

# Capital Adequacy and Risk Management: A Study of the Nigerian Banking Sector

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## Abstract

Capital adequacy ratio is one of the relevant measures of safety and soundness of a banking institution because it serves as a buffer or cushion for absorbing losses. This paper employed pooled regression analysis model to examine capital adequacy-risk management outcomes of the banks during the 2009-2015 periods. Analysis was based on twelve (12) banks whose selection was guided by convenience criteria. Variables of interest were capital adequacy ratio, risk-weighted assets ratio, deposit asset ratio, and nonperforming loans ratio. Data were extracted from published financial statements of the banks. Pooled least squares (PLS) techniques were used to obtain estimates of parameters of the model, as well as relevant inferential statistics. Results showed that risk management variables exerted differing degrees of negative effects on capital adequacy. Only risk-weighted asset ratio singularly exerted statistically significant at the 5% level. The explanatory variables jointly exerted statistically significant effect on, and were strong in explaining variations in the explained variable. The paper concluded that degree of negative effects of variables differed, and recommended objective-oriented deposit drive by the banks to attract more deposits. Loans should be adequately secured to reduce the incidence of non-performing loans to dampen the negative effects of risk management and, thus, enhance capital adequacy of the banks.

**Keywords:** Capital adequacy, Risk management, Descriptive statistics, Correlations, PLS regression

## 1. Introduction

Capital adequacy ratio is one of the important measures to assess a bank's capital in relation to the risk weighted credit exposures. The Basel Capital Accord is an international standard for the calculation of capital adequacy ratios. The Accord recommends minimum capital adequacy ratios that banks should meet. Applying the ratios guarantees stability and efficiency of the financial system and thus reducing insolvency. Bankruptcy of a bank usually leads to loss of confidence in the financial system, causing financial problems for other banks and perhaps threatening the smooth functioning of financial markets. To forestall illiquidity and insolvency, regulatory authorities endeavour to make banks sound and stronger. Risk management has been an integral part of loan process in banking business. Credit risk is the current and prospective risk to earnings or capital arising from an obligor's failure to meet the terms of any contract with the bank or otherwise to perform as agreed (Kargi, 2011). When banks grant loans, they expect the customers to repay the principal and interest on an agreed date.

A credit facility is said to be performing if payment of both principal and interest are up to date in accordance with agreed repayment terms. Non-performing loans (NPL) represent credits which the banks perceive as possible loss of funds due to loan defaults. They are further classified into substandard, doubtful or lost. Bank credit in lost category hinders bank from

achieving their set targets (Kolapo et al., 2012). Due to increasing spate of non-performing loans (NPL) and its attendant consequences, the World Bank and other international financial institution entered into agreement in December 1987 known as Basel I and II Accord. Both Accords emphasized on the importance of capital adequacy for mitigating credit risk. Capital adequacy in banking business provides protection against sudden financial losses (Greuning & Sonja, 2003). Considering the importance policy makers and industry practitioners place on risk management and capital adequacy as a distress prevention strategy, it is crucial to know whether this optimism is truly warranted. One of the biggest achievements in the Financial Sector in the Nigerian economy has been the upward review of the of the capital base of banks. This has resulted in bigger, stronger and more resilient financial institutions. Capital Adequacy can be percentage ratio of a financial institution's primary capital to its assets (loans and investments), used as a measure of its financial strength and stability. According to Nwokoji (2013), the average Capital Adequacy Ratio (CAR) of the banks in the industry was consistently above the stipulated minimum of 10.0 per cent in the first half of 2012. The industry average CAR stood at 17.7 per cent compared with 17.9 and 5.0 per cent at end-December 2011 and the corresponding period of 2011, respectively.

Based on the buffer theory of capital adequacy and bank lending spread, banks may prefer to hold a buffer of excess capital to reduce the probability of falling under the legal capital requirement especially if their capital adequacy ratio is very volatile (risk). If the amount of buffer banks hold in so far as capital adequacy is concerned relates to choice of portfolio risk, changes in capital adequacy can have implication for portfolio risk. This relationship is not steady because in the presence of limited liability and the fact that banking loans can be socialized, bank shareholders or management may not relate capital adequacy to choice of portfolio risk. The pervasive incidence of non-performing loan is one of the prime causes of failure in the banking system.

For the developing countries, the governments compel banks to raise fresh capital and strengthen their balance sheets. Alternatively, banks are encouraged to shrink the amount of risk assets (loans) on their books. In 2010, world central bankers represented collectively by the Bank of International Settlements (BIS), handed down Basel III-Accord global regulatory framework that, among other things, hikes capital requirements from 4% to at least 7% of a bank's risk-weighted assets (Hanker, 2013). To strengthen the banking sub-sector and deepen the financial sector as a whole, the Central Bank of Nigeria (CBN) increased the minimum required capital base of Nigerian banks to twenty-five billion naira (₦25 billion), beginning from 2006. The move was aimed at making banks to fully discharge the function of financing the real sector of the economy to fruitfully drive economic growth and development process of the country.

From the foregoing, this paper examines capital adequacy in relation to risk management in the Nigeria banks. The driving proposition is that risk management has no significant relationship with capital adequacy of the banks.

## **2. Conceptual Issues, Basel Accords and Theoretical Literature**

### **2.1 Conceptual Issues**

#### **2.1.1 Capital Adequacy Ratio (CAR)**

Capital adequacy ratio (CAR) is a concept that describes the protective measure of a bank against excess leverage and insolvency to hedge business difficulty. It relates a bank's capital to

its current liabilities and risk weighted assets. Risk weighted assets measure the amount of the assets of a bank adjusted for risks. Appropriate level of capital adequacy ensures that a bank has sufficient capital to expand its business; and its net worth is enough to absorb any financial downturns without becoming insolvent. The ratio determines a bank's capacity to meet maturing liabilities and such other risks as credit, market and operational among others. It is computed as the sum of various tiers of capital funds divided by risk weighted assets (RWA). Thus:  $CAR = \frac{\text{Tier I Capital} + \text{Tier II Capital} + \text{Tier III Capital}}{RWA}$ . The Reserve Bank of India (RBI) requires schedule commercial Banks (SCBs) to have a CAR of 9%. This is 1% more than the level stipulated by Basel. The RBI requires public sector banks (PSBs) to keep the ratio at 12%.

### **2.1.2 Capital Adequacy and Banking Risks (CABR)**

It is normal to examine a bank's capital adequacy with reference to value at risk. Capital adequacy stipulates that a bank's capital must match its risks. Risk monitoring and risk measurement are germane because capital is the most scarce and costly resource. The central role of risk-based capital in regulations is a major incentive to the development of new tools and management techniques. Obviously, the most important recent innovation in terms of the modeling 'toolbox' is the value at risk concept for assessing capital requirements. The concept of value at risk is the foundation of risk-based capital. Alternatively, it is economic capital (Bessis, 2002). The methodology aims at valuing potential losses resulting from current risks; relying on simple facts and principles. It recognises that loss over a portfolio of transactions could extend to the entire portfolio. However, it is an event that has a zero probability given the effective portfolio diversification of banks. Hence, measuring potential losses requires some rule to determine the magnitude for a diversified portfolio. Value at risk is the upper bound of losses that should not be exceeded in more than a small fraction of all future outcomes. Management and regulators define benchmarks for the small preset fraction termed the 'confidence level' to measure the appetite for risk of banks. Economic capital is value at risk based on quantified present value of potential future losses. Its relevance is to ensure that a bank has capital sufficient to sustain worst-case losses. Such risk valuation potentially extends to all main risks.

Koehn and Santomero (1980) examined portfolio-capital reaction requirements by considering the effect of capital ratio regulation on portfolio behaviour of commercial banks. The study investigated how increases in minimum capital-asset ratio by supervisory authorities affect portfolio risk of banks. The central assumption was that regulation was intended to reduce portfolio risks, failure potentials and increase stability and viability of banks. The study found that variance in returns increases the probability of failure, and that increase in returns or capital ratio reduces failure risk.

### **2.1.3 Deposit-Asset Ratio (DAR)**

The level at which deposit-insuring agency just breaks-even in guaranteeing deposits of a given bank with premium it pays is considered to be adequate capital to the bank (Yu Min-The, 1996). The author employed option theoretical framework to measure fair capital adequacy holdings for a sample of depository institutions in Taiwan during 1985-1992. Larger capital-asset ratio or capital-deposit ratio signifies safety of deposits. If the value of an institution's assets declines in the future, its' deposits will generally be safer the larger the current value of assets in relation to the value of deposits. Dowd (1999) showed that imposition of minimum capital standards on

financial institutions by regulators is a means of strengthening the safety of deposits and soundness of the banking system. The author also showed that information asymmetry between bank managers and depositors has market failure potential and, thus, serves as a rationale for government intervention in the financial system. Such intervention would take the form of capital adequacy regulation to force banks to maintain a stronger capital position. Similarly, Harold (1999) showed that many regulators and consumers were concerned about the safety of deposit insurance system. The study applied existing bank risk-based capital requirements to current credit union data to measure credit union's risk-based capital strength.

Failure of banks indicates possible conflict among capital adequacy, deposit protection and the perspective of such other stakeholders as equity holders (Stone & Zissu, 1994). Deposit protection schemes are operational in many countries but most do not protect the full value of every depositor's claim. The intention is usually to ensure that depositors bear some responsibility for their actions when a bank liquidates. If the deposits were entirely risk free then a significant group of stakeholders would have no interest in the risks being taken and banks might be tempted to acquiring inappropriate types and levels of risk. Also, users of the products of financial sector of the economy benefit from competition within the sector, and in response banks and other firms seek to optimise business mix. To engender competition within the financial sector, the agents responsible for monitoring capital adequacy give firms the freedom to take risks. On occasions, this means that firms in the financial sector will fail. If this never happened, either the costs to users of banking services would be prohibitive (and/or the range of services themselves extremely limited) or the lender of last resort would effectively be taking all of the risks, but have no influence over which risks it acquired.

#### ***2.1.4 Non-Performing Loans (NPLs)***

The Central Bank of Nigeria (CBN) explains non-performing loans as those whose: (1) Interest or principal is overdue for 90 days or more; and (2) Interest payment equal to 90 days interest or more have been capitalised, rescheduled or rolled over into a new loan. Non-performing facilities are further classified into sub-standard non-performing loan, doubtful non-performing loan and lost non-performing loan. Sub-standard non-performing facilities are those in which unpaid principal or interest remains outstanding for more than 90 days but less than 180 days in respect of which customer shows: (a) inadequate cash flow to service the debt; (b) absence of adequate financial information or collateral documentation; (c) undercapitalisation or insufficient working capital; and (d) irregular payment of principal and/or interest. Doubtful non-performance facilities consist unpaid principal and interest remain outstanding for 180 days but less than 360 days and are not secured by legal title to leased assets or perfected realisable collateral in the course of collection or realisation in respect of which the customer shows, in addition to the weakness associated with substandard loans that full repayment of debt, is not certain or that realisable collateral values will be insufficient to cover bank's exposure. This category of asset requires a 50% provision. Lost non-performing facilities arise when unpaid principal and interest remain outstanding for 360 days or more and are not secured by legal title to leased assets or perfected realized collection in respect of which the customer shows that weakness associated with doubtful credit facilities above and which are considered uncollectible and are of such little value that continuation as bankable assets are unrealistic. The category of non-performing loans is known as losses and bad debts and therefore requires 100% capital cover.

### **2.1.5 Risks in Banking Operations (RBOs)**

The risks usually associated with banking operations include: (1) Credit risks, also known as default risk, and is one of the oldest. It is the most vital form of risks faced by banks as financial intermediaries (Broll, et. al., 2002). It is the potential loss arising from the failure of a borrower to meet its obligations in accordance with agreed terms; (2) Market risks - risk associated with volatility in the market that affects banks' return. It is the risk of loss from adverse movement in financial market rates (interest and exchange rates) and bond, equity or commodity prices. A bank's market risk exposure is determined by both the volatility of underlying risk factors and the sensitivity of the bank's portfolio to movements in those risk factors (Hendricks & Hirtle, 1997); (3) Operational risk - the potential financial loss as a result of breakdown in day-to-day operational processes. It can arise from failure to comply with policies, laws and regulations, and from fraud or forgery (Njogo, 2012). These include direct and indirect laws resulting from inadequacy of internal processes, people and systems or from external event.

### **2.2 Basel Accords (BAs)**

The Basel Committee on Banking Supervision has its origins in the financial market turmoil that followed the breakdown of the Bretton Woods system of managed exchange rates in 1973. After the collapse of Bretton Woods, many banks incurred large foreign currency losses. On 26 June 1974, West Germany's Federal Banking Supervisory Office withdrew Bankhaus Herstatt's banking license after finding that the bank's foreign exchange exposures amounted to three times its capital. Banks outside Germany took heavy losses on their unsettled trades with Herstatt, adding an international dimension to the turmoil. In October the same year, the Franklin National Bank of New York also closed its doors after incurring large foreign exchange losses. In response to these and other disruptions in the international financial markets, the central bank governors of the G-10 countries established a Committee on Banking Regulations and Supervisory Practices at the end of 1974. Later renamed the Basel Committee on Banking Supervision, the Committee was designed as a forum for regular cooperation between its member countries on banking supervisory matters. Its aim is to enhance financial stability by improving supervisory know-how and the quality of banking supervision worldwide.

The Committee seeks to achieve its aims by setting minimum standards for the regulation and supervision of banks, sharing supervisory issues, approaches and techniques to promote common understanding, improve cross-border cooperation and by exchanging information on developments in the banking sector and financial markets to help identify current or emerging risks for the global financial system. To tackle the challenges presented by diversified financial conglomerates, the Committee also works with other standard-setting bodies. The Committee has been meeting three or four times a year since its first meeting in February 1975. From the G-10 as a body, the Committee expanded its membership in 2009 and 2014 to now include 28 jurisdictions. The Committee reports to an oversight body, the Group of Central Bank Governors and Heads of Supervision (GCBGHOS), which comprises central bank governors and non-central bank heads of supervision from member countries. However, decision of the Committee, whose Chairman is Stefan Ingves and Governor of Sveriges Riksbank, Sweden's Central Bank, has no legal force. Rather, the Committee formulates supervisory standards and guidelines and recommends sound practices in the expectation that individual national authorities will implement them. It encourages full, timely and consistent implementation of its standards by members and, in 2012, began monitoring implementation to improve the resilience of the global



banking system, promote public confidence in prudential ratios and encourage a regulatory level-playing field for internationally active banks.

### **2.2.1 Basel I: The Capital Accord (CA)**

Having laid the foundations for supervision of internationally active banks, capital adequacy became the main focus of the Committee's activities. In the early 1980s, the onset of the Latin American debt crisis heightened the Committee's concerns that the capital ratios of the main international banks were deteriorating at a time of growing international risks. Backed by the G-10 Governors, Committee members resolved to halt the erosion of capital standards in their banking systems and to work towards greater convergence in the measurement of capital adequacy. This resulted in a broad consensus on a weighted approach to the measurement of risk, both on and off banks' balance sheets. Strong negotiation ensued within the Committee about the overriding need for a multinational accord to strengthen the stability of the international banking system and to remove a source of competitive inequality arising from differences in national capital requirements. Consequent upon a consultative paper published in December 1987, a capital measurement system commonly referred to as the Basel Capital Accord (1988 Accord) was approved by the G-10 Governors and released to banks in July 1988. The 1988 Accord called for a minimum capital ratio of capital to risk-weighted assets of 8% to be implemented by the end of 1992. Ultimately, the framework was introduced not only in member countries but also in virtually all other countries with active international banks. In September 1993, the Committee issued a statement confirming that banks of the G-10 countries with material international banking business were meeting the minimum requirements set out in the Accord.

The Accord was always intended to evolve over time. It was amended first in November 1991 to give greater precision to the definition of general provisions or general loan-loss reserves that could be included in the capital adequacy calculation. In April 1995, the Committee issued an amendment, effect from end-1995, to recognise the effects of bilateral netting of banks' credit exposures in derivative products and to expand the matrix of add-on factors. In April 1996, another document was issued explaining how Committee members intended to recognize the effects of multilateral netting. The Committee also refined the framework to address risks other than credit risk, which was the focus of the 1988 Accord. In January 1996, following two consultative processes, the Committee issued the so-called Market Risk Amendment to the Capital Accord (or Market Risk Amendment), to take effect at the end of 1997. It was designed to incorporate within the Accord a capital requirement for the market risks arising from banks' exposures to foreign exchange, traded debt securities, equities, commodities and options. An important aspect of the Market Risk Amendment was that banks were, for the first time, allowed to use internal models (value-at-risk models) as a basis for measuring their market risk capital requirements subject to strict quantitative and qualitative standards. Much of the preparatory work for the market risk package was undertaken jointly with securities regulators.

### **2.2.2 Basel II: The NEW Capital Framework (NCF)**

In June 1999, the Committee issued a proposal for a new capital adequacy framework to replace the 1988 Accord. This led to the release of the Revised Capital Framework in June 2004. Generally known as "Basel II", the revised framework comprised three pillars, namely: (i) Minimum Capital Requirements, which sought to develop and expand the standardised rules set out in the 1988 Accord; (ii) Supervisory review of an institution's capital adequacy and internal

assessment process; and (iii) Effective use of disclosure as a lever to strengthen market discipline and encourage sound banking practices. The framework was designed to improve the way regulatory capital requirements reflect underlying risks and to better address the financial innovation that had evolved in recent years. That was to reward and encourage continued improvements in risk measurement and control. The framework in 2004 came after six years of intensive preparation, during which the Committee extensively with banking sector representatives, supervisory agencies, central banks and outside observers in an attempt to develop more significantly risk-sensitive capital requirements. Following the June 2004 release, which focused primarily on the banking book, the Committee turned its attention to the trading book. In close cooperation with the International Organisation of Securities Commissions (IOSC), which is the international body of securities regulators, the Committee published in July 2005 a consensus document governing the treatment of banks' trading books under the new framework. For ease of reference, the new text was integrated with the June 2004 framework in a comprehensive document released in June 2006 to further enhance the Basel II It was tagged International convergence of Capital Measurement and Capital Standards: A Revised Framework.

## **2.3 Theoretical Literature**

### ***2.3.1 Buffer Theory of Capital Adequacy***

The theory is anchored on the volatility of capital adequacy ratio as well as reliability and dependability on capital for long term planning. Further, a bank faces the danger of capital base erosion if it is unable to mobilise sufficient deposits. In that case, the bank may be endangered by capital adequacy ratio volatility. Therefore, the theory postulates that banks may prefer to hold a 'buffer' of excess capital to reduce the probability of falling under the legal capital requirements, especially if their capital adequacy ratio is very volatile. This is to hedge against prolonged undercapitalisation and avoid sanctions and possible closure by the regulatory authorities which consider breach of the capital requirements as a major infringement of banking legislation. The buffer theory by Calem and Rob (1996) predicts that a bank approaching the regulatory minimum capital ratio may have an incentive to boost capital and reduce risk in order to avoid the regulatory costs triggered by a breach of the capital requirements.

### ***2.3.2 Deposit Insurance Theory***

The theory views banks as portfolio of risky claims. It posits that as insured banks increase their risk of failure without limit, there is an expected value transfer of wealth from government deposit Insurance Corporation to bank owners. Regulators are concerned about soundness of the banks particularly with respect to solvency or the probability of bank failure. Thus, regulation of bank risks exposure is necessary to reduce the expected losses incurred by the deposit insurance corporation. The theory provides an insight into the behaviour of commercial banks.

### ***2.3.2 Portfolio Regulation Theory***

The theory explains that regulation of banks is necessary to maintain safety and soundness of the banking system to position it to meet its liabilities without difficulty. By so doing, regulatory authorities ensure solvency and liquidity on individual banks than making it optional. It gauges liquidity position of banks as liquid asset-deposit (LAD) ratio. The higher the ratio, the better the liquidity and solvency of the individual banks. If the asset portfolio is deemed too risky or capital

inadequate, the relevant supervisory agency will attempt to compel a change in the bank’s balance sheet.

### 2.3.3 Expense Theory

This is also known as the theory of managerial discretion. The theory posits that managers have the option in pursuing policies which maximise their own utility rather than profit for shareholders. The central objective is the satisfaction managers derive from certain types of expenditure such as prestige, power and status associated with luxurious buildings/offices, company cars among others.

The theories are relevant in this paper because each relates to capital adequacy and risk management of banks in one way or the other.

## 3. Methodology

Descriptive statistics, correlation and pooled regression analysis based on longitudinal data sets across the banking units were employed in this paper. The paper considered twelve (12) Nigerian banks for the period of seven (7) years 2009 to 2015. The purpose was to examine capital adequacy ratio in relation to risk management in the Nigerian banks. The approach is consistent some previous studies (e.g., Al-Sabbagh, 2004). The twelve (12) out of twenty-one (21) Nigeria were considered on the basis of years of operation in the Nigerian banking industry, annual financial statements publications, data availability and compliance with disclosure guidelines of the Central Bank of Nigeria (CBN). Descriptive statistics were used to examine the mean, minimum and maximum levels as well as the standard deviations of values of the variables during the periods. Correlation analysis was done to check for multicollinearity problem among the risk management variables and, thus, ensure non-spurious regression results. Data were extracted published financial statements of the banks. The data sets were: Dependent Variable - capital adequacy ratio (CAR) and Independent variables - risk-weighted assets ratio (RWAR), deposit-asset ratio (DAR) and non-performing loans ratio (NPLR).

On the aggregate, the regression model was specified as:

$$CAR_{i,t} = \beta_0 + \beta_j \sum_{t=1}^7 RMNB_{i,t} + \mu_{i,t}$$

where  $CAR_{i,t}$  is the capital adequacy ratio of individual bank  $i$  during year  $t$ .

$\sum_{t=1}^7 RMNB_{i,t}$  is the sum of risk management elements in each Nigerian bank  $i$  during year  $t$ , for  $t$  ranging from 1 to 7 years.

On the aggregate, the regression model was specified as:

$$CAR_{i,t} = \beta_0 + \beta_j \sum_{t=1}^7 RMNB_{i,t} + \mu_{i,t}$$

where  $CAR_{i,t}$  is the capital adequacy ratio of individual bank  $i$  during year  $t$ ;  $\beta_0$  is the intercept of the regression line or level of capital adequacy ratio that is non-dependent on the risk management variables;  $\beta_j$  ( $j = 1, 2, 3$ ) is vector of sensitivity coefficients of the risk management variables; and  $\mu_{i,t}$  ( $i = 1, 2, 3, \dots, 12; t = 1, 2, 3, \dots, 7$ ) is vector of the random variables.



Alternatively, the pooled regression model is specified as:

$$CAR_{i,t} = \beta_0 + \beta_1 RWAR_{i,t} + \beta_2 DAR_{i,t} + \beta_3 NPLR_{i,t} + \mu_{i,t}$$

where  $\beta_1$ ,  $\beta_2$  and  $\beta_3$ , respectively, are the sensitivity coefficient of associated risk management variables (RWAR, DAR and NPLR).

For specific effects and hypotheses, the model is disaggregated as follows:

$$CAR_{i,t} = \beta_0 + \beta_1 RWAR_{i,t} + \mu_1 \dots\dots\dots Hypothesis 1 (H_01)$$

$$CAR_{i,t} = \beta_0 + \beta_2 DAR_{i,t} + \mu_2 \dots\dots\dots Hypothesis 2 (H_02)$$

$$CAR_{i,t} = \beta_0 + \beta_3 NPLR_{i,t} + \mu_3 \dots\dots\dots Hypothesis 3 (H_03)$$

The risk management variables were expected to exert significant negative effects on capital adequacy ratio. That is, capital adequacy ratio was expected to dampen in response to increases in the respective risk management components. It was also expected that some level of capital adequacy ratio would subsist when the risk management variables are non-existent. Thus,  $\beta_0 > 0$ ;  $\beta_j (j = 1, 2, 3) < 0$ .

## 4. Results and Discussion

### 4.1 Descriptive Statistics

The descriptive statistics are shown in Table 1, and subsequently discussed.

**Table 1: Descriptive Statistics**

	CAR	RWAR	DAR	NPLR
Mean	23.2491	65.9735	68.1025	8.6312
Maximum	38.9499	118.7853	122.6892	74.7639
Minimum	15.5721	0.07976	4.2468	0.0832
Std. Deviation	7.6431	21.6883	16.3498	8.8889
Observations	84	84	84	84

Source: Author's computation (2016)

As shown in Table 1, mean values of CAR, RWAR, DAR and NPLR during the period were about 23.25%, 65.97%, 68.10 and 8.63% respectively. The average CAR of the banks during the period, 23.25%, exceeded 10% and 15% stipulated by the regulatory authorities. This suggests that the Nigerian banking industry remained strong despite the challenges the sub-sector faced as a result of the global economic meltdown. CAR of the banks posted maximum and minimum values of 38.95% and 15.57%, respectively. However, the standard deviation of the banks' CAR was considerably high at 7.64%. Maximum values of RWAR, DAR and NPLR were about 118.79%, 122.69% and 74.76% respectively, with corresponding minimum values of about 0.08%, 4.25% and 0.08%. The standard deviation of RWAR, 21.69%, suggests that substantial proportions of total assets of the banks were risky assets. That could find explanation in the trade-off between risks and returns such that the banks would always combine asset portfolios in sufficient proportions to guarantee commensurate returns at various levels of risks. The level of standard deviation of DAR, 16.35%, implies that depositors' money were well secured during the period since about 68% of total assets of the banks would have been required to pay back depositors in the event of liquidation.

#### 4.2 Correlation Coefficients

The correlation coefficients between capital adequacy ratio and each of the risk management outcomes of the banks are shown in Table 2, and discussed thereafter.

**Table 2: Matrix of Correlation Coefficients**

	CAR	RWAR	DAR	NPLR
CAR	1.0000	-0.4498	-0.2287	-0.0857
RWAR	-0.4498	1.0000	0.0993	0.3619
DAR	-0.2287	0.0993	1.0000	-0.2522
NPLR	0.0857	0.3619	-0.2522	1.0000

Source: Author’s computation (2016)

It is evident from the correlation coefficients in Table 2 that the risk management variables are negatively correlated with capital adequacy ratio. The coefficients provide evidence of negative coincidence relationship between capital adequacy and risk management elements in operations of the banks during the period under study. Correlation is appropriate for determining the relationship between two variables (Chandrasekharan, 2009). However, it does not necessarily guarantee dependent relationship between the variables. It is merely used to determine the strength and direction of the relationship between the variables being investigated. The negative coefficients in the table indicate that capital adequacy ratio and the risk management variables of the banks changed in the opposite direction during the study period. Further, correlation coefficients are used to test for multicollinearity between set of pair-wise independent variables. The correlation coefficients between any two of the risk management variables range from minimum of -0.4498 to maximum of 0.3619. Since none of the correlation coefficients between any two indicators of risk management in the banks during the period exceeds the 0.80 prescribed for multicollinearity problems by Kennedy (2008), the resulting regression results are adjudged to be non-spurious. That is, since the correlation coefficients between any pair of the risk management variables were not greater than 0.80 (Kennedy, 2008), there are no high degrees of correlations among the risk management variables. Therefore, the data sets were considered appropriate for reliable regression analysis results.

#### 4.3 Pooled Regression Analysis Results and Estimated Model

Results of the pooled regression analysis are shown in Table 3. The table shows estimates of the intercept and coefficients of the risk management indicators in the analytical, as well as relevant statistics for inferential evaluations. Table 4 shows multiple and specific forms of the estimated model of capital adequacy-risk management relationships.

**Table 3: Results of Regression Analysis**

Dependent Variable: CAR    Method: Pooled Least Squares    Sample: 2009 2015  
 Included Observations: 84

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	27.3954	11.3253	21.2491	0.0000
RWAR	-0.0986*	0.0322	-5.1602	0.0427
DAR	-0.0987	0.0935	-3.2761	0.1829
NPLR	-0.0073	0.0832	-4.376	0.7332
R-squared = 0.7854    F-statistic = 54.3275*    S. E. of Regression = 0.8259				
Adjst. R-Squared = 0.7710    Prob(F-statistic) = 0.0000    Durbin-Watson stat = 1.9111				

Source: Regression Analysis Output; \*Significant at the 5% level

**Table 4: Estimated Model in Multiple and Specific Formats**

$CAR = 27.3954 - 0.0986RWAR - 0.0987DAR + 0.0073NPLR + \varepsilon_i$	
<b>Specifics</b>	<b>Hypotheses</b>
$CAR = 27.3954 - 0.0986RWAR + \varepsilon_1$ Std. Error: (0.0325)*	Hypothesis 1 ( $H_{01}$ ) RWAR has no significant effect.
$CAR = 27.3954 - 0.0987DAR + \varepsilon_2$ Std. Error: (0.0732)	Hypothesis 2 ( $H_{02}$ ) DAR has no significant effect.
$CAR = 27.3954 - 0.0073NPLR + \varepsilon_3$ Std. Error: (0.0723)	Hypothesis 3 ( $H_{03}$ ) NPLR has no significant effect.

Source: Regression Analysis Output; \*Significant at the 5% level

Results in tables 3 and 4 show multiple and simple forms of the estimated pooled regression model. Estimates of the coefficients reveal negative relationship between capital adequacy and the respective banks' risk management variables during the period under study. The sensitivity coefficients show that the risk management variables exerted negative effects on capital adequacy ratio during the period. That is, increase in any of the risk management ratios induced a jeopardised capital adequacy of the banks, and vice versa. These were consistent with pre-estimation expectations expressed under the methodology in section three of this paper. Interestingly, p-values of t-statistics of coefficients of risk management variables show that only the negative effect of risk weighted asset ratio (RWAR) was statistically significant on capital adequacy ratio (CAR) of the banks. The p-value ( $0.0427 < 0.05$ ) provided empirical evidence of significance of negative effect of RWAR on CAR during the period. The other p-values ( $0.1829 > 0.05$ ,  $0.7332 > 0.05$ ) provided inferential evidence that deposit-asset ratio (DAR) and non-performing loans ratio (NPLR), respectively, did not have significant negative effect on CAR during the period. On the basis of these, therefore, Hypothesis 1 ( $H_{01}$ ) is rejected while Hypotheses 2 and 3 ( $H_{02}$  and  $H_{03}$ ) are accepted. The findings were consistent with the study by Al-Sabbagh (2004).

However, the risk management variables (RWAR, DAR and NPLR) jointly had statistically significant effect on capital adequacy ratio (CAR) of the banks during the period under review. This is evident in the F-statistic value of 54.3275 with p-value of 0.0000. Further, the adjusted R-squared value of 0.7710 in Table 3 shows that the risk management variables were very strong in explaining variations in capital adequacy of the banks. The risk management variables explained about 77% of the total variations in capital adequacy ratio of the banks during the period. Thus, the pooled regression model proved to be a good fit. The Durbin-Watson statistic, 1.9111, shows that the time series values of the risk management variables were free from the problems of autocorrelation. Consequently, this paper infers that while the risk management variables in the Nigerian banking sector exerted differing levels of negative effects on capital adequacy of the banks during the 2009-2015 periods, only risk weighted asset ratio (RWAR) had significant negative effect; and the risk management variables jointly had significant effect on capital adequacy of the banks during the 2009-2015 periods. Further, the variables were very relevant in explaining variations in capital adequacy ratio and were not auto-correlated.

## 5. Conclusion and Recommendations

This paper has analysed capital adequacy ratio in relation to risk management practice in the Nigerian banking industry. The results showed that the risk management variables considered in

the analysis (RWAR, DAR and NPLR) had differing degrees of negative effects on capital adequacy ratio (CAR) of the industry during 2009-2015. The descriptive statistics showed that the Nigerian banking industry remained even in the face of challenges posed by the global economic meltdown of 2008. Further, the statistics showed that considerable proportions of total assets of the banks were risky. However, depositors' monies remained well secured given that up to 68% of banks' assets were available to mitigate any liquidation. Coefficients of correlations showed that capital adequacy ratio and risk management of the banks moved in the opposite direction during the period.

Results of the regression analysis substantiated the negative relationship between capital adequacy and risk management in the banks. However, only risk-weighted asset ratio had significant negative effect on capital adequacy during the period. But on the aggregate, the risk management indices jointly had significant negative effect.

Consequently, the paper recommends that the banks should endeavour to reduce risk-weighted assets, deposit-asset ratio and non-performing loans ratio. It is recommended that deposit-asset ratio be reduced adopting objective-oriented deposit drive to attract more deposits from individuals and businesses. Banks should also ensure that loans are adequately secured so as to reduce the incidence of non-performing loans. These, among other prudential measures, would dampen the negative effects of risk management and, thus, enhance capital adequacy of the banks.

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