

# Effect of Monetary Policy on the Banking System Stability in Nigeria

**Bamidele, A., J., Musa, L. Bala-Keffi, O. Owolabi and S. Imam\***

## **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 authors are staff of the Monetary Policy Department, Central Bank of Nigeria. The views expressed in this paper are those of the authors and do not necessarily reflect the opinions of the Central Bank of Nigeria.

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 Kashyap 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)**

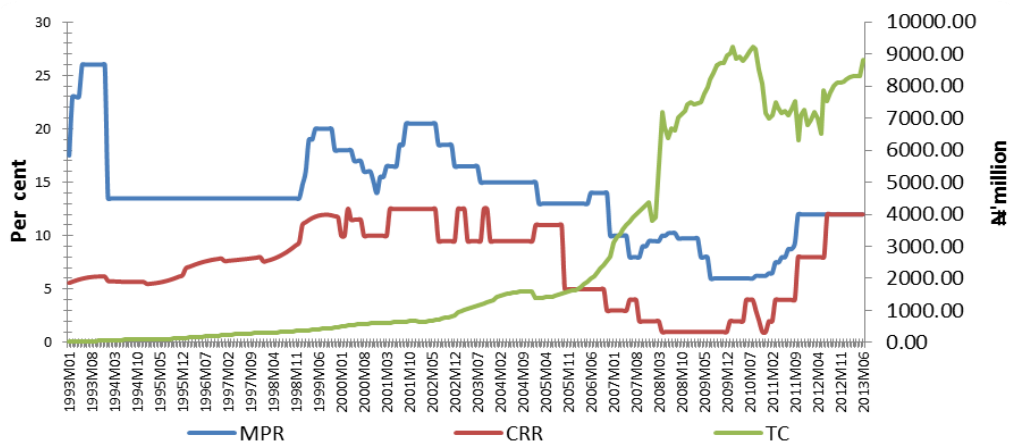
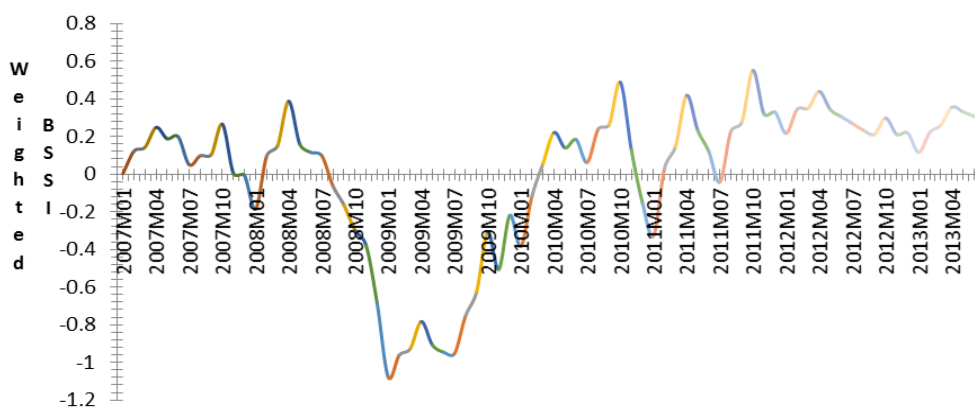


Figure 1 shows that as MPR and CRR were reduced, DMBs' total credit increased and vice versa, which is consistent with the economic theory. However, rising bank credit may not translate to banking system stability.

### 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)**



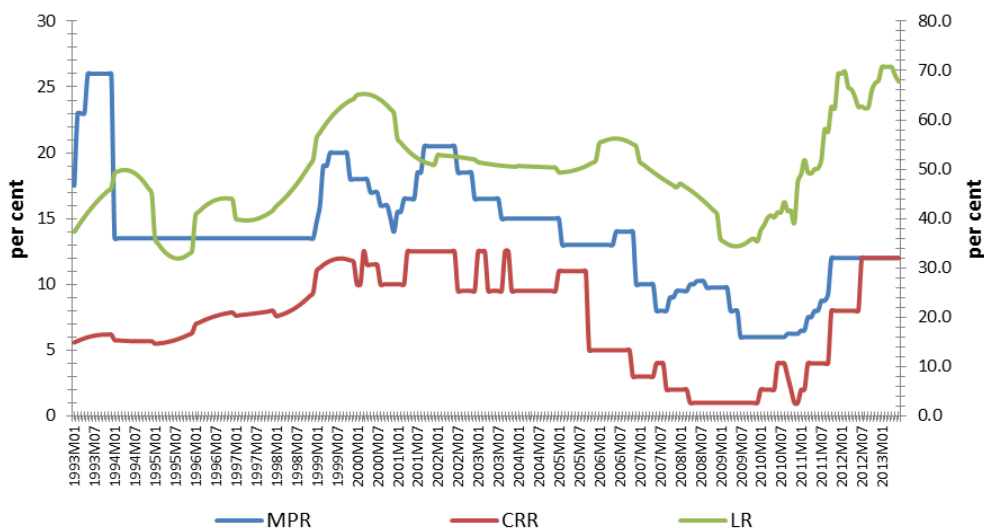
Several banking sector reforms had been implemented since the Banking Ordinance to ensure soundness, safety and stability of the banking system. Therefore, reform programmes such as increase in the capital base of banks in 1962, 1992, 1998, 2002, 2005 and 2010, liberalisation of interest and foreign 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 exists 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 unchanged 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

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

$Z_t$  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

$$I_t^n = \left( \frac{I_t - \text{Min}(I_t)}{\text{Max}(I_t) - \text{Min}(I_t)} \right) \quad (2)$$



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).

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

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

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:

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

### 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:

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

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:

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

#### 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 ( $\beta$ ) 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  $I(1)$ . The ECM is stationary at level,  $I(0)$  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	
<b>BSSI</b>	-2.4843	-2.9029	0.1235	7.8345	-2.9012	0.000	$I(1)$
<b>CRR</b>	0.1386	-2.8996	0.9667	8.4428	-2.9001	0.000	$I(1)$
<b>MPR</b>	-0.7065	-2.8996	0.8384	8.1123	-2.9001	0.000	$I(1)$
<b>EXCH</b>	-1.2090	-2.9001	0.6668	5.8162	-2.9001	0.000	$I(1)$
<b>INF</b>	-1.6370	-2.8996	9.4590	8.8900	-2.9001	0.000	$I(1)$
<b>ECM</b>	-3.0875	-2.8996	0.0317				$I(0)$

### 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<sup>2</sup>) 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	-0.0428	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

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

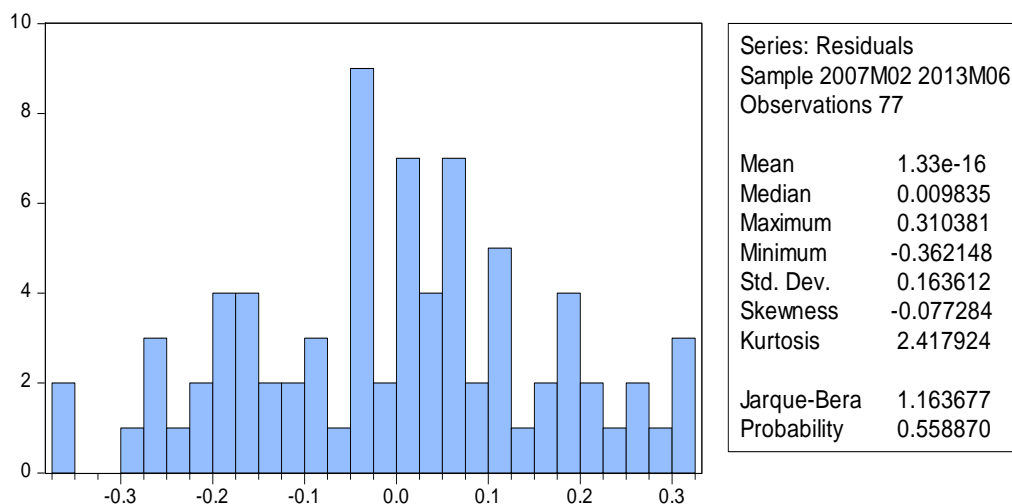
Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level

\* denotes rejection of the hypothesis at the 0.05 level

\*\*MacKinnon-Haug-Michelis (1999) p-values



**Table 5: Result of Normality Test**



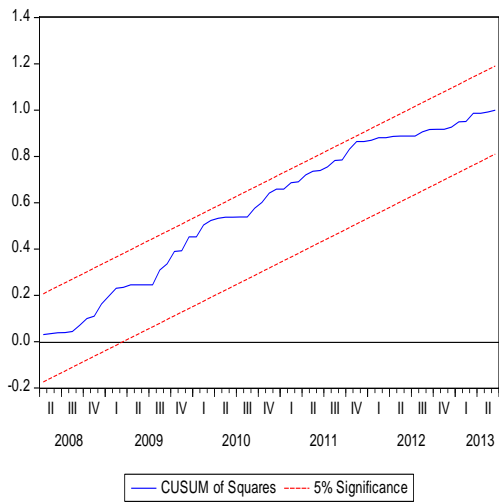
**Table 6:** Breusch-Godfrey Serial Correlation LM Test:

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**

