



Macro Prudential Stress Test of Monetary Policy and Assets Quality of Commercial Banks in Nigeria

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ABSTRACT

Macro-feedback effects of monetary policy and assets quality have been identified as a key missing element for more effective macro-prudential stress testing. To fill this gap, this paper develops a framework that facilitates the analysis of both the direct effects of monetary policy shocks on the asset quality of Nigeria commercial banks and feedback effects of assets quality on monetary policy variables using causality test. The framework ensures consistency in the key relationships between monetary policy variables and asset quality. This is accomplished by embedding a standard stress-testing framework based on aggregate commercial banks' data in a semi-structural monetary policy model. The framework has numerous applications that can strengthen stress testing and macro financial analysis. The paper found that asset quality respond strongly to volatility of prime lending rate and monetary policy but weak respond to volatility of Treasury bill rate, reserve requirement and maximum lending rate. The paper recommends that commercial bank managers formulate policies that will managed the volatility of the variables.

Keywords: Macro Prudential Stress Testing, Asset Quality, Monetary Policy Shocks, Commercial Banks, Monetary Policy Rate

INTRODUCTION

Nigerian banks operate in a monetary environment that is characterized with monetary instability and policy nightmares. Commercial banks are the institutional transmission mechanism for monetary policy. They facilitate the realization of the monetary policy goals and enhance the functionality of the payment system in Nigeria. Interest rates are the most influential auto-pilot instrument used to achieve set monetary policy and macroeconomic goals. Apart from the macroeconomic objective of monetary policy, the monetary authorities are empowered to formulate monetary policy for sound and stable financial market. Asset quality is an aspect of bank management which entails the evaluation of firm assets in order to facilitate the measurement of the level and size of credit risk associated with its operation. Asset quality is micro prudential determinants commercial banks soundness and profitability. It relates to the left-hand side of a bank balance sheet and focused on the quality of loans which provides earnings for a bank (Abata, 2014). It is seven out of twenty-five core principles of effective banking supervision by BASEL Committee on banking supervision in 1997. Sustaining sound assets quality involves careful granting of loans that must be examined and compliance to banking rules. As a micro determinant of profitability, poor assets quality affects the financial performance and the soundness of the banking system.

The process of bank credit, the principal function of commercial banks is fraught with risk due to uncertainty in the bank's business environment. Okereke (2003) posited that the banking business is characterized with judicial risk, compliance risk, reputational risk and professional risks. Nigeria Deposit Insurance Corporation reports had shown clearly that both distressed and potentially distressed banks controlled 4.9 per cent of the total assets of the Nigerian banking industry. Their total deposits portfolio

was 4.4 per cent of the industry, while loans and advances, including leases constituted 7.4 per cent. However, the non-performing loans, advances and leases accounted for 29.5 per cent of the industry total. In the distressed banks the proportion of non-performing loans and leases was 7.9 per cent, while it was 60.2 percent in the potentially distressed banks. The high proportion of classified loans and leases in distressed banks can be distinguished from the 19.5 per cent classified loan portfolio recorded in the entire banking industry. Another interesting part of the Nigeria Deposit Insurance Corporation Report is that the distressed and potentially distressed banks had a recapitalization requirement of N16.2 billion in 1998, with the Nigeria Deposit Insurance Corporation level of risk exposure fixed at N9.3 billion.

The Nigeria Deposit Insurance Corporation level of risk exposure is determined by the forced market value of total assets of distressed banks plus recoverable loans and advances minus total deposits and other liabilities. This has two major implications for the banking industry. First, most financially troubled banks held most of their liquid assets in cash and bank balances, and with an expending portfolio for non-performing loans and advances, they depleted their core deposit base, thus necessitating distress borrowing from money market sources. The Nigeria Deposit Insurance Corporation Report indicates that a total of N9.38 billion fraud cases were recorded in 2003 in the Nigerian banking industry. However, about N8.6 billion representing 92 per cent of the fraud cases were recorded in just 10 of the banks. Analysis of the Report shows that 56 insured banks representing 63 per cent of the total operators complied with the requirements of fidelity insurance coverage indicating a significant drop from the 74 or 82.2 percent (Toby, 2014).

Macro stress tests for credit risk are carried out in three phases. Stress tests determine the firmness and flexibility of a financial system mainly by intentionally subjecting the problem to extreme and particularly adverse situations which were not planned prior (Guegan & Hassani, 2015). Credit risk is the most important risk that banks encounter, and the accomplishment of this relies on accurate measurement and practical control of credit risk more than any other risk (Giesecke, 2004). Increases in credit risk increase the minimal value of debt and equity that in shift doubles the cost of funds for a financial institution (Basel Committee, 1999). According to Arias, Jara-Bertin, & Rodriguez bank performance is negatively related to credit risk (Arias, Jara-Bertin, & Rodriguez, (2013).

In Nigeria, Banks and Other Financial Institution Act (BOFIA) 1990 as amended regulates banks operations and restrict bank lending to avoid the issue of non-performing loans and ensure assets quality, for instance section 18 prohibit any personal interest in any loans and advance of bank staff without declaration of the nature of interest while section 20 restrict loans and advance to the rate 20 percent of shareholders fund to a single obligor. This is complemented by the provisions of BASEL I, II and III. The challenges of Nigerian banks in the past have been the mismatch of assets and liabilities. Banking sector crisis over the years has been blamed on the poor quality of assets. This study examined macro prudential stress test of monetary policy shocks and commercial banks capital adequacy in Nigeria which is lacking in literature. Existing studies examined the effect of asset quality and commercial banks profitability in Nigeria (Toby, 2004; Akani, 2017; Lucky and Nwosi, 2015; Kolapo, Ayeni & Oke, 2012; Ezeohua, (2011).

LITERATURE REVIEW

Conceptual Framework and Development of Hypothesis

Prime Lending Rate

The prime lending rate is the interest rate that commercial banks charge their most credit-worthy customers. Generally, a bank's best customers consist of large corporations (Akani, 2017). The prime interest rate, or prime lending rate, is largely determined by the Central Bank rate, which is the overnight rate that banks use to lend to one another; the prime rate is also important for individual borrowers, as the prime rate directly affects the lending rates available for a mortgage, small business loan or personal loan. The prime rate serves as a basis, or point of reference, for determining most other interest rates lenders make available to borrowers, even though it might not be specifically listed as a component of the rate

ultimately charged. Interest rates serve as compensation for the risk taken on by the lender based on the borrower's credit history and other financial details, and provide a way to cover costs associated with lending. Increase prime lending rate will reduce bank lending to core customers, therefore we hypothesize positive relationship between prime lending rate and assets quality of commercial banks.

Maximum Lending Rate

This is defined as the highest lending rate which the commercial banks can lend money to the various sectors of the economy. It is strictly determined by the money supply and the market forces of demand and supply. Maximum lending rate is sometime influenced by the monetary policy authority to channel bank credit to some specific sectors of the economy (CBN, 2015). Increase in maximum lending rate will reduce lending habit of commercial banks; therefore we hypothesize positive relationship between maximum lending rate and assets quality of commercial banks.

Monetary Policy Rate

The monetary policy rate is the rate at which the Central Bank of Nigeria (CBN) lends money to banks gripped by temporary liquidity squeeze and it usually goes a long way to determine the rate banks will apply when lending funds to businesses in the country. A lower monetary policy rate can have a salutary effect on general lending rates depending on the degree of dependence of banks on Central (CBN, 2015). Therefore we hypothesize positive relationship between monetary policy rate and assets quality of commercial banks.

Treasury bill Rate

The Treasury bill is a money market and monetary policy instruments that is used to influence the quantity of money supply that affect the rate of interest rate, domestic credit and investment. The rate measures the Central Bank of Nigeria discounting rate for Treasury bill holders (Akani, 2017). The theoretical relationship is built on the Keynesian's speculative theory of holding money. Therefore we hypothesize positive relationship between Treasury bill rate and assets quality of commercial banks.

Liquidity Reserves

Liquidity as component of liquidity reserves is one determinant of deposit money banks profitability and a crucial function in operation of the banking business. A liquid bank has the capacity to fund increase in asset and meet both anticipated and unanticipated obligations at reasonable cost without running into unacceptable losses. Liquidity reserves are monetary policy instrument used to achieve set macroeconomic goals and ensure financial system stability that will maximize shareholders wealth through profitability. It is the transmission channel for the realization of the government monetary and macroeconomic policy and a means of implementing modern payment system (Etienne & Christopher, 2010). Liquidity was an instrumental factor during the recent financial crisis. As uncertainty led funding sources to evaporate, many banks quickly found themselves short on cash to cover their obligations as they came due. As such, policy makers have suggested that banks should hold more liquid assets than in the past, to help self-insure against potential liquidity or funding difficulties. The Central Bank of Nigeria guideline on reserved for bank is that the banks must meet up the minimum reserve requirement set up for them and consider banks to be liquid enough in the economy. Since liquid assets such as cash and government securities generally have a relatively low return, holding them imposes an opportunity cost on a bank. In the absence of regulation, it is reasonable to expect banks will hold liquid assets to the extent they help to maximize the firm's profitability.

In Nigeria, liquidity reserves comprise currency, reserve requirement, stabilization securities and Central Bank of Nigeria bills (CBN, 2014). The Central Bank Act of 1969 as amended empowered Central Bank of Nigeria to implement liquidity management and liquidity reserves policies in the economy, through the banking sector with the objective of achieving set goals such as price stability, economic growth and banking sector stability. The introduction of liquidity reserve was among a set of direct policy tools implemented by Central Bank of Nigeria shortly after it was established in 1959 to control money and credit in attempt to minimize fluctuations in price, employment and exchange rate. Central Bank of Nigeria manages banking sector liquidity by supplying or withdrawing liquidity from the Banking Sector

which it deems to be consistent with a desired level of short-term interest rates or reserves money. This will enable the banking sector withstand shocks and meet customers withdrawal needs (Uremadu, 2012). Conceptually, liquidity reserve is a statutory reserve and a legal requirement expected of banks to keep with the Central Bank. It is a qualitative measure of deposit liquidity relationship as defined by the regulatory authorities. It is a short term contractionary monetary policy instrument.

Overview of Liquidity Reserve

Reserve requirement is the minimum amount of cash or cash-equivalents (computed as a percentage of deposits) that banks and other depository institutions (credit unions, insurance companies) are required by law to keep on hand, and which may not be used for lending or investment. Reserve requirements serve as (1) a safeguard against a sudden and inordinate demand for withdrawals (as in a run on a bank), and (2) as a control mechanism for injecting cash (liquidity) into or withdrawing it from an economy (Joshua, 2012). Reserve requirement is a central bank regulation employed by most, but not all of the world's central banks that set the minimum fraction of customer deposit and notes that each commercial bank must hold as reserve (rather than lend out) (Dasol, 2011). These required reserves are normally in the form of cash stored physically in a bank vault (vault cash) or deposit made with a central bank. The required reserve ratio is sometimes used as a tool *in monetary* policy, influencing the country's borrowing and interest rate by changing the amount of funds available for banks to make loans with. The effect is multiplied because money obtained as loan proceeds can be re-deposited; a portion of those deposits may again be loaned out, and so on. The effect on the money supply is governed by the following formulas;

$$M1 = Mb * mm; \quad mm = (1+c)/(c+R) \quad 1$$

Derived formula for the money multiplier mm, the factor by which lending and re-lending leads M1 to be a multiple of the monetary base:

Where,

C = The currency ratio, the ratio of the public's holdings of currency (undeposited cash) to the public's holdings of demand deposit; and

R = the total reserve ratio (the ratio of legally required reserve plus non-required reserve holdings of banks to demand deposit liabilities of banks). As a monetary policy instrument the monetary base of the money multiplier from reserve requirement is formulated as follows:-

$$MB = C + R \quad 2$$

$$R = SR + VC + PD + ER \quad 3$$

Where

- MB = Monetary base
- C = Currency in circulation
- R = Bank reserve
- SR = Statutory reserve
- VC = Vault cash
- PD = Penalty deposit
- ER = Excess reserve

Liquidity Reserve and Banks Earning Assets

Variations in reserve requirement such as liquidity reserve, cash reserve and supplementary reserves can also be effectively used by the central bank to control commercial banks liquidity and influence their credit operations (Frederic, 2012). This instrument include the manipulation of banks cash reserves balance (variable cash reserve ratio), liquid assets reserve (variable liquidity ratio and several types of supplementary reserves (like special deposits) and stabilization securities). In using this, the monetary authorities have the power not only to alter the composition of the liquid assets for computation of the liquidity ratio but also the liquidity ratio itself. If the reserve is increased, commercial banks will have less cash for investment, thereby affecting its performance negatively. However, Nigerian monetary policy

administration is too harsh to the commercial banks management and therefore does not impact positively to the performance of commercial banks

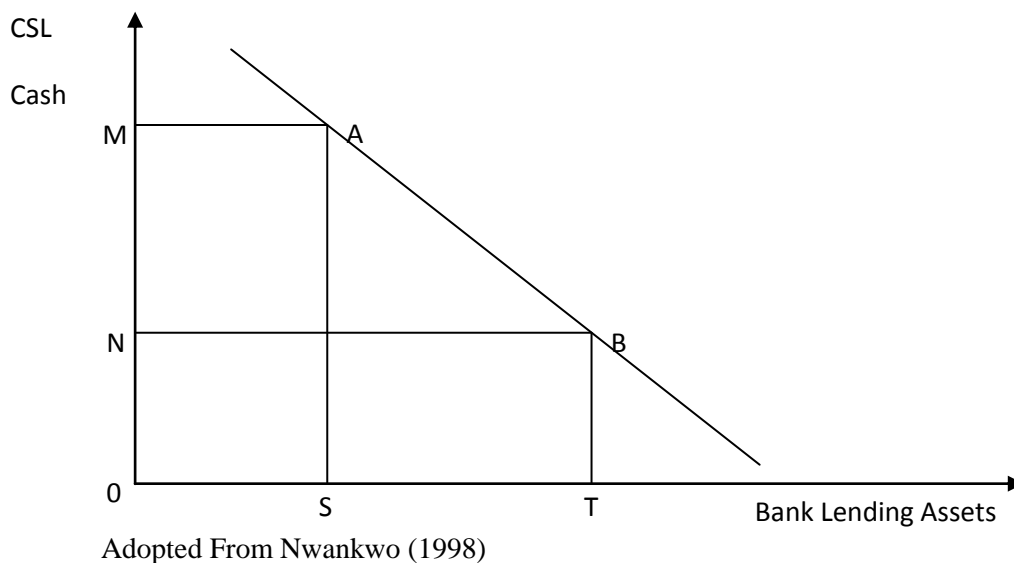


Fig. 1 Commercial Bank Liquidity reserve, earning assets and the Trade-Off

At point “A”, the bank has OM cash and OS earning assets, this shows more cash (liquidity) are in the bank vault. At point “B”, the bank has ON cash and OT earning assets signifying more earning assets.

Liquidity Reserve as a Macro-prudential Tool

In recent years, central bank in Nigeria as in other emerging market economies has actively used reserve requirements on bank deposits and other bank liabilities in a countercyclical manner to address systemic risk. Although similar in spirit to the original conception of reserve requirements as liquidity and credit policy tool, their use with a macro-prudential perspective is relatively new (Gray, 2011). This contrasts with the long-held view that considered reserve requirements (on deposits) as a supplementary monetary policy tool for macro-economic purposes (Chan-Lau, 2012) or an integral component of a financially depressed economy. In that light, several countries dismantled reserve requirements with the implementation of inflation-targeting frameworks once short-term interest rates became the main monetary policy instrument. Nonetheless, reserve requirements have remained part of central banks’ policy toolkit in most emerging market economies and its role re-examined.

Reserve requirements are a regulatory tool that requires banking institutions to hold a fraction of their deposits/liabilities as liquid reserves. These are normally held at the central bank in the form of cash or highly liquid sovereign paper. When applied to deposits, the regulation usually specifies the size of the requirement according to deposit type (e.g., demand or time deposit) and its currency denomination (domestic or foreign currency). The regulation also sets the holding period relative to the reserve statement period for which the reserve requirement is computed, and whether they are remunerated or unremunerated (Agenor et al, 2012). When they apply to new deposits from a reference period only, they are referred to as marginal reserve requirements. In addition, reserve requirements can apply to domestic or foreign (non-deposit) liabilities of banks’ balance sheet. Reserve requirements could be applied on

assets rather than on liabilities (Glocker et al, 2012). The experience so far shows a preference for reserve requirements on liabilities.

Reserve Requirements are no free lunch as they have associated costs and may introduce distortions in the financial system (Peydro-Alcalde et al, 2011). Reserve requirements constrain banks' funding and also, if reduced below market rates, act as a tax on banks. In response, banks may pass its cost to other agents by raising the spread between lending and deposit rates. This may stimulate bank disintermediation, increase non-bank financing and lead to excessive risk taking in other less regulated sectors. Reserve requirements can also reduce credit through the effect on bank's funding, especially if reserve requirements are binding (for example, for banks that do not have sufficient reserves). Furthermore, reserve requirements can also generate incentives for regulatory arbitrage. In some instances, such incentives materialize in the form of a proliferation of weakly regulated "bank-like" institutions, such as off-shore banks. Finally, when implemented in an asymmetric manner across market agents, reserve requirements become a de-facto cross-subsidy scheme that distorts bank behaviour, pushing some banks to change their funding pattern towards more unstable funding sources (Robitaille, 2011). Therefore we hypothesize positive relationship between Treasury bill rate and assets quality of commercial banks.

Theoretical Review

Corporate Risk Management Theory

There are many theories on Corporate Risk Management and amongst them is the fiscal economics approach to corporate risk management, which subsequently been the most productive regarding extensions of theoretical models and pragmatic research. This study builds on Modigliani-Miller traditional paradigm of (Miller & Modigliani, 1958) that sets out the circumstances for the insignificance of financial configuration for the value of a company. This theory was afterward introduced in the field of risk management. This approach further requires that equivocation resulted in lower instability of currency flow and lesser instability of the company's value. The justification for corporate risk management reasoned from indifference surroundings and incorporated higher obligation capability (Miller & Modigliani, 1963). Smaller expected costs of insolvency, progressive income tax charge, (Smith & Stulz, 1985), secure internal funding (Froot et al., 1993), equivalent to sequence (Geczy et al., 1997) and practical benefit in sequence (Stulz, 1996). The end outcome of equivocation, if useful to a company, should be high equivocation quality. Facts forecasting financial economics theories to risk management are weak. Even though, risk management results in the lesser unpredictability of a company's worth (Jin & Jorion, 2006). The requirement for all other effects, appearing to be little evidence of this is related to benefits particular to the theory. Plus the citation by Tufano (1996) found no evidence to support economic theories and instead focuses on the influence of managerial partiality. Resting on that, the assumptions of a greater debt capability appear to be positively confirmed, as revealed by Graham & Rogers (2002), Guay (1999) and Faff & Nguyen (2002). The internal financing theory was checked by Geczy et al. (1997) and Guay (1999) while discarded by Mian (1996) and Faff & Nguyen (2002). Judge (2006) found substantiation in financial distress to support the idea.

Agency Theory

Significantly another theory that informs this research is the agency theory. The agency theories broaden the testing of company property and division between management control and incentive extends. In the field, corporate risk management was revealed to manipulate management approaches towards risk management (Smith & Stulz, 1985). Also, theory clarifies a likely shift of concern among shareholders, board and liability possessor owing to asymmetries in the sharing of profits, which may affect a company, engaged in excessive risk or one that does not participate in the net positive worth of tasks (Mayers & Smith, 1987). Therefore, the agency theory entails equivocation guidelines that define the significance control on a company's worth (Fite & Pfliegerer, 1995). These assumptions relates to the financial formation, and present similar forecast for financial theory.

The assumptions of financial policy were tested in studies of financial theory since both approaches give similar predictions in this regard. Overall, most of the empirical evidence seems to be contrary to the

assumptions of the agency theory. However, a new perception on risk management is presented by the new institutional economics. The emphasis here is on the process of governance and socio-economic organizations that direct these courses of action, as Williamson (1998) described. Even though there is no pragmatic study on new approaches to risk supervision in institutional economics, the theory proffers another justification of corporate performance. Specifically, it predicted that risk management preparation could be indomitable by an institution or the conventional practice in a bazaar. A more actual insinuation of this premise is that shareholders might be fascinated in estimating mass property by reducing the risk of the company.

Empirical Review

Beck, Demircug-Kunt, and Levine (2005) examined the inter-linkage between bank concentration and banking system fragility where they have established that higher bank concentration is associated with lower profitability. Lis, *et.al.* (2000) have found that Gross Domestic Product growth, bank size and Capital had negative effect on Non-Performing Assets while Loan growth, collateral, net interest margin, debt-equity, market power and regulation regime had a positive impact on Non-Performing Assets. Babihuga (2007) analyses the relationship between selected macroeconomic and Financial Soundness Indicators (FSI) for 96 countries for the period 1998 -2005. The determinants of asset quality were model following an approach adopted by Demircug Kunt and Huizinga (1999) using a parsimonious model with the share of non-performing loans in total loans as a function of macroeconomic variables. They find a collapse in business credit worthiness and the subsequent deterioration in the value of collateral are the main mechanism of a macroeconomic shock to bank's portfolio. Deposit insurance on Non-performing Loans (NPLs). They find that unlimited Insurance scheme create moral hazard incentives that encourage banks to take excessive risk and it also caused a remarkable increase of Nonperforming Loans (NPLs).

Resti (2002) examined corporate bond recovery rate abducting to bond default rate, macroeconomic variables such as Gross Domestic Product and growth rate, amount of bonds outstanding, amount of default, return on default bonds, and stock return wherein it was established that default rate, amount of bonds, default bonds, and economic recession had negative effect, while the Gross Domestic Product growth rate, and stock return had positive effect on corporate recovery rate. Lis, *et.al.*,(2000) used a simultaneous equation model in which they explained bank loan losses in Spain using a host of indicators, which included Gross Domestic Product growth rate, debt-equity ratios of firms, regulation regime, loan growth, bank branch growth rates, bank size, collateral loans, net interest margin, capital-asset ratio (CAR) and market power of default companies. They found that Gross Domestic Product growth, bank size, and CAR, had negative effect while loan growth, collateral, net-interest margin, debt equity, market power, regulation regime and lagged dependent variable had positive effect on problem loans. Sergio (1996) in a study of non-performing loans in Italy found evidence that, an increase in the riskiness of loan assets is rooted in a bank's lending policy abducting to relatively unselective and inadequate assessment of sectoral prospects. Interestingly, this study refuted that business cycle could be a primary reason for banks' Non-Performing Assets. Das and Ghosh (2003) established relationship between Non Performing Loans of India's public sector banks in terms of various indicators such as; asset size, credit growth and macroeconomic condition and operating efficiency indicators.

Bercoff, Giovanniz and Grimardx (2002) in their study of Argentinean banks tried to measure Non-Performing Assets by using the various bank related parameters as well as macroeconomic parameters. Bank specific parameters in their study were Ratio of Net worth to Net Assets, Banks exposure to peso loans, and type of banks such as foreign, private or public. Macroeconomic factors in this study were credit growth, reserves adequacy, foreign interest rate and monetary expansion. They have established that variables such as operating cost, exposure to peso loans, credit growth, and foreign interest rate had a negative effect on Non-Performing Assets. The macroeconomic variables such as money multiplier and reserve adequacy had a positive impact on Non-Performing Assets. Chen *et al.* (1998) study the relationship between the risks and the ownership structure, and it appears that a negative correlation exists between the managers' shareholdings and the risks faced by the financial institution. That means that if

the managers' shareholding percentage increases, the financial institution will reduce its risk behavior. Berger and De Young (1995) mention that a management team with poor operating capability is unable to correctly appraise the value of collateral, which means that it is difficult for it to follow up on its supervision of the borrower, its poor credit-rating technology will result in management being unable to control and supervise the operating expenses efficiently, thus leading to a significant increase in Non-Performing Loans.

Bodla and Verma (2006) emphasized that financial sector reforms have brought in greater competition among the banks and have brought their profitability under pressure. Singh (2005) argues that globalization of operations and development of new technologies are taking place at a rapid pace and this has led to the increase in resource productivity, increasing level of deposits, credits and profitability and decrease in Non-Performing Assets.

Rajaraman and Vasishtha (2002) in their empirical study have proved that significant bivariate relationship exists between Non-Performing Assets of the public sector banks and the inefficiency problems. Das (1999) has contrasted the different efficiency measures of public sector banks by applying data envelopment analysis model and concluded that the level of Non-Performing Assets has significant negative relationship with efficiency parameters. Kwan and Eisenbis (1997) have examined the relationship between problem loans and bank efficiency by employing Granger-causality technique and found that high level of problem loans cause banks to increase spending on monitoring working out and or selling off these loans and possibly become more diligent in administering the portion of their existing loan portfolio that is currently performing. Ranjan and Dhal (2003) attempted an empirical analysis of the Non-Performing Assets of Public Sector banks in India and probed the response of Non-Performing Assets to terms of credit, bank size, and macroeconomic condition and found that terms of credit have significant effect on the banks' Non Performing Assets in the presence of bank size and macroeconomic shocks. Kargi (2011) found in a study of Nigeria banks from 2004 to 2008 that there is a significant relationship between banks performance and credit risk management. He found that loans and advances and non-performing loans are major variables that determine asset quality of a bank.

Yixin Hou (2005) used Regression model and find that non-performing loans have nonlinear negative effect on banks' lending behavior, when banks have non-performing loans lower than the threshold; they are less regressive in increasing lending. However when non-performing loan rates are under the threshold level, non-performing loans have positive impacts on banks' lending behaviour with a statically significant positive coefficient. Ezeoha (2011) used panel data from 19 out of a total 25 banks operating in Nigeria; where he uses a multivariate constant coefficient regression model to test whether consolidation heighten incidence of non-performing credit in a fragile banking environment. He find that there is deterioration in asset quality and the deterioration in asset quality and increased credit crisis between 2004 and 2008 was exacerbated by the inability of bank to optimally use their huge asset capacity to enhance their earnings profiles. This implies that excess liquidity syndrome and relatively huge capital bases fueled reckless lending by banks portfolio ironically helped to mitigate the level of nonperforming loans within the studied period. Hu, Li and Chiu (2004) examined how ownership structure affects Non-performing Loans (NPLs). Their findings revealed that an increase in the governments' shareholding facilitates political lobbying. On the other hand, private shareholding induces more Non-performing Loans (NPLs).

Kolapo, Ayeni and Ojo (2012) using panel data regression for the period 2000 to 2010 found that the effect of credit risk on bank's performance measured by the Return on Asset (ROA) of banks is cross sectional invariant. They concluded that the nature and managerial pattern of individual firms do not determine the impact. Hosna, Manzura and Juanjuan (2009) reemphasized the effect of credit risk management on profitability level of banks. They concluded that higher capital requirement contributes positively to bank's profitability. Muhammed, Shahid, Munir and Ahad (2012) used descriptive, correlation and regression techniques to study whether credit risk affect banks performance in Nigeria from 2004 to 2008. They also found that credit risk management has a significant impact on profitability of Nigerian banks.

Pain (2003) established an observed association between the provision for loan losses of banks and the macroeconomic pointers like GDP increase, credit increase, actual interest charge, and portfolio absorption in residential loans stress exercises held by the Bank of England. In this context, credit risk models with macroeconomic variables are used. However, the study by Pain (2003) is different from this study since it focuses on macroeconomic variables. Jobst (2007) studied the generalized parametric methods of measuring the aggregated operational risk in conformity with regulatory capital necessities applicable to “operational risk in the New Basel Capital Accord (Basel II) (Jobst, 2007). Jobst carried out an incorporated evaluation of operational risk disclosure and the reliability of existing regulations on capital operational risk support on comprehensive parametric inference. However, the study by Jobst (2007) is different from this study since it was not on credit risk stress testing, but operational risk.

Mwangi (2010) stress testing a case of the Kenyan Banking System, sought to carry out a conventional stress test for the Kenyan banks so as to investigate how much stress the banking system could endure as well as how particular banks could survive shocks. The impacts of shocks were measured by examination changes in capital and the capital adequacy ratio. She discovered that the adequate provisioning for loan losses was significant for banks not to erode their capital base, which results in lower lending levels and could even lead to a financial crisis. The study differs from the current study since it does not cover aspects of credit stress testing, but stress testing as a whole.

Siba (2012) examined the correlation between financial risk management practices and financial performance of commercial banks in Kenya. As a result, banks encompass effective risk supervision practices and that there is a close connection between the performance of banks and the effectiveness of banks' risk management practices. The study differs from the current study to the extent that the current study will focus on the effects of credit stress testing levels on financial performance.

Mwangi (2012) conducted a study on the impact of risk management practices on the financial performance of commercial banks in Kenya focusing on foreign exchange risk. The study differs from the current study because it does not cover aspects of credit stress testing. Regardless of the many contributions on how the credit risk parameters fluctuate over the economic series, credit portfolio stress tests continue comparatively inadequate to date, mainly because of the limited accessible information. Peura & Jokivuolle (2004) and Rosch & Scheule (2007) researched on the macroeconomic perspective of credit risk. The key issue is how to mold the potential for aggregate credit in an economy or particular sectors such as businesses and households, correspondingly.

METHODOLOGY

This section of the paper concentrate on the general methods was employed in analyzing the data sourced from Central Bank of Nigeria Bulletin and financial statement of the quoted commercial banks in Nigeria.

Model Specification

The models below are specified in this study.

$$AQI = f(PLR, MPR, TBR, RR, MLR) \quad 1$$

It is empirically stated as

$$AQI = \alpha + \hat{y}_1 PLR + \hat{y}_2 MPR + \hat{y}_3 TBR + \hat{y}_4 RR + \hat{y}_5 MLR + e_i \quad 2$$

Where

AQI	=	Asset Quality Indicator
PLR	=	Loans to Deposit Ratio
MPR	=	Monetary Policy Rate
TBR	=	Treasury Bill Rate

RR = Reserve Requirement
 MLR = Growth of Broad Money Supply
 α_0 = Regression Intercept

$\hat{y}_1 - \hat{y}_5 =$ Coefficient of the independent variables to the dependent variable

μ = Error term

Estimation Procedure

Unit Root Test

Most of time series have unit root as demonstrated by many studies including Johansen (1991), Kutosoyiannis, (1997) and Campbell and Peron (1991). Therefore, their means of variance of such time series are not independent of time. Conventional regression technique based on non-stationary time series produce spurious regression and statistic may simply indicate only correlated trends rather true relationship Granger, (1969). Spurious regression can be detected in regression model by low Durbin Watson and relatively moderate R^2 .

Therefore, to distinguish between correlation that arises from share trend and one associated with an underlying causal relationship; we use both the Augmented Dickey fuller (Dickey and Fuller, 1979, 1981)

$$X_t = \mu + \Theta X_{t-1} + \varepsilon_t \tag{3}$$

The null hypotheses for the ADF statistic test are H_0 .

Non stationary (unit root) and H_0 : Stationary respectively

Cointegration

To search for possible long run relationship amongst the variables, we employ the Johansen and Juselius (1990) approach. Thus, the study constructed a p-dimensional (4x1) vector auto regression model with Gaussian errors that can be expressed by its first differenced error correction form as

$$\Delta Y_t = \Gamma_1 \Delta Y_{t-1} + \Gamma_2 \Delta Y_{t-2} + \dots + \Gamma_{k-1} \Delta Y_{t-k+1} - \Pi Y_{t-1} + \mu + \varepsilon_t \tag{4}$$

Where Y_t are the data series studied, ε_t is i. i. d, $N(0, \Sigma)$ $\Gamma_i + -1 + A_1 + A_1 + A_2 + A_3 + \dots + A_i$ for $i = 1, 2, 3, \dots, k-1$, $\Pi = I - A_1 - A_2 - \dots - A_k$.

The Π matrix conveys information about the long term relationship among the Y_t variables studied. Hence, testing the cointegration entails testing for the rank r of matrix Π by examine whether the eigenvalues of Π are significantly different from zero.

Johansen and Juselius (1990) proposed two tests statistics to determine the number of cointegrating vectors (or the rank of Π), namely the trace and the maximum eigen-value (λ -trace) is computed as;

$$\lambda_{trace} = -T \sum_{j=r+1}^n \ln(1 - \lambda_j) \tag{5}$$

The trace tests the null hypothesis that at most r cointegration vector, with more than r vectors being the alternative hypothesis. The maximum eigenvalue test is given as:

$$\lambda_{\max} = -T \ln(1 - \lambda_{r+1}) \tag{6}$$

It tests the null hypothesis of r cointegrating vectors against the alternative hypothesis of $r + 1$ cointegration vectors. In the equation (3) and (4), is the sample size and λ is the largest canonical correlation.

Granger Causality

In case we do not find any evidence for cointegration among the variables, the specification of the Granger causality will be a vector autoregression (VAR) in the first difference form. However, if will find evidence of cointegration, there is the need to augment the Granger-type causality test model with a one period lagged error term. This is a crucial step because as noted by Engel and Granger (1987).

$$Y_t = \alpha_o + \sum_{i=1}^n \alpha_i^y Y_{t-1} \sum_{i=1}^n X_{a1} X \mu \quad 7$$

Error Correction Model (ECM): Co-integration is a prerequisite for the error correction mechanism. Since co-integration has been established, it is pertinent to proceed to the error correction model.

A-priori Expectation of the Result: The a-priori expectation of the variables proposes that an increase in the explanatory variables lead to increase in the dependent variables ($\Delta QI = \hat{y}_1, \hat{y}_2, \hat{y}_3 \hat{y}_4, \hat{y}_5 > 0$).

RESULTS AND DISCUSSIONS

Our adopted Ordinary Least Square (OLS) regression approach used cointegration, unit root, Granger Causality Test and Vector Error Correction Models to ascertain the relationship between the independent and the dependent variables in the models.

Table 1: Monetary Policy Shocks and Asset Quality

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PLR	0.941776	0.229667	4.100612	0.0005
MPR	-0.350355	0.112500	-3.114275	0.0051
TBR	0.250474	0.523975	0.478027	0.6373
RR	-0.125441	0.081438	-1.540331	0.1377
MLR	0.109719	0.408853	0.268358	0.7909
C	29.62128	8.635480	3.430183	0.0024
R-squared	0.640130	Mean dependent var		18.17857
Adjusted R-squared	0.558341	S.D. dependent var		8.791509
S.E. of regression	5.842611	Akaike info criterion		6.555642
Sum squared resid	750.9942	Schwarz criterion		6.841114
Log likelihood	-85.77899	Hannan-Quinn criter.		6.642914
F-statistic	7.826629	Durbin-Watson stat		1.520825
Prob(F-statistic)	0.000232			

Source: Extract From E-View

The result found high rate of response of asset quality to monetary policy shocks. The R² shows that the independent variables can explain 64 percent variation on the dependent variable. This implies that volatility of the independent variables can seriously affect bank assets quality. The f-statistics found that the model is well specified. The independent variables can be explained as follows:

1. Asset quality respond volatility of prime lending rate by 0.941 with probability coefficient of 0.0006 < 0.05, this implies that asset quality respond strongly to volatility of prime lending rate.
2. Asset quality respond volatility of monetary policy rate by -3.11 with probability coefficient of 0.0051 < 0.05, this implies that asset quality respond strongly to volatility of monetary policy rate.
3. Asset quality respond volatility of Treasury bill rate by 0.478 with probability coefficient of 0.6373 > 0.05, this implies that asset quality respond slowly to volatility of Treasury bill rate.
4. Asset quality respond volatility of reserve requirements by -1.540 with probability coefficient of 0.1377 > 0.05, this implies that asset quality respond slowly to volatility of reserve requirement.
5. Asset quality respond volatility of maximum lending rate by 0.263 with probability coefficient of 7909 > 0.05, this implies that asset quality respond slowly to volatility of maximum lending rate.

Table 2: Stationarity Test of Asset Quality

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-4.477141	0.0017
Test critical values: 1% level	-3.724070	
5% level	-2.986225	
10% level	-2.632604	

Source: Extract From E-View

Probability coefficient 0.0017 < 0.05, accept H_A

Table 3: Stationarity Test of Prime lending rate

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-4.866709	0.0008
Test critical values: 1% level	-3.752946	
5% level	-2.998064	
10% level	-2.638752	

Probability coefficient 0.0017 < 0.05, accept H_A

Table 4: Stationarity Test of Monetary Policy Rate

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-3.299605	0.0268
Test critical values: 1% level	-3.752946	
5% level	-2.998064	
10% level	-2.638752	

Probability coefficient 0.0017 < 0.05, accept H_A

Table 5: Stationarity Test of Treasury Bill Rate

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-2.799388	0.0716
Test critical values: 1% level	-3.699871	
5% level	-2.976263	
10% level	-2.627420	

Source: Extract From E-View

Probability coefficient 0.0017 < 0.05, accept H_A

Table 6: Stationarity Test of Reserve Requirement

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-2.799388	0.0716
Test critical values: 1% level	-3.699871	
5% level	-2.976263	
10% level	-2.627420	

Source: Extract From E-View

Probability coefficient 0.0017 < 0.05, accept H_A

Table 7: Stationarity Test of Maximum Lending Rate

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-6.715038	0.0000
Test critical values: 1% level	-3.737853	
5% level	-2.991878	
10% level	-2.635542	

Probability coefficient 0.0017 < 0.05, accept H_A

Table 8: Pair wise Granger Causality Test Of Monetary Policy And Asset Quality

Null Hypothesis:	Obs	F-Statistic	Prob.
PLR does not Granger Cause AQI	26	1.72914	0.2018
AQI does not Granger Cause PLR		2.73477	0.0880
MLR does not Granger Cause AQI	26	0.42897	0.6568
AQI does not Granger Cause MLR		2.13246	0.1435
MPR does not Granger Cause AQI	26	0.17560	0.8402
AQI does not Granger Cause MPR		2.69192	0.0910
RR does not Granger Cause AQI	26	0.63117	0.5418
AQI does not Granger Cause RR		2.89992	0.0773
TBR does not Granger Cause AQI	26	0.08582	0.9181
AQI does not Granger Cause TBR		2.51052	0.1053

Source: Extract From E-View

Monetary policy variables in the model cannot predict volatility of asset quality in the long and short run as the causality test proved no causal relationship between asset quality and monetary policy shocks or monetary policy shocks and assets quality as formulated in the model.

Table 9: Cointegration Test Of Monetary Policy And Asset Quality

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.865377	142.0297	95.75366	0.0000
At most 1 *	0.790352	89.89236	69.81889	0.0006
At most 2 *	0.550732	49.27189	47.85613	0.0366
At most 3	0.418235	28.46838	29.79707	0.0706
At most 4	0.373452	14.38449	15.49471	0.0730
At most 5	0.082149	2.228729	3.841466	0.1355

Source: Extract From E-View

From the table prime lending rate and monetary policy rate strong predict long run volatility of commercial banks asset quality; this is evidence as the probability coefficient of the variables proved significant with asset quality.

Table 10: Error Correction Model of Monetary Policy Shocks and Asset Quality

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.034936	1.122489	1.812879	0.0949
D(AQI(-1))	-0.214205	0.364016	-0.588451	0.5671
D(MLR(-1))	-0.020216	0.250728	-0.080629	0.9371
D(MLR(-2))	0.262570	0.285653	0.919193	0.3761
D(MLR(-3))	-0.479529	0.415091	-1.155238	0.2705
D(PLR(-1))	0.102764	0.147698	0.695766	0.4998
D(PLR(-2))	0.221738	0.109259	2.029468	0.0652
D(PLR(-3))	0.176076	0.109103	1.613854	0.1325
D(MPR(-1))	0.677729	0.443285	1.528880	0.1522
D(MPR(-2))	0.226991	0.334347	0.678906	0.5101
D(TBR(-1))	-0.295911	0.255260	-1.159254	0.2689
ECM(-1)	-0.335248	0.313194	-1.070417	0.3055

Source: Extract From E-View

The stress tested error correction result proved no significant relationship between monetary policy variables and assets quality of commercial banks, the probability coefficients of the variables are greater than the critical value of 0.05, this implies that assets quality of commercial banks does not respond significantly to monetary policy shocks.

Test of hypotheses

Prime lending rate: Probability coefficient $0.0006 < 0.05$, accept H_A

Monetary policy rate: Probability coefficient $0.0051 < 0.05$, accept H_A

Treasury bill rate: Probability coefficient $0.6373 > 0.05$, accept H_0

Reserve requirement: Probability coefficient $0.1377 > 0.05$, accept H_0

Maximum lending rate: Probability coefficient $0.7909 > 0.05$, accept H_0

CONCLUSION

This paper stress tested asset quality to volatility of monetary policy using annual time series variables. The models formulated allow a formal examination of linkages between the banking sector asset quality, including at the individual bank's level, and the monetary variables using ordinary least square response functions and historical shock decompositions. In addition to "standard" analyses of monetary policy shocks on aggregate variables, the framework was also used to measure the impact of monetary policy shocks on the asset quality of the banking sector and the impact of asset quality shocks on the monetary policy shocks using the causality test. This is similar to sensitivity analysis in macro prudential stress-testing exercises. However, the framework also traces the impact of a given shock all variables that can affect asset quality of banking sector. For example, in the framework, maximum lending is affected by treasury rate shocks directly and indirectly via its impact on volatility of the independent and the dependent variables. The study conclude that volatility of prime lending rate and monetary policy rate significantly determine asset quality of commercial banks, the volatility of treasury bill rate, reserve requirement and maximum lending rate has no significant impact on asset quality.

RECOMMENDATIONS

1. Micro and macro prudential policies should be formulated to manage asset quality of commercial banks and prime lending rate and monetary policy rate should be constantly be examined to watch asset quality.
2. The monetary authorities should examine monetary policy and the effect on asset quality of commercial banks and commercial banks mangers should constantly review the lending policies of commercial banks.

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