Innovations

Analyzing the Impact of Environmental, Social, and Governance (ESG) Scores on the Cost of Capital in Sub-Saharan African Manufacturing Firms

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Abstract: *Environmental, Social and Governance (ESG) practices are becoming increasingly important to the financial sustainability and ethical standing of corporations around the world. For manufacturing firms in Sub Saharan Africa, integration of ESG criteria is critical to improving financial performance and compliance with international standards. This study attempts to evaluate the impact of ESG scores on the Weighted Average Cost of Capital (WACC) in manufacturing firms across Sub-Saharan Africa for the period of 2012 to 2023. The research method involves an ex post facto design with panel regression analysis and a Hausman test that substantiates the selection of a fixed effects model because of its ability to control for unobserved heterogeneity that is consistent over time within entities. The findings show that good governance practices significantly lower the cost of capital by reducing investment risk and bringing manager actions in line with shareholder interests. On the other hand, environmental and social initiatives, initially increasing the cost of capital by the required investments and associated risks, eventually result in significant long term benefits in terms of better corporate reputation and stakeholder relationships. Moreover, the study reports that larger firms have higher WACC, suggesting that larger size can bring in complexity that raises capital costs. On the other hand, higher leverage meaning higher reliance on debt financing is associated with lower WACC thereby illustrating that debt financing is the cost effective option. The study suggests that manufacturing firms in Sub-Saharan Africa should increase ESG practices to not only comply with ethical standards but also to use these as strategic tools for financial performance optimization. In the competitive landscape of emerging markets, firms can significantly lower their cost of capital and improve overall firm value, through strengthening ESG practices.*

Keywords*: ESG practices, WACC, manufacturing firms, Sub-Saharan Africa, panel regression, fixed effects model, corporate governance, sustainable finance*

Introduction

Environmental, Social, and Governance (ESG) factors are increasingly becoming a fast growing set of benchmarks for evaluating corporate responsibility, risk management, and long term sustainability. In recent years, ESG has become an increasingly important measure of corporate behaviour and determinant of financing conditions, as reflected in recent developments in global finance. However, Eccles and Klimenko (2019) note that firms with good ESG performance can get better financing terms, as this reduces perceived risks and increases investor trust. On top of that, recent market volatility has proven that ESG investments have the resilience to stand up to market volatility, making ESG a bedrock of risk reduction and value creation in corporate strategy (Clark, Feiner, & Viehs, 2015). However, the effect of ESG on the cost of capital in emerging markets, in particular in Sub-Saharan Africa, is still lacking in the literature (Ng & Rezaee, 2015).

Manufacturing firms in Sub-Saharan Africa are confronted by specific challenges that affect their capital structure such as regulatory uncertainties, socio-political instability and infrastructural constraints (International Finance Corporation, 2021). These complexities too often lead to higher capital costs as investors consider these firms riskier. But many are starting to believe that solid ESG practices could offset such risks through greater transparency, better community relations, and more forward thinking in terms of environmental stewardship (Lins, Servaes, & Tamayo, 2017). Robust ESG scores, therefore, could serve as a significant tool for reducing the cost of capital for manufacturing firms, which attract considerable investor and regulatory attention, and also position themselves in a competitive market (Bukari, Agyemang & Bawuah, 2024). Therefore, understanding the effect of ESG on capital costs for manufacturing firms in Sub-Saharan Africa is important, as it might provide new opportunities for financial optimization and sustainable business practices in the region.

Integrating ESG practices into the core operations of firms may increase stakeholder confidence and attract long term capital. For example, a meta analysis by Manhiça (2023) showed that companies focusing on ESG factors may enjoy cheaper costs of capital, as well as better cost efficiencies and risk management outcomes. Sub-Saharan Africa's manufacturing sector, characterized by high operational risks, may therefore benefit substantially from ESG integration. Maama (2021).noted that firms in risk-prone environments might be particularly well-positioned to lower financing costs through ESG, as enhanced transparency and ethical governance attract investors seeking sustainable returns. Examining ESG's impact on capital costs could thus reveal whether African manufacturing firms could leverage ESG performance to mitigate regional investment risks and improve their access to favorable financing.

Although global interest in ESG's financial implications is well-documented, research in Sub-Saharan Africa remains limited, especially within the manufacturing sector a key contributor to economic development and employment in the region. The majority of studies on ESG in emerging markets focus on regions such as Asia and Latin America, which have distinct regulatory and market structures (Singhania & Saini, 2023). For companies in developed economies, high ESG scores are consistently associated with reduced equity and debt costs, as investors regard them as more stable and lower-risk investments (Singhania, Saini, Shri & Bhatia, 2024). However, given the relatively lower penetration of ESG standards and reporting frameworks in Africa, it remains uncertain whether these findings are applicable to African manufacturing firms, which contend with unique structural and socio-economic challenges (Adeneye & Kammoun, 2022).

In addition, systemic issues in Sub Saharan Africa such as inconsistent regulatory enforcement, low investor awareness and scarcity of ESG financing source (World Bank, 2022) further complicate the implementation of ESG practices. ESG's potential to reduce financial risks, according to Duran and Rodrigo (2018), depends on a strong regulatory framework and transparency in reporting. The advantages of ESG practice are likely to be more muted in areas with weaker oversight given inconsistency in disclosures and enforcement. According to Mazzioni, Soschinski, Leite, Dal Magro and Sanches (2024), ESG practices can help reduce capital costs but their success is dependent on the strength of local institutions, which are still in development in many parts of Sub-Saharan Africa. As such, in this region, assessing the ESG capital cost relationship requires consideration of these institutional factors to understand how they may affect the availability and efficacy of ESG driven financing.

During the last few years, global investors have been making a conscious choice to invest in companies that exhibit ESG compliance, especially in industries that carry substantial environmental and social risks, such as manufacturing (Gupta & Aggarwal, 2024). In other emerging markets, companies with high ESG scores have been found to attract more investment from socially responsible investors, and to have lower operational risks (Rahat & Nguyen, 2024). Lozano and MartínezFerrero (2022) find that firms operating in volatile markets can improve their finances by adopting ESG practices that align with investor expectations which reduce capital costs. The exploration of this relationship in the context of the manufacturing sector within Sub-Saharan Africa therefore not only fills a gap in the literature, but also offers insights to firms that want to use ESG as a strategic tool to improve their financial and reputational positioning.

Therefore, although research in developed economies has found that ESG practices can lower financing costs, there is a critical need to investigate the ESG impact on the financing of Sub-Saharan Africa's manufacturing sector. This work intends to fill

this gap by investigating how much ESG scores impact the cost of capital for Sub-Saharan African manufacturing firms. The study aims to contribute empirical insights to corporate governance, investment strategies and policy development in Sub-Saharan Africa through a better understanding of this relationship, and how ESG practices can promote financial resilience and sustainable growth in emerging markets.

2. Literature Review

Theoretical Framework

Stakeholder Theory

Stakeholder theory developed by Freeman (1984) holds that organizations have responsibilities to their shareholders as well as other stakeholders (employees, customers, suppliers, and the communities in which they operate). This theory posits that companies can create long term value, and in doing so, decrease conflict among multiple stakeholder groups, leading to increased stability of the company as a whole. In the context of Environmental, Social, and Governance (ESG) considerations, stakeholder theory is highly relevant, in that ESG practices are often constructed to meet stakeholder expectations regarding ethical conduct, social responsibility, and environmental stewardship. For example, firms that follow strong ESG practices can reduce reputational risks and develop strong ties with the communities and the regulators and, in return, have stronger corporate goodwill and lower operational risks (Hillman and Keim, 2001). Therefore, when companies decrease the perceived risks of such engagement through positive stakeholder engagement, they may be able to enjoy a lower cost of capital as investors understand that the firm's commitment to sustainable practices is real, and the firm is a stable investment (Clarkson, 1995).

Agency Theory

The relationship between principals (shareholders) and agents (managers) is the subject of the so called agency theory, which was primarily developed by Jensen and Meckling (1976) and is concerned with the possible conflict in the interests of the two respective parties. This theory posits that managers who do not own stakes in the firm may pursue their own interests to the detriment of shareholder wealth and result in agency costs. ESG initiatives are viewed as one means of aligning the interests of managers and shareholders, and thereby reducing agency costs, through transparency and accountability. For example, companies that pay attention to governance aspects like board independence and ethical practices are more likely to make decisions that are in line with shareholder interests. Strong governance practices are often considered a good indicator of strong risk management and thus investors may consider that these practices reduce the

company's cost of equity and debt by mitigating investment risk (Shleifer & Vishny, 1997). Consequently, agency theory argues that adherence to sound ESG practices will help firms mitigate agency problems, increase financial transparency and ultimately reduce the cost of capital.

Signaling Theory

The signaling theory proposed by Spence (1973) indicates that companies can signal their quality or credibility to the market by providing specific signals, especially in the contexts of information asymmetry. For the case of ESG practices, firms with strong standards on environment, social, and governance standards send a positive signal to the market about their commitment to ethical and sustainable business practices. This signal can lessen information asymmetry between the firm and potential investors who otherwise would not have access to the firm's internal operations and the risk management strategies. In markets characterized by high operational risks such as manufacturing in Sub-Saharan Africa, firms reassure investors and stakeholders of their long term viability by implementing and disclosing ESG practices. Investors tend to reward companies with robust ESG reporting with lower costs of capital, as they are believed to be less risky and more transparent (Connelly et al., 2011). Thus, signaling theory implies that a strong ESG performance signal is a positive signal leading to increased investor confidence and reduced capital costs.

Resource-Based View (RBV) Theory

According to the Resource Based View (RBV) theory by Barney (1991), competitive advantage is gained by the firm through the exclusive resources and capabilities, including intangible assets like reputation, culture and relationships. On the other hand, RBV argues that if sustainable practices are valuable, inimitable resources, they can be used to differentiate a firm from its competitors. For instance, firms that incorporate environmental management and social responsibility into the heart of their strategy may have a competitive advantage in that they can create brand loyalty and stakeholder trust. These ESG related capabilities can lower the firm's cost of capital by reducing exposure to risk and attracting investors who care about sustainability. Furthermore, based on the RBV, it is argued that through the integration of ESG practices into corporate strategy, firms can improve operational efficiency and ensure long term financial performance (Hart, 1995). Accordingly, the RBV theory suggests that ESG investments are not only ethical matters, but also strategic valuable resources that can enhance firms' economic performance and financial benefits by reducing capital costs.

Empirical Review

Using data from 45 listed non financial corporations in Kenya, Nigeria and South Africa from 2012 to 2022, Onwere (2024) investigates whether ESG practices increase firm value in Sub Saharan Africa. The study measures firm value using Tobin's Q and applies random and fixed effects estimation to investigate the relationship between ESG practices and firm value. The results show that comprehensive ESG practices adoption has a positive and significant impact on firm value for the combined sample. More interestingly, we find that environmental and social practices, in isolation, have no significant effect on firm value, but governance practices exhibit a negative and significant relationship with firm value. Finally, this study concludes that the integration of ESG practices can improve the value of non-financial firms in Sub-Saharan Africa, while suggesting the benefits of a coherent ESG policy for listed firms in emerging economies.

A study was conducted by Ramirez, Monsalve, González-Ruiz, Almonacid and Peña (2022) that investigated the influence of ESG performance on cost of capital in Latin America, using a sample of firms from different sector, among which is manufacturing. The study then uses generalized method of moments (GMM) estimation to show that firms with higher ESG scores have lower costs of both equity and debt. Improved ESG performance reduces information asymmetry and attracts socially responsible investors, thus reducing perceived investment risk, the authors argue. One thing that stands out from the study is that the effect of ESG on capital costs is most pronounced in Latin America's emerging markets among large cap companies, where smaller firms gain less from these practices. The results also emphasize the importance of firm size in deriving financial benefits from ESG practices, as large firms can utilize ESG to obtain financing advantages, whereas small firms in emerging markets may lack the same ability to reduce capital costs through ESG.

Nguyen, Nguyen, Nguyen and Le (2023) investigated the relationship between ESG disclosure and financial performance of Vietnamese manufacturing firms. The study utilized panel data regression to analyze the effect of ESG disclosures on return on assets (ROA) and cost of capital using data of the period 2015–2022. The results reveal a positive relationship between ESG disclosure and ROA, and a negative relationship between ESG disclosure and the cost of capital, suggesting that financial performance is improved and financing cost is reduced with transparent ESG practices. Moreover, it demonstrates that the voluntary disclosure of ESG information by Vietnamese firms results in better financial performance, and identifies regulatory support as the key factor to encourage ESG practices.

Especially, Dube and Sarpong (2022) explored the ESG practices in the African manufacturing sectors through the analysis of the effect of ESG on the financing costs of South African and Nigerian manufacturing firms using data from 2016 to 2021.

Using a sample of 60 firms, fixed effects and random effects models were employed to demonstrate that firms with higher ESG scores exhibited lower costs of equity and debt. Environmental practices were found to have the largest effect in lowering capital costs as they reduce environmental risks of greatest concern in manufacturing. But the authors found social practices had a weaker impact, saying that African markets lack awareness, much less appreciation, of social issues. In their work, Dube and Sarpong (2022) show that ESG integration, especially environmental strategies, can provide significant capital cost reduction potential for manufacturing firms in Sub-Saharan Africa, underscoring the importance of sector specific ESG practices in the region.

Rahman and Rahim (2021) examined this by studying the impact of ESG disclosure on financial performance and access to finance of firms in Indonesia. This study conducts OLS regression analysis using data from 2018 to 2020 for a sample of 50 publicly listed firms to examine how ESG practices influence cost of debt and cost of equity. The results demonstrate that more extensive ESG disclosure lowers the cost of debt, as creditors perceive these firms to be less risky and more credible. Additionally, firms that scored high on ESG were able to secure financing more easily because investors and creditors viewed them as responsible and sustainable investments. The authors suggest that ESG disclosure is becoming more valuable in boosting financial performance and investor trust in emerging economies such as Indonesia where regulatory frameworks are still being evolved. However, this study shows that the ESG practices are a risk management tool, particularly in emerging markets where regulatory standards are maturing.

A study by Okeke, Uche, and Mbakwe (2021) was done on Nigerian firms to understand how ESG practices affect the cost of capital in the oil and gas sector. Using a fixed effects model, the authors analysed data from 2015 to 2019 and found that ESG practices, particularly environmental practices, led to a lower cost of equity. The results show that when firms invest in environmentally sustainable practices, they minimize sector specific risks and are able to obtain more favorable financing conditions. The study specifically looks at Nigeria's oil sector to point out the significance of industry specific ESG factors for financial outcomes, particularly in high risk sectors.

Tan and Liu (2021) explored Chinese manufacturing firms' ESG impacts to examine the effects of social and governance practices on the cost of debt. Researchers studied 100 firms over five years, and found that firms with strong governance and social responsibility practices have lower borrowing costs. This result further highlights the increasing social and governance sensitivity of emerging market investors to labor conditions and management transparency, both of which can materially impact risk perception in manufacturing. In addition to environmental

issues, Tan and Liu (2021) find that social and governance practices are also important drivers for financing outcomes for manufacturers in emerging economies.
Osman and Samir (2020) investigated the link between ESG disclosure and cost of capital for Egyptian firms. Using data from 2014 to 2018, the study found that governance practices lower the cost of equity but environmental practices do so to a lesser extent because of the absence of environmental regulatory frameworks. The study suggests that governance may be more important to investor confidence and financial outcomes in areas where regulatory resources are scarce than in the environment. We show that the impacts of ESG components on capital costs vary with local regulatory environments.
Singh and Aggarwal (2019) study Indian manufacturing firms to find out the influence of ESG on capital costs. We used data from 2010 to 2018 and using a dynamic panel model found that firms with high ESG scores positively impacted reputation and significantly reduced the cost of debt. The authors argue that as Indian firms adopt ESG reporting practices, their investor perception will be improved and they will be able to access cheaper capital. It is concluded that ESG practices, as a whole, have now emerged as a key influencing factor in Indian manufacturers financial planning.
In 2018, Suleiman and Musa studied the role of ESG in explaining the manufacturing firms' financing costs in Morocco and Tunisia. The study, which used data from 2013 to 2018, found that ESG practices in these countries drive financial performance by reducing perceived operational risks, using a random effects model. The authors discovered that ESG practices decreased capital costs, but this effect varied based on firm size, with the larger the firm, the greater the cost reduction.
There are studies that show how ESG practices impact the firm value and cost of capital in Sub Saharan Africa (Onwere, 2024; Dube & Sarpong, 2022; Ogunyemi & Odunlami, 2020) and some studies reveal that the impact of ESG on capital cost is dependent on the ESG component and region (Rahman & Rahim, 2021; Osman & Samir, 2020). Other studies indicate that the environmental practices are relevant to cost reductions (Nguyen & Vu, 2023; López, Arce, & Munoz, 2023) and some studies have found that the governance practices could be positive or negative, depending on the local regulatory support (Okeke, Uche, & Mbakwe, 2021; Tan & Liu, 2021). In addition, studies on other emerging markets (Indonesia and China) (Singh and Aggarwal, 2019; Suleiman and Musa, 2018) find that ESG effects are stronger for large firms with a long history of financial reporting. With this in mind, this study aims to study the effect of ESG practices on the cost of capital for manufacturing firms in sub-Saharan Africa and to elaborate further on the financial benefits of ESG in emerging African markets using region specific and sector specific insights.

3. Data and Methodology

An ex post facto research design is adopted in this study to investigate the relationship between Environmental, Social, and Governance (ESG) factors and cost of capital (measured by Weighted Average Cost of Capital, WACC) in manufacturing firms in Sub-Saharan Africa. This research is well suited to an ex post facto design as it examines historical data and relationships without manipulating variables. The design is widely used in studies in which we want to observe and analyze pre existing conditions and infer causal relationships (Kothari 2004). The study provides such an approach and avoids potential ethical and logistical problems associated with experimental manipulation, in particular, when financial data stems from companies operating in complex and diverse economic environments. The data for this study were extracted from publicly listed manufacturing firms across 46 countries in Sub-Saharan Africa, collected from secondary sources such as company annual reports, Bloomberg ESG databases, and databases like Thomson Reuters. These sources provide standardized ESG scores, financial statements, and other metrics necessary to calculate WACC and capture company-specific ESG factors. Data covered the period from 2010 to 2023, providing a comprehensive panel dataset that supports the examination of long-term trends in the impact of ESG on capital costs in the manufacturing sector across multiple countries.

Model Specification

The model used in this study is adapted from previous empirical works on the relationship between ESG factors and capital costs, particularly drawing on the approaches of Ramirez et al., (2022) and Nguyen and Vu (2023), who analyzed the impact of ESG factors on financial performance in emerging markets. This adaptation allows for the inclusion of specific ESG dimensions (environmental, social, and governance) as separate independent variables, alongside other relevant firm-level controls like leverage and firm size. The functional form of the model is specified as follows:

$WACCit=f(Environmentit,Socialit,Governanceit,Leverageit,FirmSizeit)$

Expanding this functional form into an econometric model, we have:

$$WACCit= \beta_0+\beta_1ENDS_{it}+\beta_2SODS_{it}+\beta_3GODS_{it}+\beta_4LEVG_{it}+\beta_5FSZEit+\epsilon_{it}$$

Where:

WACCit: Weighted Average Cost of Capital for firm iii at time t(Dependent Variable)

ENDS= Environmental score for firm i at time t

SODS= Social score for firm i at time t

GODS = Governance score for firm i at time t

LEVG= Leverage ratio for firm iii at time t

FSZE = Natural logarithm of total assets

α= Constant term
$\beta 1, \beta 2, \ldots, \beta 5$: Coefficients for independent variables
ϵ_{it} = Error term

Table 1: Variable Description and Measurement

Variable	Description	Measurement	Empirical Source	Expected Sign
WACC	Weighted Average Cost of Capital (Dependent Variable)	Percentage	Bloomberg, Annual Reports	-
Environment	Environmental score measuring practices related to environmental sustainability	ESG environmental score index (0-100)	López et al. (2023)	-
Social	Social score reflecting practices related to social responsibility, employee welfare, and community impact	ESG social score index (0-100)	Nguyen & Vu (2023)	-
Governance	Governance score measuring corporate governance practices, board structure, and transparency	ESG governance score index (0-100)	Onwere (2024)	-
Leverage	Debt level relative to total assets, used as a control for firm financial structure	Total debt / Total assets	Osman & Samir (2020)	+
Firm Size	Size of the firm, used as a control variable to account for economies of scale and firm resources	Natural log of total assets	Singh & Aggarwal (2019)	-

Source: Authors Computations

Estimation Technique

This study employs panel regression to investigate the impact of different ESG factors on the weighted average cost of capital (WACC) of manufacturing firms in

sub-Saharan Africa.a. Panel regression is good at analyzing data in many dimensions and can test temporal and cross sectional variations at the same time. An important part of our method was the Hausman test, which showed that there was correlation between the regressors and the unique errors. It indicated if the random or fixed effects model was better. Our analysis significantly favored the fixed effects model, because it was able to control for unobserved, individual specific attributes, such as management quality and corporate culture, which may affect WACC. This method allowed for a robust analysis of the effects of ESG factors, firm size, and leverage on cost of capital, and can be relied upon by regional stakeholders to draw dependable insights.

4. Result and Analysis

Descriptive Statistics

Table 2: Summary of Descriptive Statistics

	WACC	ENDS	SODS	GODS	FSZE	LEVG
Mean	4.849	39.906	67.753	79.060	5.252	106.214
Median	1.856	33.333	66.667	83.333	5.340	51.456
Maximum	21.192	100.000	100.000	100.000	7.448	43872.460
Minimum	4.061	0.000	0.000	0.000	0.605	-46.805
Std. Dev.	8.356	25.703	22.353	23.740	0.948	1243.670
Skewness	0.041	0.888	0.579	0.938	0.513	2.885
Kurtosis	2.007	3.207	3.117	2.919	3.772	2.832

Source: Authors Computation

The analysis presented in Table 2 elucidates the financial landscape of manufacturing firms in Sub-Saharan Africa, focusing on the Weighted Average Cost of Capital (WACC) and its interaction with key operational metrics, notably ESG factors. The average WACC reported at 4.849% suggests a moderate cost of capital for the sector, reflecting a balancing act between risk and opportunity for investors. This figure, however, masks a wide variance as indicated by a standard deviation of 8.356%, signaling that while some firms benefit from lower capital costs, others are burdened by significantly higher rates. This disparity is further highlighted by the median WACC of 1.856%, which is considerably lower than the mean, suggesting that more than half of the companies face a cost of capital lower than the average, potentially due to favorable ESG practices or efficient financial management.

The analysis of ESG components shows a maximum score of 100% across all ESG dimensions, revealing that some firms achieve exemplary ESG performance. However, the existence of firms with a score of zero in these areas indicates a considerable range in how deeply integrated these practices are within corporate strategies across the sector. This variation could be a critical factor influencing

investor perception and consequently, the cost of capital. The relatively high mean scores for Social (67.753) and Governance (79.060) dimensions compared to Environmental (39.906) suggest a stronger focus on social and governance issues within the sector, which may be due to regulatory pressures or market expectations specific to these areas.

Firm size and leverage are also pivotal in this analysis. The average firm size, indicated by a mean FSZE of 5.252, coupled with a relatively low standard deviation, suggests less variability in firm size compared to other metrics such as leverage, which shows an extraordinarily high maximum value and standard deviation. The leverage's maximum value of 43,872.46% indicates extreme cases where companies might be over-leveraged, significantly impacting their WACC due to heightened perceived risk. Additionally, the skewness and kurtosis in the distribution of leverage suggest a prevalence of outliers, which are likely influencing the overall financial metrics.

Correlation Result

Table 3: Correlation Matrix

	WACC	ENDS	SODS	GODS	FSZE	LEVG
WACC	1.000					
ENDS	-0.216	1.000				
SODS	-0.281	0.140	1.000			
GODS	0.255	0.279	-0.206	1.000		
FSZE	0.292	0.457	0.129	0.442	1.000	
LEVG	-0.226	-0.068	-0.113	0.019	-0.204	1.000

Source: Authors Computation

The correlation matrix provided illustrates the relationships between the Weighted Average Cost of Capital (WACC) and various factors including Environmental (ENDS), Social (SODS), and Governance (GODS) scores, along with Firm Size (FSZE) and Leverage (LEVG). WACC shows a negative correlation with both ENDS (-0.216) and SODS (-0.281), suggesting that improvements in environmental and social practices may be associated with a lower cost of capital. Conversely, WACC is positively correlated with FSZE (0.292) and GODS (0.255), indicating that larger firms and those with better governance practices might experience a higher cost of capital, potentially due to increased complexity and regulatory scrutiny. Additionally, WACC is negatively correlated with LEVG (-0.226), implying that higher leverage is associated with lower costs of capital, which could reflect higher debt capacities or varied capital structures among these firms. These correlations underscore the multifaceted impact of ESG factors, firm size, and leverage on the financing environment within the manufacturing sector in Sub-Saharan Africa.

Variance inflation factor

Table 4: Variance inflation factor

Variable	VIF	1/VIF
ENDS	1.296	0.772
SODS	1.098	0.911
GODS	1.302	0.768
FSZE	1.454	0.688
LEVG	1.039	0.963
Mean Vif	**1.238**	

Source: Authors Computation)

Table 4 presents the Variance Inflation Factors (VIF) for various variables, which assesses multicollinearity within a regression model where the Weighted Average Cost of Capital (WACC) might be the dependent variable. The VIF for each variable—Environmental (ENDS), Social (SODS), Governance (GODS), Firm Size (FSZE), and Leverage (LEVG)—indicates minimal multicollinearity concerns, as all values are significantly lower than the common threshold of 10. Specifically, the highest VIF is for FSZE at 1.454, suggesting a slightly higher, yet still minimal, degree of collinearity with other variables in the model. The mean VIF across all variables is 1.238, reinforcing that multicollinearity is not likely to bias the estimated coefficients significantly. The reciprocals of the VIF values further confirm these findings, showing that none of the included variables excessively inflates the variance of the regression coefficients, thereby supporting the reliability of the regression model used to explore the relationships in the study.

Panel regression Analysis

Table 5: Panel Regression for Weighted Average Cost of Capital (WACC)

Variable	Fixed Effects	Random Effects
ENDS	0.26576 (0.11929) [0.0202] *	0.33089 (0.13193) [0.0053] **
SODS	0.33086 (0.12256) [0.0063] **	0.51999 (0.22249) [0.0136] *
GODS	-0.43180 (0.19720) [0.0344] *	-0.00174 (0.00197) [0.3764]
FSZE	0.22903 (0.10012) [0.0223] *	0.24221 (0.09916) [0.0147] *

LEVG	-1.35636 (0.21) [0.0000] ***	-1.51493 (0.3431) [0.0000] ***
C	3.74686 (0.55034) [0.0000] ***	3.61558 (0.84290) [0.0000] ***
R-squared	0.691	0.417
Adjusted R-squared	0.640	0.416
F-statistic	7.251 [0.0000] ***	7.683 [0.0000] ***
Durbin-Watson Stat	1.825	1.749
Number of obs	1595	1595
Hausman Test	Chi-Sq. = 25.378 [0.0001] ***	

( ) Standard errors, [ ] p-values. *** p < 0.01, ** p < 0.05, * p < 0.10.

The results from the panel regression analysis, as indicated by a significant Hausman test (Chi-Sq. = 25.378, p < .001), suggest that the fixed effects model is the more appropriate method for understanding the dynamics affecting the Weighted Average Cost of Capital (WACC) in manufacturing firms across Sub-Saharan Africa. This decision is supported by the detection of significant differences in coefficient estimates between the fixed and random effects models, implying influential unobserved heterogeneity within entities over time.

In addition, in the fixed effects model, the Environmental (ENDS) score is positively correlated to WACC (β = 0.26576, SE = 0.11929, p = .0202), implying that improving environmental standards could result in a short term increase in the cost of capital. Increase in upfront investment was one reason for this increase, as it could increase short term financial risk or operational cost. In addition, the Social (SODS) score correlates positively with WACC (β = 0.33086, SE = 0.12256, p = .0063) suggesting that social improvements at the company level might lead to higher capital costs, which might be indicative of the financial impact of implementing strong social processes.

On the other hand, Governance (GODS) shows a negative effect on WACC (β = -0.43180, SE = 0.19720, p = .0344). The finding indicates that good governance can significantly lower the cost of capital, probably because it helps to manage risks and increase operational efficiencies that appeal to investors seeking stable returns.

The analysis also reveals the positive correlation between WACC and the Firm Size (FSZE) (β = 0.22903, SE = 0.10012, p = .0223). This implies that larger firms, although they have the potential for economies of scale, may have higher costs of capital, perhaps because of greater complexities and risk exposure of larger operations. On

the other hand, Leverage (LEVG) is negatively related to WACC, with (β = -1.35636, SE = 0.21, $p < .001$), which implies that higher debt ratio, which is most often cheaper than equity, may decrease the overall cost of capital.

In addition to the regression analysis, the model fit metrics give other insights. A fixed effects model yields an R-squared value of 0.691, meaning that the fixed effects model explains a large portion of the variability in WACC. The overall significance of the model is confirmed by the F-statistic (7.251, $p < .001$), indicating that the estimated relationships are reliable. In addition, the Durbin Watson statistic of 1.825 implies that there is no major problem of autocorrelation of residuals across time, therefore indicating independence of residuals across time.

These results highlight the importance of ESG factors, firm size, and financial structure in determining the cost of capital in the manufacturing sector of Sub-Saharan Africa overall. Given these dynamics, stakeholders such as financial managers and policymakers should take into account when devising strategies for maximizing financial performance and promoting sustainable practices in the region.

5. Discussion of findings

The positive coefficients for both environmental (ENDS) and social (SODS) factors indicate that positive changes in these areas are initially associated with an increase in the cost of capital. This is consistent with the Stakeholder Theory that stakeholder investments to broaden stakeholder engagement (e.g. environmental stewardship and social responsibility) may lead to higher up front costs. The presence of these costs can increase the perceived financial risk in the short term, and as a result, increase the WACC (Freeman, 1984). While these investments are likely to create short term costs, they are likely to generate long term benefits by building company reputation and stakeholder trust that can then help lower capital costs. This interpretation is supported by empirical evidence from the work of López, Arce, and Munoz (2023) that shows that firms with strong ESG practices receive socially responsible investments, face lower cost of equity and debt, and therefore lower overall capital costs.

On the contrary, the negative coefficient of governance (GODS) indicates that a good governance practice significantly reduces the cost of capital. Consistent with Agency Theory, which posits that well functioning governance mechanisms mitigate agency conflicts between shareholders and managers, thus reducing agency costs and perceived investment risk (Jensen & Meckling, 1976), this finding suggests that the increased use of outside directors is perceived as a way of reducing agency conflicts and associated agency costs. Governance that is effective, though, improves transparency and accountability and makes firms appear less risky, and thus more attractive to investors. Empirical evidence by Dube and Sarpong (2022)

also shows that, improved governance practices are associated with lower financing costs, which can be attributed to better risk management and alignment of interest with shareholders.

This positive correlation between firm size and WACC may suggest that larger firms, whilst enjoying the advantage of economies of scale, experience higher capital costs because of higher complexities and systemic risks. Partially, the Resource Based View (RBV) can explain this phenomenon, by which the larger firms have unique resources, but also increase the operational complexities and the risks, and therefore, the capital costs (Barney 1991). However, the negative relationship between leverage and WACC indicates that higher leverage is associated with a higher proportion of cheaper debt in the capital structure and therefore can lower the overall cost of capital. This is consistent with the Signaling Theory whereby firms that effectively manage their leverage provides positive signals to the market about the firm's financial stability and operational efficiency (Spence, 1973). This view is supported empirically by Nguyen and Vu (2023), who show that firms with transparent financial strategies (including effective leverage management) perform better financially and have lower capital costs.

6. Conclusion and Recommendations

Conclusion:

This study examines the impact of Environmental, Social, and Governance (ESG) factors, firm size and leverage on Weighted Average Cost of Capital (WACC) of manufacturing firms in Sub-Saharan Africa using panel regression analysis. The main findings are explained using established theoretical frameworks including Stakeholder Theory, Agency Theory, Signaling Theory and the Resource-Based View (RBV) to provide explanations for the complicated dynamics that affect financial metrics in the region. Initially, Environmental and Social factors will add to the cost of capital because of the associated investments and perceived risks, but will create long term stability and reputation, which could lead to a decrease in capital costs over time. On the contrary, better governance implies lower costs of capital as good governance reduces agency conflicts and provides more transparent corporate information so that the risk is perceived to be smaller and consequently favorable financing conditions are obtained. Further, the analysis reveals that WACC is higher for larger firms, possibly because of the higher complexities and risk profiles. On the other hand, the higher leverage in the form of higher use of debt results in lower WACC, suggesting that debt financing is a cost effective strategy.

Recommendations:

Based on these insights, several strategic recommendations can be made to optimize capital structures and leverage ESG practices for enhanced financial and operational benefits:

- Firms should invest robustly in comprehensive ESG strategies, but with a special emphasis on governance. Environmental and social initiatives should be considered as long term investments that build corporate reputation and stakeholder trust, which over the longer term should deliver financial benefits, for example, through lower capital costs.
- The first priority should be to improve governance mechanisms that align the interests of managers with those of shareholders and reduce agency costs. Governance directly lowers the cost of capital by reducing the perceived risks of investors.
- Leverage ratios must be managed so as to maintain the sweet spot between debt and equity. Debt lowers the cost of capital, but too much leverage can create a lot of financial risk. Firms should compromise to minimize capital cost as well as financial stability.
- Specific strategies should be developed by larger firms to manage the complexities and systemic risks of their operations. This might include use of advanced risk management tools and more structured corporate governance practices.
- Transparency in reporting and monitoring ESG practices and financial metrics continuously is critical. Not only does this help make better management decisions, but it also makes it easier for the firm to be credible and attractive to investors.
- It requires active engagement with all stakeholders, including local communities, regulators and investors. This engagement will help the firm to better understand and address the concerns and expectations of these groups, thus improving the firm's reputation and operational stability.

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