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DO LIQUIDITY MANAGEMENT DYNAMICS TRANSLATE TO EFFICIENCY OF THE NIGERIAN BANK? A DATA ENVELOPMENT ANALYSIS APPROACH

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ABSTRACT

Short-term financial health is essential for any business to stay stable, face economic challenges, and pursue growth opportunities. This study examines the impact of liquidity management strategies, including the Loan to Deposit Ratio (LDR), Cash Reserve Ratio (CRR), liquid assets to ratio (LATR), and overall liquidity, on the financial performance of banks in Nigeria, as measured by Constant Return to Scale Efficiency. Secondary data from the Central Bank of Nigeria's bulletin were analyzed. The research uses Ordinary Least Squares (OLS) multiple regression analysis to estimate the model. Results indicate that CRSE is negatively related to LASFR but positively related to LR, LTDR, and CRR, highlighting implications for improving asset quality and policy development to decrease non-performing loans, as recommended for the Nigerian banking sector. The finding that an increase in CRR positively impacts banks' performance aligns with Liquidity Preference Theory. This suggests that, in our context, banks' liquidity management strategies respond to changes in CRR by adjusting their liquid assets, likely anticipating shifts in interbank lending rates. This proactive approach to liquidity management helps improve financial performance.

Keywords: banking sector, banking performance, asset quality, loan-to-deposit ratio, cash reserve ratio, Non-Performing Loans, Return on Assets.
JEL: G21, D24, C61, G32, O55

INTRODUCTION

In a market-driven economy such as Nigeria's, there exist financial markets, institutions, intermediaries, instruments, rules, and regulations that facilitate the flow of funds across a macroeconomic sector. This is usually referred to as the financial system, according to Rose & Marquis, (2005); the financial system is a collection of markets, institutions, laws, regulations, and techniques through which bonds, stocks, and other securities are traded, interest rates are determined, and financial services are produced and delivered around the world.

The main goal is to direct limited loanable funds from savers to borrowers, allowing them to buy goods and services and invest in new equipment and facilities. This process helps the global economy grow and raises the standard of living for its people. It is commonly known as financial intermediation. Banks are the primary players in the financial market that make this process

possible. (Akinlo & Owoyemi, 2012) stated that banks, as financial intermediaries, gather savings from surplus units and lend them as credit to different sectors of the economy to boost growth and development. In doing so, these financial institutions aim to stay profitable and, as ongoing businesses, must keep enough liquidity.

Profitability enhances a firm's equity reserves and growth potential. Liquidity, on the other hand, allows the firm to meet both short-term and long-term financial obligations. Ahmad, (2016) asserts that profitability and liquidity are two key factors that provide insight into the performance of any business organization. Ahmad, (2016), argued that long-term survival and healthy growth depend on profit and liquidity, highlighting the connection between these two variables. In a similar vein Raheman et al., (2010), pointed out that liquidity and profitability are both important and directly relate to the goal of wealth maximization for the wealth maximization goal of shareholders.

Several factors have been identified in empirical studies as determinants of profitability. These include net profit margin, capital adequacy, size, credit risk, liquidity, and operating expenses. These are commonly known as bank-specific profitability determinants. However, there are also macroeconomic determinants, such as inflation/interest rate risk, Gross Domestic Product (GDP), monetary policy, and others. Additionally, it has been found that the most influential determinants of a bank's profitability are credit risk, liquidity, and operating costs.

A large body of financial research focuses on the efficiency of banking systems. Literature suggests that the ratio of a bank's expenses to its revenue determines the bank's efficiency, and various techniques are employed to determine the production frontier, thereby measuring banking efficiency, notably through parametric and non-parametric approaches (Alrafadi et al., 2016). Banking efficiency is evaluated to include technical efficiency, allocative efficiency, and cost efficiency. While Technical Efficiency (TE), as described by Bauer et al. (1998), explores the physical relationship between input levels and output levels, requiring only input and output data without considering prices. Allocative Efficiency (AE), according to Thanassoulis (2001), is the ratio of the minimum cost needed to produce a given level of outputs to the cost at technically efficient input levels, given specific input prices. Meanwhile, Cummins and Zi, (1998) define Cost Efficiency (CE) as the attempt to save money by enhancing the performance of the production process or activities.

The problems of DEA model misspecification have been the subject of numerous investigations (Adler & Yazhemsky, 2010; Fanchon, 2003; Luo et al., 2012; Pastor et al., 2002; Ruggiero, 2005; Simar & Wilson, 2000; Xie et al., 2014). The selection of inputs and outputs is the most contentious issue, as choosing the wrong variables can significantly affect the reliability of the results. Ullah et al., (2023) identified the input variables for banks to include the number of employees, the number of branches, administrative expenses, non-interest expenses, and loan loss provisions. In contrast, the output variables included net interest income, net commissions, and total other income.

Liquidity management is a crucial activity for every financial institution; therefore, they strive to provide and maintain a certain level of liquidity daily. This liquidity hazard itself is incomprehensible, but it is possible through a dynamic liquidity risk management arrangement to moderate its negative impacts (Rose & Marquis, 2005). Banks are exposed to liquidity risk because

they transform liquid deposits (liabilities) into illiquid loans (assets). These are the key operations of the banks, and the liquidity risk management's role is to ensure their continuity. In addition, the liquidity position is related to stakeholders' confidence. A bank having no confidence can face liquidity shortfalls, for example, withdrawal of the deposits (Aaron et al., 2012).

However, no financial institution is immune to liquidity risk, and it has been noted recently that this is one of the most significant contributing factors to bank failures nowadays. Therefore, if a financial institution wants to "eat well" (make a profit), it should keep in mind the risk that awaits it. Nonetheless, the success of any financial institution will depend on how it estimates its liquidity needs; for example, it might be through the structure of deposits or surplus, which determines that performance will be at stake.

Banks are major participants in the financial market that facilitates the process of financial intermediation to enhance economic growth and development. For deposit money banks to continue to play this dominant role of savings mobilization and channeling into investment, liquidity, management, and profitability must be taken into consideration.

The banking sector in Nigeria faces significant challenges in balancing liquidity management with operational efficiency, and efficient liquidity management is crucial for banks to meet their short-term obligations and maintain customer confidence, while also ensuring long-term profitability and stability. However, Nigerian banks are seen to be struggling with optimizing their liquidity levels, leading to either excessive liquidity, resulting in lower returns, or insufficient liquidity, posing risks of insolvency and operational disruptions.

However, it has been noted that most underlying liquidity problems in banks are primarily due to the mismatching of assets and liabilities, resulting from the extension of loans or credit to high-risk borrowers. Many deposit money banks in Nigeria had been either merged or completely shut down due to the ineffectiveness and inefficiency of the management. Some Nigerian workers had also been forcefully thrown into the unemployment market.

Empirical and theoretical literatures have demonstrated the relationship between liquidity and profitability in various financial systems worldwide, and results from empirical research have varied across different financial systems and banking industries. Conflicting results can sometimes be attributed to differences in methodologies, including sample selection, variable choice, and variable definition. There has, however, been no research linking the efficiency of banking institutions in Nigeria to the liquidity of the firm, which is where the present study is relevant.

The main objective of this study is to evaluate the effect of liquidity management on the efficiency of banks in Nigeria, while the specific objectives of the study are;

1. To examine the effect of the loan-to-deposit ratio on the efficiency of banks in Nigeria.
2. To investigate the effect of liquidity ratio on the efficiency of banks in Nigeria.
3. To determine the effect of cash reserve ratio on the efficiency of banks in Nigeria Plc.

Based on the objectives of this study, the following null hypotheses were formulated.

H_1: The non-performing loans to loan and advances ratio has no significant effect on bank efficiency.
H_2: There is no significant effect of the loan-to-deposit ratio on bank efficiency.
H_3: Cash reserve ratio has no significant effect on banking efficiency in Nigeria

This research attempts to investigate the impact of liquidity management on the profitability of the banking industry.

LITERATURE REVIEW

Theoretical framework

Illiquidity has become an impediment not only to the poor performance of deposit money banks but also to the development of Nigeria's economy. The theoretical perspectives on liquidity risk management are: commercial loan theory and shiftability theory.

The real bills doctrine was coined by Lloyd (1945) in his book, A History of Banking Theory. The real bills doctrine or commercial loan theory, according to Tarkka, (2019)It states that a deposit money bank should advance only short-term self-liquidating loans, which are meant to finance the production and movement of goods through the successive stages of production, storage, transportation, and distribution. When such goods are ultimately sold, the loans are considered to liquidate themselves automatically. Such short-term self-liquidating productive loans possess three advantages: first, Ganong and Noel (2020) suggested that they possess liquidity, they mature in the short run, and are for productive purposes, and Huang et al., (2018) stressed that there is no risk of their running into bad debts. Third, Kasasbeh (2021) asserts that, being productive, such loans earn income for the banks.

Despite these merits, the real bills doctrine suffers from certain defects. First, if a bank refuses to grant a fresh loan till the old loan is repaid, the disappointed borrower will have to reduce production, which will adversely affect business activity. Second, the doctrine assumes that loans are self-liquidating under normal economic conditions. If there is depression, production and trade suffer, and the debtor will not be able to repay the debt at maturity. Third, the doctrine neglects the fact that the liquidity of a bank depends on the saleability of its liquid assets and notes on real trade bills.

The shiftability theory of bank liquidity was propounded by Moulton (1918) who asserted that if deposit money banks maintain a substantial amount of assets that can be transferred to other banks for cash without material loss in case of necessity, then there is no need to rely on perfectly shiftable assets that must be immediately transferable without incurring capital loss when the need for liquidity arises. This is particularly applicable to short-term market investments, such as treasury bills and bills of exchange, which can be immediately sold whenever it is necessary to raise funds by banks. However, in a general crisis when all banks need liquidity, the shiftability theory requires that all banks should possess assets that can be shifted to the central bank, which serves as the lender of last resort.

The liability management theory was developed in the 1960s. According to this theory, there is no need for banks to grant self-liquidating loans and keep money market in case of need. A bank can acquire reserves by creating additional liabilities against itself from different sources. These

sources include the issuing of time. Certificate of deposit, borrowing from central banks, raising capital funds, buying shares, and ploughing back profits. The fundamental contribution of this theory was to consider both sides of a bank's balance sheet as sources of liquidity.

Conceptual framework

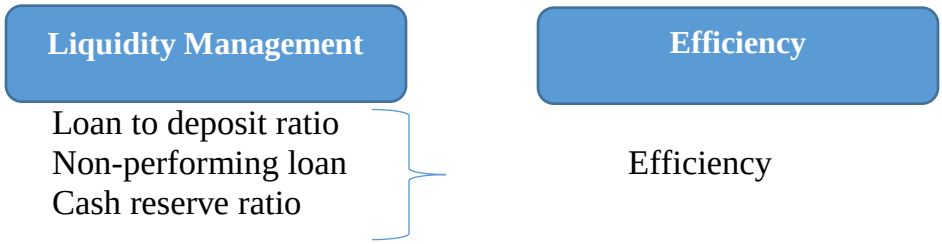

Figure 1: Conceptual framework

Loan to Deposit ratio

Pop et al., (2018) viewed the loan-to-deposit ratio as a measure to assess a bank's liquidity by comparing a bank's total loans to its total deposits for the same period; hence, to calculate the loan-to-deposit ratio, divide a bank's total amount of loans by the total amount of deposits for the same period. Typically, the ideal loan-to-deposit ratio is 80% to 90%. For instance, Edison et al. (2019) investigated the Influence of Capital Adequacy Ratio (CAR), Loan to Deposit Ratio (LDR), and Operational Costs to Operating Income (OCOI) on Return on Equity (ROE) in Private Commercial Banks in Indonesia, and found that the average value of Capital Adequacy Ratio, Loan to Deposit Ratio, Operating Costs to Revenues to Operations, and Return on Equity varies greatly.

Cash Reserve Ratio in banks

Calomiris (2012) maintained that the cash reserve ratio is a regulatory measure that is applied to all officially registered commercial banks, and these institutions are obligated to adhere to this requirement by maintaining a specified proportion of their deposits within the secure confines of central bank vaults. The term "cash reserve ratio" for Carlson (2013) connotes a predetermined percentage of the overall deposits held by a commercial bank that must be maintained as a balance in the form of cash with the central bank. The central bank implemented adjustments to the cash reserve ratio to regulate the expansion of credit by influencing the availability of funds, therefore managing the circulation of money throughout the economy (Faykuzzaman et al., 2023).

Liquid Asset Structure Ratio

Wallace (2000) explained that an asset's liquidity is determined by dividing its transaction velocity—the amount traded per unit of time—by the stock, and a sufficiently sized asset has a lower velocity and a greater yield than a sufficiently small asset. Assets are assumed to be indivisible and to differ in size, and trade using such assets is implied by pairwise matching and the absence of double coincidence in produced goods. According to Wallace (2000), there are no models of a liquidity structure of asset yields. However, it is accepted that a sufficiently large asset has a lower velocity and a higher yield than a sufficiently small asset. Asset liquidity is positively related to leverage and secured debt, while the relation with unsecured debt is curvilinear. This suggests that the costs of financial distress and inefficient liquidation, as well as the costs of managerial discretion, affect capital structure decisions (Sibilkov, 2009).

Liquidity Ratio

According to Wuryandani (2012), the ratio of total cash, demand deposits at central banks, and demand deposits at other banks to total assets is called precautionary liquidity. It is a financial indicator that measures its ability to meet immediate financial obligations and handle cash inflows and outflows. The Liquidity Coverage Ratio (LCR) is a specific liquidity ratio introduced as part of the Basel III regulatory framework during the global financial crisis. Its main goal is to improve banks' capacity to endure short-term liquidity disruptions (BIS, 2018).

Banking efficiency

According to Bikker (2010), different techniques for estimating commercial banks' performance include traditional accounting methods, such as operational cost analysis, operational profit analysis, market share analysis, and evaluation of competition and efficiency. These methodologies can be grouped into two main perspectives: the econometric approach and the accounting approach. Therefore, Adam (2014), describes technical efficiency of a commercial bank as its ability to convert various assets into multiple products and financial services such as loans, advances, investments, and more. A bank is considered wasteful if it operates below the production frontier. When technical efficiency is assessed under constant return-to-scale (CRS), it is referred to as overall technical efficiency (OTE). In the literature, methods for evaluating bank efficiency include the Stochastic Frontier Approach (SFA), Thick Frontier Analysis (TFA), Free Disposal Hull (FDH), Distribution-Free Approach (DFA), and Data Envelopment Analysis (DEA) (Bhattacharyya et al., 1997). The present study uses a non-econometric data envelopment analysis approach to measure efficiency over the study period.

Data Envelopment Analysis (DEA) is a mathematical method that uses linear programming to evaluate the relative efficiency of various decision-making units (DMUs). This is done by identifying the optimal mix of inputs and outputs, grouped according to their actual performance, as described by Zhu (2014) and Manandhar and Tang, (2002).

Empirical review

Nwangi, (2014) investigated the effect of liquidity risk management on the financial performance of deposit money banks in Kenya. The results show that a unit increase in the liquid assets to total assets ratio decreases return on assets by 1%. A unit increase in the liquid assets to total deposits ratio decreases return on assets by 2.2%. A unit increase in borrowings from banks reduces return on assets by 14.2%. Additionally, the control variable, asset quality, indicates that a unit increase in non-performing loans as a proportion of total loans leads to a 12.4% decrease in return on assets. The study concludes that liquidity risk management has a significant negative impact on the financial performance of deposit money banks. Borrowings from banks by commercial banks to meet short-term liquidity needs have the most significant effect on liquidity, at 14.2%, and are significant at 5%.

Empirically, facts from previous studies linked liquidity management and financial performance of deposit money banks in Nigeria by Takon and Ogakwu (2013), examined the impact of liquidity on banks' profitability using liquid assets, bank deposits, treasury bills, and return on assets as proxies. Secondary data was sourced from the Central Bank of Nigeria Statistical Bulletin. The

study employs Ordinary Least Squares using multiple regression techniques. It finds that there is a positive and insignificant impact between bank deposits and return on assets; a negative and insignificant impact between liquid assets and return on assets; and a positive and insignificant impact between treasury bills and return on assets. The study recommends that appropriate measures should be taken to prevent undesirable market developments that may negatively impact bank deposits; and also, the recruitment of competent and qualified personnel to manage and maintain an optimal level of liquidity.

Bassey and Ekpo (2018) investigated the critical role played by the CBN and DMBs in shaping an appropriate framework for liquidity management and identified the challenges that inhibit the effective performance of these roles. The study employs a descriptive research design and finds that deposit liabilities constitute a major source of funding liquidity for DMBs in Nigeria. These banks operate above the solvency level, with a current ratio greater than one, and are overly cautious, investing more in short-term securities to protect their liquidity positions. The study therefore recommends that DMBs should strengthen their credit risk assessment mechanisms to increase their credit exposure to the private sector. It concludes that DMBs should establish a robust liquidity risk management framework that is well integrated into the bank-wide risk management process and ensure that competitive pressures do not compromise the integrity of their liquidity risk management framework, control functions, limit systems, and liquidity.

Onyekwelu et al., (2018) examined the effect of liquidity on the financial performance of deposit money banks in Nigeria from 2007 to 2016, using secondary data from five banks. It employs multiple regression analysis and finds that liquidity has a positive and significant effect on both banks' profitability ratios and on Return on Capital Employed. The study recommends that, in addition to investing in human capital, banks should develop strategies to sensitize their customers on various activities that could hinder effective liquidity management. Furthermore, the regulatory authority should implement appropriate policy measures to ensure compliance and to control high-volume cash transactions and hoarding prevalent in the economy. The study concludes that the Central Bank of Nigeria should critically review and monitor the effectiveness of its liquidity policy tools to achieve the desired liquidity level and, where necessary, impose sanctions on banks that fail to comply.

Study's gap analysis

Empirical studies have established a causal relationship between liquidity management and the performance of banks globally and in Nigeria. In most studies, a small and a large number of banks were used. Wuave et al.;s (2020) study showed a difference in sample size, and it utilized six deposit money banks. In a similar vein, Obi-Nwosu et al., (2017) utilized 10 deposit money banks. Almost all studies focused on the accounting approach of profitability in evaluating the relationship. This study adds to the body of knowledge in exploring the impact of liquidity management on the efficiency of the bank, and in particular, a firm-specific study.

METHODOLOGY

In light of the objectives of the study, the research design adopted is the ex-post facto design. The justification for this research design is that the characteristics of the population are unknown, and the primary source of data is the Central Bank of Nigeria Statistical Bulletin. The research obtained

data from secondary sources, including the financial statements of FBN and the CBN bulletin, which were utilized, as well as information on liquidity extracted from the bank's annual reports and its website. The data covers a period of 19 years, from 2007 to 2022.

Model specification

Model for data envelopment investigation (DEA) stage 1 analysis

The model of data envelopment analysis (DEA) applied in this study is derived from Bhagavath (2009), Bhuia et al. (2012), and Obafemi (2012). The efficiency estimation can be written using usual notations as follows:

$$Efficiency\ of unit j = \frac{u_1 y_{1j} + u_2 y_{2j} + \dots}{u_1 x_{1j} + v_2 x_{2j} + \dots} \text{...(1)}$$

Where: u_1 = weights assigned to output variable 1.

$^{y}1j$ = level of output variable 1 derived from unit j.

v_1 = weights assigned to input variable 1.

$^{x}1j$ = total level of input variable 1 utilised to produce

The two surfaces of DEA evaluation, CRS and VRS models, will be used to assess specialized productivity of DMUs under examination without scale impact. Here, every vertex of Xij and Yrj lies on or below the hyperplane. The multiplier formulation of this problem passes through no less than one of the points (coordinates) (Ali & Seiford, 1953).

Using U_1 to denote the virtual multiplier identified with DMUj output 1;
and U_2 to denote the virtual multiplier identified with DMUj output 2;
and U_3 to denote the virtual multiplier identified with DMUj output 3;
and U_s = be used to denote the virtual multiplier identified with DMUj outputs
and w = virtual multiplier associated with the surface.

$$Max\ h = y_{1j}u_1 + y_{2j}u_2 + y_{3j}u_3 + \dots + y_{ks}u_s - x_{1j}v_1 - x_{2j}v_2 - x_{3j}v_3 + w \dots \dots \dots (2)$$

$$Subject\ to$$

$$y_{11}u_1 + y_{21}u_2 + y_{31}u_3 + \dots + y_{k1}u_k - x_{11}v_1 - x_{21}v_2 - x_{31}v_3 + w \ \le 0\ DMU\ 1 \dots \dots (3)$$

$$y_{12}u_1 + y_{22}u_2 + y_{32}u_3 + \cdots + y_{k2}u_k - x_{12}v_1 - x_{22}v_2 - x_{32}v_3 + w \ \le 0\ DMU\ 2 \dots \dots (4)$$

$$y_{13}u_1 + y_{23}u_2 + y_{33}u_3 + \dots + y_{k3}u_k - x_{13}v_1 - x_{23}v_2 - x_{33}v_3 + w \ \le 0\ DMU3 \dots \dots \dots (5)$$

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$$y_{1n}u_1 + y_{2n}u_2 + y_{3n}u_3 + \dots + y_{kn}u_k - x_{1n}v_1 - x_{2n}v_2 - x_{3n}v_3 + w \ \le 0\ DMUn \dots \dots \dots (6)$$

$$u_1 \ge 0 \qquad \dots \dots \dots \dots \qquad (7)$$

$$u_2 \ge 0 \qquad \dots \dots \dots \dots \dots \qquad (8)$$

$$u_3 \ge 0 \qquad \dots \dots \dots \dots \dots .. \qquad (9)$$

.
.
.

$$u_n \ge 0 \qquad \dots \dots \dots \dots \dots . \dots . \dots \dots \dots \dots \dots \dots \qquad (10)$$

The DEA Mathematical model is as follows:

$$Max\ h = \frac{\sum_r U_r Y_{rj_o}}{\sum iV_i X_{ij_o}} \quad \text{subjectto} \ldots\ldots(11)$$

$$\frac{\sum_r U_r Y_{rj}}{\sum iV_i X_{ij}} \leq 1,\ where\ j = 1, \wedge, n\ (for\ all\ j) \ldots\ldots(12)$$

To explain the model, the analyst needs to change over to its linear programming model

$$Max\ h = \sum_r U_r Y_{rj_o} \ldots\ldots(13)$$

Subject to the dual variable:

$$\sum i V_i X_{ij_o} = 100\% \qquad Z_0 \ldots\ldots(14)$$

$$\sum_r U_r Y_{rj} - \sum_i V_i X_{ij} \leq 0,\ \ j = 1, \wedge, n \qquad \lambda_j \ldots\ldots(15)$$

$$-V_i - \in \qquad i = 1, \wedge, m\ \ S_i^+ \ldots\ldots(16)$$

$$-U_r - \in \qquad r = 1, \wedge, t\ \ S_r^-. \ldots\ldots(17)$$

This formulation could be referred to as Chanes, Cooper, and Rhode (CCR) model. The dual of this model could be put together by imputing dual variables to the constraints in the primal model, which now becomes:

$$Min\ 100Z_0 - \in \sum_i S_i^+ - \ \in \sum_r S_r^- \ldots\ldots(18)$$

Subject to:

$$\sum_j \lambda_j X_{ij} = X_{ij_o} Z_0 - S_i^+, \qquad i = 1, \wedge, m \ldots\ldots(19)$$

$$\sum_j \lambda_j Y_{rj} = Y_{rj_o} Z_0 + S_r^-, \qquad r = 1, \wedge, t \ldots\ldots(20)$$

$$\lambda_j, S_i^+, S_r^- \geq 0 \ldots\ldots(21)$$

Output variables (Yrj):

1. Total loans and advances: computation of all short- and long-term financial risk assets created by commercial banks in Nigeria.
2. Total investments: Undertaking in short- and long-term activities other than traditional banking function that generates income for the bank, such as real estate, buildings, ships, and shares in the total book value of which do not exceed the bank’s capital and reserves
3. Profit after tax: The net amount earned by commercial banks after all taxation-related expenses have been deducted.

Input variables **(**Xij):

1. Total fixed assets: Summation of tangible assets or property, plant, and equipment (PP&E) employed by commercial banks.
2. Total employee expenses: These are expenses that are incurred by banks payable to staff in the performance, such as salaries and wages.
3. Total deposits: Money placed into banking institutions by customers for safekeeping, savings accounts, demand deposit accounts, foreign currency (FCY) accounts, and time deposit (fixed) accounts.

Stage 2 analysis: Regression model
The model for the assessment of the effect of liquidity management on efficiency of bank follows the footsteps of and (Wuave et al. (2020). The model was adopted with slight modification and it's presented as follows:

CRSE = (LR , LRDR, CRR)

In specifying the model, the error term is introduced because statistical measurements are not error-free.

$CRSE = \alpha_0 + \alpha_1 LR + \alpha_2 LTDRt + \alpha CRR + E.$

Description of research variables

Where: CRSE	=	Constant Return to Scale Efficiency
LR	=	Liquidity Ratio
LTDR	=	Loan to deposit ratio
CRR	=	Cash reserve ratio
α_2	=	Intercepts term
$\alpha_1 - \alpha_3$	=	Coefficient of explanatory variables
E^0	=	Error-term

Technique of data analysis
The regression model used to analyse data is:

$Y = \alpha_0 + b_1 \alpha_1 + b_2 \alpha_2 + b_3 \alpha_3 \quad E$

Where y = dependent variable
$b_1 - b_3$ =model parameters
The predictor (independent) variable is liquidity management measured by the ratio of non-performing loans to loans and advances, the loan-to-deposit ratio, and the cash reserve ratio. The criterion (or dependent) variable is measured by Return on Assets.

DATA ANALYSIS, RESULTS AND DISCUSSIONS
Data Analysis

Table 1: Data envelopment result

		2006	2007	2008	2009	2010	2011	2012	2013	2014
CRS	***Efficiency***	0.919	0.963	0.919	0.963	0.963	0.867	0.795	0.758	0.743
RTS		Decreasing	Decreasing	Decreasing	Decreasing	Constant	Decreasing	Constant	Constant	Constant

		2015	2016	2017	2018	2019	2021	2020	2021	2022
CRS	***Efficiency***	0.977	0.999	1.000	0.912	0.855	0.877	0.974	1.000	0.999
RTS		Constant	Decreasing	Constant	Constant	Constant	Constant	Decreasing	Decreasing	decreasing

The result of linear programming enveloping of banking inputs and outputs showed that banks were optimally efficient in 2017 and 2021, respectively. However, efficiency decreased from 2006 to 2009 and from 2020 to 2022, indicating a decreasing return to scale.

OLS regression results

The study regressed liquidity management variables against the efficiency scores obtained in stage one analysis, and the result was as follows:

Table 2: Regression result

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.646[a]	.418	.252	.07122	1.083

a. Predictors: (Constant), CRR, LTDR, LASFR, LIR)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.768	.085		9.023	.000
	LTDR	.002	.001	.464	2.248	.041
	LIR	.000	.003	.111	.158	.877
	LASFR	-.004	.004	-.586	-.936	.365
	CRR	.004	.002	.440	1.542	.145

From the model summary in Table 2, Pearson's correlation coefficient R of 0.646 predicted actual values of Constant Return to Scale efficiency, indicating a strong linear relationship. R Square of 0.418 showed that 41.8 percent of the variance in CRS efficiency scores is explained by the LR, LTDR, and LASFR, respectively. However, after adjusting or penalizing many predictors, the model still explained 25.2% of the variation.

From the result presented in Table 2, the coefficient of the constant term 0.768 revealed that Banks will experience a 0.76 percentage increase in efficiency when all other variables (loan to deposit

ratio, liquidity ratio, liquid asset structure ratio, and cash reserve ratio) are held constant. The result further revealed that the estimated coefficient for LASFR has a negative and insignificant effect on the efficiency scores of the banks (p-value = 0.365) and a regression coefficient of -0.004. This implies that a percentage change in LASFR will cause a decrease of about 0.4 percent in efficiency.

Furthermore, the loan-to-deposit ratio (LTDR) has a positive and significant influence on banking efficiency with a coefficient of 0.02 and a corresponding probability of 0.0041, indicating that a one unit increase in LTDR will cause an increase of 0.002 units in efficiency.

Again, liquidity ratio has a positive but insignificant influence on banking efficiency with a coefficient of 0.00087 with a probability of 0.158, indicating an increase of 0.000087 units of efficiency with a unit increase in liquidity. Lastly, cash reserve ratio (CRR) positively affects banks' efficiency with a CRR coefficient of 0.004 and a significant probability of 0.145, indicating that there is a 0.004 unit increase in efficiency with a unit increase in CRR.

The Durbin-Watson result indicates a value of 1.083. Since this value lies between 0 and 2, it can be inferred that there is no autocorrelation among the successive values of the variables in the model.

Discussion of findings

The primary purpose of this study was to determine the effect of liquidity management on the efficiency of banks in Nigeria. Findings from the analysis revealed that the Liquid Assets ASFR has a negative and insignificant effect on the efficiency scores of the banks. These findings are consistent with the work of Sibilkov (2009), who used assets from United States Companies to establish a positive relationship between liquid assets and the performance of the firms. The disparity in the study is the performance indicators for efficiency of the firms, which include capital structure and secured debts.

Moreover, the loan-to-deposit ratio (LTDR) has a positive and significant influence on banking efficiency, and this is consistent with the study of Sari and Sulistyo (2018), who investigated 31 commercial banks listed on the Indonesian Stock Exchange. The study concluded that the loan-to-deposit ratio influences the profitability of banks in Indonesia.

Again, the liquidity ratio has a positive but insignificant influence on banking efficiency, with a coefficient of 0.00087, indicating a 0.000087-unit increase in efficiency for every unit increase in liquidity. These findings support the work of Akinroluyo and Dimgba, (2022), who concluded that banks' liquidity ratio has a significant impact on their operational efficiency and financial leverage. Maintaining an optimal liquidity ratio is crucial for banks to achieve efficiency in their operations and reduce operational expenses (Le *et al.*, 2020).

Lastly, it was found that the cash reserve ratio (CRR) has a positive coefficient of 0.00033 with a significant probability value of 0.0333. This means that the cash reserve ratio positively influences bank profitability and is statistically significant. The findings of the study are in line with the results of Majakusi (2012), who concluded that the cash reserve ratio had a positive and significant effect on ROA. On the contrary, they disagree with Islam (2018), who concluded that the cash reserve ratio has an insignificant positive relationship with return on assets.

CONCLUSION AND RECOMMENDATIONS

The study determined the effect of liquidity management on the profitability of banks in Nigeria from 2007 to 2022. Liquidity management was assessed using the non-performing loans to loan and advances ratio, the loan to deposit ratio, and the cash reserve ratio, and efficiency was measured by return on assets. The econometric results reveal that:

1. Liquidity ratio is negatively and significantly affected by banking efficiency in Nigeria. Hence, the study accepted the alternative hypothesis of the study and concluded that the non-performing loans to loan and advances ratio has a significant effect on bank profitability.
2. The loan-to-deposit ratio negatively and insignificantly affects banking efficiency in Nigeria. Hence, the study accepted the null hypothesis and concluded that there is no significant effect on bank profitability due to the loan-to-deposit ratio.
3. Cash reserve ratio (CRR) positively affects banking efficiency in Nigeria, but was found to be statistically significant. Hence, the study accepted the alternative hypothesis and concluded that the cash reserve ratio has a significant impact on bank profitability.

Conclusion

The relationship results show that CRSE is negatively related to LASFR but positively related to LR, LTDR, and CRR, all at 5% significance level. This means that, all things being equal, the higher the ratios of LR, LTDR, and CRR, the higher the efficiency of banks in Nigeria. Conclusively, the result shows that an increase in LASFR will cause a corresponding decrease in bank efficiency. The inverse relationship conforms to the liquidity and profitability tradeoff of commercial loan theory and shiftability theory.

Recommendations

From the findings, the study makes the following recommendations for policy and practice:

1. The CBN and management of banks should enhance the quality of their assets and draft policies that will reduce the amount of non-performing loans, since it is crucial for the banks in terms of their efficiency.
2. Management of banks should strike a balance between financial intermediation through conversion of deposits into loans and being liquid by having liquid assets that can easily be converted into cash in order to generate the maximum profit possible.
3. Policy makers through the central bank should come up with initiatives to improve bank liquidity through a favorable prescribed cash reserve ratio that will keep banks profitable in their operations.

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