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**Monetary Policy and Bank Soundness in Nigeria: A Panel Data Analysis of Capital Adequacy Indicator.**

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**Abstract**

This study examined the effect of monetary policy on Nigeria commercial bank soundness. Cross sectional data were sourced from annual reports of commercial banks and Central Bank of Nigeria Statistical Bulletin. Capital adequacy indicators of commercial banks soundness were used as dependent variables while cash reserve ratios, open market operation rates, monetary policy rate, treasury bills rates and money supply were used as independent variables. Panel data methodology was employed while the fixed effects model was used as estimation technique at 5% level of significance. Fixed effects, random effects and pooled estimates were tested while the Hausman test was used to determine the best fit. Panel unit roots and panel cointegration analysis were conducted on the study. Findings of the study proved that cash reserve ratio have positive but insignificant relationship with capital adequacy indicators of commercial bank soundness. Open market operations had positive and no significant relationship with capital adequacy indicators. Monetary policy rate has positive and no significant relationship with capital adequacy indicator. Treasury bills rates have positive and have no significant relationship with capital adequacy indicators. Monetary policy rates have positive but insignificant relationship with capital adequacy indicators. Money supply has positive and no significant relationship with capital adequacy indicators. The study concluded that cash reserve ratio, open market operations rates, treasury bills rates and monetary policy rates have no significant relationship with capital adequacy. From the findings we recommend that Central Bank of Nigeria should intensify the use money supply as a veritable effective monetary policy tool to achieve bank soundness in Nigeria. Furthermore, Central Bank of Nigeria should redefine these monetary policy instruments such as open market operation to make them more attractive to the banks, moderate cash reserve ratio as a tool for regulating commercial banks operation.

**Keywords:** *Monetary Policy, Bank Soundness, Capital Adequacy Indicator, monetary policy rate, Treasury bill rate.*

**Introduction**

The opinion that monetary policy shocks can affect banking system soundness can be traced to the great depression of 1930s which was blamed on cumulative decrease in monetary multiplier. Monetary economists such as Milton Freedman and Irvin Fisher recognized the potential effect of monetary policy on the aggregate economic activities. Commercial banks are the transmission mechanism for monetary policy. The Banks and Other Financial Institution Act (BOFIA) 1991 as amended empowered commercial banks with the monetary function of intermediating between the surplus and deficit economic units to bridge the financial disequilibrium that exist among the economic agents while the Central Bank Decree of 1969 empowered CBN with the monetary policy function to ensure financial system soundness and achieve set macroeconomic goals. Managing bank soundness in a volatile monetary environment poses unique challenges as the relationship between monetary policy and banking system soundness has received increasing attention after the Asian financial crises.

The concept of banking fragility dates back to Fisher (1933) and Keynes (1936), who theorized that the debt financing of investment can have destabilizing effects. Both economists' writings were motivated by their personal observations of the Great Depression and of numerous banking panics. Banking fragility exist when substantial default of a member of household and banks without necessarily becoming bankrupt occurs and the aggregate profitability of the banking sector decreases significantly which is banking crisis (Toby, 2014). Banking fragility indicators (F.S.I) are statistical measures for monitoring the financial health and soundness of a country's financial sector and its corporate and household counterparts. Bank can be considered sound if the bank is capitally adequate, can withstand monetary and macroeconomic shocks and fall in the composite rate of 1 and 2 as specified by the Federal Deposit Insurance Corporation.

Bank capital is one of the instruments of the regulatory authorities at domestic and international level; the monetary authorities in Nigeria used bank capital as a complementary instrument of monetary policy. The policy framework of the regulatory authority has been for banks to be capitally adequate. For instance, the regulatory authorities in Nigeria have increased bank capital from £12,500 in 1952 to ₦25 billion in 2005. Capital adequacy ratios and earnings are two models of CAMELS; the ratios are used as means of assessing the stability of financial institutions. Capital adequacy ratio refers to the minimum capital that a commercial bank must have in order to comply with Central Bank of Nigeria regulations. It consists of equity capital and declared reserves (Cornett, 2004). The minimum requirement was put in place to ensure that customers are protected when creating financial accounts. The main objective of commercial banks is to maintain higher profitability by maintaining circular and efficient flow of amount of money deposited by the customers and lenders (OgboiandUnuafe, 2013; Gathigia, 2016). The capital adequacy of a bank is rated based upon and not limited to an assessment of level and quality of capital and the overall financial condition of the institution, ability of management to address emerging needs for additional capital, nature, trend, and volume of problem assets, and the adequacy of allowances for loan and lease losses and other valuation reserves and risk exposure represented by off-balance sheet activities (Lucky, 2017).

The economic important of bank is well documented in literature. Inadequate supply of credit to the private sector can constrain the long-run growth prospects for any economy. Such a credit-fragility hypothesis is associated with two aspects of credit growth. First, a plethora of empirical studies provide evidence that rapid credit growth predicts financial crises (Mendoza and Terrones, 2008; Obstfeld and Rogoff, 2010, Jorda et al., 2011; Schularick and Taylor, 2012). Mishkin (2010) argues that the great global recession mainly reflected what is called a credit-driven bubble. Second, an acute slump in domestic credit is also bad for financial stability because it can abruptly suffocate investment and hurt economic activity (Gourinchas and Obstfeld, 2012). A weak banking sector not only jeopardizes the short and long-term sustainability of the economy but can be a source of financial crisis which can result in economic crisis (Vaithelngm, 2015). A fragile banking sector places constraint on the monetary policy in the view of the lender of last resort function of Central Bank of Nigeria, for instance the banking sector crisis of 2009 result in injection of N620 billion into the economy. The fragility of the banking system limits the effectiveness of the monetary policy and monetary transmission mechanism (Toby, 2006). This pro-cyclical effect of commercial banks credit requires that the monetary authorities formulate policies ensure equilibrium credit level in the economy.

A strong, sound and reliable banking sector is a necessary condition for sustained economic growth since a sound financial system will support economic activities by pooling and mobilizing saving for productive use; providing information on potential and existing investments; exerting corporate governance; and facilitating trading, diversification, and risk management. The primary objective of banking regulation as contained in Central Bank of Nigeria Act and Bank and Other Financial Institution Act is to achieve sound banking sector that can effectively transmit monetary policy for the realization of macroeconomic goals. Despite the numerous studies on the effect of monetary policy and banking system soundness, the results remain controversial and inconclusive as some found that monetary policy has no significant effect on financial fragility while others found that financial stability is a linear function of bank procyclicality of bank lending (Toby, 2006; Toby, 2014; Toby, 2008). Again, the variables used in existing literatures are aggregate data from the banking industry; this creates a knowledge gap on the effect of various components of monetary policy and bank soundness indicators. From the above knowledge gap and research problem, this paper intends to examine the extent to which various instruments of monetary policy affect Nigerian bank soundness in Nigeria proxy by capital adequacy.

### **Capital Adequacy**

Capital adequacy is used to assess the financial health of the banking system as it reflects the capacity of this sector to absorb the eventual losses caused by either internal or external factors or even both. Roman and Şargu (2013) noted that bank soundness can be proxy by the ratio of total equity to total assets (TETA) and the ratio of total equity to total debts (TETD). TETA represents the proportion of total assets that are financed by a bank's shareholder while TETD reflects the necessary internal sources that can be used to address default risk. Accordingly, the higher the ratio, the safer a bank is. Therefore, the highest rank is attributed to a bank that has registered the highest score for these indicators. The capital which banks hold with themselves as required by financial regulator is known as minimum capital requirement. Banks exposed to various types of risks while granting loans and advances to various sectors. In order to absorb any losses which banks face from its business, it is imperative that banks should have sufficient capital. If banks have adequate capital, then it can protect its depositors from unforeseen contingencies as well promotes the stability and efficiency of financial systems. Components of Capital Tier I Capital: The elements of Tier I capital includes paid-up capital (ordinary shares), statutory reserves, disclosed free reserves, Perpetual Non-cumulative Preference Shares (PNCPS) subject to laws in force from time to time, Innovative Perpetual Debt Instruments (IPDI) and capital reserves representing surplus arising out of sale proceeds of asset. It is generally referred as the core capital which absorbs losses without a bank required to cease trading and thus provides more of protection to its depositors. Tier II Capital: The elements of Tier II capital include undisclosed reserves, revaluation reserves, general provisions and loss reserves, hybrid capital instruments, subordinated debt and investment reserve account. It is the supplementary capital which absorbs losses in the event of winding up and thus provides lesser degree of protection to its depositors. Tier II items qualify as regulatory capital to the extent that they absorb losses arising from bank's activities. Tier III Capital: This is arranged to meet part of market risk, viz. changes in interest rate, exchange rate, equity prices, and commodity prices. To qualify as Tier III capital, assets must be limited to 250% of a bank's Tier I capital, be unsecured subordinated and have a minimum maturity of 2 years. Capital Adequacy: A Financial Soundness Indicator for Banks. Capital Adequacy Ratio (Car) Capital adequacy ratio is the ratio which protects banks against excess leverage, insolvency and keeps them out of difficulty. It is defined as the ratio of banks capital in relation to its current liabilities and risk weighted

assets. Risk weighted assets is a measure of number of banks assets, adjusted for risks. An appropriate level of capital adequacy ensures that the bank has sufficient capital to expand its business, while at the same time its net worth is enough to absorb any financial downturns without becoming insolvent. It is the ratio which determines banks capacity to meet the time liabilities and other risks such as credit risk, market risk, and operational risk.

### **Monetary Policy**

Monetary policy is defined by the Central Bank of Nigeria (CBN) as a combination of measures designed to regulate supply and cost of money in an economy, in consonance with the level of economic activities. Odufalu, (1994) defined monetary policy as the combination of measures taken by monetary authorities (the CBN and the ministry of Finance) to influence directly or indirectly both the supply of money and credit to the economy and the structure of interest rate for economic growth, price stability and balance of payment equilibrium. Onyido, (1993) sums it up when he said that monetary policy is therefore applied to influence the availability and cost of credit in order to control the money supply policy. He generally describes the action taken by the Central Bank as using tools / instrument at its disposal to influence monetary conditions in particular, the quantity and supply of money in the economic growth. Folawewo and Osinubi (2006) defined monetary policy as a tool designed to control the supply, volume and cost of money in the circulation in line with predicted economic activities. Monetary policy is concerned with discretionary control of money supply by the monetary authorities (Central Bank with Central Government) in order to achieve stated or desired economic goals. Governments try to control the money supply because most governments believe that its rate of growth has an effect on the rate of inflation espoused by the quantity theory of money. Hence monetary policy comprises those government actions designed to influence the behavior of the monetary sector. Monetary Policy is essentially the tool for executing the mandate of monetary and price stability. Monetary policy is essentially a programme of action undertaken by the monetary authorities generally the central bank, to control and regulate the supply of money with the public and the flow of credit with a view to achieving predetermined macroeconomic goals (Dwivedi, 2005) goals of full employment, price stability, external balance and economic growth.

### **Monetary Policy Instruments**

Monetary policy instruments used under indirect control regime have evolved over the years with the monetary authority time-turning than as dictated by trends in the economy especially the overall money aggregates, such major instruments are:

#### **Open Market Operation**

It refers to the purchase and sale of government securities by CBN for the purpose of increasing or reducing the money supply. Open Market Operation expands monetary base, thereby raising the money supply and lowering short term, interest rates. In 2002, the CBN introduced another monetary instrument known as the CBN certificate to compliment the use of government security for conduction of open market operation (CBN Guideline 2002). The CBN certificate is different from other instrument in the sense that, it cannot be discounted. This is to enhance the efficiency of monetary policy actions, given the instability of the only available instrument of Treasury

bill. In terms of impact, the sales and purchase of CBN certificate has the same impact as the sales and purchase of other government securities. The OMO bill have maturity period of 30 to 60 days to be issued on the basis of need based on the Dutch auction system and targeted at the authorized deals only (CBN 2002). Equally, Open Market Operation (OMO) will be conducted weekly in the secondary market, mainly in short term government securities of carrying maturities, or in order to meet the various preferences of participant in the market. OMO will be complimented by reserve requirements and discount window operation including Re-purchase Agreement (REPOS) while discount houses will continue to play the role of principal dealer in the market (CBN Guideline 2002/2003)

### **Monetary Policy Rate**

It refers to the rate CBN lends to deposit money banks in forming its rate as a lender of last resort. It primarily involves changes in the discount rate (for minimum rediscount ratio MRR) and affects the volume of loans to the banks, and to monetary base and expand the money supply, a fall in discount rate reduces the monetary base and reduce the money supply. The CBN facility at which discount loans or discounts are made to banks is called the Discount Window. The MRR is also used to influence the level and direction of other rates determines whether the deposit money bank is adopting a policy of monetary ease or monetary restraint. The MRR is currently fixed at 11.5 percent (Balogun, 2007).

### **Cash Reserve Ratio**

The reserve requirement (or cash reserve ratio) is a central bank regulation that sets the minimum fraction of customer deposits and notes that each commercial bank must hold (rather than lend out) as reserves. These required reserves are normally in the form of cash stored physically in a bank vault (vault cash) or deposits 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 rates by changing the amount of funds available for banks to make loans with. Western central banks rarely alter the reserve requirements because it would cause immediate liquidity problems for banks with low excess reserves; they generally prefer to use open market operations (buying and selling government-issued bonds) to implement their monetary policy (Chodechai, 2004).

## **Theoretical Review**

### **Joseph Schumpeter Theory Financial Fragility**

Joseph Schumpeter (1961) developed a model with a boom-bust cycle which can also lead to a financial crisis. Starting from an equilibrium situation some entrepreneurs start with an innovation (a new technology, a new product, a new organization). A stock of inventions is always available. It is the entrepreneur which selects some of them and triggers economic development, entrepreneurship, which is very close to the Keynesian category of animal spirits (Keynes 1936), plays the key role during an expansion process. According to Schumpeter, capitalist development cannot take place without credit. Credit is created ad hoc (out of nothing) (Schumpeter 1911) by the banking system and gives the entrepreneur the financial power to get the physical inputs to implement the innovation. The essential function of credit in our sense consists in enabling the entrepreneur to withdraw the producers' goods which he needs from their previous

employment, by exercising a demand for them, and thereby to force the economic system into new channels. Schumpeter (1911) Schumpeter then assumes a kind of herding behaviour of firms following the innovative entrepreneurs. The followers imitate the innovation to get some of the extra profits which can be earned in the new market. They are also forced to do so by competition. If they do not follow they will sooner or later be eliminated by the market. Driven by high investment and credit expansion a boom phase develops which at a certain point comes to end and gives way for a contraction. This expansion phase, where firms invest into the new innovation or take credit to reorganize and get more productive is accompanied by a second, often bigger and more visible phenomenon. Prosperity is accompanied by speculation. Companies speculate on the further expansion and increase orders and inventory. Speculation in the narrow sense may occur and lead to a bull market. Private households may take consumption loans, etc. The general expansion also leads companies to increase capacities (without increasing productivity) in anticipation of continuing high demand.

### **Irving Fisher Financial Fragility Theory**

Irving Fisher (1911) is the founder of the modern version of the quantity theory of money which was set out by David Hume and taken over by David Ricardo and almost all classical economists. Fisher argues, following the classical and neoclassical paradigm that in the long run money is neutral and changes of money supply in the end only affect the price level. But what is important here is that changes in the money supply can have deep and destabilizing effects on the economy in the short and medium term. In the short term, money is anything else but neutral. Periods of “transition” from one equilibrium to another after an increase in the supply of money leads to “action and reaction” and “a cycle of ‘prosperity’ and ‘depression (Fisher 1911). Later Milton Friedman (1968) argued in exactly the same way. Also for him, money can become a fundamentally disturbing factor for the real economy. His recommendation was to follow strict monetary targeting as an economic policy rule had the purpose of enforcing the neutrality of money. For the older versions of the classical and neoclassical paradigm we can sum up: In spite of the hypothesis of the long-term neutrality of money the latter can become a fundamentally disturbing factor for the economy. Asset price bubbles and financial crisis are extreme versions of such destructive disturbances created in the monetary sphere.

### **Asymmetry Information Theory of Financial Fragility**

There are two polar views of the nature of financial crises in the literature. Monetarists beginning with Friedman and Schwartz (1963) have associated financial crises with banking panics. They stress the importance of banking panics because they view them as a major source of contractions in the money supply which, in turn, had led to severe contractions in aggregate economic activity in the United States. Their view of financial crisis leads monetarists to advocate a lender-of-last-resort role for the central bank, so that banking panics and the subsequent monetary instability will be prevented. Events in which there is a sharp drop in wealth but no potential for a banking panic and a resulting sharp decline in the money supply are not seen by monetarists as real financial crises that require any central bank intervention. Indeed, Schwartz (1986) characterizes these situations as pseudo financial crises.

### **Commercial Loan Theory**

The essence of the theory is that short term loans are preferred by commercial banks as they will be repaid from the proceeds of transactions they facilitate and finance. A proposition that has been immensely subjected to criticism Dodds (1982) and Nwankwo (1992). Its antagonists argue that the theory is a deterrent to economic development especially for developing countries like Nigeria that require huge long-term funds to provide a big push for development. The commercial loan or the real bills doctrine theory states that a commercial bank should finance only short-term self-liquidating productive loans to business organizations. Loans meant to finance the production, and evolution of goods through the successive phases of production, storage, transportation, and distribution are considered as self-liquidating loans. This theory also states that whenever commercial banks make short term self-liquidating productive loans, the central bank should lend to the banks on the security of such short-term loans. This principle assures that the appropriate degree of liquidity for each bank and appropriate money supply for the whole economy. The central bank was expected to increase or erase bank reserves by rediscounting approved loans. When business started growing and the requirements of trade increased, banks were able to capture additional reserves by rediscounting bills with the central banks. When business went down and the requirements of trade declined, the volume of rediscounting of bills would fall, the supply of bank reserves and the amount of bank credit and money would also contract.

### **Empirical Review**

Toby (2014) examined financial fragility and performance of Nigerian banking institutions. The study analyzes how balance sheet problems in the form of non-performing loans affect the liquidity, funding and profitability of selected Nigerian banks in two critical periods, the bank distress era (1999-2001) and the post- consolidation era (2007-2009). The data for this study were computed from the balance sheets of twenty-two universal banks in the first period, and twenty-two consolidated Deposit Money Banks in the second period. Three multiple regression models were estimated at the 5% level of significance. In the bank distress era (1999-2001), an average NPL ratio of 21.1% was accompanied by a Loan-to-Deposit Ratio (LTDR) of 53.9%, below the prudential maximum of 80.0%. However, in the post-consolidation era, the average NPL ratio fell drastically to 7.1% with an accompanying LTDR of 57.7%, still below the prudential maximum. The inferential results show that the explanatory powers of non-performing loans (NPLs) and Loan Loss Reserves (LLR) are high in causing variations in Loan-to-Total Assets (LTA) during the bank distress era (1999-2001). The deteriorating asset quality in the bank distress era constrained significantly bank liquidity, funding growth and profitability. In the post-consolidation era, the pursuit of consolidation and risk-based supervision (RBS) moderated NPLs without a corresponding impact on liquidity and funding growth (LTDR). Heavier regulation in the post-consolidation era must aim at keeping the banks safe, profitable and relevant, and not merely becoming a stringent response to market failures and cumulative risk concentrations. Erari, Salim, SyafieIdrus and Djumahir (2013) applied three different models such as; CAMEL, Z-score and Bankometer in assessing financial performance of P.T Bank Papua covering the period 2003-2011. Their study revealed that both CAMEL and Bankometer have showed same assessment in determining financial position but Altman's Z-score model has reversely put Papua banking industry into gray zone. This study also implied that Z-score model is not suitable for evaluation of banking industry having some limitations. However, the

study concluded that Z-score model provides early indication about bankruptcy in assessing financial performance and based on the results of above mentioned three models; Bank Papua's profitability is good. Makkar & Singh (2012) examined the solvency of 37 Indian commercial banks covering the period of 2006-07 and 2010- 11 using the Bankometer model. They checked whether analyzing the vulnerability of financial distress on the banks is better than the conventional methods like CAMELS and CLSA Stress test. The study found that all the Indian banks are financially solvent and also showed that private sector banks are financially more sound than public sector banks. This study also revealed some unperformed banks and concluded that Bankometer model will assist internal management in avoiding insolvency issues. Ivica, Maja & Bruno (2011) carried out a study to assess companies' bankruptcy using statistical tools from Croatia's commercial banks. Exactly 78 Bankrupt Companies and 78 healthy companies were sampled and statistical model of DA and LR were used. DA model has 79% accuracy in bankruptcy predication while LR model is more robust. Rahman (2017) examined the soundness of twenty- four selected private banks in Bangladesh using the Bankometer model to measure the health status of selected banks from 2010 to 2015. The study revealed that all selected banks were sound individually and the financial system was in a favorable position during period under review. Igan and Tamirisa's (2009) analyzed credit growth in the Baltics and Central and East European countries revealed that bank profitability, measured by net interest margins, was a significant driver of private sector credit expansion. Iossifov and Khamis (2009) empirical finding, on credit growth in the Sub-Sahara African countries from 1997-2007, suggest that bank credit to the private sector was mainly driven by GDP per capita, the nominal interest rate, the money multiplier and credit extension of foreign banks to local banks.

Guo and Stepanyan (2011) examined changes in bank credit across 38 emerging market economies. Analyzing both pre-crisis and post-crisis periods, authors find that domestic deposits and non-residents liabilities contribute positively and symmetrically to credit growth. Furthermore, they stress that loose monetary conditions result in higher credit growth rates. Their results also indicate that stronger GDP growth leads to higher credit growth and high inflation, while increasing the nominal credit decreases the real credit growth. Finally, they highlight that a banking sector with a healthy balance sheet and lower NPLs is desirable for credit growth. Rosenberg and Tirpák (2019) examined the determinants of foreign currency lending in new EU member states of the CEE and find significant positive relations with the share of foreign deposits and the interest rate differential (difference between domestic and foreign currency interest rates). On the other hand, they conclude that foreign currency borrowing is negatively affected by net foreign assets of the banks, exchange rate volatility and regulatory measures that discourage borrowing in foreign currency. Albulescu (2019) evaluated two equations through OLS. The growth rate of credit granted in domestic currency and of those denominated in foreign currency serves as dependent variable, respectively, for Romania. In the first equation, the author finds that credit growth rate is linked positively with economic growth, deposits in domestic currency growth and unemployment rate, but negatively with net wages growth and interest rates. In the second equation, foreign currency credit dynamics are explained by net wages and foreign currency deposits. The ratio of foreign currency credit to deposit is an important factor, negatively related to growth rates of foreign currency credit. Vika (2019) through the GMM method, identifies several factors that affect total credit to private sector and credit denominated in domestic currency 'Albanian lek' (during 2004-2016), finding positive correlation of the dependent variable with NEER, GDP, liquidity of the banking



system and the interaction term between monetary policy indicator and liquidity (although the last two factors are statistically insignificant). On the other side, the relation is negative with the repurchase agreement rate (REPO), size of banks and interaction term between monetary policy and size (in contrast to expectations for a positive sign of the last two variables). Kahn and Santos (2013) the term fragility stems from the interconnection's banks establish to protect themselves from liquidity shocks. It is argued that since mutual insurance appears to be privately advantageous under the assumption that aggregate shocks are a zero-probability event, banks may be indifferent between arrangements leading to varying degrees of fragility should the zero probability events actually materialize (Allen and Gale, 2010). Diamond and Rajan (2001) provided a modification of the model of banks in which banks decide on the correct degree of mutual insurance. On the other hand, when it comes to the role of financial institutions in the payments system, such flexibility is not available.

### Methodology

This study adopted quasi-experimental research design to examine the relationship between monetary policy and commercial banks capital adequacy in Nigeria. The data was panel time series collected from the Central Bank of Nigeria statistical bulletin and financial statement of commercial banks in Nigeria.

### Model Specification

The following models are specified to achieve the objectives of this study:

$$CBI = \beta_0 + \beta_1 CRR + \beta_2 OMO + \beta_3 MPR + \beta_4 TBR + \beta_5 MS + \varepsilon_i \quad 1$$

#### Where:

CBI = Capital adequacy indicator of bank soundness

CRR = Cash reserve ratio

OMO = Open market operation

TBR = Treasury bill rate

MPR = Monetary policy rate

MS = Money supply proxy by growth of M2

$\beta_0$  = Regression Intercept

$\beta_1 - \beta_5$  = Coefficient of the Independent to the Dependent Variables

**Table 1: Variables and A-priori Expectations**

Variable	Measurement	Notation	Expected relationship
Capital adequacy indicator	Tier 1 plus tier 2 to total risk weight assets	CBI	Dependent variable
Cash reserve ratio	minimum fraction of customer deposits that each commercial bank must hold	CRR	+
Open market operation	Monetary value of money market instrument hold by commercial banks to total bank assets	OMO	+
Monetary policy rate	The rate CBN lends to deposit money banks	MPR	+
Treasury bill rate	The rate which CBN sells and discount treasury bills to commercial Banks	TBR	+
Money supply	Growth rate of broad money supply	MS	+

**Techniques of Data Analysis**

The study adopts the panel data method of data analyses which involve the fixed effect, the random effect and the Hausman Test. The technique used in this study is the Ordinary Least Square (OLS) estimation technique. The test instruments in the OLS are the T-statistics and F-test which were used to test the significance of variables and the overall significance of the regression respectively. Other test instruments also employed were the Durbin Watson test which was used to test the presence or absence of auto correlation between and among the explanatory variables and the adjusted R square used to test the percentage variation of the dependent and the independent variables. To achieve the stated objective, the collected time series data will be analyzed using descriptive statistics, correlation matrix and multiple linear regression analysis. The descriptive statistics (Mean values and standard deviations) will be used to analyze the general trends of the data from 2009-2018 based on the sample of 14 commercial banks. The rationale for choosing OLS is that, if the Classical Linear Regression Model (CLRM) assumptions 5 hold true, then the estimators determined by OLS will have a number of desirable properties, and are known as Best Linear Unbiased Estimators (Brooks 2008). In addition, as noted in Petra (2007) OLS outperforms the other estimators when the following holds; the cross section is small- and the-time dimension is short.

- (i) Coefficient of Determination ( $r^2$ ) Test – this measures the explanatory power of the independent variables on the dependent variables. For example, to determine the effect of monetary policy on commercial bank soundness, we used the coefficient of determination. The coefficient of determination varies between 0.0 and 1.0. A coefficient of determination says 0.20 means that 20% of changes in the dependent variable is explained by the independent variable(s).

- (ii) F-Test: This measures the overall significance. The extent to which the statistic of the coefficient of determination is statistically significant is measured by the F-test. The F-test can be done using the F-statistic or by the probability estimate. We use the F-statistic estimate for this analysis.
- (iii) Student T-test: measures the individual statistical significance of the estimated independent variables. At 5% level of significance.
- (iv) Durbin Watson Statistics: This measures the colinearity and autocorrelation between the variables in the time series. It is expected that a ratio of close to 2.00 is not auto correlated while ratio above 2.00 assumed the presence of autocorrelation.
- (v) Regression coefficient: This measures the extent in which the predictor variables affect the dependent variables in the study.
- (vi) Probability ratio: It measures also the extent in which the predictor variables can explain change to the dependent variables given a percentage level of significant.

**Pooled Regression (OLS) Model (PRM):** is equally known as the constant coefficient model (CCM). It is the simplest among the three models in panel data analysis. However, it disregards the space and the time dimensions of the pooled data. In a situation where there is neither significant cross-section unit nor significant temporal effects, one could pool all of the data and run an ordinary least squares (OLS) regression model.

**Fixed Effects (FE) Model:** in the FE technique, the slope coefficients, are constant but the intercept, varies across space i.e. the intercept in the regression model is allowed to vary across space (individuals). This is as a result of the fact that each cross-sectional unit may have some special characteristics. The FE technique is very suitable in cases where the individual specific intercept may be correlated with one or more regressors (independent variables). In order to take into cognizance of different intercepts, the mean differencing or dummy method is usually employed based on which is found more suitable. It is known as the least-squares dummy variable (LSDV) model in cases where dummy variables are used. This is another way of calculating within estimate, most especially when the number of observations ( $N$ ) is not relatively large. The major disadvantage of the LSDV model is that it significantly reduces the degrees of freedom when the number of cross-sectional units,  $N$ , is very large. In this case,  $N$  number of dummies is introduced, which will help to reduce the common intercept term. We stipulated that the error term should be independently and normally distributed with zero mean and constant variance and more importantly must not correlate with the independent variables pooled OLS linear regression is given as follows:

$$Y_{it} = \beta_0 + \beta_1 X_{1it} + \beta_2 X_{2it} + \beta_3 X_{4it} + \beta_4 X_{5it} + U_{it} \quad 2$$

Where  $Y_{it}$  is the dependent variable;  $\beta_0$  is a constant term;  $X_1$ , to  $X_4$ , are the independent variables;  $\beta_1$  to  $\beta_4$  are slope parameters;  $i \dots n$  refer to the cross-sectional units and  $t$  is the time period.

**Random Effect (RE) Model:** the RE technique which is equally known as the Error Components Model (ECM) is an alternative to FE technique. Basically, the RE estimator assumes that the intercept of an individual unit is a random component that is drawn from a larger population with a constant mean value. The individual intercept is then expressed as a deviation from this constant mean value. One major merit of the RE over the FE is that it is economical (parsimonious) in degrees of freedom. This is because one does not have to estimate  $N$  cross-sectional intercepts but just only the mean value of the intercept and its variance. The RE technique is suitable in cases where the (random) intercept of each cross-sectional unit is uncorrelated with the regressors. Since there is no significant correlation between the unobserved units of observation, specific random effects and the regressors, the RE model may be more appropriate. In our

case, this leads to the assumption that they  $\alpha_i$  are random factors, independently and identically distributed over individuals. Thus we write the random effects model as

$$y_{it} = \mu + x_{it}\beta + x_{it}\beta + \alpha_i + \varepsilon_{it} \quad 3$$

Where  $\alpha_i + \varepsilon_{it}$  is treated as an error term consisting of two components: an individual specific component, which does not vary over time, and a remainder component, which is assumed to be uncorrelated over time.

### **Estimation Techniques**

#### **Panel Unit-Root Tests**

Recent literature suggests that panel-based unit root test have higher power than unit root test based on individual time series, see Levin, Lin and Chu(2002), Im, Persaran and Shin(2003), and Breitung(2000) to mention a few of popular test purchasing power parity (PPP) and growth convergence in macro panels using country data over time. This research focus on five type of panel unit root test such as Levin, Lin and Chu(2002), Breitung(2000), Im, Pesaran and Shin(2003), Fisher-Type test using ADF and PP-test (Maddala and Wu(1999) and Choi(2001)), Hadri(1999).

#### **Panel Cointegration Test**

Kao (1999) uses both DF and ADF to test for cointegration in panel as well as this test similar to the standard approach adopted in the EG-step procedures. Also, this test start with the panel regression model as set out.

## Results and Discussions

**Table 2: The effect of Monetary Policy on Capital Adequacy Indicators of Commercial Banks in Nigeria**

Variable	Coefficient	Std. Error	t-Statistic	Prob.
<b>Fixed Effect Regression Model</b>				
CRR	0.172570	0.169510	1.018046	0.3108
M2	0.048350	0.054920	0.880373	0.3805
OMO	0.045071	0.104713	0.430423	0.6677
MPR	0.095118	0.178569	0.532669	0.5953
TBR	0.019276	0.120813	0.159553	0.8735
C	13.10715	3.937770	3.328572	0.0012
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	0.593331	Mean dependent var		18.91400
Adjusted R-squared	0.530227	S.D. dependent var		4.384490
S.E. of regression	3.005128	Akaike info criterion		5.168314
Sum squared resid	1047.572	Schwarz criterion		5.577205
Log likelihood	-329.8612	Hannan-Quinn criter.		5.334476
F-statistic	9.402465	Durbin-Watson stat		1.397629
Prob(F-statistic)	0.000000			
<b>Random Effect Regression Model</b>				
CRR	0.172814	0.169504	1.019523	0.3099
M2	0.048370	0.054915	0.880825	0.3801
OMO	0.044747	0.104666	0.427526	0.6697
MPR	0.093600	0.178493	0.524393	0.6009
TBR	0.019073	0.120812	0.157870	0.8748
C	13.15282	4.036391	3.258559	0.0014
Effects Specification				
Cross-section random			S.D.	Rho
Idiosyncratic random			3.361857	0.5559
			3.005128	0.4441
Weighted Statistics				
R-squared	0.341334	Mean dependent var		5.231207
Adjusted R-squared	0.204177	S.D. dependent var		3.017087
S.E. of regression	2.998221	Sum squared resid		1159.623
F-statistic	1.112402	Durbin-Watson stat		1.239421
Prob(F-statistic)	0.047041			
Unweighted Statistics				
R-squared	0.317951	Mean dependent var		18.91400
Sum squared resid	2529.742	Durbin-Watson stat		0.585429
<b>Hausman Test of the Models</b>				
Model 1	12.574942	5	0.0257	Accept alternate Fixed effect model

Source: computed from E-view 9.0

From the result in Table 2, cash reserve ratio has a positive and highly not significant relationship with the capital adequacy indicators of the commercial banks. The results of the two different estimators (the random and the fixed effect models) also give consistent results that are all significant at 5 percent level. Money supply also has a positive and no significant relationship with the capital adequacy of the commercial banks within the periods covered in this study. The table shows that the two estimation models also offer similar results and same levels of significance for the size coefficients. The money supply coefficient is not also significant at 1percent level under the random effects and fixed effects estimation models. Omo still shows a positive non-significance relationship with the capital adequacy of the commercial banks within the periods covered in this study as shown by the fixed effects and random effects models and also not significant at 1 percent level under the Panel Least Square regression model. Furthermore, Treasury bill rate and monetary policy rate have positive but not significant relationship with capital adequacy indicators of the commercial banks.

The adjusted  $R^2$  (**R-squared**) is satisfactory and ranges from 0.530227 and 0.204177 which indicates that more than 53 percent and 20.4 percent of the variations in the capital adequacy indicators of the commercial banks have been explained by the variation in the Nigeria monetary policy variables as modeled in the regression model. The **F-statistics** (Fisher statistics which is a measure of the overall goodness of fit of regression) of 9.402465 and 1.112402 for both the Fixed effects and Random models, however, the prob (F-statistics) of 0.000000 and 0.047041 are highly significant for Capital adequacy indicator of commercial bank soundness, which implies that the regression model fitted the data, therefore there is goodness of fit. The rule of thumb for Log Likelihood criteria is that it must be very low in value; therefore, from the observed value above of -329.8612 in our model, it means that the model has performed well and is very reliable. Akaike Info Criterion and Schwarz Criterion were also evaluated from the regression results above. The rule of thumb here is that it must be very low. The observed figures in the table above are very low in value and therefore means the model has strong forecasting power.

**D-W** statistics also showed significant values. The value of the DW statistics which ranges from 1.397629 to 1.239421 further indicates that the regression equation is free from the problem of autocorrelation. Hence, the results can be relied upon to make meaningful inferences. From the analysis above, we undertake test of panel unit root in the table below.

**Table 3: Test of Unit Root**

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
<b>Series: D(CBI)</b>				
Levin, Lin & Chu t*	-6.81702	0.0000	14	98
Im, Pesaran and Shin W-stat	-2.98509	0.0014	14	98
ADF - Fisher Chi-square	60.0767	0.0004	14	98
PP - Fisher Chi-square	116.634	0.0000	14	112
<b>Series: CRR</b>				
Levin, Lin & Chu t*	-18.2336	0.0000	11	88
Im, Pesaran and Shin W-stat	-14.5913	0.0000	11	88
ADF - Fisher Chi-square	167.673	0.0000	11	88
PP - Fisher Chi-square	258.408	0.0000	11	99
<b>Series: D(M2)</b>				
Levin, Lin & Chu t*	-5.56776	0.0000	14	98
Im, Pesaran and Shin W-stat	-2.88844	0.0019	14	98
ADF - Fisher Chi-square	57.6057	0.0008	14	98
PP - Fisher Chi-square	313.063	0.0000	14	112
<b>Series: D(MPR)</b>				
Levin, Lin & Chu t*	-6.02873	0.0000	14	98
Im, Pesaran and Shin W-stat	-2.24376	0.0124	14	98
ADF - Fisher Chi-square	49.1869	0.0080	14	98
PP - Fisher Chi-square	85.2379	0.0000	14	112
<b>Series: D(OMO)</b>				
Levin, Lin & Chu t*	-7.23939	0.0000	14	98
Im, Pesaran and Shin W-stat	-2.15623	0.0155	14	98
ADF - Fisher Chi-square	48.0189	0.0107	14	98
PP - Fisher Chi-square	159.523	0.0000	14	112
<b>Series: D(TBR)</b>				
Levin, Lin & Chu t*	-18.6355	0.0000	14	98
Im, Pesaran and Shin W-stat	-6.81131	0.0000	14	98
ADF - Fisher Chi-square	108.918	0.0000	14	98
PP - Fisher Chi-square	60.5753	0.0003	14	112

Source: computed from E-view 9.0

As a starting point of panel stationarity analysis, we employ the first-generation panel unit root tests which allow for cross-sectional independence between variables. As displayed in Table 4.3 the results suggest that the monetary policy and commercial bank soundness null hypothesis should be rejected by all the first-generation tests (LLC, IPS, ADF and PP Fisher).

Furthermore, the results of the panel unit root tests confirm that the variables are stationary at level. Table 3 presents the results of the tests at first difference for IPS test in constant and constant plus time trend. We can see that for all series the null hypothesis of unit root test is rejected at both one percent and five percent levels of significance. Hence, based on IPS test, there is strong evidence that all the series are in fact integrated of orders one. We can conclude that the results of panel unit root test (IPS test) reported support the hypothesis of a unit root in all variables across among the variables, as well as the hypothesis of zero order integration in first differences. Even at one percent significance level, we found that all tests statistics in both with and without trends significantly confirm that all series strongly reject the unit root null. Given the result of IPS test, it is possible to apply panel cointegration method in order to test for the existence of the stable long–run relation among the variables.

**Table 4: Panel Cointegration Test**

Alternative hypothesis: common AR coeffs. (within-dimension)

	<u>Statistic</u>	<u>Prob.</u>	<u>Weighted Statistic</u>	<u>Prob.</u>
Panel v-Statistic	-5.140551	0.0030	-2.260859	0.0481
Panel rho-Statistic	3.776564	0.0419	3.656993	0.0399
Panel PP-Statistic	-6.674640	0.0200	3.622896	0.0333
Panel ADF-Statistic	6.350032	0.0015	2.738654	0.0469
Alternative hypothesis: individual AR coeffs. (between-dimension)				
	<u>Statistic</u>	<u>Prob.</u>		
Group rho-Statistic	5.528640	0.0000		
Group PP-Statistic	4.935520	0.8252		
Group ADF-Statistic	4.059837	0.0000		

Source: computed from E-view 9.0

The next step is to test whether the variables are cointegrated using Pedroni’s (1999, 2001, 2004). This is to investigate whether long–run steady state or cointegration exist among the variables and to confirm what Coiteux and Olivier (2000) state that the panel cointegration tests have much higher testing power than conventional cointegration test. Since the variables are found to be integrated in the same order I (1), we continue with the panel cointegration tests proposed by Pedroni (1999, 2004). Cointegrations are carried out for constant and constant plus time trend and the summary of the results of cointegrations analyses are presented in table 4. In constant level, we found that the seven statistics reject null hypothesis of no cointegration at the five percent level of significance for the ADF statistic and group  $\rho$  –statistic, while the group –ADF is significant at one percent level.



**Table 5: Pairwise Granger Causality Tests**

Null Hypothesis:	Obs	F-Statistic	Prob.
CRR does not Granger Cause CBI	101	4.12596	0.0191
CBI does not Granger Cause CRR		1.40633	0.2500
M2 does not Granger Cause CBI	112	3.91486	0.0229
CBI does not Granger Cause M2		0.66493	0.5164
MPR does not Granger Cause CBI	112	0.57554	0.5641
CBI does not Granger Cause MPR		0.13610	0.8729
OMO does not Granger Cause CBI	112	1.29477	0.2782
CBI does not Granger Cause OMO		4.46553	0.0137
TBR does not Granger Cause CBI	112	3.51466	0.0332
CBI does not Granger Cause TBR		1.42915	0.2440

Source: computed from E-view 9.0

As summarized in table 5, a unidirectional causal relationship has been found between cash reserve ratio and capital adequacy indicator of the commercial banks which is significant at 5 percent probability, because the p-value is  $< 0.05$ . A unidirectional causal relationship has been found between money supply and capital adequacy indicator of the commercial banks which is significant at 5 percent probability, because the p-value is  $< 0.05$ . A unidirectional causal relationship has been found between capital adequacy ratio and open market of the commercial banks which is significant at 5 percent probability, because the p-value is  $< 0.05$ . A unidirectional causal relationship has been found between treasury bill rate and capital adequacy indicator of the commercial banks which is significant at 5 percent probability, because the p-value is  $< 0.05$ .

### Discussion of Findings

Cash reserve ratio was predicted not to have any significant relationship with commercial bank soundness in Nigeria. However, from the regression results, the coefficients of cash reserve ratio, though as expected is positively correlated with capital adequacy. This implies that a unit increase on cash reserve ratio will not significantly increase commercial banks indicators of capital adequacy indicator. The positive effect of cash reserve ratio on capital adequacy indicator confirms our a-priori expectation of the study and the objective of monetary policy. It also confirms the operational objective of bank regulation as contained in Central Bank of Nigeria Act 1959 as amended. The Central Bank of Nigeria Act 1959 as amended empowered the Central Bank with the regulatory function on the commercial banks. Over the years cash reserve ratio has been varied with the objective of achieving set goals such as ensuring that the commercial banks are liquid to avoid over trading that can lead to bank failure. The positive effect of the variables confirms liquidity theories such as the real bill doctrine. The commercial loan or the real bills doctrine theory states that a commercial bank should finance only short-term self-liquidating productive loans to business organizations. Loans meant to finance the production, and evolution of

goods through the successive phases of production, storage, transportation, and distribution are considered as self-liquidating loans. 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 includes 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 on the commercial banks management and therefore does not impact positively to the performance of commercial banks. The positive effect of cash reserve ratio confirms the empirical findings of Akanbi & Ajagbe (2012) that net profit, liquidity ratio, cash ratio and interest rate on savings have positive impact on profitability of selected banks which confirms to the prior expectation. Akomolafe, Danladi, Babalola & Abah (2015) that there is a positive relationship between banks profits and monetary policies as proxied by money supply and interest rate. And the findings of Amidu & Wolfe (2008) that Ghanaian banks' lending behavior is affected significantly by the country's economic support and change in money supply.

Open market operation was predicted not to have any significant relationship with commercial bank soundness in Nigeria. However, from the regression results, the coefficients of open market as expected is positive and have no significant relationship with capital adequacy. This implies that a unit increase on open market operation will not significantly increase commercial banks capital adequacy indicator of commercial banks soundness. The positive effect of open market operation on capital adequacy indicator and assets quality confirm our a-priori expectation of the study and the objective of monetary. It also confirms the operational objective of bank regulation as contained in Central Bank of Nigeria Act 1959 as amended. The Central Bank of Nigeria Act 1959 as amended empowered the Central Bank with the regulatory function on the commercial banks. The positive effect of the variables also confirms liquidity theories such as the real bill doctrine. The positive effect of open market operation confirms the empirical findings of Akanbi & Ajagbe (2012) that net profit, liquidity ratio, cash ratio and interest rate on savings have positive impact on profitability of selected banks which confirms to the prior expectation. Akomolafe, Danladi, Babalola & Abah (2015) that there is a positive relationship between banks profits and monetary policies as proxied by money supply and interest rate. Akomolafe, Danladi, Babalola & Abah (2015) that there is a positive relationship between banks profits and monetary policies as proxied by money supply and interest rate. And the findings of Amidu & Wolfe (2008) that Ghanaian banks' lending behaviour is affected significantly by the country's economic support and change in money supply.

The coefficients of monetary policy rate as expected is positive and have no significant relationship with capital adequacy. This implies that a unit increase on monetary policy rate will not significantly increase commercial banks capital adequacy indicator of commercial banks soundness. The positive effect of monetary policy rate on capital adequacy indicator confirms our a-priori expectation of the study and the objective of monetary. The positive effect of monetary policy rate on commercial bank soundness contradict the findings of Ndugbu & Okere (2015) that amongst all the monetary policy variables (bank deposit rate, bank lending rate, cash reserve ratio and

liquidity ration) considered in the model, only bank deposit rate has significant relationship though inverse relationship. Obidike, Ejeh & Ugwuegbe (2015) that interest rate spread, negatively and significantly impact on bank performance in the long-run. Ogbulu and Torbira (2012) showed that of the variance decomposition of BKA to shock emanating from CRR, MRR and MNS show that own shocks remain the dominants source of total variations in the forecast error of variables. The coefficients of Treasury bill rate as expected is positive and have no significant relationship with capital adequacy indicator of commercial banks soundness within the periods covered in this study. This implies that variation on Treasury bill rate will not significantly increase commercial banks soundness indicators. Again, the positive effect of treasury bill rate on capital adequacy indicator confirm our a-priori expectation of the study and the objective of monetary. Furthermore, the coefficients of money supply are positive and have no significant relationship with capital adequacy. This implies that a variation in money supply will not significantly increase commercial banks capital adequacy indicator of commercial banks soundness. The positive effect of money supply on capital adequacy indicator confirms our a-priori expectation of the study and the objective of monetary.

### **Conclusion**

Specifically, the study concluded that cash reserve ratio has no significant relationship with capital adequacy ratio, Furthermore, the study concluded that open market operation has no significant relationship with capital adequacy indicator of commercial bank soundness in Nigeria within the periods covered in this study. The study also concluded that Treasury bill rate have no significant relationship with capital adequacy indicators. However, money supply showed no significant impact on capital indicators of commercial bank soundness.

### **Recommendations**

1. The Central Bank of Nigeria should redefine these monetary policy instruments such as open market operation to make them more attractive to the banks. This will make banks to embrace them beyond mere coercion. Banks in Nigeria should avail themselves of the additional benefit of soundness enhancement component of minimum rediscount rate for better implementation.
2. Central Bank of Nigeria (CBN) should moderate cash reserve ratio as a tool for regulating commercial banks operation. Again there is need to modify the monetary policy instruments to reflect and respond more rapidly and easily to Nigeria commercial banks soundness. The Central Bank of Nigeria (CBN) should adjust the monetary policy rate by reducing the cash reserve ratio which will increase liquidity to enable the commercial banks to discharge their lending and investment duties effectively to the public.
3. The cash reserve ratio should be complementing the Open Market Operations (OMO) in ensuring that excess liquidity or lack of it in the banking system is minimized, that way Money Supply (M2) will be more effective as a tool on measuring other performance indicators. The study recommends that the regulatory authorities should manage the constraint of higher reserve requirements on bank lending.

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