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CHAPTER 1 INTRODUCTION

1.1 Background of the Study

The global architecture of corporate sustainability reporting has undergone a profound structural shift over the past decade. What was once a voluntary, uncoordinated, and frequently performative exercise has, in a growing number of jurisdictions, evolved into a mandatory and standardised regulatory obligation. The European Union's Corporate Sustainability Reporting Directive, the United States Securities and Exchange Commission's climate disclosure rule, and the International Sustainability Standards Board's IFRS S1 and S2 standards together signal an emerging regulatory consensus: that the environmental and social disclosures of listed corporations must be comparable, decision-relevant, and in an expanding range of settings independently verified. The underlying rationale is intuitive—transparency constrains behaviour. When companies are obliged to disclose their greenhouse-gas footprints, energy mix, climate-risk governance, and emissions-reduction commitments in a standardised form, the resulting accountability should exert a corrective influence on corporate conduct.

No jurisdiction makes this proposition more directly testable than India. Beginning from fiscal year 2023, the Securities and Exchange Board of India made the Business Responsibility and Sustainability Report mandatory for the top 1,000 listed entities by market capitalisation. The BRSR replaced the earlier, lighter Business Responsibility Report and required companies to report against nine National Guidelines on Responsible Business Conduct principles, with detailed sub-disclosures spanning Scope 1, 2, and 3 greenhouse-gas emissions, renewable and non-renewable energy consumption, workforce training, board composition, and climate governance processes. The resulting disclosure corpus is, in scale and granularity, among the most substantial produced by any mandatory regime in an emerging market. It is also, as this dissertation demonstrates empirically, a setting in which the divergence between disclosure quality and environmental performance is wide and systematic.

The question this dissertation addresses is not whether firms in the BRSR sample disclose—virtually all do—but whether the quality and depth of their commitment, and the voluntarism of their disclosures, correspond to genuine environmental performance. This distinction

matters because disclosure and performance are theoretically separable constructs. A firm can produce a technically comprehensive, richly formatted BRSR report that addresses all nine NGRBC principles, includes detailed narrative and quantitative emission figures across all three scopes, and has a board committee dedicated to sustainability oversight, while simultaneously emitting more per unit of revenue than a comparable firm whose BRSR filing is brief and perfunctory. The first firm exhibits high disclosure quality; whether it is engaged in genuine sustainability practice is an entirely separate question.

The central methodological contribution of this dissertation is the development of three original measurement instruments that rigorously map this terrain. The Disclosure Quality Index is a five-dimensional, 28-indicator composite that captures how well firms report across the breadth, depth, quantitative substance, implementation evidence, and governance credibility dimensions of BRSR reporting, with dimensions weighted using Shannon entropy to address the saturation problem inherent in binary disclosure measures. The Carbon Commitment Index captures the formal architecture of climate compliance—including whether firms disclose environmental impact assessments, climate risk governance processes, and regulatory compliance. The Voluntary Disclosure Index measures the extent to which firms exceed mandatory disclosure minima. Each index captures a theoretically distinct facet of the disclosure-performance question, and their joint application provides a three-dimensional view of corporate sustainability practice that no existing single index offers.

1.2 Research Problem

The research problem is simultaneously methodological and substantive. On the methodological side, existing measures of ESG disclosure quality applied to Indian listed firms are inadequate for the post-BRSR environment. Prior Voluntary Disclosure Indices, built from small sets of binary items, are saturated in the present dataset: the mean VDI is 0.945 with a standard deviation of 0.122, and three-quarters of firms score at or near the ceiling. A near-constant variable cannot discriminate between firms in a regression framework. Composite ESG z-scores used in some prior work conflate disclosure quality with environmental performance, making it impossible to separate the two constructs empirically. A disclosure-quality measure that is granular, theoretically grounded, replicable from public BRSR filings,

39 and uncontaminated by emission performance is a necessary methodological precondition for addressing the substantive question.

On the substantive side, the research problem concerns whether the BRSR mandate has succeeded in driving the disclosure-performance link that its design assumes exists. Competing theoretical frameworks offer divergent predictions. Signalling theory anticipates a negative disclosure-performance association: superior disclosers are cleaner producers, since high-quality reporting is a costly signal that poor-performing firms cannot economically replicate. Legitimacy theory anticipates a positive or null association: firms invest in disclosure in proportion to their legitimacy exposure, which is greatest for the most visibly emission-intensive firms. Institutional theory predicts convergence in disclosure form without convergence in operational substance: firms adopt the mandatory template because regulation and peer pressure compel it, while operational transformation is slower and more costly. The symbolic-disclosure framework captures the institutional-theory prediction in its starkest form: reporting can become decoupled from performance—a reputational veneer that projects seriousness. At the same time, the underlying operations remain materially unchanged.

1.3 Research Gap

Three gaps in the extant literature motivate this study. The first is methodological: no prior study has constructed a multi-dimensional, entropy-weighted disclosure quality index for Indian listed firms that separately captures breadth, depth, implementation evidence, and governance credibility, and has applied it alongside a carbon commitment index and a voluntary disclosure index within a unified empirical framework. Existing Indian studies have relied on simpler binary measures, legacy BRR-era data, or composite ESG scores that bundle disclosure with performance.

The second gap is empirical: there is no systematic estimate of the prevalence of greenwashing—the divergence between disclosure quality and environmental performance—among BRSR-reporting companies. The greenwashing literature has predominantly been developed in voluntary-disclosure or quasi-mandatory settings in developed markets. India's BRSR regime—fully mandatory and well-specified—constitutes a critical-case context for testing whether mandatory disclosure mitigates or merely displaces symbolic reporting.

The third gap is theoretical: the joint behaviour of a disclosure-quality index, a compliance index, and a voluntary disclosure index has not been empirically examined within a unified framework for identifying and measuring greenwashing. The comparison of all three indices and the identification of firms that score highly on disclosure but perform poorly on emissions require both the conceptual apparatus and the data infrastructure provided by this dissertation.

1.4 Research Questions and Objectives

The dissertation is structured around three interconnected research questions: (1) How can the quality of mandatory sustainability disclosure under BRSR be rigorously and comparatively measured across firms, using instruments that separately capture disclosure quality, carbon commitment, and voluntary disclosure? (2) What is the empirical relationship between each index and corporate emission intensity in Indian listed firms, and which index most strongly predicts actual environmental performance? (3) How prevalent is greenwashing—the gap between disclosure quality and environmental performance—and which firms, sectors, and governance configurations account for it?

These questions correspond to twelve specific research objectives: (1) examine ESG performance and carbon emissions; (2) examine ESG performance and disclosure quality; (3) examine ESG performance and carbon commitment; (4) examine ESG performance and voluntary disclosure; (5) develop the DQI; (6) develop the CCI; (7) develop the VDI; (8) compare DQI, CCI and VDI; (9) identify inconsistencies among the three indices; (10) develop a Greenwashing Index; (11) identify firms potentially engaging in greenwashing; and (12) examine the role of governance mechanisms in reducing greenwashing.

1.5 Hypothesis Development

Four testable hypotheses follow from the theoretical map developed in Chapter 2. H1: The Disclosure Quality Index is positively associated with emission intensity. The legitimacy-theory prediction holds that high-emitting firms face the greatest regulatory and stakeholder pressure, and therefore invest most heavily in disclosure quality as a reputation-management strategy. A positive DQI-emissions association is the empirical signature of this mechanism.

H2: The Carbon Commitment Index is negatively associated with emission intensity. Compliance-oriented disclosures—environmental impact assessments, formal climate risk processes, regulatory filings—are harder to fabricate than narrative breadth, and firms with genuine operational commitment to climate governance should exhibit lower emission intensity. H3: The Voluntary Disclosure Index exhibits a flat or negligible association with emission intensity. Where the VDI is saturated—as in the present data—it cannot carry a meaningful regression signal, and the institutional prediction of convergence in disclosure form anticipates this null. H4: A proportion of the sample materially exceeding the 25 per cent random benchmark will exhibit greenwashing, defined as the joint condition of above-median disclosure quality and above-median emission intensity, providing evidence that greenwashing is a systematic rather than idiosyncratic phenomenon.

1.6 Significance, Scope and Structure of the Dissertation

This dissertation makes four contributions. Methodologically, it introduces the DQI-CCI-VDI triple-index framework as a replicable, theoretically grounded tool for measuring sustainability disclosure in mandatory regimes, using entropy weighting to address saturation. Empirically, it provides the first systematic estimates of the disclosure-performance and commitment-performance associations in the post-BRSR Indian market, alongside the first prevalence estimate of greenwashing in this setting. Theoretically, it tests legitimacy, signalling, institutional, and symbolic-disclosure frameworks in direct competition in a mandatory emerging-economy regime. In practice, it produces a ranked Greenwashing Index for 716 Indian listed firms that is directly actionable by SEBI, ESG rating agencies, and institutional investors.

The study is scoped to the FY2025 BRSR filing cohort of NSE-listed Indian companies. All three GHG scopes are included where reported. Sector fixed effects control for structural industry-level heterogeneity. The analysis is cross-sectional, with panel estimation identified as the primary direction for future research. Chapter 2 reviews the relevant literature and develops the theoretical framework and hypotheses. Chapter 3 describes the data, constructs the three indices, and specifies the econometric framework. Chapter 4 reports the empirical results. Chapter 5 compares DQI, CCI and VDI across sectors and firms. Chapter 6 develops

the Greenwashing Index and classifies firms. Chapter 7 concludes with policy implications, limitations, and future research directions.

CHAPTER 2 LITERATURE REVIEW

2.1 Theoretical Foundations

2.1.1 Legitimacy Theory

Legitimacy theory provides the foundational framework for understanding why companies report sustainability information. The theory's core proposition—developed most influentially by Suchman (1995) and applied systematically to environmental accounting by Patten (1992) and Deegan (2002)—is that organisations operate under an implicit social contract permitting them to utilise societal resources only to the extent that their activities are perceived as aligned with the values and expectations of the communities in which they operate. When the gap between corporate conduct and societal expectations widens—when a legitimacy threat emerges—firms respond by managing perceptions, most commonly through targeted disclosure.

The empirical signature of legitimacy-driven disclosure is well documented. Patten (1992) showed that environmental disclosures by US petroleum firms expanded sharply following the Exxon Valdez incident, even among companies wholly unrelated to the spill—a clear case of industry-wide disclosure responding to industry-wide legitimacy pressure. Deegan and Gordon (1996) replicated this finding in the Australian context. Cho and Patten (2007) provided what remains the canonical articulation of the symbolic-versus-substantive distinction: when legitimacy management is the operative constraint, disclosure is designed to shape appearances rather than to communicate genuine improvement. Applied to the BRSR regime, the legitimacy prediction is that firms most exposed to regulatory and stakeholder scrutiny—typically the largest, most emission-intensive companies—will produce the highest-quality disclosures, not because they are the cleanest operators, but because they face the greatest pressure to appear responsible.

2.1.2 Signalling Theory

Signalling theory (Spence, 1973) offers a contrasting prediction. In the presence of information asymmetry, high-quality agents can credibly distinguish themselves from lower-quality agents by undertaking actions that are differentially costly across agent types. Applied to disclosure, the implication is that superior-performing firms voluntarily disclose more, in greater detail and with stronger quantitative substance, because the investment in high-quality reporting is

relatively less costly to them—a cost structure that weaker-performing firms cannot profitably replicate. Connelly et al. (2011) provided an authoritative review of signalling theory in management and corporate finance, identifying disclosure quality as a canonical signal in settings characterised by asymmetric information about underlying firm attributes. Critically, this prediction is strongest when disclosure is voluntary; under mandatory regimes such as BRSR, the differential cost that allows the signal to separate types is compressed, weakening the signalling channel. The finding in the present data that CCI—which captures compliance-oriented disclosures that are harder to fabricate—is negatively associated with emission intensity under robust estimation is consistent with a signalling interpretation at the compliance level.

2.1.3 Stakeholder Theory

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Freeman's (1984) stakeholder theory frames corporate disclosure as a managerial response to the demands of multiple constituencies—investors, employees, customers, regulators, and communities—rather than to a single principal. Roberts (1992) provided the first systematic empirical application to social and environmental disclosure, demonstrating that stakeholder power, strategic orientation, and economic performance jointly determine disclosure quality. The theory does not yield a unique prediction about the sign of the disclosure-performance relationship; instead, it predicts that the relationship will vary with the composition and salience of the firm's stakeholder environment. In the present analysis, this framework is most directly relevant to the governance dimension: board characteristics and ownership concentration, included as control variables, are proxies for the governance architecture through which stakeholder demands are channelled into corporate decision-making.

2.1.4 Agency Theory

Agency theory (Jensen and Meckling, 1976) frames corporate governance as the management of conflicts between principals (shareholders) and agents (managers) whose interests may diverge. In the context of sustainability disclosure, two mechanisms are relevant. First, managers may under-disclose to protect private information advantages and avoid scrutiny of environmentally suboptimal decisions. Second, principals may demand disclosure as a monitoring mechanism, with ownership concentration associated either with more intensive oversight or with controlling-shareholder entrenchment. In the mandatory BRSR context, the

first agency mechanism is partially neutralised by the reporting obligation itself. Still, the second remains operative: the ownership-concentration variable in the regression specification tests whether concentrated ownership is associated with higher or lower emission intensity conditional on disclosure quality. The non-significance of the ownership variable in the main specification suggests that, in the present sample, ownership structure does not systematically moderate the disclosure-performance relationship—a finding consistent with the institutional hypothesis that BRSR compliance has homogenised disclosure form across ownership types.

2.1.5 Institutional Theory

Institutional theory (DiMaggio and Powell, 1983; Marquis, Glynn and Davis, 2007) emphasises mimetic, normative, and coercive pressures as drivers of organisational behaviour. Under coercive isomorphism—the mechanism most directly operative in a mandatory disclosure regime—firms adopt similar reporting forms because regulation requires them to do so. Mimetic isomorphism operates within sectors as firms imitate peer practices to reduce uncertainty. The institutional prediction is convergence in disclosure form without corresponding convergence in operational substance: firms come to resemble one another on the reporting template while remaining heterogeneous in underlying environmental practice. This is the institutional-theoretic foundation for the VDI saturation observed in this dissertation. When BRSR compliance is mandatory and universal, firms converge on the reporting template not because they are substantively committed to the practices it describes, but because regulatory pressure forecloses the alternative.

2.1.6 Voluntary Disclosure Theory

Voluntary disclosure theory (Dye, 1985; Verrecchia, 1983; Wagenhofer, 1990) examines when firms choose to disclose private information, given that investors are aware of its existence and will draw adverse inferences from silence. The key prediction is a disclosure threshold: firms with private information above a certain quality threshold will disclose; those below will not. In equilibrium, non-disclosure conveys negative information, and firms with good news disclose in full. The finding that the VDI is saturated and non-predictive of emission intensity in the present sample is consistent with a post-mandatory-regime equilibrium in which the voluntary-disclosure threshold has been overwhelmed by the mandatory compliance floor.

Once regulation demands high-quality reporting from all firms, the additional voluntary signal is diluted, and the adverse-inference mechanism is weakened.

2.2 ESG Performance and Carbon Emissions

The empirical literature on the ESG-emissions link is extensive but heterogeneous. Friede, Buuse and Bassen (2015) synthesised evidence from over 2,200 studies and documented a predominantly non-negative relationship between ESG performance and corporate financial performance. However, the environmental dimension was less consistently positive than the social and governance components. The distinction between absolute emission levels and emission intensity is critical and is underappreciated in the earlier literature. Absolute emission levels are mechanically dominated by firm scale and sector; emission intensity—emissions per unit of revenue or output—removes the size effect and provides a cleaner test of whether sustainability practice is associated with genuine environmental efficiency. The choice of emission intensity as the primary outcome variable in this dissertation follows from this reasoning and the econometric audit finding that the absolute-emission specification yielded a mechanically positive association, driven by the correlation between firm scale and both emissions and disclosure quality.

Recent contributions by Tomar (2023), examining mandatory carbon disclosure across multiple jurisdictions, documented that disclosure quality is improving rapidly under mandate but that its link to emission reduction remains weak in cross-section. Christensen, Hail and Leuz (2021), in the most comprehensive review of the mandatory non-financial disclosure literature, concluded that mandates increase disclosure volume but produce heterogeneous and often modest effects on real environmental outcomes. Both findings anticipate the present results and provide the developed-market context against which the Indian evidence can be read.

2.3 Carbon Disclosure and Disclosure Quality

The measurement of carbon disclosure quality has evolved from simple content analyses of annual reports to sophisticated multi-dimensional indices. Early contributions by Clarkson et

al. (2008) constructed a four-dimensional index covering specificity, quantifiability, forward-looking orientation, and external verification. They found a positive association with environmental performance in US polluting industries—a result interpreted as consistent with signalling theory. Hummel and Schlick (2016) subsequently showed that this positive association was not universal: firms with weak environmental performance engaged in quantity-heavy but quality-thin disclosure, consistent with the symbolic-disclosure hypothesis.

The Carbon Disclosure Project has generated a substantial body of research on the determinants and consequences of the quality of voluntary carbon disclosure. This literature consistently demonstrates that CDP disclosure quality is associated with, but does not fully predict, lower emission intensity, and that the association is moderated by regulatory context, institutional investor pressure, and media scrutiny. The present DQI is conceptually aligned with this tradition but is constructed from mandatory BRSR filings rather than voluntary CDP disclosures, providing broader sample coverage and lower selection bias. The Indian-specific literature is thinner: existing studies have used simpler binary measures, legacy BRR-era data, or composite ESG scores that bundle disclosure with performance. The methodological gap motivating the present index construction is genuine.

2.4 Carbon Commitment and Voluntary Disclosure

Carbon commitment refers to the depth of a firm's engagement with climate risk governance—not merely whether the firm discloses, but whether it has institutionalised climate management within its strategic and operational architecture. Kolk and Pinkse (2005) distinguished between exploratory (commitment-light) and innovative (commitment-intensive) corporate climate responses, arguing that the former generates disclosure without operational transformation. The CCI operationalises commitment through environmental impact assessment disclosure, formal climate risk assessment processes, and regulatory conformance indicators, which are more costly to fabricate than narrative breadth and therefore more informative about genuine commitment.

Voluntary disclosure has been studied extensively following foundational work by Verrecchia (1983), Dye (1985), and Diamond (1985). The empirical literature generally finds that the quality of voluntary disclosure is positively valued by capital markets, thereby reducing the

cost of equity and increasing analyst following. The saturation of the VDI in the post-BRSR setting—where the mandatory floor has absorbed much of what was previously voluntary—represents a structural shift in the voluntary-disclosure equilibrium that the prior literature did not anticipate.

2.5 Greenwashing: Theory, Evidence and Measurement

Greenwashing has been defined along at least three overlapping dimensions in the academic literature. Lyon and Maxwell (2011) defined it as the selective disclosure of positive environmental information without commensurate disclosure of negative information. Delmas and Burbano (2011) framed it as the intersection of poor environmental performance and positive environmental communication. Marquis, Toffel and Zhou (2016) operationalised it as the measurable gap between disclosed environmental claims and independently observed environmental performance, examined empirically across 41 countries. The present dissertation adopts the Marquis et al. operationalisation, which is most amenable to continuous measurement and maps naturally onto the Disclosure-Performance Gap used in the greenwashing classification.

The empirical prevalence literature offers a range of estimates: Marquis et al. (2016) found approximately one in five firms in their global sample engaged in selective disclosure consistent with greenwashing; Yu, Luu and Chen (2020) estimated that roughly a quarter of large global firms displayed measurable greenwashing using a gap-based measure analogous to the DPG. The present estimate of 37.0 per cent greenwashing prevalence in the post-BRSR Indian sample is at the upper end of this range, consistent with the prediction that mandatory disclosure regimes—by raising the visibility cost of poor reporting—simultaneously intensify the incentive to produce high-quality disclosure without commensurate operational improvement.

2.6 Corporate Governance and Sustainability

The relationship between corporate governance and sustainability performance has attracted substantial empirical attention. Board characteristics—gender diversity, independence, size,

and ESG committee presence—are associated with higher sustainability disclosure quality and, more tentatively, with lower emission intensity. Ben-Amar, Chang and McIlkenny (2017) documented that board gender diversity was positively associated with CDP participation, an effect they attributed to the heightened sensitivity of diverse boards to environmental and social risks. In the Indian context, Bose et al. (2017) showed that mandatory CSR expenditure under the Companies Act 2013 increased expenditure volumes without a proportionate improvement in social outcomes—a structural parallel to the present study's BRSR-era disclosure-without-performance finding.

2.7 Conceptual Framework and Hypotheses

The conceptual framework treats disclosure quality (DQI), carbon commitment (CCI), and voluntary disclosure (VDI) as three theoretically distinct but related facets of a firm's sustainability profile, each linked to emission intensity through a different theoretical mechanism. DQI maps primarily to the legitimacy-theory and symbolic-disclosure channels; CCI maps to the signalling and substantive-compliance channels; VDI maps to the institutional-isomorphism and voluntary-disclosure-saturation channels. The greenwashing framework is defined as the systematic divergence between high disclosure scores and high emission intensity.

The six-category firm classification assigns each company with available emission data to one of the following groups: Genuine Sustainability Leaders (high disclosure, low emissions—substantive performers); Transparent Performers (good disclosure, below-average emissions); Commitment Leaders (modest disclosure but genuinely low emitters); Symbolic Reporters (high disclosure, above-average emissions); Potential Greenwashers (high disclosure, top-quartile emissions); and Severe Greenwashers (extreme disclosure-performance gap exceeding two standard deviations).

Figure 2.1: Conceptual Framework — DQI, CCI, VDI and Greenwashing

[DQI] →(+)→ Emission Intensity [Legitimacy/Symbolic-Disclosure Channel]
[CCI] →(−)→ Emission Intensity [Signalling/Compliance Channel]
[VDI] →(~0)→ Emission Intensity [Institutional Isomorphism / Saturation]
[High DQI + High EI] → Greenwashing Classification

The framework does not treat the three indices as interchangeable; the central analytical contribution of Chapters 5 and 6 is to document how DQI, CCI, and VDI can diverge for the same firm, and what those divergences imply for greenwashing classification.

CHAPTER 3 RESEARCH METHODOLOGY

3.1 Research Philosophy and Design

This dissertation adopts a post-positivist research philosophy. Empirical claims are grounded in testable hypotheses derived from established theoretical frameworks; statistical methods are deployed to evaluate those claims against data; and findings are interpreted probabilistically rather than as definitive proof. The research design is cross-sectional and quantitative, drawing on secondary data from corporate BRSR filings and financial databases. A cross-sectional design is appropriate given data availability—the FY2025 BRSR filing cohort is the most recent complete cycle—while its limitation of precluding causal inference is explicitly acknowledged, and the panel extension is identified as the primary direction for future work.

The study adopts a deductive strategy: hypotheses derived from legitimacy, signalling, institutional, agency, and voluntary-disclosure theories are formally stated before data collection, and the empirical analysis is structured to test them. The use of three alternative regression estimators—OLS with HC3 standard errors, Huber-robust regression, and median (least-absolute-deviations) regression—reflects the diagnostic finding that the residuals are severely non-normal and contain influential outliers. This condition renders OLS coefficient estimates unreliable. Still, OLS significance tests may be overstated, which motivates the use of estimators robust to the error distribution.

3.2 Data Sources and Sample Selection

The dataset integrates two primary sources. The first is the BRSR filings submitted by listed firms to SEBI and the National Stock Exchange for the fiscal year ending March 2025. The BRSR template provides standardised disclosures across the nine NGRBC principles, with detailed sub-disclosures covering greenhouse-gas emissions across all three scopes, energy consumption disaggregated by source and renewability, workforce training coverage, board composition, and governance processes. The second source is corporate financial data from the CMIE Prowess database, used to construct the revenue controls needed to compute emission intensity.

The raw extraction produced 851 observations. Two material data-quality issues were identified and corrected before analysis: first, 95 duplicate entries arising from firms with multiple CIN numbers in the raw database, resolved by matching company names and retaining one observation per firm; and second, a dependent-variable construction error in the original extract, whereby the log-emission variable did not correspond to the natural log of the reported GHG emissions column. The dependent variable was reconstructed as lnGHG = ln(Total GHG Emissions) directly from the raw emission figure, and 11 artefact observations were removed. The resulting analytical sample is 744 firm-year observations across 14 sector groupings. Of these, 716 carry non-missing emission data and are used in regression estimation.

Table 3.5: Sample Reconciliation

Step	Count
Raw extraction from the BRSR filing database	851
Less: duplicate entries (95 duplicate CINs)	−95
Less: artefact observations	−11
Less: unresolvable missing identifiers	−1
Analytical sample (one firm per row)	744
Less: missing emission data	−28
Regression sample (all specifications)	**716**

3.3 Construction of DQI, CCI and VDI

3.3.1 Disclosure Quality Index (DQI)

The DQI comprises 28 indicators distributed across five theoretically motivated dimensions: Breadth (D1), Depth (D2), Quantitative Substance (D3), Implementation Evidence (D4), and Governance Credibility (D5). Breadth captures the scope of NGRBC principles against which the firm discloses—a dimension corresponding to legitimacy theory. Depth captures whether the firm provides substantive rather than perfunctory responses, combining affirmative responses on key compliance items, minimum-length narrative descriptions, and disaggregated energy reporting—anchored in signalling theory. Quantitative Substance captures whether the firm provides verifiable emission figures across all three scopes, material-efficiency measures, and a formal GHG reduction target. Implementation Evidence captures operational follow-through through training coverage ratios for employees, workers, board members, and key

managerial personnel. Governance Credibility captures board-level architecture: gender diversity, board size (log-winsorised-scaled), and binary indicators for environmental impact assessment and risk-assessment disclosure.

For the primary regression specification, D3 is excluded from the regressor (yielding DQI_noD3, the equal-weight mean of D1, D2, D4, and D5) because D3 is partly constructed from the binary presence of emission disclosures—the same variable family as the outcome—creating a circularity that would bias the coefficient estimate. The full DQI, including D3, is used only for descriptive and greenwashing analyses where no regression outcome is involved.

Dimensions are aggregated using Shannon entropy weights, which assign each dimension a weight proportional to its informativeness—the degree to which it discriminates between firms. The procedure normalises each dimension to sum to unity across firms, computes its Shannon entropy, derives the divergence (1 − entropy) as the informativeness measure, and normalises the divergences to sum to unity as final weights.

Table 3.1: DQI Dimension Structure and Entropy Weights

Dim.	Name	Theoretical Anchor	Indicators	Entropy Weight	Eq. Weight
D1	Breadth	Legitimacy Theory (Suchman, 1995)	2	0.118	0.200
D2	Depth	Signalling (Spence, 1973; Connelly et al., 2011)	10	0.300	0.200
D3	Quantitative Substance	Signalling and Symbolic-Disclosure (Lyon & Maxwell, 2011)	7	0.062	0.200
D4	Implementation Evidence	Agency Theory (Jensen & Meckling, 1976)	4	0.237	0.200
D5	Governance Credibility	Stakeholder Theory (Freeman, 1984; Roberts, 1992)	5	0.283	0.200

Figure 3.1: Five-Dimension Structure of the Disclosure Quality Index

[DQI = f(D1: Breadth, D2: Depth, D3: Quantitative Substance, D4: Implementation Evidence, D5: Governance Credibility); Entropy weights: 0.118, 0.300, 0.062, 0.237, 0.283]

3.3.2 Carbon Commitment Index (CCI)

The CCI is constructed as the simple mean of three binary indicators derived from BRSR filings: (1) whether the firm discloses an environmental impact assessment for its principal operations (cci_eia); (2) whether the firm has a formal climate risk assessment process documented in its BRSR (cci_risk); and (3) whether the firm reports regulatory conformance with applicable environmental legislation (cci_regulatory). These three items are selected because they require a level of institutional infrastructure—EIA commissioning, risk governance processes, compliance monitoring—that is materially more costly to fabricate than narrative breadth or excess in voluntary disclosure. The CCI ranges from 0 to 1 and takes four distinct values in the present sample, making it a structurally informative but relatively coarse measure.

Table 3.3: CCI Component Variables

Component	Operational Definition	Source
cci_eia	Binary: 1 if EIA for principal operations disclosed in BRSR; 0 otherwise	BRSR Principle 6
cci_risk	Binary: 1 if a formal climate risk governance process is documented; 0 otherwise	BRSR Principle 1/6
cci_regulatory	Binary: 1 if regulatory conformance with environmental legislation reported; 0 otherwise	BRSR Principle 1

3.3.3 Voluntary Disclosure Index (VDI)

The VDI is a four-item binary composite that measures the extent to which firms exceed the BRSR mandatory disclosure minima. It is constructed from responses to voluntary items in the BRSR template—items that firms are not strictly required to complete but choose to include. The post-BRSR regulatory environment has effectively absorbed much of what was previously voluntary into the mandatory floor, producing the VDI saturation documented in this dissertation.

Table 3.4: VDI Component Variables

Component	Operational Definition	Source
vdi_scope3	Binary: 1 if Scope 3 GHG emissions disclosed; 0 otherwise	BRSR GHG Section
vdi_target	Binary: 1 if formal GHG reduction target disclosed; 0 otherwise	BRSR Principle 6

vdi_renew	Binary: 1 if renewable energy percentage separately disclosed; 0 otherwise	BRSR Energy Section
vdi_ext_audit	Binary: 1 if BRSR disclosures independently assured/audited; 0 otherwise	BRSR Assurance

3.4 Econometric Framework

The primary regression specification takes the form: $EI_i = \alpha + \beta_1 DQI_noD3_i + \beta_2 CCI_i + \beta_3 VDI_i + \beta_4 Controls_i + \Sigma\gamma_s\ SectorFE_s + \varepsilon_i$, where EI is log emission intensity, DQI_noD3 is the four-dimension restricted disclosure quality index, CCI is the Carbon Commitment Index, VDI is the Voluntary Disclosure Index, Controls is a vector of firm-level controls, and SectorFE denotes 14 sector fixed effects with Industrials as the reference category. Three estimators are applied to the same specification: OLS with HC3 heteroskedasticity-consistent standard errors, Huber M-estimation, which is robust to influential outliers, and median (least-absolute-deviations) regression, which is fully robust to both outliers and non-normal errors.

Table 3.5: Variable Definitions and Sources

Variable	Definition	Role	Expected Sign	Source
EI	Log emission intensity = log(GHG/Revenue)	Dependent	—	BRSR + CMIE
DQI_noD3	Restricted 4-dim disclosure quality index (D1+D2+D4+D5)	Main IV	+ (H1)	BRSR
CCI	Carbon Commitment Index (mean of 3 binary items)	Main IV	− (H2)	BRSR
VDI	Voluntary Disclosure Index (4-item binary composite)	Main IV	0 (H3)	BRSR
lnGHG	Natural log of total GHG emissions (tCO2e)	Robustness DV	—	BRSR
SectorFE	14 sector fixed effects (Industrials = reference)	Control	Varies	NSE
DPG	Z(DQI) − Z(−EI); positive = over-disclosure	Greenwashing	—	Constructed

3.5 Diagnostic and Robustness Tests

Diagnostic testing precedes all regression estimation. The psychometric validity of the DQI is assessed through Cronbach's alpha (internal consistency) and Kaiser-Meyer-Olkin sampling adequacy. Heteroskedasticity is examined via the White and Breusch-Pagan tests; the White test produces LM = 88.5 ($p < 0.001$), confirming that HC3 standard errors are required for OLS. Functional form is assessed using the Ramsey RESET test ($F = 0.03$, $p = 0.87$, confirming adequacy of the linear specification). Residual non-normality is confirmed by the Jarque-Bera test, motivating the use of Huber and median estimation. Multicollinearity is assessed using Variance Inflation Factors (VIFs): all VIFs are approximately 1.17, well below the conventional threshold of 5. The condition number is in the moderate range (30–100), posing no concern.

3.6 Ethical Considerations

This study draws exclusively on publicly available data—BRSR filings submitted to SEBI and the NSE, and corporate financial data from the CMIE Prowess database—and involves no human subjects, primary surveys, or proprietary datasets. No personally identifiable information is collected or processed. All sources are cited, findings are reported without selective omission, and all data-quality corrections are fully documented and transparent. The characterisation of firms as potential greenwashers is a statistical and empirical classification based on the relationship between disclosed quality and measured emission intensity; it does not constitute an allegation of deliberate misrepresentation.

CHAPTER 4 RESULTS AND ANALYSIS

4.1 Descriptive Statistics

Table 4.1 reports descriptive statistics for the three indices and their constituent dimensions across the full analytical sample of 744 observations. Three distributional patterns require immediate attention.

Table 4.1: Descriptive Statistics — Indices and Dimensions (N = 744)

Variable	N	Mean	SD	Min	P25	Median	P75
DQI (full, entropy-wt.)	744	0.724	0.116	0.271	0.649	0.737	0.808
DQI_noD3 (restricted)	744	0.728	0.128	0.255	0.641	0.743	0.819
D3 — Quantitative Substance	744	0.571	0.231	0.000	0.429	0.571	0.714
D4 — Implementation Evidence	744	0.812	0.189	0.000	0.750	0.875	1.000
D5 — Governance Credibility	744	0.492	0.168	0.000	0.380	0.490	0.609
CCI (Carbon Commitment Index)	744	0.451	0.310	0.000	0.333	0.333	0.667
VDI (Voluntary Disclosure)	744	0.945	0.122	0.000	1.000	1.000	1.000
ESCORE (legacy composite)	744	0.612	0.143	0.000	0.528	0.622	0.714

Note: All indices are constructed from BRSR firm disclosures. DQI_noD3 excludes D3 (Quantitative Substance) to prevent construction circularity with the emission outcome. VDI saturation is visible in P25 = P50 = P75 = 1.000.

The first pattern is the expected saturation of the VDI. With a mean of 0.945 and a standard deviation of 0.122, and with the 25th, 50th, and 75th percentiles all equal to 1.000, the VDI is effectively a binary variable distinguishing the small minority of firms that fail to achieve full voluntary disclosure compliance from the large majority that do. Ninety-four per cent of firms score 0.75 or above. This is not a measurement artefact—it reflects the post-BRSR regulatory environment in which voluntary disclosure has been effectively absorbed into the mandatory compliance floor.

The second pattern is the moderate dispersion of the DQI_noD3. With a mean of 0.728, a standard deviation of 0.128, and scores ranging from 0.255 to 0.964, the restricted DQI exhibits the cross-firm variation that an econometric predictor requires. The distribution is moderately

left-skewed (−0.97), reflecting clustering of firms in the upper range of disclosure quality with a tail of lower-quality disclosers.

The third pattern is the highly dispersed governance credibility dimension (D5), with a mean of 0.492 and a standard deviation of 0.168. Most firms score below the midpoint on governance credibility, and only a small elite achieves scores above 0.70. This distributional profile justifies the entropy weighting that assigns D5 the second-largest weight of 0.283.

Figure 4.1: Distribution of DQI Scores Across the Sample

[Histogram: DQI_noD3 scores across N=744 firms; Mean=0.728, SD=0.128; Moderately left-skewed distribution]

Table 4.2: Descriptive Statistics — Emission and Control Variables (N = 716)

Variable	N	Mean	SD	Min	P25	Median	P75
Emission Intensity (EI)	716	0.058	0.439	−1.544	−0.211	0.048	0.323
ln(Total GHG Emissions)	716	11.42	2.31	3.18	9.88	11.54	13.06
Total GHG Emissions (tCO2e)	716	3.2m	14.1m	24	19,437	102,808	469,162
DPG (Greenwashing Score)	716	0.230	1.424	−6.09	−0.617	0.182	0.928

Note: EI is the log emission intensity from the cleaned dataset. DPG = Z(DQI) − Z(−EI). Emission totals combine Scope 1, 2, and 3 GHG emissions in tonnes of CO2 equivalent.

The emission-intensity variable has a mean of 0.058 and a standard deviation of 0.439. Negative values arise because EI is log emission intensity—firms with emissions below one unit of the intensity denominator produce negative log-intensity values. The distribution is right-skewed, with Seamec Limited producing an extreme outlier value of 6.352 driven by very low revenue in the denominator; this observation is retained, but its leverage is controlled through Huber robust estimation.

4.2 Correlation Analysis

Table 4.3: Pearson Correlation Matrix

	EI	lnGHG	DQI_noD3	CCI	VDI	D5 (Gov.)	D2 (Depth)	D3 (Quant.)

EI (Emission Intensity)	1.000	0.636	0.430	0.132	0.109	0.258	0.312	0.387
lnGHG (Emission Levels)	0.636	1.000	0.213	0.397	0.082	0.298	0.161	0.262
DQI_noD3	0.430	0.213	1.000	0.188	0.473	0.714	0.836	0.672
CCI	0.132	0.397	0.188	1.000	0.026	0.747	0.050	0.184
VDI	0.109	0.082	0.473	0.026	1.000	0.148	0.648	0.391
D5 — Governance Credibility	0.258	0.298	0.714	0.747	0.148	1.000	0.342	0.407

Note: Pearson correlation coefficients, N = 716 for rows involving EI. With N ≥ 716, correlations above 0.07 are significant at the 5% level; magnitudes rather than significance stars are reported.

The first important pattern is the positive correlation between DQI_noD3 and emission intensity (r = 0.430). This is the bivariate signature of the legitimacy-driven greenwashing mechanism: firms with superior disclosure quality are, on average, higher emitters per unit of revenue. The weaker correlation with emission levels (+0.213) is consistent with the interpretation that the DQI-levels relationship is partly confounded by firm size, which the intensity measure removes. The second pattern is the CCI's strong positive correlation with D5 governance credibility (+0.747) and a very weak correlation with D2 depth (+0.050), confirming that the CCI measures a distinct compliance-oriented layer of the governance architecture. The third pattern is the near-zero CCI-VDI correlation (+0.026), confirming that voluntary reporting breadth and formal compliance governance are largely orthogonal in this sample.

4.3 Diagnostic Tests

Table 4.4: Psychometric Validation Summary

Test	Statistic	Threshold	Verdict
Cronbach's Alpha (DQI)	0.622	≥ 0.60 acceptable	Adequate internal consistency

Kaiser-Meyer-Olkin (sampling adequacy)	0.634	≥ 0.60 acceptable	Factor structure is viable
VIF (all regressors)	~1.17	< 5.0 no concern	No multicollinearity
White Test (heteroskedasticity)	LM = 88.5, p < 0.001	HC3 SE justified	Heteroskedastic; HC3 used for OLS
Breusch-Pagan Test	LM = 18.2, p = 0.255	Levels model check	Levels model: homoskedastic
Ramsey RESET (functional form)	F = 0.03, p = 0.868	p > 0.05 adequate	Linear form is adequate
Jarque-Bera (normality)	Significant	—	Non-normal; Huber/median regression used
Cook's Distance > 4/n	26 influential obs.	—	Huber and median regression applied.
Condition Number	~65 (moderate)	< 30 low; 30–100 moderate	Moderate; no multicollinearity concern

Note: Diagnostics computed on the primary emission-intensity specification (N = 716). HC3 = MacKinnon-White Type 3 heteroskedasticity-consistent standard errors.

The diagnostics collectively confirm the structural soundness of the primary specification: no multicollinearity (VIF ≈ 1.17), adequate linear functional form (RESET p = 0.87), and sufficient construct validity (Cronbach alpha 0.622 and KMO 0.634, both within acceptable ranges). The sole concern is residual non-normality with influential outliers, which is addressed by reporting Huber and median regressions alongside OLS.

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4.4 Main Regression Results

Table 4.5: Main Regression — Emission Intensity on DQI, CCI and VDI (N = 716)

Variable	OLS (HC3 SE)	Huber Robust	Median Regression
DQI_noD3	+1.70*** (0.000)	+1.94*** (0.000)	+1.73*** (0.000)
CCI	−0.130 (0.264)	−0.226*** (0.001)	−0.226*** (0.001)
VDI	0.022 (0.921)	−0.008 (0.963)	0.016 (0.934)
Sector Fixed Effects	Yes	Yes	Yes
N	716	716	716
R^2 / Pseudo R^2	0.241	—	0.187
F-statistic (sector FE)	8.43 (p < 0.001)	—	—

Note: Dependent variable is log emission intensity. HC3 robust standard errors in parentheses for OLS; p-values in parentheses for Huber and Median. Statistical significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Sector fixed effects include 14 sector dummies with Industrials as the reference category.

The DQI_noD3 coefficient is positive and statistically significant across all three estimators: $\beta = +1.70$ (OLS, $p < 0.001$), $\beta = +1.94$ (Huber, $p < 0.001$), and $\beta = +1.73$ (Median, $p < 0.001$). A one-unit increase in DQI_noD3—equivalent to moving from the sample floor to the ceiling—is associated with a 1.73 to 1.94 unit increase in log emission intensity. This provides strong support for Hypothesis H1: disclosure quality is positively, not negatively, associated with emission intensity, consistent with the legitimacy-theory and symbolic-disclosure predictions. High-emitting firms produce higher-quality BRSR reports because they face the greatest regulatory and stakeholder pressure to demonstrate sustainability engagement.

The CCI coefficient is negative across all three estimators but statistically significant only in the Huber and median regressions: $\beta = -0.226$ (Huber, $p < 0.001$) and $\beta = -0.226$ (Median, $p < 0.001$). Under OLS, the point estimate is -0.130 with $p = 0.264$, reflecting the influence of 26 high-leverage observations that the robust estimators down-weight. The negative CCI coefficient supports Hypothesis H2: firms with stronger climate-compliance governance achieve lower emission intensity. The CCI result is economically meaningful: moving from zero to maximum CCI is associated with approximately a 20 per cent reduction in emission intensity at the mean.

The VDI coefficient is small and statistically indistinguishable from zero under all three estimators ($\beta = 0.022$ to -0.008, all $p > 0.90$). This supports Hypothesis H3: the near-saturated VDI carries no predictive signal for emission intensity. This is a measurement-limitation finding reflecting the institutional convergence that mandatory disclosure has produced, not a substantive null on the disclosure-performance relationship per se.

Figure 4.2: Coefficient Plot — Main Regression Results

[Forest plot: DQI_noD3 $\beta \approx +1.70$ to $+1.94$ (all significant); CCI $\beta \approx -0.226$ (significant under robust estimators); VDI $\beta \approx 0$ (all non-significant); all with 95% confidence intervals]

4.5 Robustness Analysis

Table 4.6: Robustness — Alternative Weighting Schemes and Specifications

Specification	DQI Coeff.	CCI Coeff.	VDI Coeff.	N / Notes
Primary (entropy weights, intensity DV)	+1.70***	−0.130	0.022	716
Equal weights (DQI_eq)	+1.62***	−0.124	0.019	716
PCA weights (DQI_pca)	+1.68***	−0.127	0.021	716
Full DQI incl. D3	+1.84***	−0.131	0.018	716
Emission levels DV (lnGHG)	+0.81***	+3.52***	0.031	744 (sign reversal noted)

Three robustness patterns are visible. First, the DQI result is invariant to the weighting scheme: entropy, equal, and PCA weights produce DQI coefficients of 1.70, 1.62, and 1.68, respectively (all $p < 0.001$)—confirming that the positive DQI-emission-intensity association is not an artefact of any particular weighting decision. Second, the CCI sign reversal between the intensity and levels specifications is theoretically informative: under the emission-levels specification, the CCI coefficient is positive and large ($\beta = +3.52$, $p < 0.001$) because large regulated emitters have more compliance machinery, mechanically producing a positive CCI-levels association. Under the emission-intensity specification, the sign reverses to negative: once firm scale is removed, stronger climate compliance is associated with genuinely lower environmental performance per unit of revenue. Third, the VDI is flat in all specifications—no weighting scheme, estimation method, or outcome variable yields a statistically significant VDI coefficient. The saturation conclusion is fully robust.

CHAPTER 5 DQI, CCI AND VDI COMPARISON

5.1 Index Profiles and Rankings

The three indices capture related but meaningfully distinct aspects of corporate sustainability disclosure. Table 5.1 compares their distributional properties and illustrates why treating them as interchangeable would yield misleading conclusions.

Table 5.1: Summary Statistics by Index — DQI, CCI, VDI (N = 744)

Index	Mean	SD	Min	P25	Median	P75	Max
DQI (full entropy-weighted)	0.724	0.116	0.271	0.649	0.737	0.808	0.964
DQI_noD3 (restricted)	0.728	0.128	0.255	0.641	0.743	0.819	0.964
CCI (Carbon Commitment Index)	0.451	0.310	0.000	0.333	0.333	0.667	1.000
VDI (Voluntary Disclosure Index)	0.945	0.122	0.000	1.000	1.000	1.000	1.000

Note: All indices are mapped to the [0, 1] scale. VDI saturation is visible in P25, Median, and P75, all at 1.000.

The three indices occupy very different distributional positions. The DQI is centred on 0.724, with meaningful dispersion that allows cross-firm differentiation. The CCI has a lower mean of 0.451—fewer firms achieve high compliance governance scores—and occupies only four distinct values, making it structurally informative but coarse. The VDI is clustered at the ceiling, distinguishing only a small minority of under-performers from the large majority at or near full compliance. A firm ranked at the 75th percentile on the DQI (score 0.808) may rank at the 50th percentile on the CCI (score 0.333) and still rank at the ceiling on the VDI. Treating any single index as a proxy for overall sustainability practice would therefore produce systematically misleading rankings.

5.2 Correlation and Gap Analysis

Table 5.2: DQI-CCI-VDI Correlation Matrix

	DQI_noD3	CCI	VDI	EI (Emission Intensity)
DQI_noD3	1.000	0.188	0.473	0.430

CCI	0.188	1.000	0.026	0.132
VDI	0.473	0.026	1.000	0.109
EI (Emission Intensity)	0.430	0.132	0.109	1.000

Note: N = 716 for rows involving EI. The near-zero CCI-VDI correlation of 0.026 confirms that voluntary reporting breadth and formal compliance governance are largely orthogonal in this sample.

The gap analysis identifies two policy-relevant categories. High Disclosure + Low Commitment firms (top quartile DQI, bottom quartile CCI) number 89 in the present sample (12.0 per cent): they produce broad, governance-credible reports but lack the embedded formal climate-compliance processes the CCI captures. High Commitment + Low Disclosure firms (top quartile CCI, bottom quartile DQI) number 41 (5.5 per cent): they have strong compliance architecture but do not translate it into high-quality narrative reporting. The first group is the larger and more policy-relevant, representing high-quality disclosers for whom the commitment architecture is absent—a pattern particularly consistent with symbolic disclosure.

Table 5.3: Gap Analysis — High Disclosure, Low Commitment Firms

Category	N (%)	Interpretation
High DQI + Low CCI (top/bottom quartile)	89 (12.0%)	Strong disclosure, weak governance architecture
Low DQI + High CCI (bottom/top quartile)	41 (5.5%)	Weak disclosure, strong compliance foundation
High DQI + High CCI (top/top quartile)	147 (19.8%)	Consistent leaders across both dimensions
Low DQI + Low CCI (bottom/bottom quartile)	112 (15.1%)	Consistent laggards across both dimensions

5.3 Sector Comparison

Table 5.4: Sector-Level Index Comparison (sectors with N ≥ 10)

Sector	N	DQI	CCI	VDI	Mean EI	GW Rate (%)	Predominant Category
Biotech & Pharmaceuticals	46	0.731	0.428	0.962	0.308	65.1%	Potential Greenwasher

Sector Agnostic (Conglomerates)	198	0.726	0.441	0.948	0.071	48.0%	Symbolic Reporter
Automobiles	44	0.719	0.447	0.941	0.124	45.5%	Potential Greenwasher
Metals and Mining	22	0.743	0.621	0.955	0.244	40.9%	Commitment Leader / GW mix
Industrials	227	0.716	0.449	0.943	0.062	36.2%	Mixed
Apparel and Textiles	18	0.694	0.389	0.917	0.089	27.8%	Transparent Performer
Health Care Providers	31	0.708	0.398	0.935	0.138	25.8%	Mixed
Banking & Capital Markets	38	0.596	0.404	0.921	−0.200	0.0%	Quiet Performer

Three sector-level patterns merit emphasis. First, Biotechnology and Pharmaceuticals is the most problematic sector: a mean DQI_noD3 of 0.731 (among the highest across sectors) combines with a mean emission intensity of 0.308 (the highest of any sector) and a greenwashing rate of 65.1 per cent. The pharmaceutical sector's high disclosure quality reflects its global exposure to ESG-conscious capital and BRSR enforcement among mid-cap pharmaceutical firms; its high emission intensity reflects the energy-intensive nature of Active Pharmaceutical Ingredient manufacturing. Second, Banking and Capital Markets stands at the opposite extreme: a mean DQI_noD3 of 0.596 (below the sample median), a mean emission intensity of −0.200, and a greenwashing rate of 0.0 per cent. Service-sector firms achieve lower DQI scores because many implementation and quantitative dimensions are less applicable to their operations. Still, their low emission intensity means that even moderate disclosure quality does not outpace environmental performance. Third, the Sector Agnostic conglomerates have the largest absolute number of greenwashers (95 firms, 48.0 per cent of the sector): large diversified firms face broad legitimacy exposure and invest heavily in disclosure forms across multiple sector reporting templates, but their highest-emitting subsidiaries drive their consolidated emissions intensity.

5.4 Firm-Level Classification

At the firm level, four groups are identifiable from the joint distribution of DQI and CCI: Consistent Leaders (top quartile of both, 147 firms, 19.8 per cent), Consistent Laggards

(bottom quartile of both, 112 firms, 15.1 per cent), High Disclosure Low Commitment firms (89 firms), and High Commitment Low Disclosure firms (41 firms). Among the Consistent Leaders, adding the VDI filter yields 89 firms with strong performance across all three dimensions—roughly 12 per cent of the sample. The most actionable group for policy and investor purposes is the High Disclosure Low Commitment cohort: firms that produce high-quality BRSR reports without having embedded the compliance governance that the CCI measures. For an institutional investor screening on DQI, these firms would appear as sustainability leaders; the CCI would flag the governance gap. This is precisely the type of inconsistency the three-index framework is designed to identify and that a single-index approach would miss.

CHAPTER 6 GREENWASHING ANALYSIS

6.1 Greenwashing Framework and Index

The greenwashing framework developed in this dissertation operationalises the concept of Marquis, Toffel and Zhou (2016) and Delmas and Burbano (2011) as the measurable gap between a firm's disclosure quality (captured by the DQI) and its observed environmental performance (captured by emission intensity). The framework has two components: a continuous Greenwashing Score and the Disclosure-Performance Gap (DPG), and a categorical quadrant classification that assigns each firm with available emission data to one of six descriptive categories.

The continuous DPG is defined as:

$$DPG_i = Z(DQI_i) - Z(-EI_i) \quad ...(6.1)$$

where Z(·) denotes standardisation and the negation of EI ensures that a higher DPG corresponds to a firm that discloses more than its emission performance justifies. A positive DPG identifies potential greenwashers; a negative DPG identifies firms performing better than their disclosure quality suggests (Quiet Performers or Commitment Leaders). In the present sample, the DPG has a mean of 0.230 and a standard deviation of 1.424, ranging from −6.09 to +15.00.

Table 6.1: Greenwashing Index Construction and Six-Category Classification

Category	DQI Quartile	EI Quartile	Description
Genuine Sustainability Leaders	Q3–Q4 (top half)	Q1–Q2 (bottom half)	High disclosure, genuinely low emissions; substantive performers
Transparent Performers	Q2–Q3 (above median)	Q1–Q2 (bottom half)	Good disclosure, below-average emissions
Commitment Leaders	Q1–Q2 (bottom half)	Q1–Q2 (bottom half)	Modest disclosure but genuinely low emitters
Symbolic Reporters	Q3–Q4 (top half)	Q3 (above median)	High disclosure, above-average emissions
Potential Greenwashers	Q3–Q4 (top half)	Q4 (top quartile)	High disclosure, top-quartile emissions
Severe Greenwashers	Q4 (top quartile)	Q4 AND DPG > 2σ	Extreme disclosure-performance gap

6.2 Firm Classification Results

Table 6.2: Greenwashing Classification — All Quadrants (N = 744)

Classification	N	% of 716	Theoretical Interpretation
Greenwasher (High DQI, High EI)	265	37.0%	Legitimacy-driven symbolic disclosure
Substantive (High DQI, Low EI)	149	20.8%	Signalling-consistent genuine performers
Quiet Performer (Low DQI, Low EI)	208	29.1%	Under-reported genuine performance
Laggard (Low DQI, High EI)	94	13.1%	Neither discloses adequately nor performs well
No emission data (unclassified)	28	—	Cannot be classified
Random benchmark (greenwasher %)	—	25.0%	Expected under the independence of DQI and EI

Note: Quadrant assigned by median split on DQI and emission intensity. The Greenwasher quadrant is the High DQI / High EI cell.

Figure 6.1: Greenwashing Quadrant Classification

[2×2 matrix: X-axis = Emission Intensity (Low/High); Y-axis = DQI (Low/High); Q1 (Low EI, High DQI) = Substantive 20.8%; Q2 (High EI, High DQI) = Greenwasher 37.0%; Q3 (Low EI, Low DQI) = Quiet Performer 29.1%; Q4 (High EI, Low DQI) = Laggard 13.1%]

The headline finding is a prevalence of greenwashing of 37.0 per cent, well above the 25 per cent random benchmark. Under a null hypothesis of independence between DQI and emission intensity, the standard error at N = 716 is approximately 1.6 per cent, placing the observed 37.0 per cent more than seven standard errors above the benchmark. The null hypothesis of no systematic greenwashing is overwhelmingly rejected, and Hypothesis H4 is supported.

Only 20.8 per cent of the sample qualifies as Substantive—firms whose high disclosure quality is matched by low emission intensity. Greenwashers outnumber Substantive firms by nearly 1.8-to-1 in a mandatory disclosure regime explicitly designed to make reporting quality the public face of corporate sustainability. The interpretation is not that 37.0 per cent of Indian listed firms are engaged in deliberate deception; rather, that 37.0 per cent produce disclosure quality that systematically outstrips their environmental performance, whether as a consequence of conscious impression management or as an emergent property of a regulatory environment that rewards disclosure form without verifying operational substance.

The largest single category is the Quiet Performers at 29.1 per cent—firms with below-median disclosure quality but also below-median emission intensity. These firms are systematically under-recognised by disclosure-based ESG screening: their environmental performance is genuine, but their reporting infrastructure does not communicate it effectively to capital markets.

6.3 Sector Concentration of Greenwashing

Table 6.3: Sector Composition of Greenwashers

Sector	N (GW)	GW Rate (%)	Mean DPG (GW)	Interpretation
Biotech & Pharmaceuticals	30	65.1%	1.84	High ESG visibility + API emission intensity
Sector Agnostic (Conglomerates)	95	48.0%	1.52	Broad legitimacy exposure; subsidiary emissions
Automobiles	20	45.5%	1.47	Manufacturing emissions: high DQI investment
Metals and Mining	9	40.9%	1.63	Intensive operations; strong regulatory exposure
Telecommunications	8	38.1%	1.29	Network energy intensity; investor ESG focus
Banking & Capital Markets	0	0.0%	N/A	Low emission intensity dominates

The sector concentration pattern reveals a clear regulatory logic: industries with high regulatory exposure, energy-intensive operations, and sophisticated investor relations teams are disproportionately represented among greenwashers. Biotechnology and Pharmaceuticals produce the highest within-sector greenwashing rate (65.1 per cent), reflecting the combination of high DQI scores—pharma firms have substantial sustainability reporting capacity and face growing pressure from ESG-conscious institutional investors—and high emission intensity from API manufacturing, solvent use, and cold-chain logistics.

6.4 Top Greenwashing Firms by Disclosure-Performance Gap

Table 6.4: Top 15 Firms by Disclosure-Performance Gap (DPG)

Firm	Sector	DPG Score	Classification
Seamec Limited	Industrials	15.000	Severe Greenwasher (outlier: low revenue denominator)
Pidilite Industries Ltd	Chemicals	4.812	Severe Greenwasher
Polycab India Ltd	Industrials	4.103	Potential Greenwasher
Tata Steel Ltd	Metals & Mining	3.947	Potential Greenwasher
JSW Steel Ltd	Metals & Mining	3.721	Potential Greenwasher
Godrej Industries Ltd	Sector Agnostic	3.508	Potential Greenwasher
Themis Medicare Ltd	Biotech & Pharma	3.291	Potential Greenwasher
Vinati Organics Ltd	Chemicals	3.084	Potential Greenwasher
Rossari Biotech Ltd	Biotech & Pharma	2.973	Potential Greenwasher
Hindalco Industries Ltd	Metals & Mining	2.826	Potential Greenwasher
Jubilant Foodworks Ltd	Consumer Services	2.614	Potential Greenwasher
Privi Speciality Chemicals	Chemicals	2.498	Potential Greenwasher
Nuvoco Vistas Corporation	Construction Materials	2.461	Potential Greenwasher
Websol Energy System Ltd	Industrials	2.412	Potential Greenwasher
Speciality Chemicals (aggregated)	Chemicals	2.361	Potential Greenwasher

Note: DPG = Z(DQI) − Z(−EI). All 15 firms fall in the Greenwasher (High DQI, High EI) quadrant. The characterisation as potential greenwashers is empirical and statistical; it is not an allegation of deliberate misrepresentation.

Several observations follow. First, the list includes both reputationally prominent large-cap firms (Tata Steel, JSW Steel, Hindalco, Godrej Industries) and smaller speciality firms (Rossari Biotech, Themis Medicare, Vinati Organics, Privi Speciality). The presence of large, resource-intensive groups is expected on legitimacy grounds. These companies face intense regulatory and stakeholder scrutiny and have developed sophisticated sustainability reporting functions. Still, their absolute emission volumes mean that even genuine decarbonisation ambitions produce elevated near-term emission intensity. Second, the speciality chemicals and pharmaceuticals names illustrate the sector-level finding: firms with relatively modest absolute emission volumes but high emission intensity per unit of revenue, combined with high-quality BRSR reports that their sector peers and sustainability consultants have professionalised.

Third, Seamec Limited's extreme DPG of 15.000 is an outlier driven by an exceptionally low revenue denominator rather than a particularly large emissions volume, highlighting the sensitivity of the intensity measure to very low-revenue firms and motivating the use of robust estimation methods.

CHAPTER 7 CONCLUSION AND RECOMMENDATIONS

7.1 Summary of Findings

This dissertation set out to determine whether the quality, commitment, and voluntarism of BRSR-mandated sustainability disclosure among listed Indian companies translate into genuine environmental performance, and to measure the prevalence of greenwashing where they do not. Three original measurement instruments—the Disclosure Quality Index, the Carbon Commitment Index, and the Voluntary Disclosure Index—were constructed, validated, compared, and applied to a sample of 744 de-duplicated firm-year observations across 14 industry sectors. Four principal findings emerge.

First, disclosure quality is positively and significantly associated with emission intensity. Firms with higher DQI scores—better breadth, depth, implementation evidence, and governance credibility in their BRSR filings—exhibit higher emission intensity per unit of revenue, not lower. This result is positive, robust across three estimation methods and two weighting schemes, and statistically significant at the one per cent level. It represents the single most consequential empirical result of the dissertation: the BRSR mandate has improved disclosure quality across the top 1,000 listed firms, but that improvement has not produced the negative disclosure-performance relationship that the signalling-theory argument for mandatory disclosure requires.

Second, carbon commitment is negatively associated with emission intensity when using estimators robust to non-normal residuals. The CCI coefficient of −0.226 under Huber and median regression ($p < 0.001$) indicates that firms with stronger formal climate governance—EIA disclosure, climate risk processes, regulatory conformance—achieve lower emission intensity per unit of revenue. This is the one dimension of corporate sustainability practice that appears to be doing genuine environmental work in the current sample, and it is captured by the CCI rather than the DQI or VDI.

Third, the Voluntary Disclosure Index is flat and non-predictive of emission intensity in all specifications. The VDI's saturation at the mandatory compliance ceiling renders it econometrically uninformative—a structural consequence of the post-BRSR equilibrium rather than a conceptual failure of voluntary disclosure theory.

Fourth, the greenwashing quadrant classification identifies 265 of 716 firms (37.0 per cent) as Greenwashers—above-median disclosure quality combined with above-median emission intensity. This share is materially and statistically above the 25 per cent random benchmark (more than seven standard errors). Greenwashing is not idiosyncratic in this sample; it is a systematic pattern concentrated in Biotechnology and Pharmaceuticals (65.1 per cent of the sector), Sector Agnostic conglomerates (48.0 per cent), and Automobiles (45.5 per cent), and absent from Banking and Capital Markets (0.0 per cent).

7.2 Academic Contributions

The dissertation makes four distinct academic contributions. Methodologically, it introduces the DQI-CCI-VDI triple-index framework as a replicable, theoretically grounded approach to measuring sustainability disclosure in mandatory regimes, using entropy weighting to address the saturation problem. Empirically, it provides the first systematic estimates of disclosure-performance and commitment-performance associations in the post-BRSR Indian market, as well as the first estimate of greenwashing prevalence in this setting. Theoretically, it tests legitimacy, signalling, institutional, and symbolic-disclosure frameworks in direct competition in a fully mandatory emerging-economy regime—a critical-case context that the prior literature has not exploited. In practice, it produces a ranked Greenwashing Index for 716 Indian listed firms that is directly actionable by SEBI, ESG rating agencies, and institutional investors.

7.3 Managerial Implications

For firm management, the results carry a clear message: high disclosure quality, while necessary for regulatory compliance and investor relations, does not substitute for the operational changes that the CCI captures. Firms that have invested heavily in BRSR reporting infrastructure without committing equally to formal climate governance processes—EIA embedding, climate risk integration, regulatory compliance tracking—are exposed to the reputational risk of being detected for greenwashing as the ESG analytics industry matures. The differential return to CCI improvement (negative emission-intensity association of −0.226 per unit) versus DQI improvement (positive emission-intensity association of +1.70 per unit) is an unambiguous managerial signal: investment in operational climate governance, not in

reporting sophistication, is what generates measurable environmental performance in the present data.

7.4 Policy Implications

Three policy implications follow for SEBI and other sustainability regulators. First, mandatory disclosure without independent verification is insufficient. The BRSR regime has raised disclosure volume and quality across the top 1,000 Indian listed firms, but, on the evidence of this study, has not driven measurable improvements in environmental performance. The conventional theory of change—that transparency disciplines behaviour—requires a verification mechanism to complete the accountability loop. SEBI should expand its third-party assurance requirement, currently mandatory only for BRSR Core indicators among the top 150 listed firms, to a broader set of companies and a wider range of indicators.

Second, the BRSR template should be modified to require disclosure of formal climate risk governance processes—the items captured by the CCI—as part of the mandatory reporting floor for all in-scope firms. The CCI is the one dimension that correlates negatively with emission intensity under robust estimation; making CCI-type disclosures mandatory is a direct policy lever for improving the disclosure-performance relationship.

Third, sector-specific disclosure standards would address the heterogeneity that the present uniform framework leaves unresolved. The Biotechnology and Pharmaceuticals sector presents a fundamentally different emission profile from the Banking sector; a one-size-fits-all template produces disclosure that is simultaneously over-engineered for financial firms and under-targeted for process-chemical companies.

7.5 Investor Implications

For institutional investors and ESG rating agencies, the finding that DQI correlates positively with emission intensity ($r = 0.430$) while CCI correlates negatively under robust estimation is a direct challenge to the practice of using disclosure-form measures as proxies for environmental performance. Composite ESG scores that heavily weight disclosure quality without independently verifying performance will systematically overrate the 37.0 per cent of

firms that combine high disclosure quality with high emission intensity. The DPG measure offers a transparent, replicable way to identify these firms: positive-DPG firms warrant additional due diligence before inclusion in ESG-screened portfolios; negative-DPG firms—the Quiet Performers—may be systematically under-recognised by current screening systems.

7.6 Limitations

Five limitations should qualify the interpretation of these results. First, the cross-sectional design precludes causal inference; the positive DQI-emission-intensity association is consistent with the legitimacy-management mechanism but is also consistent with alternative causal interpretations. A panel design with lagged disclosure variables and a quasi-experimental shock to assurance requirements would provide stronger identification. Second, the absence of individual firm-level controls for income, board composition, and energy mix in the reconstructed analytical dataset means that sector fixed effects bear more cross-sectional heterogeneity than in an ideal specification. Third, the CCI's coarseness—four distinct values from three binary items—limits its discriminating power. Fourth, all disclosure data are self-reported under the BRSR template, potentially biasing the DQI-emission-intensity association, in which firms with weaker operational practices also underreport emissions. Fifth, the study covers a single fiscal year, precluding detection of structural change in the disclosure-performance relationship as firms adapt to the BRSR regime over time.

7.7 Future Research Directions

Four natural extensions follow from this work. First, the panel extension: as multiple years of BRSR data accumulate, fixed-effects and dynamic panel estimators can separate between-firm variation from within-firm change, testing whether emission intensity reductions follow DQI score improvements over time. Second, causal identification: the staggered rollout of BRSR Core assurance requirements across market-capitalisation brackets offers a natural experiment to identify the causal effect of verified disclosure on emissions performance. Third, text-based DQI extensions: unstructured narrative text in BRSR principle responses contains an additional disclosure-quality signal that NLP measures of specificity, forward-looking language, and tone could capture. Fourth, market response: whether the stock market prices the greenwashing

signal—negative abnormal returns around BRSR disclosure for firms with high DPG scores—would directly test whether the capital-market discipline mechanism operates in the Indian setting.

59 The dissertation's broader social contribution is to name the gap between corporate sustainability disclosure and environmental performance, provide a measurement framework, and assign a number: 37.0 per cent of the BRSR-reporting sample over-discloses relative to its actual emissions performance. The harder work—translating a high-quality reporting infrastructure into measurable decarbonisation of Indian corporate operations—is the agenda that the next generation of disclosure research, regulatory design, and corporate governance practice must take up.

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APPENDICES

APPENDIX I — Variable Inventory by Role

Variable	Role	Type	Definition / Construction
lnGHG	Dependent (primary)	Continuous	lnGHG = ln(Total GHG Emissions); reconstructed from raw Scope 1+2+3 GHG (tCO2e)
EI	Dependent (primary)	Continuous	Log emission intensity decouples size from environmental performance
DQI_noD3	Main IV	Continuous [0,1]	Equal-weight mean of D1, D2, D4, D5; D3 excluded to prevent circularity
DQI (full)	Descriptive / Greenwashing	Continuous [0,1]	Entropy-weighted composite of all five dimensions (D1–D5)
D1 — Breadth	DQI Dimension	Continuous [0,1]	NGRBC principles coverage (2 indicators)
D2 — Depth	DQI Dimension	Continuous [0,1]	Specificity, narrative depth, energy sub-categories (10 indicators)
D3 — Quantitative Substance	DQI Dimension (excl. from regressor)	Continuous [0,1]	Scope 1/2/3 presence, GHG target, material efficiency (7 indicators)
D4 — Implementation Evidence	DQI Dimension	Continuous [0,1]	Employee, worker, board and KMP training ratios (4 indicators)
D5 — Governance Credibility	DQI Dimension	Continuous [0,1]	Board diversity, board size, EIA and risk disclosure (5 indicators)
CCI	Main IV	Continuous [0,1]	Carbon Commitment Index: mean of cci_eia, cci_risk, cci_regulatory
VDI	Main IV	Continuous [0,1]	Voluntary Disclosure Index: 4-item binary composite
DPG	Greenwashing Measure	Continuous	Z(DQI) − Z(−EI); positive = over-disclosure relative to performance
Greenwashing_Category	Classification	Categorical (6 levels)	Six-category median-split and DPG-threshold classification
SectorFE	Control	14 dummies	Industry sector fixed effects; Industrials = reference category

APPENDIX II — Sample Reconciliation

Step	Count
Raw extraction from the BRSR filing database	851
Less: duplicate entries (95 duplicate CINs)	−95

Less: artefact observations (DQI = 0.0267 pattern)	−11
Less: unresolvable missing identifiers	−1
Analytical sample (one firm per row)	744
Less: missing emission data	−28
Regression sample (all specifications)	**716**