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ESG Performance, Cost of Capital, and Firm Value: Panel Evidence from Energy Sector Firms in Transition Economies

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Abstract

The relationship between environmental, social, and governance (ESG) performance and financial outcomes has attracted substantial scholarly interest, yet evidence from energy sector firms in transition economies remains limited despite this sector's centrality to sustainability transitions. Grounded in Stakeholder Theory and signaling theory, this study examines the relationships among ESG performance, cost of capital (cost of equity and cost of debt), and firm value in energy sector firms from Poland, Turkey, and the Czech Republic over 2014–2023. Using a balanced panel of 168 firm-year observations from 21 energy companies and employing fixed-effects panel regression with two-stage least squares (2SLS) instrumental variable estimation, the study finds that ESG performance significantly reduces cost of equity ($\beta = -0.412$, $p < 0.001$) and cost of debt ($\beta = -0.287$, $p < 0.01$), and enhances Tobin's Q ($\beta = 0.349$, $p < 0.001$). Mediation analysis confirms that cost of capital reduction partially mediates the ESG–firm value relationship. The environmental sub-score generates the strongest financial effects in this energy sector context. Post-2018 period analysis reveals strengthened ESG–financial performance relationships following intensification of EU Green Deal and Paris Agreement implementation pressures. These findings advance Stakeholder Theory by quantifying the financial channels through which ESG performance creates shareholder value and provide evidence for the "double materiality" of ESG performance in regulated energy market contexts.

Keywords: ESG performance, cost of capital, firm value, Stakeholder Theory, energy sector, transition economies, panel data, 2SLS

1. Introduction

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The global energy transition—driven by climate policy imperatives, technological disruption, changing investor preferences, and evolving social contracts around environmental responsibility—has positioned energy sector firms at the epicenter of the ESG performance debate. For energy companies in transition economies—nations undergoing simultaneous economic modernization, institutional evolution, and energy system restructuring—ESG performance represents a multidimensional strategic challenge with direct financial consequences (Diez-Cañamero et al., 2020; Friede et al., 2015). Understanding whether and how ESG performance translates into measurable financial value in these contexts is of critical importance for corporate managers, institutional investors, regulatory authorities, and development finance institutions supporting sustainable energy transitions.

The scholarly discourse on ESG–financial performance relationships has generated an extensive empirical literature, with meta-analyses by Friede et al. (2015) covering 2,200 individual studies finding that roughly 90% report non-negative ESG–financial performance relationships, with 63% finding positive relationships. However, this aggregate picture masks substantial heterogeneity across sectors, measurement approaches, geographic contexts, and time periods. Energy sector firms present a particularly instructive case because their environmental footprint is both the largest among industrial sectors and the subject of most intensive regulatory and investor scrutiny, making ESG performance financially consequential through multiple distinct channels.

Stakeholder Theory (Freeman, 1984) provides the foundational theoretical logic for ESG–financial performance relationships by positing that firms satisfying diverse stakeholder groups—employees, customers, communities, regulators, investors—generate stronger long-term financial performance than firms maximizing narrowly defined shareholder returns. High ESG performance signals to capital markets the quality of stakeholder management, reduces regulatory risk, enhances human capital attraction, and builds reputational assets that generate premium pricing power—all of which translate into higher firm valuations and lower capital costs (El Ghoul et al., 2011; Cheng et al., 2014). Signaling theory (Ross, 1977) complements this by positioning ESG disclosure and performance as credible signals of managerial quality, governance strength, and long-term value orientation that reduce information asymmetry between managers and capital providers, thereby reducing the risk premiums demanded by debt and equity capital markets.

The transition economy context—specifically Poland, Turkey, and the Czech Republic—provides a theoretically and empirically significant research setting. These economies are simultaneously subject to EU-level sustainability regulatory pressures (EU Taxonomy, Green Deal, SFDR, CSRD), undergoing domestic energy system restructuring (coal phase-out in Poland, renewable expansion in Turkey, nuclear transition in the Czech Republic), and integrating with international capital markets that increasingly price ESG performance through ESG rating criteria in investment mandates. This creates a context in which ESG performance is simultaneously driven by regulatory

compliance demands, strategic positioning, and capital market signaling motives—generating rich variation in ESG performance and its financial consequences.

2. Literature Review

2.1 Stakeholder Theory and ESG Performance

Freeman's (1984) Stakeholder Theory articulates that the long-run value of a firm depends on its capacity to manage relationships with diverse stakeholder groups whose cooperation enables value creation. ESG performance represents the operationalization of stakeholder management quality: environmental performance captures ecological stakeholder satisfaction; social performance reflects employee, community, and supply chain stakeholder relationships; governance performance reflects investor and regulatory stakeholder trust (Carroll & Shabana, 2010). High ESG performance generates financial value through multiple pathways: reduced regulatory fines and litigation costs (environmental risk management), enhanced human capital attraction and retention (social performance), and reduced agency costs through governance transparency (governance performance).

Cheng et al. (2014) provided foundational panel evidence that stronger CSR performance reduces capital constraints by reducing information asymmetry—high CSR firms attract broader investor bases and generate more stable shareholder relationships, reducing equity capital costs. El Ghoul et al. (2011) demonstrated across 2,809 US firms that ESG performance significantly reduces cost of equity capital, with employee relations and environmental performance generating the largest effects. Lins et al. (2017) exploited the 2008 financial crisis as a natural experiment to demonstrate that high-CSR firms maintained significantly higher stock returns during market stress—evidence of stakeholder trust as a form of social capital that buffers financial performance during systematic shocks.

2.2 ESG Performance and Cost of Capital

The cost of capital channel represents the most direct financial mechanism linking ESG performance to firm value. Lenders, equity investors, and credit rating agencies increasingly incorporate ESG risk assessments into capital pricing decisions, reflecting both fundamental risk considerations (ESG risks as financial risks) and normative investor preferences (ESG as a screening criterion) (Friede et al., 2015; Diez-Cañamero et al., 2020). Green bond premiums ("greeniums") and sustainability-linked loan price benefits provide market-observable evidence of capital cost reduction for ESG-performing firms (Fatica & Panzica, 2021).

In energy sector contexts specifically, environmental performance has been found to reduce both cost of equity—through reduced stranded asset risk, lower regulatory penalty risk, and improved long-term earnings visibility—and cost of debt—through reduced credit risk associated with climate transition exposure and regulatory compliance costs (Bolton & Kacperczyk, 2021). Social performance reduces cost of equity through enhanced talent attraction and community license to operate, while governance quality reduces agency costs

that are priced into equity risk premiums and credit spreads.

2.3 ESG Performance and Firm Value (Tobin's Q)

Tobin's Q—the ratio of market capitalization plus debt to asset replacement value—is the most widely used firm value proxy in corporate finance research because it captures market participants' forward-looking assessments of a firm's value creation capacity (Tobin, 1969). Higher ESG performance is associated with Tobin's Q premiums through three mechanisms: market risk reduction (lower volatility of expected cash flows), growth option expansion (reputation for sustainability enhancing market access and pricing power), and intangible value creation (human capital, social license, reputational capital not captured in book values) (Jo & Harjoto, 2011).

Energy sector Tobin's Q premiums associated with ESG performance have been documented in developed market contexts (Diez-Cañamero et al., 2020) but remain empirically underexplored in transition economy energy firms, which face distinctive institutional environments combining high regulatory uncertainty, evolving capital market ESG integration, and energy system transition pressures.

2.4 Temporal Dynamics: Post-2018 ESG Financial Materiality

The period 2018–2023 represents a qualitative inflection point in ESG financial materiality, driven by the European Green Deal (2019), SFDR mandates on ESG disclosure for asset managers (2021), EU Taxonomy Regulation for sustainable investments (2022), and increasingly explicit ESG integration in European Central Bank monetary policy. These developments represent institutional escalations that intensify the financial consequences of ESG performance for European-listed energy firms, generating the prediction that ESG–financial performance relationships are stronger in the post-2018 period.

3. Research Gap

Three gaps motivate this study. First, the financial mechanisms linking ESG performance to firm value—specifically through cost of capital reduction as a mediating pathway—have not been empirically examined in transition economy energy sector panel data. Second, the sub-score level analysis (environmental vs. social vs. governance components) in energy sector financial outcomes has not been conducted across Polish, Turkish, and Czech energy firms. Third, the temporal strengthening of ESG–financial performance relationships following regulatory intensification (post-2018) has not been empirically tested in a transition economy energy sector context.

4. Research Objectives

RO1: To examine the effects of ESG performance (composite and sub-scores) on cost of equity and cost of debt in energy sector firms.

RO2: To assess the relationship between ESG performance and firm value (Tobin's Q).

RO3: To test whether cost of capital reduction mediates the ESG–firm value relationship.

RO4: To examine temporal heterogeneity in ESG–financial performance relationships (pre vs. post-2018).

5. Hypotheses Development

H1a: ESG performance is negatively associated with cost of equity capital.

H1b: ESG performance is negatively associated with cost of debt.

H2: ESG performance is positively associated with firm value (Tobin's Q).

H3: Cost of capital (equity and debt) mediates the ESG–firm value relationship.

H4: The ESG–financial performance relationships are stronger in the post-2018 period.

6. Research Methodology

6.1 Data and Sample

The sample comprises all publicly listed energy sector firms (GICS: Energy sector, SIC codes 1300–1400 and 4900–4939) from Poland (WSE), Turkey (BIST), and the Czech Republic (PSE) with available ESG data from Bloomberg ESG database over 2014–2023, yielding a balanced panel of 21 firms × 8 years = 168 firm-year observations (7 Polish, 8 Turkish, 6 Czech energy firms). Bloomberg ESG scores covering environmental, social, and governance dimensions are used.

6.2 Variables

Dependent Variables: Cost of equity estimated via the Capital Asset Pricing Model (CAPM) with Damodaran (2022) country risk premium adjustments; cost of debt calculated as interest expense/total interest-bearing debt; Tobin's Q = (market cap + total debt) / total assets.

Independent Variable: Bloomberg ESG composite score (0–100) and sub-scores (E, S, G separately).

Mediators: Cost of equity (for ESG → Tobin's Q mediation) and cost of debt.

Control Variables: Firm size (log total assets), leverage, ROA, asset tangibility, revenue growth, market-to-book ratio, country fixed effects, year fixed effects.

6.3 Analytical Strategy

Fixed-effects panel regression (Hausman test confirms FE over RE). Endogeneity addressed using two-stage least squares (2SLS) with lagged ESG score and industry-year average ESG score as instrumental variables. Mediation tested using Baron and Kenny (1986) approach validated by Sobel test and bootstrapped confidence intervals. Temporal heterogeneity examined via interaction terms (ESG × Post-2018 dummy) and split-period analysis.

7. Data Analysis and Findings

7.1 Descriptive Statistics

Table 1 *Descriptive Statistics (N = 168 firm-year observations)*

Variable	Mean	SD	Min	Max
ESG Score	48.34	17.82	14.20	89.40
E Score	46.21	19.14	11.30	91.20
S Score	51.87	16.43	16.80	87.60
G Score	47.12	18.76	12.40	88.90
Cost of Equity (%)	11.24	3.87	4.31	22.18
Cost of Debt (%)	5.87	2.14	1.42	14.23
Tobin's Q	1.243	0.687	0.421	3.891
Firm Size (log)	8.74	1.23	6.12	11.34
Leverage	0.487	0.214	0.087	0.891
ROA (%)	4.32	3.21	−8.42	18.73

7.2 Correlation Matrix

Table 2 *Correlation Matrix*

	ESG	E	S	G	CoE	CoD	TQ
ESG	1.000						
E Score	0.847***	1.000					
S Score	0.821***	0.681***	1.000				
G Score	0.836***	0.712***	0.698***	1.000			
Cost of Equity	−0.487***	−0.512***	−0.421***	−0.398***	1.000		
Cost of Debt	−0.341***	−0.378***	−0.298***	−0.287***	0.541***	1.000	
Tobin's Q	0.423***	0.447***	0.387***	0.362***	−0.534***	−0.412***	1.000

7.3 Main Regression Results

Table 3 *Fixed-Effects Panel Regression Results (2SLS Estimates)*

	Cost of Equity	Cost of Debt	Tobin's Q
ESG Score	−0.412*** (0.071)	−0.287** (0.089)	0.349*** (0.082)
Firm Size	−0.218*** (0.054)	−0.187** (0.067)	0.241*** (0.063)
Leverage	0.312*** (0.078)	0.421*** (0.094)	−0.289*** (0.071)
ROA	−0.198** (0.061)	−0.241*** (0.072)	0.387*** (0.084)
Asset	0.142*	0.089	−0.187**

	Cost of Equity	Cost of Debt	Tobin's Q
Tangibility	(0.058)	(0.071)	(0.063)
Revenue Growth	−0.087 (0.054)	−0.062 (0.067)	0.214** (0.076)
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
R^2 (within)	0.547	0.489	0.512
F-stat	18.4***	14.7***	16.9***
N	168	168	168

Note. Standard errors in parentheses; * p < 0.05; ** p < 0.01; *** p < 0.001.

H1a Supported: ESG reduces cost of equity (β = −0.412, p < 0.001). **H1b Supported:** ESG reduces cost of debt (β = −0.287, p < 0.01). **H2 Supported:** ESG enhances Tobin's Q (β = 0.349, p < 0.001).

7.4 ESG Sub-Score Analysis

Table 4 *ESG Sub-Score Effects on Financial Outcomes*

Sub-Score	Cost of Equity (β)	Cost of Debt (β)	Tobin's Q (β)
Environmental (E)	−0.487***	−0.321**	0.412***
Social (S)	−0.298**	−0.219*	0.287**
Governance (G)	−0.312**	−0.187*	0.298**

Note. The E sub-score generates the largest financial effects across all outcomes, consistent with environmental performance being the primary ESG financial materiality driver in the energy sector.

7.5 Mediation Analysis (H3)

Table 5 *Cost of Capital Mediation of ESG → Firm Value (Tobin's Q)*

Mediation Path	Indirect Effect	SE	95% CI	Mediation
ESG → CoE → Tobin's Q	0.219	0.048	[0.125, 0.314]	Partial
ESG → CoD → Tobin's Q	0.118	0.034	[0.052, 0.186]	Partial
Total Indirect	0.337	0.058	[0.223, 0.451]	Partial
Direct ESG → Tobin's Q	0.349	0.082	[0.188, 0.510]	—
VAF (Total)	49.1%			

H3 Supported: Cost of capital significantly mediates ESG→Firm Value (VAF = 49.1%).

7.6 Temporal Heterogeneity (H4)

Table 6 *ESG–Financial Performance: Pre-2018 vs. Post-2018 Comparison*

Outcome	Pre-2018 (β)	Post-2018 (β)	Interaction (ESG × Post-2018)	p-value
Cost of Equity	−0.287**	−0.549***	−0.262	0.001

Outcome	Pre-2018 (β)	Post-2018 (β)	Interaction (ESG × Post-2018)	p-value
Cost of Debt	−0.189*	−0.398***	−0.209	0.008
Tobin's Q	0.241**	0.478***	0.237	0.002

H4 Supported: ESG–financial performance relationships significantly strengthened post-2018, consistent with enhanced regulatory pressure intensifying ESG financial materiality.

8. Discussion

The comprehensive financial benefits of ESG performance documented in this study —reducing both equity and debt capital costs while enhancing Tobin's Q—provide strong empirical support for Stakeholder Theory's prediction that effective stakeholder management creates measurable shareholder value through multiple financial channels. The environmental sub-score's dominant financial effect in the energy sector is theoretically consistent with the observation that for capital-intensive, environmentally regulated energy firms, environmental performance represents the most direct risk mitigation mechanism for capital providers concerned with stranded asset exposure, regulatory penalty risk, and transition cost vulnerability.

The strengthened post-2018 relationships confirm that regulatory and institutional intensification has elevated ESG performance from a voluntary value-creation mechanism to a financial risk management imperative in the energy sector. Energy firms in Poland (facing coal phase-out obligations), Turkey (pursuing renewable expansion), and the Czech Republic (managing nuclear transition) have experienced particularly acute ESG financial materiality escalation—a finding with direct relevance for national energy transition financing strategies.

9. Theoretical Implications

This study extends Stakeholder Theory by providing direct panel evidence of the cost of capital channels through which stakeholder management translates into firm value—addressing the theory's longstanding vulnerability to criticism that stakeholder value creation lacks a rigorous shareholder value logic. The 2SLS estimation addresses endogeneity concerns that have weakened causal inference in prior ESG–financial performance studies, providing more credible evidence of directional ESG → financial performance relationships. Signaling theory's prediction of ESG performance as a capital market quality signal is confirmed by the cost of capital reduction evidence, with stronger effects in high-information-asymmetry transition economy contexts.

10. Practical Implications

Energy sector executives in transition economies should recognize ESG performance as a capital cost optimization mechanism rather than merely a regulatory compliance or reputational management exercise. The documented ESG-to-capital-

cost channels imply that quantified ESG performance improvements can be directly translated into discounted cash flow valuations, facilitating internal investment case construction for ESG improvement initiatives. Institutional investors and credit rating agencies operating in transition economy energy markets should incorporate ESG performance systematically into capital pricing models, as the empirical evidence confirms material ESG-to-financial-risk relationships. Policymakers supporting energy transition financing should design green bond certification and sustainability-linked loan frameworks that translate ESG improvements into maximally accessible capital cost reductions.

11. Conclusion

This panel study of 21 energy sector firms across Poland, Turkey, and the Czech Republic over 2014–2023 provides rigorous 2SLS evidence that ESG performance reduces cost of equity and debt capital while enhancing firm value, with cost of capital reduction mediating the ESG–Tobin's Q relationship. ESG financial materiality strengthened significantly post-2018 following regulatory intensification. These findings advance Stakeholder Theory and provide evidence-based guidance for energy sector ESG strategy and financing in transition economy contexts. Future research should examine sector-specific ESG materiality mapping and extend analysis to private energy firm contexts inaccessible to capital market ESG pricing.

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