

ESG Performance and Financial Returns in Renewable Energy Firms: Evidence from Indian Markets: Part 2: Research Methodology

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Abstract: This is a basic paper that details the research design adopted to study the connection between ESG (Environmental, Social, and Governmental) performance and monetary results for Renewable energy companies listed in India. Building on the theoretical foundations and systematic literature review presented in Part 1, this study follows up on the aforementioned in a quantitative panel data way using the time span 2014-2023. In the paper, the sample selection method, the data sources, the operationalisation of the variables and the econometric strategy are highlighted. It offers fixed-effects panel regression models, Generalised Method of Moments (GMM), and instrumental variable (IV) methods to deal with endogeneity. Robustness checks are conducted using alternative ESG rating sources, using sub-period analysis, and conducting quantile regression. The design is based on stakeholder theory, resource-based view and legitimacy theory, and it is adjusted to India's institutional framework, such as the SEBI BRSR framework and the Indian target of 500GW of renewable energy by 2030.

Keywords: ESG Ratings; Renewable Energy; India; BRSR Framework

1. Introduction

In this series, Part 1 sets out the theoretical foundations and systematic evidence of the relationship between ESG performance and financial returns in the renewable energy sector in India. It identified the financial performance being the most robust predictor of governance quality, identified the sector-specific effects of the environmental and social dimensions and identified two methodological challenges of the literature: measurement divergence and endogeneity.

In this sequel paper these challenges are addressed through a rigorous empirical research design. The study answers three research questions which are carried forward from Part 1:

1. Is there a relationship between the ESG performance and financial performance (ROA, Tobin's Q, stock return) of Indian renewable energy companies?
2. Which of the ESG dimensions, Environmental, Social or Governance, has the most powerful and sustained impact on financial performance?
3. What is the moderating effect of institutional environment in India with regard to the relationship between ESG and performance, specifically ownership structure, regulatory environment, and firm size?

The rest of this paper follows the structure as below: Section 2 is a definition of research philosophy and approach. The sampling and data collection are described in Section 3. Section 4 operationalises variables. The econometric models are described in section 5. Robustness procedures are described in Section 6. Ethical and limitations issues are discussed in Section 7.

2. Research Philosophy and Design

As the study is anchored in a post-positivist ontological perspective, it acknowledges that the relationship between performance and causality (ESG and financial) is probabilistic and not deterministic. This fits the fact that the effects of ESG are well documented to vary by context of institutional environment and sector outlined in Part 1.

Epistemologically the research has adhered to a modified objectivist position that there are no universal causal laws, but regularities can be discovered by systematic empirical research, with the appropriate control of measurement error and confounding. This approach is in line with the accounting and finance positivistic tradition of quantitative research (Bryman, 2016).

This study uses explanatory and deductive methods of research and aims to simultaneously test the theories on the linkages between ESG and performance with the data panel. The sector is evolving rapidly and a longitudinal panel data structure is therefore preferred over a cross-sectional data since the firm-level heterogeneity can be netted out and temporal changes can be accounted for.

Table 1. Research Hypotheses Derived from Theory (Part 1)

H#	Hypothesis	Theoretical Basis
H1	ESG performance is positively associated with financial returns (ROA, Tobin's Q, stock return) among Indian renewable energy firms.	Stakeholder Theory; RBV
H2	Governance quality exerts a stronger positive effect on financial returns than environmental or social pillars.	Agency Theory; Legitimacy Theory
H3	Environmental performance has a stronger effect on financial returns in more carbon-intensive segments of the renewable energy sector.	RBV; Legitimacy Theory
H4	Firm size and leverage moderate the ESG–financial performance relationship.	Contingency Theory; RBV
H5	The ESG–financial performance relationship strengthened after the SEBI BRSR disclosure mandate (2021).	Legitimacy Theory; Institutional Theory

3. Sample Selection and Data Sources

3.1 Population and Sampling Frame

The target group will consist of all publicly-traded companies in the Bombay Stock Exchange (BSE) and the National Stock Exchange (NSE) in India whose main source of income is obtained through renewable energy-related activities such as solar power production, wind power production, hydropower, bioenergy, and diversified clean energy utilities. Companies that have less than half of their turnover attributed to renewable energy will be excluded in order to maintain homogeneity in the sector.

The first sampling frame was based on the cross-referencing of S&P BSE Energy Index, NSE Sectoral Index (NIFTY Energy, NIFTY50 ESG), SEBI annual listing record, and industry databases such as Bloomberg, Refinitiv Eikon and CMIE Prowess database.

3.2 Inclusion and Exclusion Criteria

A firm needs to meet all of the following requirements to be in the final sample:

- Share price has been continuously listed on BSE or NSE during the entire study period (2014-2023).
- ESG score from at least one of the three rating agencies used in this study (See Section 4.2) for at least five years.
- Audited financial statements for all the ten years from CMIE Prowess or Bloomberg are available.
- In each of the reported years, over half of the revenue comes from renewable energy.
- No mergers, de-mergers or nationalisations that have occurred over the period of study that would have caused structural breaks in the data.

These filters result in a final balanced sample of 62 firms observed over a ten-year period, with 620 firm-year observations. This sample size is large enough to be used for estimation of System GMM and sufficient power for the main regressions at conventional significance levels (power ≥ 0.80 , $\alpha = 0.05$) as confirmed a priori by power analysis using GPower 3.1.

3.3 Data Sources

Data are drawn from multiple independent sources to triangulate measurements and to facilitate robustness checks:

Data Category	Primary Source	Supplementary Source
ESG Scores (Pillar-level)	Refinitiv ESG (formerly Thomson Reuters)	MSCI ESG; Sustainalytics
Financial Statements	CMIE Prowess IQ	Bloomberg Terminal
Stock Price & Market Data	NSE / BSE Official Data	Refinitiv Datastream
Ownership Structure	MCA21 Database (Ministry of Corporate Affairs)	Prowess IQ Shareholding Module
Macroeconomic Controls	RBI Handbook of Statistics on Indian Economy	World Bank Open Data
Regulatory Event Dates	SEBI Official Circulars; MNRE Notifications	PIB Press Releases

4. Variable Operationalisation

4.1 Dependent Variables

Three complementary measures of financial performance are employed to capture different dimensions of firm value creation (Whelan et al., 2021):

- Return on Assets (ROA): Net income divided by total assets. Captures accounting-based profitability and is robust to capital structure differences among firms with varying leverage profiles.
- Tobin's Q: Ratio of market capitalisation plus total debt to total assets (Chung & Pruitt, 1994 approximation). Captures forward-looking market valuation and intangible value associated with ESG reputation.
- Abnormal Stock Return (ASR): Jensen's alpha derived from a four-factor Carhart model estimated annually per firm. Controls for market risk, size, book-to-market, and momentum, yielding ESG-attributable excess returns.

Using multiple dependent variables guards against the metric-dependency findings documented in the meta-analysis by Friede et al. (2015) and cited in Part 1.

4.2 Key Independent Variable: ESG Score

To address the rating divergence highlighted in Part 1, ESG scores are sourced from three agencies: Refinitiv ESG (primary), MSCI ESG (secondary), and Sustainalytics (tertiary). Pillar-level scores (E, S, G) are extracted separately in addition to the composite score.

A composite ESG index is constructed as the standardised mean of the three agency scores after confirming sufficient inter-rater reliability (Krippendorff's $\alpha \geq 0.60$). Sensitivity analyses using each individual agency score separately are reported in the robustness section.

4.3 Control Variables

Control variables are selected based on the prior literature (Table 3) and India-specific institutional factors. All continuous controls are winsorised at the 1st and 99th percentiles to limit the influence of outliers.

Variable	Measurement	Expected Sign	Source
Firm Size	Natural log of total assets	+	CMIE Prowess
Leverage	Total debt / total assets	–	CMIE Prowess
Age	Years since IPO	+/-	BSE Listing Date
R&D Intensity	R&D expenditure / total assets	+	CMIE Prowess
Promoter Holding	% shares held by promoters	+/-	MCA21; Prowess
Institutional Ownership	% shares held by FIIs + DIIs	+	MCA21; Prowess
GDP Growth	Annual real GDP growth rate	+	RBI Handbook
Interest Rate	RBI repo rate (annual average)	–	RBI
BRSR Dummy	1 if year ≥ 2022 , else 0	+	SEBI Circular
Technology Segment	Solar / Wind / Hydro / Bio / Diversified	Varies	Annual Reports

5. Econometric Strategy

5.1 Baseline: Fixed-Effects Panel Regression

The baseline model is a two-way fixed-effects (TWFE) specification that controls for time-invariant firm characteristics (α_i) and common time shocks (γ_t):

$$FP_{it} = \beta_0 + \beta_1 ESG_{it} + \beta_2 X_{it} + \alpha_i + \gamma_t + \epsilon_{it}$$

where FP_{it} denotes the financial performance measure (ROA, Tobin's Q, or ASR) of firm i in year t ; ESG_{it} is the composite ESG score; X_{it} is a vector of firm-level and macroeconomic controls; α_i is the firm fixed effect; γ_t is the year fixed effect; and ϵ_{it} is the idiosyncratic error term. Standard errors are clustered at the firm level to address within-firm serial correlation (Petersen, 2009).

5.2 Addressing Endogeneity: System GMM

The TWFE estimator is susceptible to simultaneity bias, as more profitable firms likely invest more in ESG, and reverse causality from Tobin's Q to ESG is theoretically plausible. To address this, the primary causal

inference strategy is the Arellano-Bond (1991) and Blundell-Bond (1998) two-step System GMM estimator, implemented in Stata 18 using Roodman's (2009) `xtabond2` command.

Instruments for ESGit are constructed as follows: lagged ESG scores in levels are used as instruments in the differenced equation, while lagged differences of ESG scores are used as instruments in the levels equation. The instrument count is constrained to avoid the 'too many instruments' problem (Roodman, 2009), with the instrument matrix collapsed and restricted to lags 2 through 4. Validity of instruments is tested via the Hansen J-statistic (H_0 : instruments exogenous) and the Arellano-Bond AR(2) test (H_0 : no second-order serial correlation in residuals).

5.3 External Instrumental Variable

As a complementary IV strategy, the study uses the MSCI India ESG Leaders Index inclusion status of each firm as an external instrument for ESG score. Inclusion in this index is plausibly exogenous with respect to current-period financial performance (after controlling for prior performance) because the inclusion decision is made by an independent agency using a rules-based scoring system. The relevance condition is tested via the first-stage F-statistic (≥ 10 , Stock & Yogo, 2005), and the exclusion restriction is argued on theoretical grounds and validated via falsification tests.

5.4 Moderation Analysis

To test H4 on the moderating role of firm size and leverage, interaction terms (ESGit $\times$ SIZEit and ESGit $\times$ LEVIt) are included in the System GMM models. Marginal effects of ESG at different levels of the moderator are plotted following Brambor et al. (2006).

5.5 Temporal Dynamics and Structural Break

The post-BRSR intensification of the ESG-performance link is tested by performing a Chow test for structural breaks in 2022 for H5. Furthermore, a time-varying coefficient model estimated using the Kalman filter (see Huang et al., 2020) was used to trace the ESG coefficient for the entire period 2014–2023, which resulted in a more detailed picture of the development of the relationship over the course of the period and its connection to regulatory and market developments.

5.6 Pillar-Level Analysis

Estimated regressions with individual scores for E, S and G to uncover any one of the three drives the overall aggregate performance are used to directly test H2 and H3. The coefficient equality across the pillars is tested for each financial performance equation using the Seemingly Unrelated Regression (SUR) specification.

6. Robustness and Sensitivity Checks

The following robustness checks will be planned in order to stress the main findings:

1. Alternative ESG ratings: All main regressions replicated using MSCI ESG scores only and Sustainalytics scores only to assess sensitivity to rating source.
2. Alternative financial performance measures: Operating Return on Equity (OROE) and Price-to-Book Value (PBV) are used as substitute dependent variables.
3. Sub-period analysis: The full panel is split into pre-BRSR (2014–2021) and post-BRSR (2022–2023) windows. Shorter post-period is acknowledged as a limitation.
4. Placebo test: ESG scores are randomly permuted within the sample 1,000 times, and the distribution of coefficients is compared to the actual estimate to test for spurious significance.
5. Quantile regression: Quantile regressions at the 25th, 50th, and 75th percentiles of the financial performance distribution are estimated to assess whether ESG effects are concentrated in high- or low-performing firms.
6. Removal of outlier years: Observations from 2020 (COVID-19 disruption) are excluded and models re-estimated to assess shock-period sensitivity.
7. Balanced vs. extended panel: A sensitivity check using a balanced sub-panel of the 35 firms with complete ten-year ESG coverage is estimated alongside the main unbalanced panel.

7. Ethical Considerations and Limitations

7.1 Ethical Considerations

The study uses exclusively publicly available secondary data from regulatory filings, licensed commercial databases, and stock exchange disclosures. No human subjects are involved. All commercial data sources are accessed under institutional licenses. Data handling complies with applicable data protection norms and the ethical guidelines of the affiliated institutions.

7.2 Limitations

A few limitations are noted and will be a factor in analyzing the results:

- Despite employing a variety of agencies and composite indexes, the divergence in ESG ratings is an issue that lies beyond the scope of measurement. The primary rater selection may have an impact on results.
- A 50% revenue criterion can be applied to defining renewables in a way that fails to capture some of the diversity within the renewable energy market (in particular to diversified conglomerates with non-dominant renewable energy components).
- To draw causal inference about regulatory effect (H5), the post-BRSR sub-period (2022-2023) has only two years of post-treatment data.
- The IV strategy is based on the exclusion restriction, which may be postulated theoretically but not tested. The results should be understood as evidences of association but not as evidence of causality.
- The sample does not include unlisted renewable energy companies—these companies may be systematically different in terms of their ESG behavior and ownership structure.

8. Conclusion

This paper has provided a detailed and replicable empirical research design to study the ESG-financial performance linkage in the renewable energy sector in India. The design directly tackles the two major methodological issues in Part 1—ESG rating divergence and endogeneity—by using a multi-agency composite ESG index and a dual identification strategy using System GMM and an external instrumental variable. The balanced panel of 62 listed Indian renewable energy companies over the 2014-2023 period offers both time depth and sector-specificity. The study's use of TWFE, System GMM, IV, moderation, and time-varying coefficient analyses provides causal and contextualised insights that are more useful for policymakers, investors, and corporate sustainability officers than the insights from current cross-sectional studies. Part 3 of this series will present empirical results, including full estimation results, robustness checks, and the implications for theory and practice in the Indian renewable energy sector.

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