

# Determinants of the intellectual capital efficiency of listed banks in Nigeria: a DEA approach

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## Abstract

**Purpose** – This study empirically investigates the level of intellectual capital efficiency amongst the listed commercial banks in Nigeria and the factors influencing its efficient utilisation.

**Design/methodology/approach** – The paper employs the data envelopment analysis (DEA) to determine intellectual capital efficiency for the listed banks in Nigeria using data obtained from their annual financial reports from 2013 to 2019. After obtaining the efficiency scores, the Tobit regression technique was used to analyse the impact of firm-specific factors on intellectual capital efficiency.

**Findings** – The study found that only 8.33% of the sampled Nigerian commercial banks are at optimum capacity in utilising their intellectual capital, while 91.67% are inefficient. It also finds that bank size and directors' shareholdings positively impact intellectual capital efficiency, while market and ownership concentration debar the attainment of optimum intellectual capital efficiency.

**Research limitations/implications** – This study contributes to very scarce literature on intellectual capital efficiency measurements by using the non-parametric analysis (DEA) to measure intellectual capital efficiency for listed banks in Nigeria.

**Practical implications** – This study showcases the importance of measuring intellectual capital efficiency amongst listed banks in Nigeria. It provides more information to the regulators and stakeholders on the need to enforce the disclosure of the value created from intellectual capital investment.

**Originality/value** – This study contributes to the scarce literature on measuring intellectual capital efficiency using a non-parametric analysis (DEA). It also provides new insights into the factors that influence intellectual capital efficiency amongst listed commercial banks in Nigeria.

**Keywords** Intellectual capital efficiency, Data envelopment analysis, Listed banks, Nigeria

**Paper type** Research paper

## 1. Introduction

In the last 2 decades, a drastic transition of economies has emerged, from a traditional-driven approach to a more knowledge-intensive driven approach (Ali and Anwar, 2021; Vidyarthi, 2018). The change is in line with the catch-up of economies with Industrial Revolution 4.0 with particular insights into competitiveness and value creation (Adeosun *et al.*, 2021; Ofori-Sasu *et al.*, 2019). Thereafter, knowledge became a vital tool for achieving a sustained competitive advantage for the economies and firms domiciled in such economies (Nitkiewicz *et al.*, 2014). In this modern age, this composition of knowledgeable assets in a firm has moved away from mere acquisition of highly skilled employees to more encompassing components such as structural capability development, trade secret, patent and trademarks, customer retentiveness, social responsibilities and a host of other intangible assets (Isola *et al.*, 2019; Sardo and Serrasqueiro, 2019). This intangible component within the firm is what is referred



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to as intellectual capital. Intellectual capital was first mentioned by Galbraith (1969) and later popularised by Stewart (1997). The concept has thereafter received scholarly attention in the firm performance literature due to its value relevance on firm competitiveness, growth and sustainability (Isola *et al.*, 2020; Hamdan, 2018).

Due to the sustainability goal of firms amidst increasing competition, corporate drivers are becoming more enlightened on the need to develop their intellectual capital or assets (Buallay *et al.*, 2020; Kweh *et al.*, 2021). Intellectual capital improves and sustains rare and imitable comparative advantages (Sardo and Serrasqueiro, 2019; Xu *et al.*, 2021; Wang *et al.*, 2014). Furthermore, it builds organisational competencies as well as drives value addition. Overall, intellectual capital improves firms' productivity, growth and sustainability (Kamukama, 2013). Although intellectual capital development poses significant advantages to firms with massive investment in it, measuring its efficiency is essential to their survival and sustainability. Measuring intellectual capital efficiency assists the corporate drivers in making decisions on the optimal utilisation resources for performance improvement (Jamsidy *et al.*, 2014).

Despite the importance of intellectual capital to firm performance, the complexity in measuring its efficiency becomes elusive. Ratio analysis is one of the most exhaustive measures of intellectual capital efficiency adopted in the literature (Anifowose *et al.*, 2018; Isola *et al.*, 2020; Kweh *et al.*, 2021). The ratio analysis measure of intellectual capital uses the ratio of human, structural and relational intellectual capital to the firms' value-added. The ratio analysis as a measure of efficiency may not be an appropriate measure because of its partial and subjective nature. Hence, the ratio analysis approach of measuring efficiency may provide misleading findings. In light of this, the measure of intellectual capital efficiency through the data envelopment approach (DEA) may be more appropriate. DEA, which is a non-parametric measurement approach, can conveniently extend the ratio analysis to accommodate the interactions between multiple inputs and outputs (Feroz *et al.*, 2003).

In developed countries, numerous studies (Jamsidy *et al.*, 2014; Mohd-Ariff *et al.*, 2016; Sardo and Serrasqueiro, 2019) have examined intellectual capital implications on firm performance, and their findings pointed that intellectual capital, as a strategic resource, aids firms' competitiveness and performance. However, in the developing countries, there has been divisive pieces of evidence on the few strands of studies on the link between intellectual capital efficiency and firm performance (Anifowose *et al.*, 2018; Kweh *et al.*, 2013; Olunifesi and Bontis, 2012). For instance, Anifowose *et al.* (2018) found that intellectual capital efficiency positively influences firms' performance for firms in Nigeria. Olunifesi and Bontis (2012), on the other hand, observed that intellectual capital management does not have any influence on the performance of telecommunication companies.

Amidst mixed findings on the link between intellectual capital and firm performance, it is imperative to understand the factors that enhance firms' efficient utilisation of intellectual capital. This is because the factors underlining intellectual capital efficiency may influence its impact on performance. Although the link between intellectual capital and performance has been well established in the literature, very rare studies are found on the critical examination of the factors that influenced intellectual capital efficiency. The factors that determine intellectual capital efficiency could significantly contribute to the discrepancies in the outcomes of studies on the link between intellectual capital and firm performance. Secondly, the use of DEA as a measure of efficiency has not been widely explored in the intellectual capital efficiency literature. Hence, this study intends to measure intellectual capital efficiency through the DEA approach. It further un-riddles the determinants of the intellectual capital efficiency of banks in Nigeria. Hence, this study contributes to the literature by being the first to measure the degree of efficient utilisation of intellectual capital for commercial banks in Nigeria. Secondly, it contributes to the scarce literature on the factors that influence intellectual capital efficiency of listed commercial banks in Nigeria.

The rest of the study is organised as follows. [Section 2](#) presents a concise theoretical and empirical review of existing studies. [Section 3](#) delves on the methodological and analytic framework of the study by justifying the use of DEA for estimating intellectual capital efficiency and Tobit regression analysis for examining its causal factors. [Section 4](#) presents the empirical findings, and the key outcomes are as follows. One, findings emanating from the non-parametric analysis insinuate that listed banks in Nigeria are not technically efficient in utilising intellectual capital. Two, the bank size and director's shareholding strongly influence the banks' intellectual capital efficiency. Three, ownership and market concentration exhibit detrimental effects on intellectual capital efficiency. Arising from the highlighted empirical discoveries, [Section 5](#) highlights the study's concluding implications and future research agenda on intellectual capital efficiency.

## 2. Review of literature

The human theory believes that firm employees are crucial assets and emphasises the need to develop them for improved productivity, growth and survival ([Tran and Vo, 2020](#)). However, the theory fails to consider the role of structural processes, procedures and databases as critical components that enhance the performances of human capital. Furthermore, it fails to explain the influence of the social and customer interrelationship with the organisation as another critical element to the productivity and growth of the organisation. An improvement in human capital theory was explained by the organisational learning theories, resource-based theory and resource-dependency theory. The resource-based theory lays particular importance on the development of internal resources for optimal firm performances ([Anifowose et al., 2018](#); [Bayraktaroglu et al., 2019](#); [Isola et al., 2020](#)). The internal resources are both the human and structural capabilities in the organisation. Although the theory lays credence to efficient utilisation of resources within an organisation, it fails to point to the significance of the firms' relationship with external resources such as the customers, regulators and society ([Cenciarelli et al., 2018](#)). The external resources, when built up, create intangible assets in terms of social or relational capital to the firms. On the other hand, the resource-dependency theory links the performances of firms to the intangible resources accumulated through the firm's external relations.

Empirically, studies on the efficient utilisation of the company's intangible resources have continued to attract increasing attention due to its importance to the growth and survival of firms. The findings of the studies are therefore mixed. For instance, [Vidyarthi \(2018\)](#) assessed the impact of intellectual capital on banks' performances in India. Using the DEA and Tobit regression, the study found that intellectual capital exhibited a positive and significant impact on banks' technical, allocative and scale efficiencies in India. Similarly, [Kweh et al. \(2013\)](#) studied the importance of intellectual capital on the operational efficiency of non-life insurance firms in China. The study employed the DEA and the ordinary least squares (OLS) regression for its analysis for the period between 2006 and 2010. It found that intellectual capital contributes significantly to the firms' operational efficiency. [Wu et al. \(2007\)](#) did a cross-sectional examination of the influence of intellectual capital on firms' performances in Taiwan for the year 2006. It was, however, discovered that only half of the firms in Taiwan are technically efficient during the period under examination. [Venugopal and Nambi \(2018\)](#) conducted a case study analysis of the impact of intellectual capital efficiency on the performance of a particular firm for twenty years. The study revealed that the firm was at full intellectual capital efficiency for only one-third of the period under investigation. On the contrary, [Nitkiewicz et al. \(2014\)](#) assessed the impact of intellectual capital across regions in Poland. The study posits that intellectual capital efficiency is not evenly distributed across the region.

Extensive empirical analysis on the implications of intellectual capital on firm performance was also explored in the developing countries, albeit with mixed outcome.

Alhassan and Asare (2016) conducted an empirical examination on the impact of intellectual capital on technical efficiency and productivity of commercial banks in Ghana. The study found that intellectual capital has positive impacts on banks technical efficiency and productivity in Ghana. Similarly, Onyekwelu *et al.* (2017) discovered that intellectual capital has a strong and positive implications of banks' performance in Nigeria. However, Mohammed and Irbo (2018) documented contrary evidence on the link between intellectual capital and performances of banks in Ethiopia. The study found that intellectual capital is weakly correlated to the returns on assets for the commercial banks in Ethiopia.

More so, Anifowose *et al.* (2018) enquired on the effects of intellectual capital efficiency on economic value added of firms in Nigeria. The study which employed the system generalised methods of moment (SYSGMM) found that intellectual capital has a positive and significant relationship on economic value added and future cash flows of firms in Nigeria. While Isola *et al.* (2019) could not ascertain the significance of intellectual capital on the listed firms in Nigeria, Olunifesi and Bontis (2012) noted that intellectual capital is weakly correlated to performances of firms in the Nigerian telecommunication industry.

Based on the different outcomes of the impact of intellectual capital on performances, scholars enquired into the factors that determine the efficient utilisation of intellectual capital. For instance, Meressa (2016) examined the determinants of the intellectual capital performance of banks in Ethiopia. The study that adopted the fixed effect regression analysis found that bank profitability and investment in ICT are the main determinants of intellectual capital efficiency. Kweh *et al.* (2013) examined the level and determinants of the intellectual capital of software companies in Malaysia. The study adopted DEA to analyse the IC efficiency levels of the companies, and later employed the OLS and Tobit regression to analyse the factors that determine the intellectual efficiency of the firms. The findings revealed that the firms are not efficient in intellectual capital utilisation. It further revealed that sales growth significantly improves the efficient utilisation of intellectual capital of the software companies. It was, however, noted that there appears to be a dearth of literature on the determinants of intellectual capital efficiency in Nigeria. This study, therefore, assesses the efficient utilisation of the intellectual capital of banks in Nigeria.

### 3. Data and method of analysis

The study employed longitudinal data to examine the determinants of intellectual capital efficiency of listed commercial banks in Nigeria. The input, output and other determining variables were obtained from the annual reports of listed commercial banks as published in the Nigerian Stock Exchange (NSE). The data span from the year 2013 through 2019. The study focuses on the listed commercial banks in Nigeria. The number of the listed banks in Nigeria stood at 23 as at the end of the 2019 financial year. The study selected only 12 listed commercial banks based on the following exclusion criteria. First, listed commercial banks that reported a negative return on assets during the study period were excluded. This is because the estimation technique for the efficiency analysis does not accommodate negative values. Second, listed banks with regional licenses are also excluded from the analysis based on the inconsistency in their financial reporting. Lastly, listed banks with 5-year data gap and those with non-availability of key variables were also excluded from the analysis. After all the exclusion criteria are carefully considered, the study considered twelve listed commercial banks as its sample size.

#### 3.1 Data envelopment analysis: a non-parametric efficiency measurement approach

Data envelopment analysis (DEA) is an efficiency measurement technique based on the linear programming composite tool for the comparison of multiple inputs and outputs of firms (otherwise known as decision-making units (DMU)). DEA allows measuring efficiency and

setting a benchmark for x-efficiency firms (Charnes *et al.*, 1978). It has been widely adopted for measuring efficiency because it allows for a multiplicity of inputs and outputs rather than the unidimensional financial ratios. The DEA is suitable for efficiency measures of the interaction of multiple indicators such as the intellectual capital components. DEA specifically projects the x-inefficient DMUs and their position on the production possibility frontiers, where inefficiency is measured in terms of input or output orientation (Kuo *et al.*, 2020). The input orientation centres on the measures to reduce production inputs, while output remains constant. On the other hand, the output orientation concerns the maximum variation of output when all the productive input is constant over time (Banker *et al.*, 2021).

In examining the efficiency levels of intellectual capital, the corporate drivers are saddled with the responsibility of deciding on the limit of intellectual capital investments that the DMUs are willing to undertake. Hence, the study applies the output orientation approach. Another cogent criterion for employing the DEA is the possibility of choosing the scale of returns of the DMUs. DEA model allows for the flexibility of choice of the returns to scale. The basic and foremost CCR (Charnes *et al.*, 1978) model assumes that the DMUs are operating at a constant return to scale, but this assertion was criticised by Banker *et al.* (2021) with the model developed to accommodate the variable returns to scale since DMUs are not operating on the same level of scale returns. Based on the above, the study applies the Banker, Charnes and Cooper (BCC) model because it overcomes the challenges of constant returns to scale (Charnes *et al.*, 1978).

Against this background, the study assumes  $\rho$  number of DMUs with  $\alpha$  series of output and  $\beta$  different inputs. Therefore,  $DMU_t (t = 1, 2, 3 \dots \dots \dots f)$  consumes  $y_{it} (i = 1, 2, \dots \dots \dots g)$  of input  $\beta$  and produces  $\Psi_{xt} (x = 1, 2, \dots \dots \dots h)$  of output  $\alpha$ . The model for the evaluation of intellectual capital technical efficiency of the banks (DMUs) stems on the works of Kweh *et al.* (2013), and it is expressed as follows:

$$\text{Maximise } \theta_o = \sum_{\alpha=1}^s \omega_r, \Psi_{x_o} \omega_o$$

Subject to:

$$\sum_{\alpha=1}^{\beta} v_i y_{it} = 1$$

$$v_i \geq 0, \omega_r \geq 0, \omega_o \text{ free in sign}$$

where  $\omega_r$  and  $v_i$  are the output and input weights,  $\omega_o$  is the equality condition and the efficiency parameter equals 1.

### 3.2 Description of variables

Following Kweh *et al.* (2013) and Lu *et al.* (2010), intellectual capital efficiency is estimated using the DEA model. The VAIC model of Pulic (2000), the most widely acceptable measure of intellectual capital, shall be adopted for this study. The model has experienced wide acceptability due to its objectivity in data collection and its ability to enhance intra- and inter-industrial comparison of firms. Despite that, the model does not proffer any information on how other factors determine IC efficiency. In light of this, the study still maintains the components as introduced by Pulic (2000) but further stratifies it into input and output variables to examine the efficiency levels of firms' intellectual capital. Intellectual capital is made up of the human capital, structural capital and the capital employed; however, Pulic (2000) expresses the IC components as a ratio of firms' value-added. Hence, the components are derived as a ratio of the value-added sum in an organisation.

The formula is expressed as:

$$\begin{aligned} \text{HCE} &= \text{value added} / \text{human capital} \\ \text{SCE} &= \text{value} - \text{added} / \text{structural capital} \\ \text{CCE} &= \text{value} - \text{added} / \text{Equity capital} \end{aligned}$$

where HCE + SCE is the intellectual capital components (ICE), while CCE is the financial/physical capital. The summation of the ICE and CCE is what is termed the value-added intellectual capital. Value-added is the difference between the operating revenue and the operating expenses (employee cost excluded). Human capital is proxy as the cost of salaries and wages; structural capital is the difference between value-added and employee cost. Equity capital is the closing value of shareholders fund for a particular year. The DEA model assumes the utilisation of particular inputs for a desired maximum output. In the estimation of value-added intellectual efficiency, the components of intellectual capital in terms of human, structural and equity capital shall be the input, while returns of equity and assets are the banks outputs.

### 3.3 Model specification

Following the need to examine the levels of intellectual capital of commercial banks in Nigeria as the factors that influence its efficient utilisation, a two-stage procedure involving DEA and regression analysis shall be employed. The explanatory variable shall be the VRS technical efficiency scores obtained from DEA, while the explained variables are firm size, market concentration, ownership and directors' shareholdings. The model for the second stage regression analysis is expressed as follows:

$$EFF_{scoreit} = \gamma_0 + \gamma_1 Firm_{it} + \gamma_1 Herf_{it} + \gamma_1 Ownc_{it} + \gamma_1 Dshare_{it} + \varepsilon_{it}$$

where  $EFF_{scoreit}$  is the variable returns to scale efficiency score obtained through the output-oriented BCC model.  $Firm_{it}$  is the size of bank expressed as the natural log of the total assets, while  $Herf_{it}$  is measures the concentration of the bank within the industry. It suggests that the position of the banks may influence their level of competitiveness.  $Ownc_{it}$  is the ratio of individual ownership to institutional ownership.  $Dshare_{it}$  is the percentage of the capital owned by the board of directors.

## 4. Empirical results

Table 1 present the descriptive behaviour of the input and output factors employed in the DEA analysis. The factor outputs are performance measures, while the factor input components of intellectual capital are the inputs. The table shows that human capital exhibits a more significant influence than structural and equity capital in terms of creating values for the firms within the period examined. Moreover, the bank has better utilisation of the

Variable description	Mean value	Std. dev.	Maximum	Minimum
Return on assets	0.02	0.02	0.08	0.00
Return on equity	0.15	0.16	1.19	0.01
Human capital efficiency	3.35	1.79	9.49	1.20
Structural capital efficiency	0.63	0.17	0.89	0.16
Equity capital efficiency	0.38	0.11	0.62	0.16

Source(s): Authors computation, 2021

**Table 1.**  
Descriptive statistics

shareholders' fund than its assets. This affirms that banks create more value through their intangible resources than their physical assets.

*4.1 Efficiency analysis of banks in Nigeria*

The efficiency scores of the selected commercial banks in Nigeria are presented in [Table 2](#). The mean technical efficiency of the banks is 58.5% for the period examined. This indicated that the banks in Nigeria are not fully efficient. The dynamic utilisation of resources amongst the banks suggests a higher efficiency level than the constant returns to scale efficiency measure. This is reflected in the 85.6 and 62.8% overall mean values of the variable returns to scale and the scale efficiency, respectively. Overall, it was suggestive from the result that the corporate drivers of the banks are inefficient in the utilisation of intellectual capital due to technical and allocative problems, as only 8.33% of the firms attained optimum technical efficiency. Technical in the sense that the managers cannot extensively deploy state-of-the-art technological and innovative tools to drive competitiveness.

The allocative deficiencies may arise as a result of issues relating to conflict resolutions. However, the banks should improve their intellectual capital efficiencies to improve competitiveness and value creation. The result aligns with the works of [Kweh et al. \(2013\)](#), who confirm that only 50% of the insurance firms in China are fully efficient in utilising their intellectual capital.

*4.2 Determinants of intellectual capital efficiency in Nigeria banks*

In determining the factors influencing the intellectual capital efficiency of commercial banks in Nigeria, it is required to establish that the covariates are not strongly correlated to reduce the problems of multicollinearity. [Table 3](#) presents a correlation analysis of the determining factors of the intellectual capital efficiency of listed banks in Nigeria. The correlation coefficient shows that all the confounding covariates are not perfectly correlated with intellectual capital efficiency. By implication, the model specified is free from running into spurious regression output because the fear of multicollinearity is allayed.

However, the ownership concentration and director shareholding positively influence the efficient utilisation of intellectual capital. From the analysis, there is no incidence of multicollinearity. The result from the OLS regression and Tobit regression is presented in

Name of banks	CRS Technical efficiency	VRS Technical efficiency	Scale efficiency
Access Bank	0.643	0.799	0.823
Diamond Bank	0.319	0.913	0.359
Fidelity Bank	0.494	0.894	0.553
First Bank of Nigeria	0.397	0.625	0.618
Guarantee Trust bank	1.000	1.000	1.000
Skye Bank	0.452	0.699	0.646
Stanbic IBTC Bank	0.466	0.751	0.558
Sterling Bank	0.725	0.970	0.739
United Bank of Africa	0.602	0.748	0.796
Unity Bank	0.568	0.988	0.641
Wema Bank	0.464	0.923	0.514
Zenith Bank	0.893	0.958	0.935
Mean efficiencies	0.585	0.856	0.682

**Table 2.**  
Efficiency scores of  
selected commercial  
banks in Nigeria

**Source(s):** Authors' compilation from DEAP version 2.1 (2021)

**Table 4.** The result shows that the bank size has a positive and robust contributory effect in influencing intellectual capital efficiency.

This may be attributed to the fact that large banks are more profitable than smaller banks; hence, they invest more in their intellectual capital stock, thus creating increased efficiency. This study contradicts the results of *Kweh et al. (2013)*, which noted that firm size is not a significant determinant of the intellectual capital efficiency of insurance firms in China. The findings further reveal that director shareholding is another critical determinant of the intellectual capital efficiency of banks in Nigeria. The result is consistent with the study's outcome by *Siti et al. (2012)*, which indicated that intellectual capital performance depends on the directors' shareholding in Malaysia.

The study further shows that market concentration has negative implications on the intellectual capital efficiency of banks in Nigeria. This may be attributed to the fact that market concentration may dissuade firm drivers from concentrating on investments in intellectual capital. This finding negates the position of *Choi (2019)*, who could not find any significant link between market concentration and firm performance. Finally, the result also revealed that the ownership concentration negatively influences the efficient utilisation of intellectual capital resources in the banking sector. The finding implies that ownership concentration may reduce the efficiency of firm resource utilisation when decisions on investment and productive activities are hijacked from the managers by the business owners. This study outcome contrasts the position of *Nashier and Gupta (2020)* who posit that ownership concentrations reduce agency cost, thus having a considerable influence on firm performance through efficient resource utilisation.

### 5. Conclusion

This study examines the level of intellectual capital efficiency and its determinants in the Nigerian banking industry. Using annual data obtained from the audited annual financial reports of the banks between 2013 and 2019, the study found that majority of the banks in Nigeria are inefficient in utilising their intellectual capital. This indicated that most of the banks

Description of variables	(a)	(b)	(c)	(d)	(e)
VRS technical efficiency	(a) 1.00				
Firm size	(b) -0.26	1.00			
Herfindahl index	(c) -0.26	0.62	1.00		
Ownership concentration	(d) 0.07	-0.54	-0.55	1.00	
Director's shareholding	(e) 0.22	-0.40	-0.26	0.36	1.00

**Source(s):** Authors' computation, 2021

**Table 3.** Descriptive analysis of the determinants of the intellectual capital efficiency of the banks

Variable description	OLS regression		Tobit regression	
	Coefficient	P value	Coefficient	P value
Firm size	0.112	0.000	0.112	0.000
Herfindahl index	-7.270	0.013	-7.270	0.008
Ownership concentration	-0.002	0.449	-0.002	0.430
Director's shareholding	0.095	0.085	0.095	0.070
R <sup>2</sup>	0.855			
Log-likelihood			26.828	

**Source(s):** Authors' compilation, 2021

**Table 4.** Empirical results on the determinants of intellectual capital efficiency in Nigerian banks



are losing value through the inefficient utilisation of their intellectual capital. The findings revealed that only 8.33% of the banks attain full capacity in utilising their intellectual capital, while 91.67% are inefficient. By implication, the findings suggests that majority of banks in Nigeria are expected to seek actionable ways to improve the efficient utilisation of their intellectual capital. Thus, this leads the study to the enquiry on how intellectual capital efficiency can be improved by the banks. Empirical evidences revealed that bank size and director's shareholding are the dominant factors influencing the intellectual capital efficiency of banks in Nigeria. It was further revealed that the ownership structure and market concentration inhibit the efficient utilisation of commercial banks in Nigeria.

The findings arising from this study raise salient recommendations for policy improvements on banks' performance in Nigeria. First, it is advised that bank regulators should intensify efforts to enforce the disclosure of the banks' intellectual capital in their financial reports. This will considerably drive the attention of the bank managers on the need to effectively identify and manage their intellectual capital resources for improved efficiency and value creation. Secondly, a critical examination of the internal corporate issues within the banking system should be embarked upon as it greatly debars the intellectual capital efficiency of the banks in Nigeria.

Conclusively, this study appears limited because it adopts the exclusion of firms with missing data as a treatment for incomplete data. As such, other researchers may seek to engage other missing data treatment techniques such as the multiple imputation by chained equation (MICE) to replace missing data points. Moreover, this study adopted the DEA non-parametric analysis in evaluating intellectual capital efficiency. Other studies may seek to expand knowledge by adopting other efficiency measures such as the stochastic frontier analysis (SFA) to compare empirical findings. The determinants of intellectual capital efficiency for other sectors and industries are another future research agenda extending the frontiers of knowledge in the intellectual capital efficiency literature.

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