THE EFFECT OF TANGIBLE ASSETS AND GREEN INTELLECTUAL CAPITAL ON PROFITABILITY: THE MEDIATING ROLE OF ESG PERFORMANCE (STUDY ON GO PUBLIC COMPANIES IN INDONESIA)

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Abstract**:** *Integrating sustainable practices into business strategies is essential for enhancing economic performance and mitigating environmental impacts. In Indonesia, where economic growth and environmental sustainability are critical, this study examines the impact of tangible assets (TA) and green intellectual capital (GIC) on the profitability of publicly listed companies. The research investigates how tangible assets and green intellectual capital influence company profitability through the mediating role of ESG (Environmental, Social, Governance) performance. The study uses a dataset of 363 observations from 122 companies listed on the Indonesia Stock Exchange from 2020 to 2023. Path analysis is employed using RStudio to examine the relationships between tangible assets, green intellectual capital, ESG performance, and profitability (measured by ROA). The findings reveal a significant positive relationship between tangible assets and ESG performance, indicating that companies with substantial tangible assets are better equipped to implement sustainable practices. However, GIC does not show a significant direct impact on ESG performance or profitability (ROA). The mediation analysis underscores the critical role of ESG performance in enhancing profitability, demonstrating a significant positive effect on ROA. This suggests that ESG practices are essential in translating tangible and intellectual resources into financial gains. Despite the non-significant direct effects of GIC, its contribution through improved ESG performance highlights the importance of integrating green intellectual capital into corporate strategies for long-term profitability and sustainability. These findings offer valuable insights for corporate managers and policymakers, emphasizing the need for investments in tangible assets and green intellectual capital to foster sustainable practices and improve financial outcomes. The research underscores the importance for companies to focus on corporate social responsibility, environmental, and governance practices. Implementing ESG concepts helps companies build a good reputation, attract investors, achieve operational efficiency, and ensure long-term sustainability. This study supports the implementation of robust ESG frameworks to achieve both economic and environmental goals.*

Keywords: Tangible Assets, Green Intellectual Capital, ESG Performance, Profitability

1. Introduction

In recent years, the integration of the Sustainable Development Goals (SDGs) into corporate strategies has emerged as a significant focus for businesses around the globe, including in developing countries such as Indonesia. The SDGs, established by the United Nations, represent a comprehensive agenda to address global challenges such as poverty, inequality, climate change, environmental degradation, peace, and justice by 2030 (United Nations Development Programme, 2024; Kleinfox, 2024). While alignment with the SDGs offers significant opportunities for businesses, including market differentiation, improved supply chain resilience, and increased investor interest, it also poses major challenges that can affect profitability (Garcia, 2024; Zuniga, 2024).

In Indonesia, there is a growing recognition among companies of the importance of sustainable business practices as a means of enhancing profitability. A report by McKinsey indicates that Indonesia is developing multifaceted strategies to support the renewable energy sector and improve the investment environment for sustainability (Agarwal, Balasubramanian, Ashwin, Dischа, & Tan, 2024). Furthermore, the PwC report indicates that companies in Indonesia are increasingly adopting sustainable finance practices, driven by the growing demand from investors and the SDGs goals (PwC Indonesia and Oxford Business Group, 2023). As reported by PwC Indonesia and Oxford Business Group, there are ongoing efforts to integrate sustainable finance into Indonesia's growth plans. This includes the issuance of the region's first SDG-linked bonds in September 2021, which were used to finance projects that address environmental challenges and promote socio-economic development (PwC Indonesia and Oxford Business Group, 2023).

In Indonesia, the emphasis on the environmental dimension of the SDGs has prompted a re-examination of the issue of climate injustice. Climate injustice refers to the disproportionate impacts of climate change on vulnerable and low-income communities that often contribute the least to carbon emissions yet are most affected by its effects. For instance, companies in Indonesia engaged in the renewable energy sector should contemplate the social and environmental consequences of their operations to guarantee that their eco-friendly initiatives are not only financially lucrative but also just and inclusive (Garcia, 2024). The implementation of green technologies and investment in renewable energy often necessitates a significant capital outlay, which represents a significant burden for small and medium-sized enterprises. Nevertheless, with the implementation of supportive government policies and financial incentives, such as the issuance of SDG-related bonds, companies can overcome the financial barriers that impede their ability to contribute to climate change mitigation (PwC Indonesia and Oxford Business Group, 2023).

The integration of the Sustainable Development Goals (SDGs) into business operations presents a number of challenges, particularly in relation to the high costs associated with the implementation of green technologies. These include renewable energy, energy management systems and waste handling technologies, which require substantial capital investment and may result in a reduction of short-term profitability margins (Agarwal, Balasubramanian, Ashwin, Dischа, & Tan, 2024). Companies in Indonesia that invest in solar panels or biomass technology face significant start-up costs before they can expect to see a return on their investment. The phenomenon of greenwashing, whereby companies claim to engage in sustainable practices without any tangible evidence of such actions, can have a detrimental impact on a company's reputation and investor and consumer confidence. This can result in a decline in share value and a loss of market trust (PWC Indonesia, 2023). Furthermore, the implementation of increasingly stringent environmental regulations has compelled businesses

to allocate a greater proportion of their resources towards compliance, including waste management, emission reduction, and environmental certification. This has led to an increase in compliance-related operating costs. In Indonesia, the implementation of policies such as PROPER (Program Penilaian Peringkat Kinerja Perusahaan dalam Pengelolaan Lingkungan Hidup) serves to encourage companies to enhance their environmental performance. However, this also results in an increase in compliance-related operating costs (IBCSD, 2023).

While the integration of environmental pillars in business strategy can offer long-term benefits, the associated costs and operational challenges can affect a company's profitability in the short term. Consequently, it is of paramount importance for companies to develop a comprehensive and balanced strategy that takes into account both the long-term benefits of sustainability and the short-term financial challenges that may be encountered.

Tangible assets represent a significant aspect of business operations. It is anticipated that tangible assets will generate future economic benefits and contribute to the realization of cash flows from investing activities, either directly or indirectly (Floștoiu & Milandru, 2020). The optimal utilization of fixed assets can facilitate a more rapid turnover and enhance the productivity and profitability of the company (Aleksandrova et al., 2022). Tangible assets, such as property, plant, and equipment, facilitate operational efficiencies that can reduce environmental impacts through more effective management of energy and raw material use (Tamulevičienė & Mackevičius, 2019). Furthermore, tangible assets may be utilized as collateral to facilitate the financing of sustainable projects through investments in green technology and other sustainability initiatives (Bellavite Pellegrini et al., 2019). The transparent disclosure of information regarding tangible assets can also enhance stakeholder confidence (Buallay, 2019). Empirical evidence indicates a robust positive correlation between tangible assets and financial performance, as measured by return on assets (ROA). The prudent investment of capital in fixed assets can enhance the productivity and profitability of the company (Varghese, 2023).

Green Intellectual Capital (GIC) plays a significant role in advancing green innovation and enhancing corporate environmental performance. GIC is defined as a collection of intellectual assets related to an organization's knowledge and ability to manage environmental issues. Organizational training programs and workshops can be utilized to enhance employees' awareness and understanding of green practices (Ullah Khan et al., 2021). GIC provides assistance to organizations in creating environmentally friendly product and process innovations (Ali et al., 2021). It is recommended that a structured environmental management system, such as ISO 14001, be implemented to ensure that company operations comply with environmental standards (D. Liu et al., 2022). Collaboration with non-governmental organizations (NGOs) and local communities should be undertaken for the implementation of environmental projects such as reforestation and environmental cleanup (Yusoff et al., 2019). By implementing environmentally focused human, structural, and relational resource management strategies, GIC can enhance the efficiency with which resources are utilized and mitigate the negative environmental impacts associated with its operations (Ullah Khan et al., 2021). A study conducted in Indonesia revealed that the integration of green banking and GIC components, such as human capital efficiency and capital employed efficiency, has a considerable, positive impact on a bank's Return on Assets (ROA) (Wongso et al., 2023). In the manufacturing sector, especially in Pakistan, green human capital and green structural capital increase the adoption of green innovations that can ultimately support firm profitability (Ali et al., 2021).

While previous research has examined the respective roles and relationships of tangible assets (TA) and green intellectual capital (GIC) on profitability, there remain some unaddressed

gaps in the literature. It is crucial to cultivate both tangible and intangible resources in order to achieve optimal green process innovation performance (Jirakraisiri et al., 2021). The majority of research has investigated the impact of Green Intellectual Capital (GIC) on the sustainable performance of firms (Sauid et al., 2023). Nevertheless, research that integrates the role of tangible assets with that of GICs in achieving the SDGs remains scarce.

Further research is necessary to elucidate the manner in which tangible assets can be employed in conjunction with GICs to enhance profitability and achieve sustainability objectives. The majority of studies concentrate on the long-term impact. Nevertheless, further research is required to investigate the immediate impact of investments in GICs and tangible assets on profitability and ESG scores. The significance of ICs for profitability, both before and during the pandemic, has been well documented. However, the short-term impact of such investments still requires further investigation (Hoi Hin & Liu, 2023; Yen et al., 2023; Zavyalova et al., 2023).

Empirical evidence indicates a robust positive correlation between tangible assets and financial performance, as measured by return on assets (ROA). The effective investment in fixed assets has the potential to enhance the productivity and profitability of the company (Shastry & Rao, 2023). Nevertheless, it is not always the case that non-current assets (including tangible assets) have a positive impact on firm profitability. This study identifies that differences in asset measurement and valuation can affect profitability ratios in complex and not always favorable ways (Uriawan & Permana, 2023). The banking sector in Indonesia demonstrates that intellectual capital exerts a positive influence on ROA, whereas tangible assets exert no significant effect on banking profitability (Shabilah et al., 2023). Furthermore, the GIC component has a significant positive effect on bank return on assets (ROA) (Wongso et al., 2023). Conversely, the GIC index has no significant effect on the company's financial performance as measured by ROA (Amijaya & Alaika, 2023). This discrepancy may be attributed to an imbalanced investment in the elements of intellectual capital (Sapiri & Putra, 2023).

It is therefore necessary to explore the mediating role of ESG (Environmental, Social, and Governance) performance scores between the relationship of tangible assets (TA) and green intellectual capital (GIC) to profitability. ESG performance scores can serve as an indicator of a company's commitment to sustainable business practices and can add significant value in the short and long term. This mediating variable is significant because it can elucidate the manner in which investments in tangible assets (TA) and green intellectual capital (GIC) can be translated into increased profitability through improved environmental, social, and governance (ESG) performance. Research incorporating ESG performance scores as a mediating variable will provide more comprehensive insights into how firms can achieve enhanced financial performance while meeting sustainability goals. In this case, green innovation can serve as a mediator between ESG practices and financial performance. This can be the basis for further research that combines TA and GIC with ESG performance scores to improve corporate profitability (Chouaibi et al., 2022). Furthermore, certain components of GIC that have a significant positive effect on ROA can serve as an additional reference point in understanding the manner in which GIC contributes to corporate profitability through the ESG pathway (Wongso et al., 2023).

The objective of this research is to examine the characteristics and performance of companies in Indonesia. In the context of sustainable performance, companies in Indonesia play an important role for several reasons related to economic, environmental, and social conditions. In terms of economic conditions, the industrial sector and large companies make a substantial contribution to the country's gross domestic product (GDP). As indicated by data

from the Badan Pusat Statistik (BPS), the manufacturing sector constituted approximately 19% of Indonesia's gross domestic product (GDP) in 2021. The capacity of large companies in this sector to implement sustainable business practices is significant, as it can affect the country's economic and environmental performance (Badan Pusat Statistik, 2023). According to a Greenpeace report from 2022, Indonesia is one of the countries with the highest deforestation rates in the world (Greenpeace, 2018). Additionally, air pollution in major cities such as Jakarta frequently exceeds the safe limits set by the WHO (Greenpeace indonesia, 2021). The industrial and mining sectors exert a profound influence on the environment, underscoring the imperative for the implementation of sustainable practices to mitigate the adverse effects of such activities. Moreover, Presidential Regulation No. 77 of 2019 on Sustainable Management of Energy and Natural Resources and Presidential Instruction No. 6 of 2019 on the National Action Plan for Air Pollution Abatement. It is therefore incumbent upon companies operating in Indonesia to comply with these regulations, which serves to reinforce the importance of their role in sustainable performance (Indonesia, Peraturan Presiden (Perpres) Nomor 63 Tahun 2024 , 2024; Indonesia, Instruksi Presiden (INPRES) Nomor 6 Tahun 2019 , 2019). In a related study by WWF and Nielsen, it was found that 63% of Indonesian respondents expressed willingness to pay more for environmentally sound products, despite the price being a major barrier to adopting an eco-friendly lifestyle (WWF, 2017).

This study aims to identify and analyze the ways in which tangible assets and green intellectual capital can work synergistically to increase corporate profitability, with the mediation of ESG performance scores. The benefit of this research is to provide a more comprehensive understanding of the integration strategy of tangible assets (TA) and green intellectual capital (GIC) to achieve sustainability and profitability goals. In addition, this research is expected to assist companies in developing more effective and sustainable business policies and practices, as well as increasing transparency and trust from stakeholders.

2. Literature Review

This literature review examines the interrelationships between tangible assets and green intellectual capital (GIC) and their influence on firm profitability. The review examines the role of Environmental, Social, and Governance (ESG) performance as a mediator in this relationship, with the objective of contributing to the achievement of the Sustainable Development Goals (SDGs). The study is based on the Resource-Based View (RBV) and Triple Bottom Line (TBL) theories, with particular emphasis on the environmental pillar and climate injustice issues.

The RBV theory posits that a firm's resources and capabilities are pivotal to attaining a sustainable competitive advantage (Barney, 1991). In this framework, tangible assets, such as physical infrastructure, technology, and financial resources, are of paramount importance. Empirical evidence indicates that these assets are instrumental in enhancing operational efficiency and profitability (Penrose, 1995).

GIC is defined as the knowledge, capabilities, and practices related to environmental sustainability within an organization. It encompasses green human capital, green relational capital, and green structural capital. The extant literature indicates that GIC enhances innovation and efficiency, which in turn leads to improved environmental performance and profitability (Y. S. Chen, 2008). The integration of GICs with tangible assets generates synergies that enhance a firm's capacity to implement sustainable practices and innovate.

The TBL framework builds upon the traditional reporting framework by incorporating social, environmental, and financial performance (Elkington, 1997). ESG performance

represents a practical application of TBL, whereby companies are evaluated according to their environmental impact, social responsibility, and governance practices. A high ESG performance is associated with superior risk management, enhanced reputation, and long-term profitability (Eccles et al., 2014).

The environmental aspect of ESG performance is of paramount importance in addressing climate injustice. The term "climate injustice" is used to describe the unequal burden of environmental degradation and climate change impacts on marginalized communities. The implementation of robust environmental practices by corporations can facilitate a reduction in their carbon footprint, encourage the utilization of sustainable resources, and mitigate the adverse effects on vulnerable populations (Bullard & Johnson, 2000).

The integration of tangible assets and GICs has been demonstrated to result in enhanced ESG performance, which in turn has been shown to lead to increased profitability. These synergies enable firms to develop sustainable innovations, improve operational efficiency, and meet regulatory requirements, resulting in cost savings and increased revenues (Hart, 1995). Empirical studies have demonstrated that firms that invest in tangible and intellectual green resources exhibit superior performance compared to firms that do not (Chang & Chen, 2012).

The relationship between tangible assets, GIC, and profitability is mediated by ESG performance, which ensures the effective implementation and monitoring of sustainability practices. A high ESG performance reflects a firm's commitment to sustainability, which can attract investors, reduce risk, and improve financial results (Friede et al., 2015).

2.1 Hypothesis

Recent research indicates that tangible assets such as physical infrastructure and technology play a crucial role in enhancing a company's ESG performance. The presence of advanced technology and robust physical infrastructure can significantly improve a company's ability to implement effective environmental practices, leading to better ESG scores (Serrano, 2023; Xu et al., 2021).

H1. Tangible Assets Positively Influence ESG Performance

High ESG performance is often associated with improved risk management, enhanced reputation, and greater investor attraction, which in turn lead to better financial performance. Companies with strong ESG practices are more likely to achieve sustainable profitability (Broadstock et al., 2020; Eccles et al., 2014; Friede et al., 2015; D. Zhang & Liu, 2022).

H2. ESG Performance Positively Influences Profitability

The integration of tangible assets with ESG practices leads to improved operational efficiencies and innovative capabilities, resulting in cost savings and increased revenues. Therefore, tangible assets indirectly boost profitability by enhancing ESG performance (Hart, 1995; G. Zhou et al., 2022).

H3. Tangible Assets Positively Influence Profitability through ESG Performance

Tangible assets like advanced technology and infrastructure directly enhance a company’s operational efficiency and profitability by improving resource management and production processes. Financial technology investments, for example, have increased operational efficiency in banks, boosting net profits and improving deposit-loan ratios (Zhao, 2021). Data assets optimize production and customer relationship management (Hu et al., 2022). In manufacturing, technological investments increase labor productivity (Novotná et al., 2021). Advanced audit technologies improve loan asset quality and reduce audit times in banking (Dawodu et al., 2023).

H4. Tangible Assets Directly Influence Profitability

Green intellectual capital (GIC), encompassing green human, relational, and structural capital, significantly enhances a company's sustainable practices, fostering innovation and improving ESG scores (Chen, 2008). Recent studies support this: GIC positively influences economic, environmental, and social performance in manufacturing firms (Yusliza et al., 2020). ESG performance also boosts green innovation by easing financing constraints and enhancing human capital (J. Zhang & Liu, 2023).

H5. Green Intellectual Capital Positively Influences ESG Performance

GIC enhances a company's capability to innovate and implement efficient environmental practices, which in turn improve ESG performance. Enhanced ESG performance attracts investors, reduces risks, and leads to better financial outcomes, thereby increasing profitability (Chang & Chen, 2012). Beyond its indirect effects through ESG performance, GIC directly contributes to profitability by fostering a culture of innovation and sustainability. Companies that invest in GIC are better positioned to develop sustainable products and processes, leading to a competitive advantage and improved financial performance (Todericiu, 2021b; Yusliza et al., 2020).

H6. GIC Positively Influences Profitability through ESG Performance

Beyond its indirect effects through ESG performance, GIC directly contributes to profitability by fostering a culture of innovation and sustainability. Companies that invest in GIC are better positioned to develop sustainable products and processes, leading to a competitive advantage and improved financial performance (Todericiu, 2021a; Yusliza et al., 2020).

H7. GIC Directly Influences Profitability

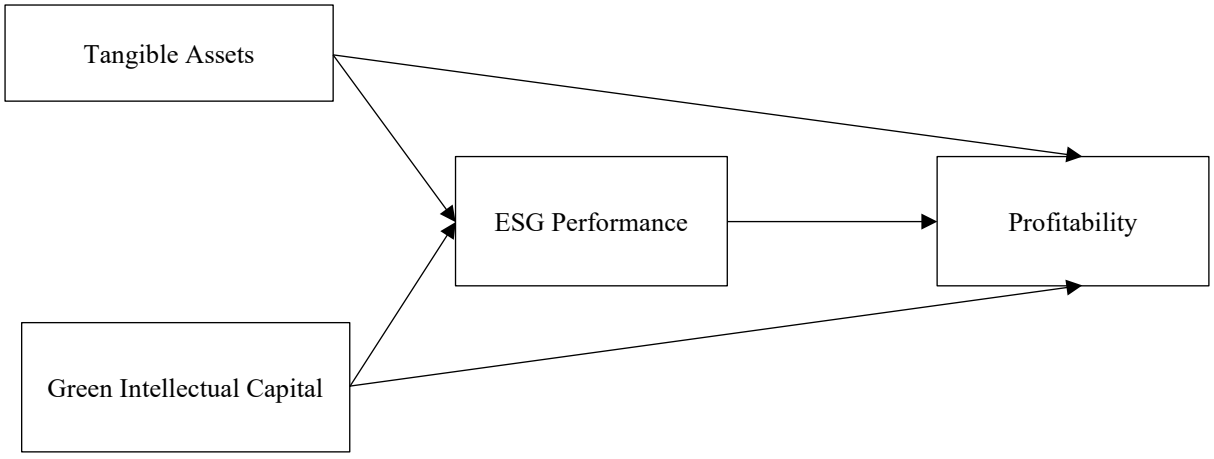

Figure 1. Conceptual Framework

3. Data and Methodology

This section consists of a brief description of the sample data, variables, descriptive statistics and methodology.

3.1. Sample Data

There are 903 companies listed on the Indonesia Stock Exchange. We filter out companies that have ESG performance scores from 2020-2023 and end up with a sample data of 122 companies and 363 observations.

3.2. Dependent Variable

ROA is one of the most widely used indicators of profitability. ROA provides clear insights into the company's ability to convert investments into net income. Recent research makes it clear that it is important across various sectors. It shows how effective asset management can drive profitability (Aydoğmuş et al., 2022; Kayakus et al., 2023; Rutkowska-Ziarko, 2020). We obtain ROA from Yahoo Financials. ROA is calculated using the following formula:

ROA = Net Income/Total Assets

3.3. Independent Variable

Net Tangible Assets (NTA) is the most important financial metric for assessing the real value of a company's tangible assets. It is used to deduct liabilities and intangible assets to get a clear picture of the company's tangible assets. This measure provides a definitive picture of the actual physical assets a company owns. The formula is:

NTA = Total Tangible Assets – Total Liabilities – Intangible Assets

Recent research underscores the importance of accurate accounting, valuation, and management of tangible assets to ensure financial statements reflect the true value of these assets (Karić-Zvekić, 2019; Tamulevičienė & Mackevičius, 2019; Thum-Thysen et al., 2019) (Bužinskienė & Montrimienė, 2023) (Zham et al., 2023).

Green Intellectual Capital (GIC) is an emerging concept that emphasizes the integration of environmental concerns into intellectual capital. This approach recognizes the value of intangible assets that contribute to environmental sustainability (S. Liu et al., 2021; Tjan & Regina Jansen Arsjah, 2023; Yusliza et al., 2020). We use 19 items to assess the contributions of green human capital, green structural capital, and green relational capital. This data was obtained from the Sustainability Report. The formula index is:

GIC = Disclosed Item/Total Item

Table 1. Items of Green Intellectual Capital

Indicator		
Green Human Capital	GHC1.	Employees who contribute to environmental protection/green innovation.
	GHC2.	Employees who are knowledgeable about environmental protection/green innovation.
	GHC3.	Product/service quality and environmental protection/green innovation.
	GHC4.	Teamwork in environmental protection/green innovation.
	GHC5.	Support from managers for environmental protection/green innovation tasks.
Green Structural Capital	GSC1.	Management system related to environmental protection/green innovation.
	GSC2.	Company innovation in environmental protection/green innovation.
	GSC3.	Significant profit from environmental protection/green innovation activities.

	GSC4.	Sales investment for R&D in environmental protection/green innovation.
	GSC5.	Employee involvement in environmental management/green innovation.
	GSC6.	Investment in environmental protection/green innovation facilities.
	GSC7.	Green product development competencies.
	GSC8.	Operational processes related to environmental protection/green innovation.
	GSC9.	Knowledge management system supporting environmental management.
Green Relational Capital	GRC1.	Product/service design in accordance with environmental protection/green innovation.
	GRC2.	Customer satisfaction with environmental protection/green innovation efforts.
	GRC3.	Cooperation with suppliers on environmental protection/green innovation.
	GRC4.	Cooperation with clients in environmental protection/green innovation.
	GRC5.	Good relations with strategic partners in environmental protection/green innovation.
	GRC6.	Low-cost competitive advantage.
	GRC7.	High quality green products/services.
	GRC8.	Research, development and innovation related to environmental protection/green innovation.
	GRC9.	Managerial capability to manage environmental protection/green innovation.

Source: (Chen Y. S., 2008; Yahya, Arshad, & Kamaluddin, 2015; Malik, et al., 2020; Asiaei, O'Connor, Barani, & Joshi, 2023)

3.4. Mediation Variable

We apply ESG Score to measure ESG Performance (R. Chen, 2023; Junius et al., 2020; Yu & Xiao, 2022). ESG Score are obtained from ESG Intelligence. The ESG score from number of items environment, social, and governance disclosed divided by number of items based on GRI (ESG Intelligence, 2024).

3.5. Descriptive Statistics

Table 2. Descriptive Statistics

	N	Mean	SD	Min	Median	Max
Dependent Variable						
Profitability (ROA)	363	3.95	11.48	-87.08	2.50	59.93
Independent Variables						
Tangible Assets (Log_NTA)	363	4.99	2.20	-6.47	5.52	7.26
Green Intellectual Capital (GIC)	363	0.43	0.21	0.05	0.42	0.89
Mediation Variables						
ESG Performance (ESG)	363	0.54	0.21	0.12	0.52	1.00

Source: Data Processed using R (2024)

The dataset encompasses 121 companies over the period 2020-2023, resulting in a total of 363 observations. The NTA and ROA scores were extracted from Yahoo Financials, while the GIC scores were obtained from the company's Sustainability report. The ESG scores were derived from ESG Intelligence.

GIC measures investment in green innovation. Higher GIC means more green practices. On average, companies in the dataset are moderately committed to green intellectual capital. NTA shows the net value of assets minus liabilities. Higher NTA means a strong asset base. The average Log_NTA is 4.99, showing that companies have a lot of tangible assets. Some companies have liabilities that exceed their tangible assets, which is a financial risk. ESG performance shows how well companies follow environmental, social, and governance standards. The average ESG score is 0.54, which means companies in the dataset generally do well in these areas. ROA measures how well a company makes money from its assets. A higher ROA means better performance. Most companies in the dataset have an average ROA of 3.95, but some have a lower value. Generally, an ROA of 5% or above is good, showing that a company is making a profit.

3.6. Methodology

The dataset is a panel data with 131 companies over 3 years. According to "Introduction to Econometrics" by Stock and Watson and other econometric sources, the main tests include Panel Unit Root Test, Hausman Test, Heteroscedasticity Test, Autocorrelation Test, Cross-Sectional Dependence Test, and Multicollinearity Tests. These tests ensure the robustness of the model and the reliability of the conclusions before running the path analysis using RStudio.

4. Results

4.1.Correlation Results

Table 3. Correlation Matrix

Variables	ROA	LogNTA	GIC	ESG
ROA	1.0000			
LogNTA	0.0849	1.0000		
GIC	0.0353	0.0272	1.0000	
ESG	0.1726	0.1067	-0.0391	1.000

Source: Data Processed using R (2024)

The correlation analysis between ROA, LogNTA, GIC, and ESG reveals several key relationships. ROA and ESG show a positive correlation of 0.173, indicating that companies with higher Return on Assets (ROA) tend to have better Environmental, Social, and Governance (ESG) performance. Although this correlation is not very strong, it suggests a positive relationship between profitability and sustainable practices.

LogNTA and ESG have a positive correlation of 0.107, suggesting that companies with higher tangible asset values (in logarithmic form) tend to have better ESG performance. This moderate correlation indicates that tangible assets may contribute to sustainable performance.

GIC and ESG show a very weak negative correlation of -0.039, indicating that Green Intellectual Capital (GIC) may not have a significant direct relationship with ESG performance in this dataset. This suggests that while GIC is an important aspect of a company's intellectual resources, its direct impact on ESG performance might not be as pronounced as that of tangible assets or profitability. It could imply that the benefits of GIC might be more long-term or indirect in nature.

ROA and LogNTA have a very weak positive correlation of 0.085, indicating a minimal relationship between profitability and tangible assets. This weak correlation suggests that the direct impact of tangible assets on profitability is not strong.

Overall, these results show that there is no significant multicollinearity between the main variables analyzed (ROA, LogNTA, GIC, and ESG), as there are no very high correlation coefficients between these variables. However, some moderate positive relationships, such as between ROA and ESG as well as between LogNTA and ESG, indicate important connections. These relationships suggest that more profitable companies and those with larger tangible assets may tend to perform better in ESG metrics, which is relevant for sustainable business strategies.

4.2. Statistical Test Results

Table 4. Statistical Analysis Results

Statistical Test	Coefficient	P-Value	Description
Panel Unit Root Test			
GIC	-7.4192	< 0.01*	Stationary
NTA	-6.8234	< 0.01*	Stationary
ESG	-7.0009	< 0.01*	Stationary
ROA	-6.3546	< 0.01*	Stationary
Hausman Test			
ESG ~ GIC + LogNTA	2.7512	0.2527	Random Effect Model
ROA ~ GIC + LogNTA + ESG	10.804	0.01283*	Fixed Effect Model
Heteroscedasticity Test			
Random Effect	0.80209	0.6696	No heteroscedasticity
Fixed Effect	2.3412	0.5047	No heteroscedasticity
Autocorrelation Test			
Random Effect	8.5636	0.03569*	serial correlation in idiosyncratic errors
Fixed Effect		< 2.2e-16*	serial correlation in idiosyncratic errors
Cross-Sectional Dependence Test			
Random Effect	1.8263	0.0678	No cross-sectional dependence
Fixed Effect	3.1036	0.001912*	cross-sectional dependence
Multicollinearity Test			
GIC	1.002550		No Multicollinearity
NTA	1.012609		No Multicollinearity
ESG	1.013331		No Multicollinearity

*) Significant

A review of the statistical test results presented in the table allows for the drawing of several important conclusions. The stationarity test (Panel Unit Root Test) indicates that all variables (GIC, NTA, ESG, and ROA) are stationary with a p-value less than 0.01. The Hausman test indicates that the random effect model is more appropriate for ESG, with a p-value of 0.2527, while the fixed effect model is more suitable for ROA, with a p-value of 0.01283. The heteroscedasticity test indicates that there is no significant heteroscedasticity issue present in either the random effect or fixed effect models, with p-values of 0.6696 and 0.5047, respectively. However, the autocorrelation test indicates the presence of serial

correlation in idiosyncratic errors for both the random effect (p-value 0.03569) and the fixed effect (p-value < 2.2e-16). The cross-sectional dependence test indicates that there is no cross-sectional dependence for the random effect (p-value 0.0678), but there is for the fixed effect (p-value 0.001912). The multicollinearity test shows that there is no significant multicollinearity with VIF values around 1 for all variables (GIC, NTA, ESG).

To address the issue of serial correlation and potential heteroscedasticity, the use of robust standard errors is recommended when conducting path analysis. This corrects the standard errors, thereby enhancing the accuracy and validity of the estimates. Consequently, these measures guarantee that the panel data model analysis will yield more reliable estimates.

4.3. Path Analysis Results

Table 5. Path Analysis Results with Robust Standard Errors

Path	Estimate	Std. Err	z-value	p-value	Description
Regression					
ESG ~					
GIC	-0.042	0.051	-0.824	0.41	Not significant
LogNTA	0.01	0.005	2.048	0.041	Significant
ROA ~					
ESG	8.28	2.599	3.186	0.001	Significant
GIC	0.843	3.129	0.269	0.788	Not significant
LogNTA	0.279	0.388	0.718	0.473	Not significant
Variances					
.ESG	0.042	0.003	15.252	0	Significant
.ROA	127.832	30.974	4.127	0	Significant
Defined Parameters					
indirect_GIC	-0.347	0.429	-0.809	0.419	Not significant
indirect_NTA	0.084	0.043	1.931	0.053	Marginally significant
total_GIC	0.496	3.159	0.157	0.875	Not significant
total_NTA	0.362	0.401	0.903	0.367	Not significant
Model Fit Indices					
Comparative Fit Index (CFI)	1.000				Excellent model fit
Tucker-Lewis Index (TLI)	1.000				Excellent model fit
Root Mean Square Error of Approximation (RMSEA)	0.000				Excellent model fit
Standardized Root Mean Square Residual (SRMR	0.000				Excellent model fit
Information Criteria					
Akaike (AIC)	2683.012				
Bayesian (BIC)	2710.273				
Sample-size adjusted Bayesian (SABIC)	2688.065				

Source: Data Processed using R (2024)

The results of the analysis indicate that the model is an excellent fit. The estimator employed is maximum likelihood (ML), and the optimization method utilized is NLMINB. The analysis was conducted on a sample of 363 observations, with seven model parameters. The results of the user model fit test indicate that the test statistic value is 0.000 with 0 degrees of freedom, which signifies that the model is an exact fit to the data.

The baseline model yielded a test statistic value of 14.666 with 5 degrees of freedom and a p-value of 0.012, indicating a less optimal fit than the user model. The comparative fit index (CFI) and the Tucker-Lewis index (TLI) were both equal to 1.000, indicating an excellent fit for the model.

The information criteria indicated that the Akaike (AIC) value was 2683.012, the Bayesian (BIC) value was 2710.273, and the sample-size adjusted Bayesian (SABIC) value was 2688.065. The Root Mean Square Error of Approximation (RMSEA) value was 0.000, with a 90% confidence interval from 0.000 to 0.000, indicating an excellent model fit.

The parameter estimates indicate that GIC is not a significant predictor of ESG, with a p-value of 0.410. In contrast, LogNTA is a significant predictor of ESG, with a p-value of 0.041. The results indicate a significant positive correlation between ESG and ROA (p-value 0.001), whereas no significant correlation was found between ESG and GIC or LogNTA. The variance of ESG and ROA were found to be significant, with a p-value of 0.000. The indirect effect of GIC on ROA is not statistically significant, whereas the indirect effect of LogNTA on ROA is approaching statistical significance (p-value 0.053). The total effect of GIC and LogNTA on ROA is not statistically significant. However, robust standard errors indicate that ESG has a significant effect on ROA, and LogNTA has a significant effect on ESG. Furthermore, while GIC is not found to have a significant direct effect on ESG or ROA, it does have a significant indirect effect on ROA.

5. Discussion and Conclusion

This study examines the combined effect of tangible assets (TA) and green intellectual capital (GIC) on firm profitability in Indonesia, with ESG performance as a mediating variable. The findings provide significant insights into how these variables interact and affect financial outcomes, particularly in the context of achieving the Sustainable Development Goals (SDGs).

The analysis shows a significant positive relationship between tangible assets and ESG performance. Companies with substantial tangible assets, such as physical infrastructure and technology, are better equipped to implement sustainable practices, thereby improving their ESG scores. This finding is consistent with the Resource-Based View (RBV) theory, which posits that a firm's resources are critical to achieving a sustainable competitive advantage.

Surprisingly, GIC did not show a significant direct effect on ESG performance. This may be due to the varying levels of integration and effectiveness of GIC practices in different companies. Although GIC includes green human capital, green relational capital, and green structural capital, the impact of these components may not be immediately apparent or uniformly applied. Additionally, the data collection period of 2020-2022 coincides with the COVID-19 pandemic, which significantly disrupted business operations worldwide. The pandemic could have affected the implementation and effectiveness of GIC practices due to operational disruptions, prioritization of immediate survival strategies over long-term sustainability goals, and economic uncertainty. This period may not have allowed sufficient time for the benefits of GIC to fully manifest, as the impacts of green intellectual capital are often realized over a longer term (Lestari & Adhariani, 2022; Tanjung, 2023).

There is a significant positive relationship between ESG performance and profitability, as evidenced by the correlation between ESG scores and return on assets (ROA). Companies with higher ESG performance tend to attract more investors, demonstrate superior risk management, and benefit from enhanced reputational capital, which ultimately translates into improved financial results.

The mediation analysis underscores the pivotal function of ESG performance in the nexus between tangible assets and profitability. While GICs do not exert a significant direct influence on profitability, their indirect impact through ESG performance is noteworthy. This highlights the significance of ESG practices in transforming tangible and intellectual resources into financial returns.

The considerable influence of tangible assets on ESG performance and enhanced profitability through ESG scores indicates that tangible assets serve as a fundamental foundation for sustainable practices. The implementation of effective environmental, social, and governance strategies is more readily achievable by companies that possess robust physical infrastructure and advanced technology.

In conclusion, this study highlights the significance of tangible assets in enhancing ESG performance and profitability. While the direct impact of GICs on ESG performance and profitability is not statistically significant, the potential indirect impact through ESG performance underscores the importance of GICs in sustainable business practices. The findings offer valuable insights for corporate managers and policymakers seeking to achieve a balance between financial performance and sustainability objectives.

Additional research also shows that effective implementation and management of green intellectual capital can play a crucial role in the long-term performance of companies (Hwang et al., 2021; D. Zhou & Zhou, 2021). These practices require time to fully integrate and yield significant results in ESG performance and profitability. Moreover, long-term strategies focusing on sustainability can help companies navigate economic crises, such as the COVID-19 pandemic (Hendriyeni et al., 2023). Good ESG performance also helps companies reduce stock volatility during the pandemic, underscoring the importance of sustainability in managing economic uncertainty (Laokulrach, 2022).

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