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DETERMINANTS OF LIQUIDITY MANAGEMENT: EVIDENCE FROM NIGERIAN BANKING SECTOR

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Abstract. The study examined the determinants of liquidity management in twelve Nigerian banks during 2009–2018. Liquidity ratio (LQR) and deposit to asset ratio (DAR) were used as surrogates for liquidity management. As the potential liquidity management determinant indicators, five bank-specific variables (capital adequacy, size, asset quality, profitability and deposit growth) and three macroeconomic variables (GDP growth rate, inflation rate and interest rate) were used as proxies. Results from balanced fixed effects least square regression analytical technique show that size, profitability, GDP growth rate and inflation rate are important liquidity determinants in Nigerian banks. Specifically, bank size has a positive and significant influence on LQR, while GDP growth rate and inflation rate exhibit a negative and significant relationship with LQR. It further reveals a positive and significant relationship between profitability (ROA) and DAR. It is recommended that banks' management should focus attention on both bank-specific (size and profitability) and macroeconomic (GDP growth and inflation rate) factors when deciding appropriate liquidity management strategy to be adopted. These four variables have the capacity to influence the profitability, sustainable growth and survival of banks operating in a volatile business environment such as Nigeria.

Key words: deposit money banks, determinants, liquidity, Nigeria, panel data.

ДЕТЕРМИНАНТЫ УПРАВЛЕНИЯ ЛИКВИДНОСТЬЮ: ОПЫТ РАБОТЫ БАНКОВСКОГО СЕКТОРА НИГЕРИИ

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Аннотация. В статье исследуются детерминанты, влияющие на управление ликвидностью в двенадцати банках Нигерии в течение 2009–2018 годов. Показатель ликвидности и отношение долга к активам были использованы как второстепенный показатель при управлении ликвидностью. В качестве показателей-детерминант для управления ликвидностью были выбраны пять специализированных банковских показателей: достаточность капитала, размер и качество активов, доходность и рост депозитов, а три макроэкономические переменные – темп роста ВВП, уровень инфляции и уровень процентной ставки – были использованы как эрзац-переменные. Результаты расчетов при помощи регрессии наименьших квадратов показывают, что размер, доходность, рост ВВП и уровень инфляции являются важными детерминантами, влияющими на ликвидность в банках Нигерии. В частности, размер банка имеет положительное и сильное влияние на уровень ликвидности, в то время как рост ВВП и уровень инфляции имеют отрицательную и значительную связь с уровнем ликвидности. Далее исследование показало позитивную и сильную зависимость между прибыльностью и показателем отношения долга к активам. Менеджменту банка рекомендуется ориентироваться на специфичные банковские факторы (размер и прибыльность) и макроэкономические (рост ВВП и уровень инфляции), когда будет необходимость выбирать ту или иную стратегию управления ликвидностью. Эти четыре переменные могут влиять на доходность, устойчивое развитие и жизнеспособность банков, работающих в нестабильных экономических условиях в Нигерии.

Ключевые слова: депозитные банковские учреждения, детерминанты, ликвидность, Нигерия, данные длительного наблюдения.

Introduction

Every business organization requires liquid resources for its daily operation. Firms with liquidity challenges are likely to experience operational failure which may in turn alter their profitability lead to bankruptcy in the future. Liquidity is essential to banks as their ability to meet up with depositors' obligation and create new loan is anchored on efficient management of liquid assets. The ability of a bank to finance asset growth and meets up with obligations without incurring unacceptable losses is the prime product of optimum management of liquidity [Basel Committee ... , 2010]. As a result, banks are required to keep adequate liquid assets to meet both immediate need of customers and cover for unforeseen risk that may occur.

Liquidity is one of the prime measures of the banks' strength since such banks are able to effectively and efficiently perform their main business of financial intermediation which involves serving as the foremost channel of fund mobilization from less productive sector to high productive sector of the economy. The fruitful output of efficient financial intermediation is that it serves as impetus to economic growth and development as bank is able to finance real sector and provide liquidity to businesses [Alzoubi, 2017] which in turn results in increase of real output, employment, price stability and efficient utilization of capacity among others. Liquid resources are also considered as the blood that runs in the vein of a business for continuous survival and stability. The need for proper management and maintenance of optimum liquidity balance is apt and expedient in this era of liquidity trauma which has claimed the existence of some banks with liquidity deficiency while others are only struggling to survive.

The financial crisis of 2008 resulted in the collapse of some commercial banks especially with liquidity challenge [Bhati et al., 2012]. The collapse of most of those banks has taught existing banks a good lesson and now they are striving harder than ever to maintain optimum liquidity so as to secure their daily operations as well as shareholders wealth maximization and long term

stability and survival. Optimum management of liquidity is specifically desired so as to balance liquidity-profitability dilemma as low liquid banks may encounter insolvency while banks with excess liquidity may be faced with low profitability which ultimately impairs shareholders wealth and take a toll on long term stability and survival.

Some prior studies have demonstrated that liquidity management affects banks performance [Bordeleau et al., 2010; Uremadu, 2012; Kehinde, 2013; Lartey et al., 2013; Lina et al., 2015; Idowu et al., 2017; Akhter, 2018]. It is imperative for managers in the banking sectors to know the factors (apart from profitability) that influence liquidity management and the direction of the effect of any identified determinant. It is expected that when these factors are known, better decision on planning, management and utilisation of liquid resources are made effectively.

It is to be noted prior studies on liquidity management, especially in the developing countries, have mainly focused on nexus of liquidity and profitability of firms and limited works on determinants of liquidity [Bordeleau et al., 2010; Kehinde, 2013; Alshatti, 2015; Dahiyat, 2016; Idowu et al., 2017; Akhter, 2018; Kajola et al., 2019; Khati, 2020; Dzapasi, 2020]. For most of the earlier studies on determinants of liquidity conducted in the developed countries, results produced different factors as influencing the liquidity management [Aspachs et al., 2005; Rauch et al., 2010; Bordeleau et al., 2010; Deléchat et al., 2012; Cucinelli, 2014; Petria et al., 2015].

However, very limited studies have been conducted in the area of determinants of liquidity using data from the Nigerian banking sector. Attempts were made by Nwakanma and Mgbataogu [2014] and Agbo and Nwude [2018], but these studies have some inherent gaps. For instance, Nwakanma and Mgbataogu [2014] laid emphasis on the factors that accounted for the excess liquidity in the system, without considering bank-specific factors. Agbo and Nwude [2018], on the other hand, only examined the bank-specific determinants of liquidity without considering macroeconomic (external) factors that are capable of influencing liquidity management of banks.

This study attempts to mitigate part of the knowledge gap in the financial management empirical literature by having primary objective of examining the effect of both bank-specific and macroeconomics determinant factors on liquidity of listed Nigerian banks during financial years 2009–2018.

Literature Review and Hypotheses Formulated

Theoretical Framework

The study is anchored on two main theories of liquidity management. These are Trade-off theory and Resource-based theory. The Trade-off theory states that there is a trade-off between liquidity and profitability as banks cannot achieve the same objective of being liquid and profitable simultaneously. In financial management, liquidity is one of the prime resources without which the operation of any business is impossible.

The theory that best explains the link between liquidity and its determinants is Resource-based theory, which was propounded by Wernerfelt in 1984 [Wernerfelt, 1984]. According to Grant [1991], a firm is viewed from the perspective of having varieties of resources which are consummated to create organisational capabilities that can be used to generate above average profitability. In the light of this, each firm develops competencies from these resources and when they are well developed they become the source of the firm's competitive advantages.

The two theories are relevant to this study because one of the prime measures of a bank's strength and performance is liquidity and is expected that banks will commit resources and activities toward ensuring its optimum level. Among the resources and activities that may affect banks liquidity are capital adequacy, asset quality, firm size, profitability, deposit growth and macroeconomic variables.

Hypotheses Formulated

Capital adequacy and liquidity management

Banks source their capital from three main sources: share capital, retained earnings and borrowed fund. Capital adequacy is a strong measure of a bank's strength and stability as it measures the proportion of a bank's capital that is financed with owners' equity. The higher the capital adequacy ratio, the less risky a bank is

and this may require higher investment in liquid assets. Some prior studies have established the effect of capital adequacy on liquidity to be positive and significant [Melese, 2015; Singh et al., 2016; Annor et al., 2017; Farooq et al., 2017; Shamas et al., 2018; Al-Homaidi et al., 2019]. On the contrary, Djan, Stephen, Bawuah, Halidu and Kuutol [2015] provide evidence of inverse relationship between capital adequacy ratio and liquidity of listed banks in Ghana. The following null hypothesis is formulated:

H_o1: Capital adequacy ratio has no significant influence on banks' liquidity.

Bank size and liquidity management

Bank size is the combination of current and non-current asset utilized in the ordinary course of business. As a result of economies associated with the scale of size which makes larger banks to be able to spread their fixed cost over wide range level of operation, larger banks are expected to perform better than smaller banks. Several studies have produced inconsistent and mixed findings on the size on banks' liquidity nexus. Kolapo, Ayeni and Oke [2012], Samad [2015], and Kajola, Olabisi, Adedeji and Babatolu [2018a] found a direct but insignificant effect of size on banks' liquidity. Conversely, studies by Vodova [2013] and Cucinelli [2014] found that bank liquidity was negatively influenced by size. On the other hand, Chagwiza [2014], Moussa [2015], El-Khoury [2015] and Al-Homaidi et al. [2019] found direct and significant association between size and liquidity. The following null hypothesis is tested:

H_o2: Bank size has no significant effect on banks' liquidity.

Asset quality and liquidity management

Banks generate significant part of their incomes from financial intermediation of fund. By this action, loans are granted to borrowers from the pool of deposit and other funds deposited by customers. Asset quality depicts the proportion of nonperforming loan to total loan. In order not to jeopardize its long-run survival, banks are expected to have good asset quality in form of having a low non-performing loan

ratio. Banks that are able to recover substantial part of their loans stand a better chance of having optimum liquidity. Liquidity optimization, according to Assfaw [2019], requires good assets quality as it enhances the ability of banks to fulfill its commitments promptly. Studies by Subedi and Neupane [2011], Growe, De Bruine, Lee and Maldonado [2014], Mazreku et al. [2019] and Al-Homaidi et al. [2019] have demonstrated high ratio of nonperforming loan to total loan to be negatively associated with liquidity. However, in the studies conducted by Tseganesh [2012] and Fola [2015], asset quality was found to influence liquidity positively. The following hypothesis is tested:

H_o3: Asset quality has no significant effect on banks' liquidity.

Profitability and liquidity management

Profitability depicts ability of a bank to make profit from available resources. Profit is the successive outcome of operation of a business arising from the generation of revenue over its total cost incurred in generating such revenue and other expenses. Profitability is often used to measure the financial performance of management of any profit-oriented outfit. Existing studies on profitability and liquidity dynamics have suggested inconsistent and conflicting results. Assfaw [2019] and Obim, Takon and Mgbado [2020] revealed the a positive but insignificant influence of profitability on liquidity of private Ethiopia banks. Same conclusion was also reached in the study conducted in nine countries from the Balkan region by Mazreku et al. [2019]. In a comparative study of USA and Asia, Abbas, Iqbal and Aziz [2019] reported that liquidity has a negative relation with profitability of USA large banks, while it was positive in the case of Asian developed economies in the post crisis era. Uremadu [2012], Vodova [2012], Kehinde [2013], Fola [2015], Al-Homaidi et al. [2019], Kajola et al. [2019] and Alalade, Ogbebor and Akwe [2020] revealed a direct and significant effect of liquidity on profitability. On the contrary, Chen et al. [2010], Alshatti [2015] and Bencharles and Abubakar [2020] showed that profitability negatively influenced liquidity management of banks. The following hypothesis is formulated:

H_o4: Profitability has no significant effect on banks' liquidity.

Deposit growth and liquidity management

Deposit is the claims of customers in the assets of a bank. It is a liability to a bank. The level of deposit in the banking sector as well as its growth may influence the liquidity position of financial institutions. As bank attracts more deposit, the liquidity position increases, which enables the bank to advance more loans and advances to borrowers (ceteris paribus) and this in turn suggests more interest income and ultimately profitability. Some prior studies have demonstrated the link between deposit and liquidity management to be of positive in nature [Moussa, 2015; Mazreku et al., 2019], while Assfaw [2019] indicated a significant indirect effect of deposit on liquidity of Ethiopian private banks. However, Ayoola and Onyeiwu [2018] provided evidence of insignificant association between deposit growth and liquidity management in the study where 6 Nigerian deposit money banks were used as a sample. The following hypothesis is tested:

H_{o5}: Growth in deposit has no significant effect on banks' liquidity.

Level of economic activity and liquidity management

The major variant in the literature for measuring level of economic development is Gross Domestic Product (GDP). Activities of various sectors in the economy can influence the economic growth. In the period of boom, banks are expected to have more liquid resources so as to be able to finance working capital and expansion need of many businesses. Conversely, during the period of economic crisis, less liquidity is needed by the banking sector. Studies by Moussa [2015], Fola [2015], Farooq and Nasir [2017] and Mazreku et al. [2019] showed a positive association between GDP growth rate and liquidity. Vodova [2012] and Singh and Sharma [2016] however, reported a negative relationship, while Tseganesh [2012] and Mennawi and Ahmed [2020] found positive but no significant effect of GDP growth rate on liquidity of Ethiopian and Sudanese banks, respectively. The following hypothesis is tested:

H_{o6}: GDP growth rate has no significant effect on banks' liquidity.

Inflation and liquidity management

During inflationary period the cost of production and services rises. This subsequently leads to increase in firm's working capital requirements. Banks in an attempt to meet up with the increase in their working capital requirements and those of their customers may need to maintain high liquidity position. The contrary is a situation of deflationary period. Studies conducted by Vodova [2011], Fola [2015] and Singh and Sharma [2016] suggested a positive and significant relationship between inflation and liquidity. However, Malik and Rafique [2013] and Horváth, Seidler and Weill [2014] found negative effect of inflation on liquidity, while Farooq and Nasir [2017] and Mazreku et al. [2019] produced insignificant result. The following hypothesis is postulated:

H_{o7}: There is no significant effect between banks' liquidity and inflation.

Interest rate and liquidity management

Interest represents the amount charged on loan and advances granted by banks to customers. The Central Bank of Nigeria (CBN) is legally empowered to determine the minimum rediscount interest rate for banks in Nigeria. An increase in the CBN's minimum rediscount interest rate will significantly affect the interest rates banks are willing to charge their customers. An increase in interest rate of banks translates to granting more loans to customers who will in turn reduce banks' liquidity but increase profitability and risk. Studies by Tseganesh [2012], Laurine [2013], Fola [2015] and Mazreku et al. [2019] demonstrated a significant positive effect of interest rate margin on liquidity of banks. However, Drakos (2003) cited in Mazreku et al. [2019], reported a negative and significant relationship between the two variables. The following hypothesis is formulated:

H_{o8}: Interest rate has no significant effect on banks' liquidity.

Review of Related Empirical Studies

Several studies on determinants of liquidity management especially in the economically advanced countries are well documented. However, only few of these studies are available

in the developing countries. Although, there is still no consensus on the factors that appear to influence liquidity management, but outcomes of some notable studies suggested that both bank-specific and macroeconomic factors have the capacity to influence liquidity management. The degree of influence, however, differs across firms, countries and regional/economic blocks [Wojcik-Mazur et al., 2015; El-Chaarani, 2019].

Roman and Sargu [2014] assessed the determinants of bank liquidity risk in Romania and Bulgaria during the period 2003-2011. Four liquidity indicators examined were capital adequacy, asset quality, profitability and management quality in 15 Romanian and 11 banks in Bulgaria. Results provided evidence of an indirect and significant association between capital adequacy and the two liquidity indicators (liquid asset and net loan to total assets ratio) in both countries. The result further indicated a positive relation between asset quality and liquidity indicators in Bulgaria but negative association between the two variables in Romania.

Wojcik-Mazur and Szajt [2015] explored the determinants of liquidity risk of 84 commercial banks in two European Union groups: 11 countries classified as the old European Union and 7 countries as the new European Union. For the determinants of liquidity risk, 5 internal and 3 external factors were used. Internal factors are credit risk, interbank market engagement, profitability, equity and bank size. Inflation rate, overnight index average and GDP growth served as proxies for external determinant factors. Results of the regression revealed that internal-specific liquidity factors for banks in the countries of old EU are marginally different from those operating in the countries of new EU. However, margin volume, credit risk level and engagement in the interbank market are internal factors that influence all the countries regardless of liquidity risk proxy adopted.

Idowu et al. [2017] assessed the effect of one factor, profitability, on liquidity of selected Nigerian banks for the period 2007-2016. Return on equity (ROE) and Return on assets (ROA) were adopted as performance proxies. Result indicated a positive and significant relationship between liquidity and ROE, but insignificant relationship with ROA.

Farooq and Nasir [2017] assessed the liquidity determinants of 31 listed Pakistani commercial banks for the years 2005-2014. Fixed effects model was used as analytical technique. Results showed that bank capital and GDP have a direct and significant relationship with bank liquidity while non-performing loan and inflation have positive but statistically insignificant association with liquidity.

Agbo and Nwude [2018] assessed the effect of internal factors on liquidity of seven Nigerian banks for 2001-2015. The findings showed that total capital ratio, impaired loans on total loans, profitability (Return on equity) and bank size have negative and insignificant effect on liquidity, while profitability (ROA), and interest expenses over deposit have a direct and statistically insignificant inluence on liquidity.

In Vietnam, Tran et al. [2019] explored data from 35 banks covering 2010-2015 to determine factors that influence liquidity risk. Using OLS as analytical tool, the study indicated that total loan to capital ratio, debt to capital ratio, loss provision to loan ratio and long-term lending rate have an indirect and significant relationship with liquidity risk.

El-Charaani [2019] examined bank liquidity factors of 183 banks in 8 countries of Middle East region for the 3-year period 2014-2016. Four internal factors (asset quality, capital ratio, profitability and bank size) and three macroeconomic factors (economic growth, inflation and unemployment) were used as proxies for liquidity determinants, while two variables (loans to assets and loans to deposits) measure liquidity level. Result produced significant impacts of economic growth, assets quality, capital level and bank size on liquidity of the banks.

Mennawi and Ahmed [2020] investigated the factors that affect liquidity risk of 11 Islamic banks in Sudan for the 2012-2018 financial years. Cash position, short-term investment, customers' deposit, credit risk and GDP were the determinant factors used. The multiple regression result showed a significant negative relation of cash and short-term investment with the liquidity risk. The result further revealed that customers' deposit and credit risk had a positive and significant relationship with liquidity risk, while GDP had no significant effect.

Dzapasi [2020] used a mixed methodology approach (both qualitative and quantitative) to explore the nexus between liquidity management and performance of 5 commercial banks in Zimbabwe. Results produced a strong direct association between liquidity and financial performance.

Methodology

Research Design

Ex post facto research design in the form of usage of historic financial data of the sampled banks was adopted for the study. Data were gathered from secondary source only. Data relating to bank's specific factors were obtained from published annual accounts, reports of the banks and the Nigerian stock exchange fact book [2009–2018], while those relating to macroeconomics variables were extracted from various editions of statistical bulletins of the CBN.

Population and Sample

As for the financial year end on December 31, 2020, Nigeria has a total of 15 listed deposit money banks. Through a purposive sampling technique (which was influenced by availability of complete data set), a sample of 12 banks (representing 80% of the population) was chosen for the study. The list of the banks is provided in Appendix 1.

Variable Descriptions

Dependent variable

Liquidity management is the dependent variable. Different measurements of liquidity are found in the literature. One approach, the traditional method, uses such measurements like current ratio, quick asset ratio and liquidity ratio. Another approach uses liquid balance, working capital requirement and cash conversion cycle [Nazir et al., 2009; Hill et al., 2010; Zakaria et al., 2013; Rezaei et al., 2015; Konak et al., 2016; Yunos et al., 2018]. The study however adopted two commonly used traditional approach variables that are peculiar

to the banking sector [Jedidia et al., 2015; Fola, 2015; Mazreku et al., 2019] to serve as the proxy for measuring liquidity management. These variables are Liquidity ratio (LQR) and Deposit to asset ratio (DAR).

Independent variables

Some prior studies, such as Masood and Ashraf [2012], Vodova [2012], Cucinelli [2014], Jedidia and Hamza [2015], Milic and Solesa [2017], Assfaw [2019] and Tran et al. [2019] indicate that liquidity in the financial sector is influenced by both internal and external factors. The internal factors are peculiar and within the control of bank management while external factors are exogenously determined. In this study and in line with empirical literature reviewed, five firm-specific and three macroeconomic variables are used as surrogates of independent variables. The firm-specific (internal) variables are capital adequacy, bank size, asset quality, profitability and deposit growth, while external variables are growth in GDP rate, inflation rate and interest rate.

Model Specification

Panel data estimation was adopted for the study. This helps to control the bank-level heterogeneity in the model. The specific models for the study are shown in equations 1 and 2:

$$LQR_{it} = \beta_0 + \beta_1 CAR_{it} + \beta_2 BSZ_{it} + \beta_3 ASQ_{it} + \beta_4 ROA_{it} + \beta_5 DGR_{it} + \beta_6 GGDP_{it} + \beta_7 INF_{it} + \beta_8 INT_{it} + e_{it} \qquad (1)$$

$$DAR = \beta_0 + \beta_1 CAR_{it} + \beta_2 BSZ_{it} + \beta_3 ASQ_{it} + \beta_4 ROA_{it} + \beta_5 DGR_{it} + \beta_6 GGDP_{it} + \beta_7 INF_{it} + \beta_8 INT_{it} + e_{it}, \qquad (2)$$

where LQR – liquidity ratio; DAR – deposit to asset ratio; CAR – capital adequacy ratio; BSZ – bank size; ASQ – asset quality; ROA – return on asset; DGR – growth rate in deposit; GGDP = GDP growth rate; INF – inflation rate; INT – interest rate; e_{it} – stochastic error term.

Measurement of Variables

Table 1 depicts the measurement of the study variables.

Data Analytical Technique

In achieving the purpose of the study, multiple regression approach in form of Fixed effects and Random effects techniques were used as data analytical tools.

Results and Discussion

The summary of descriptive statistics is presented in Table 2. The average liquidity ratio (LQR) is 19.95%. Deposit to asset ratio (DAR) averaged to 49.39%, with a maximum value of 733.54% and a minimum of about 0.06%. Capital adequacy ratio (CAR) has an average of 12.04% with a maximum value of 29.01% and a minimum value of -154.7%. Bank size has a mean value of 12.0045 (about ₦1.01 trillion or $3.35 billion). The ratio of nonperforming loan to deposit (ASQ) has an average of 5.97%, ranging from maximum of 59.75% and minimum of 0.8%. The average profitability (ROA) is 1.46% and ranges between -31.06% and 25.48%. This indicates that banks' management did not judiciously utilise the assets to generate sufficient profit. Deposit growth rate (DGR) averaged 7.8% and this ranges between -99.99% and 105.64%. The rate of growth of gross domestic product (GGDP), inflation rate (INF) and interest rate (INT) averaged to 4.83%, 11.85% and 16.52%, respectively. INF rate (standard deviation = 2.7535) has the highest degree of variability, while GGDP (standard deviation = 0.0325) has the least degree of variability.

The study adopted the Variance Inflation Factor (VIF) and correlation matrix approaches in testing for multicollinearity among the explanatory variables used in the study. Results of the two tests are depicted in Table 3 and Table 4.

The VIF of the variables ranges between 1.048 (DGR) and 1.658 (ASQ), with an average of 1.347, which is less than 10. This confirmed absence of multicollinearity issue [Gujarati et al., 2009; Wooldridge, 2012].

From Table 4, no coefficient of association between two explanatory variables has value of above 0.70 (the cut-off point suggested by [Rumsey, 2007]); the highest being 0.587 (association between LQR and BSZ). This further confirmed that no multicollinearity problem existed among the variables.

The association between the variables is further revealed in Table 4. However, correlation matrix does not show strength of relationship between variables. Therefore, using it to make unbiased inferences may give misleading interpretation. To mitigate this inadequacy of correlation matrix, the study adopted a multivariate regression using the Fixed effects and Random effects models for each of the two specific models.

Table 1

Variable Measurement

Variable	Acronym	Measurement	Source
Liquidity ratio	LQR	$\dfrac{\text{Cash + treasury bill}}{\text{Total deposit}}$	Bassey and Moses [2015], Idowu et al. [2017], Tabash [2018]
Deposit to asset ratio	DAR	$\dfrac{\text{Deposit}}{\text{Total assets}}$	Sopan and Dutta [2018], Ayoola and Onyeiwu [2018], Kajola et al. [2019]
Capital adequacy ratio	CAR	$\dfrac{\text{Shareholders fund}}{\text{Total assets}}$	Ozili [2016], Ghenimi, Chaibi, and Omri [2017], Lotto [2018], El-Chaarani [2019]
Bank size	BSZ	Log of total assets	Samad [2015], Sopan and Dutta [2018], El-Chaarani [2019]
Asset quality	ASQ	$\dfrac{\text{Nonperforming loan}}{\text{Total loan}}$	El-Khoury [2015], Sopan and Dutta [2018], Mazreku et al. [2019]
Profitability	ROA	$\dfrac{\text{Profit after tax}}{\text{Total assets}}$	Moussa [2015], Salim and Bilal [2016], Mazreku et al. [2019]
Deposit growth	DGR	$\dfrac{\text{Deposit}_t - \text{deposit}_{t-1}}{\text{Deposit}_{t-1}}$	Ayoola and Onyeiwu [2018], Mazreku et al. [2019]
Level of economic activity	GGDP	$\dfrac{\text{GDP}_t - \text{GDP}_{t-1}}{\text{GDP}_{t-1}}$	Moussa [2015], El-Chaarani [2019], Mennawi and Ahmed [2020]
Inflation rate	INF	Annual rate of inflation	Ghenimi et al. [2017], Kajola et al. [2018b], Mazreku et al. [2019]
Interest rate	INT	Annual rate of interest	Ongore and Kusa [2013], Perera and Wickramanayake [2016], Kajola et al. [2019]

Note. Authors' compilation.

Table 2

Descriptive Statistics

Variable	Mean	Minimum	Maximum	Standard Deviation	Skewness	Kurtosis
LQR	.1995	.0000	.6221	.1312	.8563	3.5629
DAR	.4939	.0006	7.3354	.7166	7.2449	70.4973
CAR	.1204	-1.5470	.2901	.1752	-7.5032	70.1226
BSZ	12.0045	10.7636	12.7353	.3861	-.5443	3.0314
ASQ	.0597	.0080	.5975	.0885	3.3419	15.9577
ROA	.0146	-.3106	.2548	.0448	-2.0211	31.9068
DGR	.0780	-.9999	1.0564	.3143	-.5034	7.1757
GGDP	.04830	-.0160	.0950	.0325	-.526	-.549
INF	11.8460	8.0500	16.5000	2.7535	.2380	-1.047
INT	16.5230	14.0000	18.3600	1.1253	-.706	.526

Note. Authors' own computations.

Table 3

VIF Test Result

Variable	VIF
CAR	1.100
BSZ	1.524
ASQ	1.658
ROA	1.106
DGR	1.048
GGDP	1.574
INF	1.399
INT	1.369
Average	1.347

Note. Authors' own computations.

Table 4

Correlation Matrix

	LQR	DAR	CAR	BSZ	ASQ	ROA	DGR	GGDP	INF	INT
LQR	1									
DAR	-.149 (.104)	1								
CAR	.118* (.099)	-.091 (.163)	1							
BSZ	.587*** (.000)	-.099 (.140)	.144* (.058)	1						
ASQ	-.353*** (.000)	.028 (.381)	-.134* (.073)	-.528*** (.000)	1					
ROA	.103 (.131)	.359*** (.000)	.177** (.026)	.186** (.021)	-.220*** (.008)	1				
DGR	.008 (.465)	.003 (.488)	-.024 (.398)	.167** (.034)	-.125* (.087)	.113 (.110)	1			
GGDP	-.196** (.016)	.050 (.296)	.077 (.200)	-.302*** (.000)	.204** (.013)	-.027 (.384)	-.118 (.099)	1		
INF	-.109 (.119)	-.021 (.410)	-.135* (.071)	-.006 (.475)	.215*** (.009)	-.003 (.488)	-.010 (.457)	-.404*** (.000)	1	
INT	-.117 (.101)	-.092 (.159)	.144* (.058)	-.137* (.068)	.235*** (.005)	-.106 (.124)	-.074 (.211)	.444*** (.000)	-.268*** (.002)	1

Note. Significant at 1% (***), 5% (**) and 10% (*) level of significance.

The result of the first model (liquidity ratio as liquidity management proxy) is depicted in Table 5, while that of the second model (deposit to asset ratio as liquidity management proxy) is provided in Table 6.

As revealed in Table 5, the Adjusted R^2 for the Fixed effects least square regression is .4838 and that of Random effects generalised least square is .1739. The F-statistics of the two regressions are significant at 1%, ($p < 0.01$), indicating fitness of the model. The Durbin-Watson value of 1.8411 for the Fixed effects least square regression indicates no serial autocorrelation among the variables in the model. However, there is presence of little serial autocorrelation in the variables under the Random effects generalised least square with Durbin-Watson value of 1.3200.

As shown in Table 6, F-stat is significant for the two regressions, no serial autocorrelation in the model under the Fixed effects least square regression (Durbin-Watson value of 1.8066) and high serial autocorrelation in the model as

Table 5

Regression Result of Model 1

	Fixed effects			Random effects		
	Coeff	t-stat	prob	Coeff	t-stat	prob
Constant	-.6949	-.9452	.3468	-1.3866	-2.4938	.0141
CAR	-.0078	-.1407	.8884	.0076	.1393	.8895
BSZ	.0970	1.6699*	.0981	.1519	3.4722***	.0007
ASQ	.0251	.1864	.8525	.0141	.1060	.9158
ROA	-.0527	-.2551	.7992	-.0503	-.2446	.8072
DGR	-.0216	-.7370	.4628	-.0257	-.8836	.3788
GGDP	-.6894	-1.7254*	.0876	-.4533	-1.2462	.2153
INF	-.0095	-2.3926**	.0186	-.0081	-2.1042**	.0376
INT	-.0075	-.8274	.4100	-.0072	-.7999	.4255
R^2	.5662			.2295		
Adj. R^2	.4838			.1739		
F-stat	6.8689*** (.0000)			4.1316*** (.0002)		
Durbin-Watson stat	1.8411			1.3200		
Observations	120			120		

Note. Significant at 1% (***), 5% (**) and 10% (*) level of significance.

Table 6

Regression Result of Model 2

	Fixed effects			Random effects		
	Coeff	t-stat	prob	Coeff	t-stat	prob
Constant	-2.9552	-.6962	.4879	.95565	.2935	.7697
CAR	-.3084	-.9607	.3390	-.4048	-1.2910	.1994
BSZ	.3600	1.0730	.2859	.0476	.1856	.8531
ASQ	.8950	1.1487	.2534	.8505	1.1065	.2709
ROA	7.2714	6.0977***	.0000	7.1775	6.0379***	.0000
DGR	-.0458	-.2711	.7869	-.0458	-.2727	.7856
GGDP	2.9973	1.2985	.1971	1.6999	.8057	.4221
INF	-.0065	-.2827	.7780	-.0134	-.6060	.5458
INT	-.0642	-1.2334	.2203	-.0642	-1.2339	.2199
R^2	.5146			.2654		
Adj. R^2	.4224			.2124		
F-stat	5.5798*** (.0000)			5.0123*** (.0000)		
Durbin-Watson stat	1.8066			0.8455		
Observations	120			120		

Note. Significant at 1% (***), 5% (**) and 10% (*) level of significance.

presented by the Random effects least square generalised regression.

For inference purpose, the study adopted Hausman's [1978] specification test to discriminate between the regression results provided by Fixed effects and Random effects models and this result is as presented in Table 7.

Table 7 reveals the Chi-square have prob values of 0.0358 and 0.0236 in Models 1 and 2, respectively and are significant at 5% ($p < 0.05$). Thus, following the submissions of Hausman [1978], Gujarati and Porter [2009] and Wooldridge [2012] the specification test suggests the use of estimation based on the Fixed effects over the Random effects models.

Consistent with the outcome of the Fixed effects least square regression in model 1 (as provided in Table 5), capital adequacy ratio (CAR) has a negative but no significant relationship with liquidity ratio (LQR). The outcome is supported by studies conducted by Fekadu [2018], Ayoola and Onyeiwu [2018] and Agbo and Nwude [2018], which used data from Ethiopian and Nigerian commercial banks, respectively. This provides evidence that CAR is not an important factor that determines liquidity management of banks in Nigeria. The study, therefore, failed to be reject null hypothesis 1.

Bank size has a weak positive effect on liquidity ratio and this relationship is significant at 10% ($p < 0.1$) This outcome suggests that bank size is an important determinant of banks' liquidity management. The finding has support of earlier studies of Chagwiza [2014], Moussa [2015], El-Khoury [2015] and Al-Homaidi et al. [2019]. The null hypothesis 2 is hereby rejected.

Asset quality (ASQ) exhibits a positive but insignificant influence on liquidity management. This result is in agreement with the works by Roman and Sargu [2014]. The outcome indicates that ASQ is not a major factor that determines liquidity management in Nigeria. We therefore, failed to reject null hypothesis 3.

Return on assets (ROA), Deposit growth rate (DGR) and Interest rate (INT), have a negative and insignificant relationship with liquidity ratio. This indicates that the three variables are not important in influencing the liquidity management of Nigerian banks. Thus, hypotheses 4, 5 and 8 are failed to be rejected.

Gross domestic product growth rate (GGDP) has a negative and significant effect at 10% ($p < 0.1$) with liquidity management. It indicates that during the period of economic boom, customers' borrowings from banks increase. This eventually led to banks having propensity to give out more loans to satisfy their customers' requests, thereby resulting in decrease in liquidity. This outcome of the study suggests that GGDP is an important factor that influences liquidity management of banks in Nigeria. This produces the same outcome as in the works of Vodova [2012], Chen and Phuong [2013], Trenca, Petria and Corovei [2015], Wojcik-Mazur and Szajt [2015], Singh and Sharma [2016] and Rashid, Ramachandran and Fawzy [2017]. Null hypothesis 6 is hereby rejected.

The inflation rate (INF) has a negative and significant effect at 5% level ($p < 0.05$) level with liquidity ratio. Since inflation has the capacity to lower the purchasing power of the people, invariably leading to increase in demand for loans, which effectively results in lower liquidity of bank. The study period coincided with period of high inflation rate in Nigeria. This confirms that inflation is an important determinant factor that influences liquidity management of Nigerian banks. The outcome is in line with the studies of Malik and Rafique [2013] and Rashid et al. [2017]. Null hypothesis 7 is hereby rejected.

For model 2, as shown in Table 6, profitability (ROA) is the only significant factor that appears to influence the liquidity management of Nigerian banks when deposit to asset ratio is used as a proxy to measure liquidity. ROA has a positive and significant association with DAR at 1% level

Table 7

Result of Hausman's Specification Test

Model	Dependent variable	Chi-square stat	Degree of freedom	Prob
1	LQR	8.5656	5	0.0358
2	DAR	12.9728	5	0.0236

Note. Authors' own computations.

(p < 0.01). The outcome is similar to the works by Al-Homaidi et al. [2019], Dzapasi [2020] and Mohamed and Adel [2020]. We therefore reject null hypothesis 4.

CAR, DGR, INF and INT have negative but insignificant relationship with DAR, while BSZ, ASQ and GGDP have positive and no relationship with DAR.

Conclusion

The study examined the influence of five bank-specific and three macroeconomic variables on liquidity management of twelve purposively selected Nigerian banks for the period 2009-2018. The bank-specific factors included capital adequacy, bank size, asset quality, profitability and deposit growth. GDP growth, inflation and interest rates comprised the macroeconomic variables. The effect of these eight determinant factors on two liquidity management variables, liquidity ratio and deposit to asset ratio, were analysed with the use of balanced fixed effects least square regression.

By combining the outcomes of the two models, the findings indicated that bank asset, GDP growth, inflation rate and profitability were the determinant factors that influenced the liquidity management of Nigerian banks during the study period. Similarly, the study could not provide empirical support for capital adequacy, asset quality, deposit growth and interest rate as important factors that influenced liquidity of the banks.

In order to effectively manage liquidity and mitigate unforeseen liquidity challenges, banks operating in Nigeria should come up with policies that will enhance bank size (total assets) and profitability. Government legislation and actions should be directed at properly managing the macro-economic variables, particularly inflation, as well as boosting the economic activities of the country. This will lead to improvement in GDP and subsequently enhance the capacity of banks to keep optimum liquidity and deal appropriately with unforeseen liquidity risk capable of destabilizing banks' operations and the entire economy.

Future research efforts should focus on examining liquidity determinant factors in other sectors such as insurance, pension funds, manufacturing, oil and gas. Possibility of increasing the study time frame and replicating this study in other emerging/developing countries should also be considered.

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