Stress Testing in the Nigerian Banking Sector

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ABSTRACT
This paper examined stress testing in the Nigerian banking sector from 2004-2014 using error correction mechanism (ECM) and Ordinary Least Square (OLS) methodologies. The study adopted the bottom-up approach to stress management. Evidence from the analysis showed that stress testing is important to building a strong and viable financial system in the country. Bank's going concern depends on profitability, solvency and liquidity whereas banks performance index depends on the behaviours of macroeconomic variables. The study found that Nigerian banking system is susceptible to various risks both within and outside the country. They are also exposed to macroeconomic risks as their performance index is based on these variables. The study concluded that how banks respond to risks determines the going concern and the viability of the nation's financial system. Thus, a thorough credit risk management framework championed by the major stakeholders involved in the credit disbursement was recommended.

Key Words: Stress Testing, Banking Sector, Credit Risk, Bottom-up Approach, Performance Index

1. INTRODUCTION

Theoretically, stress testing is an investigation of the performance of an entity under abnormal operating conditions. This involves modelling a sectoral probability of default to assess the interrelationship between the macroeconomic environment and sectoral defaults, including performing a series of stress tests under different scenarios. From financial stability viewpoint, the entity of interest is the financial system. However, the financial system is a complex entity consisting of a wide-range of financial institutions, financial markets, and payments and settlement systems. In practice, the analysis of financial system stability focuses on individual components, most often the financial institutions, to arrive at the overall assessment of the financial system (Bank of Canada, 2006).

Macroeconomic stress tests of the financial system have been developed in recent years from a recent survey and discussion (see Sorge, 2004; Bank of England, 2006). These tests assess the vulnerability of the banking system or more broadly the financial system to extreme but plausible adverse macroeconomic shocks. Stress tests are more useful from the central banks perspective, since they are tractable and provide a useful benchmark to assess the risks of the financial system (Bunn *et al,* 2005).

Two major approaches had been identified in literature for investigating the banking sector performance, namely; the bottom up approach or top down approach. Bottom up approach examines the performance of individual banks and the aggregate results while top down approach involves looking at the banking sector as a whole. Both approaches have their strength and weaknesses and the decision to use either of them depends on the nature and causes of financial instability (Bank of Canada, 2006, Gauthier and St-Amant, 2005 and Borio, 2005). This paper adopts the top down approach on the premise that systemic vulnerabilities can result from common exposures whether from exposure to similar classes of assets or ultimately, similar risk factors. However, an important key to the identification of vulnerabilities is scenario selection. Scenario means events or in a broader implication, abnormal operating conditions. Therefore, proper scenario selection and analysis help in managing these vulnerabilities.

In Nigeria, the financial sector stands the risk of financial depression. Although the consolidation exercise of 2004 necessitated the merger and acquisition of most banks to form formidable institutions immune to sundry distresses often witnessed in the pre-consolidation banking era in the county; many banks are still exposed to several risks such as credit risk, exchange rate risk, interest rate risk and so on. This study emphasizes banks' exposure to credit risk because of its nature in determining the overall performance status of the banks. Credit risk, according to Banker's Almanac, is designed to improve the speed and efficiency of credit decision making by providing instant access to reliable and comparable risk information on thousands of regional and global financial institutions. Some of the risks are; excessive concentrations, inadequate compliance oversight, insufficient collateral cushion, repayment sources, inability to withstand rise in rates or increased vacancy. To mitigate such risks, there is need to identify, measure, monitor and control them. The post-consolidation performance of Nigerian banks therefore raises some fundamental questions. What are the potential vulnerabilities of the banking system in Nigeria? What are the determinants of the overall risk exposures in the banking system that could lead to the disruption of financial markets? What are the effects of risk asset practices on bank's profitability? What is the depth of risk assets in Nigerian banking industry? In answering these questions, the objective of this paper is to assess the vulnerabilities of several institutions in Nigeria to abnormal shocks and market condition by using the tool known as stress testing.

The rest of the paper is as follows; section two presents the literature review, section three presents the theoretical framework and methodology. Section four presents the results of the analysis while the last section five presents the conclusion and policy recommendations.

2. LITERATURE REVIEW

Several studies have been undertaken to explain the relationship between asset risk management and banks' profitability. For instance, Baritrop and McNaughton (2003) noted that risk assets are credit arrangements between a bank and its customer, specifying the maximum amount of credit the bank will permit the firm to have at any time and the mode of operating such a line and the collateral for same. A Bank Credit Risk Management starts with banks' lending practices, the lending environment and the repayment outcomes. Thus, prudent management of risk is the heart of banking. They also noted that any fool can lend money but it takes a banker to get it back and stressed that the capacity of a bank to manage credit risk should start with the existence of a well-defined and published internal credit policies and procedures.

To Thornhill (2001), a loan cannot be a good loan until it is repaid in full. Indeed risk asset management concerns the ability of a bank to increase the level of loan recovery or to reduce the rate of loan default. He added that for credit policy to be effective, it must be revised to fit economic business and environmental Changes. American Bankers Association Journal (2002) agrees with this view by noting that credit risk deals with the probability of a debtor being unable to repay a debt. This sort of risk can be called market risk.

Barltrop and McNaughton (2003) again surprisingly showed that many banks in developing countries do not have formal credit policies and procedures that defined the bank's loan products and the conditions under which such facilities should be extended to potential borrowers. They concluded that senior management in banks of some developing countries made credit decisions according to their understanding of the market and personal knowledge of individual borrowers.

Gimbason (2004) opined that whenever some credit facilities were extended to friends of the Board members on complimentary cards, ten percent (10%) or more of such loans were offered as kickbacks. Such loans were never repaid thus leading to poor risk asset quality. Other findings include the issue for

granting advances without collateral. Ebhodaghe (1992), the Chief Executive of Nigeria Deposit Insurance Corporation (NDIC) confirm that in Nigeria, highly placed government officials directed bank credit to favoured customers, friends and relatives without such people going through the normal credit analysis procedures. Sometimes such credits are not collateralized giving rise to huge bad and doubtful debts.

The report of CBN bank examination highlighted a number of short-comings such as poor credit policy, large portfolio of non-performing assets, weak internal control, inside abuses etc. as the causes of poor asset quality in Nigeria. A problem loan is one where there has been a default in the repayment agreement, resulting in undue delay in collection or in which there appears to be a potential loss. The Prudential Guidelines introduced by CBN, defines bad debt as non-performing loan classified into three categories of sub-standard, doubtful, and lost accounts, depending on the period for which outstanding accrued interest and (or) principal loan repayment remain(s) unpaid. Therefore, the primary purpose of credit analysis is the determination of the viability of a project coupled with the ability and willingness of the borrower to repay a credit facility prior to making lending analysis. It is a function that requires skillful knowledge by the lending officers to evaluate credit request on a basis that will contributes to the healthy growth of banks (CBN, 2000 and Clarke 2001).

Ogbodu (2003) opined that banks need an efficient administrative structure of loan policy and necessary approval. A well-defined criterion for individual customers, standard information and agreed upon basis for interpreting such information is necessary, for the bank to institutionalize workable and practicable loans' management approach. A bank's performance is judged largely by its lending, hence the need for bankers to make efforts to realistically assess the degree of credit risks inherent in all loans and make certain decisions based on their experience and the guidelines established by the bank.

The study of Nwankwo (1988) showed that over 70% of Nigerian bank's credit advances are inform of overdraft, substantial portion of which eventually becomes evergreen despite the commonly stipulated terms and conditions that such over drafts are payable on demand. The practice in most countries in Europe and Asia including India, Indonesia, Malaysia is such that overdraft facilities are payable annually. This has enabled banks in these countries to curtail the cases of overdraft facilities going bad as such borrowers will always be on guard in order not to default.

Universally, credit analysis is essentially default risk analysis in which a loan officer evaluates the borrower's ability and willingness to repay. McRea and Dobbins (2002) noted that credit evaluation involves a systematic process of three related steps namely:

(i) Obtaining information about the applicant.

(ii) Analysing this information to determine the applicant's credit worthiness.

(iii) Making the credit decision. The credit decisions, in turn establish whether credit should be extended and what the maximum amount of credit should be.

Weston and Brigham (2001) believe that credit information about an applicant can be obtained through credit associations, and also from the borrowers' statement of accounts. Bank references may be obtained by way of status enquires from outside sources to substantiate a credit applicant's ability to repay a loan. In Nigeria, CBN (in 1996) established a scheme known as Credit Risk Management Service (CRMS) purposely to appraise the performance of existing borrowing customers of the banks. On request, CBN provides credit information on such clients to an interested bank. Such report usually shows the performing or non-performing positions of such customers with their various existing bankers. Also personal references are usually taken by banks to ascertain some relevant information from people who know the prospective customer better, before the final decision is taken.

Empirically, Kithinji (2010) assessed the effect of credit risk management on the profitability of commercial banks in Kenya using data on the amount of credit, level of non-performing loans and profits from 2004 to 2008. His findings revealed that the bulk of the profits of commercial banks were not influenced by the amount of credit and non-performing loans, and therefore suggested that other variables other than credit and non-performing loans impact on profits. Chen and Pan (2012) examined the credit risk efficiency of 34 Taiwanese commercial banks over the period 2005-2008. Their study employed financial ratio to assess the credit risk and was analyzed using Data Envelopment Analysis (DEA). The credit risk parameters were credit risk technical efficiency (CR-TE), credit risk allocative efficiency (CR-AE), and credit risk cost efficiency (CR-CE). Their findings showed that only one bank was efficient in all types of efficiencies over the evaluated periods. Based on their result, they concluded that banks in Taiwan showed relatively low average efficiency levels in CR-TE, CR-AE and CR-CE in 2008.

The impact of credit risk on the profitability of Nigerian banks was evaluated by Kargi (2011). Financial ratios as measures of bank performance and credit risk were collected from the annual reports and accounts of sampled banks from 2004-2008 and analyzed using descriptive, correlation and regression techniques. The findings revealed that credit risk management has a significant impact on the profitability of Nigerian banks. It concluded that banks' profitability is inversely influenced by the levels of loans and advances, non-performing loans and deposits thereby exposing them to great risk of illiquidity and distress.

The impact of bank's specific risk characteristics, and the overall banking environment on the performance of 43 commercial banks operating in 6 of the Gulf Cooperation Council (GCC) countries over the period 1998-2008 was assessed by Al-Khouri (2011). Using fixed effect regression analysis, his results showed that credit risk, liquidity risk and capital risk are the major factors that affect bank performance when profitability is measured by return on assets while the only risk that affects profitability when measured by return on equity is liquidity risk.

Poudel et al. (2009) studied the factors affecting commercial bank performance in Nepal for the period of 2001 to 2012 and followed a linear regression analysis technique. The study revealed a significant inverse relationship between commercial bank performance measured by ROA and credit risk measured by default rate and capital ratio. Poudel (2012) further analysed the impact of the credit risk management in bank's financial performance in Nepal using time series data from 2001 to 2011. The results of the study indicated that credit risk management is an important predictor of bank's financial performance.

Boahene (2012) found a positive and significance relationship of commercial banks performance and credit risk in his study of six Ghanaian commercial banks covering a period of 2005-2009. The panel data analysis model employed in the study revealed that indicators of credit risk, namely: non-performing loan rate, net charge-off rate, and the pre-provision profit as a percentage of net total loans and advances were positively related with profitability measured by ROE. The author suggested that Ghanaian commercial banks enjoy high profitability at time when the levels of credit risk variables are high. It is reasoned out on this study that this might be, because of prohibitively lending/interest rate, fees and commissions.

The quantitative effect of credit risk on the performance of commercial banks in Nigeria over the period of 11 years (2000-2010) was empirically investigated by Kolapo, Oke and Ayeni (2012). The study considered five commercial banks on a cross sectional basis for eleven years using panel model analysis. The study used traditional profit theory to formulate profit, measured by Return on Asset (ROA), as a function of the ratio of non-performing loan to loan and advances (NPL/LA), ratio of total loan and advances to total deposit (LA/TD)and the ratio of loan loss provision to classified loans (LLP/CL) as measures of credit risk. The results showed that the effect of credit risk on bank performance measured by the return on assets of banks is cross-sectional invariant and this effect is similar across banks in Nigeria,

though the degree to which individual banks are affected was not captured. Specifically, a 100 percent increase in non-performing loan reduces profitability (ROA) by about 6.2 percent, a 100 percent increase in loan loss provision also reduces profitability by about 0.65percent while a 100 percent increase in total loan and advances increase profitability by about 9.6 percent. The study thus recommended that banks in Nigeria should enhance their capacity in credit analysis and loan administration, while the regulatory authority should pay more attention to banks' compliance to relevant provisions of the Bank and Other Financial Institutions Act (1999) and prudential guidelines.

Rufai (2013) submitted that managing of credit risk adequately in financial institutions is critical for the survival and growth of the financial institutions. He also assessed the efficacy of managing credit risk to optimize banks performance with the view to determine if credit risk affects profitability. His findings revealed that credit risk affects the performance of bank, and that to maintain high interest income; attention needs to be given to credit risk management especially in the area of lending. The study recommended that bank should ensure that loans given out to customers should be adequately reviewed from time to time to assess the level of its risk and that such loan should be backed by collateral security.

Despite these studies, there is still a gap in the literature as no study has introduced firm's specific variables into examining stress management in the Nigerian financial institution to the best of our knowledge. This study therefore attempts to contribute to existing study by introducing firm's specific variables such as bank capital, gross earning risk, total assets, and interest income into the analysis. Firm's specific variables are highly significant because they not only determine banks' profitability but also the extent to which bank responds and withstand shocks.

3. THEORETICAL FRAMEWORK AND METHODOLOGY

3.1 Theoretical Framework

Many studies done on risk asset management either on individual country basis or on group adopted the asset liability management theory. Some of these studies include: Zenios, S. A. (1995); Frank J. Fabozzi and Atsuo Konishi (1991,1996); Markowitz, H. M. and E. van Dijk (2006); Stavros A. Zenios and William Ziemba (2003,2006); Mathias Drehmann (2006) and Yuliya Romanyuk (2010). Therefore, the theoretical framework adopt in this study is based on the asset management theory developed by Yuliya Romanyuk (2010). The recent development in asset allocation foundations includes the classical mean-variance efficiency.

The mean-variance (MV) efficiency (Markowitz, 1952, 1959; Roy, 1952) is the classical paradigm for portfolio optimization and the foundation of modern portfolio theory. Introducing the following notation:

$w = \left[w_{1,} w_{2,....} w_N \right]!$: N-dimensional vector of weights for the assets in consideration;

$\mu = \left[\mu_{1,} \mu_{2....} \mu_N \right]!$: N-dimensional vector of expected returns of the assets;

$\mu_p = w^1 \mu$: expected portfolio return;

$\Sigma : N * N$ matrix of co-variances of expected returns;

$\sigma_p^2 = w^1 \sum w$: portfolio variance.

Returns of individual assets are assumed to be normally distributed with mean μ and covariance matrix $\sum$

In the classical setting, we maximize μ_p subject to a given σ_p^2 (alternatively, minimize σ_p^2 subject to a given μ_p).

By plotting the possible combinations of risk/return levels, we obtain the so-called mean-variance efficient frontier, a curve on which, for a given level of return, the portfolio variance is minimal (or, for a given variance, the return is maximal). We can combine return and variance into a single objective function, weighing their relative importance: maximize

$$f(w) = c\mu_p - \frac{\sigma_p^2}{2}, c\xi(0,\infty), \quad (3.1)$$

Subject to $\sum_{n=1}^{N} w_n = 1, 0 \le w_n \le 1,$ the typical constraints for most investors (portfolio weights must sum to 100 per cent and short selling is not allowed). The value of means that we care mostly about minimizing risk; c = 1 implies that we are indifferent between a 1-basis-point squared decrease in variance and a 1-basis-point increase in returns.

Although Markowitz in his early works did not specify which portfolio along the efficient frontier should be selected by the investor (Markowitz and van Dijk, 2006), Roy (1952) recommended choosing the portfolio along the efficient frontier that maximizes where d is a disastrous level of portfolio return. `Cash' as a `risk-free asset' (with zero variance) was included by Tobin (1958) citing `liquidity preference' as a reason for holding this relatively low-yielding instrument. He shows that portfolios containing cash consist of cash and specific combinations of risky securities, now known as tangent portfolios. Later work by Sharpe (1964) and Lintner (1965) assumes that investors can borrow at the risk-free rate, and shows that efficient portfolios consist of either tangent portfolios, tangent portfolios and positive cash holdings, or tangent portfolios and negative cash holdings (leveraged portfolios). MV-efficient asset allocation takes advantage of correlations between asset returns to minimize the portfolio variance. As pointed out by Rubinstein (2002), this was a key insight of Markowitz: the idea to evaluate securities not in isolation but as a group, and to decide whether to hold individual securities based on their diversification benefit to the portfolio. However, correlations among assets in bear markets tend to be higher and diversification benefits lower than in bull markets; this effect should be accounted for in an asset allocation model (Ang and Bekaert, 2002, Mathias Drehmann, 2006; Yuliya Romanyuk (2010).

3.2 Model Specification

In line with the specific objectives, our model specification examines stress testing in the Nigerian banking system from 2004 – 2014. Based on the theoretical framework for stress testing in banks, four important variables matter for this estimation, they include: credit risk, exchange rate risk, interest rate risk, profitability, bank assets, gross earnings. Ratio of non-performing loan, loan-to-credit ratio, liquidity ration and commercial bank total credit to the economy were however used as the intervening variables. Therefore, the stress testing framework for banks in Nigeria is specified in the following function:

PROFIT = F (CR, IRR, EXRR, LR, CBTA, TCECO, GE, NPL, LTD) (3.2)

The regression form of the model specification is thus:

$PROFIT_t = \alpha_0 + \alpha_1 CR_t + \alpha_2 IRR_t + \alpha_3 EXRR_t + \alpha_4 LR_t + \alpha_5 CBTA_t + \alpha_6 TCECO_t + \alpha_7 GE_t + \alpha_8 NPL_t \alpha_9 LTD_t + \mu_t$ (3.3)

$(\alpha_1, \alpha_2, \alpha_3 \alpha_4, \alpha_5, \alpha_6, \alpha_7 > 0,$ while $\alpha_8, \alpha_9 < 0)$

Where the dependent variable is Profit and other variables on the right-hand side are independent variables. PROFIT = profitability as a proxy for stress testing; CR = credit to risk; IRR = interest rate risk; EXRR = Exchange rate risk; LR = liquidity ratio; CBTA = commercial banks' total assets; TCECO = total credit to the economy; GE = gross earnings; NPL = non-performing-loans; LTD = loan-deposit-ratio; μ_t = Error term.; α_0 = Intercept of relationship in the model; α_1 _ α_9 = Coefficient of each exogenous or explanatory variable.

3.3 Estimation Procedure and Data Sources

To underscore the relationship under study, this project employed a time series estimation techniques. The study went further to engage in descriptive statistics of variables with the aim of determining the mean, median, maximum, and minimum value for each of the variables under consideration. Also, in the determination of the stationarity of the variables; traditional Augmented Dickey-Fuller and Phillips-Perron unit-root tests were employed. More so, we employed the use of error correction model (ECM) and Johansen co-integration to capture both short-run dynamic and speed of adjustment, as well as long-run dynamics respectively. Lastly, we made use of Granger Causality to determine the direction of causality among the variables. Secondary data shall be the basis for this study. The relevant data to be used would be sourced from the Central Bank of Nigeria's statistical reports, banks' annual reports, National Bureau of Statistics (NBS)'s Annual Reports, banks' published data and statement of accounts for the years under review.

4. RESULTS

4.1 DESCRIPTIVE STATISTICS

The summary statistics of the variables drawn for the study is presented on Table 4.1 below. Deviations of variables used in the estimation did not show much variation. The results further revealed that the average CR over the period was about 0.35%, with a maximum of 0.50% and minimum of 0.2/% respectively. The EXRR averaged 1.08% with a maximum of 17.40% and minimum of -7.50%. The IRR averaged -0.07% over the study period with a maximum of 0.13% and minimum of -5.8%. The LCBTA was at the average of 4.17% and it fluctuated between the upper limit of 4.40% and a lower limit of 3.70%.

Moreover, the average LGE during the period stood at 11.00%, with a maximum of 11.56% and minimum of 10.16%. The LTCECO averaged 3.73% over the study period with a maximum of 4.10% and minimum of 3.20%. The LTD was at the average of 64.11% and it fluctuated between the upper limit of 85.70% and a lower limit of 33.40%. Also, the average NPL during the period stood at 12.50%, with a maximum of 37.30% and minimum of 3.40%. For PROFIT, the average figure was 40.73% with fluctuations between the highest of 99.30% and a lowest of 5.20% while LR averaged 45.66% with the maximum value of 96.60% and minimum value of 30.40%.

Table 4. 1: Summary Statistics of Data

	CR	EXRR	IRR	LCBTA	LGE	LTCECO	LTD	NPL	PROFIT	LR
Mean	0.352273	1.089318	0.072727	4.170455	11.00858	3.734091	64.11818	12.50000	40.73182	45.66818
Median	0.400000	0.010000	0.130000	4.200000	11.12634	3.900000	68.60000	8.700000	34.00000	46.35000
Maximum	0.500000	17.40000	2.860000	4.400000	11.53406	4.100000	85.70000	37.30000	99.30000	96.60000
Minimum	0.200000	7.500000	5.68000	3.700000	10.16160	3.200000	33.40000	3.400000	5.200000	30.40000
Std. Dev.	0.079207	4.848338	1.511707	0.209739	0.423046	0.282796	14.87435	10.28035	32.35280	11.55762
Sum	15.50000	47.93000	3.200000	183.5000	484.3774	164.3000	2821.200	550.0000	1792.200	2009.400
Sum Sq. Dev.	0.269773	1010.774	98.26607	1.891591	7.695604	3.438864	9513.585	4544.480	45008.25	5743.875
Observations	44	44	44	44	44	44	44	44	44	44

Source: Author's computation

Note: *cr, irr, exrr, ltd, npl lr are credit risk, interest rate risk, exchange rate risk, ration of non-performing loan, and liquidity ration while lcbta, lge and ltceco* are the log of *commercial banks' total assets, gross earnings and total credit to the economy respectively.*

4.2 UNIT ROOT TEST RESULTS

This study commences its empirical analysis by testing the properties of the time series used for investigation. The stationarity tests on the variables were carried out using both the Augmented Dickey-Fuller (ADF) test. The augmented Dickey-Fuller (ADF) technique employed is based on the McKinnon critical values. The unit root tests results for stationarity for ADF at levels and at first difference are presented in tables 4.2 below;

Table 4.2: Unit Root Test Results for Stationarity (ADF at various levels)

Variable	DF	ADF (Test Critical Values)	t-Statistic	P-Values	Order of Integration
ΔPROFIT(1)	1%	-4.2528*	-5.8809	0.0000	I~I(1)
	5%	-3.5484**			
ΔCR(1)	1%	-4.2436*	-5.6807	0.0000	I~I(1)
	5%	-3.5442**			
ΔEXRR	5%	-4.5041**	-4.5041	0.0049	I~I(0)
ΔIRR	1%	-6.7259*	-6.6311	0.0000	I~I(0)
ΔLCBTA(1)	1%	-2.8565*	-6.0066	0.0001	I~I(1)
ΔLTCECO(1)	1%	-1.4328*	-1.3182	0.0000	I~I(1)
ΔLGE(1)	1%	-1.8034*	-6.4913	0.0002	I~I(1)
ΔLTD(1)	1%	-1.1717*	-5.7173	0.0000	I~I(1)
ΔNPL(1)	1%	-1.9475*	-5.6911	0.0000	I~I(1)
ΔLR(1)	1%	-0.9044*	-5.5727	0.0000	I~I(1)

Source: Author's Calculation

Key: MacKinnon (1996) one-sided p-values; *Significant at 1%; **Significant at 5%; ***Significant at 10%

From the results presented in Table 4.2, it was observed that only EXRR and IRR were stationary at 5 per cent level of significance in their level form, that is, integrated of order I (0). The remaining variables were non-stationary at their level form. This led to test at first differences, which revealed that all the remaining variables (I.e. PROFIT, LGE, NPL LTD LCBTA, LTCECO, LR and CR) were stationary at first difference, that is, integrated of order one I(1). After establishing stationarity, next is the examination of the co-integration relationship among the variables.

4.3 COINTEGRATION TEST RESULTS

The cointegration test results of trace statistics and maximum eigen-value statistics are presented in tables 4.3 and 4.4 respectively below;

Table 4.3 : Johansen Unrestricted Cointegration Rank Test (Trace)

Null	Alternative	Trace Statistics	95% Critical Values	Prob.**
r=0	r≥1	359.8062	239.2354	0.0000
r≤1	r≥2	249.5440	197.3709	0.0000
r≤2	r≥3	176.7562	159.5297	0.0041
r≤3	r≥4	124.6431	125.6154	0.0572
r≤4	r≥5	90.27055	95.75366	0.1123
r≤5	r≥6	63.34886	69.81889	0.1472

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 4.4: Johansen Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Null	Alternative	Maxi-Eigen Statistics	95% Critical Values	Prob.**
r=0	r≥1	110.2623	64.50472	0.0000
r≤1	r≥2	72.78780	58.43354	0.0011
r≤2	r≥3	52.11305	52.36261	0.0530
r≤3	r≥4	34.37256	46.23142	0.5004
r≤4	r≥5	26.92169	40.07757	0.6385
r≤5	r≥6	24.81459	33.87687	0.3977

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

The results of the co-integration test therefore indicated that there are two co-integrating equations by the maximum eigen-value statistics while the trace statistics indicated three co-integrating equations at 5%. The implication of this is that a long run relationship exists among the variables.

4.4 OLS REGRESSION RESULT

Table 4.5 shows that the overall significance of the OLS regression results for the model shows that it is statistically significant at 1 percent level of significance. More so, about 90 percent of the total variation in profitability (PROFIT) is explained by credit ratio (CR), liquidity ratio (LR), exchange rate risk (EXRR),

interest rate risk (IRR), commercial banks' total assets (LCBTA), total credit to the economy (LTCECO), gross earnings (NGE), non-performing loan (NPL), and loan-to-deposit ratio (LTD).

Table 4.5: OLS Regression Result.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-351.9756	139.9290	-2.515386	0.0168**
CR	228.8600	52.15863	4.387769	0.0001*
LR	-0.185423	0.220027	-0.842728	0.4053
EXRR	0.668626	0.394405	1.695277	0.0992***
IRR	-1.196498	1.268998	-0.942868	0.3524
LCBTA	4.911538	43.74125	0.112286	0.9113
LTCECO	-74.78952	41.32123	-1.809954	0.0791**
LGE	57.73222	24.45476	2.360776	0.0241**
NPL	-1.927405	0.341157	-5.649617	0.0000*
LTD	-0.513595	0.185334	-2.771193	0.0090**
R-squared	**0.907249**	**Mean dependent var**	**40.73182**	
Adjusted R-squared	**0.882697**	**S.D. dependent var**	**32.35280**	
S.E. of regression	**11.08067**	**Akaike info criterion**	**7.844998**	
Sum squared resid	**4174.563**	**Schwarz criterion**	**8.250496**	
Log likelihood	**-162.5900**	**Hannan-Quinn criter.**	**7.995376**	
F-statistic	**36.95251**	**Durbin-Watson stat**	**1.757496**	
Prob(F-statistic)	**0.000000**			

***, ** and *** denotes 1%, 5% and 10% level of significance respectively**
Source: Author's computation using E-Views 7.2

The model result tells us that PROFIT has a positive and significant relationship with CR, EXRR, and LGE but negative and significant relationship with LTCECO, NPL and LTD. Thus a 1% increase in CR, EXRR, and LGE will result into about 22.86%, 0.67% and 57.73% increases in PROFIT respectively while a 1% increase in LTCECO, NPL and LTD will result into about 74.79%, 1.93% and 0.51% increases in PROFIT respectively. However, PROFIT has a positive and insignificant relationship with LR and LCBTA; and a negative and insignificant relationship with IRR.

This implies that bank stress (as proxy by banks' profitability parameter), is seriously influenced by credit risk (CR), exchange rate risk (EXRR), and gross earnings (LGE). Based on their performance, these variables are perceived to provide buffer against loss. For a thorough stress management therefore, these variables must be well monitored, since they determine the stability in the financial sector in Nigeria. Consequently, bank stress management in Nigeria is sensitive to total credit to the economy, non-performing loan, and loan-to-deposit ratio because they impact negatively towards banks' profitability. This implies that loan performance, cumulative effect of the volume of credit to the economy as well as loan to deposit ratio determine the profitability and the going concern of the financial sector. Thus, these variables constitute grave danger if not well managed. However interest rate risk, liquidity ratio, and commercial banks total asset constitute less concern since they are controllable.

The R^2 of 0.9072 indicates that about 91% of total variation in the dependent variable (PROFIT) is accounted for by the explanatory variables (i.e. CR, EXRR, LGE, LTCECO, NPL, LTD, LR, LCBTA an IRR). This result remains robust even after adjusting for the degrees of freedom (d.f.) as indicated by the value of adjusted R^2, which is 0.882697 (i.e. $\approx$ 88%). Thus, the regression has a good fit. The F-statistic, which is a test of explanatory power of the model is 36.95 with the corresponding probability value of

0.0000, is statistically significant at 1%. Therefore, this implies that the explanatory variables (CR, EXRR, LGE, LTCECO, NPL, LTD, LR, LCBTA and IRR) have joint significant effect on the profitability. The Durbin-Watson statistic of 1.7575 indicates that the model is not prone to autocorrelation.

4.5 ERROR CORRECTION MODEL (ECM) ESTIMATES

Table 4.6 shows the parsimonious error correction model (ECM) estimates. Parsimony is determined based on improvement in adjusted *R2* and the Akaike information criterion.

The parameter estimate associated with commercial banks total assets is negatively signed statistically significant at 1%, 5%. This implies an inverse relationship between banks' assets and profitability. The parameter estimate associated with exchange rate risk is negative and is statistically significant only at 10% and not at the conventional 1% or 5%. This implies that banks profitability is affected by exchange rate risk exposure or volatility in exchange rate.

The parameter estimates associated with liquidity ratio and the one-period lag of liquidity ratio is both positive and statistically significant at 1% and 5% respectively. This implies that liquidity ratio has a positive effect on profitability and even after some time lag, the influence still remains valid. The parameter estimates associated with credit risk is negative and statistically significant at 10%. This implies that banks' profitability is affected by exposure to credit risk.

The parameter estimates indicate that non-performing loan, interest rate risk and ratio of loan to deposit at their current and period lags do not have any significant impact on profitability in Nigeria in the short run. This implies that these variables do not constitute any problem or not breed banks susceptibility to stress. The parameter estimate associated with LGE, though it has a positive sign, is not statistically significant at 1%, 5% or 10%. This implies that gross earnings do not have significant impact on bank's profitability in the short run in Nigeria. This result is similar to the findings of Amidu and Hilson (2006).

Table 4.6. Parsimonious Error Correction Model (ECM) Estimates

Variable/Constant	Coefficient	Standard Error	t-statistic	Probability
C	1.632725	1.218260	1.340210	0.1922
D(CR)	-63.21268	31.85195	-1.984578	0.0583***
D(EXRR)	-0.270660	0.227103	-1.191793	0.2445
D(EXRR(-1))	-0.660593	0.273891	-2.411882	0.0235**
D(EXRR(-2))	-0.098869	0.249867	-0.395688	0.6957
D(IRR)	-0.415928	0.628702	-0.661566	0.5143
D(LCBTA)	-64.52323	33.70201	-1.914522	0.0671***
D(LCBTA(-1))	-16.61557	31.10960	-0.534098	0.5980
D(LGE)	8.677292	17.80897	0.487243	0.6303
D(LGE(-1))	-8.747330	17.80385	-0.491317	0.6275
D(LR)	0.551969	0.137795	4.005736	0.0005*
D(LR(-1))	0.353539	0.136895	2.582552	0.0161**
D(LR(-2))	0.174954	0.135744	1.288851	0.2092
D(LTCECO)	96.80012	34.82337	2.779746	0.0102**
D(LTCECO(-1))	30.61340	32.42653	0.944085	0.3542
ECM(-1)	-0.076589	0.131355	0.583071	0.0011
R2=0.987996; Adjusted R2 =0.984995; F-statistic=329.2213; Prob (F-statistic)=0.0000.				
Durbin Watson= 2.131056; AIC: 6.8272; Log likelihood = -123.96971				
SC: 7.4963				

Source: Author's computation using E-Views 7.2

Note: *, **, *** implies statistically significant at 1%, 5% and 10% respectively.

The error correction term (ECM_1) has a negative sign and is statistically significant; these are in line with expectation. The absolute value of the error correction term indicates that the variables adjust very fast towards their long-run equilibrium position. The model is generally robust; this is shown by the value of the F-statistic which is statistically significant at 1%. The model has a good statistical fit. The Durbin-Watson statistic, which is close 2.13, suggests that the model does not suffer from first order autocorrelation. Thus, the estimates of the model are reliable and should be taken with high degree of confidence. This was later emphasized by further diagnostics performed on the model,

4.6 IMPORTANT DIAGNOSTICS

In order to boost the robustness of the analysis, some important diagnostics were done and the results presented. Captured in this diagnostics include; the Breusch-Godfrey serial correlation LM test, the Breusch-Pagan-Godfrey heteroscedasticity test and the Ramsey RESET tests respectively.

4.6.1 Breusch-Godfrey Serial Correlation LM Test Result

The Breusch-Godfrey serial correlation LM test result shows that the null hypothesis of no autocorrelation cannot be rejected at any order of 1%, 5% or 10% level of significance.

Table 4.7: Breusch-Godfrey Serial Correlation LM Test:

F-statistic	24.07966	Prob. F(2,32)	0.0000
Obs*R-squared	26.43498	Prob. Chi-Square(2)	0.0000

Source: Author's computation using E-Views 7.2

4.6.2 Heteroskedasticity Test Result: Breusch-Pagan-Godfrey

The Breusch-Pagan-Godfrey heteroscedasticity test result shows that the null hypothesis of homoscedasticity cannot be rejected at 1%, 5% or 10% level of significance.

Table 4.8: Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	3.698082	Prob. F(9,34)	0.0026
Obs*R-squared	21.76547	Prob. Chi-Square(9)	0.0097
Scaled explained SS	15.56123	Prob. Chi-Square(9)	0.0766

Source: Author's computation using E-Views 7.2

4.6.3 Ramsey RESET Test Result

The Ramsey RESET test result indicates that the null hypothesis of no specification error cannot be rejected at 1%, 5% or even 10% level of significance. Table 4.10 below presents the result of the test:

Table 4.9: 'Ramsey RESET Test

	Value	df	Probability
t-statistic	3.912892	33	0.0004
F-statistic	15.31072	(1, 33)	0.0004
Likelihood ratio	16.77042	1	0.0000

Source: Author's computation using E-Views 7.2

As seen in Tables 4.6.1-3 above, the results of the various diagnostics done showed that the estimates of the model are reliable and should be taken with high degree of confidence. Therefore, our conclusions are reliable.

5. CONCLUSION AND POLICY RECOMMENDATION

5.1 Conclusion

This study has provided evidence on stress testing in the Nigerian financial sector using error correction mechanism (ECM) and Ordinary Least Square (OLS) methodologies. It is clear from the analysis that stress testing is important to building a strong and viable financial system in the country. Bank's going concern depends on profitability, solvency and liquidity. Using a bottom-up approach to stress management, banks performance index depends on the behaviours of macroeconomic variables. How banks respond to risks determines the going concern and the viability of the nation's financial system.

This implies that bank stress (as proxy by banks' profitability parameter), is seriously influenced by credit risk (CR), exchange rate risk (EXRR), and gross earnings (LGE). Based on their performance, these variables are perceived to provide buffer against loss. For a thorough stress management therefore, these variables must be well monitored, since they determine the stability in the financial sector in Nigeria. Consequently, bank stress management in Nigeria is sensitive to total credit to the economy, non-performing loan, and loan-to-deposit ratio because they impact negatively on banks' profitability. This implies that loan performance, cumulative effect of the volume of credit to the economy as well as loan to deposit ratio determine the profitability and the going concern of the financial sector. Thus, these variables constitute grave danger if not well managed. However interest rate risk, liquidity ratio, and commercial banks total asset constitute less concern since they are controllable.

The parameter estimates indicate that non-performing loan, interest rate risk and ratio of loan to deposit at their current and period lags do not have any significant impact on profitability in Nigeria in the short run. This implies that these variables do not constitute any problem or not breed banks susceptibility to stress. The parameter estimate associated with LGE, though it has a positive sign, is not statistically significant at 1%, 5% or 10%. This implies that gross earnings do not have significant impact on bank's profitability in the short run in Nigeria. Undauntedly, Nigerian banking system is susceptible to various risks both within and outside the country. They are also exposed to macroeconomic risks as their performance index is based on these variables.

5.2 Policy Recommendation

Having examined the stress testing potency in the nation's financial sector in relation to how the macroeconomic risks affect banks performance and going concerns, the following are the policy recommendations based on the findings of the study:

(i) Credit officers should undertake a proper loan appraisal and follow-up, careful loan screening procedure and timely disbursement of approved loans to minimize defaults.

(ii) Credit administrators should take a lot of precautions in reducing credit risks by demanding for appropriate collateral security before granting loan, and ensuring effective loan supervision and monitoring by credit officer.

(iii) Credit risk managers should adopt global best practices in monitoring the performance and suitability of the bank's credit risk management methods and strategies.

(iv) Central bank of Nigeria (CBN) as the apex financial sector regulator should reinforce the performance evaluation department by critically assessing the stress associated macroeconomic variables from time to time, using different approaches to avoid liquidation and weakening the financial intermediation role of the Nigerian banks.

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