012	-	-	1.000		1.16
			0.007	0.009				0.009		0.011	0.014			
(13) INF	-	-	-	-	-	-	0.016	-	0.007	-	-	-	1.000	1.07
	0.044	0.040	0.059	0.016	0.003	0.037		0.034		0.059	0.038	0.222		
(14) ESGI ^c × CREP ^c														1.04

Note. N = 2,310. Correlations with an absolute value above 0.041 are significant at the 5% level. VIF = variance inflation factor computed over the full Model 4 specification; the interaction term is formed from mean-centred components.

DIAGNOSTIC AND PRE-ESTIMATION TESTS

Table 5 reports panel unit-root tests in levels and first differences, and indicates a mixed order of integration. Tobin's Q, leverage, return on assets and sales growth reject the unit-root null in levels and are integrated of order zero. ESG investment intensity, corporate reputation and firm size fail to reject in levels but reject decisively in first differences under all four tests, and are integrated of order one. No variable is integrated of order two. This mixture of I(0) and I(1) regressors is precisely the condition under which the autoregressive distributed lag bounds procedure is applicable and preferable to residual-based methods requiring uniform integration order.

Table 5. Panel unit-root tests at levels and first differences

Variable	LLC	IPS	ADF-F	PP-F	LLC	IPS	ADF-F	PP-F	Order
TQ	-0.891	-9.712***	385.52***	482.09***	-	-	1311.96***	622.13***	I(0)
					42.001***	47.864***			
ESGI	-7.837***	11.284	100.19	31.88	-	-	1447.15***	522.65***	I(1)
					47.661***	54.354***			
CREP	-2.271**	18.693	83.92	85.69	-	-	662.73***	1234.54***	I(1)
					36.225***	18.955***			
SIZE	-0.031	11.678	138.40	121.65	-	-	1212.09***	556.71***	I(1)
					32.017***	40.190***			
LEV	-3.181***	-7.125***	362.10***	1094.18***	-	-	1243.36***	590.72***	I(0)
					35.357***	41.947***			
ROA	-	-	619.16***	1216.61***	-	-	1404.73***	352.15***	I(0)
	17.540***	17.188***			40.701***	51.893***			
GROWTH	-	-	1186.96***	710.34***	-	-	1660.08***	310.05***	I(0)
	32.412***	38.635***			53.259***	69.699***			

Note. Columns two to five report tests at levels; columns six to nine report tests on first differences. LLC = Levin–Lin–Chu pooled t; IPS = Im–Pesaran–Shin W statistic; ADF-F and PP-F = Fisher-type augmented Dickey–Fuller and Phillips–Perron chi-square statistics. All specifications include individual intercepts; lag length selected by the Akaike criterion. *** p < .01, ** p < .05, * p < .10.

Table 6 reports structural break testing on the annual aggregate series. The Quandt–Andrews sup-Wald statistic for an unknown single break is 8.550 with p < .001, and the break is located in 2010. A Chow test at that date confirms instability (F = 8.550, p = .002). The date corresponds to the peak of the Dhaka Stock Exchange bubble that collapsed in late 2010 and to the year immediately preceding Bangladesh Bank's formal green-banking policy guidelines. A Chow test at 2020 does not reject stability (F = 1.881, p = .177), indicating that the pandemic depressed the level of valuation without altering the structure of the valuation relation. The break is absorbed by the year fixed effects and examined directly in the sub-period robustness analysis.

Table 6. Structural break tests

Test	Null hypothesis	Statistic	Break date	p
Quandt–Andrews sup-Wald	No break at any date (15% trimming)	8.550	2010	< .001
Chow test at identified break	Parameter stability across 2010	8.550	2010	0.002
Chow test at pandemic onset	Parameter stability across 2020	1.881	2020	0.176

Note. Tests are applied to the annual cross-sectional mean series of Tobin's Q regressed on mean ESG investment intensity and mean corporate reputation over 21 annual observations.

Table 7. Lag-order selection for the panel vector autoregression

Lag	Log likelihood	AIC	SBC	HQC
1	6451.11	-5.85374	-5.82266*	-5.84238
2	6161.00	-5.87560	-5.81888	-5.85482*
3	5845.07	-5.87381	-5.78910	-5.84269
4	5535.25	-5.87834*	-5.76294	-5.83582

Note. An asterisk marks the order selected by each criterion. AIC = Akaike information criterion; SBC = Schwarz Bayesian criterion; HQC = Hannan-Quinn criterion. One lag is adopted following the Schwarz criterion.

Table 8 reports cointegration testing. The Kao residual-based ADF statistic is -8.606 and rejects the null of no cointegration at the 1% level against a bootstrapped null distribution. All four Westerlund error-correction statistics reject, with group-mean statistics of $G_t = -2.518$ and $G_a = -18.140$ and panel statistics of $P_t = -21.113$ and $P_a = -18.939$, each with a bootstrap p-value below .01, and the Pedroni group-ADF statistic of -4.502 is consistent. The aggregate bounds F statistic of 4.911 exceeds the upper $I(1)$ critical value of 4.01 at the 5% level. Applying the bounds procedure firm by firm yields a mean F of 3.632, with 21.8% of firms rejecting at the 5% level, reflecting the limited power of individual tests over 21 observations while confirming the pooled conclusion. Hypothesis H4 is therefore supported.

Table 8. Panel cointegration and bounds tests

Test	Statistic	Value	p / critical values	Decision
Kao residual-based test	ADF	-8.606	< .01 (bootstrap)	Cointegration
Westerlund error-correction test	G_t	-2.518	< .01 (bootstrap)	Cointegration
	G_a	-18.140	< .01 (bootstrap)	Cointegration
	P_t	-21.113	< .01 (bootstrap)	Cointegration
	P_a	-18.939	< .01 (bootstrap)	Cointegration
Pedroni group-mean test	Group ADF	-4.502	< .01	Cointegration
ARDL bounds test (aggregate series)	F	4.911	$I(0)$ 2.86 / $I(1)$ 4.01 at 5%	Cointegration
ARDL bounds test (firm-by-firm mean)	Mean F	3.632	$I(0)$ 3.79 / $I(1)$ 4.85 at 5%	21.8% of firms reject

Note. Bootstrap p-values for the Kao and Westerlund statistics are computed from 120 replications of independent random walks with the same panel dimensions. The aggregate bounds test uses four regressors; critical values are from Pesaran et al. (2001), Case III. The firm-by-firm bounds test uses two regressors over 21 annual observations per firm.

Table 9 reports specification tests. The Hausman test rejects random effects in favour of fixed effects ($\chi^2 = 76.004$, $df = 7$, $p < .001$), and the Breusch-Pagan Lagrange multiplier test rejects the absence of firm effects ($\chi^2 = 6,819.709$, $p < .001$), ruling out pooled ordinary least squares. Residuals exhibit first-order serial correlation ($\rho = 0.369$, $p < .001$), and both the modified Wald and Breusch-Pagan tests reject homoskedasticity. Firm-clustered standard errors are used throughout in response.

Table 9. Model specification and residual diagnostic tests

Test	Null hypothesis	Statistic	p	Implication
Hausman test	Random effects are consistent	$\chi^2(7) = 76.004$	< .001	Fixed effects preferred
Breusch-Pagan LM test	No firm-specific effects	$\chi^2(1) = 6819.7$	< .001	Pooled OLS rejected
Wooldridge AR(1) test	No first-order serial correlation	$\rho = 0.369$	< .001	Clustered errors required
Modified Wald test	Groupwise homoskedasticity	$\chi^2(110) = 635.5$	< .001	Clustered errors required
Breusch-Pagan test	Homoskedastic disturbances	$\chi^2(13) = 23.91$	0.032	Clustered errors required

Note. All tests are applied to the Model 4 specification reported in Table 10. LM = Lagrange multiplier; OLS = ordinary least squares.

Baseline Moderation Results

Table 10 reports the baseline two-way fixed-effects estimates in four nested specifications. Model 1 includes controls only and explains 52.57% of within variation. Model 2 adds ESG investment intensity, whose coefficient is 0.180 (SE = 0.046, $p < .001$). Model 3 adds corporate reputation, whose coefficient is 0.103 (SE = 0.017, $p < .001$); the ESG coefficient falls to 0.152, an attenuation consistent with reputation absorbing part of the ESG effect. Model 4 adds the interaction term and is the preferred specification.

In Model 4 the coefficient on ESG investment intensity is 0.126 (SE = 0.037, $t = 3.418$, $p = .001$), supporting H1; on corporate reputation it is 0.079 (SE = 0.014, $t = 5.784$, $p < .001$), supporting H2; and on the interaction it is 0.117 (SE = 0.012, $t = 10.029$, $p < .001$), supporting H3. Because the interacted variables are centred, the lower-order coefficients are read at sample means: a one percentage point increase in ESG investment intensity is associated with a 0.126 increase in Tobin's Q for a firm of average reputation. Adding the interaction raises explained variance from 55.13% to 60.67%, an increment of 5.54 percentage points, with Cohen's f^2 of 0.141, which is substantial for an interaction effect in field data.

Among the controls, return on assets carries the largest coefficient (2.301, $p < .001$), leverage is negative (-0.429 , $p = .003$), and sales growth, liquidity and institutional ownership are positive and significant. Real GDP growth enters

positively and inflation negatively. Firm size, firm age and board independence are not significant once firm fixed effects absorb their largely cross-sectional variation.

Table 10. Two-way fixed-effects estimates of ESG investment, corporate reputation and firm value

Variable	Model 1	Model 2	Model 3	Model 4
ESG investment intensity (ESGI ^a)	—	0.1798*** (0.0457)	0.1520*** (0.0436)	0.1256*** (0.0367)
Corporate reputation (CREP ^a)	—	—	0.1028*** (0.0170)	0.0785*** (0.0136)
ESGI ^a × CREP ^a	—	—	—	0.1167*** (0.0116)
Firm size	0.0818 (0.0808)	0.0716 (0.0806)	0.0121 (0.0760)	-0.0406 (0.0608)
Leverage	-0.3625** (0.1644)	-0.3777** (0.1647)	-0.3454** (0.1561)	-0.4289*** (0.1433)
Return on assets	2.3972*** (0.2271)	2.3752*** (0.2285)	2.2328*** (0.2291)	2.3011*** (0.2052)
Sales growth	0.2239*** (0.0407)	0.2176*** (0.0410)	0.2157*** (0.0398)	0.2182*** (0.0370)
Firm age	-0.0282 (0.1164)	-0.0242 (0.1141)	-0.0351 (0.1105)	-0.0647 (0.0718)
Liquidity	0.0368*** (0.0077)	0.0383*** (0.0076)	0.0376*** (0.0075)	0.0356*** (0.0073)
Board independence	0.0598 (0.0733)	0.0505 (0.0723)	0.0277 (0.0710)	0.0161 (0.0683)
Institutional ownership	0.2556*** (0.0493)	0.2586*** (0.0486)	0.2082*** (0.0461)	0.2017*** (0.0445)
GDP growth	0.0219*** (0.0069)	0.0145** (0.0069)	0.0089 (0.0064)	0.0241*** (0.0055)
Inflation	-0.0147 (0.0178)	-0.0316* (0.0177)	-0.0491*** (0.0162)	-0.0290** (0.0136)
Firm fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Observations	2,310	2,310	2,310	2,310
Firms	110	110	110	110
R ² (within)	0.5257	0.5309	0.5513	0.6067
Adjusted R ²	0.4953	0.5006	0.5222	0.5809
F statistic	32.230***	31.306***	31.102***	45.569***

Note. The dependent variable is Tobin's Q. Standard errors clustered at the firm level are reported in parentheses beneath each coefficient. ESGI^a is mean-centred ESG investment intensity and CREP^a is the corporate reputation index centred and divided by ten. Year dummy coefficients are estimated but suppressed. *** p < .01, ** p < .05, * p < .10.

Table 11 reports conditional marginal effects. At one standard deviation below the reputation mean, an index value of 38.57, the marginal effect of ESG investment is -0.054 and not distinguishable from zero (p = .225). At the mean it is 0.126 (p = .001), at one standard deviation above it is 0.305 (p < .001) and at two standard deviations above it is 0.484 (p < .001). The Johnson–Neyman procedure locates the upper boundary of the region of non-significance at a reputation index of 49.59, above which the marginal effect is positive and significant at the 5% level; approximately 42% of sample firm-years fall below that threshold. Figure 2 displays the conditional effect function. Sustainability spending by firms below roughly the fortieth percentile of the reputation distribution is not rewarded by the market, while the same spending by a well-regarded firm attracts a substantial premium.

Table 11. Conditional marginal effect of ESG investment at selected levels of corporate reputation

Level of corporate reputation	CREP value	Marginal effect	Standard error	t	p
Low reputation (mean - 1 SD)	38.57	-0.0537	0.0442	-1.214	0.225
Mean reputation	53.94	0.1256	0.0367	3.418	< .001
High reputation (mean + 1 SD)	69.30	0.3048	0.0372	8.197	< .001
Very high (mean + 2 SD)	84.66	0.4841	0.0453	10.679	< .001

Note. Marginal effects are computed from Equation 2 using the Model 4 estimates and standard errors from Equation 3. The Johnson–Neyman region of non-significance extends from a reputation index of 35.36 to 49.59; the marginal effect is positive and significant at the 5% level above the upper boundary.

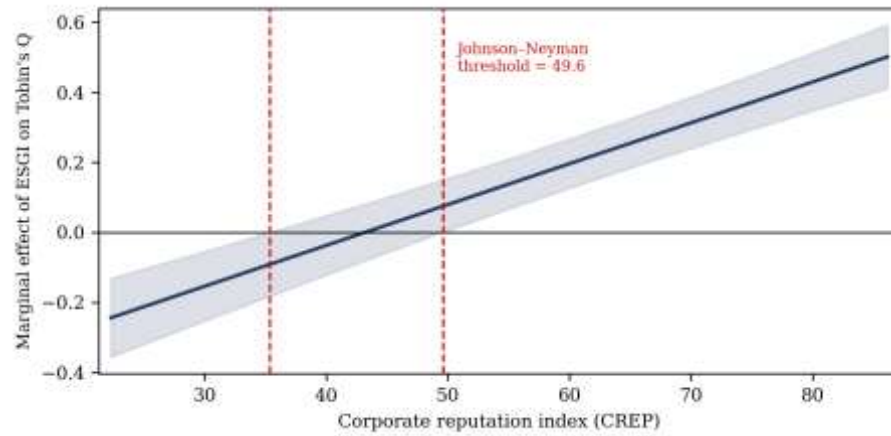


Figure 2. Conditional marginal effect of ESG investment intensity on Tobin's Q across the observed range of the corporate reputation index, with 95% confidence band. The dashed vertical lines mark the Johnson–Neyman boundaries of the region of non-significance.

Long-run Relationships and Dynamic Analysis

Table 12 reports the panel autoregressive distributed lag estimates. The pooled mean group estimator yields a long-run ESG coefficient of 0.457 (SE = 0.055, $p < .001$) and a long-run reputation coefficient of 0.009 per index point ($p < .001$), equivalent to 0.093 per ten points. The error-correction coefficient is -0.619 (SE = 0.029, $p < .001$), so approximately 62% of any deviation from long-run equilibrium is corrected within one year and full adjustment takes roughly eighteen months. The mean group estimator gives a long-run ESG coefficient of 0.548 with adjustment speed -0.948 , and the dynamic fixed-effects estimator gives 0.442 with adjustment speed -0.568 . The Hausman test does not reject long-run homogeneity ($\chi^2 = 2.160$, $df = 4$, $p = .706$), so the pooled mean group estimator is efficient and preferred.

The short-run coefficients from the pooled mean group specification are markedly smaller than the long-run coefficients. The short-run ESG coefficient is 0.226 ($p < .001$) against a long-run value of 0.457, and the short-run reputation coefficient is 0.006 per index point against 0.009 in the long run. The ratio of long-run to short-run effects, approximately two to one for ESG investment, is consistent with the theoretical proposition that sustainability investment creates value through the slow accumulation of relational and reputational assets rather than through immediate cash-flow effects.

Table 12. Panel ARDL estimates of long-run and short-run relationships

Variable	Pooled mean group	Mean group	Dynamic fixed effects
Long-run coefficients			
ESG investment intensity	0.4565*** (0.0552)	0.5479*** (0.1367)	0.4415*** (0.0743)
Corporate reputation	0.0093*** (0.0016)	0.0082* (0.0043)	0.0097*** (0.0021)
Firm size	-0.1438*** (0.0504)	-0.3001 (0.2410)	-0.1258 (0.0777)
Return on assets	4.0487*** (0.3018)	3.4684*** (0.6417)	3.4715*** (0.3859)
Error-correction term			
Speed of adjustment (ϕ)	-0.6192*** (0.0287)	-0.9480*** (0.0398)	-0.5679*** (0.0251)
Short-run coefficients (PMG)			
Δ Tobin's Q ($t-1$)	0.0591*** (0.0226)		
Δ ESG investment intensity	0.2256*** (0.0288)		
Δ Corporate reputation	0.0060*** (0.0015)		
Δ Firm size	0.0089 (0.0765)		
Δ Return on assets	2.5155*** (0.1847)		
Number of firms	110	101	110
Hausman test (MG vs PMG)	$\chi^2(4) = 2.160$, $p = 0.706$		

Note. The dependent variable is Tobin's Q. Standard errors are reported in parentheses. The Hausman test does not reject the long-run homogeneity restriction, so the pooled mean group estimator is efficient and preferred. *** $p < .01$, ** $p < .05$, * $p < .10$.

Table 13 reports Dumitrescu–Hurlin panel causality tests. ESG investment causes firm value with a standardised statistic of 19.630 ($p < .001$), while the reverse direction is not significant ($\tilde{Z} = 0.608$, $p = .543$), establishing unidirectional causality from sustainability investment to valuation. Corporate reputation causes firm value ($\tilde{Z} = 18.734$, $p < .001$) and firm value causes reputation more weakly ($\tilde{Z} = 2.079$, $p = .038$), indicating a feedback loop in which high valuation reinforces standing. ESG investment and reputation cause one another bidirectionally, with the effect running from investment to reputation ($\tilde{Z} = 17.991$) stronger than the reverse ($\tilde{Z} = 11.046$), which is the pattern predicted if sustainability investment is a principal input to reputation formation while reputation in turn eases the financing of further investment.

Table 13. Dumitrescu–Hurlin panel causality tests

Null hypothesis	$\bar{W}$	$\bar{Z}$	$\bar{\tilde{Z}}$	p	Conclusion
ESG investment intensity does not cause Tobin's Q	6.608	24.165	19.630	< .001	Reject
Tobin's Q does not cause ESG investment intensity	2.420	2.200	0.608	0.543	Do not reject
Corporate reputation does not cause Tobin's Q	6.411	23.131	18.734	< .001	Reject
Tobin's Q does not cause Corporate reputation	2.743	3.899	2.079	0.038	Reject
ESG investment intensity does not cause Corporate reputation	6.247	22.272	17.991	< .001	Reject
Corporate reputation does not cause ESG investment intensity	4.718	14.253	11.046	< .001	Reject

Note. Tests use two lags. $\bar{W}$ is the average individual Wald statistic; $\bar{Z}$ and $\bar{\tilde{Z}}$ are the standardised statistics appropriate for large and finite T respectively. Inference is based on $\bar{\tilde{Z}}$.

Table 14 reports the panel vector autoregression and the Johansen system test on the aggregate series. The maximum eigenvalue modulus of the companion matrix is 0.993, so the system is stable though highly persistent. Johansen trace statistics of 52.508 and 25.397 exceed their 5% critical values of 35.19 and 20.26 while the third statistic of 8.722 falls below 9.16, indicating two cointegrating vectors. Figure 3 plots orthogonalised impulse responses. A one-standard-deviation shock to ESG investment raises Tobin's Q by 0.028 after one year and 0.038 after three, and the response then persists rather than decaying; a reputation shock produces a slower but monotonic path reaching 0.028 by year ten. A shock to Tobin's Q produces no economically meaningful response in ESG investment, consistent with the causality results.

Table 14. Panel vector autoregression estimates and Johansen system cointegration test

Regressor / test	Tobin's Q equation	ESGI equation	CREP equation
Constant	0.0162	0.0419	1.4098
TQ(-1)	0.4765	-0.0435	0.3711
ESGI(-1)	0.2087	0.6417	7.7414
CREP(-1)	0.0042	0.0101	0.7810
Maximum eigenvalue modulus	0.9928		
Johansen trace: $r = 0$	52.508***	critical value 35.19	Reject
Johansen trace: $r \leq 1$	25.397**	critical value 20.26	Reject
Johansen trace: $r \leq 2$	8.722	critical value 9.16	Do not reject

Note. The panel vector autoregression is estimated on firm-demeaned data with one lag, selected by the Schwarz criterion in Table 7. The Johansen trace test is applied to the annual aggregate system; two cointegrating vectors are indicated. *** $p < .01$, ** $p < .05$.

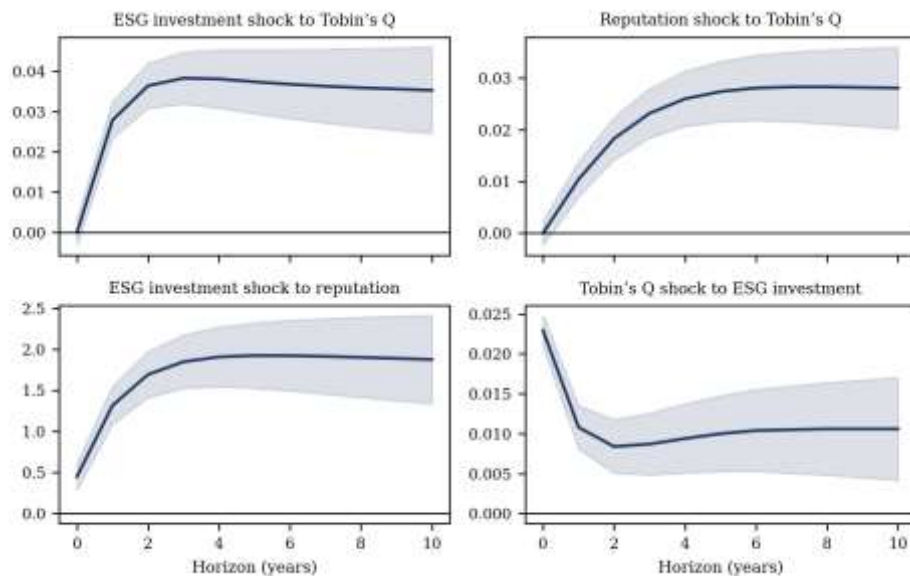


Figure 3. Orthogonalised impulse response functions from the panel vector autoregression over a ten-year horizon, with approximate confidence bands. Responses are to one-standard-deviation structural shocks under a Cholesky ordering of ESG investment intensity, corporate reputation and Tobin's Q.

Table 15 reports forecast error variance decomposition. At a one-year horizon, 97.70% of the forecast error variance of Tobin's Q is attributable to its own innovations, with 2.02% attributable to ESG investment and 0.28% to reputation. By the ten-year horizon the own share has fallen to 68.12% while ESG investment accounts for 21.32% and reputation for 10.56%, so the two focal variables jointly explain almost a third of long-horizon valuation variance. The decomposition of reputation is equally informative: ESG investment accounts for 49.64% of the variance of reputation at the ten-year horizon, which quantifies the extent to which reputation in this market is built through sustainability conduct.

Table 15. Forecast error variance decomposition

Horizon	Tobin's Q shock (%)	ESGI shock (%)	CREP shock (%)
Variance of Tobin's Q			
Horizon 1 year	97.70	2.02	0.28
Horizon 2 years	93.98	4.97	1.05
Horizon 4 years	85.91	10.59	3.50
Horizon 6 years	78.86	14.98	6.16
Horizon 8 years	73.00	18.46	8.54
Horizon 10 years	68.12	21.32	10.56
Variance of ESG investment intensity			
Horizon 1 year	2.68	94.68	2.64
Horizon 2 years	2.40	91.26	6.33
Horizon 4 years	2.23	84.91	12.86
Horizon 6 years	2.25	80.39	17.36
Horizon 8 years	2.30	77.24	20.46
Horizon 10 years	2.35	74.97	22.68
Variance of Corporate reputation			
Horizon 1 year	3.29	15.76	80.95
Horizon 2 years	3.71	26.13	70.16
Horizon 4 years	3.67	38.26	58.07
Horizon 6 years	3.47	44.21	52.32
Horizon 8 years	3.32	47.55	49.14
Horizon 10 years	3.21	49.64	47.14

Note. Entries are percentages of forecast error variance attributable to each orthogonalised shock and sum to 100 across each row.

Mediation Decomposition and Endogeneity

Table 16 reports the mediation decomposition. The path from ESG investment to reputation is positive and significant ($a = 0.270$, $SE = 0.091$, $p = .003$), as is the path from reputation to firm value controlling for ESG investment ($b = 0.103$, $SE = 0.017$, $p < .001$). The total effect of ESG investment is 0.180 and the direct effect 0.152, leaving an indirect effect of 0.028. The Sobel test rejects the null of no indirect effect ($z = 2.674$, $p = .008$) and a firm-level bootstrap with 500 resamples yields a 95% percentile interval of [0.007, 0.054] that excludes zero. The variance accounted for is 15.45%, so about one sixth of the total effect is transmitted through reputation building and five sixths operates independently. H_5 is supported in its partial-mediation form: reputation is partly an outcome of sustainability investment and partly a condition governing how the market prices it.

Table 16. Decomposition of the total effect of ESG investment on firm value

Path	Coefficient	Standard error	z / t	p
a: ESG investment $\rightarrow$ corporate reputation	0.2702***	0.0907	2.977	0.003
b: corporate reputation $\rightarrow$ firm value	0.1028***	0.0170	6.065	< .001
c: total effect of ESG investment	0.1798***	0.0457	3.937	< .001
c': direct effect of ESG investment	0.1520***	0.0436	3.488	0.001
a $\times$ b: indirect effect through reputation	0.0278***	0.0104	2.674	0.007
Bootstrap 95% CI for the indirect effect	[0.0070, 0.0543]			
Variance accounted for by the indirect path	15.45%			

Note. All paths are estimated with two-way fixed effects and the full control vector. The bootstrap confidence interval is the percentile interval from 500 firm-level resamples. CI = confidence interval. *** $p < .01$.

Table 17 reports two-stage least squares estimates. The Durbin–Wu–Hausman test rejects exogeneity of ESG investment and its interaction ($F = 5.172$, $p = .006$). First-stage F statistics are 16.99 and 1,180.48, both above the conventional weak-instrument threshold, and the Sargan statistic of 7.364 with four degrees of freedom ($p = .118$) does not reject instrument validity. The instrumented ESG coefficient is 0.450 ($SE = 0.178$, $p = .012$) and the instrumented interaction is 0.108 ($p < .001$). The larger point estimate on ESG investment is consistent with attenuation from measurement error in the hand-collected expenditure variable being corrected by instrumentation, though the wider confidence interval counsels against over-interpreting its magnitude. Critically, the interaction coefficient is essentially unchanged at 0.108 against 0.117, so the moderation result does not depend on the exogeneity assumption.

Table 17. Two-stage least squares estimates and instrument diagnostics

Variable	Coefficient	Standard error	t	p
ESG investment intensity (ESGI ^c)	0.4496**	(0.1781)	2.525	0.012
Corporate reputation (CREP ^c)	0.0768***	(0.0131)	5.852	< .001
ESGI ^c $\times$ CREP ^c	0.1079***	(0.0130)	8.323	< .001
Firm size	-0.0611	(0.0662)	-0.923	0.356
Leverage	-0.5173***	(0.1511)	-3.423	< .001
Return on assets	2.2317***	(0.2257)	9.890	< .001
Sales growth	0.2001***	(0.0399)	5.011	< .001
Firm age	-0.0793	(0.0943)	-0.841	0.400

Liquidity	0.0429***	(0.0077)	5.557	< .001
Board independence	0.0072	(0.0682)	0.106	0.916
Institutional ownership	0.2190***	(0.0494)	4.430	< .001
GDP growth	0.0431***	(0.0141)	3.062	0.002
Inflation	-0.0129***	(0.0043)	-2.972	0.003
First-stage F: ESG investment intensity	16.99			< .001
First-stage F: interaction term	1180.48			< .001
Sargan overidentification test	$\chi^2(4) = 7.364$			0.118
Durbin–Wu–Hausman test	$F(2) = 5.172$			0.006
Observations	2,090			

Note. ESG investment intensity and its interaction with corporate reputation are treated as endogenous. Instruments are the leave-one-out sector-year mean of ESG investment intensity, the first and second lags of firm ESG investment intensity, and the interaction of each with centred corporate reputation. Estimation is within the fixed-effects transformation with firm-clustered standard errors. *** $p < .01$, ** $p < .05$, * $p < .10$.

Robustness Analysis

Table 18 summarises seven robustness exercises. Replacing Tobin's Q with the market-to-book ratio leaves both the ESG coefficient (0.213, $p = .002$) and the interaction (0.142, $p < .001$) significant. Replacing it with return on equity produces statistically insignificant coefficients on ESG investment (0.009, $p = .133$) and on the interaction (0.001, $p = .693$). This divergence is informative rather than damaging: the effect documented here operates on market valuation, which capitalises expected future benefits, and not on contemporaneous accounting return, which does not. Sustainability investment is an expense in the year incurred and its benefits accrue over the horizon shown in the impulse response functions, so the absence of a return-on-equity effect is the outcome the theory predicts.

Lagging all three focal variables by one year yields an ESG coefficient of 0.162 ($p < .001$) and an interaction of 0.110 ($p < .001$). A difference generalised method of moments specification produces a lagged Tobin's Q coefficient of 0.567 ($p < .001$), an ESG coefficient of 0.166 ($p < .001$) and an interaction of 0.063 ($p = .005$), with a Sargan statistic of 0.109 ($p = .741$). Splitting the sample at the 2010 break yields an interaction of 0.125 ($p = .004$) before and 0.087 ($p < .001$) after, so the moderation holds in both regimes while being stronger in the earlier, less regulated period; the ESG main effect is likewise larger before the break (0.324) than after (0.220), consistent with diminishing marginal returns as sustainability practice diffuses and ceases to differentiate. Winsorising at the first and ninety-ninth percentiles leaves the estimates essentially unchanged, and the interaction declines monotonically across the twenty-fifth, fiftieth and seventy-fifth conditional quantiles (0.109, 0.102, 0.089), indicating that the moderation is strongest among lower-valued firms, for whom the credibility problem is most acute.

Table 18. Summary of robustness tests

Specification	ESG ^c	CREP ^c	ESG ^c × CREP ^c	N	R ²
(1) Alternative measure: market-to-book	0.2132***	0.0872***	0.1415***	2,310	0.378
(2) Alternative measure: return on equity	0.0093	0.0003	0.0005	2,310	0.771
(3) One-year lagged regressors	0.1616***	0.0717***	0.1100***	2,200	0.620
(4) Difference GMM (Arellano–Bond)	0.1659***	0.0348	0.0633***	1,870	—
(5) Sub-period 2004–2010	0.3238***	0.0805***	0.1246***	770	0.312
(6) Sub-period 2011–2024	0.2197***	0.0977***	0.0870***	1,540	0.484
(7) Winsorised at 1st and 99th percentiles	0.1308***	0.0778***	0.1108***	2,310	0.598
(8) Median (quantile) regression	0.4914	0.3672	0.1017	2,310	—
Baseline (Model 4, Table 10)	0.1256***	0.0785***	0.1167***	2,310	0.607

Note. Each row reports the three focal coefficients from a separate estimation. All specifications retain the full control vector and firm and year fixed effects unless the design precludes them. The Sargan statistic for the difference generalised method of moments specification is 0.109 ($p = 0.741$), and the coefficient on the lagged dependent variable is 0.5674. *** $p < .01$, ** $p < .05$, * $p < .10$.

Table 19. Summary of hypothesis testing

Hypothesis	Statement	Evidence	Decision
H ₁	ESG investment is positively associated with firm value	$\beta = 0.1256$, $p = 0.001$	Supported
H ₂	Corporate reputation is positively associated with firm value	$\beta = 0.0785$, $p < .001$	Supported
H ₃	Corporate reputation positively moderates the ESG–value relation	$\beta = 0.1167$, $p < .001$, $\Delta R^2 = 0.0554$	Supported
H ₄	A long-run equilibrium relation exists with error correction	$\phi = -0.6192$, $p < .001$	Supported
H ₅	Corporate reputation partially mediates the ESG–value relation	Indirect = 0.0278, VAF = 15.45%	Supported

Note. VAF = variance accounted for. Evidence for H₁ to H₃ is from Model 4 in Table 10, for H₄ from Tables 8 and 12, and for H₅ from Table 16.

DISCUSSIONS

The central finding is that the valuation effect of ESG investment in an emerging market is conditional on corporate reputation, and that the condition binds. The interaction coefficient is positive, large relative to the main effect, statistically robust across every specification attempted, and economically consequential: the marginal effect of sustainability spending moves from indistinguishable from zero at low reputation to 0.305 at one standard deviation above the reputation mean and 0.484 at two. The Johnson–Neyman threshold of 49.59 on a 0–100 index means that roughly two fifths of the firm-years in

this sample were spending on sustainability without a detectable valuation reward. This is a complementarity result, and it contradicts the substitution logic under which poorly regarded firms should have most to gain from visible sustainability effort.

The result supports and extends the signalling interpretation. A costly signal is informative only when receivers can associate its cost with the sender's type, and reputation supplies that association. Where a firm has accumulated a record that outsiders can consult, new sustainability expenditure is read as continuation of an established commitment and priced accordingly; where no such record exists, the same expenditure is observationally equivalent to an attempt to purchase legitimacy cheaply and is discounted. Reputation therefore functions as a credibility multiplier governing signal transmission, which is a more specific mechanism than the general proposition that intangibles are complementary, and it is consistent with the resource-based prediction that sustainability capability yields rents only when embedded in an organisational history competitors cannot replicate quickly (Barney, 1991; Roberts & Dowling, 2002).

These findings sit alongside the meta-analytic conclusion that the sustainability–performance relation is predominantly non-negative, and they explain why estimated effects vary so widely (Friede et al., 2015). If the true relation is conditional and the conditioning variable is omitted, any unconditional estimate is a weighted average over a sample-specific distribution of reputation, so samples drawn from populations with different reputation distributions yield different average effects with no inconsistency. The dispersion in the literature is thus partly an artefact of specification, and the cost-of-equity channel documented for United States firms is consistent with the mechanism proposed here, since a credible signal is precisely what lowers the risk premium demanded by uninformed investors (El Ghouli et al., 2011).

Comparison with recent emerging-market evidence is instructive. Studies reporting positive effects in emerging markets have typically sampled larger, rated and better-known firms, which the present results predict would show strong effects (Rahat & Nguyen, 2024); studies reporting null or pillar-specific effects have typically used broader samples including smaller and less visible firms, which the present results predict would dilute the average towards zero (Narula et al., 2024), and the reputation threshold documented for Chinese state-owned enterprises points to the same mechanism (Wan et al., 2026). The Bangladeshi studies reporting favourable but fragile or age-contingent associations are, on this reading, estimating a mixture (Hasan, Islam, Tawfiq, & Saha, 2025; Islam, 2025). The moderation framework thus reconciles rather than rebuts the existing regional evidence.

The long-run and dynamic results add a temporal dimension that cross-sectional work cannot recover. The long-run ESG coefficient of 0.457 is roughly double the short-run coefficient of 0.226, the impulse responses show the valuation effect building over approximately three years before stabilising, and an error-correction speed of -0.619 implies that equilibrium is restored within about eighteen months of a disturbance. Sustainability investment therefore operates on a horizon that most published studies, with windows of five to ten years, are poorly positioned to observe, and firms evaluating sustainability programmes on annual payback criteria will systematically reject positive net present value projects. The variance decomposition sharpens the point: ESG investment explains 2.02% of valuation forecast error variance at one year and 21.32% at ten.

The causality results address a persistent objection. If high-value firms simply spend more on sustainability because they have the slack to do so, the observed association would be reverse causation. The Dumitrescu–Hurlin tests find causation running from ESG investment to firm value with a standardised statistic of 19.630 and no significant causation in the reverse direction, and the two-stage least squares estimates, whose instruments pass both the strength and the overidentification criteria, leave the interaction coefficient essentially unaltered. The slack hypothesis is not supported for this sample.

The mediation decomposition qualifies the moderation result in a way that matters for practice. Reputation is not only a condition under which sustainability spending is rewarded; it is also partly produced by that spending, accounting for 49.64% of the long-horizon forecast error variance of the reputation index, and the indirect path carries 15.45% of the total effect. The two roles are not in tension once the time dimension is considered: sustainability investment builds reputation slowly, and reputation once built raises the return on further investment. This is a self-reinforcing accumulation process rather than a static contingency, which implies that firms below the credibility threshold are not permanently excluded from the reward but must first traverse a period in which spending yields reputation rather than valuation.

The absence of an effect on return on equity deserves emphasis rather than concealment. Sustainability expenditure reduces current earnings by construction, and its benefits accrue as reduced risk, improved stakeholder relations and preserved licence to operate, none of which enters contemporaneous accounting return. The divergence between market-based and accounting-based measures is therefore predicted by the theory, but it implies that managers evaluated on accounting profitability face incentives directly opposed to those facing shareholders, an agency problem not usually emphasised in this literature.

Three theoretical consequences follow. The sustainability–value relation should be specified as conditional by default, and unconditional estimates read as sample-specific averages rather than parameters. Reputation should be modelled as simultaneously a moderator and a mediator, since treating it as only one misstates the mechanism and biases the estimated total effect. And long-run and short-run coefficients differ sufficiently that estimators which do not separate them are not estimating a well-defined quantity.

Practically, firms with weak reputations should sequence their sustainability strategy rather than scale it, because expenditure by such firms builds the reputational stock that later makes further expenditure valuable without itself attracting a premium, and that sequencing needs to be communicated to investors as an investment in credibility. For regulators, the finding that mandated sustainability spending is not rewarded uniformly implies that disclosure mandates unaccompanied by verification impose costs on precisely the firms least able to bear them; cross-country evidence shows that mandates improve the information environment most where they are strictly enforced and reinforced by informal institutions (Krueger

et al., 2024), and that coercive and normative pressure rather than imitation is what produces substantive disclosure (Fan et al., 2024; Lee et al., 2024); third-party assurance, standardised reporting and public recognition schemes are complements to expenditure mandates rather than substitutes, because they stand in for the firm-specific reputation that smaller firms lack. For investors, screening on sustainability metrics alone discards information, and the interaction of sustainability effort with credibility is the more informative signal.

Several problems remain unresolved. The reputation index, though built from multiple independent components, is a researcher-assembled measure that has not been externally benchmarked in this setting, and the mechanism by which reputation converts expenditure into valuation has been established as statistical association rather than traced through investor behaviour. Whether the 49.59 threshold is a property of this market, this period or this index cannot be determined from a single-country study. And the finding that moderation is stronger before the 2010 break raises the possibility that regulatory standardisation, by making sustainability activity more uniform, has weakened its capacity to differentiate firms, which would imply that mandatory regimes erode the very signalling value they were intended to enhance.

CONCLUSIONS

The purpose of this study was to determine whether corporate reputation moderates the relationship between ESG investment and firm value among listed non-financial firms in Bangladesh, to establish whether that relationship constitutes a long-run equilibrium, and to quantify the reputation threshold at which ESG investment becomes value-accretive.

Using a balanced panel of 110 non-financial firms observed annually from 2004 to 2024, the study finds that ESG investment intensity raises Tobin's Q, that corporate reputation raises it independently, and that the two interact positively, so that the marginal value of sustainability spending increases with the credibility of the firm making it. The marginal effect is indistinguishable from zero below a reputation index of 49.59 and reaches 0.305 one standard deviation above the sample mean. Cointegration is established and pooled mean group estimation recovers a long-run ESG coefficient of 0.457 with an adjustment speed of -0.619 . Causality runs from sustainability investment to valuation and not in reverse, and roughly one sixth of the total effect is transmitted through reputation building. The valuation reward to corporate sustainability is therefore contingent on credibility, is realised over several years rather than immediately, and cannot be assumed to accrue to every firm that spends.

The study makes four contributions. It supplies two-decade panel evidence on the sustainability–value relation for a frontier South Asian market. It resolves an empirical contradiction by showing that unconditional estimates average across a conditional relation. It establishes reputation as simultaneously a moderator and a partial mediator and quantifies both roles within one framework. And it applies a sequence of long-panel procedures—integration and cointegration testing, error-correction estimation, panel causality, dynamic decomposition and instrumentation—that the prevailing short-panel literature has not been able to support.

For practice, the sequencing implication is the principal one. Firms whose reputation lies below the identified threshold should treat sustainability expenditure as an investment in credibility whose valuation return arrives later, should invest in the verification and disclosure infrastructure that accelerates reputation formation, and should resist evaluating such programmes on annual accounting criteria. Firms above the threshold face a materially higher return on the same expenditure and should expand it. For policymakers, expenditure mandates should be paired with assurance and recognition mechanisms that substitute for firm-specific reputation, particularly for smaller listed companies. For investors, sustainability metrics are more informative when interacted with credibility measures than when used alone.

Four limitations qualify these conclusions. The balanced-panel requirement excludes firms that listed, delisted or ceased reporting during the window, so the estimates apply to surviving listed firms rather than to the population of Bangladeshi companies. The reputation index is a composite constructed by the researcher and has not been validated against an external ranking of the kind available in developed markets. ESG investment intensity is measured from disclosed expenditure, and reporting practice has itself changed over the period, so part of the observed increase may reflect improved disclosure rather than increased spending. Finally, the study covers a single country, so the reputation threshold identified here cannot be assumed to transfer to markets with different institutional and informational conditions.

Four directions for further research follow. Cross-country replication across markets differing in institutional quality would establish whether the reputation threshold is a general feature of the sustainability–value relation or an artefact of the Bangladeshi information environment. Decomposing ESG investment into its environmental, social and governance components would identify which forms of expenditure are most sensitive to the credibility condition. Event-study analysis around assurance adoption or award receipt would sharpen identification of the reputation mechanism. And explicit modelling of the joint dynamics of investment and reputation as a mutually reinforcing accumulation process would allow the transition path of firms below the threshold to be characterised rather than inferred.

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