



Measuring efficiency in the Nigerian banking system: A critical review

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Abstract

An efficient banking system is important for wealth creation, job creation, and trade facilitation, as it provides a way for individuals and businesses to participate in their local and global economy, thus facilitating economic growth and development. The purpose of this study is to examine the effectiveness of using data envelopment analysis (DEA) in measuring efficiency in the Nigerian banking system with the data envelopment analysis program. A critical review of selected peer-reviewed empirical studies was conducted. Papers were assessed to determine their inclusion or exclusion in the review process. For analytical purposes, the studies were generally grouped into two, namely, those that used one approach to measuring bank efficiency and those that used multiple approaches to measuring bank efficiency. Based on the critical review of extant literature conducted, findings suggest that there is a growing rate of adoption of DEA as a means of measuring bank efficiency in Nigeria, also that DEA has proved to be a scientific and effective means of measuring bank efficiency.

Keywords: Decision-making units, return to scale, scale efficiency, technical efficiency;

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1. Introduction

Globally, the banking system plays an important role in the development of effective financial systems (Olszewska, 2018; Khalil, 2021). An efficient banking system is therefore important for wealth creation, job creation, and trade facilitation, as it provides a way for individuals and businesses to participate in their local and global economy, thus facilitating economic growth and development (Ogbebor & Ongbowa, 2019; Haque, 2020; Thampy & Tiwary, 2021). Over the years, various scholars have used different metrics in measuring bank performance including return on asset, return on equity, return on turnover, return on investment, and return on capital employed among others (Freihat et al., 2019; Khalil, 2021; Prihatna et al., 2021). These are mostly used for ratio analysis which has certain limitations, including the fact that it is historic, does not take external factors affecting business (such as an economic recession) into account, does not measure the individual component of a firm, and can only be used to compare with other firms of the same size and type (Odewole & Salawu, 2020; Belasri et al., 2020). These limitations highlight the need for other means of measuring bank performance, hence the use of the Data Envelopment Analysis (DEA) approach in measuring bank efficiency.

Considering that the banking system is a multiple-input and multiple-output organization, an appropriate multiple criteria evaluation technique is, therefore, necessary to comprehensively assess its efficiency. Due to the above, most scholars have used the DEA method to empirically measure the efficiency of decision-making units (DMUs) in the banking sector (Sharif et al., 2019). DEA has received the attention of researchers as a scientific tool for measuring bank efficiency because it accommodates the multiple input and output nature of banks, which makes it an appropriate evaluation technique for the banks' efficiency (Li et al., 2019). It also takes into consideration the concept of "return to scale" (that is, the relationship between the rate of increase in output concerning inputs) in calculating efficiency (Li et al., 2019). The efficiency of the banks helps them to survive and compete better with other banks in the industry. Measurement of efficiency, therefore, is important as it is a means by which production units are evaluated and inefficiencies are identified to improve performance (Mamadi and Makhdut, 2020; Rashid et al., 2020; ur Rehman et al., 2021).

1.1. Literature Review

1.1.1. Bank efficiency

In general, efficiency measures how well resources are allocated to achieve the highest output rate (Mor & Gupta, 2021). It includes how the banks simultaneously lower costs and increase revenue (Blatter & Fuster, 2022). Different ways of measuring bank efficiency include but are not limited to technical efficiency (also divided by pure technical and scalability), allocative, cost, and scope efficiency. Technical efficiency means the ability to avoid waste by producing as much output as input consumption allows, or by employing as minimal input as production allows (Cantor & Poh, 2018). Achieving technical efficiency means producing maximum output by employing the most minimal cost (Cantor & Poh, 2018; Mirasol & Garcia, 2020).

Pure technical efficiency measures bank management's ability to utilize the available resources, while scale efficiency (ϵ) is related to economies of scale, by operating on a constant return to scale (Li et al. 2020; Arinah et al., 2019). The second approach is "allocative efficiency" which refers to the ability to combine inputs and outputs at fair value, given the available prices and available production technologies (Zeng et al., 2020; Bedasa & Gebissa, 2020). Put differently, allocative efficiency is about choosing between the technically efficient combinations of input used to produce the highest possible results (Zeng et al., 2020; Bedasa & Gebissa, 2020). Taken together, productive efficiency is determined by allocative and technical efficiencies (Zeng et al., 2020; Bedasa & Gebissa, 2020; Wu et al., 2022). The third approach is "cost efficiency" which is defined as the difference between the actual and the estimated cost of a given scale and mix of outputs (Soleimani-Chamkhorami & Ghobadi, 2021). The last method of efficiency considered for review is "scope

efficiency,” which refers to a coproduction economy, where the cost of coproduction is less than the total cost of independent production of goods and services (Ashrafi & Kaleibar, 2017).

1.1.2. Data Development Analysis (DEA)

The DEA is a non-parametric method of assessing the efficiency of decision-making units (DMUs) (a bank in the case of this study). Presented first in a study of the works of Charnes, Cooper, and Rhodes, DEA is a way of determining the efficiency of a firm based on multiple inputs and multiple outcomes (Emrouznejad and Yang, 2018). It is a scientific tool employed to measure total factor productivity change; technological change; technical efficiency changes; and SE change. The next section has reviewed the studies that used the DEA in measuring bank performance.

1.2. Related Studies

This section presents a critical review of empirical studies that used DEA in measuring bank efficiency. In doing that, the studies were grouped into two: the first group contains those studies that used one approach to measuring bank efficiency, while the second group contains studies that used multiple approaches to measuring bank efficiency. For analytical purposes, each of the two groups was further divided into two, the first containing studies that found efficiency in the banks investigated and the second, those that found inefficiency in the banks investigated.

1.2.1. Review of studies based on a single dimension of measuring bank efficiency

This subsection begins with a review of studies that found efficiency in the banks investigated starting with Romdhane (2013) who examined the efficiency of Information Technology (IT) investments in 15 Tunisian banks between 1998 and 2009. Using DEA, findings revealed a positive impact of IT investments on Tunisian banks' efficiency, and that size and management capacity had a positive and significant impact on the efficiency of Tunisian banks' cost efficiency (Romdhane, 2013). Okorie and Agu (2015) also examined the impact of Nigerian banking sector reforms on Nigerian banks' efficiency in 2 time periods (pre- and post-consolidation periods). Using DEA, the findings revealed different levels of efficiency in both cases. Although some banks are still not performing well, there has been a general improvement in efficiency in the post-consolidation period (Okorie & Agu, 2015).

Similarly, Yilmaz (2013) analyzed the effectiveness of the Turkish banking system during the years 2007- 2010. The performance scores of 30 commercial banks were measured using the DEA and the findings showed that domestic banks performed better than their foreign counterparts (Yilmaz, 2013). Omankhanlen (2013) investigated the Nigerian Banks' efficiency between 2005 and 2009 with a comparative analysis of the banks' efficiency. In doing that, the effects of the banks' fixed assets, operating expenses, and total deposits on their efficiencies were measured, including the effect of the banks' efficiency on profitability.

1.3. Purpose of study

There exist many approaches to the measurement of efficiency, especially in the banking sector, they include technical efficiency (further divided into pure technical efficiency and SE), allocative efficiency, cost efficiency, and scope efficiency (Alfarisi & Lukman, 2019; Mercan, 2020). The purpose of this study is to critically evaluate the effectiveness of DEA in using these different approaches to measure banks' efficiency in Nigeria. The central research question of this study, therefore, is: how effective is DEA in measuring bank efficiency? This study is therefore presented in four sections including this introductory one. The next section provides a critical review of the empirical studies that adopted DEA in measuring bank efficiency, the third section is the research methodology a summary of findings, and lastly, the conclusion and recommendations which are contained in the last section.

2. Materials and Methods

2.1. Data collection

This study conducted a critical review of selected peer-reviewed empirical studies downloaded from different databases and conducted in the context of different countries across the globe. Papers were assessed to determine their inclusion or exclusion in the review process. In doing that, studies included in the critical review were those that: (i) had “bank efficiency” or “bank + efficiency” in their titles; (ii) were published between the years 2011 and 2021; and (iii) are empirical studies and; used DEA in measuring bank efficiency.

2.2. Data analysis

The studies were grouped into two: that is, those that used one approach to measuring bank efficiency and those that used multiple approaches to measuring bank efficiency. Each of the two groups was further categorized into two, containing those studies that found efficiency in the banks investigated and those that found inefficiency in the banks investigated. Table 1 provides the description and application of the Systematic Quantitative Assessment Technique (SQAT) in this study.

Table 1. Description and application of SQAT

S/N	Step	Application in the current study
1.	Define topic	Measuring Efficiency of Nigeria Banking System with DEA: a critical review
2.	Research question	“How effective is DEA in measuring bank efficiency?”
3.	Identify key words	“Bank Efficiency” or “Bank + Efficiency”
4.	Read and assess publications	<ol style="list-style-type: none"> 1. Abstracts of papers found were read to ensure that they were dealing with DEA as a measure of bank efficiency. 2. Literature reviews, book chapters, and conference proceedings were not included; only peer-reviewed empirical papers were used.

Source: Authors’ tabulation (2021)

3. Results

DEA (under the assumptions of SE, Variable Return to Scale (VRS), and Constant Return to Scale (CRS)) was used to measure the efficiency scores of the banks. The findings of the study showed that GTBank was the most efficient in Nigeria as it employed the minimum amount to generate the same level of output as other banks.

The worst performers were Unity Bank, Afribank, and UBA. The study also revealed a positive and significant relationship between efficiency and profitability (Omankhanlen, 2013). Similar to Omankhanlen (2013) who measured, the effects of Nigerian banks' fixed assets, operating expenses, and total deposits on their efficiencies. Joshi and Bhalerao (2011) also investigated the technical efficiency of India’s major commercial banks using the DEA model with four input variables (deposits, interest expenses, operating expenses, and assets) and four output variables (advances and loans, investments, net interest income, and non-interest income). Findings revealed that most banks operate efficiently (Joshi and Bhalerao, 2011). Finally, Antunes et al. (2021) used the DEA model to evaluate the efficiency of 39 Chinese commercial banks between the periods 2010 and 2018. Findings suggest that the banks experienced a steady increase in the efficiency rate until 2015 after which the efficiency rate declined and finally reached its highest point by the end of 2018 (Antunes et al., 2021).

As for studies that found inefficiencies in the banks investigated, Asekome and Ihensekhien (2017) investigated the technical efficiency of 15 Deposit Money Banks (DMBs) in Nigeria by relying on the Slack-Based Methodology of DEA (SBM-DEA) to determine the relative technical efficiency of the respective banks. Findings showed that most DMBs operated below 100% technical efficiency. Only two of the banks operated at 100% technical efficiency. The remaining 13 banks operated below the efficiency frontier (Asekome & Ihensekhien, 2017). Similarly, Obafemi et al. (2013) used the two-

phase DEA approach to evaluate the technical efficiency of the Nigerian banking sub-sector. Using a separate segment of commercial banks and brokers, research has shown that the Nigerian banking industry was not performing well in both the pre-liberalization period and the post-liberalization era.

The study also revealed that market share is the strongest determinant of technical efficiency in the Nigerian banking industry (Obafemi et al., 2013). Still, in the context of Nigeria, Olele (2018) intends to establish a presence or otherwise of efficiency in the Nigerian banking sector. Using DEA and data from ten consolidated banks from 1993 to 2013, findings showed that inefficiencies existed in pre-consolidated Nigerian banks but showed improvement after the implementation of the consolidation policy (Olele, 2018). Akeem and Moses (2014) also conducted an in-depth analysis of the allocative efficiency of Nigerian commercial banks between 2002 and 2011, when ten randomly selected banks out of 15 banks operating in Nigeria. The DEA model was implemented with three input variables (deposit, operating costs, and assets) as well as four output variables (loans and development, investments, revenue, and non-profit revenue). Findings revealed that the mean allocative efficiency was 89.6%, which raises the inefficiency of the banks under investigation (Akeem & Moses, 2014).

3.1. Review of studies based on multiple dimensions of measuring Efficiency

This section begins with a review of studies that found the banks investigated to be efficient. From a global perspective, Alharthi (2016) conducted a comparative analysis of investigations into the determinants of efficiency in the banking sector between the years 2005 and 2012. Efficiency was assessed using DEA and samples included 323 banks (43 Islamic, 242 conventional, and 38 socially responsible banks) all over the world, involving a total of 37 countries. Findings revealed that socially responsible banks are the most efficient and the least effective scores are obtained by regular banks. In the case of Islamic banks, the major banks are more effective (Alharthi, 2016).

Similarly, from a regional perspective, Cheriye (2020) measured the efficiency of Pan-African commercial banks using the DEA method over the years (2010–2015). Findings indicated that there was an increase in the technical efficiency of Pan-African commercial banks during the period under review. The findings also revealed that on average, the technical efficiency of the Pan African commercial banks is largely contributed by SE than pure technical efficiency (Cheriye, 2020).

In the context of Libya, Alrafadi et al. (2014) conducted an in-depth comparative analysis of the performance of 17 banks in Libya between 2004 and 2010. DEA was used to evaluate the technical, purely technical, and scale efficiencies of the sampled banks. Findings revealed that specialized banks showed better technical efficiency compared to commercial and private banks. In Nigeria, Ipeghan et al. (2019) examined the technical efficiency and SE of 15 commercial banks operating in Nigeria from 2007 to 2015.

Using DEA to estimate the efficiency scores, results suggest that inefficiency across 15 mega banks is quite low compared to the industry average. As for SE, it was found to be significantly higher in mega-banks than in smaller banks (Ipeghan et al., 2019). Eriki and Osifo (2015) did not care whether banks performed well or not but reviewed the determinants of efficiency for 19 selected Nigerian banks in 2009. Three effective measures of efficiency (that is, variable returns to scale, constant returns to scale, and SE) models were used by employing the DEA method. Findings indicate that the size of the bank and age is closely related to the efficiency of the bank; however, board independence and ownership structure are negatively related to bank efficiency in Nigeria (Eriki and Osifo, 2015).

In conducting a comparative analysis of the major, medium, and small banks in Nigeria, Idolor and Agbadudu (2020) evaluated selected Nigerian commercial banks using DEA models. The 19 studied banks were taken from the 2009 Central Bank of Nigeria audit report. In examining the sampled commercial banks, the study used variable returns to scale, SE, and constant return to scale. The findings revealed that the major banks in Nigeria are facing the problem of total asset idleness, while the medium and smaller banks are better at converting their smaller assets and equity input into better outcomes compared to the major banks (Idolor and Agbadudu, 2020).

In the case of studies that found inefficiency in the banks investigated, Chaudhary et al. (2016) examined the effects of mergers and acquisitions on bank efficiency in Pakistan. The DEA was applied and the technical efficiency, pure technical efficiency, and SE of the banks were evaluated. The findings showed a decrease in the average efficiency scores for most of the banks investigated during the consolidation/acquisition period (Chaudhary et al., 2016).

Similarly, Tamatam et al. (2019) estimate the overall technical, purely technical, and scale efficiencies of 21 public sector banks (PSBs) and 17 private banks in India by employing 18 different DEA models, using panel data between 2008 and 2017. The findings revealed that between 2016 and 2017, only 9 of the 38 banks were technically efficient and the other 29 were underperforming and with scale inefficiency having a greater impact than pure technical inefficiencies (Tamatam et al., 2019). Still in the case of India, Bhatia and Mahendru (2016) analyzed the technical efficiency of PSBs.

To measure the technical, purely technical, and scale efficiencies, the DEA was used to determine the causes of inefficiencies. The research sample included 26 PSBs operating in India between 2007–2008 and 2011–2012. Results showed the inefficiency in PSBs for the most part due to the inefficiency of the scale inefficiency (Batia & Mahendru, 2016). Zeitun and Benjelloun (2013) evaluated the efficiency of Jordanian banks between 2005 and 2010. Using the DEA with a sample of 12 banks in Jordan, constant return to scale and VRS were used to evaluate the associated efficiency of the banks. The results showed that, on the technical efficiency, scale, the majority of the banks were found to be inefficient in financial resource management, and only a few of them were found to be efficient (Zeitun & Benjelloun, 2013).

Similarly, only a few banks are efficient on the scale of pure technical efficiency (Zeitun & Benjelloun, 2013). Another high level of inefficiency among the banks investigated was also found in the Nyong (2017) study, which evaluated the efficiency of the Nigerian domestic commercial banking sector before and after the restructuring and consolidation in 2005 through the use of DEA to determine the level of efficiency of 66 banks (2001, 2002) and 22 banks (2008, 2009). The inefficiency of the banks was due to pure technical rather than scale effect. Finally, from a regional point of view, Cheriye (2020) measured the efficiency of Pan African Commercial Banks using Malmquist DEA Methods for the period 2010-2015. The findings indicated that the total factor productivity of the banks decreased during the study period due to declining technology efficiency.

The popular use of DEA among scholars in measuring efficiency in the banking system highlights its critical relevance as a scientific tool for assessing bank performance. This is evidenced in the rate of adoption of the method by Nigerian-based papers in this study. Ten out of the 22 empirical studies reviewed were in the context of Nigeria, three were Indian-based, and two of the studies used Africa as their study area. The study was in the context of each of the following countries; Tunisia, Turkey, China, Libya, Pakistan, and Jordanian.

Only one of the studies covered the whole world as data were collected from banks across the globe. This study has not only highlighted the effectiveness of using DEA in measuring bank efficiency but has also revealed the level of efficiency of the Nigerian banking system in the recent past. While 12 of the 22 studies reviewed found efficiency in the banks investigated, ten found the banks investigated to be generally inefficient. Ten of the 22 studies reviewed were Nigerian-based, five of them found the banks investigated to be efficient while the remaining five found the banks investigated to be inefficient.

4. Conclusion

This study concludes that DEA has been widely applied in studies of bank efficiency in Nigeria and, therefore, confirms the effectiveness of using DEA as a scientific tool for measuring bank efficiency. Furthermore, most studies analyzing bank efficiency consider the operational process to be a “black box,” so only the initial inputs and the final outputs become the focus of an investigation, but the complicated operational process inside of the black box is typically ignored. From the studies

reviewed, the focus has mostly been on the input variables which are widely used by scholars while using DEA to determine bank efficiency.

Further studies can focus on the operational process inside of the “black box” in determining bank efficiency, an under-researched area. The use of DEA in measuring efficiency in other sectors of the economy can also be explored by other scholars. As for the limitations of the study, the focus of this study is only on the banking system without a review of studies in the context of other sectors of the economy. Furthermore, out of the many metrics for measuring firm performance, only efficiency was explored in this study. Finally, this study recommends that the banks that are not efficient should study the operations of the efficient ones to improve their efficiency.

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