Institutional Factors Influencing ESG Risk in the Energy Services Industry – A cluster approach

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Abstract: Different companies listed on stock exchanges are declaring their non-financial reports alongside their financial statements, aiming to provide more detailed and substantial information on environmental, social, and governance (ESG) issues. Based on this, the risk associated with these three dimensions is also assessed. This paper examines the possible effect of certain institutional factors—such as political, economic, social, educational, and technological aspects—on the ESG risk of companies operating in the energy services industry. The results indicate that some macroeconomic factors of a country, such as legal regulations for employee protection, competitiveness, market concentration of firms, the human development index, and the percentage of GDP spent on research and development, influence the quality of non-financial reporting and ESG risk. This implies that companies operating or headquartered in countries or regions with more favorable institutional factors tend to exhibit a better approach to environmental, social, and governance issues, resulting in lower ESG risk.

Keywords: ESG risk, institutional factor, energy service industry

1 Introduction

In contemporary corporate governance, non-financial reporting has gained prominence as an essential instrument for conveying information on a firm's environmental, social, and governance (ESG) performance. These disclosures serve not only as a transparency mechanism but also as a strategic communication tool for engaging a

broad spectrum of stakeholders, including investors, regulators, and civil society. ESG risk—defined as the potential for adverse effects stemming from a firm's environmental practices, social impact, or governance structures—has become an essential point in evaluating long-term corporate sustainability and resilience.

Global ESG rating agencies have developed standardized frameworks to quantify and compare ESG risk across firms and industries, thereby facilitating informed decision-making in capital markets. For publicly listed entities, compliance with ESG disclosure obligations has transitioned from voluntary reporting to regulatory imperative, especially in jurisdictions with progressive sustainability requirements.

The determinants of ESG risk are multifaceted, encompassing both endogenous variables (e.g., corporate policies, managerial competencies, and internal risk controls) and exogenous influences (e.g., macroeconomic conditions, regulatory frameworks, and societal expectations). Within this analytical duality, institutional factors—such as the strength of legal institutions, enforcement mechanisms, and the prevailing norms governing corporate behavior—have emerged as critical in shaping the ESG risk landscape.

This study explores the extent to which institutional factors influence the ESG risk distribution of firms operating in the energy sector. Given the sector's inherent exposure to environmental externalities, regulatory scrutiny, and socio-economic sensitivity, understanding the institutional underpinnings of ESG risk is imperative for developing effective policy interventions and enhancing corporate accountability.

2 Literature review

2.1 Sustainability and ESG accounting

ESG reporting refers to the systematic disclosure of a firm's performance and practices concerning sustainability dimensions, such as environmental (E), social (S), and governance (G) factors. It aims to enhance transparency and accountability for stakeholders by providing standardized and comparable information on how a company manages non-financial issues that may impact long-term value creation [15]

ESG risk, on the other hand, refers to the exposure of a company to environmental, social, or governance factors that could materially impact its financial performance or reputation. ESG risk ratings, often provided by agencies such as Sustainalytics, MSCI, or Refinitiv, assess how vulnerable a firm is to ESG-related incidents or systemic issues and how well it manages these risks. High ESG risk may indicate poor practices, inadequate governance structures, or failure to address stakeholder concerns, which can result in regulatory penalties, reputational damage, or financial losses.

Although conceptually distinct, ESG reporting and ESG risk are closely interrelated. Transparent and high-quality ESG reporting can contribute to lower ESG risk by signaling robust risk management practices, improving investor confidence, and demonstrating regulatory compliance. Conversely, poor or non-existent ESG disclosures may elevate a firm's perceived ESG risk due to a lack of verifiable information regarding its non-financial performance [32][9].

2.2 Institutional factors and ESG risk

Scholars have consistently emphasized that national institutional environments play a critical role in shaping organizational behavior by establishing the "rules of the game" that influence the efficiency and legitimacy of organizational structures [9]. In the context of sustainability, empirical research has demonstrated that an organization's country or regional origin significantly affects the **adoption** [6][21], **scope** [7][15][32], and **quality** [40] of sustainability reporting practices. These differences are largely attributed to variations in institutional characteristics across countries, including legal and political systems, economic and financial structures, socio-cultural norms, and education and labor systems (see also [15]; [21])

Country-level institutional factors influence the publication of integrated reports[21]. Their findings highlighted the significance of variables such as investor and employment protection laws, the extent of market coordination and ownership concentration, levels of socio-economic development, national corporate responsibility norms, and underlying societal value systems as key determinants of reporting behavior.

Regarding the literature review, the study tents to explore the relationship between institutional factors and ESG risk. The hypotheses are organized around six institutional domains: politics and law, economics and finance, society and culture, technology and innovation, education and labor, and sustainability. The first four categories align with established national institutional frameworks commonly discussed in institutional theory [21] [26]. It further advances with the literature review by integrating two additional institutional domains—technology and innovation, and sustainability—which have been empirically linked to organizational sustainability outcomes [17] [21] [37].

2.2.1 Politics and law

Political and legal systems significantly shape organizational strategies and sustainability outcomes, with the degree of influence varying by legal tradition. In civil law countries, stronger political involvement in economic and accounting matters fosters broader expectations for corporate transparency and stakeholder responsibility [21] [22]. In contrast, common law countries exhibit weaker political influence, leading firms to prioritize shareholder interests over broader stakeholder concerns

[23][24].Thus companies operating in the civil law countries tend to show lower ESG risk comparing with the latest ones.

To examine the link between ESG risk and political-legal systems more thoroughly, the analysis also considers the social and environmental dimensions of legal protection and public policy. The assumption is that in countries where social issues (e.g., labor rights) and environmental concerns (e.g., pollution reduction) are highly prioritized, political and legal frameworks are more likely to enforce robust protections in these areas [20] [21]. Consequently, organizations in such contexts may experience stronger institutional and societal pressure to address sustainability issues, which can enhance both their sustainability performance [1][18][30] and their commitment to sustainability disclosures, minimising ESG risk.

2.2.2 Economics and finance

[21][11] state that sustainability reporting practices are influenced by the level of economic development in an organization's country of origin. Economically advanced countries often exhibit stronger institutional frameworks and greater societal capacity to support sustainability initiatives [19]. As a result, organizations in these contexts are more likely to possess the necessary resources for sustainability efforts [5] and as a result derive lower ESG risk . Therefore, it is hypothesized that higher economic development positively influences the extent of ESG risk.

Furthermore, the authors propose that economic freedom may also influence sustainability reporting. Prior research suggests that, when combined with supportive contextual factors such as a strong national sustainability culture, economic freedom can positively impact a country's overall sustainability performance [35]. In this regard, economic freedom may serve as an enabling condition for enhanced sustainability performance [11] [21], as it can mitigate corruption and foster corporate accountability toward social welfare [5], implicating that higher levels of economic freedom are associated with lower ESG risk.With regard to financial systems, the authors differentiate between market-based and bank-based systems. In market-based systems—characterized by high levels of market coordination—companies rely on a broad base of financial stakeholders [21]. These stakeholders independently assess corporate disclosures and make investment decisions accordingly, incentivizing firms to publicly report on their overall performance, including sustainability efforts, to attract support and maintain legitimacy.

Conversely, in bank-based systems, where market coordination is comparatively lower, banks serve as primary financial intermediaries. Due to their influential role and direct access to corporate information, banks are well-positioned to internally monitor company performance [10]. As a result, firms in bank-based contexts face reduced external pressure to disclose performance data publicly, including sustainability-related information and performance [3], hence tempting to show lower ESG risk score.

2.2.3 Social development

A country's social development plays a critical role in advancing the other two pillars of sustainable development: economic growth and environmental protection [36]. In this context, the study focuses on two key dimensions of social development—human development and civic engagement.

Human development has been empirically linked to positive economic outcomes, reduced levels of corruption, and greater female participation in the labor force [2][38][27]. The higher levels of human development and civic engagement positively influence the extent of SDG reporting, as socially advanced societies are more likely to foster public accountability, inclusive policies, and stakeholder expectations for transparent sustainability performance and as consequence we expect lower ESG risk.

Civic engagement has been consistently linked to sustainability outcomes [13][14] and is even regarded as a fundamental component of sustainability itself [31]. In line with this view, civic engagement is identified as a highly influential factor in determining the level of CSR adoption across countrie[16]. Building on this evidence, it is suggested that civic engagement may also significantly impact the reduction of ESG risk.

2.2.4 Technology and innovation

It is assumed that organizations operating in countries with higher levels of innovation and technological capability possess greater knowledge resources to support the adoption of sustainability practices aligned with the SDGs [21]. Research has shown that R&D efforts are positively associated with CSR activities, as developing sustainable production systems often requires technological innovation [4][17]. Countries with strong innovation performance are also more likely to lead in sustainability-focused technological advancements [28]. As innovation infrastructure and intensity drive the flow of sustainable technologies over time [12][28], firms in such environments may be more inclined to engage in lower ESG risk.

2.2.5 Education and labor

Research in the fields of CSR and business ethics has demonstrated that education significantly shapes individuals' attitudes, perceptions, and expectations regarding responsible business conduct [8][34]. Individuals with higher education levels tend to exhibit deeper understandings of CSR [33]. At the national level, higher education attainment is also positively associated with environmental sustainability[29]. Based on these findings, it is hypothesized a negative relationship between education and ESG risk. It is verified that organizations in countries with greater investment in tertiary education are more likely to engage with emerging research and adopt innovative sustainability management frameworks[21], and as a result this study suggests also lower ESG risk.

With regard to the labour system, the authors affirm that a high density of trade unions within a country is positively associated with greater employee participation in decision-making processes [21]. Based on this, we may argue that enhanced employee involvement and socio-political progress may foster stronger organizational sensitivity toward the Sustainable Development Goals (SDGs) and a better ESG performance and lower ESG risk.

2.2.6 Innovation

Prior research [21][39][22], argue that a country's overall level of corporate responsibility, environmental performance, and sustainable development can significantly influence the sustainability performance of its organizations. This relationship may stem from the impact of national regulations and cultural norms on corporate sustainability practices. Accordingly, the authors assume that higher national standards in these areas are also positively associated with the extent of SDG reporting. At the same time regarding the sector of energy services, the environmental performance of a country can especially put these national standards, which can, at a certain extent impact the ESG risk of the company

3 A Cluster Analysis

3.1 Methodology and dataset

In this study we take the data for the energy sector, extracted from Sustainalytics.com on 20th March 2025, consisting in 93 firms, from 22 various countries, regarding their ESG risk. Instutional factor data is retrieved from the sources as in the table.

Institution	Institutional Factor	Description	Source
Political/law	POL_law	Common/Civil law	La Porta et al. (1998)
	POL_empl	Employee protection	OECD (2022)
	POL_env	Environment protection stringency	OECD (2022)
Economy	ECON_gni	GNI	OECD (2022)
	ECON_HHI	Market Structure HHI	World Bank (2022)
	ECON_Free	Economic Freedom	The heritage Foundation (2022)
Social	SOC_HDI	Human Development Index	United Nations Development Program (2022)
	SOC_civic	Ivic Engagement	OECD (2022)
Technology/Innovation	TECH_RD	Company R&D % of GDP	World Bank (2022)
	TECH_Innov	Innovation Capacity	World Economic Forum (2022)
Education/Labor/ Sustainability	ED_ed	Education level	World Economics
	ED_tertiary	Spendings on tertiary education	OECD
	LAB_TU	Trade Union density	OECD
	SUST_env_perf	Environmental performance	Yale University

Figure 1
Institutional factors

We use the 2 step cluster model, trying to create clusters uring the BIC criterion (**Bayesian Information Criterion)** to evaluate the goodness of fit of the model and to generate the optimal number of clusters. After creating the clusters, we identify the components which vary more between clusters, trying to create a profile for the generated groups. As a last step we test if ESG risk score does significantly differentiate between these clusters.

3.2 Results

The two step cluster model generetes two clusters, with a size ratio of 1,26 (44.3%: 55.7%), in a good model quality. From the modelview we can identify the variables that play the most important role in positioning between the two clusters.

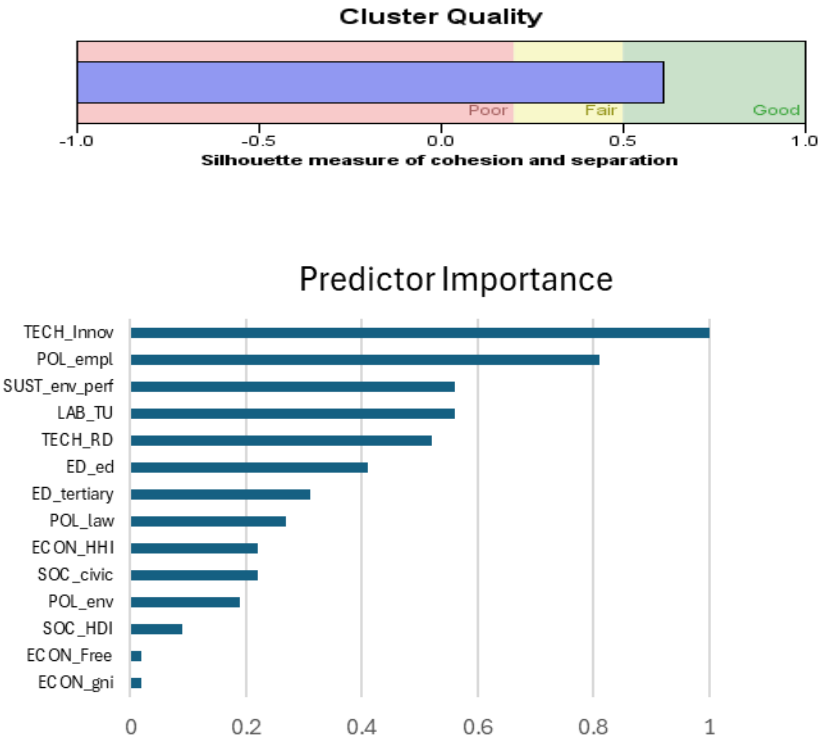

Figure 2

Model quality and predictor importance

The cluster analysis indicates that variables such as innovation capacity, employee protection, environmental performance, trade union density, research and development expenditures, and educational attainment emerge as the most significant predictors distinguishing the two identified clusters. Conversely, economic indicators—including Gross National Income (GNI) per capita, economic freedom, and market structure—exert a comparatively minimal influence on cluster differentiation. Similarly, social dimensions, represented by the Human Development Index (HDI) and civic engagement metrics, do not substantially contribute to the separation between clusters.

Based on the importance of these predictors, the first cluster predominantly comprises companies operating within the energy services sector, situated in countries characterized by a higher capacity for innovation and substantial investments in research and development. These nations also exhibit robust employment protection frameworks, superior environmental sustainability performance, greater trade union density, and elevated levels of educational attainment, including increased spending on tertiary education. Collectively, these factors suggest that the first cluster is defined more by technological, political, environmental, and educational dimensions than by purely economic or social indicators.To assert if the ESG risk score is significantly

lower in cluster one, with the features dimension described above, we apply t-test for independent groups.

Group Descriptives

	Group	N	Mean	SD	SE	Coefficient variation	Mean Rank
ESG_rate	1	31	24.029	6.133	1.102	0.255	35.065
	2	39	28.287	5.378	0.861	0.190	54.449

Independent Samples T-Test

	Test	Statistic	df	p
ESG_rate	Student	-3.092	68	0.001
	Mann-Whitney	346.000		0.001

Figure 3
ESG difference between clusters

Since sig<0.05, we reject the null hypothesis, stating that cluster one has significantly a lower ESG risk score than the second cluster.

Conclusions

Environmental, Social, and Governance (ESG) risk is shaped not only by a firm's internal practices but also by the broader institutional, legal, and socio-economic context of the country in which it operates. National-level characteristics play a crucial role in either mitigating or amplifying ESG-related vulnerabilities.

Legal institutions,such as the rigorosity and enforcement of employee protection regulations, as well as whether a country follows a common or civil law tradition, have significant implications for corporate accountability,thereby influencing ESG performance and lowering ESG risk. Labor and education, including the density of trade unions and the extent of educational attainment across the population, particularly investments in tertiary education, further contribute to uphold responsible business conduct and low ESG risk. In addition, technological and environmental investments notably in research and development (R&D) and in proactive environmental management are essential prerequisites for reducing ESG risk. Firms operating in countries with high innovation capacity and strong environmental

performance metrics tend to be better equipped to align with ESG standards and adapt to sustainability-driven market and regulatory expectations.

Acknowledgement

The authors acknowledge the institutional support provided by University of Shkoder "Luigj Gurakuqi". The insights and resources made available through the institution have been instrumental in the completion of this work.

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