ASSESSING THE IMPACT OF INTELLECTUAL CAPITAL EFFICIENCY ON FINANCIAL PERFORMANCE OF LISTED MANUFACTURING FIRMS IN NIGERIA

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Abstract
This study examines the relationship between intellectual capital efficiency and the financial performance of listed manufacturing firms in Nigeria, grounded in the resource-based view (RBV) theory. Utilizing the Modified Value-Added Intellectual Coefficient (M-VAIC) model, the research analyzed panel data from 27 firms over a 13-year period (2012-2024). Although the Hausman test favored a Random Effects model, a Fixed Effects model with Clustered Robust Standard Errors was adopted to rigorously control for significant groupwise heteroskedasticity detected in the manufacturing sector. The empirical results reveal that structural capital efficiency is the sole significant and positive predictor of financial performance ($\beta=0.221$, $p<0.01$). Conversely, while human capital efficiency shows a high mean value, its impact on performance is positive but statistically insignificant ($p=0.125$) in the robust model, likely due to labor cost volatility and brain drain. Furthermore, capital employed and relational capital efficiencies demonstrate no significant relationship with Return on Assets (ROA). The findings suggest that Nigerian manufacturers should prioritize institutional systems and process innovation over traditional physical asset accumulation to enhance profitability.

Keywords: Intellectual capital, manufacturing firms, financial performance, M-VAIC

1.0 Introduction
As the modern business world settles into knowledge-based competitive age, the organizational value creation capabilities largely dependent on its efficient application of knowledge-dependent assets (Chowdhury et al., 2019). In their quest for competitive superiority, organizations are no longer solely relying on physical and financial resources only, hence attention has shifted to other additional competitive edges in form of recognizing and enhancing the value of intangibles. Entities with skilled and educated employees (human capital-HC), methodical systems and technological procedures (structural capital-SC), and good stakeholder engagement (relational capital-RC) are well positioned to outperform their competitors

Further, the conventional accounting approach is seen incapable of reflecting the fair financial view of the modern business world where intangible assets account for a significant portion of firms' financial performance. This one-sidedness is seen to have led to ill-informed investment decisions. Finding a fitting system to properly recognize and value intangibles becomes a concern for various

stakeholders. Consequently, this study was motivated to measure IC efficiency as used in Nimtrakoon (2015).

In the literature a clear distinction has been established as to why entities exist. For instance, while the nonprofit entities are established to advance a common good, the profit-oriented entities exist to reward the effort of shareholders. The same distinction could be visibly seen in the practical operations of the different entities based on their orientation. In achieving entities' objectives there is an underlying rule that requires operations to utilize the best mixture of tangible and non-tangible assets. Therefore, in the ever-changing landscape of modern-day business, the importance of intellectual capital (IC) as a crucial resource has gained wide popularity in the literature because it (IC) facilitates the production process where goods are produced. This multipart action is central to the generation of sales revenue and earning profits for which the profit-oriented entities existed to achieve. On the other hand, financial performance represents organizational ability to generate earnings in excess of the costs and expenses it incurred. This ability signifies the organizational efficiency of translating inputs into valuable outputs which is, in part, facilitated by IC components (Lieberman, 2021).

The important role being played by the manufacturing industry in Nigeria cannot be emphasized enough. It provides critical support to the overall economy by creating jobs which in turn contributes to GDP growth. This sector is crucial to the economic diversification effort being pursued by this and other administrations before it. Additionally, the sector has been tipped to possibly increase Nigeria's export potential and boost foreign exchange earnings. The sector accounted for 13% of total employment in Nigeria in 2024(Ajayi, 2024) the Nigeria Exchange Group (NGX) revealed that about 44 companies, with a combined value of approximately N350 billion were removed from the official daily list. Part of the reason for the decline in the fortune of these companies was linked to the erosion of their competitive advantage (Oji, 2024).

The intention of this study is to empirically examine the intellectual capital efficiency and financial performance based on MVAIC model as in Nimtrakoon (2015). This study considered ROA to estimate firm financial performance as it is believed to be appropriate because it shows the efficiency of assets (both tangible and intangible) in adding value to shareholders' wealth. Additionally, this paper also seeks to contribute to the strategic management literature strand by further disclosing the function of intangible resources in increasing firm's financial performance.

The findings of this paper are expected to be of interest to wide array of stakeholders including financial analysts, investors and regulators to mention a few. Using the fixed-effects model with clustered robust standard errors, the study found that IC has a significant positive effect on firm financial performance.

To understand this relationship the following hypotheses were tested

H_{01}: Human capital efficiency has no statistical effect on financial performance in Nigeria listed manufacturing firms
H_{02}: Structural capital efficiency has no statistical effect on financial performance in Nigeria listed manufacturing firms
H_{03}: Relational capital efficiency has no statistical effect on financial performance in Nigeria listed manufacturing firms
H_{04}: Capital employed efficiency has no statistical effect on financial performance in Nigeria listed manufacturing firms

2.0 Review of Related Literature and Theoretical Framework

Financial performance is a multidimensional view, one of such views is that it explains organizational efficiency in how it manages its resources in generating profits from assets deployed for that purpose (Xu & Li, 2022). Again, financial performance is viewed to be at the center of understanding the economic health of an entity, its viability as well as the determiner of its continued existence (Maletič & Maletič, 2021). In another view, financial performance represents organizational capability to generate earnings in excess of incurred costs and expenses. Therefore, it is an understatement to regard financial performance asvital indicator of the efficiency with which entities' conducts their operations (Lieberman, 2021).

Osazefua (2020) sees financial performance as directly influencing the wider health of an organization by maintaining liquidity, solvency, and overall organizational stability. In the study of Aziz(2023) financial performance is viewed at the center of informing strategic decision-making, providing guidance on resource allocation, helping in deciding between available investment alternatives. Consequently, a profitable organization is better positioned to go in for growth opportunities and pass-through economic challenges. Another positive effect of profitability is that it enhances shareholders' confidence in the organization's ability to generate sustained value (Kadim & Husain, 2020).). Lastly, it can be deduced that organizations that innovate in products and processes stand to gain a competitive edge which could translate into driving profitability and thereby increasing financial performance.

Concept of Intellectual Capital

Decades ago, in its infancy stage, the likes of (Sveiby, 1997; Stewart, 1997; Edvinsson & Malone, 1997; Bontis, 1998) through rigorous academic inputs, positioned intellectual capital as an important asset for companies. Their observations were later validated by the fact that production processes, and the global economy were heading towards knowledge-based stage. Those earlier works that highlighted the significance of IC, ultimately led to further academic efforts on how best it should be measured, managed, and reported (Giuliani & Chiucchi, 2019). The intellectual capital literature is full of different views on what best defines IC, each emphasizing different aspects. However, from all the definitions offered what is clear is that this capital has a part to play in increasing shareholders' wealth thereby enriching entities' value.

The debate on how to capture intellectual capital further expands on the components to be included in the attempt to measure this intangible aspect of firms. After the initial offering by Public (2000) to categorize IC as containing human, structural and capital employed, many other considerations were put forward, for instance Bueno et al. (2004) asserted that IC contains five elements (human, organizational, technological, social, and relational capitals). Lately, innovation capital (Bontis, 1998) and spiritual capital (Zohar & Marshall, 2004) were also studied as constituents of IC. However, this study opted to use the model with relational capital as in Nimtrakoon (2015).

Firstly, human capital, this particular asset is seen as workers-related constituents it captures the talents, proficiencies, and experiences found in employees. HC signifies the knowledge and skills firms' employees have acquired over the years which can improve the productivity of the organizations (Clarke et al., 2011). This constituent of IC is embedded in workers and can only be considered an asset belonging to an organization so long as those employees are under its payroll. Consequently, it has been tutored to be the most important asset a firm can possess.

On the other hand, structural capital could be aptly described as entrenched memory or organizational DNA. SC covers embedded organizational knowledge found in its systems that help

employees perform their functions efficiently (Forte et al., 2019). This organizational capital includes all knowledge-based resources that stays in the organization after its workers have clocked out for the day. In addition, SC is remarkably different from HC in the sense that later walks out while the earlier stays behind all day and every day. It also unites other constituents of IC because it enables organizations to create a replicable model that allow them to improve their operations and function steadily instead of depending solely on employees' efforts (Edet et al., 2023)

Moreover, relational capital describes the deployment of organizational assets concerned with the development and improvement of external relationships. This capital is likened to a bridge that links organizations and stakeholders because it is structured on excellence and depth of connections with the outside world. Whereas human capital was described as knowledge embedded in employees and structural capital as the environment and systems that support their knowledge, relational capital is the belief, devotion, and reverence that goes into every contact with customers, suppliers and partners (Edet et al., 2023). This capital goes beyond brand name, it is also adds to organizational reputation every time a commitment is made and kept towards stakeholder engagement. Additionally, RC comes from organizational effort to show a real sense of being part of the wider community and ability to demonstrate remarkable capacity to develop and sustain cooperation between people, systems and organizations (Izzo et al., 2020).

Empirical review

Eweroke (2018) conducted a study in Nigeria's pharmaceutical sector from 2004 to 2013 using Pulic's (2000) VAIC. The study found that human capital efficiency shows a positive effect on firm value. While, Anidebe et al. (2021) studied listed industrial goods companies over a ten-year period and found that higher investments in research and development have helped in the improvement of existing products, creation of new products and innovation of the production processes of industrial goods companies thereby improving financial performance. Additionally, Iorun et al (2021) investigated the relationship between Intellectual Capital efficiency and Financial Performance of listed consumer goods firms in Nigeria. The results revealed that all the four IC components considered in his study have significant relationships with financial performance. Equally in Rufus et al. (2022), using 35firms listed on the Nigerian ExchangeGroup over a ten-year period found a significant positive impact between IC efficiency and financial performance. Similarly, Hudu et al. (2023) investigated the effect of intellectual capital efficiency on performance of listed industrial goods firms in Nigeria over the period of 2017-2021. The findings from the analysis showed that apart from human capital efficiency, all other components showsignificant positive effect on financial performance.

Theoretical framework

Resource based view theory posits that profit oriented firms should follow unique strategies, plans and procedures to reinforce their existence in an ever-changing business environment. The philosophy behind RBV implies that the attainment of competitive advantage and significant performance is contingent upon acquisition and efficient usage of unique resources (Soewarno and Tjahjadi, 2020). A deeper reflection on this theory suggests that the rare the organizational assets the superior its performance. Weqar & Haque, (2020) lend support to this reflection as they opined that in today's knowledge-intensive economy, intangible assets fits this "rarity" criteria because tangible assets are easily replicable., Furthermore, proposes that the RBV theory should be considered in studies that are dealing with valuable, uncommon, inimitable and non-substitutable resources. Consequently, this paper opted for RBV as it lays a foundation of understanding how Nigeria's manufacturing firms can use their inimitably developed capabilities to achieve higher financial performance. The Resource-Based View (RBV) serves as the foundational theoretical

lens for this study, positing that a firm's ability to achieve and sustain superior financial performance depends on its acquisition and efficient deployment of unique, strategic resources. Within the context of the Nigerian manufacturing sector, RBV shifts the focus from external market positioning to the internal portfolio of assets as the primary driver of value.

3.0 Methodology

This paper employs a quantitative explanatory research design by using panel data regression techniques to investigate the effect of intellectual capital efficiency on firms' financial performance. This panel-inclined data methodology is considered suitable since it controls for unobserved firm-specific heterogeneity and increases estimation efficiency by combining cross-sectional and time-series dimensions (Baltagi, 2021). By utilizing both inter and intra firm variations, this estimation technique lowers omitted variable bias and yields more consistent parameter estimates compared to purely cross-sectional models.

Population and Sample

The population of this study includes all listed manufacturing firms under Nigeria Exchange Group (NGX). The final sample comprises of 27 firms observed over the period from 2012–2024, thus producing 351 firm-year observations. The study period begins in 2012 to ensure post-IFRS reporting consistency and ends in 2024. An unbalanced panel structure is utilized because of differences in firm listing periods and reporting completeness.

Table 1:
Population and Sample

Item	Description
Population	All listed Nigerian manufacturing firms
Sample Size	27 firms
Time Period	2012–2024 (13 years)
Total Observations	351 firm-year observations

Source: Authors compilation, 2026.

Data Source

The data for this study is from secondary source which was extracted from audited annual financial statements of the sampled firms. And the variables of the study were computed directly from published reports to ensure reliability.

Measurement of Variables

Dependent Variable:

Firm financial performance is proxied by Return on Assets (ROA), measured as net income divided by total assets. ROA is widely used in intellectual capital research as an accounting-based performance measure (Pulic, 2000).

Independent Variables:

Intellectual capital components are measured using the Modified Value-Added Intellectual Coefficient (MVAIC) model used in Nimtrakoon (2015). The components include Human Capital Efficiency (HCE), Structural Capital Efficiency (SCE), Relational Capital Efficiency (RCE), and Capital Employed Efficiency (CEE). HCE is computed as value added divided by human capital expenditure. SCE is calculated as structural capital divided by value added. RCE captures relational value-added efficiency consistent with extended VAIC approaches. CEE is measured as value added divided by capital employed.

Model Specification

The baseline econometric model is specified as follows:

$$ROA\ it = \beta O + \beta 1HCE_it + \beta 2SCE_it + \beta 3RCEit + \beta 4CEEit + \beta 5LEV_it + \mu_i + \varepsilon_it$$

Where;

i represents firms

t denotes time

μ_i captures unobserved firm-specific effects

ε_it is the idiosyncratic error term.

Estimation Techniques

The study initially estimates pooled Ordinary Least Squares (OLS) as a benchmark model. Subsequently, Fixed Effects (FE) and Random Effects (RE) estimators were used. The FE estimator controls for time-invariant firm-specific characteristics (Wooldridge, 2010), while the RE estimator assumes no correlation between regressors and unobserved effects (Greene, 2018). Model selection between FE and RE is determined using the Hausman (1978) specification test. A non-significant test statistic indicates preference for the RE model.

Diagnostic Tests

Variance Inflation Factor (VIF) is employed to assess multicollinearity. Panel stationarity is examined using the Levin–Lin–Chu unit root test (Levin et al., 2002). Groupwise heteroskedasticity is tested using the Modified Wald test, while serial correlation is assessed using the Wooldridge test for autocorrelation in panel data. Given evidence of heteroskedasticity, the FE model is re-estimated using Fixed Effects model with Robust Standard Errorsat the firm level to ensure consistent inference (Wooldridge, 2010).

4.0 Results and Discussion

Descriptive Statistics

The descriptive statistics for the 27 listed manufacturing firms over the period 2012-2024 (351 firm-year observations) are presented in the table below.

Table 2:

Descriptive Statistics

Variable	Mean	Standard Deviation	Min	Max
ROA	0.0806	0.1281	-0.5401	0.7927
HCE	3.0215	1.7154	-7.5432	9.3251
SCE	0.3866	0.1662	-0.4215	1.0399
RCE	0.1467	0.1541	0.0020	1.5203
CEE	2.5113	2.1882	-8.6287	9.5628

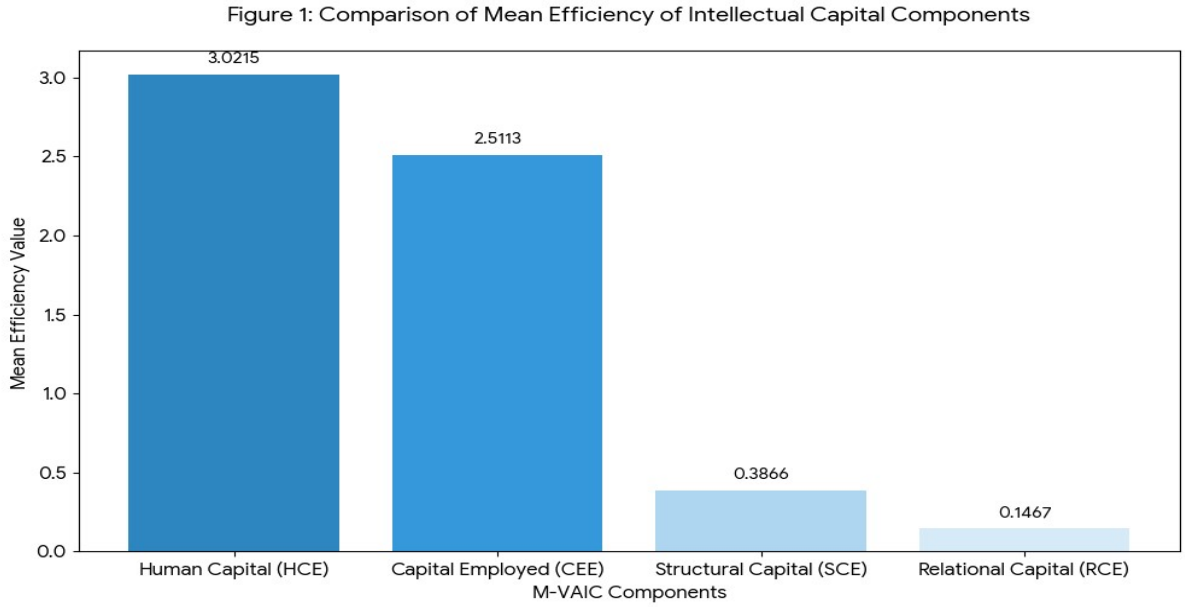
Source: Author's computation 2026.

The Return on Assets' mean of 8.06% points to a sector that is generally profitable, though the wide range between the minimum and the maximum (-54% to 79%) indicates significant performance volatility among the studied firms. Notably, human capital efficiency has the highest mean (3.0215) among the M-VAIC components, suggesting that manufacturing firms invest heavily in human resources. However, the relatively low mean of structural capital efficiency

(0.3866) suggests that many firms have yet to fully institutionalize their knowledge into robust internal systems.

Figure 1: Mean Efficiency of Intellectual Capital Components

Below is the component comparison chart in the Nigerian manufacturing sector.



As illustrated in Figure 1, there is a significant disparity between the high levels of Human Capital Efficiency (HCE = 3.02) and the relatively low levels of Structural Capital Efficiency (SCE = 0.39). This visual gap underscores the study's finding that while Nigerian manufacturing firms invest heavily in human resources, they have yet to effectively translate that talent into institutionalized organizational systems.

Correlation Analysis

Table 3:

Pearson correlation matrix

Variables	(1) ROA	(2) HCE	(3) SCE	(4) RCE	(5) CEE
(1) ROA	1.000				
(2) HCE	0.6909*	1.000			
(3) SCE	0.5658*	0.5846*	1.000		
(4) RCE	-0.1558*	-0.1948*	-0.2258*	1.000	
(5) CEE	0.2922*	0.5713*	0.1058*	-0.0355	1.000

**Significant at 5% level*

Source: Author's computation 2026.

The Pearson correlation matrix (Table 2) indicates a strong positive relationship between HCE and ROA (r = 0.69) and SCE and ROA (r = 0.56). This preliminary finding suggests that as intellectual capital efficiency increases, financial performance tends to follow. Moreover, the result for Pearson correlation matrix revealed that the DV (ROA) is positively and significantly related to HCE (r =

0.691, $p < 0.01$), SCE ($r = 0.566$, $p < 0.01$), and CEE ($r = 0.292$, $p < 0.01$). Conversely, RCE shows a weak negative correlation in its relation with ROA ($r = -0.156$, $p < 0.01$).

Diagnostic Tests and Model Selection

Table 4:

Summary of Post Estimation Tests

Test	Statistic	P-value	Rationale
Hausman Test	2.23	0.6941	Determines if Fixed or Random Effects should be used. P > 0.05 favors Random Effects (though we used FE Robust for stringency).
Modified Wald Test	3313017.43	0.0000	Tests for Heteroskedasticity. The significant result confirms variance is inconsistent across firms.
Wooldridge Test	0.226	0.6385	Tests for Autocorrelation. The insignificant result shows no major first-order correlation issues.
Mean VIF	1.76	—	Confirms no Multicollinearity (VIF < 10).

Source: Author's computation 2026.

To ensure the reliability of the estimates, several diagnostic tests were conducted. The Modified Wald Test for groupwise heteroskedasticity yielded a Chi-square value of 3,313,017.43 ($p=0.000$), indicating a severe violation of the homoskedasticity assumption. The Wooldridge Test for autocorrelation ($p=0.6385$), however, suggests that first-order serial correlation is not a concern.

Regarding model selection, the Hausman Test resulted in a p-value of 0.6941. While this statistically Favors the Random Effects (RE) model, the presence of extreme heteroskedasticity necessitated the use of the Fixed Effects (FE) model with Clustered Robust Standard Errors. This approach ensures that the standard errors are adjusted for firm-level clusters, providing more conservative and reliable p-values for hypothesis testing. Again, this choice is a precautionary diagnostic measure because while the Hausman test suggests no correlation between the error term and regressors, the Modified Wald test showed extreme heteroskedasticity ($\chi2=3,313,017.43, p=0.0000$). This justifies the FE Robust model as it provides more reliable, conservative estimates in the presence of non-constant variance, which is common in volatile markets like Nigeria

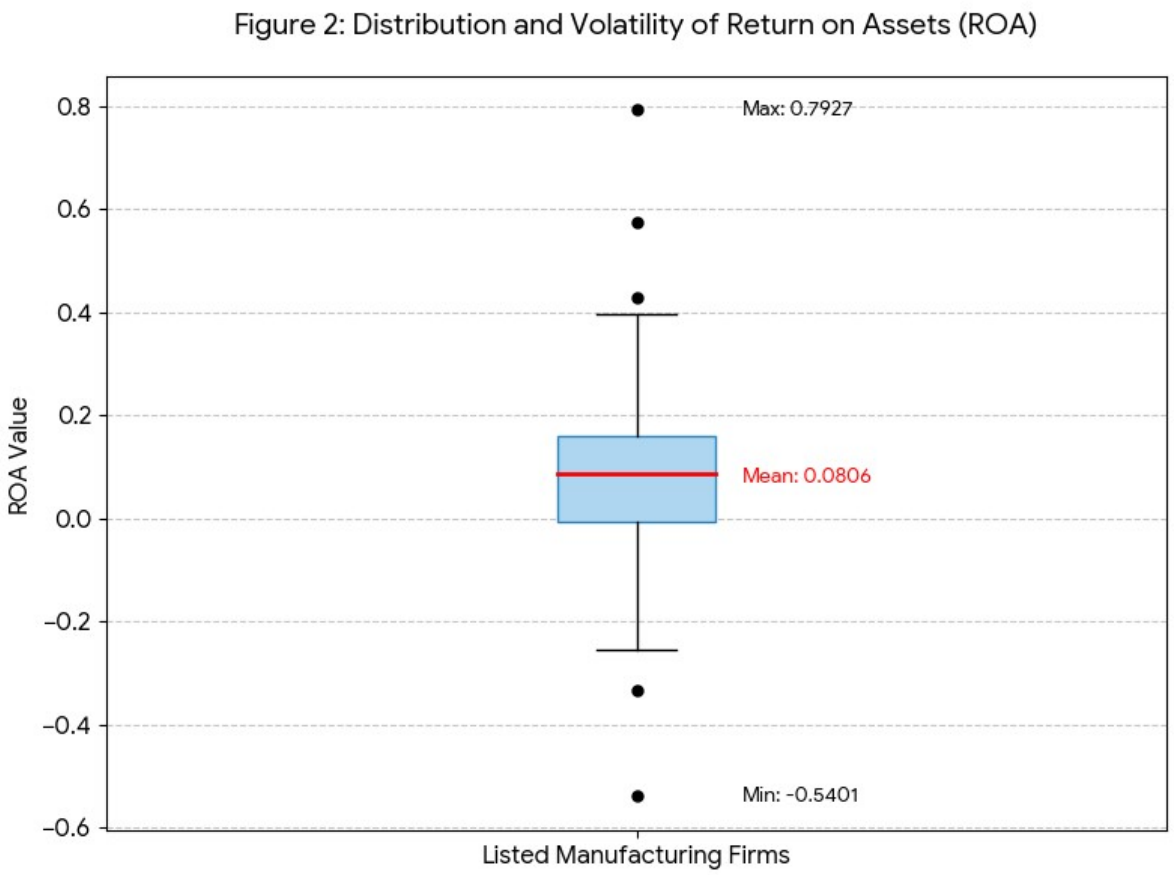


Figure 2 above visually illustrates the extreme volatility within the Nigerian manufacturing sector during the study period. The presence of significant outliers (ranging from -54% to +79%) and the wide interquartile range provide empirical justification for the significant heteroskedasticity detected by the Modified Wald Test ($\chi 2$=3,313,017.43, p=0.0000), thereby validating the use of a Fixed Effects model with robust standard errors."

Regression Results

The table below summarizes the results of the Robust Fixed Effects regression:

Table 5

Regression Results (Fixed Effects Robust)

Dependent Variable: ROA

Independent Variables	Coefficient	Std. Error	t-statistic	P-value
HCE	0.0329	0.0207	1.59	0.125
SCE	0.2210	0.0718	3.08	0.005*
RCE	-0.0091	0.0491	-0.18	0.855
CEE	-0.0008	0.0215	-0.04	0.971
Cons	-0.1009	0.0348	-2.90	0.007
R-Squared (Within) 0.4850				
F-Statistic | 58.59 | 0.0000				

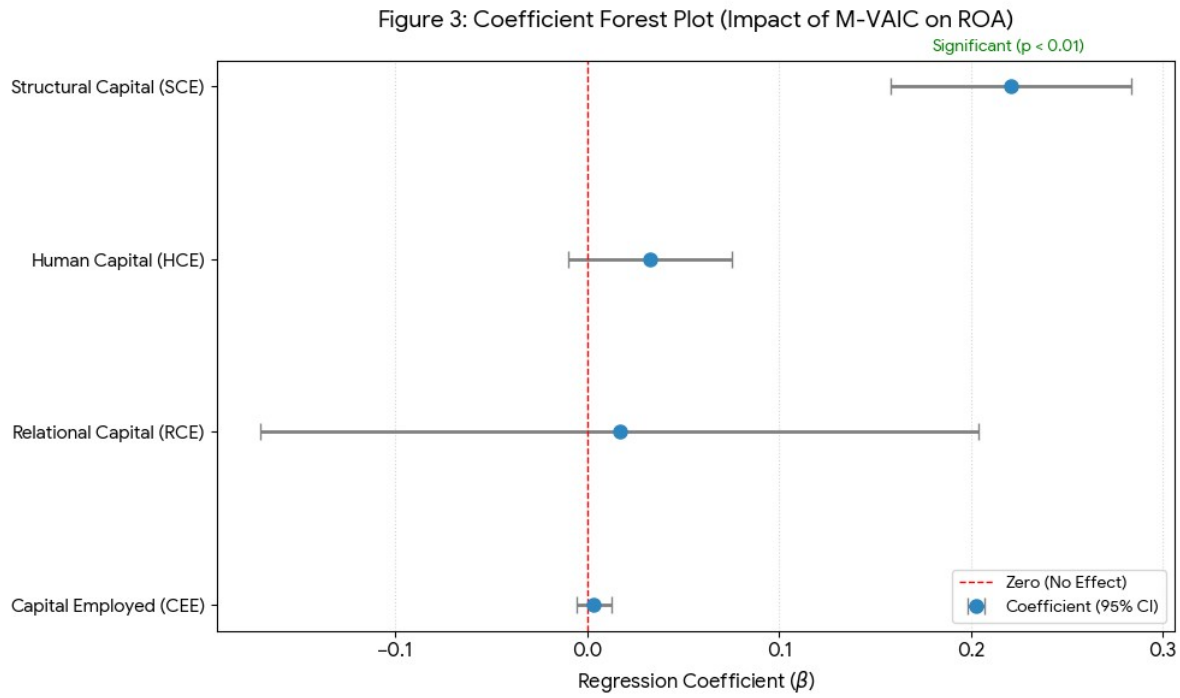
Source: Researcher's computation (2026).*Significant at 1% level

Discussion of Findings

The empirical results provide a nuanced view of how intellectual capital drives value in Nigeria's manufacturing sector. First of all, structural capital efficiency (SCE) and Financial Performance: The study found that SCE has a positive and highly significant impact on ROA ($\beta=0.221$, $p<0.01$). This implies that for every unit increase in structural capital efficiency, financial performance increases by approximately 22.1%. This confirms that manufacturing firms with superior internal processes, databases, and organizational structures are better positioned to convert intellectual resources into tangible profits (Lestari & Adhariani, 2022; Ayu et al., 2024). This aligns with the Resource-Based View (RBV), suggesting that "stored" organizational knowledge is a key competitive advantage (Tran &Vo, 2022; Zuliyati & Rahayu, 2024). Structural Capital Efficiency (SCE) emerged as the most significant predictor of performance ($\beta=0.221$, $p<0.01$). Within the RBV framework, SCE represents the "Organized" component—the internal systems, databases, and automation that allow a firm to institutionalize knowledge so it remains even after employees leave.

Secondly, contrary to some prior studies (Ousama & Fatima, 2015; Ayu et al., 2024; Urban et al, 2026) HCE was found to have a positive but statistically insignificant effect on ROA ($p=0.125$). While the raw data shows that firms spend significantly on staff, this investment does not automatically translate into bottom-line growth. This may be attributed to the "brain drain" phenomenon or high labour turnover in the Nigerian manufacturing sector, where the value created by skilled employees is lost to the firm before it can be fully realized. This is a major finding of this paper as it shows that manufacturing firms in Nigeria are spending but not gaining from their workforce which is further confirmed by high significance at ($p=0.005$). This has been previously argued by Lestari & Adhariani, (2022) that without strong internal systems (SCE), the value created by employees (HCE) is lost out of the firm due to turnover or inefficiency. While the study shows high investment in human capital (HCE mean of 3.02), this resource alone did not yield significant financial returns ($p=0.125$). This suggests that while human talent is valuable and rare, it is insufficient for competitive advantage if the firm is not proper structured to capture that value.

Lastly, both RCE ($p=0.855$) and CEE ($p=0.436$) were found to be insignificant. The lack of significance for this component suggests that in the modern knowledge economy, the mere possession of physical and financial capital is no longer a primary differentiator for performance (Ogah & Oladele, 2024). Similarly, the insignificance of relational capital suggests that external relationships may not be as critical to ROA as the efficiency of internal structural systems in the current operating environment (Nadeem et al., 2023).The insignificance of Capital Employed Efficiency (CEE) suggests that physical machinery is no longer a "Rare" or "Inimitable" resource in the Nigerian manufacturing landscape, as these assets can be purchased by any competitor with sufficient funding. True competitive advantage now lies in the "inimitably developed capabilities" found in a firm's structural systems.



As depicted in Figure 3, Structural Capital Efficiency (SCE) is the only variable whose confidence interval does not cross the zero threshold, confirming its status as the sole significant driver of financial performance in the model ($\beta=0.221, p<0.01$). In contrast, the error bars for Human Capital, Relational Capital, and Capital Employed all encompass zero, visually reinforcing their lack of statistical significance when controlling for firm-specific heterogeneity and heteroskedasticity.

5.0 Conclusion and Recommendations

This study investigated the impact of intellectual capital efficiency on the financial performance of listed Nigerian manufacturing firms over a 13-year period (2012–2024). Grounded in the Resource-Based View (RBV) theory, the empirical evidence demonstrates that intellectual capital is a fundamental driver of corporate success in the Nigerian context. However, the results indicate that this impact is not uniform across all components of the M-VAIC model.

The most critical finding is that Structural Capital Efficiency (SCE) serves as the primary and most significant predictor of financial performance. This suggests that for Nigerian manufacturers, the strength of internalized systems, proprietary knowledge, and operational processes is more influential in driving profitability than traditional physical assets. While the descriptive data shows high investment in personnel, Human Capital Efficiency (HCE) proved statistically insignificant in the robust regression model. This implies that without robust structural support, high-cost human resources fail to consistently translate into superior financial returns, potentially due to external macroeconomic pressures like brain drain and rising labor costs. Furthermore, the insignificance of Capital Employed Efficiency (CEE) and Relational Capital Efficiency (RCE) highlights a strategic shift; firms are moving away from an era where heavy machinery and traditional stakeholder ties alone guaranteed a competitive edge, toward an era of institutional intelligence and process automation.

Recommendations

Based on the empirical findings, the following recommendations are proposed. Generally, the empirical evidence indicates that manufacturing firms seeking improved financial performance should prioritize investments in structural capital like internal knowledge systems, operational efficiency, and process innovation. Additionally, firms, should continually conduct Skills-Audit to ensure that the high cost of labor is actually being utilized by the company's structural systems to produce value, as indicated by the HCE being insignificant in this study. To the management, there is need for more focus to be shifted from purely hiring the best people only, to building and improving the best systems that remain with the firm even if staff leaves. Lastly to the regulators, it is recommended that they should improve oninstitutional frameworks that boost intangible asset development.

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