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Asset Liability Management and Performance of Listed Deposit Money Banks in Nigeria

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Authors' contributions

This work was carried out in collaboration between both authors. Author OAAR designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author AKA managed the analyses and the literature searches of the study. Both authors read and approved the final manuscript.

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ABSTRACT

The study examines the impact of Asset Liability Management (ALM) on financial performance of deposit money banks in Nigeria using time series annual data from 2005-2018. Data on asset liability management was proxied with loan and advance, non-performing loan, demand deposit and borrowing while performance was proxied with return on asset and return on investment. Ex-post facto research design was used for the study. Data from audited annual reports of fourteen listed deposit money banks were used and the data were analyzed using panel data regression analysis. The study found that asset liability management exerts both positive and negative effect on return on asset and return on investment of listed deposit money banks in Nigeria. It further revealed that loan and advance and bank size have positive effect on return on asset while, non-performing loan exhibit negative effect on return on asset of deposit money banks in Nigeria. The study also found that demand deposit, borrowing and bank size exerts positive effect on return on investment of deposit money banks while, increase in bank size exhibits negative effect on return on investment of deposit money banks in Nigeria. The study concludes that adequate attention must be placed on loan and advance, non-performing loan, demand deposit and borrowings of deposit money banks in Nigeria to facilitate and guarantee better asset liability management. The study therefore recommends that a comprehensive Asset Liability Management policy framework should be put in place by every deposit money banks which should be adequately driven by a very dynamic and proactive asset liability management committee (ALCO) constituted by the board with specific roles of regularly probing the appropriate mix of assets and liabilities that maximizes banks profitability so as to consistently enhance performance and create value for the shareholders.

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1. INTRODUCTION

As financial intermediaries, banks are known to accept deposit and lend money to entrepreneurs to make profit. They essentially intermediate between the opposing liquidity needs of depositors and borrowers. In the process, they function with an embedded mismatch between highly liquid liabilities on the one side and less liquid and long term assets on the other side of their balance sheets [1]. Over and above this balance sheet conflict, they also stand exposed to a wide array of risk such as market risk, transformation risk, credit risk, liquidity risk, forex risk, legal risk, operation risk, reputational risk, interest rate risk, etc. [2]. The recognition of three main risks i.e. interest rate risk, liquidity risk and credit risk gave rise to the concept of Asset Liability Management. The ALM system has different functions to manage risks such as market risk management, trading risk management, liquidity risk management, funding and capital planning, profit planning and growth projection [3]. It enables the banks to make symmetry business decisions in a more informed framework through risks. ALM is an integrated approach that covers both types and amounts of financial assets and liabilities with the complexities of the financial market. The largest source of income to banks is interest income from lending activity less interest paid on deposits and debt [4]. But it should be noted that banks cannot give out loans without deposit and banks primarily makes their profit through loan creation [5]. Banks cannot make profit without credit administration, and there cannot be credit administration without deposit. For a bank to attain the same objectives, then it has to ensure proper ALM which encompasses liquidity risk management, interest rate risk management and credit risk management [6].

The objective of ALM is to manage risk and not eliminate it [7]. Risks and rewards go hand in hand. The objectives do not limit the scope of the ALM functionality to mere risk assessment, but expanded the process to the taking on of risks that might conceivably result in an increase in economic value of the balance sheet. Apart from managing the risks, ALM should enhance the net worth of the institution through opportunistic positioning of the balance sheet. Banks engage in ALM to achieve three main goals; to ensure high profitability, to maintain desired liquidity level and to ensure security [8]. ALM enables the firm to balance between its liabilities and assets. This in turn minimizes financial risks and hence improves profitability. The primary goal of ALM is to produce a high quality, stable, large, and growing flow of net interest income. This goal is accomplished by achieving the maximum combination and level of assets, liabilities and financial risk. Also, ALM has grown up as a response to the problem of managing modern day business which is exposed to a wide variety of risks in an environment where interest rates, exchange rates and economic conditions are highly volatile.

Before 2015, Nigerian deposit money banks relied more on wholesale deposits and this poses threat not only to the profitability of banks but also to the stability of the entire banking system. This is because wholesale deposits are usually considered to be expensive and volatile. Before now, public funds were stashed in multiple bank accounts, exceeding more than 10,000 in various deposit money banks in Nigeria [9]. Therefore, the sudden withdrawal of public funds from Nigerian deposit money banks provoke serious maturity mismatch in asset and liability of most deposit money banks. The maturity mismatches and changes in the levels of assets and liabilities cause both liquidity risk and interest-rate risk to be on the increase. Given these mismatches, a continuing challenge for banks is to ensure that new funding replaces maturing funding in similar amounts and in a timely manner in order to continue to support a relatively stable pool of assets [10].

Following from the above, it is evident that there is a relationship between ALM and bank performance but, this relationship were not thoroughly examined due to the fact that most of the previous studies concentrated on bank specific factor with fewer number of banks examined and scanty number of years covered. Therefore, the present study attempts to not only widen the scope and period, but shall also evaluate the changing perspectives of the banks in maintaining sound assets liability management through critical assessment of the effect of maturity mismatches and at the same time ensure sustainable trends in profitability. Also, in variance from previous studies, panel data regression analysis shall be applied to analyze

fourteen years data collected from fourteen deposit money banks in Nigeria.

Against this backdrop, the main objective of this study is to empirically examine asset liability management and performance of selected listed deposit money banks in Nigeria. In line with this objective, the research questions are: does asset management has any significant effect on profitability of Nigerian deposit money bank? And, what is the effect of liability management on return on investment of Nigerian deposit money bank? To answer these questions, the remaining part of this paper is structured thus: section two reviewed literature on asset liability management and performance, section three outlines the methodology adopted for the study, data analysis and discussion were presented in section four while section five concludes the paper and proffer recommendations.

2. LITERATURE REVIEW

One of the ways for managing the risk inherent in banking business is Asset liability management, ALM, is defined by different scholars like [11,12,13]. [13] defined ALM as a dynamic process of planning, organizing, coordinating, and controlling the assets and liabilities; their mixes, volume, maturities, yield, and costs in order to achieve a specified net interest income. [14], defined asset liability management as the practice of managing a business so that decisions and actions taken with respects to assets and liabilities are coordinated in order to ensure effective utilization of company's resources to increase its profitability. [15] argue that ALM is a cost profit function which takes into account the assumed risk, level of earnings and liquidity of the bank. They indicated that banks management need to maintain a good balance between profitability and stability and the most important thing for bank management is to manage market liquidity risk and interest rate risk. They further highlighted that banks needs a framework which enables them to combat these risks and help them to optimize the performance of banks, and in this scenario, ALM is very useful and helpful tool to analyze the liquidity and interest rate risk of the bank.

On the other hand, the concept of performance is a controversial issue due to its multi-dimensional meanings. According to [16] the choice of performance (either operational or financial) depends upon the objectives that are set by firms. It is a subjective measure of how well a firm can use its' assets from its' primary business to generate revenues. [17] argued that financial performance measures like profitability and liquidity among others provided a valuable tool to stakeholders to evaluate the past financial performance and the current position of a firm. This term is also used as a general measure of a firm's overall financial health over a given period of time, and can be used to compare similar firms across the same industry or to compare industries or sectors in aggregation. [18] submitted that when banks have increase in capital structure and credit risk there would be increased in performance and that when banks are experiencing decrease in asset profile and liquidity risk there would be increase in performance. This is in line with the view of [19]. Thus in this study performance is proxy with profitability.

It follows therefore that, profitability is proxied with return on assets (ROA) and return on investment (ROI) in this study. Moreover, the return on assets (ROA) is a measure of performance that shows managerial efficiency i.e. how effective and efficient the management of banks has been using the assets to generate earnings. Return on assets (ROA) is measured as the ratio of profit after tax to total asset [20]. A higher ratio indicates a higher performance and efficient utilization of the assets of the firm and lower ratio is the indicator of inefficient use of assets. It will therefore be used in our regression model as one of the measures of performance. Similarly, return on investment (ROI) is a ratio that indicates the ability of the firm to earn a satisfactory return on all assets it employs. This ratio tells us how effective the firm is in terms of generating income, given its asset base. It determines the yield on the firm's assets by relating net income to total assets. It is therefore an important measure of the efficiency of management. Return on investment (ROI) is measured as the ratio of total investment to total asset [21]. The higher the ratio is the better, because this provides some indication of future growth prospects. This will also be used in our regression model as another measure of performance.

Empirical studies from developed nations of the world showed that, [22] investigated the relationship between asset liability management and financial performance of commercial banks in United States. The study used a cross-sectional research design and secondary data were extracted from financial statement of

commercial banks sampled. The study employed panel data for three years and the analysis was done using a regression model. The study concluded that there was a positive relationship between asset liability management and financial performance of service firms in United States. Conversely, [23] did a study on the impact of asset liability management and financial performance of Swedish firms. The study used a cross-sectional survey design whereby secondary sources of data were obtained from the financial statements of Swedish micro firms. The study used descriptive statistics for analysis; the results established that there was a positive correlation between asset liability management and financial performance of Swedish micro firms.

Furthermore, empirical review from emerging nations showed that, [24] examined the effect of asset liability management on the Commercial banks profitability in Indian financial market by taking into consideration one public sector bank namely Union Bank of India and one private sector bank namely ICCI bank using Gap Analysis Technique. Statistical tools, multivariate statistical technique and ratio analysis were used to interpret the financial statements and analyze the data. This study primarily based on secondary data, attempts to assess the interest rate risk that both banks are exposed to over a period from 2009 to 2014. The study found that it is evident that both banks are performing satisfactorily in terms of profitability and adequacy, but there are needs to address the immediate concern of liquidity. The study concluded that Indian bank is more profitable with good asset liability management strategy; therefore Investors would be motivated to invest in a bank which has high profitability ratio. On the contrary, [25] examined asset liability management and the profitability of listed banks in Ghana using panel data. The regression result shows that the logarithm of total bank asset has a positive significant effect on listed banks profitability. In other words, assets management has positive effect on commercial banks profitability. The research also found from the observation of seven banks listed on the Ghana Stock Exchange in the period of 2008 to 2012 that banks profitability is negatively affected by liabilities. In other words, liability management has negative effect on the Ghanaian listed banks profitability. The findings show that the liabilities are significantly costing the profitability of listed banks in Ghana.

Moreover, empirical studies from Nigeria reflected that, [26] carried out a research on asset liability management on performance of some selected Nigerian commercial banks. The study covered 15 Nigerian banks from 2008 to 2012. The study employed secondary source of data and adopted the Statistical Cost Accounting (SCA) Model. The result from the findings showed that all the parameter of asset liability management of Nigerian banks had positive and significant impact on profitability within the period of this study. The study concluded that the due process of asset liability management of banks instituted by the apex regulatory authorities in Nigeria within the period of this study have been effective. Conversely, [27] examined effects of ALM on financial performance of some selected Nigerian banks. The study employed secondary data which were sourced from the annual statistical bulletin and audited financial statement of selected Nigerian deposit money banks. The study adopted panel data regression analysis to explore the relationship between asset liability management and financial performance. The study found that loans and advances are positively related to return on equity especially when profitability is measured as proxy of financial performance, while the liability variables are negatively related to the measure of bank performance adopted in this study. The study concluded that asset liability management has significant effect on financial performance of Nigerian deposit money banks.

Following from the preceding discussion, this study adopts liability management theory to underpin the relationship between asset liability management and performance of deposit money banks in Nigeria. This theory states that, there is no need for banks to lend self-liquidating loans and maintain liquid assets as they can borrow reserve money in the money market whenever necessary. A bank can hold reserves by building additional liabilities against itself via different sources. Also, from the literature reviewed, it was found that there is no consensus among researchers on the effects of asset liability management on performance of deposit money banks and this justify further study in this area with particular emphasis on Nigeria. In addition to this, it was discovered that most of the studies were not current, does not cover wider periods and were limited to fewer banks which may not represent fair occurrences in the deposit money banks. These necessitate recent study in this area.

3. METHODOLOGY

A well-defined expos-facto research design is adopted in this study which is characterizes with quantitative or numeric description of historical data. The study used panel data, which are combination of time series and cross sectional data. To account for the dynamic relationship between asset liability management and performance variables, the study panel vector autoregressive framework was adopted in this study and this is similar to the specification of [28]. The study involves fourteen deposit money banks out of the listed on the Nigerian Stock Exchange (NSE) as at December, 2018. The study used annual data of the banks for the period 2005 to 2018 which were collected from the Nigerian Stock Exchange (NSE), CBN published financial statement of the affected banks, banking survey reports and Nigeria Deposit Insurance Corporation. Moreover, the fourteen banks were selected due to availability of their annual report and accounts in the Nigerian Stock Exchange for the period 2005 to 2018. This period was also chosen because major reforms like recapitalization and consolidation, cashless policy, adherence to corporate governance etc took place in the banking sector. These reforms affects virtually all the banks during which some banks were merged, some were absorbed, some were bailed out and some were nationalized.

3.1 Variable Description and Measurement

Table 1. Measurement of variables

S/N	Variables	Types	Measurements	Source
1	Return on Assets	Dependent Variable 1	Ratio of profit after tax to total asset.	Farouk, (2014)
2	Return on Investment	Dependent Variable 2	Ratio of total investment to total asset	Saleh (2009)
3	Asset Management	Independent Variable 1	Ratio of total loan to total asset, ratio non-performing loan to loan,	Eldomiaty, Fikri, Mostafa & Hager (2015)
4	Liability Management	Independent Variable 2	Ratio of demand deposit to total asset and ratio of borrowing to total asset	Das, (1996).
5	Bank Size	Control variable	Logarithm of total asset	Kariuki, Muturi, and Ngugi, (2016)

Source: Various Empirical Studies (2020)

3.2 Model Specification

The model specifications for this study are in two categories based on the number of formulated hypotheses and each category will detail the pooled, fixed effect and random effect of the panel model. The specifications are as follows:

3.2.1 Model one: Asset management and profitability

The specification draws a relationship between return on assets, ratio of total loan to total asset and ratio of non-performing loan to total loan. Thus, the model of interest for this study is discussed under the static and dynamic frameworks. The former comprises the pooled, fixed and random effect regression model, while the latter deals with dynamic model as presented below:

$$ROA_{it} = \pi_0 + \lambda_1 LOA_{it} + \lambda_2 NPL_{it} + \lambda_3 \mathrm{BSZ} + \varepsilon_{it0} \quad (3.1)$$

$$ROA_{it} = \pi_0 + \lambda_1 LOA_{it} + \lambda_2 NPL_{it} + \lambda_3 \mathrm{BSZ} + u_i + \varepsilon_{it1} \quad (3.2)$$

$$ROA_{it} = \pi_0 + \lambda_1 LOA_{it} + \lambda_2 NPL_{it} + \lambda_3 \mathrm{BSZ} + w_i + \varepsilon_{it2} \quad (3.3)$$

Where ROA is the return on assets, LOA is ratio of total loan to total asset, NPL is the non-performing loan to loan, BSZ is the bank size which serves as a control variable, λ_1-λ_3 represent the coefficients of the variables, ε represents the error term, π_0 represent the constant i is the deposit money banks and t is the time frame in the study, ui which is the specific fixed effect, wi is the specific random effect and ε is the idiosyncratic shock or individual observation error term.

Dynamic models for return on asset, ratio of total loan to total asset and ratio of non-performing loan to total asset are specified below:

$$ROA_{\text{it}} = \pi_{01} + \lambda_{11} ROA_{it-1} + ... \lambda_{1p} ROA_{it-p} + \lambda_{12} LOA_{\text{it}-1} + ... \lambda_{1p} LOA_{it-p} + \lambda_{13} NPL_{\text{it}-1} + \lambda_{1p} NPL_{it-p} + \lambda_{14} BSZ_{\text{it}-1} + \lambda_{1p} BSZ_{\text{it}-p} + f_i + d_i + \varepsilon_{\text{it}1} \quad (3.4)$$

$$LOA_{\text{it}} = \pi_{01} + \lambda_{11} ROA_{it-1} + ... \lambda_{1p} ROA_{it-p} + \lambda_{12} LOA_{\text{it}-1} + ... \lambda_{1p} LOA_{it-p} + \lambda_{13} NPL_{\text{it}-1} + \lambda_{1p} NPL_{it-p} + \lambda_{14} BSZ_{\text{it}-1} + \lambda_{1p} BSZ_{\text{it}-p} + f_i + d_i + \varepsilon_{\text{it}1} \quad (3.5)$$

$$NLP_{\text{it}} = \pi_{01} + \lambda_{11} ROA_{it-1} + ... \lambda_{1p} ROA_{it-p} + \lambda_{12} LOA_{\text{it}-1} + ... \lambda_{1p} LOA_{it-p} + \lambda_{13} NPL_{\text{it}-1} + \lambda_{1p} NPL_{it-p} + \lambda_{14} BSZ_{\text{it}-1} + \lambda_{1p} BSZ_{\text{it}-p} + f_i + d_i + \varepsilon_{\text{it}1} \quad (3.6)$$

$$BSZ_{\text{it}} = \pi_{01} + \lambda_{11} ROA_{it-1} + ... \lambda_{1p} ROA_{it-p} + \lambda_{12} LOA_{\text{it}-1} + ... \lambda_{1p} LOA_{it-p} + \lambda_{13} NPL_{\text{it}-1} + \lambda_{1p} NPL_{it-p} + \lambda_{14} BSZ_{\text{it}-1} + \lambda_{1p} BSZ_{\text{it}-p} + f_i + d_i + \varepsilon_{\text{it}1} \quad (3.7)$$

The a priori expectation are ROA > 0, LOA > 0, NPL < 0, and BSZ > 0

3.2.2 Model two: Liability management and return on investment

The specification draws a relationship between return on investment, ratio of demand deposit to total asset and ratio of borrowing to total asset. Thus, the model of interest for this study is discussed under the static and dynamic frameworks. The former comprises the pooled, fixed and random effect regression model, while the latter deals with dynamic model similar to [28].

$$ROI_{\text{it}} = \pi_0 + \lambda_1 DDA_{\text{it}} + \lambda_2 BTA_{\text{it}} + \lambda_3 \text{BSZ} + \varepsilon_{\text{it}0} \quad (3.8)$$

$$ROI_{\text{it}} = \pi_0 + \lambda_1 DDA_{\text{it}} + \lambda_2 BTA_{\text{it}} + \lambda_3 \text{BSZ} + u_i + \varepsilon_{\text{it}1} \quad (3.9)$$

$$ROI_{\text{it}} = \pi_0 + \lambda_1 DDA_{\text{it}} + \lambda_2 BTA_{\text{it}} + \lambda_3 \text{BSZ} + w_i + \varepsilon_{\text{it}2} \quad (3.10)$$

Where ROI is the return on investment, DDA is ratio of demand deposit to total assets, BTA is borrowing to total assets, BSZ is the bank size which serves as a control variable, λ_1-λ_3 represent the coefficients of the variables, ε represents the error term, π_0 represent the constant i is the deposit money banks and t is the time frame in the study, ui which is the specific fixed effect, wi is the specific random effect and ε is the idiosyncratic shock or individual observation error term. Dynamic models for return on investment, ratio of demand deposit to total asset and ratio of borrowings to total asset are specified below;

$$ROI_{\text{it}} = \pi_{01} + \lambda_{11} ROI_{it-1} + ... \lambda_{1p} ROI_{it-p} + \lambda_{12} DDA_{\text{it}-1} + ... \lambda_{1p} DDA_{it-p} + \lambda_{13} BTA_{\text{it}-1} + \lambda_{1p} BTA_{it-p} + \lambda_{14} BSZ_{\text{it}-1} + \lambda_{1p} BSZ_{\text{it}-p} + f_i + d_i + \varepsilon_{\text{it}1} \quad (3.11)$$

$$DDA_{it} = \pi_{01} + \lambda_{11} ROI_{it-1} + ... \lambda_{1p} ROI_{it-p} + \lambda_{12} DDA_{it-1} + ... \lambda_{1p} DDA_{it-p} + \lambda_{13} BTA_{it-1} + \lambda_{1p} BTA_{it-p} + \lambda_{14} BSZ_{it-1} + \lambda_{1p} BSZ_{it-p} + f_i + d_i + \varepsilon_{it1} \quad (3.12)$$

$$BTA_{it} = \pi_{01} + \lambda_{11} ROI_{it-1} + ... \lambda_{1p} ROI_{it-p} + \lambda_{12} DDA_{it-1} + ... \lambda_{1p} DDA_{it-p} + \lambda_{13} BTA_{it-1} + \lambda_{1p} BTA_{it-p} + \lambda_{14} BSZ_{it-1} + \lambda_{1p} BSZ_{it-p} + f_i + d_i + \varepsilon_{it1} \quad (3.13)$$

$$BSZ_{it} = \pi_{01} + \lambda_{11} ROI_{it-1} + ... \lambda_{1p} ROI_{it-p} + \lambda_{12} DDA_{it-1} + ... \lambda_{1p} DDA_{it-p} + \lambda_{13} BTA_{it-1} + \lambda_{1p} BTA_{it-p} + \lambda_{14} BSZ_{it-1} + \lambda_{1p} BSZ_{it-p} + f_i + d_i + \varepsilon_{it1} \quad (3.14)$$

The a priori expectation are ROI > 0, DDA > 0, BTA > 0 and BSZ >0

4. RESULT AND DISCUSSION

4.1 Objective 1

Effect of asset management on profitability of Nigerian DMBs.

Table 2. Descriptive analysis

Statistical Tools	ROA	LOA	NPL	BSZ
Mean	1.693371	0.404741	0.18452	12.42206
Median	1.807400	0.408664	0.01447	13.20519
Maximum	10.00860	0.768769	6.52223	15.59986
Minimum	-28.51420	0.060491	0.00186	5.056246
Std. Dev.	3.327109	0.131668	0.88091	2.581763
Skewness	-4.451989	-0.138587	5.69146	-1.189891
Kurtosis	38.89613	2.967530	34.76325	3.627250
Jarque-Bera	11170.47	0.636021	9297.545	49.46388
Probability	0.000000	0.727595	0.000000	0.000000
Observations	196	196	196	196

Source: Researchers' Computation, 2020

The Table 2 showed the descriptive analysis results of all the activities regarding the effect of asset management on the profitability of DMB in Nigeria for the period 2005-2018. The return on asset (ROA) measured the profitability of the DMB under investigation while loan and advance (LOA), non-performing loan (NPL) and bank size (BSZ) proxied asset management. The result revealed on average that, the return on asset (ROA), loan and advance (LOA), non-performing loan (NPL) and bank size (BSZ) to be 1.693, 0.405, 0.185 and 12.422 percent respectively. This implies that emphasis must be put on loan and advance (LOA) and non-performing loan (NPL) of the DMBs to ensure and facilitate better asset management. The maximum & the minimum value fo return on asset (ROA), loan and advance (LOA), non-performing loan (NPL) and bank size (BSZ) were: 10.009 & -28.514, 0.769 & 0.060, 6.522 & 0.001 and 15.600 & 5.056 percent respectively. The standard deviation values of 3.237, 0.132, 0.881 and 2.582 revealed the rate at which the return on asset (ROA), loan and advance (LOA), non-performing loan (NPL) and bank size (BSZ) were been deviated from their respective expected value.

Also, it was discovered that, non-performing loan (NPL) was positively skewed with skewness coefficient of 5.691 and thus have a distribution with a long tail to the right while the return on asset (ROA), loan and advance (LOA) and bank size (BSZ) with skewness coefficient of -4.452, -0.139 and -1.190 respectively were negatively skewed and thus have a distribution with a long tail to the left. However, the kurtosis of the financial variables showed that the return on asset (ROA), non-performing loan (NPL) and bank size (BSZ) with kurtosis coefficient indexes

of 38.896, 34.763 and 3.627 respectively were mesokurtic in nature while loan and advance (LOA) with kurtosis coefficient index of 2.968 was leptokurtic. The Jarque-Bera and probability values revealed that the return on asset (ROA), non-performing loan (NPL) and bank size (BSZ) were statistically significance in examining the impact of asset management on the profitability of DMB in Nigeria.

The correlation coefficients presented in Table 3 showed the degree or the extent of relationship that exist between asset management and profitability of DMB under investigation in Nigeria. From Table 3, it was discovered that a positive correlation exist between return on asset (ROA) and loan and advance (LOA) and return on asset (ROA) and bank size (BSZ) with correlation coefficient of 0.02 and 0.01 respectively. Also, a positive correlation was discovered between loan and advance (LOA) and bank size (BSZ). It was also discovered that non-performing loan (NPL) negatively correlated with all the variables under consideration. This implies that an increase in loan and advance (LOA) and bank size (BSZ) increased the profitability of the deposit money bank in Nigeria. Thus, it also shows that a continuous increase in non-performing loan (NPL), reduces the profitability of the money deposit banks drastically.

The panel unit root test presented in Table 4 showed that all the variables were stationary. The return on asset (ROA), loan and advance (LOA), non-performing loan (NPL) and bank size (BSZ) were all stationary at both cross section and individual level except the loan and advance (LOA) which was non stationary at individual level during the period under investigation. This was revealed as the probability of Levin, Lin and Chur t statistic values 0.000, 0.002, 0.000 and 0.000 and Augmented Dickey Fuller (ADF) test statistic values 0.006, 0.021, 0.000 and 0.003 for each of the variable was less than the probability of the error margin 0.05 allowed for the estimate in this study. This result implies that there is a short run equilibrium relationship among the variables under investigation. Thus, there is a short run stability among variables as revealed by the panel unit root test.

Table 5 showed the result of the pooled, fixed and random effect panel regression for the impact of asset management measured by loan and advance (LOA), non-performing loan (NPL) and bank size (BSZ) on return on asset (ROA) of DMBs in Nigeria. It was discovered from the results that a linear relationship exists between loan and advance (LOA), non-performing loan (NPL), bank size (BSZ) and return on asset (ROA) of DMBs in Nigeria. Specifically, the result of the three panel model showed that asset management has both positive and negative relationship with the profitability of the selected listed DMBs. Thus, it was revealed that loan and advance (LOA) and bank size (BSZ) positively related with return on asset of DMBs, while, non-performing loan (NPL) negatively related with return on asset of listed DMBs in Nigeria.

Table 3. Correlation matrix

Variables	ROA	LOA	NPL	BSZ
ROA	1.000000	0.017454	-0.059526	0.014235
LOA	0.017454	1.000000	-0.226465	0.198032
NPL	-0.059526	-0.226465	1.000000	-0.393907
BSZ	0.014235	0.198032	-0.393907	1.000000

Source: Researchers' Computation, 2020

Table 4. Panel unit root test stationary at level for the variables

Variables	Levin, Lin & Chu t* statistic	Prob	ADF statistic	Prob	PP statistic	Prob
ROA	-4.17120	0.0000	58.3993	0.0006	116.511	0.0000
LOA	-2.85674	0.0021	45.3048	0.0205	36.5518	0.1291
NPL	-5.78591	0.0000	73.6688	0.0000	118.130	0.0000
BSZ	-5.59866	0.0000	52.6139	0.0033	155.941	0.0000

Source: Researchers' Computation, 2020

Table 5. Panel least square models

Dependent Variable: ROA
Method: Panel Least Squares
Sample: 2005-2018
Periods included: 14
Cross-sections included: 14
Total panel (balanced) observations: 196

	Pooled effect		Fixed effect		Random effect	
Variable	**Coefficient**	**Prob.**	**Coefficient**	**Prob.**	**Coefficient**	**Prob.**
C	1.866656	0.1960	0.304360	0.0001	2.553298	0.2356
LOA	0.069511	0.0023	0.278069	0.0059	0.198019	0.9205
NPL	-0.348732	0.0322	-0.342808	0.0007	-0.090730	0.0052
BSZ	0.014969	0.8832	0.171588	0.5320	0.142302	0.0003
Effects specification						
					S.D.	**Rho**
			Cross-section random		1.7724	0.0384
			Idiosyncratic random		3.0025	0.7416
	Cross-section Pooled		Cross-section fixed		Cross-section random	
R-squared	0.837		0.882		0.763	
Adjusted R-squared	0.764		0.870		0.713	
F-statistic	67.096		123.778		4.814	
Prob(F-statistic)	0.038		0.000		0.044	

Source: Researchers' Computation, 2020

The result further revealed from the pooled effect model that loan and advance (LOA) and bank size (BSZ) led to increase in the return on asset of the selected DMB to the turn of 7 and 2 percent respectively while, non-performing loan (NPL) negatively related with return on asset (ROA) and thus reduced the profitability of the selected deposit money banks by 35 percent. From the fixed effect model, it was discovered that loan and advance (LOA) and bank size (BSZ) were positively related with return on asset (ROA) of the selected DMBs and thus led to increase in the profitability of DMBs under study to the turn of 28 and 17 percent respectively while, the non-performing loan (NPL) negatively related with the profitability and thus reduced the return on asset (ROA) of the selected deposit money banks by 34 percent. The random effect model showed that loan and advance (LOA) and bank size (BSZ) led to increase in the profitability of the selected DMBs to the turn of 20 and 14 percent respectively while, the non-performing loan (NPL) negatively related with the profitability and thus reduced the return on asset (ROA) of the selected DMBs by 9 percent.

Also, the probability values of 0.002, 0.032, 0.006, 0.001< 0.05 revealed that the estimated parameter for the pooled, fixed and random effect models were statistically significant in determining the profitability of the selected DMBs in Nigeria under study. However, the probability values of 0.883 and 0.532 > 0.05 revealed that the estimated parameter for bank size for the pooled and fixed effect models were statistically insignificant in determining the return on asset (ROA) of the selected DMBs in Nigeria during the period under study. Above all, the probability of the F- statistics 0.038, 0.000 and 0.044< 0.05 indicated that the pooled, fixed and random effect panel models were statistically significant, valid, reliable, appropriate and acceptable for determining the impact of asset management on profitability of the selected DMBs in Nigeria.

Table 6 showed the result of the vector autoregressive model of lag length to be selected for this study. From the result, vector autoregressive model of lag order of one (1) was discovered using Schwarz information criterion with value 32.441 while, vector autoregressive model of lag order of six (6) was revealed by Akaike information criterion and Hannan-Quinn information criterion with values given as 30.623 and 31.608 respectively. All these information criterions were statistically significance at 5 percent level. It was based on this evidence that a vector autoregressive model of lag order one (1) which was the smallest minimum lag order as revealed by Schwarz information criterion was selected for this study.

Table 6. VAR Lag order selection criteria

VAR Lag Order Selection Criteria
Endogenous variables: ROA LOA NPL BSZ
Exogenous variables: C
Sample: 2005 2018
Included observations: 112

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-2108.164	NA	2.82e+11	37.71722	37.81431	37.75661
1	-1769.506	647.0801	8.88e+08	31.95546	32.44090*	32.15242
2	-1748.693	38.28122	8.16e+08	31.86951	32.74331	32.22404
3	-1718.523	53.33559	6.35e+08	31.61648	32.87864	32.12858
4	-1706.395	20.57502	6.84e+08	31.68562	33.33613	32.35528
5	-1666.773	64.38481	4.52e+08	31.26381	33.30268	32.09104
6	-1614.884	80.61384*	2.41e+08*	30.62292*	33.05015	31.60773*

Source: Researchers' Computation, 2020

Table 7. Vector autoregressive estimates

Vector Autoregression Estimates
Sample (adjusted): 2006 2018
Included observations: 182 after adjustments
Standard errors in ( )

	ROA	LOA	NPL	BSZ
ROA(-1)	0.208536	0.002148	-0.033164	0.014523
	(0.07299)	(0.00227)	(0.012361)	(0.00722)
LOA(-1)	0.050939	0.575455	-0.313794	-0.063976
	(1.95452)	(0.06067)	(0.331004.)	(0.19335)
NPL(-1)	-1.20E-07	-6.27E-09	0.724494	2.41E-08
	(3.0E-07)	(9.4E-09)	(0.05145)	(3.0E-08)
BSZ(-1)	0.019774	0.004698	-0.038415	0.986947
	(0.10663)	(0.00331)	(0.018057)	(0.01055)
C	1.005598	0.113240	663617.0	0.367552
	(1.49719)	(0.04648)	(253554.)	(0.14811)
R-squared	0.546716	0.388580	0.621947	0.983620
Adj. R-squared	0.525173	0.374763	0.613403	0.983250
Sum sq. resids	1989.071	1.916786	5.70E+13	19.46428
S.E. equation	3.352266	0.104064	567715.5	0.331614
F-statistic	22.16851	28.12257	72.79700	2657.184
Log likelihood	-475.8657	156.1086	-2667.098	-54.82306
Akaike AIC	5.284238	-1.660534	29.36372	0.657396
Schwarz SC	5.372260	-1.572512	29.45174	0.745418
Mean dependent	1.592685	0.406320	197250.5	12.55886
S.D. dependent	3.395273	0.131607	913064.8	2.562243

Source: Researchers' Computation, 2020

Table 7 showed the result of vector autoregressive model to examine the dynamic of asset management in relation to the return on asset (ROA) of selected DMBs in Nigeria with the coefficient of parameters and (standard error). It was discovered that return on asset at lag one (ROA (-1)), loan and advance at lag one (LOA (-1)), bank size at lag one (BSZ (-1)), under consideration have a direct relationship with the current level of return on asset (ROA) of the DMBs in Nigeria. The result further revealed that one percent improvement of the return on asset at lag one (ROA (-1)), loan and advance at lag one (LOA (-1)) and bank size at lag one (BSZ (-1)) led to an increase in the current level of return on asset (ROA) of the DMBs under consideration in Nigeria by 21, 5 and 2 percent respectively. Thus, returns to be generated from the asset is vital in determining the profitability level of the DMBs. This indicates that, the loan and advance

of the DMBs must be judiciously utilized to expand the banks horizon in order to enhance the profitability of the DMBs.

Above all, the test for the overall significant or the adequacy of the autoregressive model done using F-statistic showed that the F-statistic values of 22.17, 28.12, 72.79 and 2657.18 > 2.65, and at critical value at 5 percent level of significance and thus revealed that the model was adequate in examining the dynamic effect of asset management in relation to profitability of the DMBs in Nigeria. This result led to the test for the stability condition of the VAR model condition check and the results were presented in the Table 8 and Fig. 1.

The result in Table 8 and Fig. 1 showed that the vector autoregressive stability condition check for the dynamic in the profitability of the deposit money bank and the asset management captured by loan and advance, non-performing loan and bank size and return on asset of the deposit money bank in Nigeria is impressive. Here, the rule of thumb is that if any of the root or eigen value is greater than one, then vector autoregressive model fail stability test. However, from the result above, all the roots or the eigen values were less than one and were within the unit circle. Thus, the eigen value were within the unit circle and therefore implies that the vector autoregressive model satisfied stability condition. Hence, the model is stable and as such, it can be used for policy formation and implementation with regard to relationship of asset management and profitability of DMBs in the Nigeria.

4.2 Objective 2

Effect of Liability Management on return on investment of Nigerian DMBs.

Table 8. Vector error correction model stability condition check

Roots of Characteristic Polynomial **Endogenous variables: ROA LOA NPL BSZ** **Exogenous variables: C** **Lag specification: 1 1**	
Root	**Modulus**
0.982767	0.982767
0.742473	0.742473
0.562513	0.562513
0.207679	0.207679

Source: Researchers' Computation, 2020

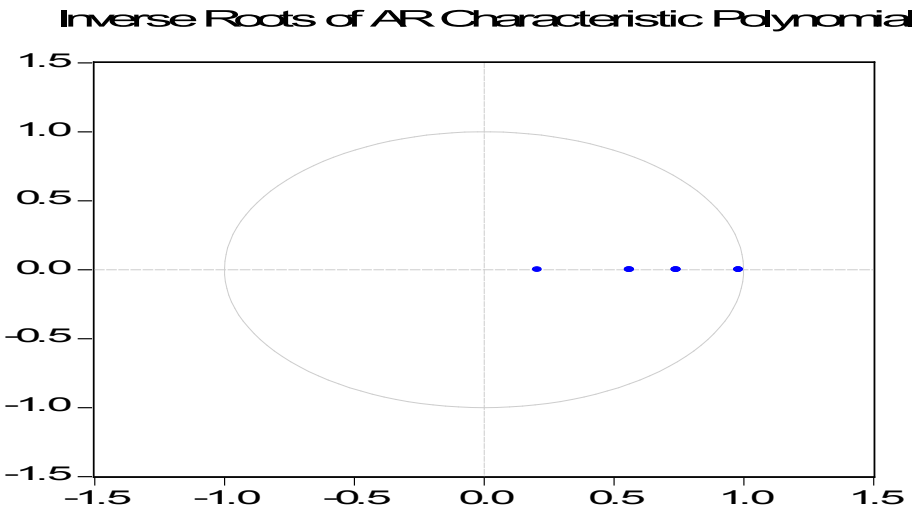

Fig. 1. Diagrammatic representation of VAR model stability condition
Source: Researchers' Computation, 2020

Table 9. Descriptive analysis

Statistical tools	RO1	DDA	BTA	BSZ
Mean	11.97320	0.348377	0.771639	12.42206
Median	11.30620	0.329935	0.416169	13.20519
Maximum	35.40630	1.244753	19.44856	15.59986
Minimum	-8.747800	0.032765	0.021620	5.056246
Std. Dev.	6.516811	0.181240	1.873524	2.581763
Skewness	0.936497	1.795215	6.880115	-1.189891
Kurtosis	5.296833	8.709850	58.62093	3.627250
Jarque-Bera	71.73235	371.5309	26811.43	49.46388
Probability	0.000000	0.000000	0.000000	0.000000
Observations	196	196	196	196

Source: Researchers' Computation, 2020

Table 9 showed the descriptive analysis results of all the activities regarding the effect of liability management on return on investment of DMBs in Nigeria for the period 2005-2018. The return on investment (ROI) measured the profitability of the DMBs under investigation while ratio of demand deposit to total asset (DDA), ratio of borrowing to total asset (BTA) and bank size (BSZ) were used to capture liability management. The result revealed on average that, return on investment (ROI), ratio of demand deposit to total asset (DDA), ratio of borrowing to total asset (BTA) and bank size (BSZ) to be 11.973, 0.348, 0.772 and 12.422 percent respectively. This result implies that emphasis must be put on the ratio of demand deposit to total asset (DDA) and ratio of borrowing to total asset (BTA) of the DMBs to ensure a better liability management. The maximum & the minimum value for the return on investment (ROI), ratio of demand deposit to total asset (DDA), ratio of borrowing to total asset (BTA) and bank size (BSZ) were: 35.408 & -8.748, 1.245 & 0.033, 19.449 & 0.022 and 15.600 & 5.056 percent respectively. The standard deviation values of 6.517, 0.181, 1.874 and 2.582 revealed that the rate at which the return on investment (ROI), ratio of demand deposit to total asset (DDA), ratio of borrowing to total asset (BTA) and bank size (BSZ) were been deviated from their respective expected value.

Also, it was discovered that return on investment (ROI), ratio of demand deposit to total asset (DDA) and ratio of borrowing to total asset (BTA) were positively skewed with skewness coefficient of 0.936, 1.795 and 6.880 respectively. Thus, it had a distribution with a long tail to the right while bank size (BSZ) with skewness coefficient of -1.190 was negatively skewed and thus have a distribution with a long tail to the left. However, the kurtosis of the financial variables showed that return on investment (ROI), ratio of demand deposit to total asset (DDA), ratio of borrowing to total asset (BTA) and bank size (BSZ) with kurtosis coefficient index of 5.297, 8.710, 58.621 and 3.627 were mesokurtic in nature. The Jarque-Bera and probability values revealed that the return on investment (ROI), ratio of demand deposit to total asset (DDA), ratio of borrowing to total asset (BTA) and bank size (BSZ) were statistically significance in assessing the effect of liability management on the return on investment of DMBs in Nigeria.

The correlation coefficients presented in Table 10 showed the degree or the extent of relationship that exist between liability management and return on investment that can be used to measure profitability of DMBs under investigation in Nigeria. From the table, it was discovered that a positive correlation exist between the return on investment (ROI), ratio of demand deposit to total asset (DDA) and ratio of borrowing to total asset (BTA) with correlation coefficient of 0.25 and 0.13 respectively. Also, a positive correlation was discovered between ratio of demand deposit to total asset (DDA) and ratio of borrowing to total asset (BTA) with correlation coefficient 0.52. It was also discovered that the ratio of demand deposit to total asset (DDA) and ratio of borrowing to total asset (BTA) negatively correlated with bank size (BSZ) under consideration with the correlation coefficient of -0.42 and -0.24 respectively. This result implies that when there is an increase in the ratio of demand deposit to total asset (DDA) and ratio of borrowing to total asset (BTA), the return on investment (ROI) of DMBs also increase on one hand and, on the other hand, a continuous increase in bank size (BSZ) led to a decline in the return on investment (ROI), ratio of demand deposit to total asset (DDA) and ratio of borrowing to total asset (BTA) of the DMBs under consideration in Nigeria.

Table 10. Correlation matrix

Variables	ROI	DDA	BTA	BSZ
ROI	1.000000	0.252864	0.130556	-0.019907
DDA	0.252864	1.000000	0.521149	-0.421131
BTA	0.130556	0.521149	1.000000	-0.244308
BSZ	-0.019907	-0.421131	-0.244308	1.000000

Source: Researchers' Computation, 2020

Table 11. Panel unit root test at level for the variables

Variables	Levin, Lin & Chu t* statistic	Prob	ADF statistic	Prob	PP statistic	Prob
ROI	-3.04342	0.0012	39.5900	0.0719	45.1631	0.0212
DDA	-3.94490	0.0000	44.5092	0.0247	45.6099	0.0191
BTA	-3.95389	0.0000	44.5994	0.0242	32.5719	0.2519
BSZ	-5.59866	0.0000	52.6139	0.0033	155.941	0.0000

Source: Researchers' Computation, 2020

The panel unit root test presented in the Table 11 showed that all the variables were stationary. The return on investment (ROI), ratio of demand deposit to total asset (DDA), ratio of borrowing to total asset (BTA) and bank size (BSZ) were all stationary at cross section level during the period under investigation. This was revealed as the probability of Levin, Lin and Chur t statistic values 0.001, 0.000, 0.000 and 0.000 respectively. At the individual level, the Augmented Dickey Fuller (ADF) test statistic values 0.025, 0.024 and 0.003 for each of the variable except return on investment (ROI) which were less than the probability of the error margin 0.05 allowed for the estimate in this study revealed the stationarity of liability management and return on investment. Thus, it implied that a short run equilibrium relationship exist among the financial variables under investigation to examine the effect of liability management on return on investment of the DMBs in Nigeria. Hence, short run stability was established between liability management and return on investment as revealed by the panel unit root test.

Table 12 showed the result of the pooled, fixed and random effect panel regression for the effect of liability management measured by ratio of demand deposit to total asset (DDA), ratio of borrowing to total asset (BTA) and bank size (BSZ) on return on investment (ROI) of DMBs in Nigeria. It was discovered from the results that a linear relationship exists between the ratio of demand deposit to total asset (DDA), ratio of borrowing to total asset (BTA) and bank size (BSZ) and return on investment (ROI) of DMBs in Nigeria. Specifically, the result of the three panel model showed that liability management has both positive and negative relationship with the profitability of the selected listed DMBs. Thus, it was revealed from the pooled panel model that ratio of demand deposit to total asset (DDA), ratio of borrowing to total asset (BTA) and bank size (BSZ) were positively related with the return on investment (ROI) of DMBs under consideration in Nigeria.

The result further revealed from the pooled panel effect model that the ratio of demand deposit to total asset (DDA), ratio of borrowing to total asset (BTA) and bank size (BSZ) led to an increase in return on investment (ROI) of the selected DMBs to the turn of 17, 0.7 and 45 percent respectively. From the fixed effect model, it was discovered that the ratio of demand deposit to total asset (DDA) was positively related with the return on investment (ROI) of the selected DMBs and thus led to increase in the profitability of DMBs under study to the turn of 11 percent while, the ratio of borrowing to total asset (BTA) and bank size (BSZ) were negatively related with profitability and thus reduced the return on investment (ROI) of the selected DMBs by 38 and 85 percent respectively. The random effect model showed that ratio of demand deposit to total asset (DDA) was positively related with the return on investment (ROI) of the selected DMBs and thus led to increase in the profitability of DMBs under study to the turn of 47 percent while, the ratio of borrowing to total asset (BTA) and bank size (BSZ) were negatively related with the profitability and thus reduced the return on investment (ROI) of the selected deposit money banks by 31 and 32 percent respectively. The result showed that DMB need to invest their borrowings more efficiently and expand the scope of their business in order to achieve better return on investment.

Also, the probability values of the estimated parameters for the pooled, fixed and random effect models that were less than 0.05 revealed their statistical significance of the liability management in assessing the return on investment as a measure of profitability of DMBs in Nigeria. Above all, the probability of the F-statistics 0.002, 0.000 and 0.001< 0.05 indicated that the pooled, fixed and random effect panel models were statistically significance, valid, reliable, appropriate and acceptable for assessing the effect of liability management on return on investment as a measure of profitability of the selected DMBs in Nigeria.

Table 13 showed the result of the vector autoregressive model of lag length to be selected for this study. From the result, vector autoregressive model of lag order of one (1) was discovered using Schwarz information criterion with value 32.441 while, vector autoregressive model of lag order of three (3) was revealed by Hannan-Quinn information criterion with value given as 7.3796 and a vector autoregressive model of lag order of six (6) was revealed by Akaike information criterion with statistical value given as 6.4509. All these information criterions were statistically significance at 5 percent level. It was based on this evidence that a vector autoregressive model of lag order one (1) which was the smallest minimum lag order as revealed by Schwarz information criterion was chosen for this study.

Table 12. Panel least square models

Dependent Variable: ROI
Method: Panel Least Squares
Sample: 2005-2018
Periods included: 14
Cross-sections included: 14
Total panel (balanced) observations: 196

	Pooled effect		Fixed effect		Random effect	
Variable	**Coefficient**	**Prob.**	**Coefficient**	**Prob.**	**Coefficient**	**Prob.**
C	4.955598	0.0981	22.39186	0.0001	15.00620	0.0005
DDA	0.165091	0.0008	0.107094	0.7585	0.474172	0.0214
BTA	0.006648	0.9813	-0.377130	0.0442	-0.307286	0.0361
BSZ	0.448253	0.0214	-0.845330	0.0411	-0.322508	0.0028
			Effects specification			
					S.D.	**Rho**
			Cross-section random		3.328395	0.2864
			Idiosyncratic random		5.254300	0.7136
R-squared	0.730554		0.664032		0.618119	
Adjusted R-squared	0.713852		0.639930		0.602777	
F-statistic	15.04404		7.560509		11.81016	
Prob(F-statistic)	0.002189		0.000000		0.001102	

Source: Researchers' Computation, 2020

Table 13. VAR lag order selection criteria

VAR Lag Order Selection Criteria
Endogenous variables: ROI DDA BTA BSZ
Exogenous variables: C
Sample: 2005 2018
Included observations: 112

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-790.6920	NA	17.10589	14.19093	14.28802	14.23032
1	-405.6245	735.7540	0.023498	7.600438	8.085885*	7.797399
2	-377.2287	52.22816	0.018854	7.379083	8.252886	7.733613
3	-332.5797	78.93293	0.011336	6.867495	8.129655	7.379594*
4	-318.6930	23.55781	0.011834	6.905232	8.555750	7.574900
5	-287.6091	50.51129	0.009116	6.635878	8.674752	7.463114
6	-261.2482	40.95357*	0.007673*	6.450861*	8.878092	7.435666

Source: Researchers' Computation, 2020

Table 14. Vector autoregressive estimates

Vector Autoregression Estimates
Sample (adjusted): 2006 2018
Included observations: 182 after adjustments
Standard errors in ( )

	ROI	DDA	BTA	BSZ
ROI(-1)	0.665176	0.002255	0.009309	0.002770
	(0.05282)	(0.00117)	(0.01386)	(0.00389)
DDA(-1)	3.311590	0.751241	2.358356	-0.228046
	(2.35396)	(0.05204)	(0.61756)	(0.17314)
BTA(-1)	-0.153635	0.002792	0.653115	-0.002138
	(0.20571)	(0.00455)	(0.05397)	(0.01513)
BSZ(-1)	-0.020612	-0.008412	-0.012431	0.975913
	(0.14348)	(0.00317)	(0.03764)	(0.01055)
C	3.105850	0.162431	-0.484976	0.554729
	(2.19153)	(0.04844)	(0.57494)	(0.16120)
R-squared	0.508647	0.709696	0.632448	0.983424
Adj. R-squared	0.497543	0.703135	0.624142	0.983050
Sum sq. resids	3640.650	1.779019	250.5731	19.69670
S.E. equation	4.535267	0.100254	1.189818	0.333588
F-statistic	45.80750	108.1762	76.14119	2625.307
Log likelihood	-530.8747	162.8961	-287.3435	-55.90325
Akaike AIC	5.888733	-1.735122	3.212566	0.669266
Schwarz SC	5.976755	-1.647100	3.300588	0.757289
Mean dependent	11.93614	0.351206	0.803320	12.55886
S.D. dependent	6.398136	0.184003	1.940746	2.562243

Source: Researchers' Computation, 2020

Table 14 showed the result of vector autoregressive model to examine the dynamic of liability management in relation to the return on investment of DMBs in Nigeria with the coefficient of parameters and (standard error). It was discovered that the return on investment at lag one (ROI (-1)) and the ratio of demand deposit to total asset at lag one (DDA (-1)) under consideration had a direct relationship with the current level of return on investment (ROI) of DMBs in Nigeria. The result further revealed that one percent improvement of the return on investment at lag one (ROI (-1)) and the ratio of demand deposit to total asset at lag one (DDA (-1)) led to an increase in the current level of return on investment (ROI) of DMBs by 0.67 and 3.312 percent respectively. Thus, returns to be generated from liability management is very crucial in assessing the profitability level of the DMB. This implies that demand deposit and borrowing by DMBs must be efficiently invested so as to enhance their profitability.

In similar vein, the result of this study revealed that the ratio of borrowing to total asset at lag one (BTA (-1)) and bank size at lag one (BSZ (-1)) were inversely related with the current level of return on investment (ROI) of the DMB in Nigeria. Thus, the ratio of borrowing to total asset at lag one (BTA (-1)) and bank size at lag one (BSZ (-1)) reduced the current level of return on investment by 0.15 and 0.02 percent respectively. Also, it was revealed that one percent increase in return on investment at lag one (ROI (-1)), the ratio of demand deposit to total asset at lag one (DDA (-1)) and ratio of borrowing to total asset at lag one (BTA (-1)) led to an increase in the current level of the ratio of demand deposit to total asset (DDA) of the DMBs under consideration to the turn of 0.002, 0.751 and 0.003 percent respectively. While, bank size at lag one (BSZ (-1)) reduced the current level of the ratio of demand deposit to total asset (DDA) by 0.008 percent.

The result further indicated that the return on investment at lag one (ROI (-1)), the ratio of demand deposit to total asset at lag one (DDA (-1)) and ratio of borrowing to total asset at lag one (BTA (-1)) led to an increase in the current level of the ratio of borrowing to total asset (BTA) of the DMBs under consideration to the turn of 0.009, 2.358 and 0.653 percent respectively. While, bank size at lag one (BSZ (-1)) reduced the current level of the ratio of borrowing to total asset (BTA) by 0.012 percent. It was further

discovered from the result that return on investment at lag one (ROI (-1)) and bank size at lag one (BSZ (-1)) led to an increase in the current level of the bank size (BSZ) of the DMBs under study to the turn of 0.003 and 0.976 percent respectively. While, the ratio of demand deposit to total asset at lag one (DDA (-1)) and ratio of borrowing to total asset at lag one (BTA (-1)) reduced the current level of the bank size (BSZ) by 0.228 and 0.002 percent respectively.

An examination of the significance of vector autoregressive model using Adjusted R-Square revealed that 49.7, 70.3, 62.4 and 98.3 percent variations or changes in the current level of return on investment (ROI), ratio of demand deposit to total asset (DDA), ratio of borrowing to total asset (BTA) and bank size (BSZ) of DMBs in Nigeria can be explained by their respective lag value. Moreover, the test for the overall significance or the adequacy of the autoregressive model done using F-statistic showed that the F-statistic values of 45.807, 108.176, 76.141 and 2625.307 > 2.65, and at critical value at 5 percent level of significance and this showed that the model was adequate in examining the dynamic effect of liability management in relation to profitability of the deposit money bank in Nigeria. This result led to test for the stability condition of the VAR model and the results were presented in Table 15 and Fig. 2.

The result in Table 15 and Fig. 2 showed that the vector autoregressive stability condition check for the dynamic in return on investment (ROI) of DMB and the liability management captured by ratio of demand deposit to total asset (DDA), ratio of borrowing to total asset (BTA) and bank size (BSZ) of the DMB in Nigeria is impressive. However, from the result, it was evidence that all the roots or the eigen values were less than one and were within the unit circle. Thus, the eigen value were within the unit circle and therefore implies that the vector autoregressive model satisfied stability condition. Hence, the stability of the model and as such can be used for policy formulation and implementation with regard to liability management and profitability of the DMB in the Nigeria's economy.

Table 15. Vector autoregressive model stability condition check

Roots of Characteristic Polynomial **Endogenous variables: ROI DDA BTA BSZ** **Exogenous variables: C** **Lag specification: 1 1**	
Root	**Modulus**
0.985623	0.985623
0.798254	0.798254
0.702782	0.702782
0.558786	0.558786

Source: Researchers' Computation, 2020

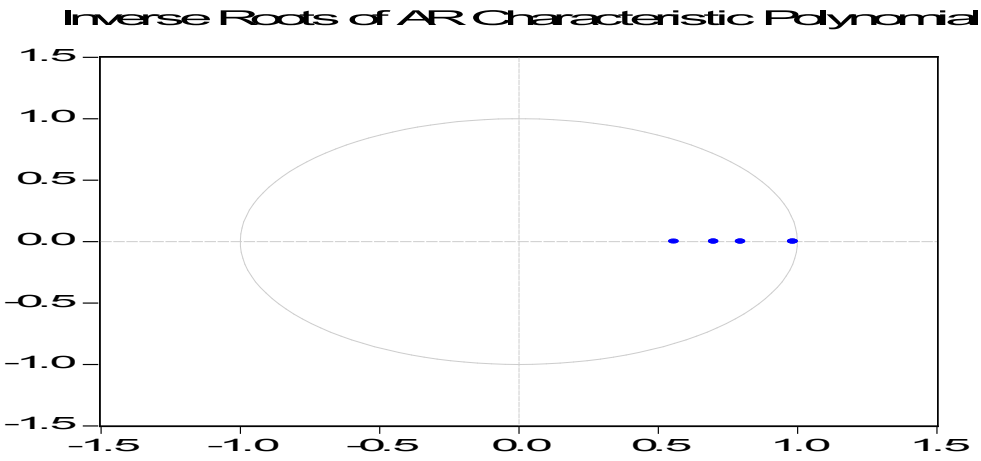

Fig. 2. Diagrammatic representation of VAR model stability condition
Source: Researchers' Computation, 2020

5. CONCLUSION AND RECOMMENDATION

The study empirically examined the effect of asset liability management on the performance of fourteen listed deposit money banks in Nigeria. The period of study spanned 14 years from 2005 to 2018. Loan and advance, non-performing loan, demand deposit and borrowing were used as surrogates for asset liability management while return on asset (ROA) and return on Investment (ROI) were used to proxy performance. With the use of random effects vector autoregressive (VAR) model regression as data estimation technique, the study produced a significant relationship between loan and advance (LOA), non performing loan (NPL), demand deposit (DDA), borrowing (BTA), bank size (BSZ) and performance indicators of return on asset (ROA) and return on investment (ROI). The study indicates that the return on asset (ROA), non-performing loan (NPL) and bank size (BSZ) were statistically significance in examining the impact of asset management on profitability of deposit money banks in Nigeria. The results show that an increase in loan and advance (LOA) and bank size (BSZ) led to significant increase in return on asset of the deposit money banks in Nigeria while a continuous increase in non-performing loan (NPL) reduces drastically the return on asset (ROA) of deposit money banks in Nigeria. This implies that adequate attention must be placed on monitoring of loan and advance (LOA) and non-performing loan (NPL) to ensure and achieve better asset management.

Also, the study further shows that demand deposit (DDA), borrowing (BTA) and bank size (BSZ) exerts positive effect on the return on investment (ROI) of deposit money banks in Nigeria while a continuous increase in bank size (BSZ) impact negatively on return on investment (ROI) of deposit money banks in Nigeria. This indicate that, an increase in demand deposit (DDA) and borrowing (BTA), led to increase in return on investment (ROI) of deposit money banks and, a continuous increase in bank size (BSZ) led to decline in return on investment (ROI) of deposit money banks in Nigeria. This means that bank management should place more emphasis on mobilization of demand deposit (DDA) and embrace more borrowing (BTA) and be conservative in assets acquisition so as to facilitate a better liability management. The result of this study is consistent with [29] and [27] who also found out that assets management positively and liability management negatively relate to the profitability of deposit money banks. In line with the outcome of the study, it is recommended that a comprehensive Asset Liability Management policy framework should be put in place by every deposit money banks to be adequately driven by a very dynamic and proactive asset liability management committee (ALCO) constituted by the board with specific roles of regularly probing the appropriate mix of assets and liabilities that maximizes banks profitability so as to consistently enhance performance and create value for the shareholders.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Appendix I. List of sampled Nigerian deposit money banks

S/N	Name of banks
1	Access Bank Plc
2.	Diamond Bank
3.	Ecobank
4.	First Bank of Nigeria Plc
5.	First City Monument Bank
6.	Guaranty Trust Bank
7..	Polaris Bank Plc
8.	Stanbic IBTC Bank
9.	Sterling Bank
10.	United Bank for Africa
11.	Union Bank
12.	Unity Bank
13.	Wema Bank
14..	Zenith Bank