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How Ownership Structure Shapes the Influence Between Esg Disclosure and Financial Performance? The Case of Nickel Industry

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ABSTRACT
This research investigates the impact of ESG disclosures on financial performance, with ownership structure as a moderating factor, in nickel companies. Adopting a quantitative method, the study compares annual and sustainability reports from the last ten years, providing 303 samples from 34 companies in ten countries—Indonesia, China, Japan, Russia, Canada, Norway, Australia, France, Brazil, and Finland—that together account for the world's biggest nickel producers and play a significant role in shaping the global nickel business. ESG performance is measured using 58 indicators from three conventional frameworks—the Global Reporting Initiative (GRI), the Initiative for Responsible Mining Assurance (IRMA), and the International Council on Mining and Metals (ICMM)—with the addition of two other indicators: Chromium Management and Life Cycle Assessment. The unbalanced panel data method is adopted, with content analysis combined with multiple regression analysis using EViews. The results show that governance has influenced ROA, whereas environmental and social aspects have no such effect. Ownership structure has neither direct influence on ROA nor moderating effects on the ESG–ROA relationship. This study suggests an inclusive ESG framework for the nickel industry, offering stakeholders practical recommendations to align operations, regulations, and investments with emerging ESG imperatives, and hence foster regulatory compliance, responsible investment, and sustainable value creation throughout the global nickel value chain.
Keywords: *Environmental, Social and Governance, Ownership Structure, Financial Performance, Nickel, Chromium, Life Cycle Assessment*

1. INTRODUCTION

Energy is a key component in daily life and economic development. In 2019, over 26,000 terawatt-hours (TWh) of electricity were generated worldwide from a mix of fossil fuels, nuclear, and renewable sources such as solar, hydroelectric, and wind power [1]. The transport sector accounts for about 25% of the world's greenhouse gas (GHG) emissions attributed to energy and is the fastest-growing sector in energy demand, thereby making the electrification of vehicles essential in mitigating environmental impacts [2]. Batteries, particularly those used in Hybrid Electric Vehicles (HEVs), Plug-in Hybrid Electric Vehicles (PHEVs), and Battery Electric Vehicles (BEVs), rely heavily on nickel. The worldwide primary production of nickel from mining increased by 10.9% in 2021 and 18.6% in 2022, with an expected increase of a further 16.1% for 2023 [2]. Nickel is key to enabling the UN SDGs, especially in clean energy technologies. Nickel mining is, however, also associated with environmental hazards such as heavy metal pollution of aquatic ecosystems, especially with chromium (Cr) [3]. Mining wastes from industry, metal processing, and battery production may release chromium and nickel into aquatic environments [4].

Environmental, social, and governance (ESG) performance measurement in the mining industry is increasingly using Life Cycle Assessment (LCA) to address greenhouse gas emissions and other impacts from production to disposal, including recycling [5]. LCA also informs ESG analyses through the quantification of GHG emissions and climate change-related impacts [6]. Good ESG performance can decrease information asymmetry and market volatility [7], but empirical findings on ESG performance's link with financial performance are still inconclusive [8] (Reber et al., 2022), in part due to a lack of standardized measurement approaches [10]. This research closes these gaps by using sectoral ESG frameworks—the Global Reporting Initiative (GRI) Mining Sector Standard, the International Council on Mining and Metals (ICMM) principles, and the Initiative for Responsible Mining Assurance (IRMA) criteria—adapted for nickel mining and processing. It also explores the moderating role of ownership form, comparing private companies and state-owned enterprises (SOEs). Focusing on the world's leading

ten nickel-producing nations—Indonesia, China, Japan, Russia, Canada, Norway, Australia, France, Brazil, and Finland [11] —the research examines annual and sustainability reports of 34 principal producers (2014–2024). The study adds a more extensive ESG evaluation framework through the incorporation of two new indicators—chromium management and LCA—providing regulators, investors, and industry stakeholders with a solid instrument to assess performance and assist sustainable finance in the nickel industry.

2. LITERATURE REVIEW

2.1. Mining Sector ESG Standards

In today's increasingly dynamic global market, Environmental, Social, and Governance (ESG) factors have become vital measures for companies involved in nickel mining operations [12]. The factors guide companies towards adopting sustainable practices with an emphasis on social responsibility, mitigation of negative environmental effects, and fair corporate governance. Within the context of nickel mining in particular, the ESG framework serves as a systematic model promoting eco-friendly production, ethical work practices, and open interaction with stakeholders. The criteria set by the Global Reporting Initiative (GRI) for the Mining and Metals Industry provide an in-depth framework that allows companies to measure and report their environmental and social impacts, such as greenhouse gas emissions, energy use, consideration of biodiversity, and community relations [13]. Similarly, although the Initiative for Responsible Mining Assurance (IRMA) and the International Council on Mining and Metals (ICMM) introduced further standards that seek to promote sustainable mining activities, the former mainly focuses on sustainable development, ethical practices, and progress toward climate resilience [14]. IRMA, on the other hand, outlines an exhaustive set of measurement standards related to environmental control, social responsibility, and governance obligations [15].

The scholarly and professional peer literature establishes that compliance with Environmental, Social, and Governance (ESG) standards has evolved from voluntary to a strategic imperative to attain sustainable operation legitimacy, identify investment prospects, and mitigate reputational risks [16]. Investment companies, particularly those dealing with resource-based businesses, are increasingly integrating ESG considerations into their capital-budgeting decisions, hence encouraging mining activities to be in line with widely accepted sustainability metrics [17].

2.2. Global Reporting Initiative (GRI) Mining Sector Standard

KPMG reports that the Global Reporting Initiative (GRI) is recognized as the leading framework for global sustainability reporting. Originally introduced in 2000 and governed by the Global Sustainability Standards Board (GSSB), the GRI framework has evolved as an accepted standard that helps companies prepare ESG performance reports that are concise, consistent, and comparable [18]. The GRI 14: Mining Sector 2024 standard provides sector-specific guidance that applies to entities operating mining activities. It helps companies identify key issues that reflect their most significant economic, environmental, and social implications. The standard emphasizes an impact-based materiality concept that requires companies to evaluate the probability and magnitude of their current and future impacts across their value chains [13]. In a practical sense, it supports mining companies to prioritize disclosures related to issues like water resources management, mine closure plans, human rights due diligence, and community development. Notably, recent updates to the GRI Mining Standard align with global sustainability movements, including increased disclosure on climate change mitigation, just transitions, and conservation of biodiversity. By using GRI's systematic approach, mining companies can increase stakeholder trust, improve comparability between regions, and enable embedding of ESG considerations in their business decision-making [13].

2.3. The International Council on Mining and Metals (ICMM)

The International Council on Mining and Metals (ICMM) is a global leadership group involved in advocating for sustainable development in the mining and metals industry [19]. It operates on a system of 10 principles and 8 position statements that define responsible production practices. The strategic priorities of ICMM include climate and environmental resilience, social performance, transparent governance, and innovation for sustainability. ICMM's corporate governance framework is supplemented by an independent assurance framework that assesses the operational performance of its member companies. The framework includes third party-reviewed and publicly available sustainability reports against professional standards. Transparency fosters accountability and supports comparative

analysis of member companies with the aim of encouraging ongoing improvement in ESG performance [20].

2.4. Initiative for Responsible Mining Assurance (IRMA)

IRMA Responsible Mining Standard was built through a long-drawn process spanning 16 years, involving multiple stakeholders like multinational miners, labor organizations, non-government organizations, governmental institutions, and affected people. Later, these sustainability principles were consolidated into an overarching standard that deals with every stage of the mining lifecycle, from exploration to mineral processing [15]. Recent upgrades to the IRMA standard have also included provisions relating to gender equality, land rights, tailings facility security, and ethical mineral supply chain management. These changes track with the advancement of international best practice in responsible mining, recognizing the importance of stakeholder engagement, environmental risk, and occupational health and safety issues. IRMA certification adoption by mining companies could represent a commitment to high-level international standards and could consequently facilitate market access while enhancing investor confidence [15].

2.5. Chromium and Life Cycle Assessment (LCA)

The environmental sustainability issues related to mining activities are increasingly linked to Life Cycle Assessment (LCA) approaches, which consider environmental impacts during all stages of a product's lifespan [21]. Due to significant resource consumption, together with energy usage, fossil fuel dependency, as well as greenhouse gas emissions and toxic waste, an amplified need for integrating sustainability approaches into mining activities has been triggered [22]. Chromium (Cr) and nickel (Ni) are highly used in many industries, such as electroplating, steel manufacture, tanning activities, and battery manufacturing. However, their extraction and processing lead most importantly to environmental pollution. Both Cr and Ni are listed as hazardous chemicals with inherent carcinogenic and mutagenic effects [3], causing severe threats to ecosystems as well as human health. The current research recommends using chromium concentration as another ESG environmental indicator to examine mine activity's ecological effects.

Furthermore, land use changes triggered by mining activities have significant impacts on soil condition, carbon cycling, hydrologic functions, and ecosystem diversity [23]. Despite these impacts, land use effects are seldom considered within LCA studies associated with mineral commodities [24]. Incorporation of quantitative indicators describing land use change into LCA inventories can potentially advance significantly the completeness of environmental analyses and support better-informed decisions toward sustainable production approaches.

2.6. Company Ownership and Property Rights Theoretical Framework

Theory of property rights focuses on how organizations' ownership and power are defined by those frameworks, especially where they differ between listed and state-owned enterprises [25]. As mentioned by Demsetz, property rights specificity is crucial in terms of stimulating economic efficiency. Well-established and legally binding property rights provide strong motivations for people and companies to make productive use of resources, invest in enhancements, and look for innovations leading to value creation [26]. Property rights company has considerable bearing on resource allocation both within and outside companies. Public shareholders have clear financial incentives to direct resources into their most economically beneficial uses since they immediately benefit from these investments. State-owned enterprises, however, usually face resource allocation controlled by political considerations, bureaucratic processes, or holistic socio-economic objectives that are more than mere economic efficiency [25]. These differences in incentive systems can affect strategic decision-making processes, operational priorities, and investment patterns.

Furthermore, clearly defined property rights encourage organizational leaders to invest in innovative activities by providing the desired stability and encouragement for long-term strategic planning [27]. Such innovation comes from conscious investment in time, financial capital, and managerial time. Empirical evidence illustrates that such innovation significantly improves long-term financial performance, with a greater impact demonstrated at listed companies than at SOEs [7]. Such differences occur because listed companies generally operate in competitively structured market environments where they must exhibit operational efficiency and create value, whereas SOEs might confront obligations where they need to balance financial returns with wider public service imperatives.

2.7. Corporate Financial Performance and ESG Integration

Corporate financial performance serves as an important measure used to evaluate the value impact from investments made in environmental, social, and governance (ESG) activities. Return on assets (ROA) is another widely utilized measure that evaluates how effectively a company deploys assets to create profits [28]. Empirical evidence suggests that high ROA will always boost investors' perceptions and hence drive corporate sustainability initiatives, including investments made toward the United Nations Sustainable Development Goals (SDGs) [29]. Several studies have shown that improved environmental performance, alongside successful implementation of Environmental, Social, and Governance (ESG) practices, leads to positive financial performance in mature as well as emerging economies [30]. A considerable amount of empirical evidence has also found a strong link between ESG variables and financial performance indicators, including Return on Assets (ROA) [31]. Companies that successfully integrate ESG into their considerations often enjoy improved operational effectiveness, reduced risk exposure, and enhanced stakeholders' trust, which together can result in better financial performance.

A company's fiscal health is enhanced when it achieves a high asset turnover ratio, indicating how effectively an entity exploits core assets to create high revenues [32]. In addition to providing information regarding operational efficiency, it is also an indicator reflecting implementation success of strategies for utilizing assets that are aligned with wider corporate sustainability objectives. Therefore, those companies able to align Environmental, Social, and Governance (ESG) responsibilities with higher asset productivity are better placed to enjoy a competitive edge as well as maintain long-term fiscal sustainability.

Hypothesis Development

ESG Performance and Financial Performance

The stakeholder theory suggests that companies have an obligation to exercise responsibility by building strong and transparent communications with stakeholders, who are critical to the company's long-term sustainability [33]. Stakeholders include a broad range of individuals and companies that go beyond shareholders and investors, such as employees, customers, regulatory agencies, and members of society. One popular way to respond to stakeholders' concerns is through the publication of Environmental, Social, and Governance (ESG) disclosures, which demonstrate an company’s commitment to ethical control of its social, environmental, and economic activities. ESG disclosures serve as respected pronouncements that confirm the company's attention to stakeholders' concerns and hence fortify its legitimacy as a company [34]. Effective ESG activities reinforce the company's social license to do business and potentially add to its competitive advantage in the market by demonstrating healthy control and ethical behavior.

Empirical evidence reveals that ESG adoption enhances investor confidence, boosts public reputation, and increases market competitiveness, hence building corporate resilience. According to legitimacy theory, companies that successfully embed ESG values in their operational strategies can develop societal trust, and it helps them fulfill their strategic goals [35]. One popular measure used to evaluate ESG initiatives' financial impacts is return on assets (ROA), calculated as company's ability to transform assets into net income. Additionally, research reveals that ESG initiatives do not create economic costs; instead, they are poised to maximize ROA since they foster efficiency, risk control, and innovation [28]. Therefore, the first hypothesis is stated as follows:

H1: ESG performance positively influences ROA.

Ownership Structure and Financial Performance

Property rights theory emphasizes the importance of ownership structures, both in publicly traded companies and state-owned enterprises, in promoting the distribution of resources, economic efficiency, and institutional integrity [25]. Well-defined property rights allow managers to pursue innovative activities and make long-term investments by giving them confidence regarding the expected returns on investments. Innovations, which may include process improvements or new product introductions, are linked to improvements in sustainable financial performance. Empirical evidence suggests that publicly listed companies are generally more efficient and profitable than state-owned companies, largely attributed to the influence of competitive forces and heightened market discipline [7]. Institutional ownership in publicly listed companies also leads to higher return on assets (ROA) since managerial decisions become more aligned with shareholder interests, thus encouraging substantial operating effectiveness in the short run and strategic coherence in the longer run [36]. Therefore, the second hypothesis is stated as:

H2: Company ownership type positively influences ROA.

The Moderating Impact of Ownership Structure

The ownership structure is hypothesized to have an interactive relationship with both financial and environmental, social, and governance (ESG) performance. Different ownership structures—public and state ownership—are able to drive managerial goals, investment horizons, and stakeholder engagement [37]. In situations where the environmental and social implications are thought to be significant, including for nickel mining activities, the ownership structure can influence the implementation of ESG commitments and the translation of such commitments into quantifiable financial performances. Past studies have shown that agency-like monitoring by institutional investors strengthens the association between ESG performance and financial performance by enhancing control mechanisms, holding decision-makers accountable, and channeling resources toward sustainability initiatives [7][36]. In state-owned enterprises (SOEs), however, conflicting policy purposes can reduce the financial benefits of ESG initiatives. For the capital-intensive and environmentally sensitive nature of nickel production, an interactive relationship between the ownership structure and the impact of ESG performance on financial performance is expected. This interaction is expressed as the third hypothesis:

H3: Company ownership type moderates the relationship between ESG performance and ROA.

3. RESEARCH METHODS

This study adopts a quantitative research design, which is an ordered method often used for data analysis relating to specific populations and samples [38]. Up to 2024, the top global producers of nickel—the world's top producing countries—the United States included—such as Indonesia, China, Japan, Russia, Canada, Norway, Australia, France, Brazil, and Finland—have been reported to significantly influence the global nickel market [11]. From among the countries included in the sampling, researchers considered annual reports and sustainability reports for the past ten years, collecting a complete sample of 303 observations from 34 companies. Annual and sustainability reports provide high-quality, accurate disclosures that align corporate performance with strategic objectives [39].

Tabel 1. Scoring

Quantitative
0 = If the information in the report is not disclosed in accordance with the measurement indicators.
1 = If the disclosure contains at least one word and at most one sentence. A diagram (figure, table, or chart) containing one word is considered a sentence.
2 = If the disclosure contains at least two sentences; this is considered one paragraph.
3 = If the disclosure contains two to three paragraphs.
4 = If the disclosure contains four to five paragraphs.
5 = If the disclosure contains more than five paragraphs.

Source: Gunawan & Abadi (2017)

In order to evaluate the data and information generated from these reports, the current study utilized content analysis methods with scores based on systematic, thorough, transparent, and sufficient guidelines [40]. Coding was done by three research assistants who underwent training in statistical data processing, thus maintaining objectivity through following clear, specific, and standardized coding requirements. The 58 indicators used in this study are derived from the synthesis of three well-established ESG frameworks: the Global Reporting Initiative (GRI), the Initiative for Responsible Mining Assurance (IRMA), and the International Council on Mining and Metals (ICMM). Two new indicators are included in this study, namely Chromium Management and Life Cycle Assessment. The unbalanced panel data approach is applied in this study. Multiple Regression Analysis (MRA) provides the underlying statistical method utilized to analyze the inter-relations between identified variables, preceded by additional standard tests designed to validate assumptions like the normality of residuals, multicollinearity, autocorrelation, and heteroscedasticity inherent in the regression model. Additionally, the analysis incorporates the effects of changing ownership designations (public versus state-owned enterprises) in addition to organizational size changes at the institutional level. This study's conceptual framework is exhibited in Figure 1, where empirical evidence, ESG standards, as well as relevant theoretical views, are embedded.

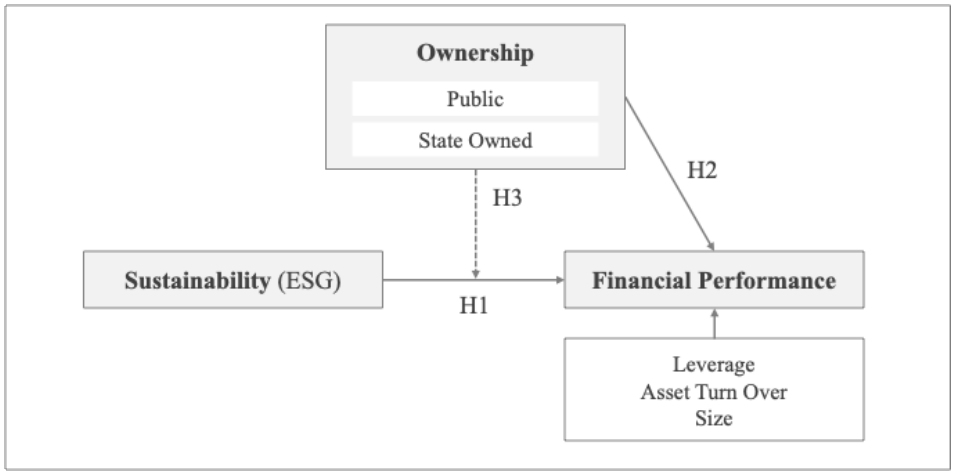

Figure 1. Conceptual Framework

In line with the research objectives and hypotheses, the following mathematical models are employed to analyze the quantitative data:

$ROAit = ß_0 + ß1\ ENV_{it} + ß2\ SOC_{it} + ß3\ GOV_{it} + ß4\ LEV_{it} + ß5\ ATO + ß6\ ENTV + ß7\ PUB + ß8\ SOE + ß9\ ENV*PUB + ß10\ SOC*PUB + ß11\ GOV*PUB + ß12\ ENV*SOE + ß13\ SOC*SOE + ß11\ GOV*SOE$

Note: ROA is Return of Asset; ENV is all environment indicators; SOC is all social indicators; GOV is all governance indicators; LEV is leverage; ATO is asset turn over; ENTV is company size; PUB is public ownership, and SOE is state own enterprise ownership.

4. RESULT AND DISCUSSION

Before carrying out testing of theoretical assumptions, classical assumptions were tested. However, based on the results from model selecting, further testing for classical assumptions turned out to be unnecessary, since the selected model had ended up being the Fixed Effect Model. The coefficient of determination test was carried out in order to determine the degree to which independent variables explain variance in the dependent variable, using the adjusted R^2 statistic as the measuring criterion. The results yielded an adjusted R^2 measure of 0.5180, which denotes that 51.8052% of variance in the dependent variable (ROA) is explained by variations in the independent variables: ESG, Leverage, Asset Turnover, Enterprise Value, Public Share Ownership, SOE Ownership, and the interaction between Public and SOE ownership with regard to ESG categories. On the other hand, the other 48.1948% of variance is due to factors not included within our model. Moreover, an extensive expansion analysis has been carried out to examine how sustainability performance—covering environmental, social, and governance dimensions—affects ROA, given that share ownership (both Public and State-Owned Enterprises) acts as moderating variables. Results from this analysis are tabulated in Table 2.

Table 2. T Testing (Partial Test)

Variable	Model ROA		
	Coefficient	T_{STAT}	Prob.
ENV	0.0784	0.5025	0.3078
SOC	0.0696	0.3421	0.3662
GOV	-0.4942	-2.0955	0.0185*
PUB	0.5062	0.0430	0.4828
SOE	-19.430	-0.8726	0.1918
ENV*PUB	-0.2604	-1.2143	0.2258
SOC*PUB	-0.0327	-0.1146	0.4544
GOV*PUB	0.8517	2.7250	*0.0039***
ENV*SOE	-0.2158	-0.4707	0.3691
SOC*SOE	-0.0441	-0.0705	0.4719
GOV*SOE	0.6283	1.0385	0.1500
LEV	-0.9030	-0.7169	0.2870
ATO	409.079	83.867	0.0000
ENTV	-0.0008	-0.3445	0.3653

*Significant influence with the p-value of the < statistics of 0.05; **=alpha 10%; =alpha 5%
Source: Processed Data (2025)

The findings in Table 2 show, as tested using the ROA model, that environmental, social, and governance aspects related to ESG performance do not have an independent significant positive impact on ROA. However, public equity ownership showed a moderating relationship with the positive link with ESG performance, in particular, at the level of the governance category, whereas no moderating effect occurred at the level of environmental or social categories. On the contrary, ownership via shares in state enterprises did not show any moderating effect regarding the link between ESG performance in all categories and ROA.

H1: ESG performance influences ROA performance.

Governance influence ROA, while environmental and social factors do not. Good governance strengthens supervision, decreases agency costs, bolsters risk-management, and accelerates correction, leading to strong ROA [41]. Board accountability, transparency, controls, and power for shareholders, as identified by 2023 G20/OECD Principles, are critical to corporate performance, and especially to companies seeking to raise capital [42]. Positive correlations between governance features (e.g., board performance, quality of audit, ownership structure) and profit levels, highlighting governance's relevance to short-term financial performance [43]. Social and environmental concerns usually fail to correlate with ROA owing to regulation cash-flow lags. Environmental and social factors have limited effect on performance, provided governance is accounted for, indicating timing and institutions mediate short-term reactions . A panel analysis also finds no considerable connection between ROA and ESG, confirming earlier findings on weak environmental and social influences on returns [44]. The research also propose financial performance is connected to governance, yet environmental and social influences are inconsistent and affect long-run outcomes or market statistics, not ROA. In conclusion, results align with the literature: governance elevates short-run productivity and ROA, and environmental and social spending produces value and reduces risk and produces payoffs later on or under favorable policies.

H2: Company ownership influences ROA performance.

Table 4.9 shows that public and state-owned enterprise ownership have no impact on ROA. This is because, in the 2023–2025 period, the global nickel market was dominated by macroeconomic forces that drove profitability across all ownership types, supporting a statistically significant difference in ROA between public and state-owned enterprises. The rapid surge in nickel supply created a sustained surplus and pushed benchmark prices down to multi-year lows, eroding margins across the industry regardless of governance model. Production growth outpaced nickel demand, resulting in price formation, so ownership factors did not influence ROA drivers during this period. At the same time, structural conditions such as the steepening of the low-grade nickel production cost curve, reduced battery demand, and tight capital discipline limited potential ROA returns. Global perspectives from energy transition studies and multilateral institutions highlight that nickel prices are likely to decline further due to increasing supply, while demand growth from stainless steel and electric vehicles has not been strong enough to support consistent profitability. These challenges reduce the likelihood that input from public or state-owned enterprises sector stability can significantly improve ROA over time; instead, vulnerability to oversupply and price pressures remain dominant factors.

H3: Company ownership moderates the influence of ESG performance on ROA performance.

Table 2 shows that public equity ownership as a moderation variable has not been shown to affect the relationship between ESG performance and financial performance of ROA. This can happen because the nature of the nickel sector makes external influences (e.g., export bans or global campaigns) rather than corporate ownership structures the cornerstone of ESG implementation [45]. The lack of integration of effective ESG practices through public stakeholders, especially extractive ones, is an additional reason that concentrated ownership, or public governance fails to result in significant improvements in ESG outcomes. In contrast, within developing countries, the implementation of ESG strategies may enhance corporate reputation and positively influence stakeholder perceptions yet may not translate into immediate improvements in financial performance, such as those reflected ROA [46]. This can happen because ESG performance is considered not always in accordance with the main operational Key Performance Indicators that affect the incentives of the board of directors, and the interests of shareholders, thus limiting ESG commitment in driving increased profitability despite the situation of extensive public control [47] [48].

The ownership of shares of state-owned companies also does not have a moderation influence on the positive impact of Environmental, Social, and Governance factors on ROA contrary to the general expectation that government ownership will automatically result in improved corporate ESG performance. SOEs tend to be associated with higher regulatory compliance and a focus on the public interest, the findings of the study suggest that state ownership is not necessarily associated with increased financial contribution of ESG practices [49]. One reason is that ESG performance may have a standalone contribution to better financial performance that is not tied to ownership structures. Through cost efficiency, risk reduction, and brand reputation, companies that handle ESG aspects well are likely to enjoy operational benefits such as improved resource allocation and minimized compliance risks, which automatically increase ROA without the assistance or intervention of state shareholders [50]. ESG performance trends in developing countries are still in their early stages for most SOEs with a level of transparency, and consistency [51] [50]. Therefore, while SOE ownership is crucial to setting the national economic agenda, its impact as a moderator of ESG's contribution to financial performance seems irrelevant, reaffirming the primacy of ESG integration at the corporate level over the structural issue of ownership.

5. CONCLUSION

The integration of empirical evidence garnered from the three hypotheses in question presents a more sophisticated understanding of the interaction between ESG performance, ownership structure and financial outcomes within the nickel industry. Evidence suggests that the governance aspect represents the most critical ESG element in determining ROA, with practices such as board accountability, transparency, and shareholder empowerment playing key roles in increasing managerial control, reducing agency costs, enforcing risk management frameworks, and triggering corrective actions. These findings provide further strength to existing literature emphasizing the quality of governance and increased operational efficiency and profitability. Conversely, environmental and social aspects do not show any statistically significant correlation with ROA, a factor that may reflect delayed sustainability-oriented investments generating financial returns, combined with the mediating role of institutional and regulatory frameworks. The second hypothesis, aimed at examining the impact of ownership type upon ROA, shows no significant differences between public enterprises and state-owned enterprises; this result corresponds with the prevailing influence of external market conditions, particularly chronic oversupply, subdued benchmark prices, and structural cost pressures, all of which exert similar downward pressures on ROA across different ownership categories.

Moreover, the third hypothesis illustrates that ownership is not a moderating variable within the ESG–ROA interface. For the nickel industry, the role of external regulatory actions, the limited integration of ESG goals into ownership-centric governance frameworks, and the misalignment between ESG goals and critical operating performance measures reduce any potential for amplification. Despite the common linkage of state ownership with intensified compliance standards and obligations concerned with public interest, the findings suggest that such ownership does not necessarily translate into strengthening the financial effectiveness of ESG practices. On the other hand, findings highlight the significance of strong corporate governance on the corporate level and compatibility of ESG efforts as critical short-term financial performance determinants regardless of ownership structures. Such findings complement the literature by explaining certain sector-level factors limiting the proximate financial impact of environmental and social efforts, highlighting strategic significance of governance on volatile commodity sectors, and explaining the minimal mediating effect of ownership structures on scenarios defined by emerging markets.

This research advances a sector-specific sustainability performance measurement framework for the nickel value chain, enabling corporate actors, policymakers, standard-setting bodies, and investors to operationalize governance mechanisms that integrate environmental stewardship, social equity, and economic resilience imperatives. By enhancing regulatory coherence, refining sustainability reporting architectures, and informing capital deployment toward low-carbon and socially inclusive outcomes, the framework strengthens adaptive capacity, mitigates ESG-related systemic risks, and catalyzes sustainable resource governance in a globally competitive market context. Further research can add Free, Prior, and Informed Consent (FPIC) Analysis Indicators. FPIC is one of the social indicators widely disclosed in last 3 years sustainability reports because it emphasizes its importance in stakeholder engagement and social license in the nickel industry. Further research also could also utilize alternative data sources to

accommodate nickel companies that do not yet have standardized sustainability reports. These data sources could include websites, presentation books, Twitter, ESG narratives, or third-party archives.

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