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Notes to Contributors
Information on manuscript submission is provided on the last and inside back cover of the Review.

Contents

Effect of Monetary Policy on the Banking System Stability in Nigeria

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Abstract

The paper examined the effect of monetary policy on banking system stability in Nigeria. The main objective was to evaluate how monetary policy affected the banking system stability during the global financial crisis in Nigeria. Static and dynamic error correction models were estimated using monthly data from January 2007 to June 2013 and the error correction model was found most efficient. The banking system stability index was computed using banking soundness index, banking vulnerability index and economic climate index. The results showed that increase in monetary policy rate, depreciation of nominal exchange rate and rising inflation rate negatively affected the banking system stability. However, similar increase in cash reserve requirement and banking reforms improved the banking system stability. Accordingly, the paper recommended that the CBN should be watchful of increase in MPR, depreciation of the Naira and rising inflation to ensure banking system stability. Also, increase in CRR and financial reforms can positively impact on the banking system stability in Nigeria. Overall, there is need for the Bank to identify appropriate adjustment in its instruments to achieve macroeconomic stability and banking system stability.

Keywords: Monetary Policy, Banking System Stability
JEL Classification Numbers: E52, G15

I. Introduction

The aftermath of the global financial crisis led to intense policy and academic debate on the effects of monetary policy on banking system stability in developed and developing economies. Even before the crisis, Friedman and Schwartz (1971) argued that the recession associated with the crash of 1929 and bank panics of the 1930s should not have resulted in a prolonged depression, if it had not been fueled by monetary policy mistakes on the part of the Federal Reserve. The same opinion was expressed by Bernanke (2000). Hartmann, Straelmans and deVaries (2005) that monetary policy had complications in assessing banking system stability during crisis periods. Maddalin and Peydro (2013), however, showed that any banking system that is well capitalised and highly liquid is more stable and resilient to shocks. In this case, a stable banking system could be described as one in which any small distortion or shock to the system will not result into higher destructive impact.

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The motivation for this paper is to bring out clearly how monetary policy helped to restore banking system stability in Nigeria following the global financial crisis (GFC) in 2008/2009. Traditionally, a sound, safe and stable financial system is the focus of regulatory and supervisory institutions like the Central Bank of Nigeria as well as monetary policy. It is, therefore, globally recognised that the banking industry is prone to volatility and fragility arising from exogenous shocks and endogenous policy measures including monetary policy (Maxwell, 1995).

On the other hand, Stiglitz (2003) and Kashayap and Stein (1994) had demonstrated that a well-developed, stable and resilient banking system is also critical to achieve effective financial intermediation and the efficacy of monetary policy. This is quite true as stable banking system can enhance monetary policy transmission mechanism thus leading to more potent monetary policy. According to the definition by the Deutsche Bundesbank in 2003, banking system stability is "a steady state in which the financial system efficiently performs its key economic functions such as allocating resources and spreading risk as well as settling payments".

To achieve that objective, the paper has been organised into five sections. Following the introduction, section two provides the literature review including stylised facts on monetary policy and banking system stability in Nigeria. Section three focuses on methodology, model specification and data transformation. Section four examines presentation and discussion of results. Section five contains summary and policy recommendations.

II. Literature Review

II.1 Stylised Facts on Monetary Policy and Banking System Stability in Nigeria

II.1.1 Review of Monetary Policy in Nigeria

The statutory mandate of the CBN is derived from the CBN Principal Act of 1958 and its subsequent amendments. Two of the objects at inception were to promote price stability and a sound financial system. Over the years, the Bank has used several monetary policy instruments to manage exchange rate, interest rate, and inflation through the control of money supply. Since inception, the Bank has implemented two monetary policy strategies; exchange rate targeting (1959-1973) and monetary targeting regime (1974 to date).

From 1974 to 1992, direct monetary control was used to pursue massive infrastructural development. Following the financial liberalisation policy, the

approach to monetary management shifted from direct to indirect monetary control from 1993 to present. This development led to the introduction of Open Market Operations (OMO) and establishment of five discount houses to facilitate the market based monetary operations.

Between 1959 and 2001, the monetary policy regimes were on short–term basis (annual) but the two year medium-term perspective started in 2002. The use of narrow money (M_1) as an intermediate target was replaced with broad money (M_2) in 1992. To strengthen the banking sector, a new monetary policy implementation framework was introduced (Monetary Policy Rate, MPR with interest rate corridor) to replace the Minimum Rediscount Rate (MRR) in December 2006. Overall, the expansionary monetary policy adopted in September 2008 was reversed in 2010.

Following these developments, the Minimum Rediscount Rate (MRR) and cash reserve requirement (CRR) which were about 18.0 and 10.0 per cent in 2000, respectively, were reduced to 9.0 and 4.0 per cent in 2007. However, in response to liquidity shortages resulting from the global financial crisis, the instruments were further reduced to 6.0 and 1.0 per cent in 2009. However, with the re-emergence of inflationary pressures in 2010, both the CRR and MPR were raised to 12.0 per cent in 2012. The tight monetary policy stance was intended to moderate inflation and halt speculative demand for foreign exchange.

Figure 1: Relationships among MPR, CRR and Total Credit (1993:01-2013:06)

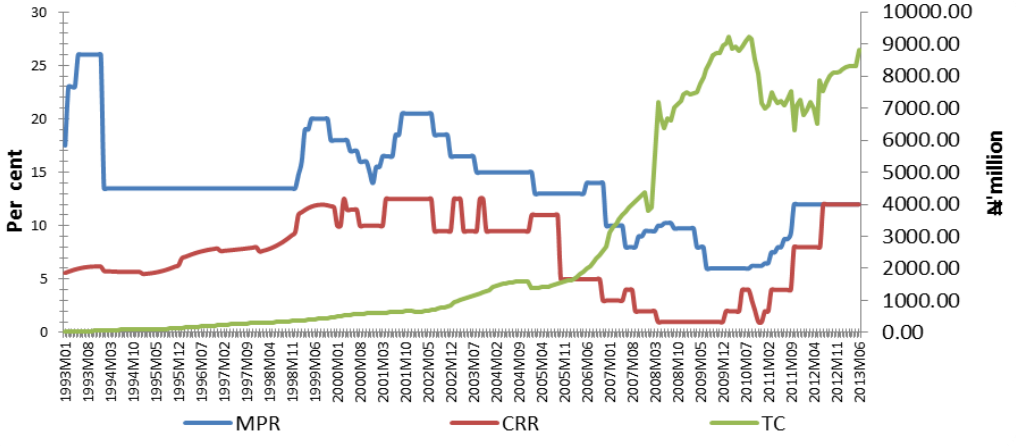
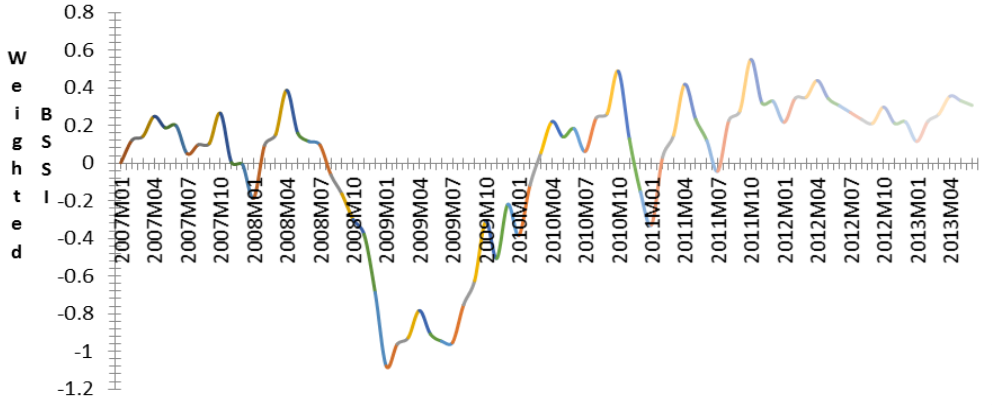


Figure 1 shows that as MPR and CRR were reduced, DMBs' total credit increased and vice versa, which is consistent with the economic theory. However, rising bank credit may not translate to banking system stability.

II.1.2 Review of Banking System Stability in Nigeria

Banking business in Nigeria started in 1892 following the establishment of the African Banking Corporation by foreign investors, which was later acquired in 1894 by the Bank for British West Africa. Local investors went into banking business recording about 185 local banks between 1947 and 1952, but many of them did not commence operations (Fadare, 2011). Banking sector distress syndrome was experienced in the 1930s, 1940s and 1950s before the introduction of regulation in 1952 (1952 Banking Ordinance). Banking system became unstable between July 2007 to January 2011, after which it remained in the positive quadrant throughout the horizon, starting from the zero value. The level of instability was more serious in 2008 and 2009 as shown by figure 2 below apparently due to the impact of the global financial crisis.

Figure 2: Banking System Stability Index (2007:01 - 2013:06)



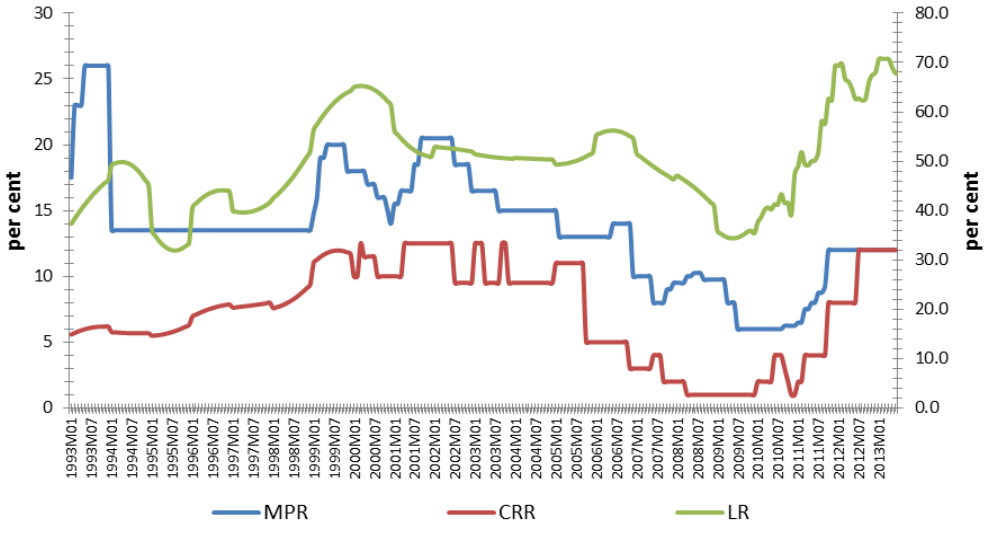
Several banking sector reforms had been implemented since the Banking Ordinance to ensure soundness, safety and stability of the banking system. Therefore, reform programmes such as increase in the capital base of banks in 1962, 1992, 1998, 2002, 2005 and 2010, liberalisation of interest and foreign exchange rates (1986/1987) and 2004 bank consolidation and restructuring were meant to stabilize the banking system. The introduction of a new monetary policy implementation framework with interest rate corridor in 2006 (MPR replaced MRR) was aimed at improving the performance of banking sector and monetary policy transmission mechanism. Other recent reforms include the launching of financial inclusion strategy in Nigeria on October 23, 2012.

The Nigerian banking system is not insulated from monetary policy shocks, which became obvious during the global financial crisis. Prior to the crisis, the CBN Management focused on managing excess liquidity but with the emergence of

the crisis, MPR was reduced from 10.25 per cent to 6.0, CRR reduced from 4.0 to 1.0 per cent, liquidity ratio adjusted downward from 40.0 per cent to 25.0 per cent, and expanded discount window was introduced to inject liquidity into the banking system to facilitate the restoration of stability of the banking system.

In the post-crisis period, particularly in 2010, there was a resurgence of inflationary threat resulting in the re-introduction of tight monetary policy. The Monetary Policy Committee (MPC) continued to monitor the interbank rates.

Figure 3: Relationships among MPR, CRR and LR -1993:01-2013:06 (per cent)



Liquidity ratio (LR) and capital adequacy ratio (CAR), which stood at about 61.0 and 21.0 per cent in 2000, had declined to 50.0 and 14.0 per cent by end-2004, respectively. Following the bank consolidation exercise in 2005, LR and CAR improved to 52.0 and 20.0 per cent. However, with the GFC; LR and CRR declined to 40.0 and 16.0 per cent in 2008. The indicators gradually improved following the resolution of the banking sector crisis with the creation of AMCON. By end-2013, LR and CAR had risen to 68.0 and 19.0 per cent, respectively. The banking system stability index showed sharp deterioration from April 2007, immediately after capital market crash of March 2007. It came out of instability in early 2010 but worsen towards the end of the month. Since July 2011, the banking system stability index has remained stable although with evidence of fluctuations.

II.2 Related Literature

II.2.1 Theoretical literature

There are theories linking monetary policy with stability of banking system. A few of them are discussed below:

Liquidity theory for bank operations

The liquidity theory by Diamond and Dybvig (1983) shows that the inability of banks to meet urgent customer withdrawal needs lead to decline in deposits, credit and consequently bank runs. In this case, banks that are vulnerable to bank runs, threaten banking system stability. Therefore, central banks should always take measures that will enable banks to meet depositors' withdrawal requests.

Credit business circle theory

The credit business circle theory originated from the work of Austrian School economists Ludwig and Hayek (1974). The theory sees business cycles as the consequence of excessive growth in bank credit resulting from extremely low market interest rate. The level of interest rates is expected to influence the health and stability of the banking system. Low interest rates often lead to the creation of sub-standard assets, which could precipitate banking system crisis. Central banks are expected to consider the level of interest rate that will not be detrimental to the health and stability of the banking system.

Cadet (2009) provided the linkage between monetary policy and banking failure in developing countries. He noted that despite the existence of treasury bills as alternative source of profit for banks in developing countries, a tightening of monetary policy increases the probability of bank failure.

The theory of portfolio regulation (Markowitz, 1952) supported by Roger and Arnold (1978) postulates that portfolio regulation is necessary to maintain safety and stability of the banking system. This has forced regulatory authorities to insist on the requirements of minimum liquidity, capital and other prudential ratios.

II.2.2 Empirical literature

A plethora of literature exits on the effect of monetary policy on banking system stability. Worms (2001) found that banks reduce their credit more easily in response to a tightening monetary policy measure as their ratio of short term interbank deposit to total asset declines. Kassim et. al., (2009) using VAR methodology observed that the balance sheet items of Islamic banks were

relatively more sensitive to monetary policy changes than conventional banks. This further confirmed that monetary policy can also influence operations of Islamic banks.

Bernanke and Blinder (1992) using VAR approach and monthly data for the period 1959:01-1978:12, on federal funds rate, banks' securities, unemployment, banks' deposits, prices and banks' credits, found that after monetary policy contraction, deposits decrease almost immediately, while loans do not react strongly. So banks reduce their securities to change their asset without reducing their credit after a monetary policy tightening. However, Kashayap and Stein (1994) using quarterly disaggregated figures showed that different banks reacted differently to monetary policy shocks. They discovered that loans from small banks declined after monetary policy contraction, while big banks either increased their loans or remained unchange as contraction increase interest rates.

Zulverdi et. al., (2006) used an analytical model of bank portfolio behaviour in Indonesia based on macro-economic theory to understand how banks portfolio behaviour in maximising profit links to the efficacy of monetary policy. Consistent with theory, they established that the volume of loans has negative relationship with the policy rate. They also revealed that increase in capital adequacy ratio will reduce loan volume as banks will prefer to invest in low risk assets instead of granting loans.

As a policy prescription to address bank crisis, Mishkin (1996) recommended expansionary monetary policy and/or lending to banks in industrial countries to help them recover from financial crisis but added that the approach may be counterproductive in developing countries in particular, as it could exacerbate inflation and cause further depreciation of the domestic currency. This was evident in Nigeria as inflation and sharp depreciation of the naira were experienced after liquidity injection to cope with impact of global financial crisis. As an alternative, he further recommended that a strong regulatory and supervisory system for banks would reduce excess risk behaviours, increase proper accounting standards and disclosure requirements in developing countries.

Altunbas et. al., (2010) discovered that an unusually low interest rate over a long time contributed to an increase in banks risk. This situation increases the volume of loans granted under lower standards and when they are due for repayment, they turned into high risk assets thereby increasing the quantum of non-performing loans. Somoye (2006) revealed that interest rate policy would be sufficient to achieve financial stability and sustainable development. This view was shared by other authors in both developing and developed economies.

Maddaloni and Peydro (2013) used generalised least squares and GMM panel regression model to discover that monetary policy rate had impact on bank stability, bank balance sheet strength and banking prudential policy. They concluded that monetary and prudential policies are strongly connected and recommended that monetary policy should pay more attention to financial stability issues while banking prudential supervision and regulation should focus on risk taking incentives possibly induced by low short-term interest rate.

III. Methodology

III.1 Theoretical framework

To capture how monetary policy impact on banking system stability, we computed the banking system stability index, which is based on IMF-FSIs Compilation Guide of 2006. In particular, the method was developed by Sere-Ejembi et. al., (2014) as follows:

i. Statistical Normalisation Methods

$$Z_t = \frac{(X_t - U_t)}{\mathrm{S}} \qquad (1)$$

Z_t is the normalised figure and X_t is the indicator x during the period under study. U_t and S are mean and standard deviation, respectively. This method was used to compute banking soundness index involving capital adequacy ratio, liquidity ratio, profitability and non-performing loan ratio. The banking vulnerability index (BVI) captures inflation, nominal exchange rate, reserves to total asset ratio, M2 to reserves ratio and credit to GDP ratio. While the economic climate index (ECI) incorporates GDP of the major trading partners including United States and China. Sixty per cent weight was attached to the banking soundness index (BSI), while banking vulnerability and economic climate indices were assigned 20.0 per cent weight each. Thus, Banking System Stability Index takes average of indicators and multiplied them by the weights of each category before adding up to derive Banking System Stability (BSSI) Index.

ii Empirical Normalisation Method

$$I_t^n = \left(\frac{\mathrm{I}_{it} - \mathrm{Min}(\mathrm{I}_t)}{Max\left(I_n\right)) - \mathrm{Min}(\mathrm{I}_t)}\right. \qquad (2)$$

The above approach is also known as Conference Board Methodology but the statistical normalisation method was used to compute the banking system stability index (BSSI).

$$BSSI_{t,ww} = W_s \sum_{t=1}^{4} \Theta_{st} Z_{ts} + W_v \sum_{t=1}^{5} \Theta_{st} Z_{ts} + W_c \sum_{t=1}^{2} \Theta_{ci} Z_{tc} \quad (3)$$

$$Where \sum_{t=s,v,t} w_r = 1 \quad (4)$$

The summation of the weights is one (BSI=0.6, BVI=0.2 and ECI=0.2). Nadya and Thomas (2011) explained that no literature has provided any convincing methodology for assigning weight to component for computing banking system stability index. The weight of individual in each sub-index is normalised as:

$$\theta_i = \frac{u_i}{\sum_{i=1} UU_i} \quad (5)$$

III.2 Relevant Variables

Banking System Stability Index (BSSI) is averaged aggregate weighted index of banking soundness indicators (liquidity ratio, capital adequacy ratio, NPL ratio and profitability ratio), banking vulnerability indicators (inflation, M2/Reserves, Reserves/Total Asset, Exchange rate, Total asset to GDP ratio) and Economic climate index (US Real GDP and China Real GDP). Monetary Policy Rate (MPR) is the policy rate of the CBN. Cash Reserve Requirement (CRR) is the per cent of total deposits of banks that should be kept with the CBN. Nominal Exchange Rate (EXCH) refers to the price of a unit of US dollar expressed in the domestic currency (naira). Inflation Rate (Inf) refers to headline inflation rate. Financial reforms dummy (D65) represents 1(one) for existence of reforms and 0 (zero) for any period without reforms.

III.3 Empirical Model

Ajayi (1978) emphasised that the choice of monetary policy instruments should depend on the nature of a particular economy. However, Schwartz (1969) posited three criteria used for choice of short-term target of monetary policy to be, whether it is measurable, and can be controlled by central bank and whether it can be used as an indicator of monetary condition. In another option,

Crockett (1973) showed two techniques of central bank implementing monetary policy to include market intervention and portfolio constraints. Central banks influence the availability and rate of returns on assets in the financial market and also restrict group of institutions (banks) from acquiring assets and liabilities; this relates to prescribed minimum and maximum prudential ratios.

Predicated on the prepositions of our theoretical framework and empirical review, the model specification is as follows:

$$BSSI_{t,www} = \alpha_{\pm} + \alpha_2 mpr + \alpha_3 exh + \alpha_4 crr + \alpha_5 \inf + \alpha_6 d65 + u_i \quad (6)$$

After the estimation of static model, variables are found to be stationary at first difference 1(1) and cointegrated, which allowed estimation of the dynamic error correction model. This model helps to identify how long it would take for any banking system instability to restore to equilibrium position (stability). The lag structure of the model was also investigated, utilising the lag-length criteria and found to be one (1) following the Schwartz criteria. The estimable dynamic error correction model is:

$$BSSI_{t,ww} = \alpha_{\pm} + \alpha_2 mpr(-1) + \alpha_3 exh(-1) + \alpha_4 crr(-1) + \alpha_5 \inf(-1) + \alpha_6 d65 + ecm(-1) + u_i \quad (7)$$

III.4 Estimation Technique

The ordinary least squares method was represented as:

$$Y_i = \alpha_0 + \beta_i X_i + u_i \quad (8)$$

Where y_i is the dependent variable and X_i is the vector of independent variables with corresponding parameters (β) including intercept and random term (u_i) which recognises the unknown variations. Both static and dynamic error correction methodologies were used: Having established that the variables were stationary at 1(1) and ECM was stationary at level 1(0), dynamic error correction methodology was adopted.

Rafiq and Malick (2008) explained that the standard Mundell-Fleming-Dornbush model revealed that when interest rate is reduced as an expansionary monetary policy, it leads to increase in prices and reduces real exchange rate as well as increases money supply and the output level. We used multiple regression models specifically static and error correction models to evaluate the effect of monetary policy actions on banking system stability.

III.5 Data Sources and Transformation

The need to evaluate the effect of monetary policy actions on banking system stability necessitates the use of high frequency data so as to capture short-term variation. The computed banking system stability index is used as the dependent variable, while monetary policy rate, cash reserve requirement, nominal exchange rate of the naira, inflation rate and financial reform as dummy represent the independent variables. The data were sourced from the CBN Annual reports, Banking Supervision Department Annual reports, NBS Official Website, e-FASS and CBN Official Website. The data were transformed by differencing and lagging to contain problems of autocorrelation and heteroscedasticity. The banking data represent the banking industry specific figures including macro variables such as inflation rate and nominal exchange rate.

IV. Presentation and Discussion of Results

The unit root test result in Table 1, using Augmented Dickey-Fuller test showed that the variables are integrated of order one 1(1). The ECM is stationary at level, 1(0) which is consistent with the theory.

Table 1: Unit Root Test

Variable	ADF Test Result						
	Level (5 per cent)			First Difference (5 per cent)			Order of Integration
	Test Statistic	Critical Value	P-Value	Test Statistic	Critical Value	P-Value	
BSSI	-2.4843	-2.9029	0.1235	7.8345	-2.9012	0.000	1(1)
CRR	0.1386	-2.8996	0.9667	8.4428	-2.9001	0.000	1(1)
MPR	-0.7065	-2.8996	0.8384	8.1123	-2.9001	0.000	1(1)
EXCH	-1.2090	-2.9001	0.6668	5.8162	-2.9001	0.000	1(1)
INF	-1.6370	-2.8996	9.4590	8.8900	-2.9001	0.000	1(1)
ECM	-3.0875	-2.8996	0.0317				1(0)

Cointegration Test

The results of the Johansen trace and maximum eigen value tests, with a linear deterministic trend indicated that each of the test has one co-integrating equation at the 5.0 per cent level of significance. This condition is necessary for

the estimation of error correction model. The static model results indicated that only nominal exchange rate, CRR and financial reforms influenced banking system stability. Inflation and MPR were not significant. In addition, the explanatory power (Adj. R^2) of 48.0 per cent was low with presence of serial correlation. The residual was tested for unit root and was found stationary at level, at 5.0 per cent level of significance.

Table 2: Estimation Results

Static Model			Dynamic Error Correction Model		
Variable	**Coefficient**	**P-Value**	**Variable**	**Coefficient**	**P-Value**
C	1.6753	0.0093	C	1.4861	0.0001
MPR	-00428	0.1239	MPR(-1)	-0.0606	0.0003
CRR	0.0989	0.0000	EXCH(-1)	-0.0088	0.0009
EXCH	-0.0136	0.0018	CRR(-1)	0.0976	0.0000
INF	0.0047	0.7475	INF(-1)	-0.0180	0.0493
D65	0.2843	0.0008	D65	0.1876	0.0004
			ECM(-1)	-0.8341	0.0000
Adj. R2	48.86		Adj.R2	81.58	
Prob(F-Stat)	0.0000		Prob(F-Stat)	0.0000	
AIC	0.44		AIC	-0.6138	
DW	0.45		DW	2.07	

The dynamic error correction model results in table 2 above indicated that rising MPR was likely to reduce banking system stability, indicating that, tight monetary policy may negatively affect banking system stability. On the contrary, increase in CRR was expected to increase banking system stability probably because banks will be able to build buffer and pay special attention to risks and portfolio management. The result also showed that increase in inflation and depreciation of the naira may make banks to become less stable. The one period lagged ECM is with negative sign and significant at 1.0 per cent. The ecm (-1) of -0.8342, shows that the banking system corrects its previous period instability at a speed of 83.4 per cent monthly. Thus, Nigerian banking system returns to steady state at a very high speed, which enables the Nigerian banking system to remain resilient.

In order to confirm the reliability and appropriateness of the estimated error correction model, various diagnostic tests were conducted including normality, serial correlation LM and Heteroscedasticity tests. Others included recursive residual and CUSUM of squares tests. The Jarque-Bera test statistic confirm

acceptance of hypothesis of normality (Table 5). Also, the result of Breusch-Godfrey serial correlation test and Heteroscedasticity test indicate that the model has no serial correlation and is homoscedastic. The recursive residual test showed no evidence of serial correction as the distribution was within the plus/minus 2 standard deviation but between 2007 and 2009, it was outside the bound indicating instability which corresponds to the period of the global financial crisis of 2008/2009. Similar situation was evidenced in the graph of the banking system stability index discussed under the stylised facts (Fig. 2).

Finally, the structural stability test using CUSUM of squares test revealed that the model was well specified and stable because the CUSUM lies within the 5.0 per cent significance bound.

V. Recommendation and Conclusion

The findings revealed that raising MPR by the CBN was likely to make banking system less stable. This required the Bank to know how far MPR could go to avoid the anticipated negative impact on the banking system stability. Similarly, increase in inflation rate and depreciation of the naira were expected to negatively affect banking system stability. On the positive side, financial reforms and increase in CRR were likely to make the banking system more stable.

In line with the results of the model, we recommend that the CBN:

I. Should continue to use CRR, MPR and exchange rate to ensure effective monetary management and stable banking system in Nigeria. However, there should be serious caution on how far tight monetary policy can go and by how much the naira should be allowed to depreciate to avoid fueling banking system instability as revealed by the paper.
II. CRR can continue to be used as macro-prudential instrument to ensure banking system stability.
III. Should endeavour to achieve its inflation objective as this would improve the banking system stability.
IV. Should sustain financial reforms of the banking system in order to engender stability. Overall, should try to balance the objective of macroeconomic stability with the objective of banking system stability to achieve sustainable economic growth in Nigeria.

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Appendices

Table 3: Summary Statistics

	BSSI	CRR	MPR	EXCH	INF	D65
Mean	0.0016	4.3462	9.1378	143.6294	10.9	0.6667
Median	0.1342	3	9.5	150.2218	11.7	1
Maximum	0.5505	12	12	158.3868	15.6	1
Minimum	-1.0768	1	6	117.7243	4.1	0
Std. Dev.	0.3947	3.9074	2.240654	14.9328	3.0325	0.4745
Skewness	-1.3065	1.0404	-0.09869	-0.7876	-0.7284	-0.70711
Kurtosis	3.7428	2.6040	1.6600	1.9281	2.6773	1.5
Jarque-Bera	23.98507	14.5825	5.9624	11.7984	7.2366	13.8125
Probability	0.0000	0.0007	0.0507	0.0027	0.0268	0.0010
Sum	0.1216	339	712.75	11203.1	850.2	52
Sum Sq. Dev.	11.9956	1175.654	386.5809	17170.29	708.12	17.33333
Observations	78	78	78	78	78	78

Table 4 : Cointegration Test

Unrestricted Cointegration Rank Test (Trace)

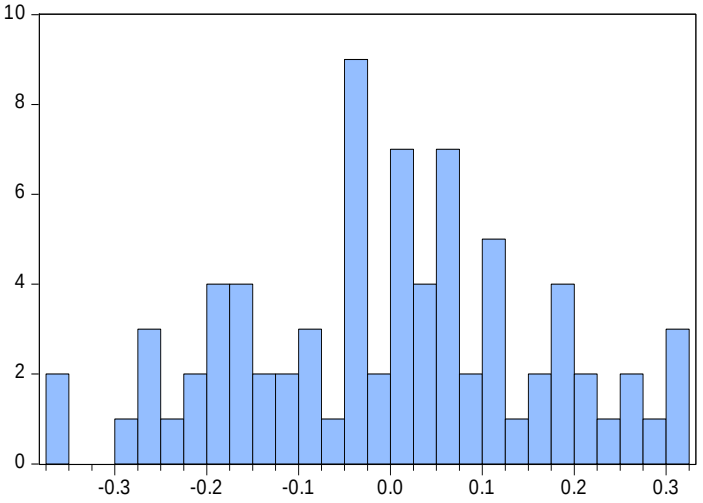
Hypothesised No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.462530	123.6453	117.7082	0.0199
At most 1	0.259964	77.07915	88.80380	0.2590
At most 2	0.224375	54.49993	63.87610	0.2381
At most 3	0.188176	35.44343	42.91525	0.2273
At most 4	0.154177	19.80801	25.87211	0.2358
At most 5	0.092137	7.249640	12.51798	0.3192

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesised No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.462530	46.56613	44.49720	0.0293
At most 1	0.259964	22.57922	38.33101	0.8284
At most 2	0.224375	19.05650	32.11832	0.7251
At most 3	0.188176	15.63542	25.82321	0.5773
At most 4	0.154177	12.55837	19.38704	0.3650
At most 5	0.092137	7.249640	12.51798	0.3192

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 5: Result of Normality Test



Series: Residuals
Sample 2007M02 2013M06
Observations 77

Mean	1.33e-16
Median	0.009835
Maximum	0.310381
Minimum	-0.362148
Std. Dev.	0.163612
Skewness	-0.077284
Kurtosis	2.417924
Jarque-Bera	1.163677
Probability	0.558870

Table 6: Breusch-Godfrey Serial Correlation LM Test:

F-statistic	2.358275	Prob. F(2,68)	0.1023
Obs*R-squared	4.994385	Prob. Chi-Square(2)	0.0823

Table 7: Heteroskedasticity Test: ARCH

F-statistic	1.213910	Prob. F(1,74)	0.2741
Obs*R-squared	1.226597	Prob. Chi-Square(1)	0.2681

Fig. 4: CUSUM of Squares

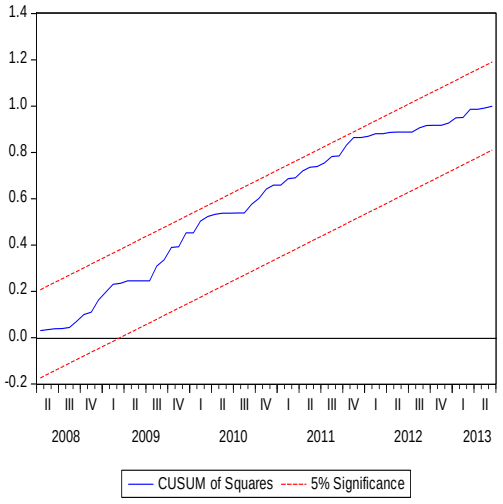
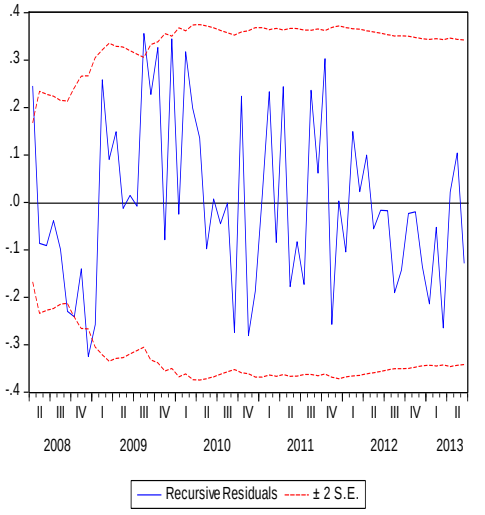


Fig. 5: Recursive Residual



An Empirical Analysis of the Effect of Monetary Policy on the Manufacturing Sector in Nigeria

Ali, M., H. Aliero and M. Abubakar *

Abstract

This study examined the effect of monetary policy on the manufacturing sector in Nigeria from 1970 to 2012 using Autoregressive Distributed Lag (ARDL) bound testing approach. Exchange rate was found as the only channel of monetary policy transmission with significantly negative effect on the manufacturing sector. This implies that manufacturing firms largely rely on foreign inputs for production and do not depend on the banking system for funding. The study, therefore, recommends indigenous technology and financial system development to reduce dependence on imported inputs and facilitate access to more funds.

Keywords: Monetary policy, manufacturing sector, and Nigeria.
JEL Classification: E52, L60

I. Introduction

The issue of monetary policy transmission has always been of key interest to economists and policy makers, though most analyses in this area have concentrated on the aggregate level of the economy (e.g. Cambazoglu and Karaalp, 2012; Hameed, 2011; Adefeso and Mobolaji, 2010; Okoro, 2013; David, 2010). Hayo and Uhlenbrock (1999), however, pointed out that this approach ignores possible asymmetries, at more disaggregated levels, of the effects of monetary policy across economic entities such as sectors or regions of the economy. Consequently, recent analyses of monetary policy have shifted focus from the question of whether monetary policy exercises significant effect on real aggregate variables to emphasising other aspects. One of such aspects that has received considerable attention of late is the sectoral effects of monetary policy shocks. Recent studies on the subject made it quite clear that different sectors of the economy respond differently to changes in monetary policy (Alam and Waheed, 2006; Saibu and Nwosa, 2012; Arnold and Vrugt, 2002). This observation has far reaching implications for macroeconomic management as the monetary authority would have to assess the differential effects of its actions on various sectors of the economy as the tightening of monetary policy might be considered mild from the aggregate perspective but it could be excessive for

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certain sectors. If this is true, then monetary policy should have strong distributional effects within the economy (Alam and Waheed, 2006). For this reason, monetary economists have called for a disaggregated analysis of monetary transmission mechanism (e.g. Carlino and Defina, 1998; Ganley and Salmon, 1997; Dedola and Lippi, 2005).

This study, therefore, is a disaggregated approach that focuses on the effect of monetary policy on the manufacturing sector. The sector is chosen because, according to Tkalec and Vizek (2009), it is one of the important and most tradable sectors of every economy, which in turn suggest that it is often the most competitive sector. Tkalec and Vizek (2009) further asserts that the importance of the manufacturing sector also stems from the fact that it is the carrier of innovation, research and development activities that eventually spill over to other sectors and result in increased productivity. The manufacturing sector reflects the extent to which an economy is developed especially as one of the ingredients of economic development is the composition of output or the degree to which an economy is able to transform primary products into manufactured goods (Todaro and Smith, 2005). Sanusi (2010) also pointed out that the sector is dynamic as it offers opportunities for capital accumulation, employment generation and economies of scale.

Ibrahim and Amin (2005), asserted that monetary policy (and the exchange rate in particular) is often considered to be the main reason for the weak performance of the manufacturing sector, and monetary disturbances may amplify fluctuations in manufacturing output at a magnitude greater than aggregate fluctuations. Given the key role of the manufacturing sector, the presence of this amplified effect on it needs to be verified empirically. Accordingly, this study examines the effect of monetary policy on manufacturing output because an understanding of the specific responses of the manufacturing sector would aid policy makers in their consideration of the sector in the formulation of monetary policy.

Most of the previous empirical studies in Nigeria (e,g. Adefeso and Mobolaji, 2010; Okoro, 2013; David 2010; Chimobi and Uche, 2010; Onyeiwu, 2013) focused on the effects of monetary policy on aggregate real output, neglecting sector specific analysis. This neglect of sectoral effect of monetary policy in the existing literature creates an empirical gap, which could undermine the policy relevance of inferences from the empirical evidence in previous studies in Nigeria. Monetary policy shock according to Alam and Waheed (2006) and Hayo Uhlenbrock (1999), have differential effect on disaggregated output. Also, sectoral effect differs as some sectors are more sensitive to certain monetary variables (Dale and Haldane, 1995). Hence, this research differs from all these earlier ones as it

investigates the sectoral effects with emphasis on the manufacturing sector. It is also different from the disaggregated studies by Saibu and Nwosa (2011 and 2012), Ubi et al. (2011) and Ubi et. al., (2012) because it examines broad money supply channel (M_2) which is absent in those previous studies, and uses more valid technique and updated data to capture recent trend and relationship between monetary policy variables and the manufacturing output. Thus, the objective of the study is to examine the relationship between monetary policy and the manufacturing output, and the channel through which monetary policy transmits its impulse on the manufacturing sector.

The paper is structured into five sections. The first section is the introduction, followed by literature review. This is then followed by the explanation of the methodology adopted in Section 3; data analysis, result discussion and policy implications are considered in Section 4 while Section 5 concludes the paper and proffer recommendations based on the findings of the study.

II. Literature Review

This section is presented in three sub-sections. The first dwells on review of major concepts. The second explains the theoretical underpinning of the study. In the last sub-section, a review of related empirical studies is presented.

II.1 Conceptual Issues

Two key concepts are used in this study. These are monetary policy and manufacturing sector, and are defined as follows:

According to Uchendu (2009) monetary policy is the use of the instruments at the disposal of the monetary authority to influence the availability and cost of credit or money with the ultimate objective of achieving price stability and sustainable growth. He further added that monetary policy influences the level of money stock and or interest rate i.e. availability, value and cost of credit in consonance with the level of economic activity. In the Nigerian context, monetary policy encompasses actions of the Central Bank of Nigeria that affect the availability and cost of commercial and merchant banks' reserve balances and thereby the overall monetary and credit conditions in the economy with the main objective being to ensure that overtime, the expansion of money and credit will be adequate enough for the long-run needs of the growing economy at stable prices (Akatu, 1993).

The manufacturing sector in Nigeria consists largely of a handful of factories engaged in the production of construction materials, clothing, textiles, footwear

and processed foods using simple assembly process (Kayode and Teriba, 1977). Mike (2010) asserts that the sector is a part of the real sector reputed to be an important engine of growth, an antidote for unemployment, a creator of wealth and the threshold for sustainable development. The art of manufacturing, according to Mustapha (2011), adds value to commodities and eventually creates more wealth. He further added that the ability of a nation to manufacture depends, to some extent, on their level of technological development.

II.2 Theoretical Framework

The study is based on the IS-LM framework, which was developed in 1937 by John R. Hicks to show theoretically how the product and money markets attain equilibrium simultaneously at the same level of income and interest rate (Anyanwu, 1995; Dwivedi, 2006). It has become the basis for understanding the adjustment process and the interaction of money and product markets (Anyanwu, 1995). According to Olweny and Chiluwe (2012), the IS-LM model offers a convenient model to analyse the effect of monetary policy on real macroeconomic variables. The IS curve shows the combinations of interest rates and levels of output at the equality between savings and investment while the LM schedule or money market equilibrium schedule represents combinations of interest rates and levels of income where demand for real money balances is equal to the supply (Olweny and Chiluwe, 2012; Dwivedi, 2006). Thus, the IS curve represents product market and LM curve represents money market (Dwivedi, 2006). Along the LM schedule the money market is in equilibrium, and along the IS curve the product market is in equilibrium (Dornbusch *et. al.,* 2002).

The adoption of the IS-LM framework follows the works of Olweny and Chiluwe (2012) and Saibu and Nwosa (2012). Olweny and Chiluwe (2012) explained that the IS-LM model offers a convenient model to analyse the effects of monetary policy while capturing the interplay of variables where private sector investment is determined by variables such as money supply, gross domestic debt, gross domestic savings and interest rates. According to Saibu and Nwosa (2012), in the Keynesian IS-LM approach, a discretionary change in monetary policy affects the real economy through the two sides of market forces – the demand and supply sides. Monetary policy from the aggregate demand side is transmitted either directly through the three channels; the exchange rate, the interest rate and the wealth channel or indirectly through the bank credit, which is transmitted through two channels; the bank-lending channel and the balance sheet channel. From the supply side, monetary policy impulse affects real variables through changes in the cost of inventory.

Though, Saibu and Nwosa (2012) acknowledged the supply side channel, they however adopted aggregate demand side channels for two reasons; first in the Keynesian framework, the aggregate supply is relatively fixed due to stickiness of price at least in the short-run. Second, the Nigerian economy is structurally weak and not well developed in a way that will allow the necessary adjustment to take place if the inventory cost approach is to be relevant, hence the adoption of the demand channel.

The channel of monetary policy transmission to the real sector is represented schematically as follows and as explained by the ISLM theory.

MS↑→INT↓→PSC↑→EXR↓→I↑→MO↑

In the above framework, **MS**↑ indicates expansionary monetary policy where there is government purchase of securities in the open market, resulting in decline in real interest rate, which in turn leads to increase in the amount of credit by Deposit Money Banks (DMBs) to the private sector; and decrease in exchange rate due to reduction in interest rate. These effects stimulate investment and consequently manufacturing output (Saibu and Nwosa, 2012). This could either result in increase or decrease in inflation level depending on the effect of money supply (MS) on price level and output.

II.3 Review of Empirical Studies

It is imperative to point out the major findings reported in the literature from both outside and within Nigeria on the effect of monetary policy on the manufacturing sector. Among the empirical studies conducted outside Nigeria, was the one by Carlino and Defina (1998). They examined whether monetary policy has symmetric effects across U.S during the period 1958:1 to 1992:4. Impulse response function from the estimated Structural Vector Auto Regression models (SVARs) revealed differences in policy response and the state of Michigan being the most responsive state to unanticipated changes in federal funds rate. The study further revealed that the size of state's long-run response to a monetary policy shock was positively related to the share of manufacturing with evidence of interest rate channel for monetary policy. The study found no evidence for the credit channel. A state's concentration of small firms has no significant effect on the size of the state's policy response and a greater concentration of small bank decrease states' sensitivity to monetary policy shocks.

Tkalec and Vizek (2009) examined the impact of macroeconomic policies on manufacturing production in Croatia. The analysis was conducted using quarterly

data from 1998:1 to 2008:2. The study modelled changes in the output of 22 manufacturing industries as a function of changes in macroeconomic conditions of monetary and fiscal policies as well as real effective exchange rate using ordinary least squares (OLS) approach. The results showed that restrictive monetary policy led to the contraction of manufacturing output. The results for exchange rate revealed that exchange rate depreciation boosts output in industries characterised by low and medium technological intensity but the opposite was true for industries requiring a high or medium level of technological intensity.

Yusof (2009) ascertained the relative effect of monetary indicators on sectoral output in Malaysia using quarterly data covering 1970:1 to 2008:3. The econometric appraisal of the monetary indicators was based on the Johansen-Juselius co-integration techniques, vector error correction model (VECM) and parsimonious error correction model (PECM). To take account of the effect of the mid-1977 financial crisis, a dummy variable was introduced in the model. The findings on Johansen-Juselius co-integration test revealed long-run relationship among the variables. The results on short-run relationship showed that broad money (M_2), interest rate and exchange rate were significantly linked to agricultural real output; while liquid money (M_1), interest rate and exchange rate were variables that affect manufacturing activity in the short run. Thus, credit and broad money do not affect manufacturing output. Construction and services output were not responsive to all the monetary indicators in the short-run.

A similar study on Pakistan by Alam and Waheed (2006) examined whether monetary policy shocks have different sectoral effects or not. The study adopted a reduced form Vector Autoregressive (VAR) approach to estimate the statistical relationship among the set of variables. The analysis estimated VAR for each sector as well as for aggregate production. The result for the real output (GDP) revealed that monetary policy, proxied by call money rate, has significant impact on the GDP i.e. real output declines in response to monetary tightening. On the sectoral output, the findings indicated that mining and quarrying; manufacturing; wholesale and retail trade; and finance and insurance sectors were more responsive to monetary shocks. Agriculture and construction sectors were weakly interrelated with interest rate.

Ibrahim and Amin (2005) investigated the dynamic effects of exchange rate and monetary policy shocks on manufacturing output in Malaysia using quarterly data spanning from 1978:1 to 1999:4. The study used Vector Autoregressive (VAR) approach and co-integration technique based on Johansen (1988) and Johansen-Juselius (1990). The co-integration test revealed that the variables were

co-integrated. The findings generally showed that shocks in the interest and exchange rates had significant negative effect on manufacturing output and output of other sectors.

Sukmana (2011) investigated the sensitivity of the economic sectors to changes in the Islamic and conventional monetary policy. The study covers the period from June 2006 to February 2011 using monthly data. The researcher carried out co-integration test based on Johansen and Juselius procedure and also estimated the Impulse Response Function (IRF). The study used Industrial Production Index (IPI) as the dependent variable while overnight interbank rate for conventional bank was adopted as a proxy for the conventional monetary instrument (CONOMIST) and the Islamic overnight interbank rate was used as a proxy for the Islamic monetary policy (ISMONINST). The findings revealed that real output was not influenced by conventional rate but it responded negatively to Islamic monetary instrument. Only the manufacturing sector responded positively to the shock of the conventional monetary rate.

Having examined evidence from other countries on disaggregated impact of monetary policy, we now report studies within Nigeria on the topic. The study by Saibu et al. (2011), studied the relative effect of monetary policy in stimulating sectoral output growth using quarterly data over the period 1986:1 to 2008:4. The model used was Autoregressive Distributed Lag (ARDL) bound testing to co-integration and the error correction model. Six sectors were analysed and the findings revealed that all the sectors were sensitive to varying monetary policy indicators but the manufacturing sector was not sensitive to any of the monetary policy variables both in the short-run and long-run.

Saibu et. al., (2012) in another related research, investigated the monetary transmission mechanism on six sectors of the Nigerian economy. The study employed quarterly data spanning from 1986:1 to 2009:4 and the sectors included were agriculture, mining, manufacturing, building and construction, wholesale and retail trade and the service sectors. Six unrestricted VAR systems for the six sectors were estimated as well as variance decomposition. The result revealed that there were differences in the channels through which monetary policy was transmitted to the various sectors and that only two channels were outstanding i.e. the interest rate channel and the exchange rate channel. Thus the credit and the asset price were weak channels of transmitting monetary policy impulse. The interest rate channel was responsible for transmitting monetary policy to the manufacturing sector.

Ubi et. al., (2011) looked at the relationship between monetary policy and industrialisation in Nigeria with data covering the period 1970-2008. The authors

adopted a Vector Autoregressive (VAR) model and the Forecast Error Variance Decomposition (FEVD) estimates. They found that the predominant sources of fluctuations in industrialisation in Nigeria were largely own shocks and to a lesser extent monetary policy i.e. linkage between industrialisation and monetary policy in Nigeria is weak and unpredictable in both the short-run and long-run.

In a similar research by Ubi et. al., (2012), an empirical assessment of the impact of monetary policy on industrialisation in Nigeria as an open economy was carried out with a sample period of 1970-2009. The study adopted the Johansen co-integration approach, error correction model (ECM) and the parsimonious model as estimation techniques. The findings revealed that monetary policy has statistically significant impact on industrialisation in both the short-run and long-run in Nigeria.

Ehinomen and Oladipo (2012) investigated the impact of exchange rate management on the growth of the manufacturing sector in Nigeria with data covering the periods 1986-2010 using Ordinary Least Square (OLS) analysis. The study found inverse relationship between exchange rate depreciation and manufacturing production in Nigeria, and significantly positive effect of inflation on manufacturing output.

In a similar study, David et. al., (2010) investigated the effects of exchange rate fluctuations on the Nigerian manufacturing sector from 1986-2005. The study used Ordinary Least Square (OLS) regression technique and the results revealed statistically significant adverse effect of exchange rate fluctuations on the manufacturing output.

The review of empirical studies suggests that studies on the effect of monetary policy on the manufacturing sector are few in Nigeria and the findings are inconclusive hence the need for further empirical investigation. This research, therefore, adds to the existing literature by including more data, relevant variables and employing more adequate econometric model in order to arrive at a robust outcome that would provide valuable information to the monetary authority in the design of appropriate monetary policy for the development of the manufacturing sector in Nigeria.

III. Research Methodology

III.1 Data

This research, in view of its nature, made use of secondary data. Annual data were employed and were sourced from the Central Bank of Nigeria (CBN) Statistical Bulletin and National Bureau of Statistics (NBS) financial and external

sector statistics for the period 1970-2012. The 43-year period is selected to meet the requirement of the Central Limit Theorem that sample size must not be less than thirty years for normality purpose, and the fact that the larger the sample, the greater the reliability or validity of time series research findings (Gujarati, 2005).

III.2 Variables Measurement

The dependent variable is real manufacturing output and is used as a proxy for the manufacturing sector following the works of Saibu *et al.* (2011 and 2012). The independent variables are measured as follows: Broad money (M_2) stands as a proxy for money supply as applied by Ubi et. al.,(2011) and Onyeiwu (2013). We used prime lending rate as a proxy for interest rate. Anthony and Mustapha (2011) also used this as a proxy. Official exchange rate of the naira to the US dollar was used as a proxy for exchange rate following David (2010), Anthony and Mustapha (2011), Saibu *et al.* (2011 and 2012), and David *et al.* (2010). Private sector credit is used to represent the credit channel following Sabiu et. al., (2011 and 2012). Consumer Price Index (CPI) is incorporated into the model as a proxy for inflation rate following the works of David (2010), Saibu et. al.,(2011 and 2012).

III.3 Model Specification

The econometric model used for the study is adapted from Saibu and Nwosa (2011) and is specified as follows:

$$InRMO = \beta_o + \beta_1 InMS_t + \beta_2 InINT_t + \beta_3 InEXR_t + \beta_4 InPSC_t + \beta_5 InCPI_t + U_t \quad (1)$$

Where:

lnRMO	=	log of real manufacturing output
β_o	=	Constant parameter
β_1- β_5	=	Coefficients of the explanatory variables
U_t	=	Stochastic disturbance term
$lnMS_t$	=	log of money supply
$lnINT_t$	=	log of interest rate
$lnEXR_t$	=	log of exchange rate
$lnPSC_t$	=	log of credit to the private sector
$lnCPI_t$	=	log of consumer price index
t	=	Time Subscript

Therefore, equation 1 was employed as a model for this research.

III.4 Method of Data Analysis

The data collected for this research were analysed using Autoregressive Distributed Lag (ARDL) model along with error correction model following the

works of Saibu and Nwosa (2011); Aliero *et al.* (2013); Khosravi and Karimi (2010). The ARDL model is a recent innovation in time series econometrics developed by Pesaran and Shin (1996); Pesaran and Pesaran (2001); for testing the existence of co-integration. One of the advantages of using the ARDL approach to testing for the existence of a long-run relationship between variables is that it is applicable irrespective of whether the underlying variables are purely I(0) or I(1), or a mixture of both (Khosravi and Karimi, 2010). However, in the presence of I(2) variables, the computed F-statistics provided by Pesaran *et al.*(2001) will become invalid.

Therefore, the use of unit root tests in the ARDL approach is inevitable to ensure that none of the variable is integrated of order I(2) or beyond. To detect the presence or otherwise of unit root, we consider a variable that has a unit root represented by a first order autoregressive AR (1) as follows:

$$Y_t = \beta Y_{t-1} - U_t. \quad (2)$$

Where Y_t is the level variable, Y_{t-1} is the first lag of the dependent variable (Y_t), β is the parameter and U_t is the white noise error term assumed to be normally distributed with zero mean and constant variance and also assumed to be serially uncorrelated. If the absolute value of the coefficient β is less than 1 (i.e. $|\beta|<1$), then Y_t is stationary. If, on the other hand, the absolute values of the coefficient β is statistically equal to or greater than 1 (i.e $|\beta| \geq 1$) then Y_t is non stationary and unit root exists (Gujarati, 2005). To identify stationarity or non-stationarity of the variables used in this research, we adopted the Phillips-Peron (PP) unit root test and the conventional Augmented Dickey – Fuller (ADF) unit root test based on the model expressed below:

$$\triangle Y_t = \beta_0 + \beta_1 Y_{t-1} + a_i \sum \triangle Y_{t-I} + u_t \quad (3)$$

Where:

$\triangle Y_t$ = Differenced value of a given time series variable
β_0 = Constant Parameter
β_1 = Coefficient of the first lag value of the series variable
Y_{t-1} = First lag value of a series variable
a_i = Coefficient of the lag values of the differenced time series variable
$\triangle Y_{t-i}$ = Lag values of the differenced series variable
u_t = Error term

The Autoregressive Distributed Lag (ARDL) model used in this study is expressed as follows:

$$\triangle \ln RMO = \delta_0 + \delta_1 \ln RMO_{t-1} + \delta_2 \ln MS_{t-1} + \delta_3 \ln INT_{t-1} + \delta_4 \ln EXR_{t-1} + \delta_5 \ln PSC_{t-1} + \delta_6 \ln CPI_{t-1} + \sum \lambda_1 \Delta \ln RMO_{t-i} + \sum \lambda_2 \Delta \ln MS_{t-i} + \sum \lambda_3 \Delta \ln INT_{t-i} + \sum \lambda_4 \Delta \ln EXR_{t-i} + \sum \lambda_5 \Delta \ln PSC_{t-i} + \sum \lambda_6 \Delta \ln CPI_{t-i} + \upsilon_t \quad (4)$$

Where δ_0= Constant Parameter

Δ = First difference operator

δ_i, λ_i = Vector of the parameter of the lagged values of the natural logarithmic values of the explanatory variables.

υ_t = Error term

The terms with the summation signs ($\sum$) in equation 4 above represent the error correction dynamics while the second part of the equation with δ_i correspond to the long-run relationship. The null hypothesis in the equation is $H_0 = a_1 = a_2 = a_3 = 0$. This denotes the absence of long-run relationship while the alternative hypothesis is H_1: $a_1 \neq a_2 \neq a_3 = 0$. The calculated F-statistic is compared with two sets of critical values. One set assumes that all the variables are I(0) and the other assumes they are I(1). If the calculated F – statistic exceed the upper critical value, the null hypothesis of no co-integration will be rejected irrespective of whether the variables are I(0) or I(1). If it is below the lower bound value, the test is inconclusive (Ali, 2015).

Once a co-integration relationship has been ascertained the long-run and short run parameters of the co-integration equation are then estimated. The long run co-integration relationship was estimated using the following specification:

$$\ln RMO = \delta_0 + \delta_1 \ln RMO_{t-1} + \delta_2 \ln MS_{t-1} + \delta_3 \ln INT_{t-1} + \delta_4 \ln EXR_{t-1} + \delta_5 \ln PSC_{t-1} + \delta_6 \ln CPI_{t-1} + U_t \quad (5)$$

In order to estimate the short-run relationship between the variables and the speed of adjustment of the model to equilibrium, the corresponding error correction equation was estimated as expressed below:

$$\ln RMO = \lambda_0 + \sum \lambda_1 \Delta \ln RMO_{t-i} + \sum \lambda_2 \Delta \ln MS_{t-i} + \sum \lambda_3 \Delta \ln INT_{t-i} + \sum \lambda_4 \Delta \ln EXR_{t-i} + \sum \lambda_5 \Delta \ln PSC_{t-i} + \sum \lambda_6 \Delta \ln CPI_{t-i} + \lambda_7 ECM_{t-1} + U_t \quad (6)$$

Where, ECM is the Error correction term of one period lag estimated from equation (6), the coefficient λ_7 measures the speed of adjustment of the model's convergence to equilibrium.

IV. Data Analysis and Results Discussions

In this section, the results of the study are presented, analysed and discussed.

IV.1 Unit Root Test Results

The results of our unit root tests using the Augmented Dickey Fuller (ADF) and Phillips Perron (PP) tests are presented in table 1.

Table 1: Unit Root Tests Results

	ADF Unit root test			PP unit root test		
Variables	**At Level I(0)**	**At First Diff. I(1)**	**Status**	**At Level I(0)**	**At First Diff. I(1)1)**	**Status**
lnRMO	-2.669*		I(0)	-2.857*		I(0)
lnMS	-0.35	-4.609***	I(1)	-0.348	-4.603***	I(1)
lnINT	-1.68	-9.148***	I(1)	-1.535	-9.139***	I(1)
lnEXR	-0.129	-5.211***	I(1)	-0.244	-5.228***	I(1)
lnPSC	-0.275	-4.923***	I(1)	-0.283	-4.905***	I(1)
lnCPI	-3.922***		I(0)	-3.82***		I(0)
Note: significant at 1 per cent (***) and 10 per cent (*). The values presented are test statistic values.						

Source: Stata 10.0.

As a first step in the analysis, the series were transformed into natural logarithm form and tests for unit roots in the variables at both level and first difference values were conducted.

Considering the manufacturing output (lnRMO) and lnCPI in Table 1, it was found that the null hypothesis of a unit root at level is rejected in both the ADF and PP tests. Hence, manufacturing output and CPI are stationary at level values I(0). This is because in absolute term, their test statistic values are greater than the critical values at 10 per cent and 1 per cent respectively. The results of data on money supply (lnMS), interest rate (lnINT), exchange rate (lnEXR) and private sector credit (lnPSC) indicate that the variables are not stationary at level. But taking their first difference, the variables became stationary at first order I(1) as their test statistic values in absolute term are greater than their respective critical values at 1 per cent. In summary, the unit root test has indicated that our independent variable (i.e. manufacturing output) and one of the explanatory variables (inflation rate) are stationary at level i.e. I(0) while the remaining variables are integrated of the first order i.e. I(1) (see Table 1). This implies that none of the series is I(2) and can all be included in the ARDL estimation.

IV.2 Optimum Lag Selection Criteria

Optimum lag selection was carried out in order to determine the number of lag(s) to be included in the model prior to the bound test. The results are presented in Table 2.

Table 2: Optimum Lag Selection Criteria

Lag	LL	LR	Df	P	FPE	AIC	HQIC	SBIC
0	-11.629				0.141635	0.88094	0.97269	1.13443
1	3.83822	30.92*	1	0.000	0.06883*	0.15809*	0.26495*	0.45364*
2	4.02341	0.37038	1	0.543	0.071821	0.19883	0.320959	0.536605
3	4.87008	1.6933	1	0.193	0.072545	0.206496	0.343891	0.586494

Source: Stata 10.0.

From Table 2, the Sequential Modified Likelihood Ratio (LR), Final Prediction Error (FPE), Akaike Information Criteria (AIC), Hanna-Quinn Information Criteria (HQIC) and Schwarz-Bayesian Information Criteria (SBIC) indicate one maximum lag selection at 1 per cent level of significance.

IV.3 Bound Test for Cointegration Analysis

Having conducted the unit root test and the optimum lag selection, F-statistic test for cointegration is required to determine whether there is cointegration among the variables captured in the unrestricted error correction version of the ARDL model. This has been estimated using the bound testing approach and the results presented in Table 3.

From table 3, the bound test results reveal the existence of six co-integrating equations among the variables. When manufacturing output is the dependent variable, i.e. in the function F_{lnRMO} (lnRMO/lnMS, lnINT, lnEXR, lnPSC, lnCPI), the null hypothesis that there is no co-integration between monetary policy variables and the manufacturing output is rejected at both 5 per cent and 10 per cent as the F-statistic, 4.0494 is greater than the critical value, 3.7583 and 3.1892 at the upper bound indicating there is co-integration between monetary policy and the output of the manufacturing sector. When money supply, interest rate and exchange rate were each captured as the dependent variable, their respective F-statistics (2.7839, 2.6404 and 3.0698) are less than the upper bound critical values (i.e. 3.7583 and 3.1892) at 5 and 10 per cent; but greater than the lower bound critical values, 2.3675 and 1.9666, at 5 per cent, which also indicate the rejection of the null hypotheses of no co-integration at 5 per cent level.

Table 3: Bound Test Results

Dependent Variable	Function	F-Statistics
$\ln RMO$	$F_{\ln RMO}(\ln RMO \mid \ln MS, \ln INT, \ln EXR, \ln PSC, \ln CPI)$	4.0494**
$\ln MS$	$F_{\ln MS}(\ln MS \mid \ln RMO, \ln INT, \ln EXR, \ln PSC, \ln CPI)$	2.7839**
$\ln INT$	$F_{\ln INT}(\ln INT \mid \ln MS, \ln RMO, \ln EXR, \ln PSC, \ln CPI)$	2.6404**
$\ln EXR$	$F_{\ln EXR}(\ln EXR \mid \ln INT, \ln MS, \ln RMO, \ln PSC, \ln CPI)$	3.0698**
$\ln PSC$	$F_{\ln PSC}(\ln PSC \mid \ln EXR, \ln INT, \ln MS, \ln RMO, \ln CPI)$	39.2623**
$\ln CPI$	$F_{\ln CPI}(\ln CPI \mid \ln PSC, \ln EXR, \ln INT, \ln MS, \ln RMO)$	3.8404**
Asymptotic Critical Value for Rejecting Null Hypothesis		
Critical value	At 5 per cent	At 10 per cent
Lower bound	2.3675	1.9666
Upper bound	3.7583	3.1892

Note: Significant at 5 per cent (**).
Source: Microfit 5.0.

Also, for the functions where private sector credit and inflation were each used as the dependent variable, the F-statistics (39.2623 and 3.8404) fall above the critical value at the upper bound (i.e. 3.7583 and 3.1892) indicating the existence of co-integration at 5 per cent level. In a nutshell, the bound testing has indicated the existence of strong co-integrating equations among the series as revealed by the F-statistic and the critical values; meaning that there is long-run relationship among the variables.

IV.4 Results of Estimated Long-run Coefficients Based on ARDL Approach

Owing to the fact that the existence of co-integration among the variables has been established, the long-run relationship between manufacturing output and monetary policy variables has also been estimated using the ARDL approach with ARDL (1,0,0,0,0,0) specification selected based on Akaike Information Criterion. The results are presented in Table 4.

The results reported in Table 4 reveal that the null hypothesis of no co-integration between money supply channel and manufacturing output in Nigeria cannot be

rejected as can be seen from the P-value 0.78770. Furthermore, on interest rate and the manufacturing sector, the p-value (0.185) implies rejection of the alternative hypothesis indicating absence of significant long-run relationship between the manufacturing sector and interest rate in Nigeria though the coefficient, 0.91002, is positive. On the other hand, a negative and significant long-run relationship is found between exchange rate channel and the manufacturing sector in Nigeria. This is because the p-value (0.000) signifies rejection of the null hypothesis at 1 per cent level of significance. While the estimated coefficient which is -0.76270 indicates that a 10 per cent increase in exchange rate in Nigeria leads to approximately 7.63 per cent decrease in manufacturing output in the long-run (see Table 4).

Table 4: Result of Estimated Long-run Coefficients Based on ARDL Approach: ARDL (1,0,0,0,0,0) Selected Based on Akaike Information Criterion (AIC)

(Dependent Variable: lnRMO)

Independent Variables	Coefficients	Standard Error	Test –Ratio
LnMS	0.97189	1.2338	0.7877
			(0.436)
LnINT	0.91002	0.67317	1.3518
			(0.185)
LnEXR	-0.7627***	0.19642	3.8829
			(0.000)
LnPSC	-0.21071	1.1764	0.17912
			(0.859)
LnCPI	-0.10913	0.27396	0.39834
			(0.693)

Note: Significant at 1 per cent (***). The values in parenthesis are probability values.
Source: Microfit 5.0.

From the results of private sector credit and inflation, they reveal the acceptance of the null hypothesis, which states that no co-integration between each of private sector credit on one hand, inflation on the other hand, and the manufacturing sector. This is because their p-values, 0.859 and 0.693, respectively, are not statistically significant though their coefficient estimates (-0.21071 and -0.10913) imply negative relationship.

Therefore, the results indicate the existence of long-run relationship between monetary policy and the manufacturing sector in Nigeria; and that monetary

policy shock is transmitted with negative effect on the manufacturing sector through the exchange rate channel of monetary transmission mechanism.

IV.5 Results of Estimated Short-run Relationship Between Monetary Policy and the Manufacturing Sector

The short-run relationship between monetary policy and the manufacturing sector is estimated using the error correction model and the results are presented in Table 5 as follows.

From Table 5, the error correction coefficient (ecm), which is approximately -0.22 not only has the expected negative sign but it is also statistically significant at 5 per cent considering the probability value which is 0.028. The value of the ecm implies a fairly slow speed of adjustment to equilibrium after a shock. Approximately 22 per cent of disequilibria from the previous year's shock converge back to the long-run equilibrium in the current year. For the respective explanatory variables, as in the case of the long-run estimation, the short-run results only show the existence of significant negative relationship between exchange rate and the manufacturing sector at 5 per cent level. The result indicates that a 10 per cent increase in exchange rate will approximately result in 0.5 per cent decline in the manufacturing output. The coefficients of other monetary/explanatory variables are not significant.

Table 5: Results of Error Correction Version of the ARDL Model

(Dependent Variable: ΔlnRMO)			
Independent Variables	**Coefficients**	**Standard Error**	**Test –Ratio**
ΔlnMS	0.20896	0.23286	0.89805
			(0.375)
ΔlnINT	0.19565	0.20283	0.96459
			(0.341)
ΔlnEXR	-0.045303**	0.062097	2.6407
			(0.012)
ΔlnPSC	-0.045303	0.24482	0.18505
			(0.845)
ΔlnCPI	-0.023463	0.057596	0.40737
			(0.686)
ecm(-1)	-0.21500**	0.094185	2.2827 (0.028)

Note: Significant at 5 per cent (**). The values in parenthesis are probability values.
Source: Microfit 5.0.

In summary, the short-run results indicate that monetary policy is transmitted with negative effects on the manufacturing sector in Nigeria through the exchange rate channel, which is the same as the long-run effects earlier explained.

IV.6 Results of the Diagnostic Test of the ARDL Approach

To justify the adequacy of the selected ARDL model, post-estimation diagnostic tests for serial correlation and heteroscedasticity were carried out and the outcome is presented in Table 6.

Table 6: Results of the Diagnostic Test of the selected ARDL Model

Test of Serial Correlation of Residuals		
L M Version	CHSQ(1)	0.0087245 (0.926)
F Version	F(1,35)	0.0072719 (0.933)
Autoregressive Conditional Heteroscedasticity Test of Residuals		
L M Version	CHSQ(1)	0.0545521 (0.815)
F Version	F(1,35)	0.045519 (0.832)

Note: The values in parenthesis are probability values.
Source: Microfit 5.0.

From Table 6, the Langrange Multiplier (LM) test was adopted and the p-value is 0.926, which is not significant and indicating that the null hypothesis of no serial correlation is accepted. This is indeed a desirable result proving the adequacy of the selected ARDL model. Also, on the test for heteroscedasticity, autoregressive conditional heteroscedasticity test was carried out and the null hypothesis, which says that the model is homoscedastic, could not be rejected going by the p-value (0.815). This indicates that the model is not heteroscedastic. In a nutshell, the two post-estimation tests have complemented each other in justifying the adequacy of the adopted ARDL model.

IV.7 Discussion of Results

This paper has empirically examined the effects of monetary policy on the manufacturing sector in Nigeria from 1970 to 2012 using time series analysis. Firstly, the data were transformed into natural logarithm as suggested by Ibrahim and Amin (2005), Khosravi and Karimi (2010) and Aliero *et al*. (2013); and ADF and PP tests were used in testing for the stationarity of the variables. Due to the outcome of our unit root tests which reveal a mixture of integration order, i.e. I(0) and I(1) among our variables, bound testing approach to co-integration with an

autoregressive distributed lagged (ARDL) model became an unavoidable estimation procedure; being a technique capable of providing consistent estimation when variables are integrated of different orders. The discussion of the outcome examines how the results of this research, earlier explained are in line with or different from similar studies previously conducted; and it takes the form of three dimensions: firstly on the long-run effects of monetary policy on the manufacturing sector; secondly on the short-run relationship among the variables. and lastly, the policy implications of the findings.

IV.7.1 Discussion of Results on the Long-run Relationship Between Monetary Policy and the Manufacturing Sector in Nigeria

To start with, the bound testing approach confirmed the existence of cointegration between monetary policy variables and the output of the manufacturing sector. This is in line with the findings of Yusof (2009), Sukmana (2011), Ibrahim and Amin (2005), and Carlino and Defina (1998). The result is, however, in contrast with the work of Saibu and Nwosa (2011), which revealed no cointegration among the variables.

On the long-run relationship among the variables, our ARDL results reveals a positive but statistically insignificant long-run relationship between broad money supply (M_2) and manufacturing output in Nigeria, which is in conformity with the work of Yusof (2009); but partially contradicts the work of Khosravi and Karimi (2010), which revealed a negative but insignificant relationship. This means that the broad money supply channel does not transmit long-run monetary policy impulse to the manufacturing output in Nigeria. The result is also in conformity with the Keynesian argument that money is neutral and has no real effect in the long-run due to liquidity trap as explained in the works of Alam and Waheed (2006), Yusof (2009), and Taylor (1995).

The interest rate channel on the other hand, reveals positive but statistically insignificant long-run relationship with the manufacturing output. The positive sign of the coefficient of interest rate is not in line with the economic theoretical proposition that rising interest rate crowd out real investment (Olweny and Chiluwe, 2012). However, the result is not statistically significant. This evidence of no long-run effect of interest rate channel on the manufacturing sector is inconsistent with the findings of Sukmana (2011), which revealed positive and significant long-run relationship; and contradicts the work of Ibrahim and Amin (2005), Tkalec and Vizek (2009), Carlino and Defina (1998), which showed negative and statistically significant long-run relationship. The result which reveals no interest rate channel aligns with what is obtainable in money supply above as

money supply transmits its impulse on the real sector through the interest rate channel of monetary transmission mechanism (Saibu and Nwosa, 2012). Hence, since there is no evidence of money supply channel, it is consistent with economic theory that there should be no evidence of interest rate channel of monetary policy transmission on real manufacturing output.

The findings on exchange rate channel, which reveal negative and statistically significant effect on the manufacturing output conforms with the research conducted by Ibrahim and Amin (2005) and Ubi et al. (2012). It is, however, in contrast with the works of Yusof (2009) and Saibu and Nwosa (2011) that found no evidence of exchange rate channel. Our result implies that exchange rate changes affect the growth of the manufacturing sector in the long-run. Lastly, the results of private sector credit and inflation that reveal no statistically significant effects are in line with the findings on both variables by Saibu and Nwosa (2011), Yusof (2009); and the findings of Carlino and Defina (1998) on the credit channel. The results buttress the findings on broad money supply channel explained above that reveals insignificant long-run relationship with the manufacturing sector.

4.7.2 Discussion of Results on Short-run Relationship Between Monetary Policy and the Manufacturing Sector in Nigeria

On the short-run relationship, it has been discovered that the error correction term is negative and statistically significant. This is in conformity with earlier studies by Saibu and Nwosa (2011), and Yusof (2009). On the short-run broad money channel, which this study found no evidence of relationship with the manufacturing sector in Nigeria, the result conforms to that of Yusof (2009) but contradicts Ubi et al. (2012) that indicated significantly positive relationship.

The findings on interest rate, which shows no significant short-run negative relationship with the output of the manufacturing sector is in line with Ubi *et al.* (2012), and Saibu and Nwosa (2011). The result is, however, in contrast with the studies conducted by Alam and Waheed (2006), Yusof (2009), Tkalek and Vizek (2009) and Saibu and Nwosa (2012) which revealed short-run negative relationship. The results of broad money supply and interest rate contradict Keynesian propositions that monetary policy is effective in the short-run as elucidated by Agba (1994) and Afolabi (1998).

On the exchange rate channel, the findings of this study reveal negative and statistically significant effect on the manufacturing sector in the short-run which, is in conformity with the works of Yusof (2009), Ehinomen and Oladipo (2012), David *et al.* (2010) and Ubi (2012). It is, however, not in line with the findings of Saibu and

Nwosa (2011 and 2012) that found no evidence of exchange rate channel on the sector in the short-run. These findings imply that changes in exchange rate adversely affect the growth of the manufacturing sector in the short-run.

While the result on private sector credit, which is positive but insignificant in the short-run, aligns with the works of Yusof (2009) and Saibu and Nwosa (2011 and 2012); the negative but statistically insignificant short-run relationship as revealed by inflation result is partially in contrast with the study by Saibu and Nwosa (2011), which revealed inflation to have negative and statistically significant short-run relationship with the sectoral output. The inflation result is, however, in conformity with the work of Alam and Waheed (2006); and partially in line with the work of Ehinomen and Oladipo (2012) that revealed positive and significant relationship.

The results of the study were also found largely not to be in conformity with the previous studies (e.g. David, 2010; Okoro, 2013; Adefeso and Mobolaji, 2010; Onyeiwu, 2013) that focus on aggregate output hence the need for sector-specific monetary policy design with regards to the manufacturing sector.

IV.7.4 Policy Implications of Findings

The findings of the study indicate that broad money supply, interest rate, private sector credit and inflation do not explain changes in the output of the manufacturing sector. It is found that exchange rate is the only effective channel of monetary policy transmission on the manufacturing sector, and increase in exchange rate have negative effect on the growth of the sector in Nigeria.

On the money supply channel, the reason why no evidence from both short-run and long-run is traceable to the manufacturing sector could be because firms in the sector are more of small and medium scale holding large and highly liquid money due to the underdeveloped nature of the Nigerian financial system and the need to safeguard against the uncertainties of the system. According to Gbandi and Amissah (2014), small and medium enterprises represent about 90 per cent of total manufacturing establishments in Nigeria.

The result which also reveals that the sector is not interest rate sensitive implies that manufacturing firms are not heavily dependent on bank loans. In addition, the credit channel is not important in both long-run and short-run, and this could be because firms in the sector largely rely on their own sources of funding such as personal savings and retained earnings; as such, interest rate, broad money and credit are not important channels. Hence, narrow/liquid money (M_1) may be having greater role in the manufacturing sector. However, this needs empirical verification. More so, the rapid technological and communications development

in banking facilities could result in a fundamental increase in M_1 given the increased demand for internet banking, telephone banking, automated teller machines (ATM), debit cards and credit cards, which allow for greater access to highly liquid money in the banking system (Yusof, 2009).

The evidence on exchange rate channel, which indicates a significant negative long-run and short-run relationship with the manufacturing sector, could be because the sector largely depends on foreign technology and inputs as explained by David *et al*. (2010). Fluctuating and high exchange rate causes instability or reduction in the purchasing power of manufacturing firms for importation of inputs, which results in reduction in the output of the sector. The finding is also in line with the theoretical argument by Yusof (2009) that in an increasingly globalising world economies, exchange rate channel of monetary transmission is one of the most dominant determinant of real output. The findings on inflation reveal no significant effect on the manufacturing sector. This implies that inflation does not explain changes in the output of the manufacturing sector. This could be because consumer price index (CPI) is used in measuring inflation. With empirical investigation, producer price index (PPI) may be having a significant impact on the sector.

In addition, our findings on the sector reveal that its reaction to changes in monetary indicators largely differs from the results on aggregate output in previous studies examined in the literature (David 2010; Okoro 2013; Adefeso and Mobolaji 2010; and Onyeiwu 2013). This, therefore, suggests that the use of monetary policy instruments to stimulate output of the manufacturing sector based on the findings on aggregate output could result in policy ineffectiveness. Hence, the need to adopt sector-specific policy measures on the basis of sectoral empirical investigations. Monetary policy aimed at improving the manufacturing sector should be designed on the basis of empirical evidences on how the transmission channels specifically affect the sector, and not from evidences from studies on aggregate output.

V. Recommendations and Conclusions

From the findings above, conclusions are drawn that broad money supply, interest rate and private sector credit do not cause changes to the growth of the manufacturing sector in Nigeria. This could mean that firms in the sector hold more of liquid money and do not depend on the financial system to finance their economic activities probably due to the underdeveloped nature of the financial system, insufficiency of funds and high rate of interest on borrowing from banks. Hence, they rely on personal or other sources of funding outside the banking

system. This calls for the need to adopt policies to further strengthen the financial system as a catalyst for economic development.

The findings on exchange rate indicated that it is the only channel responsible for transmitting monetary policy impulse with significantly negative effect on the manufacturing sector. This could be as a result of the sector depending largely on external sources of technology and other inputs. This suggests the need for policies that will encourage the development and the use of domestic technology and raw materials in manufacturing activities to reduce dependence on imported ones. The result on inflation revealed no significant long-run and short-run effects on the manufacturing sector, which implies that inflation does not explain changes in the output of the sector.

Generally, the findings of this study have demonstrated that the potential benefits of promoting growth in the output of the manufacturing sector by the Central Bank of Nigeria (CBN) can be fully realised when the sector's specific responses to monetary transmission mechanism, through empirical verifications, are taken into consideration in the design of monetary stabilisation policies.

Based on the results of this research, which revealed that broad money supply channel is not significant in influencing manufacturing output in Nigeria due to the underdeveloped nature of the financial system, we recommend development of the system through mobilisation of more savings from the public and linking resources from the informal or traditional financial sector to the banking system. This is expected to increase broad money supply (M_2) as a percentage of GDP, reduce interest rate, and increase access to funds and investment in the manufacturing sector.

It is also empirically discovered that interest rate channel does not transmit monetary policy impulse to the manufacturing sector as firms in the sector do not depend on bank loans. Based on this, it is recommended that interest rate should be reduced to a level that would facilitate access to funds in the banking system by manufacturing firms in order to enhance investment in the sector.

The findings of the study revealed that exchange rate is the only channel with significant adverse effect on the growth of the manufacturing firms due to their high dependence on imported input. Hence, development of indigenous technology and encouragement of firms in the sector to use locally sourced raw materials is recommended. These, the government could achieve by making adequate funding available to indigenous science and technology research centres, and encouragement of science and technology-based knowledge acquisition through provision of the needed facilities in schools and higher

institutions. There is also the need for more research grants to higher institutions and scholarships to science and engineering students with strict guidelines and monitoring to prevent diversion of funds. Local content laws should be adequately enforced through monitoring of firms' compliance with the relevant regulations. In relation to this finding on exchange rate, fiscal policy with regards to high customs duty should be placed on imported inputs that have local substitutes, and domestic patronage of the products of manufacturing firms should be enhanced through embargo or quota on competitive foreign products.

In addition, it is found that output of the manufacturing sector is not responsive to changes in private sector credit. This has been explained to be as a result of the sector depending largely on retained earnings, private savings and other sources of funds due to high interest rate on bank loans. It is, therefore, suggested that credit to the private sector be enhanced, monitored and a reasonable percentage be directed to the manufacturing firms in order to protect the sector from undue competition for loans, and commercial banks' credit rationing which could be in favour of other more developed and competitive sector or few firms within the manufacturing sector.

Furthermore, the monetary authority should maintain low and steady inflation rate that would enhance investors' confidence in the economy. This is expected to bring stability in the economy and higher investment in the manufacturing sector.

There is also need for sustained reform of the banking sector and strengthening of the monetary policy design and implementation by adopting sector specific policy with regards to the efficacy of the monetary transmission channels based on their relative strength and significance in influencing sectoral output. This is because the findings of this study revealed that the effects of monetary policy on the manufacturing output differ from its impact on aggregate output as revealed by previous empirical literature on the Nigerian economy.

Lastly, since broad money supply (M_2) channel is found not to have significant effect on the output of the manufacturing sector, there is need for empirical investigations to determine whether narrow money supply (M_1) explains changes in the output of the sector. There is also need to investigate domestic credit, credit to manufacturing sector, and liquidity ratio to determine their effects on the manufacturing sector. The Nigerian manufacturing sector is categorised into three – oil and gas, cement, and other manufacturing – hence, empirical investigations should be conducted to determine the possible asymmetrical effect of monetary policy on the various components of the manufacturing sector. In addition, this study could be further enriched if fiscal variables such as government expenditure

were included to examine the combined effects of both monetary and fiscal policies on sectoral output.

V.1 Suggestions for Further Study

In view of the scope of the study, the following areas for further study are suggested:

- Since broad money supply (M_2) channel was found not to have significant effect on the output of the manufacturing sector, there is need for empirical investigations to determine whether narrow money supply (M_1) explains changes in the output of the sector. There is also need to investigate domestic credit, credit to manufacturing sector, and liquidity ratio to determine their effects on the manufacturing sector as these monetary variables were not included in this study.

- The Nigerian manufacturing sector is categorised into three with respect to data availability – oil and gas, cement, and other manufacturing – hence, empirical investigations should be conducted to determine the possible asymmetrical effect of monetary policy on the various components of the manufacturing sector.

- Lastly, this study could be further enriched if fiscal variables such as government expenditure and taxation were included to examine the effects of both monetary and fiscal policies on the sector.

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Factors Explaining Exchange Rate Volatility in Nigeria: Theory and Empirical Evidence

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Abstract

The study empirically investigated the factors explaining the volatility of the bilateral exchange rate of the naira to the U.S. dollar, using data for 1970-2013 period. The EGARCH (1,1) modeling technique was used. The empirical evidence indicated that volatility of the naira exchange rate was characterised by clustering, strong leverage effect and moderate degree of persistence. It was found that increased net capital flows, greater integration of the Nigerian economy into the global market, deepening of the nation's financial system, favourable crude oil prices, increase in the level of external reserves as well as economic growth were germane to dampening conditional volatility of the country's exchange rate. It was also found that external debt and monetary expansion had the potential to exacerbate volatility in the exchange rate. Policies recommended to mitigate volatility of the exchange rate included greater integration of the economy into the global market, which implies diversification of the country's export base, less reliance on external borrowing, building up and maintaining a robust external reserves position, financial system development and use of contractionary monetary policy to control broad money growth.

Keywords: Exchange Rate, Volatility, Theory, Empirical Evidence
JEL Classification Numbers: F3, F31, F33

I. Introduction

A large volume of the literature on international trade and finance focuses on the effect of exchange rate volatility on economic growth. Several studies indicated that exchange rate volatility can negatively affect key macroeconomic indicators, including investment, productivity, consumption, trade and capital flows. However, a few empirical studies have focused on the determinants of volatility of exchange rate. Exchange rate volatility refers to wide fluctuations of the exchange rate around its equilibrium value. The swings generate uncertainty in the economy, and increase business and investment risks, with far-reaching negative spill-over effects in the case of developing and emerging market economies.

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The floating/flexible exchange rate regime is more susceptible to volatility, compared with a fixed exchange rate. Friedman (1953), however, observed that instability in exchange rate is a symptom of instability in the underlying economic structure. He argued that a flexible exchange rate system does not necessary have to be unstable, but where it is unstable, it is primarily because there is underlying instability in the economic conditions. Friedman's view was corroborated by Mckinnon and Schnabel (2004) and Stancik (2006), who noted that exchange rate stability is a fundamental property of stable economic development. The implication is that unstable economic development or output volatility is a major cause of exchange rate volatility (Morana, 2009).

The change from fixed exchange rate system to the flexible exchange rate system occurred in the industrial economies in 1971, following the collapse of the gold standard (Stockman, 1983; Mussa, 1986; Calderon and Kubota, 2009). Other countries, including some of the developing countries followed at various times later on. For example, in Nigeria, the switch from the fixed exchange rate regime to the flexible regime was in 1986, as part of the implementation of the Structural Adjustment Programme (SAP) policies; in Gambia, 1986; in Israel, 1990s; and in Venezuela, 2002. The general switch brought larger volatility for both real and nominal exchange rates (Al Samara, 2009), and the effects on economic growth and development of the nations have been pervasive. The effects have been mixed, though predominantly negative, especially in the developing economies (Davis and Lim, 2001; Devereux and Lane, 2001; Schnabel, 2007; Ezike and Amah, 2011).

Exchange rate is a key macroeconomic price which has significant implications for an economy. Excessive exchange rate volatility causes uncertainty in the economy, impacting negatively on economic growth through its effects on investment and investor confidence, productivity, consumption as well as international flows of trade and capital (Broda and Romalis, 2003; Ezike and Amah, 2011). Most developing and emerging economies with the free float/flexible exchange rate system would have to grapple with the problem of exchange rate volatility, leading to "a fear of floating". (Calvo and Reinhart, 2002; Deveneux and Lane, 2001).

From a microeconomic perspective, exchange rate volatility is associated with higher transaction costs, as the cost of hedging foreign exchange risk increase with volatility (Adubi, 1999; Schnabel, 2007). At the macro level, it causes inflation, due to the high cost of hedging foreign exchange against the risk it generates.

Exchange rate volatility also adversely affects international trade and capital flows (Stancik, 2006).

The deregulation of the Nigerian foreign exchange market in 1986, as part of the structural adjustment policies, marked the transition from fixed to the flexible exchange rate regime. Since that time the naira- exchange rate to the dollar has fluctuated remarkably. The effect of exchange rate volatility can be pervasive and devastating for an open, mono-product and highly import-dependent developing economy like Nigeria, with poorly developed financial markets (Aghion et. al., 2006). The country's export trade (especially non-oil export trade) has suffered much setback as a result of the instability in the exchange rate of the local currency (Aliu, 2003 and Nwidobie, 2007). Similarly, the nation's stock market has been adversely affected by volatility (Subair and Salihu, 2010). The nation, being highly import-dependent has experienced rising inflation rate, partly attributed to exchange rate volatility due to the high cost of hedging foreign exchange risk. Exchange rate volatility also affects both domestic and foreign investment adversely because it leads to uncertainty, affecting investors' confidence as well as engendering huge business and investment risk. It is, therefore, imperative for policy makers to implement policies that can stabilise exchange rate.

In view of the potential severe adverse implications that an excessively volatile exchange rate poses for economic growth and development, and the need to maintain stable economic growth, this paper sets out to investigate empirically the factors that may be germane to explaining the volatility in the naira-dollar exchange rates. Accordingly, the main objective of the paper is to investigate the factors that explain volatility of the bilateral exchange rate of the naira to the US dollar, with a view to recommending appropriate policies that can mitigate its volatility. To this end, we structure the rest of the paper, following this introductory section into four Sections. Section 2 surveys the related theoretical and empirical literature. The theoretical framework underlying the model to be specified and the methodology of the study are discussed in Section 3. Section 4 contains the discussion of the empirical results, while Section 5 contains the summary, policy recommendations and the conclusion.

II. Review of Literature

II.1 Factors Explaining Exchange Rate Volatility

Although, there is no consensus on the causative factors of exchange rate volatility, numerous factors have been identified in the literature. Some of the

factors are, oftentimes, country-specific. The commonly cited factors include trade openness, capital flows, economic growth rate, level of financial development, level of external reserves, external indebtedness, and existing exchange rate regime, among others. The way and manner as well as the extent to which each of the factors influences exchange rate movements, varies and depends on the prevailing economic conditions in each country (Stancik, 2006). It is widely agreed in the literature, however, that fluctuations in the exchange rate of countries in transition (i.e. emerging market economies) are more likely to be influenced by these factors (Stancik, 2006; Al Samara, 2009). In this section, we review the literature on the determinants of exchange rate volatility, and discuss the mechanism through which the various factors cause volatility.

II.1.1 Capital Flows

International capital flows comprise the flows of both long-term and short-term capital. Long-term capital such as foreign direct investment is often regarded as sustainable capital, while short-term capital comprising mainly of foreign portfolio investment (FPI) is regarded as temporary capital, (Rashid and Hussain, 2010). Inflow of capital causes appreciation of the domestic currency (Cordon, 1994; Oaikhenan and Aigheyisi, 2011), while outflow of capital leads to currency depreciation. Thus, the flow of capital in and out of an economy causes fluctuations in the exchange rate of the domestic currency in relation to the currencies of its trading partners. However, the degree of the fluctuations in the exchange rate arising from capital flows depends on the composition of the capital as well as the depth of the financial markets. Where there is a preponderance of short-term (temporary) capital which is generally believed to be highly volatile in nature, this may generate volatility in the exchange rate than when there is more of long-term (sustainable) capital (Jean-Louis, 2009 cited in Al Samara 2009). Kapur (2007) attributed excessive exchange rate volatility to what he called "destabilising capital flows". Sudden slowdown in private capital inflow into emerging market economies, and a corresponding slow reversal from large current account deficits into smaller deficits or small surpluses) can also generate volatility in the real exchange rate (Calderon and Kubota, 2009).

Capital flows generate less volatility in the exchange rate of countries with well-developed financial markets than in countries with poorly developed financial markets. Thus, it is widely agreed that international capital flows generate more volatility in exchange rate of the currencies of developing or transitional economies than in industrialised economies. This could be linked to the fact that the financial markets of most developing/emerging market economies are still poorly developed (Schnabel, 2007; Chit and Judge, 2008; Saborowski, 2009).

II.1.2 Trade Openness

Trade openness also plays a role in explaining volatility in exchange rate. The extent to which it influences exchange rate volatility depends on the degree of integration of the economy into the global market (Calderon and Kubota, 2009). The implication is that the more open an economy is, the less volatile is the exchange rate of its currency (Stancik, 2006). However, trade openness only mitigates volatility in the exchange rate where there is greater flexibility in the adjustment of aggregate prices (Obstfeld and Rogoff, 1995, 1996; Hau, 2000, 2002), and when the flexibility has been linked to greater openness of the economy (Obstfeld and Rogoff, 1996). These structural linkages between the degree of flexibility of aggregate prices and exchange rate volatility accentuate exchange rate volatility in less open economies. The situation is even more worrisome as policy actions to stabilise the exchange rate may risk greater volatility in inflation, output and interest rate. Thus, in the small open economy as espoused by Calvo and Reinhart (2002) and the sticky price model developed by Gali and Monacelli (2005), a necessary trade-off exists in the attainment of stability in exchange rate and ensuring stable inflation and output gap. Such economy can, therefore, be thought of as a balloon: squeezing volatility out of one part merely transfers the volatility elsewhere (Flood and Rose, 1999; West, 2003).

II.1.3 External Reserves

There are two main types of benefits that are derivable from a high level of external reserves holdings in the literature. The first is the reduction in the likelihood of currency crisis or a sudden stop, which is the sudden unwillingness by international lenders to renew their credit lines in times of market uncertainty. The second benefit is that higher reserves adequacy tends to be associated with lower external borrowing costs (Hviding, Nowak and Ricci, 2004). In addition, these authors also identified a third benefit of holding reserves in emerging market economies, namely it can help reduce real exchange rate volatility. This is because the monetary authority can make use of the stock of external reserves to stabilise the exchange rate of the domestic currency, thus preventing volatility in that market. The theory proposes the existence of an inverse relationship between the level of external reserves and the volatility of the real exchange rate (Cady and Gonzalez-Garcia, 2007). This relationship, according to Hviding et. al., (2004), seems to be non-linear to the extent that the benefits of holding reserves for lowering volatility diminish with higher reserves holdings. Thus, advanced economies with huge external reserves, highly liquid currencies and stable financial markets are unlikely to derive any significant value from reserves

holdings as a precautionary fund (Office of International Affairs, 2007). When the level of foreign reserves exceeds the level required for precautionary purpose, the benefit of holding reserves with a view to curtailing volatility in the exchange rate begins to diminish (Park and Estrada, 2009).

The external reserve level has important implications for macroeconomic stability and a country's ability to cope with external crises. This is particularly true for emerging market economies that are often plagued by external shocks, in the face of their limited access to international capital markets. Therefore, external reserves serve as an important insurance in these countries in the event of external shocks (Dhasmana, 2011).

II.1.4 Fiscal Deficit

Apriori reasoning considers the relationship between fiscal deficit and exchange rate volatility to be positive. This implies that huge fiscal deficits could cause wide swings in the exchange rate (Avila, 2011). This is corroborated by the existing empirical evidence which indicated that nominal effective exchange rate volatility was higher in countries with higher inflation and higher fiscal deficits (Canales-Kriljenko and Habermeier, 2009). Rising government deficits in relation to GDP, it has been argued, do not only engender high interest rate and volatility in exchange rate, it also caused adverse movements in other key macroeconomic aggregates (Ussher, 1998). Iyoha and Oriakhi (2002), in their study of the Nigerian economy, found that fluctuations in the naira-dollar exchange rates in the 1978 - 1985 period were caused by nominal shocks from fiscal deficits. Ogunleye (2008) also explained the sharp fluctuations in the real exchange rate by the excessive expenditure resulting from the oil wind-fall during the period.

II.1.5 Economic Growth

There is a plethora of theoretical and empirical studies focusing on the effect of exchange rate volatility on investment, productivity, trade, capital flows and economic growth (DeGrauwe,1988; Adubi and Okunmadewa, 1999; Aliu, 2003; Stancik, 2006, Aghion et. al., 2006; Schnabel, 2007; Aliyu, 2009; Boar, 2010; Shehu and Youtang, 2012). It is believed, however, that a two-way causal relationship exists between economic growth and exchange rate volatility. The implication is that economic growth can also cause exchange rate volatility. The exchange rates of currencies of highly developed economies appear to be more stable than those of emerging markets and developing countries (Calderon and Kubota, 2009). This has been attributed to the fact that the industrialised countries have well developed and stable financial system, unhindered access to international capital markets, highly liquid currencies, central bank

independence, highly open economies, and these countries also tend to adopt inflation targeting as their monetary policy framework. These features are known to accelerate the growth rate of their economies, and insulate them against external shocks, which cause volatility in key macroeconomic aggregates, the exchange rate inclusive. This is suggestive of the existence of an inverse relationship between economic growth and the volatility of real exchange rate. A high and possibly rising economic growth rate will tend to reduce volatility in the exchange rate (Bastourre and Carrera, 2007). Greater productivity, which is a necessary cause and effect of economic growth has also been associated with less volatility in exchange rate (Sanusi, 2004).

II.1.6 External Indebtedness

The direction of influence of external indebtedness on volatility in exchange rate remains as yet contentious. One line of argument is that external indebtedness could amplify volatility in the exchange rate, while another holds that it could mitigate it. According to Cavallo et. al., (2002), foreign indebtedness engenders volatility in the exchange rate. This is especially so in countries, where external liabilities are denominated in foreign currencies. Many emerging market economies may have little capacity to cope with a high degree of volatility in their exchange rate, compared with their creditors. This partly explains why they display *a fear of floating (*Eichengreen and Haussman, 1999; Calvo and Reinhart, 2002; Deveneux and Lane, 2002). External borrowings, especially by private commercial banks and firms, were identified as a major factor responsible for the severity of the Asia financial and currency crises during the late 1990s (Corsetti et. al., 1999; Kawai, 2002), with Indonesia, the Philippines, Thailand and South Korea the most severely affected economies. It is noteworthy that the accumulation of foreign debts had been rapid in those economies in the period that immediately preceded the outbreak of the 1997 financial crisis. The rapid accumulation of external debt, especially in the 1995/96 period resulted in an overshooting of the currencies of these Asian countries (Siregar and Pontines, 2005). Also, Devereux and Lane (2002) found that bilateral exchange rate volatility (relative to creditor countries) is strongly negatively affected by the stock of external debt. They noted that while this is true of developing economies, external debt is generally not significant in explaining bilateral exchange rate volatility in industrial countries.

II.1.7 Monetary Policy

Monetary policy is a potential stabilisation tool as well as an independent source of economic fluctuations (West, 2003; Gali and Monacelli, 2005). The goals of monetary policy include the attainment of price and exchange rate stability, full

employment, favourable balance of payments (BOP) position, maintaining low inflation rate, among others. Real exchange rate volatility has been associated with unpredictable movements in relative prices in an economy. Thus, the use of monetary policy in stabilising prices can also indirectly mitigate volatility in the real exchange rate.

The monetary authority influences the level of money supply and interest rates to achieve set targets and objectives. In economic theory, changes in money supply generate fluctuations in the exchange rate, *ceteris paribus*. While an increase in money supply depreciates the domestic currency, a decline in interest rate could trigger capital flight, resulting in a depreciation of the domestic currency (Al Samara, 2009). Changes in both foreign money supply and interest rate could also influence movements in the exchange rate of the domestic currency, if the economy is linked to the foreign economy. As a result of the linkages of money supply and interest rate to the exchange rate, shocks to money supply and interest rate could generate volatility in the exchange rate (Ogunleye, 2008; Grydaki and Fontas 2011).

In recent times, inflation-targeting has become a major monetary policy framework used by many monetary authorities. Its implementation also has some implications for exchange rate volatility. Nominal and real exchange rate volatility is typically lower in countries where this framework has been adopted, compared with countries that do not adopt inflation-targeting (Rose, 2007). Thus, monetary policy can be used to control both nominal and real exchange rate volatilities. Olalekan(2008), however, stated that exchange rate volatility responds to monetary policy with some lags. This, in his view, implies that monetary policy may be effective in dampening exchange rate volatility in the medium horizon but might not be effective in the short-run.

II.1.8 Exchange Rate Regime

The two commonly adopted exchange rate regimes are the fixed regime and the flexible regime. However, since the collapse of the Bretton Woods system in 1972, several variants of exchange rate arrangements have emerged. Some of these variants are very similar, making it almost impossible to distinguish between the fixed and the flexible exchange rate regimes, and they include the managed floating, crawling pegs, crawling bands, currency boards, dollarisation, pegged-but-adjustable-systems, among others (Frenkel, 1999; Edwards (2002) cited in Bastourre and Correra (2007). It is often hard to figure out what the exchange rate regime of a country is in practice since there are multiple conflicting regime classifications (Rose, 2011). In a fixed exchange rate regime (also referred to as

pegged exchange rate regime), the value of the domestic currency is pegged to that of another single currency or to a basket of currencies or to another measure of value such as gold. A fixed exchange rate arrangement serves to stabilise the value of a domestic currency in relation to the currency to which it is pegged. This makes trade and investment between the two countries easier and more predictable, and it is especially useful for small open economies (with relatively less developed financial markets) in which the share of external trade to GDP is significant.

In a flexible exchange rate regime, the value of a currency is allowed to fluctuate according to the market forces of demand and supply in the foreign exchange market. Managed float regime (also known as dirty-float) is an exchange rate arrangement in which the exchange rate fluctuates from day to day, with the monetary authority oftentimes intervening to influence the exchange rate by buying and/or selling the foreign currency as and when required.

The consensus is that exchange rates are generally more stable in fixed than in flexible regimes. Put differently, exchange rates tend to be more volatile in flexible regime, although the stability of the exchange rate has been linked to stable economic development (Mckinnon and Schnabl, 2004; Stancik, 2006). To Friedman (1953), the instability of the exchange rate can be linked to instability in the underlying economic structure. To him, a flexible exchange rate needs not be an unstable exchange rate, but where it is unstable, it is primarily because there is instability in the underlying economic conditions. This suggests that though exchange rate volatility is more of an issue in flexible exchange rate regime, the stability or otherwise of the exchange rate is also influenced by the stability (or otherwise) of the underlying economic conditions. Thus, according to Flood and Rose (1999), it is simply hard to believe that the post-1973 (floating) era has been so much more volatile from a macroeconomic perspective than the pre-1973 (fixed) period.

II.2 Exchange Rate Policies and Regimes in Nigeria

The main objectives of exchange rate policy in Nigeria are to preserve the value of the domestic currency (the naira), maintain a favourable external reserves position and ensure external balance without compromising the need for internal balance and the overall goal of macroeconomic stability (CBN, 2011). In Nigeria, in the early 1960s there was little concern for exchange rate policy as it had almost no significance in macroeconomic management. Between 1960 and 1967, the Nigerian currency was adjusted in relation to the British pound with a

one-to-one relationship between them. A fixed parity was also maintained with the American dollar between 1967 and 1974.

The fixed parity arrangement was abandoned between 1974 and late 1976, when an independent exchange rate management policy commenced. This pegged the naira to either the U.S. dollar or the British pound sterling, whichever currency was stronger in the foreign exchange market. The main objective of exchange rate policy in this period was to operate an independently managed exchange rate system that would influence real variables in the economy and to lower the rate of inflation. Consequently, a policy of progressive appreciation of the naira was pursued over the period, aided by the oil boom that occurred at the same time (Adubi, 1999). The oil boom in the 1970s made it mandatory to manage foreign exchange resources to avoid a shortage in the event of a slump in oil prices. However, shortages in the late 1970s and early 1980s compelled the government to introduce some *ad hoc* measures to control excessive demand for foreign exchange. It was not until 1982 that comprehensive exchange control measures were put in place. The increasing demand for foreign exchange at a time when supply was shrinking encouraged the development of a flourishing parallel market for foreign exchange. In general, the exchange control system was unable to evolve an appropriate mechanism for foreign exchange allocation that achieves internal balance. The system was discarded on September 26, 1986, with a new mechanism put in place under the Structural Adjustment Programme (SAP) that was introduced in 1986.

Under the SAP, a transitory dual exchange rate system was adopted. This, however, metamorphosed into the foreign exchange market (FEM) in 1987. Bureau-de-Change was introduced in 1989 with a view to enlarging the size of the FEM. In 1994, there was a policy reversal which was necessitated by the unrelenting pressure on the naira in the foreign exchange market. Further reforms such as the formal pegging of the naira exchange rate, the centralisation of foreign exchange in the CBN, the restriction of Bureau-de-Change to buy foreign exchange as agents of the CBN, were introduced into the foreign exchange market in 1994 to mitigate volatility in exchange rates. There was another policy reversal in 1995 to that of guided-deregulation. This resulted in the Autonomous Foreign Exchange Market (AFEM), the failure of which led to the introduction of a daily, two-way quote Inter-bank Foreign Exchange Market (IFEM) on October 25, 1999.

The Dutch Auction System (DAS) was introduced on July 22, 2002 to replace the IFEM as a result of the increased demand pressure in the foreign exchange

market, leading to depletion of the country's external reserves. The DAS was conceived as a two-way auction system in which both the CBN and authorised dealers would participate in the foreign exchange market to buy and sell foreign exchange (Omojemite and Akpokodje, 2010). The CBN is expected to determine the amount of foreign exchange it is willing to sell at the price buyers are willing to buy. Since its introduction, the DAS has been largely successful in achieving the objectives of the monetary authorities. Generally, it assisted in narrowing the arbitrage premium from double digit to a single digit. Secondly, the DAS has enhanced the relative stability of the Naira, vis-à-vis the US Dollar, which is the intervention currency (Sanusi, 2004).

II.3 Related Empirical Works

There are existing empirical studies on the factors that cause exchange rate volatility in various countries. Some of the known empirical studies include Grydaki and Fontas (2011), Rashid and Hussain (2010), Calderon and Kubota (2009), Stancik (2006), Hviding et. al., (2004), Broda and Romalis (2003), Hau (2002) among others.

Grydaki and Fontas (2011) investigated the short-run and long-run determinants of nominal exchange rate volatility in certain Latin American countries using the data for the 1979-2009 period. They estimated a multivariate GARCH model and included the covariances of certain determinants which had been ignored in similar works. They found that financial openness, alternative exchange rate regimes as well as nominal volatility in both money supply and inflation explained exchange rate volatility. Output variations were found to be important as well, but only in countries with floating exchange rate regime. The effect of financial openness on volatility of nominal exchange rate was significant in all countries studied. Flexible exchange rate regime was also found to increase exchange rate volatility.

In a study of key factors contributing to the volatility of the exchange rate of the euro in the new EU member countries, Stancik (2006) used the threshold autoregressive conditional heteroskedastic (TARCH) model. He found that openness had a negative effect on exchange rate volatility. *News* factor also had significant effect on exchange rate volatility. The extent of the effect of both factors (openness and news), however, varied substantially across countries.

Hau (2002) studied the openness of an economy (proxied by the ratio of import to GDP) and its impact on real exchange rate movements (measured as the standard deviation of the percentages of the effective real exchange rate over

intervals of 36 months). He found that trade integration and real exchange rate volatility were negatively correlated. The estimated small open economy model, capturing both the tradable and non-tradable sectors, indicated that more open economies have a more flexible aggregate price level. This flexibility reduced the effects of unanticipated money supply shocks, which in turn can lower real exchange rate volatility.

In a study of the effects of capital inflow on domestic price levels, monetary expansion and exchange rate volatility in Pakistan, Rashid and Hussain (2010), applied linear and non-linear co-integration and Granger causality test within a bivariate and multivariate frameworks. They found existence of a significant inflationary impact of capital inflow, especially during the seven-year period before their analysis. Their empirical evidence suggested the need to manage capital inflow in such a way that such flows should neither create an inflationary pressure in the economy nor fuel exchange rate volatility.

Broda and Romalis (2003) developed an empirical model to identify the relationship between trade and exchange rate volatility. Using disaggregated trade data for a large number of countries during the 1970-1997 period, they found strong evidence supporting the proposition that trade dampens exchange rate volatility. In addition, they found that once the reverse-causality problem was addressed, the large effects of exchange rate volatility on trade found in some previous literature were greatly reduced.

In another study, Calderon and Kubota (2009) used instrumental variables technique to examine the impact of trade and financial openness on real exchange rate volatility in a sample of industrial and developing countries during the 1975-2005 period. They found that high real exchange rate volatility was a result of high productivity shocks and sharp oscillations in monetary and fiscal policy shocks. Furthermore, they found that the real exchange rates of countries that were more integrated appear to be more stable. They also found that greater financial openness engendered greater fluctuations in the real exchange rate.

In their study, Hviding et. al., (2004) investigated the impact of foreign exchange reserves in reducing currency volatility in emerging market countries. They employed a panel data on 28 countries for the 1986-2006 period. They introduced a battery of control variables in the regression to account for other factors affecting exchange rate volatility. The results obtained in the study

provided support for the proposition that robust reserves holdings reduces volatility in exchange rate.

Empirical work by Avila (2011) has shown that for the Argentine economy, fiscal deficit was an important variable explaining volatility in exchange rate. An increase in the mean deficit by one point of GDP increased mean volatility by 73 points or 18.0 per cent. Their conclusion was that there was a seemingly positive correlation between fiscal deficit and the volatility of key macroeconomic prices such as the real exchange rate and the real interest rate.

In a study of the New Zealand economy, West (2003) estimated that a 25.0 per cent fall in the standard deviation of real exchange rate (i.e. unconditional real exchange rate volatility) can be accomplished at the price of an increase in the standard deviation of output of about 10-15 per cent, of inflation volatility of 0-15 per cent and of interest rate volatility of about 15-40 per cent. This implies that in an attempt to mitigate exchange rate volatility, the economy would risk increased volatility in output, inflation and interest rate.

Olowe (2009) investigated the volatility of naira/dollar exchange rates in Nigeria using GARCH(1,1), GJR–GARCH(1,1), EGARCH(1,1), APARCH(1,1), IGARCH(1,1) and JS-GARACH(1,1) models. Using monthly data from January 1970 to December 2007, volatility persistence and asymmetric properties of foreign exchange market on volatility were investigated. The study presented results separately for the period before deregulation, that is, the period of the fixed exchange rate regime (January 1970 – August 1986) and for the managed float regime period, (September 1986-December 2007). The results from all estimated models showed that volatility was persistent, and were similar for both the fixed exchange rate and the managed-float exchange rate regimes.

Employing two techniques, namely the Vector Error Correction Model (VECM) and the ARCH Modeling techniques, Al Samara (2009) investigated the factors that determine and affect the volatility of the equilibrium real exchange rate. Using data on the Syrian economy for the 1980-2008 period, the estimated results indicated that the real exchange rate exhibited volatility around its equilibrium level with a relatively slow speed of adjustment. The estimated ARCH model indicated that real shock to volatility would persist, but that they would die out slowly.

In a panel data versus a country-specific analysis of the daily volatility of the exchange rates of the U.S. dollar and fourty-three (43) other currencies, using

data for the 1990-2001 period, Golan and Beni (2007) found a positive correlation between exchange rate volatility, real interest rates and the intensity of central bank intervention. To them, the positive correlations obtained most probably reflect cross-country differences, which, in their view, may be explained by the fact that countries with relatively high exchange rate volatility maintain higher real interest rates and employ more central bank intervention. An examination of a country-specific case using Israel as case study, however, revealed that real interest rates and central bank intervention were negatively correlated with exchange rate volatility.

Chipili (2009) examined the sources of volatility in the real and nominal Zambia Kwacha exchange rates with respect to the currencies of that country's major trading partners. The study used data from January 1964 to December 2006 and a GARCH modeling technique. The result indicated that the switch from the fixed to the flexible exchange rate regimes had significant positive effect on the conditional volatility of real exchange rate. In addition, while both monetary and real factors accounted for the observed volatility in exchange rates, the former had a relatively larger effect than the latter, thus, underscoring the important role of monetary policy in exchange rate management.

III. Theoretical Framework, Model Specification and Methodology

III.1 Theoretical Framework and Model Specification

One theory that explains exchange rate volatility is that of Optimum Currency Areas (OCAs) postulated by Mundell (1961). To Horvath (2005), the optimum currency areas proposition largely explains the dynamics of bilateral exchange rate variability and pressures. It identifies variables such as intensity of trade interdependence, dissimilarity of export commodity structure, openness, asymmetric shock to output and economic size (Ling, 2001; Horvath, 2005) as germane to a country's decision to join a monetary union. One of the objectives of forming a monetary or currency union is to reduce volatility in key macroeconomic indicators, including the exchange rate. The optimum currency areas (OCAs) theory suggests that a number of variables can help to explain patterns of exchange rate variability and intervention across countries on the grounds that the same factors that inform the decision of whether to form a currency union also influence exchange rate volatility across countries (Bayaomi and Eichengreen, 1998; Masson and Yusop, 2006).

According to the OCA proposition, the higher the intensity of trade links among countries, and the more similar are shocks to their output, the more stable (or less

volatile) will the exchange rate of the national currencies be (Horvath, 2005). The volume of trade among countries and asymmetric shocks (which occur when unexpected disturbances affect one country's output differently from another's) as well as differences in countries' (economic) size are germane to explaining volatility in exchange rates. It has been argued that bringing these variables under control through the formation of a currency union has the potential to reduce exchange rate volatility (Scrimgeor, 2011).

In this study, we included as many variables as possible identified in the broad literature as determining exchange rate in our model since our major objective is to empirically investigate and identify the factors that explain the volatility of the bilateral exchange rate of the naira to the U.S. dollar. We noted that since earnings from oil export contribute well over 90.0 per cent to Nigeria's foreign exchange earnings and that it is also a significant determinant of the size of the country's foreign exchange reserves, a link could possibly exist between oil price movements and the exchange rate. Thus, volatility in oil prices is expected to explain volatility in the country's exchange rate. For this reason, we included an oil price volatility variable, among others, in our modeling of exchange rate volatility. We specify our model in its functional form as:

XRTV=*f* (NCF, OPN, XRSV, FDEF, GDP, EXDT, MS, FDEV, OILPV) (1a)

Where:
XRTV = Exchange Rate Volatility
NCF = Net Capital Flows (-)
OPN = Degree of Trade Openness (-)
XREV = External Reserves (-)
FDEF = Fiscal Deficit (+)
GDP = Gross Domestic Product (-)
EXDT = External indebtedness (+)
MS = Money Supply (M_2) (+)
FDEV = Financial Development (M_2/GDP) (-)
OPR = Oil Price (-)

The *a priori* expectations with respect to sign of the variables are indicated against the definition of each variable.

III.2 Empirical Methodology

We employed the method of Exponential Generalised Autoregressive Conditional Heteroskedasticity (EGARCH) modeling developed by Nelson (1991) to investigate the factors explaining exchange rate volatility in Nigeria. The choice

of the EGARCH, an extension of the GARCH model developed by Bollerslev (1986), is based on the fact that it fits the data better than the GARCH model. Moreover, unlike the GARCH model, the EGARCH model specifies conditional variance as an exponential function, thereby removing the need for (non-negativity) restrictions on the parameters to ensure positive conditional variance. Thus, the problem of non-negativity of the variance is solved within the EGARCH model. It also has an additional variable whose coefficient captures the leverage effect which is the asymmetric effect of past shock on conditional variance.

EGARCH modeling involves the joint estimation of a mean and (conditional) variance equations. The multivariate EGARCH (1,1) model adopted for this study (based on its simplicity and robustness) is defined as follows:

Mean equation:

$$EXRT = C + \varphi EXRT(-1) + \in_t \quad (1b)$$

Where: EXRT = Exchange rate
C = Constant intercept
$EXRT_{(-1)}$ = One-period lag values of exchange rate
$\in_t$ = error term

The mean equation is a first order autoregressive process.

The conditional variance equation, following Olowe (2009) is:

$$log(\delta_t)^2 = w + \alpha \left| \frac{\in_{t-1}}{\delta_{t-1}} - \sqrt{\frac{2}{\pi}} \right| + \gamma \left| \frac{\in_{t-1}}{\delta_{t-1}} \right| + \beta log(\delta_{t-1}^2) \quad (2)$$

Where ω, α, β and γ are the volatility parameters.

The leverage effect, which is the asymmetric effect of past shock is captured by γ which is usually negative. The implication of the negative sign of γ is that all things being equal, positive shocks generate less volatility than negative shock (Longmore and Robinson, 2004 cited in Olowe, 2009). β is a determinant of the degree of persistence of volatility. a is used to determine the presence or otherwise of volatility clustering. If a is significant, it implies the presence of volatility clustering. Conditional volatility for these models tends to rise (fall) when the absolute value of the standardised residuals is larger (smaller). Statistically, insignificant a is, however, inconclusive (Olowe, 2009).

Incorporating the explanatory variables into the framework of the conditional variance equation yields the following:

$$log(\delta_t)^2 = w + \alpha\left|\frac{\epsilon_{t-1}}{\delta_{t-1}} - \sqrt{\frac{2}{\pi}}\right| + \gamma\left|\frac{\epsilon_{t-1}}{\delta_{t-1}}\right| + \beta log(\delta_{t-1}^2) + \sum_{i=1}^{n} \varphi_i X_t \quad (3)$$

Where φ_i is the parameter of each of the explanatory variables included in the model. Estimating this equation will enable us investigate the way and manner each of the variables explains conditional volatility in the exchange rate. Our study, however, differs substantially from Olowe (2009) on account of the explanatory variables in our specification and the period covered.

III.3 The Data

The data used in this study consist of annual time series for the period 1970 to 2013. The data were obtained from several secondary sources, including the Central Bank of Nigeria (CBN) Statistical Bulletin and CBN Annual Reports and Statement of Accounts, Organisation of Petroleum Exporting Countries (OPEC) publications and publications of the National Bureau of Statistics. Data for OILPV is calculated as unconditional variance of oil price, that is, the standard deviation of the logs of quarterly oil price data.

IV. Presentation, Discussions and Implications of Results

IV.1 Presentation and Discussion of Results

We begin the analysis by generating the data series of conditional variance of exchange rate by an exponential GARCH (EGARCH(1,1)) process (Equation 2). The exchange rate volatility variable (EXRTV) is then regressed on the exogenous variables, using the method of ordinary least squares (OLS). The OLS estimated result corrected for first-order positive autocorrelation is presented in Table 1.

The robustness check revealed that the model has a fairly satisfactory goodness of fit as indicated by the R-squared and Adjusted R-squared. Specifically, the R-squared indicated that 76.7 per cent of the systematic variation in the dependent variable was explained by the regressors. The F-statistic was highly significant even at the 1.0 per cent level and it indicated that the explanatory variables were jointly significant in the determination of the naira exchange rate volatility. The Durbin-Watson statistic clearly indicated absence of first order autocorrelation in the model.

An examination of the estimated parameters revealed that the signs of the NCF, TOPN, FDEV, MS and XREV variables conformed to *a priori* expectations while those of the RGDP, XDEBT, FD and OPR variables did not conform. It also showed

that only the coefficients of the NCF, FDEV, FD, MS variables were statistically significant, though the MS variable was only significant at the 10.0 per cent level. This implied that the naira exchange rate volatility was influenced by net capital flows, financial sector development, fiscal deficit and the stock of money in the economy. Specifically, exchange rate volatility is mitigated or dampened by increase in net capital flows and financial sector development. Increase in money stock, on the other hand, engenders increase in exchange rate volatility. The influence of the other variables on naira exchange rate volatility were not statistically significant.

Table 1. OLS Estimation Result (Corrected for First Order positive Autocorrelation using AR(1)

EXRTV=158.2722 - NCF0.000139 - LTOPN16.15277 - LFDEV112.2511 + LRGDP8.866318 - LXDEBT9.094690 - FD0.000137
(0.468953) (-2.311309) (-0.350369) (-2.271016) (0.300041) (-0.742065) (-3.031522)

+ LMS31.74482 + LOPR6.845702 - LXREV1085321 + AR(1) 0.425443
(1.860803) (0.219602) (-0826449) (2.334383)

R-squared	0.767194	Akaike info criterion	10.99116
Adjusted R-squared	0.692095	Schwarz criterion	11.44626
F-statistic	10.21580	Hannan-Quinn criter.	11.15797
Prob(F-statistic)	0.000000	Durbin-Watson stat	1.941138

Source: Authors' Estimations using Eviews 8

The results presented in Table 1 were supplemented by the outcome of estimation of an exponential GARCH (1,1) model incorporating the exogenous variables, with the conditional variance of exchange rate (measure of exchange rate volatility) as the dependent variable. The result obtained were largely similar to those obtained using the OLS method and are presented in Table 2.

Our focus in the analysis was on the variance equation which modeled the conditional variance of exchange rate (measure of exchange rate volatility) and incorporated the selected regressors. We noted that the volatility parameter, γ [C(5)] capturing the leverage effect was negatively signed (as expected) and highly statistically significant, even at the 1.0 per cent level. This is indicative of a strong leverage effect and implies that positive shocks to the exchange rate generate less volatility in it than negative shocks. The parameter measuring the degree of persistence of volatility, β [C(6)] is 0.57 and is also highly significant at the 1.0 per cent level. This suggests that the volatility of the naira exchange rate is moderately persistent. The parameter that determines the presence or otherwise

of volatility clustering, a is [C(4)] and it is highly significant even at the 1.0 per cent level. This suggests that the naira exchange rate is characterised by volatility clustering.

Table 2. Exponential GARCH (1,1) Model with Variance Regressors

EXRT= -0.099086 + EXRT(-1)1.020802
(-1.004992) (80.20526)

Variance Equation:

C(3) 4.050067 + C(4)0.590951 - C(5)1.008480 + C(6)0.568318 - C(7) -4.92E-06 – C(8)0.867367 +
(3.246960) (3.076679) (-6.553218) (14.79439) (-1.814126) (-5.758703)

C(9)0.298509 - C(10)0.323641 + C(11)0.686650 - C(12)4.56E-06 + C(13)0.073219 –
C(14)0.919932 –
(0.652747) (-5.870489) (11.03092) (-2.340156) (0.795501) (-5.060665)

C(15)0.357207
(-14.76122)

R-squared	0.960807	Akaike info criterion	4.700092
Adjusted R-squared	0.959851	Schwarz criterion	5.314464
F-statistic	10.21580	Hannan-Quinn criter.	4.926653
Durbin-Watson stat	1.835806		

Source: Authors' Estimations using Eviews 8

An examination of the coefficients of the regressors revealed that the signs of most of the regressors conformed to *a priori* expectations, except those of the FDEV and FD. Furthermore, the empirical results indicated that all but the FDEV and MS variables exerted significant impact on exchange rate volatility. The empirical evidence indicated too that net capital flows, trade openness, favourable oil prices, external reserves and economic growth all served to dampen exchange rate volatility, while external debt exacerbated it. We were, however, cautious in our interpretation of the observed negative sign of the fiscal deficit variable, which was counter-intuitive and suggested that increase in fiscal deficit dampened exchange rate volatility.

Table 3. Heteroskedasticity Test: ARCH

F-statistic	0.044695	Prob. F(1,40)	0.8336
Obs*R-squared	0.046877	Prob. Chi-Square(1)	0.8286

Source: Authors' Estimations using Eviews 8

The result of the ARCH test indicated absence of remaining ARCH effect, while the residual correlation test clearly indicated absence of autocorrelation as all the probabilities were evidently larger than 0.05. With coefficient of skewness approximately zero, the normality test indicated near-normality.

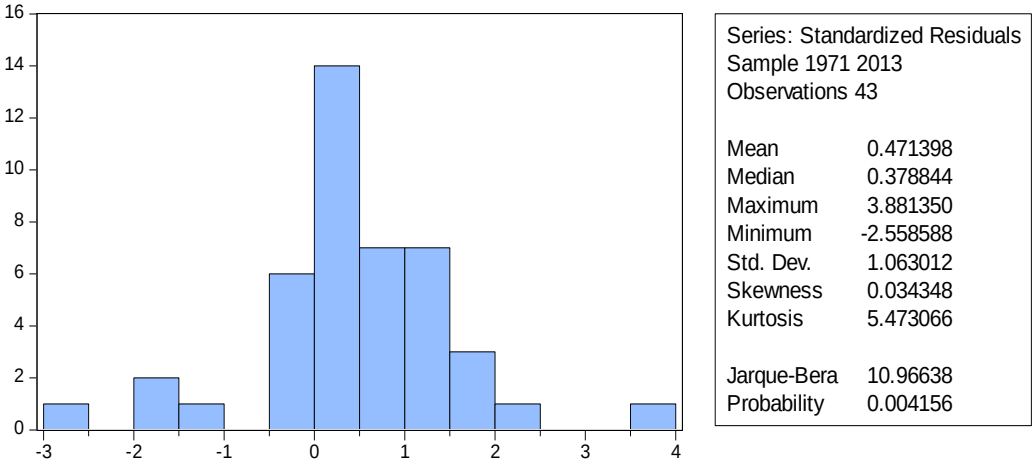
Table 4. Autocorrelation Test

Sample: 1970 2013
Included observations: 43

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
. | . |	. | . |	1	0.033	0.033	0.0512	0.821
.*| . |	.*| . |	2	-0.066	-0.067	0.2545	0.881
.*| . |	.*| . |	3	-0.104	-0.100	0.7772	0.855
.*| . |	.*| . |	4	-0.151	-0.151	1.9092	0.752
.*| . |	.*| . |	5	-0.099	-0.110	2.4059	0.791
. |*. |	. | . |	6	0.081	0.054	2.7510	0.839
. |*** |	. |** |	7	0.362	0.333	9.8019	0.200
. | . |	. | . |	8	-0.015	-0.053	9.8146	0.278
.*| . |	.*| . |	9	-0.085	-0.076	10.227	0.332
. |*. |	. |*. |	10	0.089	0.177	10.690	0.382
.*| . |	. | . |	11	-0.132	-0.047	11.745	0.383
. | . |	. |*. |	12	0.039	0.103	11.841	0.459
. | . |	.*| . |	13	-0.023	-0.100	11.875	0.538
.*| . |	**| . |	14	-0.069	-0.220	12.193	0.591
. | . |	. | . |	15	-0.060	-0.007	12.442	0.645
. | . |	. | . |	16	-0.055	-0.045	12.657	0.698
. | . |	. | . |	17	0.058	-0.064	12.912	0.742
. |*. |	. |*. |	18	0.111	0.160	13.868	0.738
. | . |	.*| . |	19	0.005	-0.099	13.870	0.791
. | . |	. | . |	20	-0.022	0.008	13.910	0.835

Source: Authors' Estimations using Eviews 8

Figure 1: Normality Test



IV.2 Policy Implications of Results

The empirical evidence obtained in the paper has far-reaching implications for policies that are aimed at stabilising the naira exchange rate. The negative sign and statistical significance of the capital flows (NCF) variable imply that large net capital flows can possibly dampen the volatility of the naira exchange rate to the dollar. Thus, the more of (growth enhancing) capital the country attracts, the less volatile the bilateral naira-dollar exchange rate is likely to be.

The coefficient of the trade openness variable, which measures the degree of integration of the Nigerian economy with the global economy, also has negative sign and it is highly statistically significant, implying that the more open the Nigerian economy is, the less volatile will be the exchange rate of the naira. This finding is in line with the theoretical proposition, and corroborates the findings of existing studies such as Broda and Romalis (2003) and Calderon and Kubota (2009).

The negative and significant coefficient of the RGDP variable suggested that economic growth is associated with exchange rate stability in a desirable way since it serves to dampen its volatility. This is in consonance with the observations of Sanusi (2004) and the findings by Bastourre and Carrera (2007) and Calderon and Kubota (2009).

The observed positive and significant coefficient of the external debt variable implied that increase in foreign indebtedness engenders a rise in the volatility of naira exchange rate. This is in conformity with Cavallo et. al.'s (2002) findings. This

is clearly undesirable and thus has implications for the country's notorious penchant to accumulate foreign debt.

The empirical evidence indicated that fiscal deficit (FDEF) significantly dampens exchange rate volatility contrary to expectation. The finding is not only atheoretic and indeed counter-intuitive, it contradicts the assertion by Iyoha and Oriakhi (2002) and the findings by Ogunleye (2008), Canalse-Kriljenko and Habermeier (2009) and Avila (2011). But it may be explained by the possibility that government borrowings to finance its deficits tend to constrain the availability of funds to speculators and *professional dealers* in foreign exchange, whose activities largely account for the wide swings and volatility that the exchange rate has exhibited, especially in recent times.

We observed that although the OLS estimates indicated that financial sector development engenders stability in the exchange rate by significantly dampening exchange rate volatility, the empirical finding based on the EGARCH (1,1) model indicates that its impact is not significant. The implication of the result from the OLS estimation is that sound financial system abates exchange rate volatility.

The observed positive and statistically significant coefficient of the broad money supply variable implied that monetary expansion significantly engenders volatility of the bilateral naira-dollar exchange rate. Furthermore, the observed negative and statistically significant coefficient of the external reserves variable, XREV, suggested that increase in the country's reserve holdings is associated with less volatility and thus greater stability of the exchange rate. This finding has implications for the management of the country's external reserves and specifically from the perspective of the highly undesirable penchant by policy makers to run down and thus deplete the country's reserve holdings, even for the flimsiest of reasons. Finally, the empirical evidence indicated that oil price increase served to dampen the volatility of the bilateral naira-dollar exchange rate. This is not unexpected, considering that increase in crude oil prices translate to increase in real GDP (since the country's economy is largely dependent on earnings from crude oil export), increase in foreign exchange reserves (since earnings from crude oil export account for a hugely significant share of the country's foreign exchange earnings) and considering also that positive shock (which is implied by a rise in crude oil prices) is associated with a decline in volatility, in line with the empirical finding with respect to the asymmetric leverage effect.

V. Summary, Policy Recommendations and Conclusion

V.1 Summary

We have empirically investigated the factors explaining volatility in the bilateral exchange rate of the Nigerian currency, the naira, to the U.S. dollar. The empirical evidence revealed that increase in net capital flows, the level of financial development, the level of external reserves, the degree of integration of the Nigerian economy with the global economy, increase in crude oil price as well as economic growth can help to mitigate the volatility of the Naira exchange rate. We found also that external indebtedness and monetary expansion have the potential to exacerbate volatility in exchange rate. Contrary to *a priori* expectation, our empirical evidence indicated that fiscal deficit negatively and significantly affects exchange rate volatility, indicating that fiscal deficit was strongly significant in dampening exchange rate volatility in Nigeria within the period covered by this study. These empirical findings have implications for policies that are formulated to manage the country's exchange rate.

V.2 Recommendations for Policy

1. Since the empirical evidence shows that net capital flows mitigates exchange rate volatility, measures that are capable of attracting more of development targeted or sustainable capital into the economy are imperative. In addition, policies that are designed to mitigate capital flight, which anecdotal evidence suggests, is increasing in the country should also be pursued. The measures should include creating a conducive/enabling environment for businesses to thrive and to develop the nation's financial system to make for greater efficiency and effectiveness. This should be accompanied by policies that are aimed at managing the inflow of capital as excessive inflow of capital has the potential to create inflationary pressures in the economy as well as fuel volatility in the exchange rate.

2. We recommend, in the light of the empirical findings with respect to the openness variable that policies that are aimed at further integrating the Nigerian economy with the global economy be formulated and implemented. This logically calls for policies that are aimed at addressing the export side of the trade equation, as failure to do this would accentuate Nigeria's import-dependency and further put Nigeria in the position of a *willing loser* in an increasingly globalising world.

3. Considering that external debt has the potential to exacerbate exchange rate volatility, the use of external loans by all tiers of government and the private sector should be carefully managed. This calls for a return to the position in 2006/2007 when State Governments were barred from contracting foreign loans.

4. There is need for measures that are aimed at controlling the growth of broad money supply and the overall level of liquidity in the economy. The Central Bank needs to deploy the use of monetary policy instruments in an efficient and optimal way to realise this. In this regard, any strategy that seeks to curtail the level of liquidity in the economy will be highly desirable as it will serve to instill financial discipline in the spending behaviour of agents in the economy. We are of the view that the Treasury Single Account initiative should be faithfully, sincerely and transparently implemented as it has the potential to check reckless spending in the economy by the various tiers of government, especially the State Governments many of whom have penchant for reckless spending that smacks off grossly irresponsible fiscal behaviour.
5. In view of the fact that external reserve was observed to dampen the volatility of the exchange rate, there is need to articulate and implement measures that are geared towards beefing up the country's external reserves position and maintain it at optimal and sustainable levels that are consistent with stable exchange rate. This implies saving significant portion of the country's export earnings which are, in any case, synonymous with oil export earnings, especially in periods of favourable movements in oil prices.

6. The finding that financial development helps to mitigate volatility of the exchange rate calls for commitment on the part of the government through its relevant agencies to the development of the nation's financial system. In this vein, policies that seek to improve the breadth and depth of the country's financial system and to enhance financial inclusion in the economy, through, for example, the agent banking initiative will be appropriate.

7. Finally, in view of the fact that economic growth is associated with reduction in volatility of the exchange rate, thus, enhancing exchange rate stability, measures to accelerate the growth rate of the economy should be put in place. These include formulation and implementation of investment friendly policies to boost the level of domestic and foreign

investment in the economy, thus boosting employment, reducing poverty, expanding the level of domestic output of goods and services, reducing importation and boosting export, increasing the level of foreign exchange reserves, etc.

V.3 Conclusion

Exchange rate volatility poses serious challenge to macroeconomic management. Indeed, it has the potential to undermine the efficacy of macroeconomic policies that are designed to influence the economy in a desired direction. We sought, in this paper, to empirically identify the factors that policy makers may tinker with in order to mitigate volatility in the bilateral exchange of the naira to the U.S. dollar. The findings in the study may be relevant even within the context of the exchange rate of the naira to any other currency or indeed the exchange rate of the naira to a basket of currencies. Consequently, we recommend the empirical findings in the paper to policy makers in the formulation and implementation of policies that are designed to attenuate the volatility that has characterised the exchange rate of the country's currency, especially since the adoption of the floating exchange rate regime in 1986.

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Sources and Impact of Excess Liquidity on Monetary Policy in Nigeria

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Abstract

This paper examined the sources and effects of excess liquidity in the Nigerian banking system. The Deposit Money Banks (DMBs) in Nigeria do not hold voluntary reserve over and above the required reserve for precautionary reasons depending on their risk appetite. The practice over the years has been that DMBs constrained themselves by holding involuntary reserve which is a major concerns to the monetary authorities. The ideal situation is that banks should deploy excess reserves as loans to the public and invest in government securities, but on the contrary this is not done based on the profit maximisation tendencies of the DMBs. The Ordinary Least Squares (OLS) estimation result using monthly data from 2002 – 2012 showed that banks foreign assets and government deposits were important contributors to observed excess liquidity in the system. Government deposit featured as a key determinant of the demand for excess reserves. The paper also found a positive relationship between excess reserves and inflation.

Keywords: Banks, excess reserves, Monetary Policy Effectiveness
JEL Classification: E2, E4, E5

I. Introduction

There is considerable interest in understanding the interaction between asset prices and monetary policy. This is because much of the transmission of monetary policy comes from the influence of short-term interest rates on other asset prices. Movements in other asset prices including long -term interest rates, bond prices, yields, and stock prices determine private borrowing costs and changes in wealth, which in turn influences real economic activity and the response of financial markets. Monetary policy has considerable influence on the behaviour of the financial markets. Thus, accurate estimates of the response of asset prices to monetary policy impulse are critical to effective investment decisions and risk management as well as the efficacy of monetary policy.

The principal objective of the Central Bank of Nigeria, under its enabling Act No. 7 of 2007, is to ensure monetary and price stability which contributes to the attainment of the other policy objectives such as promotion of a sound financial system. Under the current monetary policy framework, the Bank uses Cash Reserve Requirement (CRR) as one of the policy tools in influencing or controlling

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the amount of credit provided by the DMBs and the rate of interest prevailing in the money market.

However, high statutory reserve requirements constrain DMBs' balance sheets. Banks also voluntarily hold reserves over the required reserve, for precautionary reasons, depending on their risk profile. Excess liquidity results from a combination of deliberate actions of banks as well as the involuntary flows of liabilities from the general public. DMBs with excess reserves could deploy them rapidly, at will, which could alter the monetary conditions from their preferred levels.

As Saxegaard (2006) put it, Nigeria is one of the countries in the sub-Saharan Africa that has liquidity management challenges. Whereas central banks gross claims on DMBs are often relatively small, liabilities which include excess reserves, required reserves, term deposit and Open Market Operations (OMO) bills of commercial banks are substantial. Thus, excess liquidity in an economy typically comes from three sources: build-up of foreign exchange reserves, lending to government by the central bank and lender of last resort operations by the central bank.

Since 1973, oil exports proceeds has been the dominant foreign exchange earnings for Nigeria relative to other inflows in the balance sheet item of the government. The process of monetising this revenue inevitably leads to the creation of foreign assets by the CBN. The essence of the CBN managing foreign exchange is with a view to achieving exchange rate stability and mitigating exchange rate pass-through to domestic prices. As a result, the central bank purchases the foreign exchange earnings of Government (monetisation), thereby impacting domestic currency liquidity. In the past, lending to government by the central bank contributed to liquidity surplus in the economy but recent macroeconomic reforms have reduced its occurrence.

Agénor, Aizenman, and Hoffmaister (2004) have associated the persistence of excess liquidity in the banking system of countries like Nigeria to other factors such as a high degree of risk aversion by DMBs, insufficient development of financial markets, chronic macroeconomic instability and fiscal dominance. In most developing economies, the banking system is the most prominent source of financing unlike in developed countries (Stiglitz, 1989). In advanced economies, central Banks' balance sheets are liabilities driven, because they experience reserve scarcity. The demand for central bank liabilities enables them to provide cash and clearing balances for mostly payment purposes.

In Nigeria and other developing economies, central bank balance sheets are asset-driven, requiring the banks to increase asset items in their balance sheet in

order to meet the economies demand for their liabilities (Gray, 2006). Under the different policy frameworks that the Bank has adopted, excess liquidity has persisted. Therefore, understanding the sources of excess liquidity and its consequences are important for effective monetary management.

The objective of this paper is to identify the determinants of excess liquidity persistence in the Nigerian banking system. Following this introduction, section 2 provides a review of the literature. Section 4 deals with the methodology and interpretation of results. The paper is concluded in Section 5 with some recommendations.

II. Review of Literature

II.1 Conceptual Framework

Liquidity means different things to different economic agents. In financial terms, liquidity means the ability to transact a given assets at a predictable price. Deposit Money Banks (DMBs) and other financial institutions are interested in a viable balance sheet and the ability to meet liquidity requirement while the investors are concerned with market liquidity.

Monetary authorities on the other hand, are concerned mostly about system-wide or macro liquidity because of its relationship with credit conditions, interest rates, and future inflationary pressures in the economy (Carney, 2008). It is in the interest of any economy that there is adequate liquidity to ensure the functioning of all markets in the system. This is why central banks are interested in the availability of just sufficient liquidity in the financial system because liquidity crisis disrupts the functioning of the markets. It is through the alteration of the supply of liquidity in the financial market that central banks transmit monetary policy. Excess bank liquidity or excess reserve is a situation in which the amount of reserve funds that a DMB holds is higher than the required amount which is allowed to hold. It is also referred to as the holdings of liquid assets above the statutory level.

In Nigeria, the DMBs are the major sources of finance and thus, their liquidity is of concern to the Central Bank. The balance sheet of DMBs contains assets that are classified as disposable liquidity because they can be easily converted to cash to meet their customers' withdrawals, banks' expenses and other liabilities. Assets that are included in disposable liquidity include eligible securities, net lending in the repo market and net foreign assets which indicate that DMBs have resources for investment. Regulatory actions provide for a minimum holding of these assets (liquidity and required reserves ratios) through deposits and interbank lending. Any part of DMBs' disposable liquidity that exceeds their investment demand and

daily liquidity requirements constitute excess liquidity. It is from excess liquidity that banks give loans, advances and make investments. In the 19th and early 20th Century, high volumes of loan were usually disbursed by banks when their reserve was perceived as high and vice versa when low (Bindseil, 2004). When DMBs do not have sufficient loan requests or are not willing to give loans, the resulting excess liquidity is expected to be invested temporarily in assets that yield returns that are lower than those from loans and advances. It follows that too much liquidity (excess liquidity) can lead to unproductive use of funds, which can limit the profits of banks.

From the perspective of central banks, excess reserves are referred to as transactional account holdings in excess of the central bank requirements. Changes in central bank policy (interest) rates would set off movements in a series of prices in the financial markets, that in turn produce changes in DMBs' excess liquidity holdings. Efficient markets make it possible to forecast the outcomes of monetary policy actions, thereby promoting regulatory effectiveness. The conduct of open market operations (OMO) expands or contracts bank reserves by buying or selling Treasury Securities and constitute pure monetary policy actions under a Monetary Policy regime termed Reserve Position Doctrine, RPD (Meigs, 1962). Monetary authorities, all over the world are assumed to be able to stimulate money markets and also guide the direction of short-term interest rate because they are the sole issuers of banknotes and custodian of bank reserves in their economies. This assumption implied that it was impossible to set both the quantity (reserve target) and price (interest rate target) successfully. It was by varying the scarcity of bank reserves in order to manage the spread between the interbank interest rate and interest paid on reserves that Pure Monetary Policy works, whether or not interest is paid actually on (excess) reserves (Goodfriend, 2011). Keynesians considered that the immediate effect of an increase in the investments of a central Bank was to cause an increase in the reserves of DMBs, thereby motivating an increase in loans and advances. This suggests that increase in loans and advances by DMBs on account of increase in reserves would reduce short-term interest rates. This traditional model of excess reserves demand has been well developed and applied in the United States of America and the Euro Area (Friedman, 2000; Woodford and Eggertsson, 2003 and Goodhart 1989). It was in the early 1990s when central banks resumed explicit interest rate targeting that the assumptions of Pure Monetary Policy was reversed.

II.2 Theoretical Literature

II.2.1 Sources of Excess Liquidity

DMBs would normally, on voluntary basis, hold reserves for precautionary reasons, beyond the regulatory required reserve (CRR). The demand for precautionary money balances by DMBs has been widely debated. It is assumed that a private bank's objective is to reduce the projected cost of holding reserves, within an inventory management model in which there are two fundamental determinants: the penalty for illiquidity and the value of the alternative foregone in holding reserves. The optimal condition would be to hold that amount of reserves at which the marginal reduction in expected liquidity costs equals to the marginal cost of holding reserves. The behaviour of banks in an economy under this traditional model was first presented by Phillips (1920), but was brought to limelight by the outstanding works of Baltensperger (1974, 1980). New applications of the model have been presented by Bindseil (2004), Heller and Lengwiler (2003), Dow (2001), Selgin (2001), Allen and Gale (1998) and Nautz (1998). Thus, the holding of excess reserves for precautionary reasons by DMBs is an optimising behaviour.

But there are also excess reserves held involuntarily according to Saxegaard (2006). A lot of reasons have been proffered for the holding of unremunerated reserves by DMBs. Among other reasons, institutional factors have been identified as the major cause for holding precautionary reserves by depository institutions. DMBs in remote areas for example must necessarily hold excess reserves in the form of vault cash due to transportation cost. Similarly, where the payment system is underdeveloped with no Real Time Gross Settlement system (RTGS) for example, there will be the need to hold considerable precautionary excess liquidity. Agénor, Aizenman, and Hoffmaister (2004) pointed out that during the Asian financial crisis, commercial banks held a large amount of voluntary excess reserves because of the increased uncertainty and risk of default in the financial market at the time. In addition, the phenomenon of excess liquidity would exist in jurisdiction where the interbank money market is not well developed. DMBs in such countries or regions would have to hold a lot of excess reserves with the central bank to cover for contingencies that ordinarily should be met through the interbank market. In the same way, where banks cannot ascertain their net position with the central bank, real time or at short notice, they would be compelled to hold excess reserves to avoid sanctions.

Due to the shallowness of instruments in the financial market, there is the preference for cash holding by the public thereby availing the DMBs high involuntary excess reserves. Ritz (2009) suggested that while risk-averse DMBs are

expected to hold voluntary excess reserves, risk-neutral ones could find themselves holding involuntary excess reserves. For example, banks in the euro area were holding involuntary excess reserves, even when interest rates were low because weak economic growth prospects resulted in weak borrowing (Wyplosz, 2005). Since DMBs are risk averse in advancing loans to the needy public especially to real sector, they are expected to lessen their involuntary excess reserves by purchasing government bonds to earn some return. The assumption is that they would continue to buy bonds with involuntary excess reserves until the economy enters a liquidity trap - when bond yields become zero. However, in an undeveloped and inefficient financial market, the DMBs would still hold reserves in excess of the mandatory requirements and may still be hesitant in granting credits even when interest rates of instruments are positive. (O'Connell and Stephen 2005).

Since the recent global financial crisis, new thoughts have emerged which suggest that total reserves in the banking system of an economy is influenced by the policy decisions of central banks and not the profit-maximising decisions of private lending banks (Martin et. al., 2011; Gray, 2006; Hornstein, 2010; and Keister and McAndrews, 2009). Their argument is that the marginal lending rate of interest is not dependent on the quantity of reserves but rather on the interest on reserves. Thus a bank will prefer a loan rate that compensates for risks, marginal transaction costs and a rate equivalent to that on a safe foreign asset. In situations where the marginal loan customer is unable to pay the minimum rate, the non-remunerative excess liquidity is held by the banks instead of granting loans. In such markets, non-remunerative excess liquidity and loans become perfect substitutes (Khemraj, 2008).

According to Murta and Garcia (2009), factors that lead to excess liquidity can be broadly classified into structural and cyclical factors. Structural factors limit portfolio allocation (Saxegaard, 2006) because of the absence or shallowness of financial markets in developing countries. High degree of risk aversion is another structural factor which leads to a low demand for loan facilities. Both of these factors can result in excess liquidity in the banking system and explain the coexistence of high inflation and excess liquidity. Among the cyclical factors are inflation and high capital flows. High and volatile inflation adversely affect investment decision through increasing their riskiness so that banks would prefer higher returns investments and charge higher risk premium to be on a safer level. High risk premia may lead to a contraction in credit demand while credit rationing may limit availability of credit; both responses would therefore result in involuntary accumulation of excess reserves.

Ariyo (2005), opines that capital inflow from oil exports dominates public revenue, and is the major source of excess liquidity in Nigeria. The public revenues are not efficiently utilised by the different levels of government due to low absorptive capacity but end up in the banking system to fuel excess liquidity. The persistence of structural excess liquidity has made liquidity management by the Central Bank of Nigeria very difficult and costly. Other factors contributing to the incidence of excess liquidity in the Nigerian financial system can be attributable to the fiscal dominance and the underdeveloped nature of money market.

As noted by Agénor and Elaynaoui (2010), bank liquidity has been a concern to the monetary authorities based on its effect on price stability mandate, while it shortages will have significant effect on banks' solvency. In his view Saxegaard (2006) posited that significant amount of involuntary excess liquidity reduced the effectiveness of monetary policy transmission in controlling inflation based on his findings on some selected African countries. These two positions have been a subject of policy discuss by the monetary authorities and relevant stakeholders.

II.3 Empirical Literature

II.3.1 Measurement of Excess Liquidity

Drescher (2011) argued that there are different perceptions of appropriate monetary policy stance because of differences in the measurement of excess liquidity using variables such as interest rates, credit and monetary aggregates. The variables act as indicators of excess or shortage of liquidity in an economy. In a modern market economy, DMBs create liquidity by borrowing and lending among themselves during normal times using securities as collaterals in repo and reverse repo operations. In managing aggregate liquidity, the central bank sets minimum reserve requirements for DMBs such that holdings in excess of this are technically, excess liquidity.

But Caprio and Honohan (1993), have pointed out that regulatory minimum reserve requirement is not a sufficient reference point for measuring excess liquidity because of the existence of voluntary excess reserves. Saxegaard (2006) and Owoundi (2009) suggested methods for estimating DMBs' demand function for bank reserves and for isolating precautionary (voluntary) excess reserves in order to determine involuntary excess reserves, as a way out. Their formula is based on the fact that effective liquidity management by central banks requires measurement of excess liquidity over and above levels required for precautionary purposes. The difficulty in applying their methods is that it conflicts with official definition of excess liquidity as total bank liquidity less required bank liquidity, and involves modeling of the motives for holding reserves.

Thorsten and Dieter (2005), were of the view that involuntary excess reserves is the difference between the actual stock of money from a projected level to what will bring an economy to an equilibrium state. In determining an equilibrium money stock, the monetary aggregates would be consistent with the economy's inflation and output capacity. The relationship is represented by equation 1.

$$M \quad x \quad V = Y \quad x \quad P \qquad (1)$$

Where M represents the stock of money;
V represents the velocity of money;
Y represents real output; and
P represents the price level.

To calculate a money supply growth, given a policy reference growth rate, the identity equation can be solved in logarithmic form.

$$\Delta m \quad + \quad \Delta V \quad = \Delta Y \quad + \quad \Delta P$$, which can be solved for (2)

$$\Delta m \quad = \quad \Delta Y \quad + \Delta P \quad - \quad \Delta V \qquad (3)$$

Δm, Δy, Δp and Δv represents respectively, the policy money supply growth rate; the potential output growth rate, the forecast inflation; and the trend velocity of money in the economy, respectively.

Monetary policy action to expand or contract the balance sheet of DMBs would be taken if there is deviation from Δm, the reference policy money supply growth rate.

II.3.1.1 The Price Gap Approach

The price gap and other challenges have led to measures of excess liquidity based on other concepts. Hallman, Porter and Small (1991) introduced the Price Gap as a measure of excess liquidity based on short- and long-run equilibrium price levels, consistent with trend in the velocity of money and the potential output growth rate.

Given pt = mt + vt – yt; and Pt* = mt + vt trend - yt potential,

Where pt* represents the long-run or equilibrium price level. The difference between p_t * and p_t is termed price gap: $p_t^* - p_t^{trend} = (v_t - v_t + y_t - y_t^{potential})$. When the actual price level is below the long-term level, upward pressure on the (future) price level can be expected. But when it is above, downward pressure on the (future) price level would be expected. The price gap is made up of the

"liquidity gap" ($v_t^{trend} - v_t$), and the output gap ($y_t - y_t^{potential}$). From this information, the policy-maker can take decisions that alter macro-liquidity in the economy.

II.3.1.2 Real money gap

Gerlach and Svensson (2003), has suggested a different approach called the real money gap. They defined real money gap as actual money supply minus the actual price level: $m_{real,t} = mt - pt$. However, a model of equilibrium real money holding would be as follows: $m^*_{real,t} = mt - p_t^*$. The difference between the equilibrium and actual money supply, $[m^*_{real,t} - m_{real\ t} = (m_t - p_t^*) - (m_t - p_t) = p_t^* + p_t]$ would be the real money gap, which is not different from the price gap. This too, provides the Monetary Authority with a handle for decision making, in the face of excess liquidity.

II.3.2 Determinants of Excess Liquidity

Saxegaard (2006), using a modification of the methodology proposed by Agénor, Aizenman, and Hoffmaister (2004), studied the determinants of excess liquidity and the effect of excess liquidity on monetary policy transmission in the Central African (CEMAC) region, Nigeria and Uganda. In order to modify the estimated model by Agénor, Aizenman, Hoffmaister (2004) and Saxegaard (2006), the study estimated the following equation:

$$a_1(L)EL_t = a_2(L)\mathbf{X}_{t\,1} + a_3(L)\mathbf{X}^2_t + v_t \qquad (1)$$

Where

EL_t represents the ratio of statutory excess reserves to total deposits;
$\boldsymbol{a_j(L)}$ represent vectors of lag polynomials;
X1 and ***X2*** represent vectors of variables that explain the precautionary motive for holding excess reserves and the involuntary build-up of excess reserves, respectively and v_t is the error term.

The explanatory variables for excess liquidity included in the model were five year moving averages of the standard deviation of the output gap; cash to deposit ratio; private sector deposits divided by the five year moving average of the variable; five year moving averages of the standard deviation of government deposits divided by the five year moving average of the variable; ratio of demand to savings deposits; output gap; central bank discount rate; private sector deposits, expressed as a fraction of GDP; government deposits expressed as a fraction of GDP; ratio of private sector credit to GDP; ratio of bank credit to the central government and public enterprises to GDP; ratio of securitised

domestic debt to GDP; ratio of foreign aid inflows to GDP; ratio of oil exports to GDP; ratio of the quarterly percentage change in the price of oil; and commercial bank lending rate.

The estimation results, based on quarterly data from 1991 to 2003, found that Deposit Money Banks (DMBs) in the CEMAC, Nigeria and Uganda held excess liquidity over and above what was required to meet precautionary needs. In Nigeria, the most important determinants of the build-up of excess reserves were changes in the required reserve ratio, the maturity structure of the deposit base and the volatility of the cash to deposit ratio. In the CEMAC, Nigeria and Uganda, a non-linear structural VAR model estimate found that excess liquidity weakens the monetary policy transmission mechanism and consequently, monetary authorities' ability to influence demand conditions in the economy.

Pontes and Murta (2012) studied the determinants of the demand for excess reserves by banks in Cape Verde in the period 2003 to 2009, and also examined the effect of the global financial crisis which started in 2007 on excess reserves. In estimating the model of demand for excess reserves, macroeconomic variables such as the structure and level of development of the financial system were related to non-controllable autonomous factors such as foreign aid, emigrant's remittances and international trade receipts. The results showed that the precautionary variables were not important but involuntary variables (CRED, $BOND_{GOV}$ and IR) were. Also, the 2007 global financial crisis had a negative impact on excess reserve of the commercial banks. The country's economy became rather vulnerable and dependent on home remittances and foreign aid, which were reduced as a result of the financial crisis and high unemployment in advanced economies.

Jia (2012) estimated the relationship between inflation and excess liquidity in China from 2001 to 2010. Export-led development strategy resulted in rapid increase in foreign exchange reserves and foreign direct investment inflows into China. Given the country's exchange rate control policy, excess liquidity resulted. As a consequence, inflation became a macroeconomic problem from 1979, when the reformist policy of the government started. The result showed that there was a significant impact of excess liquidity on inflation, confirming the suggestion of macroeconomic theory that inflation is related to money supply and the capacity of potential output. It also suggested that the price gap as the measurement of excess liquidity is viable.

III. Methodology

The paper examined the determinants of excess liquidity in Nigeria, taking into account macroeconomic variables. In doing this, the Excess Reserve Models by Saxegaard (2006) and Agenor, Aizenman and Hoffmaisk (2004) were adopted. The model was estimated using the Ordinary Least Squares (OLS) as most of the variables were stationary at level i.e. I(0). The paper adopted monthly data from January, 2002 to December, 2012.

Excess Reserve holdings by DMBs were calculated as the difference between total reserves deposited in the CBN (as shown in balance Sheet) plus vault cash and the minimum requirement.

III.1 Model Specification

The model for excess reserve is specified as follows:

$$ExR_t = a_1 + a_2R_{Dt} + a_3VoLps_{t+} a_4VOLc_t + a_5DEPps_t + a_6DEP_{govt} + a_7CRED_t\ a_8BOND_{Govt} + a_9IR_t + a_{10}CRISIS_t$$

Below is table 3.1 depicting variable definitions and notations:

Variable Notation	Variable Definition
MPR	Monetary Policy Rate
BTDL	Banks' Total Deposits
PSD	Private Sector Deposits with Banks
DLTG	Deposits of Lower Tiers of Government with Banks (FGN excluded)
CIC	Currency in Circulation
HCPI	Headline (All Items) CPI
CBNFA	CBN Foreign Assets
BTA	Banks' Total Assets
BAC	Banks' Aggregate Credit
CLFGN	Claim on the Federal Government (credit to FGN)
EXR	Excess Reserves
$\mathbf{R_D}$	CBN Standing Lending Facility
$\mathbf{VOL_{PS}}$	Moving Average of the STDEV of PSD divided by the Moving Average of PSD
$\mathbf{VOL_C}$	Moving Average of the STDEV of CIC/BTDL divided by the Moving Average of the ratio
$\mathbf{DEP_{PS}}$	PSD divided by BTDL
$\mathbf{DEP_{GOV}}$	Government Deposit divided by BTDL
CRED	BAC divided by BTA
$\mathbf{BOND_{GOV}}$	Claim on the Federal Government (credit to FGN) divided by BTA
IR	CBNFA as a percentage of BTA
CRISIS	Episodes of Banking Crisis

A dummy variable ($CRISIS_t$) was used to represent the crisis period. Bank rescue as a factor in excess liquidity occured when there was banks crisis. "1" represent crisis period and "0" represents period of no crisis. Other than the CBN discount rate and the crisis variable, all others variable were ratios. The aim of transforming those variables into ratios is to ensure uniformity.

An inflation rate, (π) model in which inflation rate is regressed on excess reserves was also estimated using Ordinary Least Square (OLS). The model is expressed as follows:

$$\pi_t = a_0 + a_1 \Delta ExR_t + e_t$$

The inflation model is estimated to measure the effectiveness of monetary policy in Nigeria.

III.2 Data Analysis

All variables used were subjected to the Augmented Dickey Fuller (ADF) and the (KPSS) tests of stationarity or Unit Root (Table 3.1).

III.2.1 Pre-Estimation tests

Table 3.1: Augmented Dickey- Fuller Test (ADF)

	Constant		Constant and trend		Order of Integration
Variables	**t- Stat**	**P-Value**	**t- Stat**	**P-Value**	**Lags**
ExR	-10.7997	0	-4.581267	0.0017	I(0)
R_{Dt}	-11.02277	0	-11.2447	0	I(0)
$VoLps_t$	-3.475046	0.0102	-5.35064	0.0001	I(0)
$VOLc_t$	-3.100279	0.0291	-3.568614	0.0367	I(0)
$DEPps_t$	-3.331697	0.0154	-5.36155	0.0001	I(0)
DEP_{govt}	-12.6714	0	-5.677174	0	I(0)
$CRED_t$	-11.97296	0	-12.10998	0	I(0)
$BOND_{Govt}$	-13.55861	0	-13.5333	0	I(0)
IR_t	-13.5381	0	-13.51514	0	I(0)

The result showed that included variables were stationary at level, meaning that they individually exhibit mean reversion.

Table 3.2: Kwiatkowski, Phillips, Schmidte Shin (KPSS) Test

		Critical values			Order of Integration
Variables	**t-test**	**1 per cent**	**5 per cent**	**10 per cent**	**I(0)**
ExR	0.838668	0.739	0.463	0.347	I(0)
R_{Dt}	0.94656	0.739	0.463	0.347	I(0)
$VoLps_t$	0.625554	0.739	0.463	0.347	I(0)
$VOLc_t$	0.484658	0.739	0.463	0.347	I(0)
$DEPps_t$	1.08169	0.739	0.463	0.347	I(0)
DEP_{govt}	1.034906	0.739	0.463	0.347	I(0)
$CRED_t$	1.117964	0.739	0.463	0.347	I(0)
$BOND_{Govt}$	0.975321	0.739	0.463	0.347	I(0)
IR_t	0.553664	0.739	0.463	0.347	I(0)

III.3 Empirical Result

Table 3.3: Result of the (OLS) estimation on the determinant of the excess reserves in Nigeria

EXR = 23.9706 - RD 1.0038 - VOLPS 0.2518 + VOLC 0.3983 – DEPPS 1.0228 – DEPGOV 0.7226 - CRED 0.2289
(9.0445) (-1.7146) (-1.0056) (1.8048) (-0.6599) (2.0134) (0.0991)

- BONDGOV 0.0395 - IR 2.0073 - CRISIS 0.2890
(-0.2603) (5.1602) (-0.6932)

R-squared	0.4905	Akaike info criterion	3.1444
Adjusted R-squared	0.4529	Schwarz criterion	3.3628
F-statistic	13.0494	Hannan-Quinn criter.	3.2331
Prob(F-statistic)	0.0000	Durbin-Watson stat	1.5126

Table 3.4: Result of the regression of inflation rate on Excess Liquidity in Nigeria

EXR = 2.9851 + EXR 0.1205
(14.888) (6.896)

R-squared	0.2678	Akaike info criterion	0.4718
Adjusted R-squared	0.2622	Schwarz criterion	0.5155
F-statistic	47.5480	Hannan-Quinn criter.	0.4896
Prob(F-statistic)	0.0000	Durbin-Watson stat	0.2987

III.4 Result Interpretation

Results from the Excess Reserve determinant model (Table 4.3), indicated that only three (3) of the included variables were positively related to the dependent variables (ExR). The variables include VOLC, DEPGOV and CRED. With DEPGOV being the most crucial variable determining the accrual to excess reserves in Nigeria.

As Government release funds in the economy for FAAC distribution and other means, the level of money supply in the economy increases. The revenue that comes into Nigerian economy is oil based, therefore oil price is an important factor in determining Government revenue, hence liquidity in the system. Government deposit incorporates oil prices because oil revenue goes straight into government deposit. As Government deposits increase by a unit, the level of liquidity expands by 72.26 basis points. This support the a-priori expectation that increase in Government funds released at a point in time has a positive effect on liquidity hence inflation. Monetary authority should have to apply caution at any time government releases funds to the system so as to curb inflation pressures. As the ratio of currency in circulation to banks total deposit denoted by VOLC increases, this increases liquidity in the banking system. High volume of currency

circulation in an economy indicates high liquidity in the system. The CBN watches closely the level of currency in circulation on a daily basis and takes necessary actions if it goes beyond the required levels. From our result, we found that a unit increase in currency in circulation beyond the required level would increase liquidity position by 39.30 basis point.

The Inflation model: The estimation result (Table 4.4) showed that excess liquidity (ExR) is positively related to inflation (π). This result is in consonance with economic theory and also Jia (2012) findings for China. From our result, it can be deduced that one unit increase in excess liquidity is expected to lead to 0.12 unit increase in inflation.

V. Conclusion and Recommendation

This paper sought to investigate the sources and implications of excess liquidity for monetary policy in Nigeria. It identified government deposit as a crucial determinant of excess liquidity in Nigeria. As Government releases funds into the economy especially during FAAC disbursement, there is expansion in the liquidity condition. During these periods, money market rates decline and there is usually mopping activities performed by the CBN and Bonds issuance by the Debt Management Office (DMO).

Currency in circulation also exhibits a demonstrable impact on excess liquidity. The results showed statistically significant and positive relationship between excess liquidity and inflation, implying that the CBN has to continuously rein-in excess liquidity as part of efforts to stabilise inflation.

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Appendix I: Monetary Authority's Analytical Accounts - Liabilities (N' Million) 1981-2011

Period	Net foreign Asset	Net Domestic Asset	Broad Money (M2)	DMBs Deposit (Reserves)
1981	2,585.00	16,203.40	16,161.70	2,638.2
1982	888.10	22,272.00	18,093.60	3,210.6
1983	501.40	28,687.90	20,879.10	3,238.0
1984	1,110.70	32,020.60	23,370.00	3,265.2
1985	1,418.40	34,462.60	26,277.60	2,876.8
1986	5,367.80	37,850.50	27,389.80	2,846.1
1987	3,700.50	44,140.00	33,667.40	4,131.2
1988	9,492.40	54,813.10	45,446.90	4,601.2
1989	22,524.30	37,004.20	47,055.00	4,648.8
1990	43,909.90	58,209.30	68,662.50	6,585.0
1991	56,045.30	81,705.00	87,499.80	13,768.4
1992	35,778.30	171,071.00	129,085.50	4,648.8
1993	63,559.10	280,697.60	198,479.00	13,768.4
1994	280,697.60	439,113.80	266,944.90	41,415.0
1995	108,663.00	474,361.40	318,763.50	180,021.2
1996	237,978.50	371,079.00	370,333.50	237,352.8
1997	234,015.70	365,870.60	429,731.30	244,236.2
1998	247,041.60	512,490.30	525,637.80	229,763.7
1999	666,271.20	632,010.10	699,733.70	167,700.4
2000	1,275,016.90	472,011.70	1,036,079.50	185,006.0
2001	1,347,554.80	848,992.80	1,315,869.10	277,481.1
2002	1,282,215.50	1,329,401.30	1,599,494.60	402,601.5
2003	1,388,233.80	18,039,381.10	1,985,191.80	563,286.9
2004	2,644,672.70	2,020,173.30	2,263,587.90	885,130.5
2005	4,098,471.90	2,313,387.70	2,814,846.10	778,354.5
2006	6,307,859.30	714,205.70	4,027,901.70	745,654.9
2007	7,266,512.10	2,710,898.60	5,832,488.50	892,420.1
2008	8,550,430.30	4,951,860.30	9,166,838.30	746,229.3
2009	30,229,125.70	40,745,686.50	49,747,295.30	736,652.6
2010	26,694,973.42	35,032,523.00	44,619,131.18	1,882,421.7
2011	27,250,207.30	40,745,686.50	49,747,295.30	2,784,511.5

Source: Reserves are the DMBs Balances in CBN Statistical Bulletin

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