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Oil Price Pass-Through into Inflation: Empirical Evidence from Nigeria

Adeniyi O. Adenuga, Margaret J. Hilili and Osaretin O. Evbuomwan*

Abstract

The petroleum industry is a major driver of the Nigerian economy. Its importance has become even more noticeable in terms of its revenue generation capability for economic development as well as the multiplier effects of its downstream activities. However, due to its global significance, the sector has experienced fundamental changes and challenges. Against this background, this work is motivated by the fact that Nigeria relies heavily on crude oil export revenues, which represents about 90.0 per cent of total export earnings and on average about 70.0 per cent of government revenues in its annual budgets, thereby making it vulnerable to the vagaries of the international oil market. The monetisation of these oil proceeds affect money supply and consequently, the general price level. The objective of the paper therefore is to empirically investigate the oil price pass-through into inflation in Nigeria in order to suggest appropriate domestic policies necessary to control inflation for the policy makers. The study also attempts to answer questions like: What is the causal links between oil price and inflation in Nigeria? Is oil price highly correlated with inflation? What does the result of an estimation of a Phillips curve tell us about the pass-through for oil in Nigeria. The methodology adopted by the paper is a standard pass-through equation in the form of an autoregressive distributed lag (ARDL) model and quarterly series from 1990 - 2010 were used for the estimation. The estimation results indicate that changes in oil price have had significant effects on inflation. Other findings are that inflation has been influenced by exchange rate changes and changes in broad money supply and maximum lending rate.

Keywords: Oil, Pass-through, Inflation, Nigeria

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I. Introduction

The petroleum industry is a major driver of the Nigerian economy. In the past years, its importance has become more noticeable in terms of its revenue generation capability for economic development as well as the multiplier effects of its downstream activities. These manifested in the areas of industrialization through the provision of industrial inputs, employment generation as well as energy for productive purposes. Major projects have been financed from the revenue derived from the sub-sector, such as the steel complexes, refineries and petrochemical, fertilizer, and aluminum smelter plants as well as social infrastructure. However, due to its global significance, the sector has experienced dynamism and challenges. These include among others, the oil price shocks of the early 1970s, which was accentuated when crude oil pricing decision, usually taken by the international oil companies, was ceded to the Organisation of Petroleum Exporting Countries (OPEC). The initial increase in the oil price by exporting countries led to a cut in demand and eventual global economic depression. The resultant fall in oil prices culminated in the large drop in oil revenue of the exporting countries, including Nigeria in the 1980s. As a result of these developments, many projects and programmes embarked upon during the oil boom period remained uncompleted while the maintenance of those completed faced funding challenges (Ojo and Adebusi, 1996).

Over the years, developments in the global economy have constituted a challenge to policy makers, particularly in oil exporting countries. This is reflected in the increasing spate of fluctuations in crude oil prices in the international oil market. For example, the spot price of Nigeria's reference crude, Bonny Light (37⁰ API) oscillated between US\$10.22 per barrel in February and US\$25.75 per barrel in December in 1999. It ranged between US\$30.99 and US\$49.91 per barrel in 2004. In fact, the average price of oil has witnessed profound fluctuations from US\$17.35 per barrel in 1999 to US\$101.15 in 2008, US\$62.08 in 2009 and US\$80.81 per barrel in 2010. The slump in the average price of oil in 2009 caused a large contraction in the value of Nigeria's oil exports to US\$44.50 billion, from US\$82.00 billion in 2008 (Central Bank of Nigeria Annual Reports (various issues)). Import growth declined, owing to the fall in international oil price and low domestic demand. Persistent oil price changes could have more severe macroeconomic implications, thus inducing challenges for policy making in both the oil exporting and oil importing countries (Hooker, 1996; Daniel, 1997 and Cashin et al, 2000). These studies support the assertion that oil price being a key determinant of the price of many goods in the consumer basket, would impact on inflation directly

when it changes. The studies, suggest, therefore, that rising oil prices reduced output and increased inflation in the 1970s and early 1980s while falling oil prices boosted output and lowered inflation particularly, in the U.S in the mid-to-late 1980s. The substantial increase in the volatility of oil prices over the past decade in Nigeria and its impact on inflation rate and some other macroeconomic variables has provoked great concerns for policy makers.

Analysis of inflation in Nigeria from 2000 to 2010 showed that, it was double-digit all-through from 14.5 per cent in 2000, rising to 23.8 per cent in 2003. However, the inflationary pressure decelerated to 8.5 per cent and 6.6 per cent in 2006 and 2007, respectively before assuming an upward trend to peak at 15.1 per cent in 2008. It fell to 13.9 and 11.8 per cent in 2009 and 2010, respectively. The high inflation in 2003 was attributed to the rise in aggregate demand occasioned by the tempo of political activities (general elections), the depreciation of the naira, and increase in the pump prices of petroleum products.

From the literature, a few studies focus on changes in the degree of oil price pass-through. Hooker (2002) estimates a Phillips curve model with quarterly data from 1962:Q2 to 2000:Q1. He finds that oil price pass-through has become negligible since 1980. LeBlanc and Chinn (2004) also utilise Phillips curve framework to investigate the G5 countries, and obtain similar findings that current oil price increases are likely to have a modest effect on inflation in the U.S., Japan, and Europe. De Gregorio, et al. (2007) show evidence of a substantial decline in oil price pass-through using both a Phillips curve model and a rolling VAR model. They submit that a decline in oil price pass-through is a generalized feature of any of the 34 developed and developing countries considered.

From the above studies, the evidence appears mixed. For instance, Hooker (2002) shows that declining energy intensity is not the major cause of declining pass-through in the U.S. economy, whereas Gregorio, et al. (2007) using a similar specification for 24 industrial countries conclude that the fall in energy intensity helps explain the decline in average pass-through.

Most of the existing studies for Nigeria were on oil price shock and macroeconomic activities in Nigeria as well as oil price distortions and their short and long-run impact on the Nigerian economy (Olomola and Adejumo, 2006; Chuku, Effiong and Sam, 2010; Ayadi, 2005; Akpan, 2009; Aliyu, 2009 and Adebiji, et. al., 2009). The work is motivated by the fact that Nigeria relies heavily on crude oil export revenues, which represents about 90 per cent of total export earnings and on average about 70 per cent of government revenues in annual budgets. In addition, Nigeria has witnessed a sudden decline in oil prices from the peak of US\$141.26 per barrel in July 2008 to US\$45.64 in January 2009. The development

reflected severe implications for the Nigerian economy. It is, therefore, vital to empirically investigate the oil pass-through into inflation in Nigeria in order to suggest appropriate domestic policies necessary to control inflation for the policy makers.

These questions arise: What is the causal link between oil price and inflation in Nigeria? Is oil price highly correlated with inflation? What does the result of an estimation of a Phillips curve tell us about the pass-through for oil in Nigeria? All these questions are relevant and germane to this paper. The objective of the paper therefore, is to examine the oil price-inflation nexus in Nigeria and determine whether pass-through is comparable with those reported in recent studies on other economies. The relevance of this research to policy formulation particularly in an oil-producing economy like Nigeria is to deepen the understanding of the transmission of pass-through of oil price to inflation in order to help monetary authorities anticipate the effects of such fluctuations on inflation. The methodology adopted by the paper is a standard pass-through equation in the form of an autoregressive distributed lag (ARDL) model and quarterly series from 1990 - 2010 were used for the estimation.

In Nigeria, the relationship between the price of oil and inflation as well as the price of oil and exchange rate are shown in figures 1 and 2 in the appendix for the period 2000 - 2010. In figure 1, inflation witnessed peaks in three periods - 2001, 2003 and 2008, while it declined to low ebbs in 2002, 2004 and 2007, respectively. When oil prices are declining and the supply side of the economy is constrained by infrastructure, drought and small-scale farming pushes food prices upward leading to cost push inflation. This scenario occurred during 2000 - 2003. In spite of the efforts to achieve debt sustainability, sterilization of foreign exchange earnings and ensuring a commitment to oil price rule, headline inflation was relatively high, complementary disinflationary policies that characterized the period of the oil boom of 2004-2008 helped in reducing inflationary pressure. The spike in inflation in the era of the boom was largely occasioned by the acceleration in government spending following the monthly disbursements of oil revenue. The process involves the monetization of foreign exchange earnings leading to the jump in banking sector deposits and the attendant liquidity expansion.

From figure 2, there is a strong correlation between the movement in international oil price and the exchange rate of the Naira. It depicts that the exchange rate depreciates when the international price of oil is declining. Similarly, when the international oil price is rising the pressure on the exchange rate reduces and the currency shows signs of appreciation. This latter instance could be deciphered from 2008 and 2009.

The correlation between inflation and oil prices in domestic currency (i.e. dollar prices per barrel multiplied by the nominal exchange rate) is -0.386; the correlation between inflation and oil prices in dollar values is -0.383 while that between inflation and the exchange rate is -0.172. Therefore, it could be deduced that oil price is inversely correlated with inflation (figure 1).

Following this introduction, the rest of the paper is organized as follows: Section 2 provides the empirical literature review and the theoretical framework. Section 3 describes the methodology, covering the sources of data, scope, characteristics of variables and model specification. Empirical findings and analysis are discussed in section 4, while the policy implications and conclusion are contained in section 5.

II. Empirical Literature Review and Theoretical Framework

II.1 Empirical Literature Review

Over the years, a considerable amount of economic studies have embarked on exploring the relationship between oil price shocks and the aggregate performance of various national economies. These studies have centered on two main research perspectives. One line of research tries to quantify the impact of oil price changes on inflation and output. In recent times, increased attention has been focused on this subject due to the decline in the effect that spikes in oil prices have on inflation in both industrial and emerging economies.

Hooker (2002), De Gregorio, et al. (2007), Blanchard and Gali (2007), and Shioji and Uchino (2010) made similar conclusions that oil price pass-through has declined in a number of countries such as the US, Japan and other industrialized countries. They attributed the developments to the intensity with which oil is used in production in those countries, improved monetary policy, greater wage flexibility and the presence of off-setting shocks. In a similar study, Olomola and Adejumo (2006) analyzed the impact of oil price shocks on aggregate economic activity – output, inflation, the real exchange rate and money supply – in Nigeria using quarterly data from 1970 to 2003. The study, which made use of VAR techniques revealed that oil price shocks do not significantly affect output and inflation in Nigeria but significantly affected money supply in the long-run, therefore, suggesting the tendency of “Dutch Disease”.

Akpan (2009) analyzed the relationship between oil price shocks and the Nigerian economy using the VAR approach. The study pointed out the asymmetric effects of oil price shocks; for instance, positive as well as negative oil price shocks significantly increase inflation and also directly increases real national income through higher export earnings, though part of this gain is seen to be offset by

losses from lower demand for exports generally due to the economic recession suffered by trading partners. Furthermore, the findings of the study observed the "Dutch Disease" syndrome through significant real effective exchange rate appreciation.

On the contrary, Berument and Tasci (2002) investigated the effects of oil prices in Turkey and found that when wages and other three factors of income (profit, interest and rent) are adjusted to the general price level that include oil price increases, the inflationary effect of oil prices becomes significant.

The second line of research focuses on the identification of optimal monetary policies in response to oil shocks. Brown, Oppedahl and Yucel (1995) in their study on how oil prices transmit through various channels of the US economy to influence inflation suggest that monetary policy generally accommodated the inflationary pressure of oil price shocks. Hamilton (2003) investigated the role of monetary policy in eliminating recessionary consequences of an oil shock and concludes that the potential of monetary policy to avert the contractionary consequences of an oil price shock is little or not as great as suggested by the analysis of Bernanke, Gertler, and Watson (1997). A study by Bouakez, et al (2008), using a Dynamic Stochastic General Equilibrium (DSGE), analyzes how high oil prices would lead to an increase in inflation by a much greater magnitude under managed than under a fixed exchange rate regime. Furthermore, De Fiore, et al. (2006) looked at simple policy rules and found that oil price shocks brought about a trade-off between inflation and output stabilization and, thus, monetary policy partially accommodated oil-price increase.

This present paper differs from most of the previous empirical studies carried out because focus has mainly been on oil-importing economies, particularly the developed economies. Few studies exist on the effect of oil price shocks on key macroeconomic variables for an oil-exporting country as Nigeria. This study intends to fill this gap as it centers on the pass-through of oil prices into inflation.

Oil price shocks exert influence on macroeconomic activity through various channels. Such influences may imply a symmetric effect; however, the effect can also be asymmetric. Guo and Kliesen (2005) in their paper explicitly distinguished between two channels through which changes in oil prices affects aggregate economic activity; the change in the dollar price of crude oil (relative price change) and; the increase in uncertainty about future oil prices; noting that the former channel implies a symmetric effect of oil shocks, while the latter implies an asymmetric effect. Symmetry with respect to oil price changes implies that the responsiveness of the economic variable to a negative oil price shock will be the exact mirror image of the response to a positive oil price shock of the same

magnitude; while asymmetry simply implies that the response of an economic variable to a positive oil price shock will not be proportional to the opposite response of the variable to a negative oil price shock of the same magnitude. Chuku, et al (2010) put forth that the asymmetric responses of macroeconomic aggregates to unanticipated oil price decreases and increases can be explained through three kinds of effect: (1) the income effect, (2) the uncertainty effect and (3) the reallocation effect. They go further to state that asymmetry arises because these three effects act in a reinforcing way to amplify the response of macroeconomic aggregates to positive oil price shocks, but reduce the corresponding response to negative oil price shocks. Thus, making it possible to explain why economies experience higher recessions in response to positive oil price shocks, and smaller expansions in response to negative oil price shocks of the same magnitude.

A number of studies have focused on the empirical investigation of the theoretical mechanism and channels through which oil-price change may retard economic activity (see Brown and Yucel, 2002; Jones et al., 2004; Tang et al., 2010). These channels include the supply-side effect, wealth transfer effect, inflation effect, real balance effect, sector adjustment effect and the unexpected effect. They are discussed briefly below making use of Figure 1 which depicts the channels of transmission from oil price shocks to macroeconomic variables.

There is the *classical supply side channel* according to which oil price increase leads to a reduction in output since the price increases signal the reduced availability of basic input to production. As a result, growth rate and productivity decline. Oil price shocks can increase the marginal cost of production in many industries reducing the production. After an oil shock, since the investment determines the potential output capacity in the long run, higher input prices reduce the investments, thus, output decreases and unemployment increases (Brown and Yücel, 2002).

The second mechanism is the *wealth transfer effect* which emphasizes the shift in *purchasing power (income)* from oil importing nations to oil exporting nations (Fried and Schultze, 1975; Dohner, 1981). This shift leads to a reduction in the consumer demand for oil importing nations and increases consumer demand in oil exporting nations. In turn, the global demand for goods produced in oil importing nations is reduced and the global supply of savings is increased. Consequently, increasing supply of savings causes real interest rates to decrease. Diminishing world interest rate should stimulate investment that balances the reduction in consumption and leaves aggregate demand unchanged in the oil importing countries. If prices are downward sticky, the reduction in demand for

goods produced in oil importing countries will further reduce the GDP growth. If the price level cannot fall, consumption spending will fall more than increases in investments leading to a fall of aggregate demand and further slowing economic growth (Brown and Yücel, 2002).

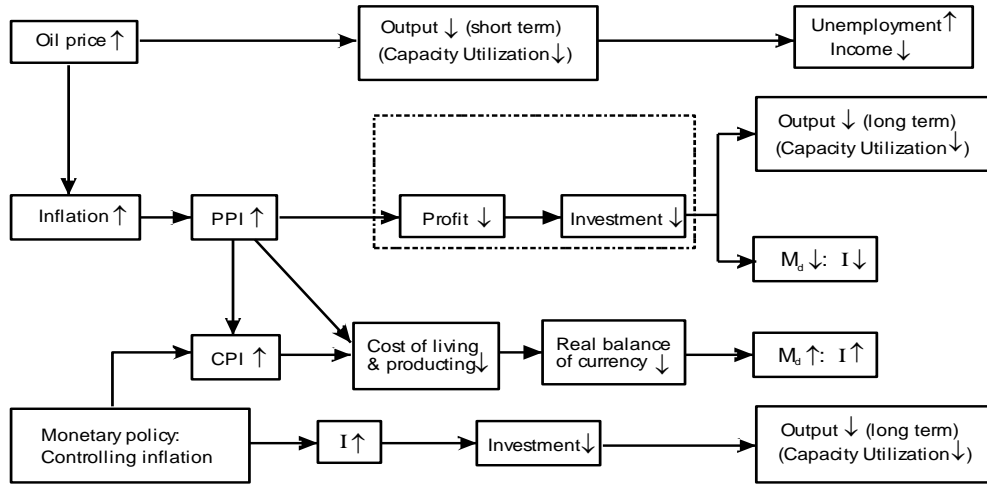
Another transmission channel which establishes a relationship between domestic inflation and oil prices is the *inflation effect*. Oil price shocks are found to create inflationary pressures in an economy. Literature on the subject has indicated that reduced output and inflation are the most likely twin effects of oil price shocks. An oil price shock constitutes a cost for domestic production (i.e. supply-side channel) resulting in an upward pressure on labour costs and prices. This can be considered as a price shocks too. According to Tang, et al (2010), when the observed inflation is caused by the oil-price increased cost shock, a contractionary monetary policy can deteriorate the long-term output by increase in interest rate and decrease in investment.

The real balance effect which elucidates the influence oil price shocks would have on money demand in an economy could occur under two scenarios. On the one hand, the variation in consumers' expectation with respect to the short-term and long-term effects of an increase in oil prices will result in borrowing or dissaving in order to align consumption. Consequently, interest rates and inflation rise and the demand for real cash balances reduce. On the other hand, working through the price-monetary transmission mechanism, oil price shocks can reduce investment due to the reduction in producers profit and equally reduces money demand (see Chuku, et al, 2010). When monetary authorities fail to increase money supply to meet growing money demand, interest rate will rise, leading to a reduction in growth rate.

The fifth transmission channel is the sector adjustment effect which works via effects of oil shocks on economic sectors. Brown and Yucel (2002) argued that possible explanations for asymmetric sectoral adjustments are monetary policy, adjustment costs and petroleum product prices and not the supply-side effect. Following an oil price shock which feeds directly to output, the cost of adjusting to changes in oil prices in each sector of an economy may also retard economic activity. As pointed out by Brown and Yucel (2002) adjustment costs arise due to sectoral imbalances and coordination problems between firms or because the energy-to-output ratio is part of the capital stock. In the case of sectoral imbalances, increasing (decreasing) oil prices would require energy-intensive sectors to contract (expand) and energy-efficient sectors to expand (contract). By implication, asymmetry in oil prices will result in underutilization of resources and rising unemployment.

The uncertainty about oil prices and its impact also influences macroeconomic activity adversely through the reduction in the investment demand of firms and consumers' demand. Uncertainty causes firms and consumers to postpone irreversible investment and consumption decisions, respectively (see Bernanke, 1983; Pindyck, 1991). For example, if the energy-to-output ratio is embedded in the capital stock, the firm must choose the energy-intensity of its production process when purchasing capital. For consumers, the uncertainty effect mainly applies to consumer durables, especially energy-using consumer durables. Uncertainty about future oil prices applies to both downward and upward movement in oil prices. Worthy of note is that as future prices becomes increasingly uncertain, the value of postponing the investment (consumption) decision increases, and the net incentive to invest (consume) decreases thereby dampening long-term prospects of output (Chuku, et al 2010).

Figure 1: Transmission Channels of Oil Price shocks



Transmission channels of oil-price shocks.

Source: Adapted from Tang *et al*. (2010)

II.2 Theoretical Framework

II.2.1 Theoretical Foundations: The Phillips Curve Methodology

The Phillips curve presents a historical inverse relationship between unemployment and inflation rates. It simply states that the lower the unemployment in an economy, the higher the rate of inflation. Generally, the Phillips curve started as an empirical observation in search of a theoretical explanation. Specifically, the Phillips curve tried to determine whether the inflation-unemployment link was causal or simply correlational. However, Milton Friedman tried in providing explanations to the regularity in the short-term Phillips

curve. He posits that there is a short-term correlation between inflation shocks and employment. When inflationary surprise occurs, workers are made to accept lower pay since the fall in real wages is not seen instantaneously. On the other hand, firms hire the workers because they view the inflation as allowing higher profits for given nominal wages.

II.2.2 Oil Price-Inflation Relationship

Inflationary pressures manifest themselves when the overall demand for goods and services grow faster than the supply, causing a decrease in the amount of unused productive resources. Economists have measured economic slack in various ways. Perhaps, the most common measure is the unemployment rate, which measures unused resources in the labor market. Another measure of slack is the real output gap, the estimated difference between actual output and the economy's potential output. The main difficulty with the output gap measures is that they depend on assumptions about the behavior of potential output, an area of macroeconomics where there is little consensus. Monetary policy is also a candidate explanation for any sustained change in the inflation process. Indeed, in the 1970s, many economists argued that relative price changes, even as large as the OPEC oil shocks, would only be inflationary if accommodated by monetary policy.

We utilize a short-run Phillips curve to describe the tradeoff between inflation (the log change in the All Items CPI-U) and a measure of economic slack, along with other variables that affect the price level by changing the cost of producing goods and services. Crude oil prices are included in the Phillips curve to test the proposition that petroleum prices are not only important in production, petroleum is used to produce and transport a wide range of goods and services, but also as a harbinger of inflationary pressure which may exceed its importance as a productive input. In addition, we also include interest rates, domestic maximum lending rate as a measure of monetary policy. Our assumption that monetary policy works strictly through interest rates is conservative, as it ignores other policy channels. We relax this assumption by including the effective exchange rate as an exogenous variable in selected models (LeBlanc and Chinn, 2004).

III. Methodology

Anecdotal evidence from the literature reveal that the autoregressive distributed lag model (ARDL) is one of the major workhorses in dynamic single-equation regressions. The ARDL approach yields consistent estimates of the long-run coefficients that are asymptotically normal, irrespective of whether the underlying regressors are $I(1)$ or $I(0)$, (Pesaran and Shin, 1995). One particularly attractive reparameterization to researchers is the error-correction model (EC);

which uses have increased over time (Engle and Granger (1987)). By determining the order of integration of the variables and forming a linear combination of the nonstationary data, all variables are transformed equivalently into an EC model with stationary series only. This methodology, in addition to other benefits already mentioned, allows researchers to explore correct dynamic structure. It allows for inferences on long-run estimates which are not possible under alternative cointegration procedures. Finally, ARDL model can accommodate greater number of variables in comparison to other Vector Autoregressive (VAR) models (Pesaran and Shin, 1995).

First, the variables used are tested for unit root. This testing is necessary to avoid the possibility of spurious regression as Ouattara (2004) reports that bounds test is based on the assumption that the variables are $I(0)$ or $I(1)$. Therefore, in the presence of $I(2)$ variables, the computed F-statistics provided by Pesaran et al. (1995) becomes invalid. Hence, the implementation of unit root tests in an ARDL procedure is still necessary in order to ensure that none of the variables is integrated of order 2 or above. If the variables are found to be $I(0)$ or $I(1)$ the ARDL approach to cointegration is applied and it consists of three stages. In the first step, the existence of a long-run relationship between the variables is established by testing for the significance of lagged variables in an error correction mechanism regression. Then the first lag of the levels of each variable are added to the equation to create the error correction mechanism equation and a variable addition test is performed by computing an F-test on the significance of all the lagged variables. The second stage is to estimate the ARDL form of equation where the optimal lag length is chosen according to one of the standard criteria such as the Akaike Information or Schwartz Bayesian. The third stage entails the estimation of the error correction equation using the differences of the variables and the lagged long-run solution, and determines the speed of adjustment to equilibrium. Further, stability of short-run and long-run coefficients is examined by employing cumulative CUSUMSQ statistics which are updated recursively and plotted against the break points. If the plots of CUSUM and CUSUMSQ statistics stay within the critical bonds of 5% level of significance, the null hypothesis that all coefficients in the given regression are stable cannot be rejected.

III.1 Sources of Data, Scope and Characteristics of Variables

The empirical investigation of oil price pass-through into inflation in Nigeria is based on a 21-year quarterly time series data (1990Q₁ to 2010Q₄), i.e 84 observations compiled from secondary sources. The sources are Central Bank of Nigeria (CBN), Statistical Bulletin, Volume 20, December 2009, CBN Annual

Reports and Statements of Accounts (various issues), Statistical News of the National Bureau of Statistics (March 15, 2011) and OPEC website.

The macroeconomic variables considered include consumer price index (CPI), real gross domestic product (RGDP), denoted by Y , crude oil price of Nigeria's Bonny Light (COP), nominal exchange rate (NEXR), broad money supply (M2), domestic maximum lending rate (MLR) and output gap (\bar{Y}). The gap is the Hodrick-Prescot filtered trend of real output. The quarterly series adopted in this paper makes it different from some of the papers on oil price shock and macroeconomic activities in Nigeria as well as oil price distortions and their short and long-run impacts on the Nigerian economy. These papers utilized annual series, which hinders the possibilities of deriving in depth insight into the impact of the oil shocks.

III.2 Models Specification and Estimation

Following Kiptui (2009), with some modifications, we estimate the effect of oil prices using the autoregressive distributed lag (ARDL). Equation (1) below is to be estimated.

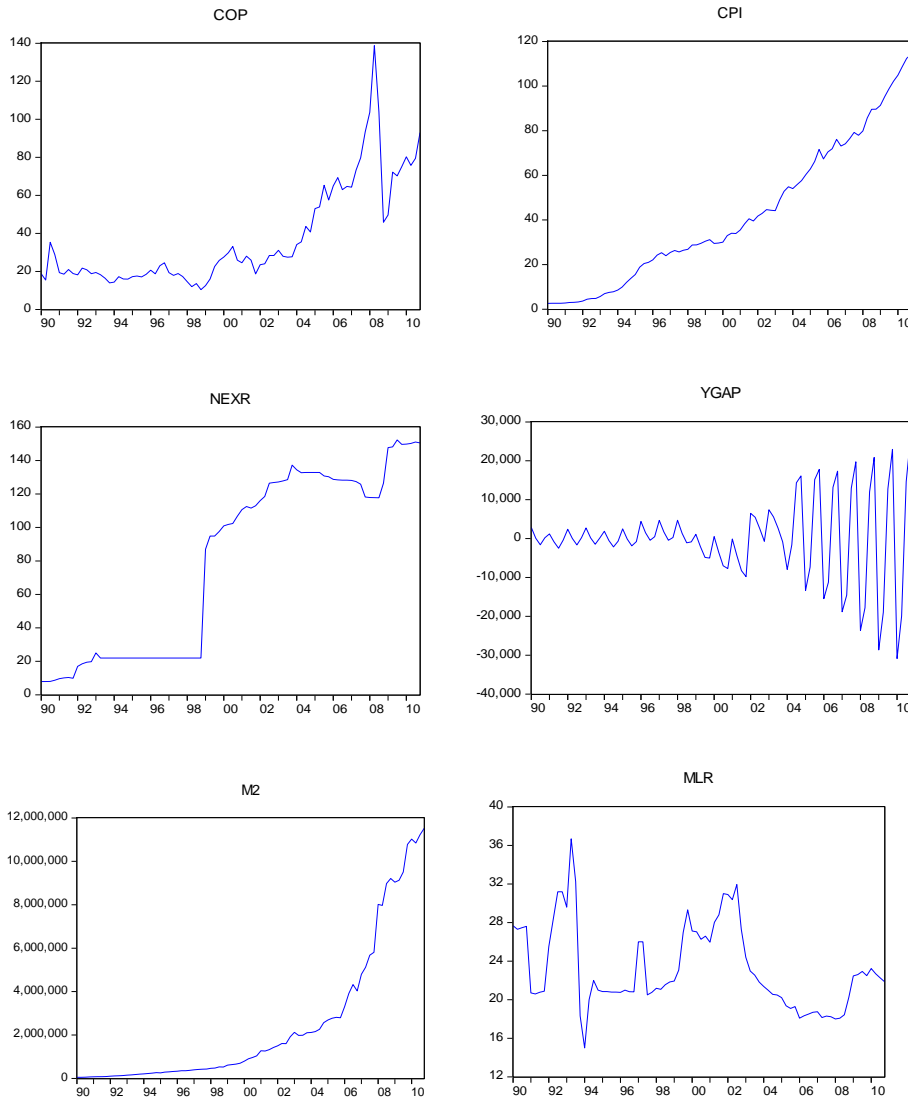
$$\begin{aligned} \Delta LCPI_t = & \alpha + \sum_{i=1}^{i=m} \beta_i \Delta LCPI_{t-i} + \sum_{i=0}^{i=m} \theta_i \Delta L COP_{t-i} + \sum_{i=0}^{i=m} \lambda_i \Delta LNEXR_{t-i} + \sum_{i=0}^{i=m} \sigma_i \Delta LM2_{t-i} + \sum_{i=0}^{i=m} \delta_i \Delta MLR_{t-i} + \\ & \sum_{i=0}^{i=m} \varphi_i \Delta (Y_{t-i} - \bar{Y}_{t-i}) + \chi_i LCPI_{t-i} + \delta_i L COP_{t-i} + \eta_i LNEXR_{t-i} + \omega_i LM2_{t-i} + \vartheta_i MLR_{t-i} \\ & + \kappa_i (Y_t - \bar{Y}_t) + \infty_i CPI_t + \wp_i COP_t + \tau_i NEXR_t + \xi_i M2_t + \gamma_i MLR_t + \mu_t \end{aligned} \quad (1)$$

where $LCPI$ is the logarithm of the CPI index, Y is real GDP, \bar{Y} is the Hodrick-Prescot filtered trend of real output, $LM2$ is the logarithm of the broad money supply (M2), mlr is the domestic maximum lending rate and $LNEXR$ is the logarithm of the nominal exchange rate, Δ is the first difference operator. The *a-priori* signs for all the variables considered are positive.

IV. Empirical Findings and Analysis

The empirical investigation begins with the plots of the variables used in the paper in order to have preliminary insights into the behavior and characteristics of the series. They are displayed as follows:

Figure 2: Graphical Representation of Variables



The next step undertaken was to investigate the summary statistics and correlation matrix of the variables. This is followed by the unit root test which is conducted to examine the order of integration of each of the variables in the model. This is to guard against the problem of spurious correlation/regression

IV.1 Results of Summary Statistics, Correlation Matrix and Unit Root Test

IV.1.1 Summary Statistics

The summary statistics of consumer price index, crude oil price, exchange rate, output gap, domestic lending rate and broad money supply are as shown in Table 1 below. The mean for the consumer price index, crude oil price, exchange rate, output gap, domestic lending rate and broad money supply was 42.27, 37.17, 79.44, 9.30E-09, 23.19 and 2,496056, respectively. The standard deviation indicates that the variables exhibit significant variation in terms of magnitude, suggesting that estimation at levels may introduce some bias in the results. The probability of Jarque-Bera for the variables, except for output gap is significant; hence we fail to accept the null hypothesis that the series are normally distributed.

Table 1: Summary Statistics of the Variables

	CPI	COP	NEXR	\bar{Y}	MLR	M2
Mean	42.26646	37.17226	79.44212	9.30E-09	23.18917	2496056.
Median	33.45555	25.87000	102.0953	-29.53364	21.83500	933448.9
Maximum	114.2000	138.7400	152.3017	26731.78	36.69000	11525530
Minimum	2.577855	10.39000	7.938800	-30865.80	15.00000	48950.50
Std. Dev.	31.81256	26.85146	54.34379	10721.61	4.317034	3311739.
Skewness	0.569379	1.440056	-0.152938	-0.247070	0.805916	1.549171
Kurtosis	2.258558	4.567507	1.218774	3.902243	2.990269	4.102302
Jarque-Bera	6.462778	37.63242	11.43214	3.703759	9.093347	37.85178
Probability	0.039503	0.000000	0.003293	0.156942	0.010602	0.000000
Sum	3550.383	3122.470	6673.138	7.81E-07	1947.890	2.10E+08
Sum Sq. Dev.	83999.22	59843.05	245119.6	9.54E+09	1546.853	9.10E+14
Observations	84	84	84	84	84	84

IV.1.2 Correlation Matrix

The correlation matrix of the variables is shown in table 2 below. The results indicate positive relationship between consumer price index and crude oil price, exchange rate, output gap and broad money supply. An inverse relationship was observed between consumer price index and domestic lending rate.

Table 2: Correlation Matrix

	CPI	COP	NEXR	\bar{Y}	MLR	M2
CPI	1	0.8477	0.8726	0.0178	-0.3733	0.9230
COP	0.8477	1	0.6686	-0.0361	-0.4074	0.8522
NEXR	0.8726	0.6686	1	-0.0195	-0.1484	0.7049
YGAP	0.0178	-0.0361	-0.0195	1	-0.0544	-0.0109
MLR	-0.3733	-0.4074	-0.1484	-0.0544	1	-0.3037
M2	0.9230	0.8522	0.7049	-0.0109	-0.3037	1

IV.1.3 Unit Root Test Results

To examine the existence of stochastic non-stationarity in the series, the paper establishes the order of integration of individual time series through the unit root tests. The tests of the stationarity of the variables adopted were the Augmented Dickey Fuller (ADF) and Phillips-Perron (PP), which are stated in generic form as follows:

IV.1.3.1 Augmented Dickey Fuller (ADF) Specification for Unit Root

The ADF involves the estimation of one of the following three equations respectively, (Seddighi, et al, 2000):

$$\Delta X_t = \beta X_{t-1} + \sum_{j=1}^p \delta_j \Delta X_{t-j} + \varepsilon_t \quad (2)$$

$$\Delta X_t = \alpha_0 + \beta X_{t-1} + \sum_{j=1}^p \delta_j \Delta X_{t-j} + \varepsilon_t \quad (3)$$

$$\Delta X_t = \alpha_0 + \alpha_1 t + \beta X_{t-1} + \sum_{j=1}^p \delta_j \Delta X_{t-j} + \varepsilon_t \quad (4)$$

The additional lagged terms are included to ensure that the errors are uncorrelated. The maximum lag length chosen begins with 4 lags and proceeds down to the appropriate lag by examining the Akaike Information Criterion (AIC) and Schwarz Information Criterion (SIC). The null hypothesis is that the variable X_t is a non-stationary series ($H_0: \beta = 0$) and is rejected when β is significantly negative ($H_a: \beta < 0$). If the calculated ADF statistic is higher than the McKinnon's critical values, then the null hypothesis (H_0) is not rejected and the series is non-stationary or not integrated of order zero $I(0)$. Alternatively, rejection of the null hypothesis implies stationarity. Failure to reject the null hypothesis leads to conducting the test on the difference of the series, so further differencing is conducted until stationarity is reached and the null hypothesis is rejected.

IV.1.3.2 Phillips-Perron (PP) Specification for Unit Root

Phillips and Perron (1988) use a nonparametric method to correct for serial correlation in the disturbances. The test is based on the estimate of the long run variance of the residuals. Their modification of the Dickey and Fuller Γ test is called the $Z(\Gamma)$ test. The critical values for Γ and $Z(\Gamma)$ are the same if the residuals are generated by an independent and identical process. Although the Phillips and Perron tests and the Dickey and Fuller tests provide identical results, the power of the (Augmented) Dickey and Fuller tests is more than the Phillips and Perron tests in the presence of negative moving average components.

The variables tested are: cop, cpi, nexr ygap, mlr and lm2. They have been transformed by deriving their natural logarithm. The results indicate that some of the variables - lcpi, mlr and ygap - are stationary at levels. lcop, lm2 and lnexr were found to be non-stationary at levels. This implies that the null hypothesis of non-stationarity for the variables is not rejected. However, they became stationary after first difference, which implies that they are I(1) series. The unit root tests results are presented in table (3) below:

Table 3: ADF and PP Unit Root Tests

Variable	ADF			Phillips-Perron		Remarks
	Level	1 st Difference	Remarks	Level	1 st Difference	
LCOP	-2.7379	-9.2362***	I(1)	-2.6193	-9.8602***	I(1)
LCPI	-3.6769**		I(0)	-2.9337**		I(0)
LNEXR	-1.6458	-8.7578***	I(1)	-1.6445	-8.7578***	I(1)
Ygap	-2.5347**		I(0)	-9.2268***		I(0)
MLR	-3.2786*		I(0)	-3.1901*		I(0)
LM2	-2.8091	-10.7623***	I(1)	-2.7017	-10.5633***	I(0)

Note: ***, ** and * indicates that the variables are significant at 1 per cent, 5 per cent and 10 per cent levels, respectively.

IV.1.4 Lag Order Selection Criteria

The table below shows the lag length which was determined by various lag order selection criteria by estimating a VAR model. Six lags were found optimal as indicated by the LR test statistic, Final Prediction Error (FPE) and Akaike Information Criteria (AIC). On the other hand, Schwarz Information Criterion and Hannan-Quinn Information Criterion found two and four lags optimal, respectively.

Table 4: Lag order selection criteria

VAR Lag Order Selection Criteria

Endogenous variables: LCOP LCPI LNXR YGAP

Included observations: 77

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1015.868	NA	3754902.	26.49008	26.61183	26.53878
1	-633.2167	715.6075	274.7578	16.96667	17.57545	17.21017
2	-581.0546	92.13033	107.7893	16.02739	17.12320*	16.46571
3	-567.9226	21.82981	117.1477	16.10189	17.68472	16.73500
4	-524.9474	66.97437	59.10351	15.40123	17.47109	16.22916*
5	-502.9716	31.96483	51.99524	15.24602	17.80289	16.26874
6	-481.0889	29.55580*	46.48941*	15.09322*	18.13712	16.31075
7	-466.8305	17.77669	51.56859	15.13846	18.66938	16.55080

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Mordi (2007) notes that typically for a given p_j , the values of these criteria will be ranked as $AIC(p_j) \leq HQ(p_j) \leq SC(p_j)$. That is, the Schwarz criterion penalizes the most the inclusion of extra lags, while Akaike has the lowest penalty. For these reasons, all criteria will not necessarily suggest the same lag length. In fact, practical experience shows that the Schwarz criterion will often choose too small an order for the VAR system. We therefore estimate an ARDL model with two lags of each variable and sequentially removed insignificant lags while observing the Akaike Information and Schwarz Information criteria for model improvement.

From Kiptui (2009), the short-run pass-through will be given by the estimated coefficient (θ) while the long-run or full pass-through from an oil price shock to inflation is derived as follows:

Pass-through

$$(\psi) = \frac{\sum_{i=0}^{i=n} \theta_i}{1 - \sum_{i=1}^{i=n} \beta_i} \quad (5)$$

IV.2 Empirical Results

The empirical estimation results contained in table 5 below, showed significant results. Crude oil price, nominal exchange rate lagged two quarters and inflation lagged one quarter were found to have significant effects on inflation at 1 per cent significant level. The domestic maximum lending rate and broad money supply lagged by one period are significant at 5 per cent. The signs on the coefficients of the variables are positive as expected suggesting that inflation increases following a rise in crude oil price in the international oil market, increased aggregate demand and a depreciation of the currency.

Table 5: Empirical Results

Dependent Variable: D(LOG(CPI))

Method: Least Squares

Sample (adjusted): 1990:4 2010:4

Included observations: 81 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.202141	0.050629	3.992587	0.0002
D(LOG(CPI(-1)))	0.329813	0.095741	3.444852	0.0009
D(LOG(COP))	0.036998	0.028594	2.729406	0.0062
D(LOG(NEXR(-2)))	0.111998	0.031017	3.610817	0.0005
D(MLR)	0.005558	0.001961	2.834825	0.0059
LOG(M2(-1))	0.012125	0.003537	3.428611	0.0010
R-squared	0.389795	Mean dependent var	0.046484	
Adjusted R-squared	0.349114	S.D. dependent var	0.054548	
S.E. of regression	0.044008	Akaike info criterion	3.337695	
Sum squared resid	0.145254	Schwarz criterion	3.160329	
Log likelihood	141.1766	Hannan-Quinn criter.	3.266533	
F-statistic	9.581888	Durbin-Watson stat	2.027545	
Prob(F-statistic)	0.000000			

From the results, the estimated short-run pass-through (θ) is 0.04, which is the coefficient for COP, β is the autoregressive coefficient of the consumer price index which is 0.33 and the long-run pass-through (ψ) from an oil price shock to inflation is computed using equation (5) as 0.06. Hence, the pass-through of oil

price increases to inflation is 0.04 in the short-run and in the long-run pass-through 0.06. It suggests that a 10.0 per cent increase in crude oil price leads to 0.004 per cent increase in inflation in the short run and 0.006 per cent in the long-run. From literature, Duma (2008), LeBlanc and Chinn (2004), and Kiptui (2009) find low and incomplete pass-through due to a combination of factors such as high component of food in the CPI basket, administered prices, as well as low persistence and volatility of the exchange rate.

This result may not be surprising given that oil price shocks affect Nigeria symbiotically. Nigeria exports crude petroleum and imports refined petroleum products. In that regard, to balance the impact over the business cycle, there must be a stabilization policy – Sovereign Wealth Investment Authority (SWIA) - as well as a mechanism that will encourage savings in a boom time and the full cost recovery on the pump price of petroleum products.

In addition, the exchange rate pass-through to inflation is 0.11 in the short-run and 0.17 in the long-run. This also represents another case of incomplete pass-through but much higher compared to the oil price pass-through to inflation.

There is anecdotal evidence that suggests a relationship between the exchange rate and oil prices. In periods of huge disbursements from the Federation Account, the resulting depreciation in exchange rate push prices up thus exerting pressure on the effective implementation of monetary policy by the central bank. In addition, there is the plausibility of the occurrence of imported inflation. These effects can only be separated through further study.

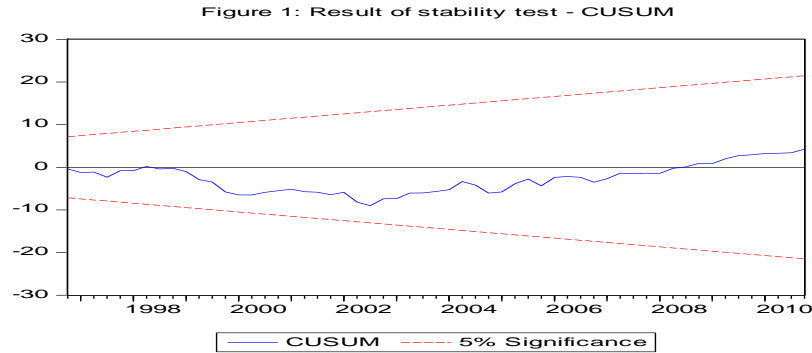
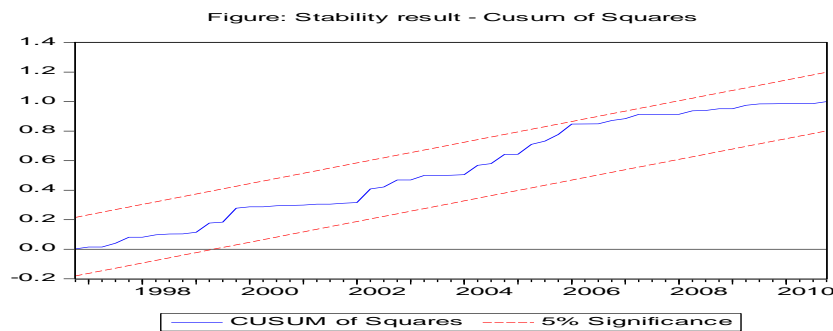
The result of the diagnostics tests is indicated below:

Table 6: Result of Diagnostic Tests

Diagnostics	Probability (p) values
Jarque-Bera Normality	0.5059
Breush-Pagan-Godfrey Heteroskedasticity	0.2637

From the result of the diagnostic tests, the Jarque-Bera statistic is not significant indicating that the residuals of the model are normally distributed. In addition, the heteroskedasticity result shows that there is no evidence of the presence of heteroskedasticity, since the *p-value* is in excess of 0.05.

The empirical results also pass the stability tests (CUSUM and CUSUM Squares tests), as shown in figures 3 and 4 below:

Figure 3: Diagnostic tests - CUSUM**Figure 4: Diagnostic tests – CUSUM of Squares**

According to Brooks (2008; pp. 187-188), “the CUSUM statistic is based on a normalized (i.e scaled) version of the cumulative sums of the residuals. The null hypothesis of perfect parameter stability, the CUSUM statistic is zero, however, many residuals are included in the sum (because the expected value of a disturbance is always zero). The standard error bands is usually plotted around zero and any statistic lying outside the bands is taken as evidence of parameter instability. Similarly, the CUSUMSQ test is based on a normalized version of the cumulative sums of squared residuals. Under its null hypothesis of parameter stability, the CUSUMSQ statistic will start at zero and end the sample with a value of 1. In the same vein, a set of ± 2 standard error bands is usually plotted around zero and any statistic lying outside these is taken as evidence of instability”. Since the line is well within the confidence bands, the conclusion is that the null hypothesis of stability is not rejected.

V. Conclusion

This paper attempts to estimate the oil price pass-through to inflation in Nigeria. It is shown that oil price is positively correlated with inflation. The measure of oil price pass-through to inflation is found to be 0.04 in the short-run and 0.06 in the long-run much lower when compared with the exchange rate pass-through of 0.11 in the short-run and 0.17 in the long-run. The paper concludes that oil price pass-through in Nigeria is low and incomplete, which is consistent with the findings in other studies.

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Appendix

FIGURE 1: RELATIONSHIP BETWEEN PRICE OF OIL AND INFLATION

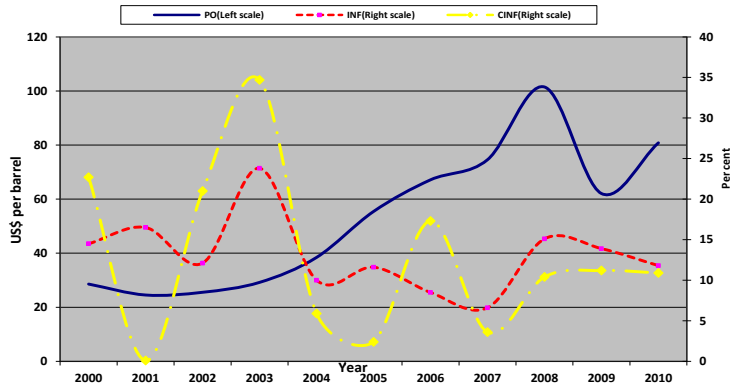
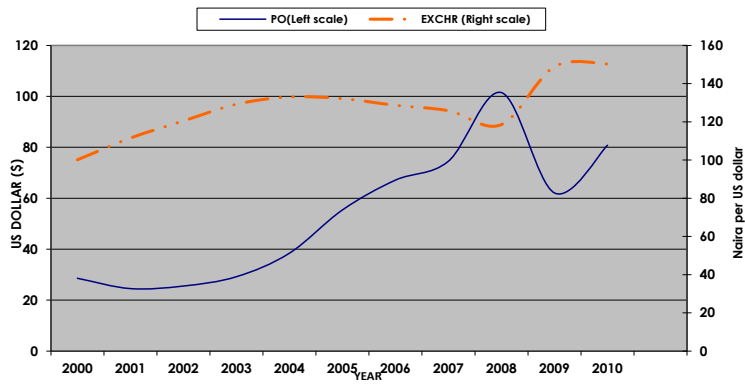


FIGURE 2: RELATIONSHIP BETWEEN PRICE OF OIL AND EXCHANGE RATE



Macroeconomic Shocks and Fiscal Deficit Behaviour in Nigeria: A VECM Approach¹

Magnus O. Abeng and Kehinde S. Alehile *

Abstract

This paper focuses on establishing the links between fiscal deficit and short-term changes in major macroeconomic variables like real output, interest rate, exchange rate, inflation rate and crude oil price in Nigeria. Empirical results show that the model adequately explains the behaviour of government of fiscal deficit and that while the accumulation of deficit is not at all detrimental to the economy per se, prudence should be exercised in the financing options adopted and more so the appropriate application of such funds to self-financing projects. It is recommended that government broaden its tax-net to curb the surging borrowing as well as prevent the current fiscal challenges from cascading into a full scale fiscal crisis. Finally, budget making should not be assumed to a mere accounting exercise only, instead the process should be focused on developing both physical and human capital through a carefully thought out socio-economic development framework.

Keywords: Budget deficit, macroeconomic stability, error correction, economic growth, Nigeria

JEL Classification: H60, E62

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I. Introduction

One of the primary macroeconomic convergence criteria under the ECOWAS economic integration and monetary cooperation, is for member states to achieve a fiscal deficit (excluding grants)/GDP ratio of 5.0 per cent or less by the end of 2000, and 4.0 per cent by the end of 2002. This ratio serves two important functions, first, as a factor for measuring members' public finance sustainability and, secondly, as an indicator for member countries' level of exposure to external shocks, such as revenue decline, which might necessitate a resort to grants or foreign borrowing for financing government activities.

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* Magnus Abeng and Kehinde Alehile are staff and NYSC member, respectively, with the Research Department of the Central Bank of Nigeria. The authors remain grateful to colleagues, especially Charles N. O. Mordi and Michael A. Adebisi (PhD) who offered invaluable comments and guidance. The usual disclaimer applies

Prior to the great depression of the 1930s, the indicative parameter for prudence in economic management was the attainment of a balanced budget. Under this regime, governments consciously refrained from undertaking expenditure beyond their revenue generating capabilities. However, this fiscal philosophy was jettisoned following John Maynard Keynes' strong advocacy for budget deficit as an antidote for stimulating economic recovery from depression. According to Keynes (1936), increased government spending and/or cutting taxes are instrumental tools to achieving the overall macroeconomic objectives of high economic growth rate, low inflation, low unemployment rate as well as a virile balance of payments position through increased aggregate demand and investment. For developing economies like Nigeria, achieving these objectives may remain an illusion without resorting to borrowing or contracting government debts.

Premised on Keynes' propositions, economic managers embarked on expenditure outlays far in excess of their revenue generation abilities. International institutions like the International Monetary Fund (IMF), through their country programmes, encouraged and supported governments' expanded expenditure profiles from borrowed funds from domestic and international financial markets. The result was the accumulation of huge foreign and domestic debts, with its ever increasing interest rate payment obligations that severely constrained growth and development in Africa. This probably explained why, as a development strategy, the ECOWAS deliberately enshrined deficit level criterion as one of the statutory requirements in the economic integration framework.

Empirical findings on the relationship between fiscal deficit and macroeconomic variables in the economic literature are mixed. Fiscal deficit is theoretically known for its crowding out of private sector credit as it lay more claims to the available funds in the economy. The reduced credit lines expectedly drive up interest rate, decelerate net foreign investment, depreciate the exchange rate as well as deteriorate trade deficit position. From the monetarist perspective, inflationary pressures are attributed to budget deficit owing largely to the printing of money or monetization of foreign reserves. This is not to say that budget fiscal do not have any developmental functions as affirmed by several empirical studies in the literature. In many economies, where effective macroeconomic management is the hallmark of monetary authorities, fiscal deficit is unquestionably the major driver for meaningful economic growth, generation of employment, and the reduction in poverty through the funding of viable self-sustaining social and economic infrastructure. These claims and counter claims in the literature would form the fulcrum of discourse in this paper in the literature review section.

Nigeria, like most developing countries, has over the years, depended considerably on deficit financing to stimulate economic activities, finance war and post-war reconstruction expenditures, as well as maintain the massive bureaucratic and democratic institutions. Consequently, between 1970 and 2009, the overall budget balance in Nigeria was consistently in the deficit except for 1995 and 1996, owing essentially to the dwindled revenue from crude oil export earnings. This probably explains why the nation's macroeconomic health was plagued by structural imbalances as reflected in the high inflation rate, weak currency, current account deficits, slow economic growth and high domestic and foreign indebtedness.

This study sets out to examine the sensitivity of domestic macroeconomy to fiscal deficit shocks in Nigeria using the Johansen and Juselius (1990) vector error correction model (VECM). The methodology is favoured because of its ability to circumvent the potential challenge of misspecification biases often associated with the conventional vector autoregression modeling technique. It is intended that the study will extend the frontiers of knowledge on the interdependence between budget deficit and key macroeconomic variables in Nigeria; provide new understanding of the implications and role of fiscal deficits in the design of stabilization, adjustment and intervention programmes in an economy that was severely pressured by the global economic and financial crisis. Using quarterly data up to 2011 do not only help incorporate the effect of pre- and post-global financial and economic crisis but also capture the political and socio-economic transformations within the economy in the model.

The rest of this paper is organized as follows: Following this introduction, section two reviews related theoretical and empirical literatures. Section three provides an overview of macroeconomic trends in Nigeria while section four presents the study methodology. In section five, the model specification and estimation results are presented. Section six proffers recommendations as well as summarises and concludes the paper.

II. Literature Review

Economic development literature is replete with theories and scholarly empirical researches conceptualized to examine the interactions between fiscal deficit and the overall macro stability in both developed and developing economies. While many of these studies focused on the correlations between deficit and macroeconomic variables, others were dedicated to determining the magnitude and direction of such causalities. Several early literature like Bailey (1971), Premchand (1984) and Barro (1990) were mainly motivated by the quest validate as well as contribute to the intense crowding-out crowding-in debate or

hypothesis. This school of economic thought argues that since financing government activities involve the sale of risk-free and high-returns yielding government debt instruments, the attraction of more private patronage crowding-out private sector credit. The result is the diversion of investible resources away from private spending and investment to the public sector to take advantage of the higher returns and reduced risk in the bonds market.

Refuting the crowding-out hypothesis are Aschauer (1989a), Eisner (1989), and Heng (1997), who argued strongly that such crowding-out is not counterproductive. Aschauer (1989a and 1989b) particularly identified a complementary relationship between public and private capital, concluding that higher public investment raises the marginal productivity of private capital and, instead, "crowd-in" private investment. Barro (1991) and Kelly (1997), in separate studies involving 98 and 73 countries, respectively, however, could not validate Aschauer's claims, as they observed a negative relationship between output growth and the proportion of government expenditure instead.

Though Plosser (1987) found no linkages between budget deficit and interest rate, Vamvoukas (2000), however, established a positive relationship between budget deficit and interest rate to the extent that budget deficit increases interest rate, and crowds-out private sector credit. Aisen and Hauner (2008), in a cross country analysis, observes a significant positive effect of budget deficits on interest rate in the order of about 26 basis points per 1.0 per cent of GDP for the complete panel and that the effect varies by country and time period. They concluded that the effect of budget deficits on interest rates depends on the interaction terms and is significant only under one of several conditions: when deficits are high; mostly domestically financed; interact with high domestic debt; and when financial openness is low. The effect is larger when interest rates are more liberalized and the domestic financial sector less developed.

The literature on fiscal deficit and exchange rate relationship exist as attested to by Allen (1977), Branson (1985), Mussa (1986), Burney and Aktar (1992) and Khan, *et al* (2002), who in their respective studies, found a relationship between budget deficit and exchange rate changes. Burney and Aktar (1992) and Khan, *et al* (2002) for instance confirmed the existence of a link between budget deficit and exchange rate through the price level with budget deficit having a bi-directional effect on real exchange rate for the Pakistani economy. Similarly, Hakkio (1996) observed from his study of 18 OECD countries that deficit reductions are often followed by exchange rate appreciation. Bisignano and Hoover (1982) further show that an increase in deficit may appreciate or depreciate the exchange rate depending on the relative importance of wealth effects as well as relative

asset substitution effects. They concluded that budget deficit, combined with tight monetary policy, will cause the exchange rate to appreciate.

A negative association between budget deficit and currency value was documented by Moreno (1995). Investigating the speculative pressures in foreign exchange markets for selected economies in the Asia-Pacific Basin, the paper found episodes of depreciation associated with larger budget deficits than with appreciation. Krugman (1979) constructed a model of balance of payment crisis that predicts a negative relationship between the budget deficit and future exchange rate. In his proposition, if a country, adopting a pegged exchange rate system, finances government deficits by increasing money supply, the increased volume of money will exert a downward pressure on its local currency exchange rate. The government, in such circumstances is compelled to use its foreign reserves to intervene in the currency market with a view to maintaining its target exchange rate level. As reserves gradually depletes, a sudden speculative attack on the currency occurs forcing the abandonment of the peg regime.

Another theoretical dimension that had received extensive consideration in the literature is the relationship between budget deficit and domestic price level. Anchored by Friedman (1968), Sargent and Wallace (1981), Miller (1983) and a host others, this strand of literature traced inflationary pressures in the economy to government deficit spending. According to this school of thought, the monetisation of deficits by the central banks usually results in an increase in the money supply and ultimately impacts the price level. Dornbusch and Fisher (1981), Choudhary and Parai (1991) and Sowa (1994) all found significant relationship between budget deficit and inflation. However, empirical evidence by Dwyer (1982) and Crozier (1976) do not find any causal relationship in the case of the US and Canadian economies, respectively.

Another argument that gained currency in literature is the twin deficit hypothesis that finds a positive correlation between budget deficit and current account deficit. Fleming (1962) and Mundell (1963), among others, have argued that an upward swing in budget deficit set in motion a string of activities, beginning with an increased interest rate to increase in capital inflows and exchange rate appreciation, and culminating in current account deficits. However, Barro (1989), under the Ricardian Equivalence Hypothesis, counters this assertion as he did not find any relationship between the two deficits. Like the connection between deficit and inflation, the link between budget deficits and the twin deficit notion is inconsistent and inconclusive.

The seminal works of Volcker (1984), Laney (1986), Eisner (1986), and Summers (1986) observed significant correlation between budget deficits and trade

deficits. They all found positive correlation between budget deficit and trade deficit through the transmission mechanism of interest rate and exchange rate. Using a VAR in his investigation of the twin deficit hypothesis, Abell (1990b) found budget deficit indirectly influencing trade deficits with the causation running through the interest rate and exchange rate. He demonstrated that while increased budget deficits exert upward pressure on interest rate, there is also evidence that higher interest rates raise the exchange rate. Kearney and Monadjemi (1990) in their study found the relationship between budget deficits varying according to countries and independence of government financing decision. Evan (1988) and Bachman (1992) found no link between budget deficit and trade deficit. Oluba (2008) also found association among fiscal deficit, national savings and domestic investment as fiscal deficits substantially reduce national saving and consequently domestic investment.

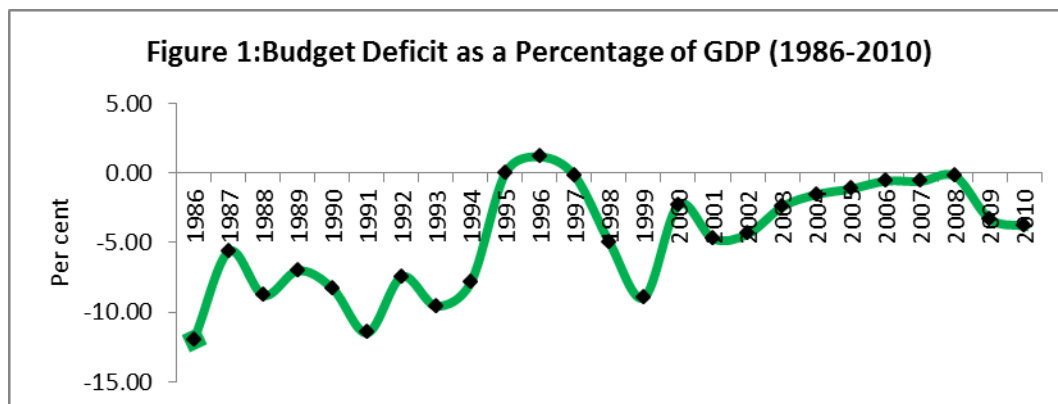
Omitogun and Ayinla (2007) examined the contributions of fiscal policy in Nigeria in the achievement of sustainable economic growth adopting the Solow growth model approach. They find fiscal policy as an ineffective tool for promoting sustainable economic growth owing largely to the structural rigidities prevalent in the economy. Oladipo and Akinbobola (2011) adopted the Granger causality technique in examining whether budget deficit operation stimulates economic growth in Nigeria. The authors observed a uni-directional causality from budget deficit to inflation and that budget deficit affects inflation directly and indirectly through fluctuations in exchange rate. Daylop (2010) also noted that fiscal deficit in Nigeria is Ricardian in nature and, therefore, have very little effect on the level of economic activity. Ezeabasili, *et al* (2012) also examined the relationship between fiscal deficits and inflation in Nigeria using a hybrid technique that incorporates cointegration technique and structural analysis. The paper finds a marginal but positive relationship between budget deficit and inflation in Nigeria as money supply was significant in the model, tended to grow at a faster rate than inflation, suggesting a procyclical movement.

III. Overview of Macroeconomic Trends in Nigeria

The overall balance of a country's budget speaks volumes about the management of its economy. For Nigeria, there are indications that all through its fiscal history until 2011, the country had achieved surplus budgets in only two years. The country's rankings in the human development index, poverty and inequality index and other development indices are worrisome and appalling for one of the most mineral-rich and human-resource endowed economies of the world. Though economic growth rate had maintained a steady average growth over time, the economy is challenged by rising unemployment, inefficient bureaucratic institutions, endemic political and economic corruption, insecurity

of life and property and weak legal system. The collapse of the international oil price in the early 1980s resulted in persistent deficits and severe financial crisis. This pressured the government into introducing the Structural Adjustment Programme (SAP) in 1986 with a view to reflating the economy through its expenditure cut and expenditure-switching programmes.

Ironically, the SAP measures swung budget deficit from ₦8.3 billion or 0.4 per cent of GDP in 1986 to a phenomenal ₦39.5 billion and ₦107.7 billion or 7.4 and 15.8 per cent of GDP in 1992 and 1993, respectively. In 1994, fiscal deficit declined moderately to ₦70.3 billion or 7.8 per cent owing to substantial increase in government revenue arising from improved non-oil revenue (company income tax, customs and excise duties and value added tax, which came into effect that year). In 1995 and 1996, owing largely to the prudent fiscal management of the government, coupled with the increase in revenue from the sales of the nation's crude oil, the economy recorded fiscal surpluses of ₦1.0 billion and ₦32.0 billion, respectively. However, deficit once again returned in 1988 and rose to about ₦133.4 billion or 4.9 per cent of GDP relative to its corresponding period. This development was not unconnected with the general review of salaries and other emoluments and entitlements of civil servants. The cost of transiting from military to civilian administration in 1999 further deteriorated the overall fiscal position with deficit standing at a staggering ₦285.1 billion. Though in 2000, budget deficit decelerated to ₦103.8 billion or 2.3 per cent of GDP, it nevertheless increased to ₦301.4 billion or 4.4 per cent of GDP in 2002 before declining to ₦172.6 billion, ₦101.4 billion and ₦47.4 billion (1.5, 0.6 and 0.2 per cent of GDP) in 2004, 2006 and 2008, respectively. In 2009, owing largely to the huge revenue decline from crude oil export, occasioned by the global financial and economic crises, overall fiscal balance plummeted significantly to ₦810.0 billion, representing about 3.3 per cent of GDP and ₦110.5 billion or 3.8 per cent of GDP recorded in 2010. Figure 1 shows the trend of Nigeria's budget deficit as a percentage of GDP from 1986 to 2010.



Growth in Nigeria's real domestic output averaged 8.4 per cent during 1971-1975 from an average growth rate of 4.9 per cent recorded during 1960 -1965. This was occasioned by the oil boom which resulted from the increase in crude oil exploration and export in the first half of the 1970s. However, between 1981 and 1985, average real GDP growth declined phenomenally due largely to the slump in oil prices, rise in global interest rates as well as domestic policy inconsistency. While the adoption of the Structural Adjustment Programme (SAP) in 1986 moderately reversed the negative growth trend, its subsequent abandonment in the following decade saw significant deterioration in economic and income per capita growth.

In 2000, there was a rebound in output growth, driven mainly by the improved macroeconomic environment, relative stability in the goods and foreign exchange markets and the enhanced investor confidence in the economy. This improved performance peaked in 2006 with a growth rate of 9.6 per cent, with relatively better performance of the non-oil sector. Between 2006 and 2010, real output grew at an average of 6.7 per cent with the highest growth of 7.9 per cent recorded in 2010. This salutary development was attributed to the sound economic management policies coupled with vast economic reforms and improved performance of the non-oil sector, which grew at 8.5 per cent. The amnesty programme of the Federal government contributed in no small measure to increased crude oil production which enhanced the funding of critical infrastructure in the economy and increased credit to the real sector. All of these cumulatively impacted positively on economic growth.

In line with the formal and informal structures of the economy, the Nigerian foreign trade and exchange rate market aligns with the dualistic nature though dominated by the formal sector. The informal or parallel market segment of the foreign exchange market, however, continue to witness high patronage, despite prohibition by law, accounting for up to 10.0 per cent of the foreign exchange needs, especially of individuals engaged in overseas travels and trans-border trade. This is in addition to the rising volume of unrecorded trade with neighbouring countries following the implementation of the ECOWAS protocol on free movements of persons and the considerable liberalization of external trade.

Foreign trade, which is dominated by the oil sub-sector (crude oil and gas), accounted for about 75.7, 73.6 and 64.8 per cent of total trade in 2006, 2008 and 2010, respectively. Similarly, oil exports accounted for 98.2 per cent of total exports receipts in 2006. This, however, declined to 97.6 and 96.4 per cent in 2008 and 2010, respectively. The patterns and trends in external trade and balance of payments position underscored the high degree of external dependence and

vulnerability of the Nigerian economy to external shocks. Though the foreign exchange content of domestic production and consumption is very high, there have been remarkable changes in the composition of non-oil imports in favour of consumer goods over the last decade, indicating a decline in production and increase in dependence. Consumer goods, which accounted for only 19.0 per cent of total imports in 1996 swung up to 47.0 per cent of total imports in 2006, while raw materials, with a total share of 42.0 per cent in 1996, declined to constitute only 29 per cent (CBN, 2010).

Inflation rate during the review period averaged 11.7 per cent, rising from a single-digit of 6.6 per cent in 1999 to about 24 per cent in 2003, before declining to 6.6 per cent in 2007. The high inflation in 2003 was attributed to increased aggregate demand driven primarily by political activities, the depreciation of the naira, and increase in the pump prices of petroleum products. Inflationary pressure eased significantly in the following years except in 2005 where increased food export (particularly cassava and grains) and stocking of the strategic grains reserve contributed to increased pressure on food prices. Clement weather, appreciation and relative stability of the naira coupled with robust macroeconomic policies all contributed to the general downward trend in price. However, in 2008 and 2009, price level resumed its upward trend, with the inflation rate standing at 15.1 and 13.9 per cent, respectively, owing largely to the surge in food prices and seasonal effects pushing inflation in Nigeria to exceed both the national and the WAMZ single-digit target.

IV. Analytical Framework and Methodology

IV.1 Analytical Framework

The fundamental building block for the analysis of the linkages between fiscal deficits and macroeconomic variables is the government budget constraint, though it is only one of the many components that impact on the total indebtedness of the government. When government revenue falls short of its expenditure outlays, it incurs a deficit which could be financed principally from external (overseas borrowing) or internal (monetary - printing money, or non-monetary - selling bonds to the public). In Nigeria, the domestic sources consist of the banking system (the Central Bank of Nigeria (CBN) and the Deposit Money Banks (DMBs)), the non-bank public and other sources such as excess crude savings. Government budget constraints, thus, goes beyond eliciting the interrelationship between deficit and the financing options but also highlight the linkages between monetary and fiscal policy as well as the macroeconomic consequences of deficits. The standard government budget constraint is expressed as

$$\delta_g - \delta_{g-1} = (c_g + i_g - \tau) + r\delta_{g-1} \quad (1)$$

Where $\delta_g - \delta_{g-1}$ is the change in debt between two periods or better defined as the net debt position of government, c is a measure of net government consumption, i_g is net government investment, τ is taxes net of transfers; and r is the nominal interest rate. Equation (1) is an identity showing that government net debt at any point in time is equivalent to budget deficit and debt service represented by the right hand side of the equation. When a government runs a deficit, it finances such deficits through the sale of bonds or other instruments to the public and private foreign investors, domestic public and private investors, the domestic banking system and the country's central bank. In most developing economies with nascent government bonds market, the weak financial capacity of domestic private investors invariably compels the central banks to hold huge proportions of government debt instruments. In Nigeria, however, the banks and discount houses and non-bank public often constitutes the major holders of government debt, with the central bank holding only a minimal component². It, therefore, implies that

$$\delta_{gc} - \delta_{gc-1} = (\delta_g - \delta_{g-1}) - (\delta_{gp} - \delta_{gp-1}) \quad (2)$$

where δ_{gc} and δ_{gp} is debt held by the central bank and the public, respectively.

Equation (2) suggests that a change in the holding of government debt by the central bank is equivalent to the total debt less the portion held by the public. Since budget deficit indirectly influences the quantum of money supply in the economy through the monetary base, it therefore means that

$$(\varpi - \varpi_{t-1}) = (\delta_{gc} - \delta_{gc-1}) + \alpha(r_c - r_{c-1}) + (l_{cb} - l_{cb-1}) \quad (3)$$

where ϖ is the monetary base; r_c is foreign reserves at the central bank; α is the domestic nominal exchange rate while l_c is the stock of loans made to commercial banks through the discount window. Assuming that the discount window do not exist i.e central bank's credit to DMBs is zero, equation (3) becomes

$$(\varpi - \varpi_{t-1}) = (\delta_{gc} - \delta_{gc-1}) + \alpha(r_c - r_{c-1}) + (l_{cb} - l_{cb-1}) \quad (4)$$

Substituting equation (2) into (4) gives

² According to the CBN Financial Markets Department Activity Report for 2010, the CBN, Banks and Discount Houses and Non-Bank Public held about 7.5%, 57.3% and 29.8%, respectively, of government bonds in 2010.

$$(\varpi - \varpi_{t-1}) = (\delta_g - \delta_{g-1}) - (\delta_{gp} - \delta_{gp-1}) + \alpha(r_c - r_{c-1}) \quad (5)$$

Rearranging equation (5) yields

$$(\delta - \delta_{g-1}) = (\varpi - \varpi_{t-1}) + (\delta_{gp} - \delta_{gp-1}) - \alpha(r_c - r_{c-1}) \quad (6)$$

Equation (6) represents the fundamental framework for financing budget deficits. First through printing of money, monetary base $(\varpi - \varpi_{t-1})$, secondly through borrowing from the public, treasury bonds $(\delta_{gp} - \delta_{gp-1})$ and thirdly, depleting the foreign exchange reserves at the central bank $\alpha(r_c - r_{c-1})$. According to Easterly and Schmidt-Hebbel (1994), each of these financing options, when used excessively, brings about macroeconomic imbalances or distortions. For instance, while money creation could lead to inflation; excessive domestic borrowing may result in credit squeeze or contraction (crowding-out), and external borrowing may result in current account deficit and exchange rate depreciation. However, a moderate mix of these options has the potency to propel economies back to the path of growth and development especially where the funds sourced are committed to economically viable and self-financing projects that have the ability to service the loans from their returns.

IV.2 Methodology

Depending on the research objective, the ordinary least squares (OLS) and the vector autoregression (VAR) approaches remain yet the most commonly applicable methodologies for the determination of inter-relationships between economic variables. Complementarily, the error correction mechanism has come to be a veritable tool for ascertaining the dynamic paths of variables as well as their ability to return to long-run equilibrium (converge) after a shock. This study adopts the VECM framework. The preference for VECM followed Phillips (1991), Gonzalo (1994) and Goswami and Jung (1997) who ascribed better properties to VECM than several other estimating techniques for long run relationship determination. Phillips (1991), for instance, prefers VECM because it gives more efficient estimators of cointegrating vectors as it allows for the testing of cointegration in a system of equations. According to Lutkepohl (2004) where a cointegrating relationship had been established among variables in the system, it becomes imperative to consider specific parameterizations that support the analysis of the cointegration structure. In this case, a VECM model set up becomes more convenient compared with a VAR.

In order to obtain reliable estimates of parameter coefficients, the series of interest were differenced to achieve stationarity where they are not stationary at levels. Also, the unit root test are carried out to determine the statistical properties of the variables and their long-run relationships before estimating the model. We find a VAR of order four (4) using the Hannan-Quinn Information Criterion (HQ) and proceeded to determine the cointegrating vectors by conducting the Johansen cointegration test. The result from the maximum eigenvalues and trace statistics indicate a cointegrating relationship at 5.0 per cent significance level. The VECM is estimated showing the long-run and short-run error correction coefficients, statistical significance, interactions and feedback across the variables of interest. This is to show the response of variables in the model to short-run evolutions with a view to eliciting useful information about the dynamics of the system.

IV.3 Data

The Central Bank of Nigeria (CBN) and the National Bureau for Statistics (NBS) serve as the major sources of data for the study. Maximum lending rate, (mlr), average nominal exchange rate (ner) and fiscal balances (fdr) of federal government were obtained from various statistical publications of the CBN. Real gross domestic product (rgdp) and consumer price index (cpi) series were sourced from the National Bureau of Statistics (NBS). The study used quarterly data from 1990Q1 to 2011Q4 for the estimation. The maximum lending rate is believed to be the most appropriate representative of interest rate in the Nigerian economy. Inflation rate is measured by the change in consumer price index in the study. Exchange rate is represented by the quarterly average nominal exchange rate vis-a-vis the US dollar while real GDP is the total domestic output deflated by the GDP deflator. All series, except the ratio of fiscal deficit to GDP and interest rate, entered the model in their natural logarithm form to enable the interpretation of the coefficients as elasticities.

IV.4 Unit Root

Since most macroeconomic time series data are found to be inherently non-stationary (Nelson and Plosser, 1982), pre-testing the variables helps to determine the order of integration before the application of the VECM technique. Consequently, the Augmented Dickey-Fuller (ADF) (1979, 1981) and the Phillip-Perron (PP) (1988) tests were employed to examine the stochastic properties of the series with a view to finding their level of stationarity. Where variables are not stationary, estimation results are very likely to be spurious leading to biased standard errors and unreliable correlations within the regression analysis (Yule, 1926).

IV.5 Cointegration

When several time series variables are found to be non-stationary, a cointegration test is required to determine whether they have a long-run relationship. Although there exist a number of tests/techniques for determining cointegration, this study employs the Johansen and Juselius (1990) vector error correction mechanism (VECM) approach. Using all variables as endogenous³, a VECM investigates the long-run as well as the short-run dynamic co-movements among economic variables. We first tested for the cointegrating vectors before applying the error correction model in which deviations from the long-run equilibrium influences the short-run dynamics of economic variables.

A VECM model is specified as follows

$$\Delta Z_t = \Gamma_1 \Delta Z_{t-1} + \Gamma_2 \Delta Z_{t-2} + \dots + \Gamma_{k-1} \Delta Z_{t-k+1} + \Pi Z_{t-k} + v_t \quad (7)$$

where $\Gamma_i = - (I - A_1 - \dots - A_i)$ ($i = 1, \dots, k-1$), a matrix representing short-term adjustments and $\Pi = - (I - A_1 - \dots - A_k)$, being a coefficient matrix showing the long-run relationship between the variables in the vector. Z_t is $p \times 1$ vector of stochastic variables integrated of order 1, k is the lag length and v_t is $p \times 1$ gaussian white noise residual factor. Johansen (1988) developed the methodology for testing the rank of Π . When Π matrix has a full rank ($r = n$), the variables in Z_t vector are said to be stationary at level that is $I(0)$ implying that the model could be used without differencing the series. If the rank of Π matrix rank is null ($r = 0$), it indicates the absence of a long-run or cointegrating relationship between the variables at level suggesting differencing of the series before use in the VAR. However, when the Π matrix has a rank that lies between zero and one ($r \leq (n - 1)$), it implies that there exist a $n \times 1$ matrix of α and β each with rank r such that $\Pi = \alpha\beta'$ where, according to Harris (1995) α is a matrix of error correction terms measuring the coefficient of the speed of adjustment to equilibrium and β is a matrix of long-run coefficients or the cointegrating vector such that the term $\beta'Z_{t-k}$ ensures that Z_t converges with their long-run steady state. r is the number of cointegrating relationships.

Consequently, long-run cointegrating relationship was estimated implying the consideration of the rank of Π . Johansen (1988) and Johansen and Juselius (1990) developed the trace (λ trace) and the maximum eigenvalues (λ max) likelihood ratio test statistics for testing of the rank of Π or number of cointegrating vectors. Both methods involve the estimation of the matrix Π but differ only in the sense

³ In a VECM, all the variables enter the system endogenously particularly with the use of the maximum likelihood method which minimizes the endogeneity bias.

that while one test against specific alternative, the other tests against general alternative. The null hypothesis for both tests is same, that is, there is no cointegration.

IV.6 Model Specification

The error correction formulation for the fiscal deficit function is specified as:

$$fdr_t = \alpha_0 + \alpha_1 \ln rgdp_t + \alpha_2 cpi_t + \alpha_3 \ln ner_t - \alpha_4 \ln po_t - \alpha_5 mlr_t + \varepsilon_t \quad (8)$$

Where $\alpha_0, \dots, \alpha_5$ represent the model parameters or coefficients to be estimated and are theoretically expected to be greater than zero ($\alpha_0, \dots, \alpha_5 > 0$). The variables fdr , $rgdp$, cpi , ner , po and mlr are the ratio of budget deficits to GDP, real gross domestic product, consumer price index (proxy for inflation), average nominal exchange rate, crude oil price and maximum lending rate, respectively. ε_t is the error term with the conventional statistical properties. Theoretically, the relationship between fiscal deficit and domestic macroeconomic variables could either be positive or negative depending on the financing method adopted. For instance, a positive real domestic output growth implies stimulation of the economy through debt acquisition while a rising inflation rate suggests the monetization of reserves or the printing of money by the central bank, all of which increases the money supply in the economy.

It is expected that deficit spending would translate into growth in gross domestic product through the financing of capital projects and infrastructure, while an inverse relationship implies the financing of more of recurrent expenditure⁴, which in an import-dependent economy like Nigeria's, decelerates growth. Theoretically, interest rate relationship with budget deficit is expected to be inverse as a downward pressure is exerted on interest rates where the deficit is financed from money printing or monetization of foreign earnings. In the same vein, where the financing is done through the market, lending rates will rise as government, in a bid to woo patronage, often lower the rate of debt instruments. The ensuring patronage by the investing domestic public drives up lending rate as resources are reallocated to take advantage of the lower rate and high yield in the government instrument. This financing option is usually known to crowd-out private investment.

Nominal exchange rate exhibit a direct relationship with rising fiscal deficits, especially in an import-dependent economy like Nigeria's, where government

⁴ According to the CBN Annual Report for 2010, recurrent expenditure accounted for 74.1 per cent of total expenditure and 10.5 per cent of GDP.

fiscal activities exert pressures on the domestic exchange rate. However, if government spending is directed at productive activities, the inverse outcome would hold as aggregate demand is stimulated and excess products exported to earn foreign exchange. The result is the appreciation of the exchange rate (as reserves build up) and worsening of the current account deficit as exports becomes less competitive and imports becomes cheaper.

V. Empirical Analysis

V.1 Unit Root Test

The unit root test results in Table 1, indicates that both the ADF and PP tests did not fail to reject the null hypothesis of unit root (or non-stationarity) in level series, but at first difference, and 1.0 per cent significance level with constant and intercept, all variables in the model are stationary. This implies that all variables are integrated of order one $I(1)$, having been differenced once. It, thus, becomes necessary to undertake a cointegration test⁵.

Table 1: Unit Root Tests

Variable	ADF Test		PP Test	
	Level	First Difference	Level	First Difference
<i>fdr</i>	-2.4590	-6.5063*	-2.2019	-6.5586*
<i>lnrgdp</i>	-1.9612	-9.9400*	0.9279	-12.6410*
<i>Inner</i>	-1.6811	-9.2544*	-1.6914	-9.2591*
<i>Incpi</i>	-0.6157	-8.6827*	-0.6362	-8.6645*
<i>mlr</i>	-0.6496	-8.5445*	-0.6493	-7.8195*
<i>lnpo</i>	0.1167	-8.5775*	-0.3973	-7.6668*
	Test Critical Values		Test Critical Values	
	*1 % level	-3.5083	*1 % level	-3.5074
	**5 % level	-2.8955	**5 % level	-2.8951
	***10 % level	-2.5849	***10 % level	-2.5847

Note: Critical values are from Mackinnon (1999)

V.2 Johansen Cointegration Test

Having established the order of integration, we proceed to test for cointegration which is used to establish the existence of long-run relationship among the

⁵ Even though the most desirable case in cointegration test is to have all the variables integrated of the same order, it is imperative to stress that cointegrating relationship still exist in cases where a mix of $I(0)$ and $I(1)$ exist, Kerry (2008).

variables. The test uses the trace (λ trace) and maximum eigenvalues (λ max) statistics to determine the number of cointegrating vectors. Appropriate optimal lag length that would give standard normal error terms was selected using the Hannan-Quinn information criterion (HQ) as the Schwarz information criterion is considered too constraining given the higher penalty it imposes. The result of the cointegration tests is presented in Table 2.

Table 2: Unrestricted Cointegration Test

Trace Statistics			Maximum Eigenvalues		
Null Hypothesis	Trace Statistic	Critical values at 0.05%	Null Hypothesis	Maximum Eigen Statistic	Critical values at 0.05%
$r = 0$	115.68*	95.75	$r = 0$	41.93*	40.07
$r \leq 1$	73.75*	69.81	$r \leq 1$	32.16	33.87
$r \leq 2$	41.59	47.86	$r \leq 2$	21.59	27.58
$r \leq 3$	19.99	29.79	$r \leq 3$	12.00	21.13
$r \leq 4$	7.99	15.49	$r \leq 4$	7.27	14.26

Note: r represents number of cointegrating vectors; * and ** indicates rejection of the null hypothesis at 5% and 1% significance level, respectively.

Starting with the null hypothesis that there are no cointegrating vectors ($r=0$), the result show that at 0.05 per cent significance level, the trace and maximum tests suggest that the variables are cointegrated with $r=2$ and $r = 1$, respectively. According to Harris (1995), this feature is a common phenomenon in estimated test statistics and that when it obtains, the maximum eigenvalue test should be favoured over the trace statistic. This suggests that the variables are cointegrated and at least one factor drives the relationship toward a stable long-run convergence. The trace statistic (λ trace) at 115.68 and 73.75 are larger than their respective critical values of 95.75 and 69.81 while the maximum eigenvalue statistics (λ max) at 41.93 exceed its critical value of 40.07. This rejects the null hypothesis at 5.0 per cent level of significance in favour of the alternative hypothesis that there is cointegrating vector ($r \geq 1$). It is also indicative from the table that the null hypothesis for $r \leq 1$, $r \leq 2$, $r \leq 3$, and $r \leq 4$ cannot be rejected at 5.0 per cent level of significance, showing that there exists at least one (1) cointegrating vector among the variables of interest.

Following Johansen and Juselius (1990) methodology, we normalise the cointegrating vector on the ratio of budget deficit to GDP (fdr) given the

evidence in favour of at least one cointegrating vector. The normalised cointegrating relationship, given one cointegrating relation ($r=1$), and lag length of 4 is expressed as:

$$bd_t = -0.006 \ln rgdp_t + 0.032 \ln cpi_t - 0.051 \ln ner_t + 0.074 \ln po_t + 0.015 mlr_t \quad (9)$$

(-0.089) 1.506 (-2.005) (2.08) (4.99)

Equation (9) shows that all the explanatory variables except real domestic output and exchange rate are positively related with the budget deficits financing. Apart from real output and maximum lending rate, other variables exert significant influences on deficit movement. A one per cent increase in cpi and po results in approximately 0.03 and 0.07 per cent increase in deficit financing, respectively. Exchange rate, oil price and maximum lending rate enter the cointegrating vector significantly. Equation (9) shows the coefficients for all the variables. The actual equilibrium relationship is presented as

$$ecm = bd_t + 0.006 \ln rgdp_t - 0.032 \ln cpi_t + 0.051 \ln ner_t - 0.074 \ln po_t - 0.015 mlr_t \quad (10)$$

(-0.089) (1.506) (-2.005) (2.08) (4.99)

Equation (10) mirrors the economic fundamentals of the Nigerian economy. The positive relationship between budget deficits and the real domestic output and nominal exchange rate is expected. The posting of a fiscal deficit in Nigeria is most often followed by a draw down on external reserves and excess crude account, the monetization of which impacts on monetary aggregates by increasing money supply and exerting inflationary and exchange rate pressures. The minimal impact of output points to the fact that much of the government spending (over 74.1 per cent) is dedicated to non-productive recurrent expenditures. The positive sign of oil price is counter-intuitive given that high oil price improves government revenue which ordinarily should lead to lower deficit. The huge government expenditure outlay on recurrent expenditure, added to the endemic corruption and high import component of consumables, offers a plausible explanation for this development.

High net imports serve as revenue leakages, depreciate the local currency, increase local price levels and consequently contribute insignificantly to economic growth. Though the level of development of the capital market in Nigeria is still nascent, government in the last decade, through prudent fiscal measures, had resorted to the market to finance its deficits, instead of depending on central bank Ways and Means Advances. However, the behaviour of interest rate, most times, do not represent actual economic expectations as the rate, to a large extent, is dependent on factors not correlated with market fundamentals and operations in the economy. In addition, anecdotal evidence suggests that the Nigerian government hardly takes market behaviour into consideration when

it is fixing the rate at which its instruments are to be sold. This distort the market behaviour of interest rates in the economy and hence the negative sign.

V.3 Wald Coefficient Test

The Wald coefficient test (Table 3) as described by Polit (1996) and Agresti (1990) was also conducted to ascertain the significance of the estimated parameters i.e. whether the parameters of the explanatory variables are zero. This is a joint significance test on the lagged explanatory values used to determine the short-run causality. The result shows that the parameter restrictions for all the variables, except for the maximum lending rate, reject the restriction hypothesis that each coefficient of the variable is zero. Therefore, all the variables are significant at 1.0 per cent significance level, except for *mlr*, and should be included in the model. However, the joint Wald test indicates overall significance for all variables.

Table 3: Wald Test

Estimated equation $0 = \alpha_0 + \alpha_1 \ln r_{gdp} + \alpha_2 \ln cpi_t + \alpha_3 \ln inner_t - \alpha_4 \ln po_t - \alpha_5 mlr_t$

Parameter Restriction	Chi-Squared Test Statistic	Probability
α_0	60.0894	0.0000
α_1	8.2193	0.0004
α_2	99.4429	0.0000
α_3	27.3077	0.0000
α_4	13.1716	0.0003
α_5	0.0972	0.7551

Note: the critical values with one degree of freedom at 1% significant level is 75

The establishment of a cointegration relationship between the variables in the model suggests that one or two of the variables in the model Granger-causes the other, making it imperative to examine more comprehensively the direction and nature of the causality. Since the cointegration test is not rejected, using the standard Granger causality test would result in misspecification (Engle and Granger, 1987), hence causality was determined by applying the error correction model on to the time series. The causal relationship is determined by the significance of the χ^2 -values.

Table 4: Granger Causality Result based on VECM

	Null Hypothesis	χ^2 - Statistics	Probability
lrgdp	\Rightarrow lpo	18.2185*	0.0001
lcpi	\Rightarrow bd	4.8939***	0.0866
lcpi	\Rightarrow lner	5.4429***	0.0658
lner	\Rightarrow bd	7.0414**	0.0296
lner	\Rightarrow lcpi	5.3344***	0.0694
lpo	\Rightarrow lrdgp	22.3144*	0.0000
lpo	\Rightarrow lcpi	7.5881**	0.0225
lpo	\Rightarrow lner	7.3476**	0.0254
mlr	\Rightarrow lner	7.5149**	0.0233

Notes: the arrow \Rightarrow denotes Granger Causality, *, **, and *** denote 1%, 5% and 10% significance level, respectively.

The statistical analysis, based on the vector error correction model (VECM) of the causal relationship among the variables is reported in Table 4 above. The results show that causality runs from price level to budget deficit and exchange rate. Similarly, the estimates reveal that a causal relationship runs from oil price to output, price level and nominal exchange rate as statistically determined by the χ^2 - values reported in the Table. In addition, the hypothesis of causality from exchange rate to budget deficit, consumer price index to exchange rate and exchange rate to prices is rejected at the 10 per cent level of significance, while others are rejected at 5.0 per cent, except real output that is rejected at 1.0 per cent. The test also indicates that none of the macroeconomic variables in the model Granger causes the maximum lending rate during the sample period. This suggests that lending rate is not a strong consideration when government is contracting debt to finance expenditures, which is consistent with outcomes in most developing countries. The plausible explanation for this behaviour is the rudimentary nature of the markets.

V.4 Vector Error Correction Model without Exogenous Factors

In econometric theory, the cointegration of two non-stationary variables implies their convergence in the long-run horizon. Having established a cointegral relationship between deficit, price level, nominal exchange rate, oil price, lending rate and real output, we proceed to estimate the error correction model of equation (11), with a view to capturing the short-run dynamics of the model such as the speed of adjustment to equilibrium or convergence in the case of

any shock. The error correction equation has the advantage of easy interpretation in terms of short and long-run responses of shocks in the model. It also separates the short-run and long-run relationships between the variables. The short-run relationships are captured by the terms in first differences while the long-run relationships are captured by the terms in levels. In the literature, several techniques, such as Engle and Granger (1987) and Johansen and Juselius (1990) are often employed in the estimation of error correction mechanism (ECM). Here we adopted the VECM technique which is more useful in estimating multivariate models. We assume fiscal deficit to be endogenous while the explanatory variables are considered weakly exogenous.

The VECM takes the form:

$$\begin{aligned} \Delta bd = & \phi_0 + \sum_{i=1}^{k-1} \phi_1 \Delta bd_{t-i} + \sum_{i=0}^{k-1} \phi_2 \Delta \ln rgdp_{t-i} + \sum_{i=1}^{k-1} \phi_3 \Delta \ln cpi_{t-i} + \sum_{i=0}^{k-1} \phi_4 \Delta \ln ner_{t-i} + \sum_{i=0}^{k-1} \phi_5 \Delta \ln po_{t-i} \\ & - \sum_{i=1}^{k-1} \phi_6 \Delta mlr_{t-i} + \phi_7 ECM_{t-1} + \mu_t \end{aligned} \quad (11)$$

The estimates of the error correction model coefficients of equation (11) have the same signs and explanations as earlier discussed. The ECM coefficient, ϕ_7 , is expected to be less than one, negatively signed and statistically significant. The negative sign of the error correction term presumes a long-run convergence of the model to equilibrium and the magnitude shows the proportion of the disequilibrium that is corrected within each period. This long-run equilibrium relationship forms the basis for the short-run dynamics of the model and shows the speed of adjustment of the system to long-run perturbations. While the estimated parameters form the long-run elasticities, the coefficients of the difference terms form the estimates of the short-run elasticities.

Hendry's (1986) general-to-specific modeling procedure was followed in the selection of the preferred error correction model. This approach requires the estimation of the VECM in their difference form and eliminating the lags with insignificant parameters, guided by the estimated standard errors for the coefficients, in order to achieve a parsimonious VECM. The optimal lag length for the explanatory variables was four using the Hannan-Quinn information criterion. The number of cointegrating equations in the model was also determined as one. Table 5 depicts the results of the parsimonious short-run model including some diagnostic tests.

Table 5: Parsimonious Short-Run Model

	<i>fdr(-1)</i>	<i>lrgdp(-1)</i>	<i>lcpi(-1)</i>	<i>lner(-1)</i>	<i>lpo(-1)</i>	<i>mlr(-1)</i>
(A) Cointegrating Equation	1.000000	-0.0063 [-0.09]	0.0316 [1.51]	-0.051 [-2.00]	-0.074 [-2.08]	0.015 [4.98]
	<i>fdr(-1)</i>	<i>lrgdp(-1)</i>	<i>lcpi(-1)</i>	<i>lner(-1)</i>	<i>lpo(-1)</i>	<i>mlr(-1)</i>
(B) Ecm_{t-1}	-0.11 [- 2.31]*	0.18 [-1.18]	-0.29 [-0.74]	2.17 [2.98]*	1.01 [-1.85]*	-19.66[- 1.99]*
$\Delta fdr(-1)$			2.67 [2.59]*			
$\Delta lrgdp(-1)$		-0.31 [-2.83]*				
$\Delta lrgdp(-2)$		-0.38 [-3.60]*				
$\Delta lrgdp(31)$		-0.38 [-3.45]*				
$\Delta lrgdp(-4)$		0.63 [5.30]*				
$\Delta lcpi(-3)$					-0.36 [-2.08]*	
$\Delta lner(-1)$				-0.29 [-2.03]*		
$\Delta lner(-4)$	0.03 [3.66]*					
$\Delta lpo(-1)$	-0.02 [1.97]*		-0.20 [- 2.15]*		0.34 [2.66]*	
$\Delta lpo(-2)$					-0.27 [-1.98]*	
$\Delta lpo(-4)$			-0.33 [- 2.19]*			
$\Delta mlr(-1)$				0.03 [2.37]*		0.49 [3.06]*
$\Delta mlr(-2)$				0.03 [2.08]*		
$\Delta mlr(-3)$						0.30 [2.18]*
c		0.023 [2.873]*				
Diagnostics						
Adj R ²	0.39	0.88	0.11	0.004	0.20	0.11
Sum sq resids	0.005	0.071	0.508	1.652	0.93	302.08
Log likelihood	283.18	175.33	93.67	44.76	68.43	-171.38

Notes: Figures in * (parenthesis) are significant levels

The parsimonious result as depicted in table 5 is very instructive and elucidating. However, the analysis requires an understanding of the fundamentals and peculiarities of the Nigerian economy. The table is divided into three sections: the cointegrating vector or long-run relationship, the error correction terms estimates and the diagnostics. Section (A) shows the cointegrating vector or long-run equation indicating that in the long-run, fiscal deficit in Nigeria is significantly cointegrated with nominal exchange rate, oil price and maximum lending rate but not with real domestic output and consumer price index.

The result of the lagged variables in their first difference form (error correction) is presented in section (B). The result of the estimate shows that the coefficient of the error correction term, which measures the speed of adjustment towards long-

run equilibrium, has the expected negative sign, less than one and is statistically significant. This implies that there exist a mean-reverting process of the variables to their long-term targets and that approximately 11.0 per cent of the disequilibrium is corrected within a quarter. It also show that the coefficients of error correction of budget deficit, nominal exchange rate, oil price and maximum lending rate are significant while that of real output and price level are insignificant. This suggest that while budget deficit, nominal exchange rate, oil price and maximum lending rate can potentially return to the long-run equilibrium, should there be a shock in the economy, in the short-run, other variables cannot revert to equilibrium.

Following Henry's general-to-specific rule, statistically insignificant variables were eliminated from the model. A cursory observation of the result indicates that nominal exchange rate and oil price influence fiscal deficit in Nigeria in the short-run. Oil price exhibits a negative relationship with fiscal deficit especially as crude oil sales comprise over 90.0 per cent of government foreign exchange earnings. A decline in prices induces fiscal deficit while increased oil prices slows government's appetite for loans. Similarly, exchange rate demonstrated a positive and significant relationship indicating the depreciation of the local currency increases fiscal deficit. However, the heavy intervention in the foreign exchange market by the central bank to stabilize the rate insulates the exchange rate from much of the dynamics of the economy, especially the depletion of reserves position or the monetisation of oil revenue earnings. Hence, its minimal impact.

The result further reveals that budget deficit and oil price significantly influence consumer price level. The result suggests that while budget deficit significantly increases price level, oil price decelerates the price level. An increase in budget deficit exacerbates inflationary pressures while favourable oil prices moderates inflation rate through a stable exchange rate and increased investment and output.

Nominal exchange rate is affected by oil price and maximum lending rate, which equally exhibits autoregressive structure. Maximum lending rate show positive and significant relationship with exchange rate. This is in consonance with the economic literature, which for instance, argues that in an economy with rudimentary money and capital market, economic agents shy away from lending to the private sector but invest in government debt instruments which are considered less risky despite their low yield and the foreign exchange market. While oil price exerts an inverse pressure on nominal exchange rate, the maximum lending rate positively affect exchange rate. Consumer price index indirectly influences oil price significantly, which also follows an autoregressive

structure. The table further reveals that real output and maximum lending rate exhibit autoregressive structures as they are not influenced by any other variable in the model except by their past behaviour. However, the statistical significance of the constant term of real output suggests the impact of other variables in the determination of real output in the short-run.

V.5 Variance Decomposition.

Variance decomposition presents a summary of the fraction of the overall forecast error variable accounted for by each of the type of innovation. It helps one to analyse the way in which the variances of each variable's innovation influences the movement (that is, variation) in each of the variable in the system. Variance decomposition is the percentage of the variance of the error made in forecasting a variable (say X) due to a specific shock (say error term of the Y equation) at a given horizon (like say 2 years). It shows which variables have relatively sizeable independent influence on other variables in the system.

The variance decomposition result reported in Table 6 (see the appendix) provides additional information on the relationship between fiscal deficit and selected macroeconomic variables in the economy. It is generally observed that the variation in all the variables in the system are significantly accounted for by their own shocks by the end of the tenth period. Results from the table indicate that variation in fiscal deficit is significantly accounted for by its own shock, declining from 97.4 per cent in the third period to 96.9 per cent by the end of the tenth period. It is also shown that oil price and interest rate account for 1.6 and 1.3 per cent of the variation in fiscal deficit, respectively, while other variables had no significant impact on budget fluctuations.

Similarly, the variation in real domestic output is largely influenced by its own shock, while oil price contributed a significant 25.0 per cent after the tenth period, having risen from 16.6 and 23.3 per cent in the third and seventh quarters, respectively. Output is not meaningfully influenced by inflation rate, nominal exchange rate and maximum lending rate. The variance decomposition result also show that 80.0 per cent of variation in inflation rate is explained by its own shock in the tenth period. While fiscal deficit contribution to variation in inflation rate rose from 9.5 per cent in the third quarter to 15.4 per cent in the tenth period, real output accounted for only 3.6 per cent in the tenth period against the 6.4 per cent obtained in the third period. No significant contribution is exhibited by other variables.

Exchange rate variation is significantly accounted for by its own shock (95.34 per cent in the tenth period against 97.1 per cent in the third quarter). Except for fiscal deficit influence of about 2.70 per cent in the variation in exchange rate,

other variables in the system did not cause any variation in exchange rate. The variance decomposition of oil price reveals an interesting result as all other variables in the model contributed meaningfully to its variation. Oil price accounted for 75.0 and 40.6 per cent of its shock in the third and tenth periods, respectively while real output, maximum lending rate, fiscal deficit and inflation rate accounted for 23.7, 12.9, 10.4 and 9.6 per cent of the variation in oil price in the tenth period, respectively. Real output and exchange rate accounted for 5.8 and 4.1 per cent of the variation in maximum lending rate while 88.6 per cent was explained by its own shock. Fiscal deficit, inflation rate and oil price exhibited insignificant influence on maximum lending rate in the system.

VI. Policy Recommendations and Conclusion

This paper focused on establishing the link between fiscal deficit and short-term changes in key macroeconomic variables. The consistency and stability of the empirical results show that the model adequately explains the behaviour of government in financing its expenditures and should be closely monitored in the process of policy formulation. The result points to the critical roles of real GDP, nominal exchange rate, inflation rate and interest rate and oil price in influencing the financing of government expenditures in Nigeria.

Fiscal deficit was found to be significantly influenced by oil price and exchange rate. This is not unexpected since oil accounts for a quantum of government revenue while exchange rate in an import-dependent economy like Nigeria is a critical determining factor. However, since oil price is an exogenous factor that is beyond the purview of government control, government should assiduously pursue its intervention policies in the foreign exchange market with a view to stabilizing the exchange rate. Though oil price is externally determined, the model reveals its impact on price level which is one of the most critical economic variables of interest to the monetary authorities. The monetization of the crude oil revenue should be strategically sequenced to militate against excess liquidity, a primary factor for inflationary pressures. In that regard, the prudent and judicious management of the excess crude account becomes crucial. This account should be an intervention tool to stabilize prices and exchange rate when the international price of crude oil dips. The current practice where proceeds of this account are shared among the tiers of government is counterproductive and negates the *prima facie* objective for which it was established. Though the Sovereign Wealth Fund (SWF) concept is applauded, its success depends on the public confidence and trust in government, the absence of which has been the reason behind the agitation for the sharing of the accumulated revenue among the tiers of government over the time. In order to forestall the situation where the custodian has undue access to the fund, we recommend that other stakeholders

be made signatories to the account to prevent abuses. This will, in no small measure, restore the waned confidence.

There is also the need to keep watch of the movements in other variables of interest in the system as interactions between them were also established in the model. For instance, the maximum lending rate was found to significantly influence exchange rate movement. In as much as government is encouraged to make concerted effort to reduce its vulnerability and dependence on oil revenue by harnessing other complementary export earning sources, the central bank has the greater role in the adjustment of its monetary policy rate. The MPR, which serves as the anchor rate in the economy influences the quality and quantity of credit flow to the private sector, the engine of growth. A credible monetary policy rate will not only deepen the credit market but also ensure the efficient allocation of resources in the economy. It is, thus, expected that the sustainability of the present policy stance would bring about the desired impact on the economy as the market now responds to the movement in the rate than before. It has been theoretically argued that effectively managing the exchange rate and interest rate would invariably stabilize inflation rate, bring about the much desired economic growth and development as well as enable the country meet and comply with the West African Monetary zone (WAMZ) convergence criteria.

This study has shown that while the accumulation of deficit is not at all detrimental to the economy per se, government should exercise prudence in the financing options adopted and more so the appropriate application of such funds in economically-viable projects that have the ability to service the loans from their returns. It is imperative that government revisit the ever increasing expenditure and low tax collection syndrome which are the major factors fuelling the widening fiscal deficit in the country. In essence, government should broaden its tax net to reduce the surging borrowing as well as curb the current fiscal challenges from cascading into a full scale fiscal crisis. Finally, budget making should not be restricted to a mere accounting exercise, instead the process should be focused on growing human capital through a carefully thought out socio-economic development framework.

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Appendix A: Table 6: Variance Decomposition

Variance Decomposition of FDR:							
Period	S.E.	FDR	LRGDP	LCPI	LNER	LPO	MLR
3	0.026173	97.42386	0.093325	0.005636	0.169348	1.960093	0.347739
5	0.036737	97.22225	0.065490	0.003934	0.107062	1.865591	0.735669
7	0.045118	97.03181	0.074312	0.006819	0.097147	1.693302	1.096614
9	0.052160	96.89275	0.068282	0.007808	0.096506	1.651791	1.282861
10	0.055350	96.85308	0.066541	0.008118	0.095512	1.633534	1.343212

Variance Decomposition of LRGDP:							
Period	S.E.	FDR	LRGDP	LCPI	LNER	LPO	MLR
3	0.141692	0.321161	82.46098	0.090382	0.381136	16.56192	0.184419
5	0.170356	0.232284	76.13603	0.215770	0.276612	22.46212	0.677182
7	0.197115	0.178931	75.41514	0.210151	0.209096	23.32289	0.663787
9	0.220133	0.143696	74.24966	0.216489	0.168018	24.54713	0.675012
10	0.230743	0.131088	73.86304	0.219468	0.152935	24.94894	0.684528

Variance Decomposition of LCPI:							
Period	S.E.	FDR	LRGDP	LCPI	LNER	LPO	MLR
3	0.191403	9.472773	6.351935	82.83587	0.524584	0.804945	0.009894
5	0.258073	12.66973	4.772204	81.46243	0.418107	0.646933	0.030594
7	0.311589	14.21494	4.028126	80.74144	0.403414	0.563802	0.048280
9	0.357306	15.09111	3.713739	80.21220	0.395222	0.537286	0.050449
10	0.378070	15.38566	3.602148	80.04485	0.391002	0.525447	0.050890

Variance Decomposition of LNER:							
Period	S.E.	FDR	LRGDP	LCPI	LNER	LPO	MLR
3	0.294893	1.075052	0.870903	0.224308	97.06084	0.672619	0.096274
5	0.377414	2.007909	0.574361	0.319734	96.18547	0.513510	0.399016
7	0.446794	2.407359	0.417286	0.381252	95.69790	0.448626	0.647579
9	0.506693	2.622972	0.336778	0.410444	95.43436	0.422390	0.773051
10	0.534095	2.702051	0.307511	0.421245	95.34044	0.410635	0.818118

Variance Decomposition of LPO:							
Period	S.E.	FDR	LRGDP	LCPI	LNER	LPO	MLR
3	0.246161	7.809995	5.902667	5.335265	3.470076	75.01750	2.464501
5	0.336855	10.07327	19.02339	7.969774	3.508592	50.95430	8.470685
7	0.406954	10.18497	21.79168	8.914597	3.024959	44.89631	11.18748
9	0.465126	10.37089	23.14141	9.400949	2.885569	41.78298	12.41820
10	0.491952	10.43360	23.70429	9.572272	2.830648	40.59222	12.86698

Variance Decomposition of MLR:

Period	S.E.	FDR	LRGDP	LCPI	LNER	LPO	MLR
3	4.945999	1.045350	2.670398	0.068209	3.056479	0.082343	93.07722
5	6.502496	1.233634	4.613938	0.068335	3.702331	0.168531	90.21323
7	7.733198	1.260660	5.266011	0.069190	3.911529	0.172000	89.32061
9	8.796838	1.276198	5.622708	0.069344	4.039788	0.178502	88.81346
10	9.282741	1.281661	5.753090	0.069550	4.083019	0.181110	88.63157

Cholesky Ordering: FDR LRGDP LCPI LNER LPO MLR

Estimation of Interest Elasticity Model for Aggregate Commercial Bank Deposits in Nigeria — (1986-2008)

Matthew I. Eboime, Phd and Edwin M. Egboro, Phd*

Abstract

The Nigerian government deregulated the financial market in 1987 in line with the McKinnon-Shaw financial liberalization paradigm. However, the subsequent policy reversal after the introduction of the structural adjustment programme has made the effect of interest rate on aggregate commercial bank deposits (CBD) mobilized unclear. This study is based on the pioneering work of Egboro (2004) who initially examined the appropriateness of these policy summersaults with data ending in 1999. However, in this present study we re-estimated an interest elasticity model of commercial bank deposits in Nigeria by employing more recent data that captured subsequent changes in the nation's financial landscape. The econometric technique applied is the two-stage least squares (2SLS) regression method given that the system of simultaneous equations is over-identified. The Statistical Bulletin of the Central Bank of Nigeria constitutes the source of data. Inter alia, the findings indicate that there is an inverse and statistically significant relationship between CBD and deposit interest rates. This relationship is inelastic in the short-run but elastic in the long-run. One of the important implications of the study is that the McKinnon-Shaw financial liberalization paradigm for less developed countries does not hold in Nigeria. Therefore, it may be concluded that there is presently no scope to use the lure of higher deposit rates to significantly stimulate increased commercial bank deposits in Nigeria.

Key words: Commercial bank deposits, interest rate elasticity, financial liberalization, Nigeria

JEL Classification: E43, G21

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I. Introduction

The need for savings mobilization and investment in the process of capital formation cannot be over-emphasized. Most economists agree that the most important limiting factor to the economic development of underdeveloped countries is the dearth of capital. Commercial bank deposits (CBD) constitute one of the important sources of savings generally available to the society. As noted in Jhingan (2007) the process of capital accumulation involves three steps: increase in the volume of real savings; mobilization of savings through financial and credit institutions and investment of savings.

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Prior to the introduction of the Structural Adjustment Programme (SAP) in Nigeria, the financial landscape was characterized by heavy financial repression symbolized by interest rate regulation and credit controls (Iyoha, (1996)). The argument was that the policy of interference resulted in various distortions in the domestic economy, which include financial disintermediation, capital flight, acquisition of hedges rather than financial assets and excessive aggregate demand. Ikpeze (1988) posits that all these distortions conspired to reduce economic growth.

Therefore, it was no surprise that the CBN deregulated the financial system with effect from August 1, 1987. In the amendment to the subsisting monetary policy, interest rate determination was subjected to market forces while credit controls were abolished. One of the most flaunted impacts of deregulation is the mobilization of societal savings and the efficient utilization of such resources in the promotion of economic growth through upward or appropriate market adjustment of real deposit and lending rates. However, with effect from 1st January, 1994, the policy was modified and interest rate deregulation was dropped. Some measure of regulation was re-introduced into the interest rate management because of wide variations and unnecessarily high rates observed during complete deregulation. Deposit rates were set at 12.15% per annum while a ceiling of 21% was fixed for lending (CBN, 1995). This marked the beginning of guided deregulation of interest rates in Nigeria.

McKinnon (1973) avers that an increase in the real rate of interest will induce the savers of less developed countries to save more, such as will enable more investment to take place. Is this hypothesis true in the case of Nigeria? Similarly, Shaw (1973) made a strong case for the removal of financial repression via an increase in the real rate of interest.

In a pioneering work, Egboro (2004) applied the elasticity concept in his model formulation, which embedded the variables that influence mobilization of CBD in Nigeria. As stated in the report, the framework can assist commercial banks, researchers and policy makers to predict the likely response of depositors to a change in the rate of interest. Using the 2SLS regression technique and quarterly data for the period 1986 -1999, he found that the lagged value of nominal interest rate, level of technology, banking habit, gross domestic product (GDP) and lagged value of aggregate CBD are the variables that determine the level of CBD mobilization in the Nigerian aggregate commercial banking system. All the variables, including interest rate exhibited positive signs and their coefficients were less than one in the short run i.e. inelastic. Calculations of the steady state elasticities showed that all the identified short run variables had positive signs with coefficients less than unity except the GDP variable whose coefficient was

greater than one. In other words, only the GDP variable showed an elastic tendency in CBD mobilization in the long-run. The implication is that, contrary to the postulation in McKinnon (1973) and Shaw (1973), an increase in the rate of interest does not impact positively on CBD mobilization; rather, it is the GDP variable that impacts positively or negatively on mobilization of CBD. As the finding is inconsistent with the McKinnon-Shaw financial liberalization paradigm for less developed countries, liberalization in Nigeria is desirable to the extent of facilitating financial market expansion and promoting competition, and is not the panacea to desired improvement in CBD or savings mobilization for investment.

Given the oscillatory nature of government policy in the Nigerian financial sector (from regulation to deregulation and back to regulation in the form of guided deregulation), the effect of interest rate variations on CBD mobilization requires further study. Hence, this study seeks to re-estimate an interest elasticity model of commercial bank deposits (CBD) in Nigeria.

The paper is divided into four sections. Following the introduction is section two, which dwells on the review of both theoretical and empirical literature while section three focuses on the methodology and data analysis. Section four concludes the paper.

II. Brief Review of Literature

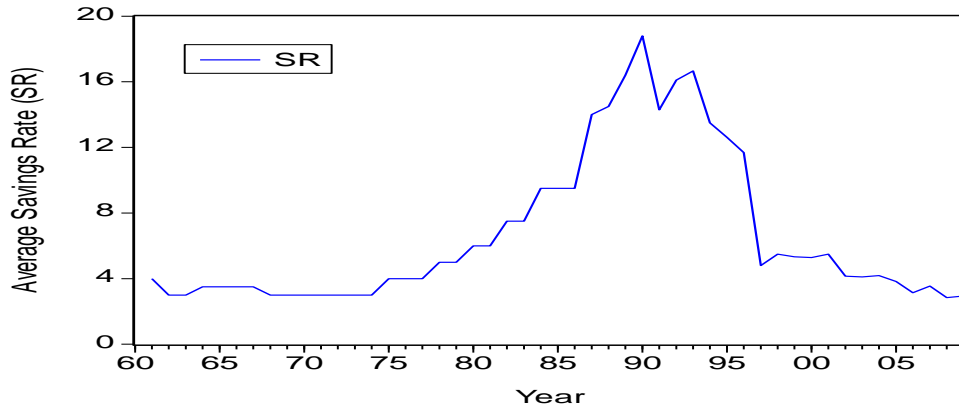
II.1 Trends in Deposit Rates and Growth of CBD in Nigeria

Soludo (2008) avers that rates are prices and must be right and attractive to reward depositors and encourage long-term savings. However, he observed that deposit rates are generally low, except for the period between 1986-1989 immediately following liberalization and the 1990-1995 period of banking sector distress.

Based on CBN (2009) Statistical Bulletin, Figure 1 shows the pattern of the average deposit (savings) rate in Nigeria from 1960 to 2009. Deposit rates were particularly low in the 1960s and 1970s as well as the first decade of the twenty first century. A 'hump' growth in commercial bank deposits rate stands out between 1987 and 1997.

The trend in commercial bank deposits (CBD) is depicted in Figure 2. Commercial bank deposits in nominal terms remained at a very low level from 1960 to 1990 with a gradual rise observed thereafter. An astronomic rise is noticeable from 2005 to 2009. This prodigious increase in CBD may be significantly linked to the banking sector reforms embarked upon by the Central Bank of Nigeria, especially the banks consolidation of 2005.

Figure 1: Average Savings (Deposit) Rate of Commercial Banks in Nigeria, 1960-2009 (percent)



When the nominal aggregate commercial banks deposit in the current year is expressed in terms of the implicit price deflator in order to take account of inflation, the real aggregate commercial banks deposits, RCB, trend, is as presented in Figure 3. Four distinct phases are observable: the stationary period of very low savings, 1960-1973; the gradual growth phase, 1974-1980; the modest phase, 1981-2005; and the astronomic deposit growth phase, 2006-2009. In terms of composition, Soludo (2008) noted that over 90% of the deposits mobilized by banks are short-term (0 to 365 days).

Figure 2: Aggregate Commercial Banks Deposits in Nigeria, ₦' Million, 1960-2009

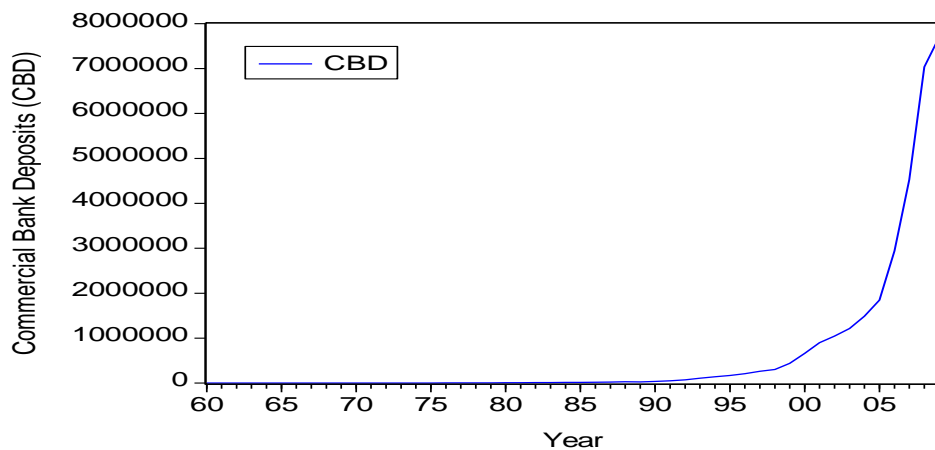
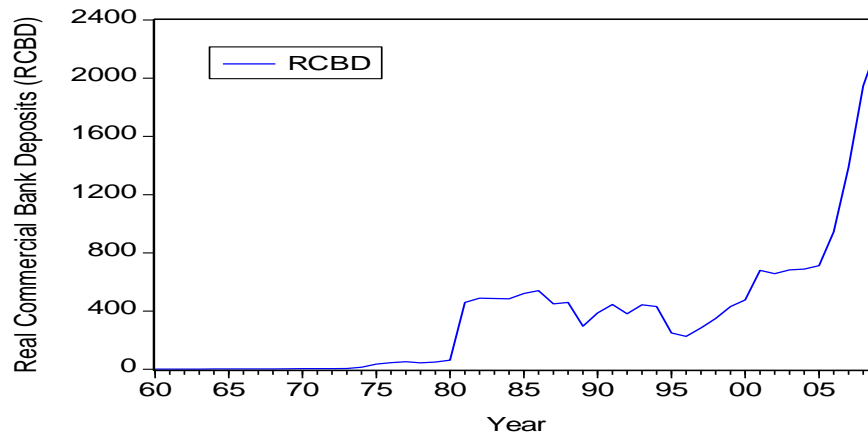


Figure 3: Aggregate Real Commercial Banks Deposits in Nigeria, ₦' Million, 1960-2009



II.2 Money Demand and Money Supply Theories

It has been postulated that savings deposit is a good proxy for money (see Akinnifesi and Phillips, (1978)), and that at equilibrium, the supply of savings deposit will equal its demand (see Egboro 2004). This review focuses on the supply side of savings deposit with a brief consideration for money demand.

Irvin Fisher, writing in 1911 indicated that money flows equals transactions flows, that is,

$$MV = PT \tag{1}$$

where,

M = nominal quantity of money in circulation; V = transaction velocity of money

P = average price of transaction; T = number of transactions in a given time period

According to Glahe (1977), given the relevant constancy assumptions, the above Fisher's equation of exchange or identity can be transformed into the theory of price level determination;

$$P = \frac{MV}{T} \tag{2}$$

The real money supply or real quantity of money in circulation m_s is represented by;

$$m_s = \frac{M_s}{P} = \left(\frac{1}{V}\right) * T \quad (3)$$

But monetary equilibrium dictates that money supply equals money demand, $m_s = m_d$. Thus,

$$m_d = \frac{M_d}{P} = \left(\frac{1}{V}\right) * T \quad (4)$$

With the advent of national income accounting, real national income replaces T and the average price of transactions became the implicit national income price index. Therefore, the demand for real quantity of money in terms of income transactions as against gross transactions can be written as;

$$m_d = \frac{M_d}{P} = \left(\frac{1}{V}\right) * Y \quad (5)$$

The Cambridge cash-balance demand equation is structurally similar to equation 2, except that both equations are not theoretically equivalent as the economic line of reasoning differs in both (Glahe (1977) and Boorman and Havrilesky, (1972)). Keynes achieved further development of the Cambridge cash-balance demand theory. He asserts that the level of transaction and precautionary demand for money bear a stable relationship with income, while the speculative demand for money is a function of the rate of interest. Other important contributors to money demand theories after Keynes include Tobin, Baumol and Friedman.

Pratten (1985) explained that notes and coins are obviously money, and since the great majority of large transactions in the economy are settled by transferring claims on the banking system (by writing cheques), most measures of money include deposits in current accounts. Hence, in Nigeria, money supply has a narrow definition (M_1) and a wider or broad definition (M_2). According to Anyanwu (1993), the narrow definition of money is:

$$M_1 = C + D \quad (6)$$

where,

M_1 = narrow definition of money supply; C = currency outside bank; D = demand deposits

The broad definition of money is the sum of M_1 , time deposits and savings, that is:

$$M_2 = C + D + T + S \quad (7)$$

where,

M_2 = broad definition of money supply; T = time deposits; S = savings deposits

However, Ajayi and Ojo (1981) contend that money supply is determined by the behaviour of three economic factors. These include: the behaviour of banks concerning the amount of reserves that they decide to keep at any point in time; the behaviour of the non-bank public in dividing their money assets between currency and demand deposits; and the decision of the monetary authorities to change the size of high-power money as well as the right of the authorities to set the legal reserve ratio. Hence, the behaviour of the three factors above can be expressed via the multiplier using the narrow definition of money as follows:

$$M = C + D \quad (8)$$

$$C = cD \quad (9)$$

$$H = R + C \quad (10)$$

$$R = rD \quad (11)$$

where,

M = narrow money; C = currency outside banks; D = demand deposits; H = high-power money; R = reserves of the banking system; c = currency-deposit ratio; r = reserves-deposit ratio.

By substituting equations (9) and (11), equation (10) can be re-written as:

$$H = rD + cD = (r + c)D \quad (12)$$

$$D = H / (r + c) \quad (13)$$

By substituting (9) into (8),

$$M = (1 + c)D \quad (14)$$

Substituting equation (13) into (14), we have;

$$M = [(1 + c) / (r + c)] * H = kH \quad (15a)$$

where,

$$k = (1 + c) / (r + c) \quad (15b)$$

Equation (15b) links the money supply to what happens to the currency deposit ratio, the reserve ratio and high-power money. The economic importance of equation (15b) is better appreciated when it is written in linear form:

$$k = k(c, r) \quad (16)$$

To account for the change in the multiplier, we totally differentiate equation (16):

$$dk = k_1 dc + k_2 dr \quad (17)$$

where k_1 and k_2 denote partial derivatives of the multiplier k with regard to the arguments in (16). Partially differentiating equation (15b) and substituting its value into equation (17) will give;

$$dk = \frac{(r-1)dc}{(r+c)} - \frac{(1+c)dr}{(r+c)} \quad (18)$$

Equation (18) shows that a rise in the currency-deposit ratio, c , will lead to a distribution of assets against the banking system, that is, banks suffer a net loss of cash reserves. Similarly, a rise in bank reserve requirements reduces the potential ability of the banks to increase the money supply.

II.3 Economic Growth Models: The Role of Savings

Todaro and Smith (2009) observed that one of the principal strategies of development necessary for any take-off was the mobilization of domestic and foreign savings in order to

generate sufficient investment to accelerate economic growth. The economic mechanism by which more savings and more investment leads to more growth can be described in terms of the Harrod-Domar growth model, a simplified version of which is presented below:

$$\frac{\Delta Y}{Y} = \frac{s}{k} \quad (19)$$

where,

Y = national income; ΔY = change in national income; s = net savings ratio;

k = national capital-output ratio.

Equation (19) represents the famous Harrod-Domar theory of economic growth and it states that the rate of growth of GDP ($\Delta Y/Y$) is determined jointly by the net national savings ratio, s and the national capital-output ratio, k . More specifically, it states that the growth rate of national income will be directly related to the savings ratio (that is, the more an economy is able to save and invest out of a given GDP, the greater the growth of that GDP will be) and inversely related to the economy's capital-output ratio (that is, the higher the k is, the lower the rate of GDP growth will be).

Furthermore, to illustrate the role of savings in economic growth, a concise presentation of the Solow neoclassical growth model is given below, starting with a form of the Cobb-Douglas production function:

$$y = Ak^{-\alpha} \quad (20)$$

where,

y = output per worker; A = productivity of labour, which grows over time at an exogenous rate; k = capital per worker.

Equation (20) states that output per worker depends on the amount of capital per worker. Given that the labour force grows at rate n per year, capital per worker grows when savings are greater than what is required to equip new workers with the same amount of capital as existing workers have. Thus, the Solow equation may be written as;

$$\Delta k = sf(k) - (\delta + n)k \quad (21)$$

This version of the Solow equation shows that the growth of k (capital deepening) depends on savings $sf(k)$, after allowing for the amount of capital needed to service depreciation, δk , and after capital widening, that is, providing the existing amount of capital per worker to net new workers joining the labour force, nk (Todaro and Smith, (2009)).

II.4 Financial Repression and Liberalization: The McKinnon-Shaw Hypothesis

The McKinnon-Shaw financial repression paradigm opines that financial repression impact adversely on economic growth through high negative effect on the quality and quantity of real capital accumulation (McKinnon, (1973) and Shaw, (1973)). The three principal channels through which the hypothesized negative effect of financial repression works include: the Shaw's "debt intermediation hypothesis" which asserts that real deposit rates reduce financial deepening resulting in a shrinking in the volume of institutional credit; the McKinnon "complementarity hypothesis" which shows that the process of self-finance within enterprise is impaired because of low real yields on deposit; that low capital rates of interest produce bias in favour of current consumption as against future consumption resulting in lower aggregate saving and investment levels (see Athukoraia and Rajapatirana, (1993)).

The remedy for financial repression is implicit in the conceptual framework – financial liberalization and financial deregulation. This will involve keeping positive

and more uniformly high real rates of interest within comparable categories of bank deposits and loans by eliminating undue reserve requirements, interest ceilings and mandated credit allocations on the one hand while stabilizing the price level through appropriate macroeconomic measures on the other hand (Anyanwu, (1995)). However, the financial liberalization model has been severely attacked by the "Neo-Structuralists" development economists (see Van Wijnbergen, (1982) and Taylor, (1983), (1988)). Using a Keynesian adjustment mechanism, a mark-up pricing framework and a Tobin-type household portfolio model involving three assets (cash, bank deposits and loans in the unorganized money markets), the findings of these neo-structuralists cast doubt on the ability of high real interest rates to increase financial deepening and capital formation in developing countries.

Soyibo and Adekanye (1982) examined the impact of regulation and deregulation of the Nigerian banking system on the saving mobilization behaviour of Nigerians, using data generated between 1969 and 1989. Their model was a modified version of McKinnon as reported by Arrieta (1988). The findings of Soyibo and Adekanye reveal a weak support for the position that financial liberalization is a possible way of promoting savings in Nigeria. Also, the ex-post real interest rate is a significant determinant of savings. Anyanwu (1995) formulated his financial deepening function based on the theoretical framework of the McKinnon-Shaw financial liberalization paradigm. Employing data from 1960 to 1992, his findings show that interest rate deregulation did not positively affect financial deepening (increased savings mobilization) as predicted by the McKinnon-Shaw paradigm.

Aigbokhan (1995) applied Granger causality model to investigate the direction of relationship between real and financial sector reforms in Nigeria. His findings provide evidence to support the supply-leading hypothesis that financial development which envisages increase in the number of bank and bank offices promote "banking habit", liberalizes interest rates and tend to induce investment. Thus, financial development induces real sector growth.

Haron and Azmi (2006) studied deposit determinants of commercial banks in Malaysia. They found an inverse relationship between fixed deposit rates and the amount deposited by customers. According to the authors, a possible explanation for this occurrence is that in most cases upward trends in fixed deposit rates are made during the booming period when customers are exposed to other more rewarding investment opportunities, especially the unit trust schemes introduced by the government.

Kraft and Galac (2004) examined the experience of Croatia which liberalized its banking system in the early 1990s. Their research revealed an unusually high

connection between deposit rates and bank failures. The deposits mobilized were used to fund high risk assets, which eventually resulted in bank failures. They found that after the banking crisis, the financial terrain continued to be characterized by zero interest elasticity on deposits.

Mwega, et al (1990) tested the Mckinnon-Shaw hypothesis in relation to Kenya that an upward adjustment in real deposit rates significantly increases the private sector financial and non-financial savings. The results of their effort fail to support the Mckinnon-Shaw hypothesis, and instead find that the private saving rate and the real demand for money are non-significantly responsive to a representative deposit rate of interest.

Olubanjo, et al (2010) studied the interrelationship among interest rates, savings and investment in Nigeria. They employed two set of models – bivariate and simultaneous equation models. By using the two-stage least squares (2SLS) technique, results of the simultaneous equations system show that nominal deposit rate had a negative and statistically significant impact on gross national savings. Nwachukwu and Odigie (2009) employed error correction modeling procedure to determine what drives private savings in Nigeria. The findings indicate that saving rates (deposits mobilized) increases with both the growth rate of disposable income and the real interest rate on bank deposits.

Agrawal (2000) used panel data econometric method to study savings, investment and growth in five South Asian countries. The coefficient of real interest rate (deposit rate) was found to be positive but very small and not significant. Thus, their results support the notion that interest rates do not have much effect on savings.

III. Methodology, Data Analysis and Discussion of Findings

III.1 Model Specification

The model specification in this study draws from several theories of bank portfolio management and various empirical research works. The bank portfolio management theories, which suggest the basic explanatory variables in a CBD model, include the liquid asset theory, the commercial loan theory, the shiftability theory, the anticipated income

theory and the liability management theory Nwankwo (1999), Elliot (1984), Adekanye (1993) and Osofisan (1993).

For instance, the liability management theory assumes that increasing the interest rate (deposit rate) offered for funds will increase its supply and provide for liquidity needs. Commercial bank deposits form the bulwark of community savings and

from various macroeconomic models, savings is a function of income or GDP (see Sorensen and Whitta-Jacobsen (2010)). Thus, CBD is a function of deposit interest rate and GDP. Two other variables included in the CBD model – level of technology in the banking system, TEC and community banking habit, BH – are based on the concept of theoretical rationale (Labovitz and Hagedorn, (1976)).

Furthermore, the loanable funds theory views interest rate as a price, which is determined by supply of and demand for loanable funds. The major sources for the supply of loanable funds are savings (summarized principally in commercial bank deposits), while the major sources of the demand for loanable funds are investment demands. Movements in these two variables which are accentuated by the level of economic activities, determine changes in the interest rate. The described scenario (for the average deposit rate [DR] model) can be summarized by saying that deposit interest rate is a function of CBD, investment demand (loans and advances as proxy) and the level of economic activity of the community (real GDP as proxy).

Lewis (1955) hypothesized that as savings institutions are - pushed right under the individual's nose – people save more. Since community savings ultimately depends on income, the community banking habit, BH (number of banking institutions as proxy) is a function of income. Studies have shown that real GDP per capita, host country financial market and bank balance sheet conditions are determinants of bank expansion (see Fotopoulos, et al (2011) and Calcagnini, et al (1999)). Thus, in this study, BH is modeled as a function of real GDP and money supply (which affect both financial market conditions as well as bank balance sheet). Finally, the models incorporate some lagged variables under the partial adjustment framework (Iyoha (1976) and Gujarati (2009)). The complete double log specification of the simultaneous equations model is given below (see Koutsoyiannis (1977) and Elikwu (2010)): [Type equation here.](#)

$$\text{LnCBD}_t = \beta_0 + \beta_1 \text{LnDR}_t + \beta_2 \text{LnTEC}_t + \beta_3 \text{LnBH}_t + \beta_4 \text{LnGDP}_t + \beta_5 \text{LnCBD}_t(-1) + u_t \quad (22)$$

$$\text{LnDR}_t = \alpha_0 + \alpha_1 \text{LnCBD}_t + \alpha_2 \text{LnVD}_t + \alpha_3 \text{LnGDP}_t + \alpha_4 \text{LnDR}_t(-1) + w_t \quad (23)$$

$$\text{LnBH}_t = \lambda_0 + \lambda_1 \text{LnGDP}_t + \lambda_2 \text{LnM}_{2t} + z_t \quad (24)$$

Based on the eclectic theoretical approach reviewed earlier in this section, the *a priori* expectations for the model coefficients are: $\beta_1, \beta_2, \beta_3, \beta_4,$ and $\beta_5 > 0$; $\alpha_1 < 0$, $\alpha_2 > 0$, $\alpha_3 > 0$, $\alpha_4 > 0$; $\lambda_1 > 0$, $\lambda_2 > 0$.

Where: CBD = commercial bank deposits; DR = average deposit rate; TEC = level of technology in the banking system (fixed assets as proxy); BH = banking habit of

the community (number of branches as proxy); GDP = real gross domestic product; CBD(-1) = one period lagged value of commercial bank deposits; VD = total investment demand (total loans and advances as proxy); DR(-1) = one period lagged value of average deposit rate; and M_2 = money supply (broadly defined); and u , v and z represent the stochastic disturbance terms.

All the three equations were subjected to both the order and rank conditions for identification:

(i) Order Condition

- In equation (22), $K-M>G-1$, that is, $3>2$

where; K = total number of variables in the system of equations, M = total number of variables in the particular equation, and G = number of equations in the system.

- In equation (23), $K-M>G-1$, that is, $4>2$
- In equation (24), $K-M>G-1$, that is, $6>2$

(ii) Rank Condition: The structural or behavioural equations were transformed into the following form;

$$-LnCBD_t + \beta_1 LnDR_t + \beta_2 LnBH_t + \beta_3 LnTEC_t + \beta_4 LnGDP_t + \beta_5 LnCBD_t(-1) + 0LnVD_t + 0LnDR_t(-1) + 0LnM_{2t} + u_t = 0 \quad (25)$$

$$\alpha_1 LnCBD_t - LnDR_t + 0LnBH_t + 0LnTEC_t + \alpha_3 LnGDP_t + 0LnCBD_t(-1) + \alpha_2 LnVD_t + \alpha_4 LnDR_t(-1) + 0LnM_{2t} + v_t = 0 \quad (26)$$

$$-0LnCBD_t + 0LnDR_t - LnBH_t + 0LnTEC_t + \lambda_1 GDP_t + 0LnCBD_t(-1) + 0LnVD_t + 0LnDR_t(-1) + LnM_{2t} + z_t = 0 \quad (27)$$

From the above transformation, the table of parameters can easily be constructed which shows that there are several non-zero determinants of order $G-1$. Thus, the rank condition is fulfilled and the system of equations is over-identified.

III.2 Estimation Technique

Given that the above system of equations is over-identified, the most appropriate analytical technique to employ to obtain unique statistical estimate of the parameters is the two-stage least squares (2SLS) regression method. The

technique requires the application of the ordinary least squares (OLS) procedure in two stages. In the first stage,

OLS is used to estimate the reduced form of all the equations in the model by regressing the dependent variables on all the predetermined variables. From this, the expected values of all the endogenous variables are obtained. In the second stage, each structural equation is estimated by OLS but the regressed values of the endogenous variables are used as instruments for the corresponding observed values while the predetermined or exogenous variables serve as their own instruments (Gujarati (2009) and Koutsoyiannis 1977)).

III.3 Sources of Data

The source of data for this study is the Statistical Bulletin of the Central Bank of Nigeria (CBN, 2008). Quarterly data spanning the period from 1986Q4 to 2008Q4 were employed in order to increase the sample size. This is because in large samples (as $n \rightarrow \infty$), the simultaneous equation bias tends to zero.

III.4 Data Analysis and Discussion

III.4.1 Presentation / Analysis of Results (2SLS Estimation)

In the first stage of the analysis, we obtained the reduced form parameter estimates of the endogenous variables:

Table 1: Dependent Variable : LnCBD			
Variables	Coefficient	T-statistics	P-Value
Constant	-0.5200	-3.1795	0.021
LnTEC	-0.1393	-2.9919	0.0037
LnGDP	-0.0861	-3.1886	0.0020
LnCBD(-1)	0.4979	6.0015	0.0000
LnVD	0.1554	2.9459	0.0042
LnDR (-1)	-0.0525	-1.9399	0.0559
LnM2	0.5915	7.2135	0.0000
R² (Adjusted)	0.9993	DW	1.3156
F-stat	20925.10	Prob (F)	0.0000

Table 2: Dependent Variable : LnDR			
Variables	Coefficient	T-statistics	P-Value
Constant	0.5739	1.8507	0.0679
LnTEC	-0.0434	-0.4911	0.6247
LnGDP	-0.0980	-1.9141	0.0591
LnCBD(-1)	-0.0477	-3033	0.7625
LnVD	-0.0405	-0.4051	0.6865
LnDR (-1)	0.8698	16.9402	0.0000
LnM2	0.1934	1.2443	0.2170
R² (Adjusted)	0.9816	DW	1.2116
F-stat	773.5617	Prob (F)	0.0000

Table 3: Dependent Variable : LnBH			
Variables	Coefficient	T-statistics	P-Value
Constant	4.4128	12.2548	0.0000
LnTEC	-0.0909	-0.8841	0.3777
LnGDP	0.0436	0.7339	0.4651
LnCBD(-1)	0.0269	0.1474	0.8832
LnVD	0.1101	0.9484	0.3457
LnDR (-1)	0.2238	3.7539	0.0030
LnM2	0.1260	0.6979	0.4872
R² (Adjusted)	0.8452	DW	0.1746
F-stat	80.1573	Prob (F)	0.0000

The results of the second stage estimation using the newly generated instrumental variables provide the following unbiased estimates:

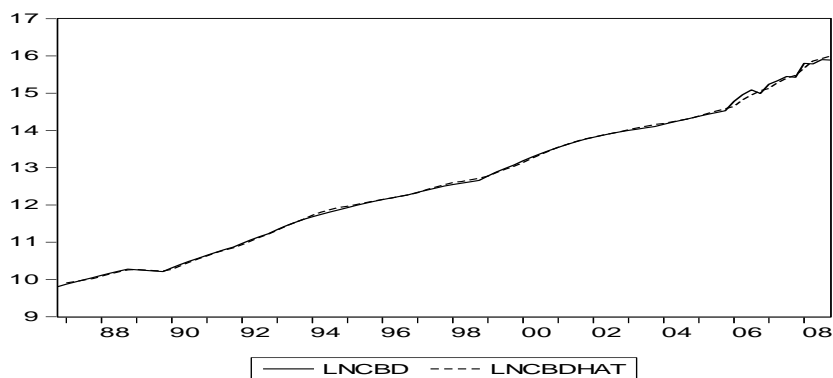
Table 4: Dependent Variable : LnCBD			
Variables	Coefficient	T-statistics	P-Value
Constant	-7.4143	-3.1202	0.0025
LnTEC	0.0231	0.4345	0.6658
LnGDP	-0.1073	-2.2630	0.0263
LnCBD(-1)	0.7423	0.0990	0.0000
LnDR Hat	-0.3767	-2.9000	0.0048
LnBH Hat	1.6204	3.0695	0.0029
R² (Adjusted)	0.998990	DW	1.8804
F-stat	17208.83	Prob (F)	0.0000
Table 5: Dependent Variable : LnDR			
Variables	Coefficient	T-statistics	P-Value
Constant	0.7398	2.7293	0.0077
LnCBD Hat	0.1353	1.7390	0.0857
LnVD	-0.1063	-1.2647	0.2095
LnGDP	-0.0704	-2.2705	0.0258
LnDR(-1)	0.8853	18.7907	0.0000
R² (Adjusted)	0.9819	DW	1.2373
F-stat	1180.178	Prob (F)	0.0000

Table 6: Dependent Variable : LnBH			
Variables	Coefficient	T-statistics	P-Value
Constant	5.9375	59.9916	0.0000
LnGDP	0.0209	0.4273	0.6702
LnM2	0.1219	2.3563	0.0207
R² (Adjusted)	0.8133	DW	0.1088
F-stat	192.7134	Prob (F)	0.0000

The parameter estimates and other statistics including the DW statistic bear some resemblance to results from simultaneous equations system in other studies (for instance, see Olofin et al (2009)). However, in line with the objectives of this paper, our dominant attention is on the regression results in Table 4 that relates to the commercial bank deposits (LnCBD)

The regression results presented in Table 4 provides good and unbiased estimates of the determinants of commercial bank deposits in Nigeria. R² (adjusted) is the adjusted coefficient of multiple determination; and DW is the calculated Durbin-Watson statistic. The t-statistics and p-values are displayed in the relevant columns. The overall explanatory power of the CBD equation is quite good as shown by the level of significance of the F statistic (1% critical value). The regressors in the CBD equation (Table 4) explain 99.9% of the variability in the levels of CBD. Figure 4 illustrates the excellent and positive co-variation between the actual and fitted values of CBD.

Figure 4: Actual and Fitted Values of CBD

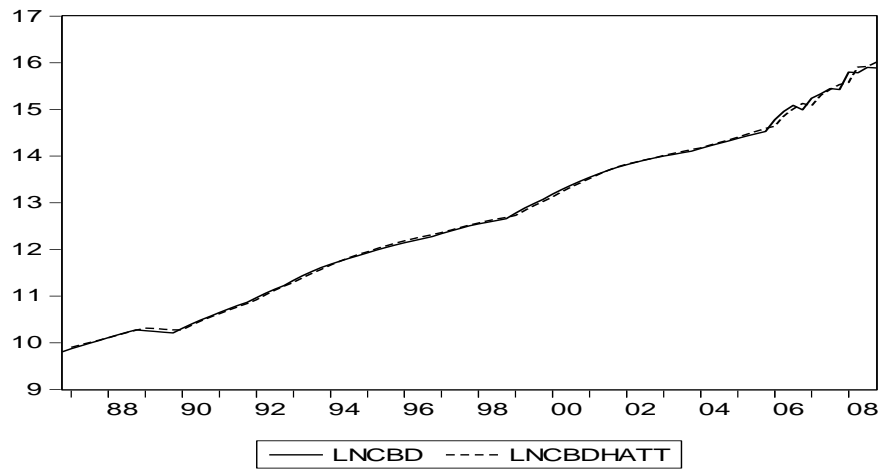


The coefficients of three explanatory variables, namely, deposit rate, banking habit of the community and the one period lagged value of CBD were found to be statistically significant at the 1% level while that of the real gross domestic product is statistically different from zero at the 5% level. Only the parameter for the level of technology is statistically insignificant, even at the 10% level. The positive a priori expectations for the banking habit (BH) and the one period lagged value of CBD variables were realized while the other variables, that is, deposit rate and real gross domestic product (GDP) had negative signs contrary a priori expectations. The DW statistic, which is 1.8804, shows the absence of serial correlation.

Furthermore, in order to obtain a more parsimonious model, the level of technology variable was dropped in the subsequent regression and the result is presented in table 7. The actual and fitted values of commercial bank deposits (CBD) with respect to the parsimonious model are shown in Figure 5 below. Again, we observe an excellent fit between the actual and predicted values of CBD.

Table 7: Dependent Variable : LnCBD			
Variables	Coefficient	T-statistics	P-Value
Constant	-7.0940	-3.1566	0.0022
LnDR Hat	-0.3656	-2.8850	0.0050
LnBH Hat	1.5468	3.1099	0.0026
LnGDP	-0.0944	-2.5644	0.012
LnCBD(-1)	0.7669	9.4970	0.0000
R² (Adjusted)	0.9990	DW	1.9267
F-stat	21723.53	Prob (F)	0.0000

Figure 5: Actual and Fitted Values of CBD (Parsimonious model)



Generally, the parsimonious model as represented in table 7 produced superior results in comparison to those contained in table 4 as all the explanatory variables were found to be statistically different from zero. The DW statistic is closer to the ideal level of 2 (a clear indication of the absence of serial correlation), the F statistic is better, the R² (adjusted) is higher and the coefficients of the regressors are more statistically significant.

Besides, we estimated the long-run elasticities of the determinants of commercial bank deposits in Nigeria. The variables in table 7 are in logarithmic form; hence the parameter estimates represent the short-term elasticities. This is the case for models that can be expressed in the form of an adjustment equation (see Greene (2003)), which are summarized in Table 8.

Table 8: Short-Run Elasticity Coefficients of CBD Model

DR	-0.3656
BH	1.5468
GDP	-0.0944

The next step is to calculate the long-run steady state elasticities to measure the effect of sustained changes of explanatory variables on the dependent variable, CBD. This was done by allowing the value of the endogenous variable to be stationary (that is, set {LnCBD = LnCBD (-1)}) and solve the expression, $\alpha/1-\beta$. The above procedure is clearly explained in Iyoha (2004). A further substantiation is found in Green (2003). Additionally, Hughes, Knittel and Sperling (2008) in their

simultaneous equations-based study averred that the fully adjusted coefficients – steady state – are generally interpreted as long-run elasticities in the literature.

Thus,

$$\text{LnCBD} - 0.7669\text{LnCBD}(-1) = -7.0940 - 0.3656\text{LnDRHat} + 1.5468\text{LnBHHat} - 0.0944\text{LnGDP} \quad (28)$$

Therefore,

$$0.2331\text{LnCBD} = -7.0940 - 0.3656\text{LnDRHat} + 1.5468\text{LnBHHat} - 0.0944\text{LnGDP} \quad (29)$$

Divide both sides of equation (29) by 0.2331, we have:

$$\text{LnCBD} = -30.4333 - 1.5684\text{LnDRHat} + 6.6358\text{LnBHHat} - 0.4050\text{LnGDP} \quad (30)$$

where LnCBD = steady state natural logarithm of CBD

The coefficient of the explanatory variables in Equation (30) in its logarithmic form represent the long-run steady-state elasticities which shows the effects of sustained changes in the regressors on CBD. The variables and their relative steady-state elasticity coefficients are summarized in Table 9.

Table 9: Long-Run Elasticities of the CBD Model

DR	-1.5684
BH	6.6358
GDP	-0.4050

The resulting postulations from the above analysis can be summarized in the following representations:

(a) Short-Run Equation;

$$\text{CBD} = f \{ \text{DR}, \text{BH}, \text{GDP}, \text{CBD}(-1) \} \quad (31)$$

$$f_1 < 0, f_2 > 1, f_3 < 0, f_4 > 0,$$

(b) Long-Run Equation;

$$\text{CBD} = f \{ \text{DR}, \text{BH}, \text{GDP} \} \quad (32)$$

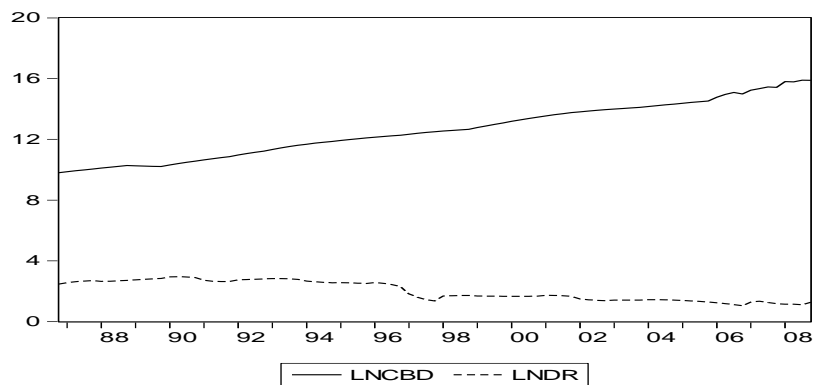
$$f_1 < 0, f_2 > 1, f_3 < 0$$

The results in these equations are the basis for the ensuing discussion in the section that follows.

III.4.2 Discussion of Results

The results of this study have tended to defy a priori expectations that high interest rates on deposits will lead to commensurate high commercial bank deposits as the above analysis resulted in a negative sign for the interest elasticity coefficient. The model employed in this study adequately captures the general behaviour and response of Nigerian depositors to changes in deposit interest rates over time. The explanation for this deviation from theoretical postulation is due to institutional failures and hence, it becomes difficult to use interest rate as a reliable predictor of deposit mobilization of commercial banks in Nigeria since there is no valid evidence to link the growth in commercial bank deposits over time to changes in the rate of interest. Figure 6 is a plot of the actual time series data, and the diagram clearly portrays the negative relationship between commercial bank deposits and interest rates.

Figure 6: Actual Plot of LnCBD and LnDR Time Series Data



The outcome of this work differs significantly from the findings in Egboro (2004). In the previous work, Egboro employed the one-period lag of deposit interest rate on savings as a regressor in the CBD equation and found that the coefficient of interest rate possessed the a priori positive sign but not statistically significant even at the 10% level. In this revised study, the deposit rate is not only statistically significant at the 1% level but possess a negative sign, which agrees with empirical reality as shown in Figure 6. Furthermore, our findings run contrary to the financial liberalization paradigm of Mckinnon (1973) and Shaw (1973) who stated expressly that the higher the real interest rate, the greater will be the

accumulation of money balances and the larger will be the inducement to invest. However, this study agrees with the empirical analysis undertaken by Anyanwu (1995) who found that for the period between 1960 and 1992, interest rate deregulation did not positively affect financial deepening in Nigeria as predicted by McKinnon and Shaw.

Additionally, the inverse relationship between CBD and deposit rate is in consonance with the findings of Soyibo and Adekanye (1992) who sought to validate the McKinnon-Shaw hypothesis using Nigerian Data. They found that the interest rate in their savings equation was not significant and it had a wrong sign. Furthermore, Olubanjo et al (2010) also found an inverse relationship between gross national savings and nominal deposit rate (see Haron and Azmi, (2006) for a similar case in Malaysia). However, our study differs from that of Soyibo and Adekanye in that the elasticity coefficient of the deposit interest rate in the present study, though negative, is statistically significant. Nnanna (2003) averred that the role of real interest rate as a determinant of savings is ambiguous in the literature, especially in developing countries.

The inelastic (short run) and negative relationship between interest rate and CBD gives the general impression that on the average, suppliers of deposits to commercial banks are rational and they possess individual and distinct utility maximizing preferences. Put differently, the rate of return on CBD does not constitute the sole criterion for the placement of deposits. All the conditions for the maximization of a consumer's (depositor's) satisfaction are contained in his utility function (Henderson and Quandt, (1980); also see Pearce (1983) and Muth (1961)).

Viewed in this way, bank depositors can be classified into three categories, namely: risk seekers, risk averters and indifferent depositors. On the one hand, the risk seekers exhibit a preference for high returns on deposits and seek to patronize new generation banks that flaunt high deposit interest rates, especially in the 1990s. On the other hand, the risk averters and indifference depositors are made up of customers who are more interested in the safety of their deposits and tend to be indifferent to rates of returns on bank deposits. The latter group constitutes the bulk of depositors in Nigeria and they place their deposits with the older generation banks who capitalize on their good will and oligopolistic structure to keep deposit rates very low and thus, reap abnormal profits. The above trend was forced on the nation's banking public by the massive and monumental bank failures in colonial Nigeria and the unprecedented bank failures / distress of the 1990s and beyond in post-independent Nigeria (see Rapu (2004) and CBN 1995)). Additionally, institutional failures have been greatly aggravated by the weak supervisory and regulatory framework of monetary authorities.

Another major finding of this study is the existence of a significant and positive relationship between the two variables – commercial bank deposit and banking habit, which is proxied by the prevalence and number of bank offices and branches. Thus, increased savings or deposits are significantly correlated with the growth in the nation's branch network.

Additionally, both the short and long run elasticities of the banking habit variable are greater than unity and this shows that there is a high degree of responsiveness of aggregate deposit mobilization to bank network expansion. This finding is in harmony with the assertion of Lewis (1955) that as savings institutions are pushed right under the individual's nose, people will save more. This postulation has been given impetus by the supply following hypothesis which states that development and expansion of the financial sector precedes the demand for its services. The financial sector mobilizes and channels resources from savers to investors and thereby induces real sector growth (Porter (1936); Mckinnon (1973) and Shaw (1973)).

Moreover, the positive and statistically significant coefficients of the lagged value of the CBD variable is supported by the postulations in Koyck's distributed lagged model (see Koyck (1954) and Koutsoyiannis (1977)). In addition, Iyoha (1976) observes that the distributed lag model demonstrates that habit persistence is characteristic of human behaviour and that the existence of lagged adjustment may be explained by the prevalence of institutional inertia and / or a positive cost of adjustment.

Furthermore, the coefficient of the real GDP variable was found not only to be inelastic but possessed a negative sign contrary to a *priori* expectation (actual data plot showed a positive relationship between CBD and real GDP variables). This discrepancy might be due to some form of interaction between the real GDP and DR variables. Consequently, by way of future studies, we suggest that consideration may be given to a model formulation that takes the interaction amongst all variables into account through higher order polynomials (see McClave and Benson (1988)).

IV. Conclusion

The paper evaluated the determinants of aggregate commercial bank deposits (CBD) in Nigeria. A number of findings emanated from the study. First, there exist a statistically significant but inverse relationship between the deposits mobilized by commercial banks and the interest rates on deposits. Second, the aforementioned relationship is inelastic in

the short-run but elastic in the long-run. Third, there is a significant and direct relationship between the banking habit of the community as proxied by the number of banking institutions/branches and mobilized bank deposits. Moreover, this relationship was found to be elastic both in the short-run and in the long-run.

The inverse relationship between the level of commercial bank deposits and savings rate can simply be interpreted to mean that over time during the period covered by the study, falling deposit rates were increasingly associated with higher levels of CBD. The basic reasons behind this finding have to do with institutional failures that have greatly eroded the confidence of the Nigerian banking public coupled with the increasing oligopolistic structure of the banks.

One of the important implications of the study is that contrary to the postulation in McKinnon (1973) and Shaw (1973), an increase in the savings rate of interest has no positive impact on CBD mobilization. As the finding is inconsistent with the McKinnon-Shaw financial liberalization paradigm for less developed countries, liberalization in Nigeria is desirable to the extent of facilitating financial market expansion and promoting competition, and is not the panacea to desired improvement in CBD or savings mobilization for investment. Therefore, unless something is done to redress the situation, it may be concluded that there is presently no scope to use the lure of higher deposit rates to significantly stimulate increased commercial bank deposits in Nigeria.

A second implication of the study is that given a scenario of increasingly higher levels of CBD or liquidity in the banking system with falling deposit rates, it is needless for the Central Bank of Nigeria (CBN) to reduce the monetary policy rate or discount rate if decisions were made on the basis of interest rate on deposits. This is because a reduction in the discount rate will lead to a fall in the lending rates charged by commercial banks. As Anyanwu (1993) noted, reduction in the interest rates will result in attractive borrowing or low cost of borrowing, and hence an expansion in liquidity, investment, and aggregate demand. Eventually, the problem of inflation will be aggravated.

In order to expand aggregate commercial bank deposits in Nigeria, we recommend that the apex monetary authorities should embark on appropriate measures to defuse savers' apathy or indifferent attitude vis-a-vis changes in deposit rates by providing a sustainable sound and safe banking environment. Additionally, the branch network of commercial banks in the country should be further expanded in order to encourage banking habit and increase savings. The findings of this work show that a significant positive relationship exists between the banking habit of the community as proxied by the number of banking institutions and mobilized bank deposits.

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Is Monetary Policy Responsive to External Reserves? Empirical Evidence from Nigeria

Baba N. Yaaba*

Abstract

The global economy has witnessed extraordinary boost in the accumulation of external reserves, following the Asian financial crisis of the 1990s. External reserves increased sharply from US\$1.2 trillion in 1995 to over US\$10.0 trillion in January 2012. Developing countries increased their share from 30.0 per cent in 1990 to 67.0 per cent in 2011. Nigeria is not left out in this trend, as external reserves grew from US\$5.5 billion in 1999 to US\$34.68 billion in March 2012, representing over 530 per cent increase within the period. This placed Nigeria as the 44th largest reserves holder in the world. Reflecting on this phenomenal increase in Nigeria's reserves, that places Nigeria in such a strategic position, there is the need to examine, if the Central Bank of Nigeria considers the changes in the level of reserves, in its monetary policy decision making. The study applied an Autoregressive Distributed Lag (ARDL) approach to an extended version of the Taylor-type rule to estimate the monetary policy reaction function for Nigeria, with emphasis on external reserves. The results show that the Central Bank of Nigeria reacts to changes in the level of external reserves and exchange rate, in addition to output gap, thereby rendering the cogent conventional Taylor rule inadequate to assess the monetary policy reaction function of the Central Bank of Nigeria. This justifies the modification of the rule to incorporate other variables in addition to inflation and output to capture the reaction of monetary policy to developments in the economy. The study also validates the interest rate smoothing behavior, showing that the Central Bank of Nigeria is concerned with costs associated with interest rate variability.

Keywords: Monetary policy, external reserves, ARDL, central bank

JEL Classification Numbers: E52, E58, C22, C24

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I. Introduction

The seminal work of Taylor (1993) provides the basis for the study of monetary policy reaction function. The rule states that central bankers increase/decrease the nominal interest rate, if inflation is above/below the target (inflation gap) and/or output is above/below the potential (output gap). However, several studies¹ later proved that policymakers consider and analyze other variables before policy decisions are taken and pronounced. Therefore, the current reality is that policymakers react to as many variables as

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¹ See Bar-Ilan and Lenderman (2007), Kato et al (2009) and Shrestha and Semmler (2011)

possible besides inflation and output gaps. This prompted the extension of the Taylor rule to incorporate other variables including macro-fundamentals (Senbet, 2011). Considering the growing influence of external reserves on central bank's policy decision making, other scholars, such as Prakash and Willi (2011) further extended the Taylor rule to include external reserves.

The global economy has witnessed a phenomenal increase in the accumulation of external reserves, following the Asian financial crisis of 1997/98. Most of these reserves are from the developing countries. Central banks' holding of external reserves has escalated sharply from US\$1.2 trillion in 1995 to over US\$10.0 trillion in January 2012. Developing countries have increased their share of the reserves from 30.0 per cent in 1990 to 67.0 per cent in 2011. In Africa, external reserves increased from US\$39.0 billion in 1995 to over US\$600.0 billion in 2011. Nigeria also follows suit, as external reserves grew from a mere US\$5.5 billion in 1999 to US\$34.68 billion in March 2012, representing over 530.0 per cent increase within the period. Thus, as at March 2012 Nigeria was the 44th largest reserves holder in the world (AllAfrica.com, March 14, 2012).

Reflecting on this phenomenal increase in Nigeria's reserves, that places Nigeria in such a strategic position, there is the need to examine, if the monetary authority considers this colossal changes in the level of reserves, in its monetary policy decision making. In other words, does the Central Bank of Nigeria respond or react to changes in the level of external reserves? This study is, therefore, an attempt to examine the link between external reserves and monetary policy with emphasis on the reactionary tendencies of monetary policy, to not only changes in the general price level and output, but also to changes in external reserves accumulation. This will, to a large extent, assist policy makers and players in the financial market, predicts the possible future path of monetary policy, using developments in both the domestic economy and in the economy of Nigeria's major trading partner.

To achieve this, the paper is structured into five sections. After this introduction, section two reviews relevant literatures and provides the basis for the extension of the Taylor-type rule monetary policy reaction function. Section three, describes the data source and methodology, while section four presents the results and section five concludes the paper.

II. Relevant Literature

II.1 Empirical Literature

There exists a large body of literature on external reserves that attempted to find the determinants of reserves holdings, as well as its optimal level. From the earlier

work of Heller (1966) to that of Aizenman and Marion (2003) and David and Yaaba (2011). There is also a great chunk of literature on the estimation of monetary policy rule in line with the work of Taylor (1993). This reflects the notion of at least, short run impact of monetary policy on the economy as against the monetary neutrality view of some monetarists. The simplest version of the Taylor rule (1993) entails that the short term interest rate should positively respond to the rate of inflation and output gap. In this regards, therefore, scholars attempted to estimate monetary policy reaction in this direction.

Douglas (2010) estimates monetary policy reaction function for OECD countries and concluded that it can provide insight into the factors influencing monetary policy decisions, but observes that differences exist across countries as to whether monetary policy reacts solely to expected inflation or takes into account expected output developments. A range of other factors, such as monetary policy in other large economies, can also influence monetary policy reactions in smaller countries. He further confirmed that monetary policy reacts less to contemporaneous measures of the output gap, while developments in asset prices do not have any influence on monetary policy decisions.

Doladoy et al (2003), investigates the implication of a non-linear Phillips curve for the derivation of optimal monetary policy rules for four European countries and the US. They opined that, the optimal policy is nonlinear, with the policymaker increasing interest rates by a larger amount when inflation/output is above target compared to the reaction when inflation/output is below target. Specifically, the model predicted that such a source of nonlinearity leads to the inclusion of the interaction between expected inflation and the output gap in an otherwise linear Taylor rule.

James et al (2007), modeled the US economy using vector autoregressive (VAR) model. The data spanned from 1984 to 2003. They found that, contrary to the official claims; the Federal Reserve neither targets inflation nor reacts to its signals, but rather unemployment signals in a way that suggests that fear of unemployment is a driving force of monetary policy decisions. They tested the variations in the workings of the Taylor rule by using data dating back to 1969 to run what they referred to as "dummy variable regressions". The results suggest that after 1983 the Federal Reserve stop reacting to inflation or high unemployment, but low unemployment. They further show that monetary policy, measured by yield curve, has significant causal effect on pay inequality. The results also provide evidence of partisan bias in monetary policy decisions, particularly during election years.

Kontonikas and Montagnoli (2004) examined the relationship between monetary policy and assets prices in the UK in the context of empirical policy rules, using data from 1992-2003. They find that UK policymakers take into account the effect of assets price inflation in setting interest rate with a higher weight to property market fluctuations. Asset-inflation augmented rules describe relatively more accurately the actual policy and the results are robust to modeling the effect of the Bank of England independence.

Jesus and Manuel (2008) adopted a simple ordered probit model to analyze the monetary policy reaction function of the Colombian Central Bank (CCB). The result provides evidence of an asymmetric reaction in the sense that, the central bank increases the bank rate when the gap between observed inflation and the inflation target is positive, but did not reduce the bank rate when the gap is negative, suggesting that the bank is more interested in achieving the announced inflation target than in reducing reasonable inflation rate. The forecasting performance of the model, both within and beyond the estimation period was sound.

Bernd and Boris (2005) estimated the monetary policy reaction functions for the Bundesbank and European Central Bank (ECB), using monthly data that spanned from 1979:4 – 1998:12; and 1999:1 – 2004:5, respectively. The results show that, while the ECB and the Bundesbank react almost the same way to inflation expectations, the ECB reacts relatively stronger than Bundesbank to output gap. According to the authors, theoretical considerations suggest that the stronger response to the output gap was due to higher interest rate sensitivity of the German output gap than to a higher weight attached to the output stabilization by the ECB. Counterfactual simulations carried-out based on the estimated interest rate reaction function proves that German interest rates would not have been lower under a hypothetical Bundesbank regime after 1999. However, their conclusion was said to be crucially dependent on the assumption of an unchanged long-run real interest rate for the crisis period.

Koiti and Naoyuki (2007) empirically analysed the Japanese monetary policy based on time-varying structural vector auto-regressions (TVSVAR). The TVSVAR is a dynamic full recursive structural VAR that includes a monetary policy reaction function, an aggregate supply function, an aggregate demand function and an effective exchange rate determination function. They used quarterly data on nominal short term interest rate, inflation rate, real growth rate and nominal effective exchange rate and the results show that monetary policy in Japan was ineffective in the 1990s.

Adanur-Akkan and Nargelecekenler (2008) estimated both backward-looking and forward-looking monetary policy reaction function of the Central Bank of the Republic of Turkey (CBRT) with focus on the post-crisis period between August 2001 and September 2006. The study laid emphasis on inflation targeting and the results show that CBRT complied with the Taylor rule in setting interest rate. The coefficient of inflation and output gap was greater in the forward-looking model than in the backward-looking model. Although, the results of the forward-looking model mirrors the monetary policy decisions in Turkey, but the expected inflation which appeared to be the main variable that reacts enormously to the policies of CBRT, suggests to some extent, the non-accommodating nature of monetary policy at least over the post-crisis period. They concluded that, in general, monetary policy based on Taylor rule was effective in inflation targeting in Turkey.

Yazgan and Yilmazkuday (2007) estimated only a forward looking monetary policy rule for Israel and Turkey with inflation target as priority against fixed target adopted in earlier research for developed countries. They asserted that a forward-looking Taylor rule provides reasonable description of central bank behavior in both countries. They concluded that monetary policy was more effective in both countries, especially in Turkey, when compared to the developed countries.

Sanchez-Fung (2002) estimated a hybrid monetary policy base reaction function for the Dominican Republic (DR). The estimated reaction function shows that the central bank was biased towards targeting the gap between the parallel market and official exchange rate. This bias was more systematic after the mid-1980s. According to him, the findings of the study confirm the long standing endorsement of a multiple exchange rate regime by the Central Bank of the Dominican Republic, supporting the learning process hypothesis for the bank.

Inoue and Hamori (2009) applied a dynamic ordinary least square (DOLS) model in estimating India's monetary policy reaction function. He constructed an open-economy version of Taylor rule using monthly data from the period April 1998 to December 2007. While the sign of the coefficient of output gap was found to be consistent with theory and statistically significant, that of inflation was not. The estimation of Taylor rule with exchange rate yielded a statistically significant and theoretically consistent coefficient of output gap and exchange rate. They, therefore, concluded that, inflation rate did not play a significant role in the conduct of monetary policy in India, during the studied period. Thus, they recommended that India should adopt an inflation-target type policy framework.

Malik and Ahmed (2008) estimated a slightly modified version of the Taylor-type reaction function for Pakistan. The results indicate a pro-cyclical response of State

Bank of Pakistan (SBP) to economic fluctuations. They proved that the emphasis of the SBP was more on economic growth than price stability and output stabilization. The study also exposed the policy inconsistency, as some parameters in the reaction function show variation in recursive estimation.

Siri (2009) analyzed the reaction function of the Central Bank of Ghana and Nigeria and the West African Economic and Monetary Union (WAEMU). The empirical result suggests that Ghana and Nigeria's monetary policy are not consistent with the monetary policy rule according to the original Taylor model or to most of the adjusted variants of the model. Interest rate reacts weakly to the variations in inflation and output gap. In the case of WAEMU, the central banks seem to apply a Taylor rule adjusted by the interest rate of France.

Iklaga (2008) used a simple Taylor-type model to estimate a reaction function for the Central Bank of Nigeria (CBN). The results show that a Taylor-rule framework summarizes well the key elements of monetary policy in Nigeria. Inflationary pressures and output were proved to be the driving force of monetary policy decisions of the CBN.

Agu (2007) used two models to estimate the monetary policy reaction function for the Central Bank of Nigeria (one based on the historical process of the Central Bank of Nigeria, while the other adheres to the Taylor-type rule). The results validate the importance of inflation in the monetary policy reaction in Nigeria. It also shows that ex-ante pronounced policy target of the central Bank of Nigeria (CBN) differs from ex-post outcomes. The result, however, did not confirm the interest rate smoothing behavior, showing that the CBN is not critically concerned with costs associated with interest rate variability or that the costs have been swamped by other policy challenges. The results did not also confirm either the thorny issue of fiscal dominance or indications of significant impact of oil prices on the monetary policy framework.

However, despite all these extensions, only a few of the studies on the estimation of monetary policy rule considered the influence of external factors in the monetary policy reaction function. Good examples of such studies are; Berument and Tasci (2004) which used the difference between interbank money market rate and the depreciation rate and found that monetary policy significantly reacts to changes in foreign reserves in Turkey.

In the same vein, Prakash and Willi (2011) examined monetary policy response to international reserves for some selected East Asian countries by extending the Taylor rule. They employed an autoregressive distributed lag (ARDL) approach and the result indicates that the countries, in addition to macroeconomic stability, consider external constraint and financial stability in their monetary

policy decisions. Thus, monetary policy significantly reacts to international reserves, particularly after the Asian financial crisis of the 1990s. They, therefore, concluded that the conventional Taylor-type rule did not properly capture the monetary policy reaction in the emerging economies of Asia.

Pei-Tha and Kian-Teng (2010) extended the structural vector auto-regression (SVAR) model based on Svensson (2000) to confirm the notion that monetary policy is not only concerned with output gap and inflation, but also external influences. Using data from Indonesia, Malaysia and Thailand, the results indicate that the sampled countries do not consider exchange rate and terms of trade in their monetary policy objectives, although they affect the actions of the central banks. They also confirmed the usefulness of interest rate as a measure of the counter-cyclical policies of the central banks.

II.2 Monetary Policy Rules: Taylor's Framework

Two distinct types of monetary policy instrument rules exist in literature; money growth and interest rate setting. The first was predominant in the 1980s and mostly referred to as Friedman's framework. The latter is associated with Taylor (1993). The Friedman's framework was also influenced by the Quantity Theory of Money (QTM). The New Keynesians concern of the unstable velocity of money, as well as the worry of the Post Keynesians about the endogeneity of money supply, led to the gradual abandonment of Friedman's framework by many advanced and emerging economies. The Taylor framework based on the seminal work of Taylor (1993) proposes a rule of setting the interest rate with a specific parameterization as a sum of the equilibrium real rate (r^*), inflation gap and output gap (y_t), such that:

$$i = r^* + \pi_t + 0.5(\pi_t - \pi^*) + 0.5y_t \quad (1)$$

Where i is nominal federal funds rate, r^* is the equilibrium real interest rate, π_t is the inflation rate over the previous four quarters, π^* is the inflation target and y_t is the percentage of deviation of real gross domestic product (GDP) from its target. With a predetermined real interest rate and the inflation target equaling 2, the rule of setting interest rate befits²: $i_t = 1 + 1.5\pi_t + 0.5y_t$.

Taylor (1993) deduced a rule-based framework based on the observed behavior of the Fed as it affects inflation and growth of risks. He argues that the rule can be derived from the quantity theory of money, assuming a constant velocity of

²Based on calibration, Taylor found that a rule with the parameters set to $r^* = \pi^* = 2$ and $f_\pi = \phi_y = 0.5$ traces fairly well, the Fed funds rate between 1987 and 1992.

money. Semmler et al. (2005), opined that the Taylor rule can also be obtained by solving a dynamic optimization problem through minimizing the central bank's loss function that includes both inflation and output gaps. Standardizing it further, they proved that in a dynamic decision problem, the arbitrary weights proposed by Taylor (i.e. 1, 1.5 and 0.5) can be obtained from the coefficients of the IS and Phillips curves. This position corroborated the earlier work of Svensson (2000). The rule attracted the attention of some policy makers, because, it was able to fairly predict the federal funds rate in the late 1990s.

This simple original framework of the Taylor rule is marred by many shortcomings. Prominent among them are: first, considering the changing role of central banks, variables other than the inflation and output gaps are as important for monetary policy decision making. These variables include real exchange rate, terms of trade, outputs of trading partners, interest rate of other countries and asset price. Second, other critical information about the economy are not captured in the rule as it dwells mainly on a closed economy. Third, Ball (1999) argues that the optimal monetary policy rule in an open economy is a function of not only short-term interest rate, but also exchange rate. This is because of the popular exchange rate channel of monetary policy transmission. Fourth, the rule is 'developed country bias' and what is suitable for developed countries may not necessarily fit the emerging and developing countries. Fifth, the Asian financial crisis of the 1990s, as well as the mortgage crisis that started from the US in 2007 proved the failure of the rule to avert crisis.

Other scholars such as Cecchetti (2000) argued that even the interest rate smoothing concept of the monetary policy reaction function which is presumed to be enough for keeping the chances of financial crisis to a minimum failed to curb financial crisis. In a nutshell, even the inflation targeting rule in the conventional Taylor-type rule, ignores the unavoidable external constraint faced by countries which are not issuing reserve currency. Following these weaknesses, therefore, an extension to Taylor rule became crucial.

II.3 An Extended Monetary Policy Reaction Function

Considering the inherent weaknesses of the analyzed Taylor-type rule and following the recent work of Prakash and Willi (2011), this study adopts a simple variant of the reaction function to examine the response of monetary policy in Nigeria to the level of external reserves, besides inflation and output changes. The extension of the monetary policy reaction function for Nigeria, therefore, can take the form below:

$$IR_t = \beta_0 + \beta_1 \log R_t + \beta_2 IF_t + \beta_3 Y_t + \mu_t \quad (2)$$

Where IR_t is the short-term interest rate, R_t represents the external reserves, IF_t is inflation, Y_t is the output gap. The *a priori* expectations of the variables, from theoretical stand point are that all the coefficients, except output gap, will take positive signs. Another expectation from the theoretical stand-point is that, the long-run coefficient of inflation should preferably exceed one. This guarantees that the Taylor rule equates inflation to its target. However, since the consideration here is not inflation gap (as advocated in the Taylor rule, the coefficient shall be implicitly determined in the estimation and not assign *a priori*. The magnitude of the coefficient on the output gap Y_t , following Prakash and Willi (2011), depends on the slope of the aggregate supply curve and the variability of output in the loss function.

In this specification, inflation is not the main focus as in the original model. The exchange rate covertly assumes the impact of the changes in exchange rate on inflation rate. The external reserves is assumed to be necessary to minimize the likely output costs in case of break out of financial crisis, when capital flows is volatile. It will also be used to maintain stability in exchange rate, so as to enhance economic growth, as well as creates employment. Short-term interest rate is retained to proxy monetary policy instrument, since both the Post Keynesians and the New Keynesians still consider short-term interest rate as exogenous, but somehow set by the central banks (Lavoie, 2006; Cecchetti, 2000). Central banks, particularly in emerging and developing countries do not rely solely on policy rate, as they occasionally intervene in the money markets to influence the short-term interest rate.

In estimating the monetary policy reaction function, the log level of external reserves is considered as against the deviation of the level of external reserves from any target used in some studies. This is, because, there is still no consensus as to what constitutes an optimum level of external reserves, hence, optimum reserves is country specific depending on the macroeconomic and political objectives of the country. Similarly, some internationally accepted ratios, such as the IMF rule of thumb and the WAMZ convergence criteria of 3 months of imports cover, the Greenspan-Guidotti's rule of covering short-term external debt, as well as the Shcherbakov approach of 5-20 per cent of broad money supply (M_2) are also not highly relevant here, because, of their myopic emphasis. They lay emphasis on either, the current account or capital account. Moreso, the Greenspan-Guidotti's rule concentrates only on the external drain, without regard to internal influences (Obstfeld et al., 2010). The available alternatives of using the ratio of external reserves to GDP or to broad money has been criticized, due to the stock-flow inconsistency and the impact on money supply or non-uniformity of computing M_2 across countries, respectively. This is especially when the data set is on quarterly basis. The choice of inflation rate as against the

deviation of inflation from a target is due to the fact that Nigeria is yet to adopt inflation targeting framework.

Nigeria being an emerging market economy, like other emerging economies, will definitely have the fear of floating, particularly when exchange rate depreciates, as well as fear of loss in term of decline in reserves, therefore, there is need for exchange rate and foreign interest rate in the extended monetary policy reaction equation, thus the equation becomes:

$$IR_t = \beta_0 + \beta_1 \log R_t + \beta_2 \log IF_t + \beta_3 \log EXR_t + \beta_4 \log FIR_t + \beta_5 Y_t + \mu_t \quad (3)$$

Where *EXR* is the exchange rate and *FIR* is foreign interest rate, proxied by 3 months treasury bills rate of the US. The choice of exchange rate is determined by the availability of data. Real effective exchange rate is preferred, but the available data does not cover the sample period. Although, this type of linear reaction function is not without its short-comings, but for the purpose of simplicity, it has been widely adopted to explain the actual monetary policy reaction and it does so fairly well.

Furthermore, Genberg and He (2009) argued that a monetary policy reaction to variables other than output and inflation does not necessarily mean that monetary policy targets the variables. The inclusion of the variables in the model simply implies that they transmit information about potential inflation in the economy. Currency depreciation, for instance, can prompt a contractionary monetary policy, because, of its possible impact on domestic prices and not necessarily, because, of an attempt to achieve a target, say a particular level of exchange rate.

Prakash and Willi (2011) viewed the response of monetary policy to external reserves as not an inflationary concern, but mostly due to external and financial fragility effect. The inclusion of foreign interest rate (*FIR*) is to provide us with information on how the activities in the securities market of Nigeria's major trading partner shape the structure of the country's policy decision making.

III. Model Specification, Data Issues and Estimation

The Autoregressive Distributed Lag (ARDL) model developed by Pesaran et al (2001) is deployed to estimate equation (3). The choice of ARDL is based on three considerations. First, the model yields a consistent estimate of the long run normal coefficients irrespective of whether the underlying regressors are stationary at I(1) or I(0) or a mixture of the two. Second, it provides unbiased estimates of the long run model, as well as valid t-statistics even when some of the regressors are

endogenous (Harris & Sollis, 2003). Thirdly, it yields high quality results even if the sample size is small.

Following Pesaran et al (2001), therefore, the ARDL format of equation (3) becomes:

$$\begin{aligned} \Delta \log IR_t = & \beta_0 + \sum_{i=1}^m \beta_1 \Delta \log IR_{t-i} + \sum_{i=0}^n \beta_2 \Delta \log R_{t-i} + \sum_{i=1}^o \beta_3 \Delta \log IF_{t-i} \\ & + \sum_{i=1}^p \beta_4 \Delta \log EXR_{t-i} + \sum_{i=1}^q \beta_5 \Delta \log FIR_{t-i} + \sum_{i=1}^r \beta_6 \Delta \log Y_{t-i} + \gamma_1 \log IR_{t-1} \\ & + \gamma_2 \log R_{t-1} + \gamma_3 \log IF_{t-1} \\ & + \gamma_4 \log EXR_{t-1} + \gamma_5 \log FIR_{t-1} + \gamma_6 \log Y_{t-1} + \mu_t \end{aligned} \quad (4)$$

Where t is time, \log is the natural logarithm, Δ is the first difference, β_0 is constant, β_1 to β_6 and γ_1 to γ_6 are the coefficients of their respective variables. Other variables are as defined earlier.

According to the Granger representation theorem, when variables are co-integrated, there must also be an error correction model (ECM) that describes the short-run dynamics or adjustment of the co-integrated variables towards their equilibrium values. Hence, the general error correction representation of equation (4) is represented as:

$$\begin{aligned} \Delta \log IR_t = & \beta_0 + \sum_{i=1}^m \beta_1 \Delta \log IR_{t-i} + \sum_{i=0}^n \beta_2 \Delta \log R_{t-i} + \sum_{i=1}^o \beta_3 \Delta \log IF_{t-i} \\ & + \sum_{i=1}^p \beta_4 \Delta \log EXR_{t-i} + \sum_{i=1}^q \beta_5 \Delta \log FIR_{t-i} + \sum_{i=1}^r \beta_6 \Delta \log Y_{t-i} \\ & + \gamma EC_{t-1} \end{aligned} \quad (5)$$

Where EC = error correction term from equation (4).

According to Pesaran, et al (2001), two stages are involved in estimating equation (4). First, the null hypothesis of the non-existence of the long run relationship among the variables is defined by $H_0: \gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = \gamma_5 = \gamma_6 = 0$. H_0 is tested against the alternative of H_1 : not H_0 . rejecting the null hypothesis implies that there exists a long run relationship among the variables irrespective of the integration properties of the variables. This is done by conducting a Wald test with an asymptotic non-standard distribution. Two sets of critical values are tabulated with one set assuming all variables are $I(1)$ and the other $I(0)$. This provides a band covering all possible classifications of the variables into $I(1)$ and $I(0)$. If the calculated F-statistics lies above the upper level of the band, the null hypothesis is rejected, implying that there is co-integration, if it lies below the lower level of the

band; the null cannot be rejected, indicating lack of co-integration. If the F-statistics falls within the band, the result is inconclusive.

III.1 Data Issues and sample Period

To estimate the equation, quarterly data spanning from the period 1999Q1 to 2012Q1 is employed. The data set on interest rate, international reserves (US\$Million), inflation and exchange rate are obtained from the publications of the Central Bank of Nigeria (CBN) and National Bureau of Statistics (NBS). The foreign interest rate which is proxied by Treasury bills rate of the US denoted as FIR is sourced from the international financial statistics (IFS) and the output gap denoted by Y is computed using an ideal band-pass filter of Christiano and Fitzgerald (2003). The derivation of the filter follows the analysis in Hens and Kai (2011) as shown in the appendix.

IV. Empirical Result

Summary statistics and the degree of correlation among the variables in the model were estimated as a preliminary check. Table 1 shows that while the logs of inflation (IF), exchange rate (EXR) and output gap (Y) are positively correlated with interest rate; reserves (R) and foreign interest rate (FIR) are negatively correlated with interest rate. The table also presents the summary statistics of the data used in the estimation equation. There are 51 observations; with the mean of the data spanning from 0.3090 for output gap (Y) to 9.9825 for log of reserves (R). The median is between 0.6627 for FIR and 10.3840 for IR.

Table 1: Summary Statistics of the Variables in the Model

	LOGIR	LOGIF	LOGR	LOGEXR	LOGTBR	Y
Mean	9.9825	2.3562	2.9349	4.8419	0.4211	0.3090
Median	10.3840	2.4989	2.9085	4.8541	0.6627	1.9049
Maximum	11.0362	3.1913	3.2658	5.0643	1.8323	22.2312
Minimum	8.4706	-1.4979	2.6926	4.4998	-2.6736	-29.4067
Std. Dev.	0.8175	0.7153	0.1475	0.1389	1.2711	11.2512
Skewness	-0.5188	-3.3106	0.4700	-0.4934	-0.8541	-0.3750
Kurtosis	1.6730	17.9060	2.5160	2.7893	2.5876	3.3230
Jarque-Bera	6.0291	565.3129	2.3752	2.1639	6.5625	1.4167
Prob.	0.0491	0.0000	0.3049	0.3389	0.0376	0.4924
Obs.	51	51	51	51	51	51

Degree of Corelation among the Variables in the Estimated Equation

	LOGIR	LOGIF	LOGR	LOGEXR	LOGTBR	Y
LOGIR	1.0000	0.1641	-0.8321	0.6781	-0.3406	0.0446
LOGIF		1.0000	0.0247	0.3258	-0.2525	-0.1261
LOGR			1.0000	-0.4563	0.3017	-0.1901
LOGEXR				1.0000	-0.8050	0.1505
LOGTBR					1.0000	-0.1636
Y						1.0000

Although, the ARDL can be applied irrespective of whether the regressors are I(0) or I(1) or a mixture of the two and hence, does not require pretesting of the data, but we decided to determine the order of integration of all the variables before implementing the model, in order to be sure that the data does not contain I(2) series. Table 2 shows the results of the Augmented Dickey-Fuller (based on AIC, SBC and HQ) and Phillips Perron (PP) unit root tests for the order of integration of the variables in the model.

Table 2: Unit-Root Test (Augmented Dickey-Fuller and Phillips-Perron)

Variable	Augmented Dickey Fuller						P-P test statistics	
	AIC		SBC		HQ		Level	First Diff.
	Level	First Diff.	Level	First Diff.	Level	First Diff.		
LIR	-0.897705	-4.923504*	-0.897705	-4.923504*	-0.897705	-4.923504*	-0.478748	-4.910412*
LR	-2.894033	-7.285177*	-2.609695	-7.285177*	-2.609695	-7.285177*	-2.840586	-7.2785*
LIF	-1.051972	-5.320129*	0.669163	-5.320129*	-1.051972	-5.320129*	-0.455639	-3.483824**
LEXR	-2.203007	-5.315952*	-2.203007	-5.315952*	-2.203007	-5.315952*	-2.298330	-5.315952*
LFIR	-2.397748	-2.222297	-2.397748	-2.222297	-2.397748	-2.222297	-1.180669	-2.341412***
Y	-0.816757	-1.862535	-0.816757	-1.862535	-0.816757	-1.862535	-3.259668**	-2.506724

Notes: *, ** and *** significant at 1%, 5% and 10%, respectively.

The result of the unit root test shows that, while interest rate (IR), reserves (R), inflation (IF) and exchange rate (EXR) based on the two tests are integrated of I(1) and significant at 1.0 per cent, foreign interest rate (FIR) is of order I(1) based only on the Phillips Perron test but significant at 10.0 per cent. Output gap (Y) is of order I(0) also based only on the Phillips Perron test at 10.0 per cent. Hence, the order of integration of the variables provides further evidence in support of the use of the ARDL model.

Equation (4) is then estimated. Table 3 presents the calculated F-statistics (F-statistics = 67.458) indicating that the null of no co-integration can be rejected at 1.0 per cent level, since it is higher than the upper bound critical value of 4.43 as tabulated in Pesaran et al (2001). In other words, there exists a long-run relationship or co-integration among the studied variables.

Table 3: Estimated Long-Run Coefficients ARDL (1, 0, 1, 1, 1, 1)

Dependent Variable: logIR			
Variables	Coefficient	t-Statistic	Prob-Values
C	0.67957	0.60835	0.54920
LOGIR(-1)	0.82323	15.55993	0.00000
R	-0.03399	-2.74274	0.01190
LOGIF	0.04426	1.59724	0.12450
LOGEXR	0.04759	1.94799	0.06430
LOGFIR	0.40589	1.25298	0.22340
Y	-0.04201	-2.30902	0.03070

$R^2 = 0.99$ $F\text{-Stat} = (5, 35) = 67.458 [0.0000]$ Durbin Watson = 2.34

$Adjusted - R^2 = 0.98$ $AIC = -2.110307$, $SBC = -1.780270$, $HQ = -2.006943$

The relevant critical values for unrestricted intercept and no trend under 6 variables for 0.05, 0.025 and 0.01 are 2.45 - 3.61; 2.75 - 3.99 and 3.15 - 4.43, respectively. They are Obtained from Pesaran et al. (2001) CI(iii) Case III.

From Table 3, the result indicates that the long run overall model is well fitted as the independent variables exerts about 98.0 per cent (adjusted-R²) influence on the dependent variable. The coefficients show that, reserves and output gap exhibit a significant negative relationship with the policy rate (IR). On the other hand, the log of the foreign interest rate (FIR) exhibits a significant positive relationship with the policy rate. While the signs of inflation and exchange rates are positive, although both are not significant.

The negative and statistically significant response³of the log of output gap (Y) is consistent with theory and implies an inverse relationship between output gap and policy rate in Nigeria, such that the more actual output in the last quarter

³This is akin to the finding of Inoue and Hamori on India (2007) and Iklaga on Nigeria (2008)

falls short of its potential, within the same period (i.e. higher negative output gap), central bank reduces the policy rate, with the notion that the economy has the capacity to absorb more liquidity and vice versa. Although, this is reactionary rather than proactive, but seems to have some degree of semblance with the expected result in a Taylor-type rule with regard to output gap. This also shows a fairly strong relationship between output gap and policy rate in Nigeria. Arguably, therefore, if a large chunk of the real sector activities can be affected by the adjustment in policy rate, this singular reaction of the CBN vis-à-vis policy rate will positively impact on output growth. In practical terms, if the output gap is negative, implying that there is a potential for increasing output or put differently the economy is performing below capacity, CBN can reduce the policy rate, to encourage borrowing, hence boost investment and output. The reverse also follows and this can be interpreted as 'demand effect'.

The significant negative response of policy rate to foreign reserves signifies that, central bank reduces policy rate in response to rise in foreign reserves. Conversely, any fall in foreign reserves coincides with the increase in policy rate. This may not necessarily be in order to attract capital inflows or stop sudden outflows, but also to discourage credit creation by the deposit money banks (DMBs). The coefficient of reserves can be interpreted to mean 'liquidity effect'⁴. This is because, by implication as reserves is depleted, especially through intervention in foreign exchange market, more naira is withdrawn from circulation, hence an increase in the policy rate as a response to increase in demand for money or shortage of naira cash balances in the economy.

Although as earlier stated, in the model, inflation is not the main focus as in the original Taylor rule. However, it is important to passively observe that the 'Fisher effect'⁵ does not strongly hold for inflation in Nigeria. Even though, the positive sign of the log of inflation would have connoted same, but it is statistically not significant. This, unlike Agu (2007), proves that CBN did not directly react to inflation rate within the study period⁶. This stem probably from two facts: first, that monetary policy in Nigeria, of recent, is conducted on the basis of opinion polls. Second, within the study period, as clearly confirmed by Iklaga (2008), when designing monetary policy, major developments in the economy are reviewed and critical areas that require intervention to enhance output or stabilise prices are identified. Policy interventions are then concentrated on the recognised

⁴ Liquidity effect asserts that in the short run, changes in the money supply induces changes in short term nominal interest rate in the opposite direction

⁵ Fisher effect is a theory that postulates a positive relationship between interest rate and inflation

⁶ Although the sign of the log of inflation is the same as Agu (2007) but the fact that it is not statistically significant informs the difference in the interpretation of the result.

areas. This focused the conduct of monetary policy mostly to the management of exchange rate, capital inflow, excess liquidity and credit creation.

The high coefficient of the log of policy rate is an indication of interest rate smoothing characteristics of the CBN. Sack and Wieland (2000) are of the opinion that in such a situation, any slight policy adjustment by the central bank would be in near distant future, followed by a relatively larger policy adjustment in the same direction. They attributed interest rate smoothing behaviour of monetary authorities, particularly in the emerging economies, to issues that have to do with stability of the system, adverse reaction of the banking system, as well as effort to protect the reputation of the central bank itself.

The log of exchange rate is positive and fairly statistically significant, implying that some degree of importance is attached to exchange rate in the monetary policy formulation process. The reason could be that since monetary policy is to a large extent anchored on monetary targeting framework, with price stability as the overriding objective, CBN tries to stabilise the exchange rate, so as to avoid speculation in the foreign exchange market, arising from wide premia, which is capable of destabilising the market. The instability or volatility in exchange rate could be counter-productive to the goals of price stability.

The foreign interest rate is positively related to the dependent variable but not statistically significant. This is an indication that, although, central bank monitors development in other economies, in this case, the United States, but hardly changes her policy rate in response to the changes in the foreign interest rate. This probably can be attributed to the effort of the CBN to discourage significant capital outflows or prevent sudden stop in capital inflows.

Table 4: Short-Run Parsimonious Error Correction Estimates of the ARDL Model

Dependent variable: $\Delta \log IR$			
Regressors	Coefficient	t-Statistic	Prob-Values
C	-0.0075	-0.4176	0.6788
$\Delta \log IR(-1)$	0.6322	3.6024	0.0010
ΔR	-0.0188	-1.5968	0.1193
$\Delta R(-1)$	-0.0447	-3.4606	0.0014
$\Delta R(-2)$	-0.0172	-1.3942	0.1720
$\Delta \log IF(-2)$	-0.0413	-1.6160	0.1151
$\Delta \log EXR(-1)$	0.6249	1.2453	0.2213
$\Delta \log EXR(-2)$	0.6175	1.3160	0.1967
$\Delta \log FIR$	0.0601	0.8045	0.4265
$\Delta Y(-1)$	0.0048	1.5896	0.1209
$\Delta Y(-2)$	-0.0078	-2.4139	0.0211
$ECM(-1)$	-0.7098	-2.9926	0.0050
$R^2 = 0.56$		Durbin Watson = 2.01647	
Adjusted - $R^2 = 0.42$		Prob. = 0.0007	

The appropriate lag length p for the error correction model is selected based on Akaike Information Criterion (AIC), Schwarz Bayesian Criterion (SBC) and Hannan-Quinn Criterion (HQ), as all the tests yielded the same optimal lag length (Table 5). The result of the error correction model (ECM) is presented in Table 4. The coefficient of the error correction term (ECM_{t-1}) is negative and highly significant. This indicates that nearly 30.0 per cent disequilibrium is corrected on quarterly basis by changes in policy rate.

Table 5: Statistics for Selecting Lag Order of the Model

p	1	2*	3	4	5
AIC	-1.51408	-1.89094	-1.64317	-1.96383	-3.53269
SBC	-1.05077	-1.18237	-0.67962	-0.73509	-2.04326
HQC	-1.33830	-1.62430	-1.28397	-1.51071	-2.98675

Note: p is the lag order of the model. AIC denotes Akaike Information Criterion, SBC is Schwarz Bayesian Criterion and HQC Hannan Quinn Criterion. * Optimal lag length

Overall, the result suggests that the simple 'Taylor-type rule' laying emphasis mainly on the output and inflation gaps, although theoretically cogent, is inadequate to track the reactionary tendencies of monetary policy of the CBN.

Thus, the extended version, which considers some other variables, besides inflation and output, is highly necessary to capture the changing pattern of monetary policy decision making process of the CBN, which can largely be attributed to, perhaps the crisis in the banking system during the studied period, as well as the rapidly increasing influence of external factors on the domestic economy.

Meanwhile, a recursive estimate of the level relationship is estimated to test for the tendency of the relationship between the estimated variables to change over time probably due to the variations in the pattern of monetary policy, arising from the emergence of new sources of shocks coupled with changes in the structure of the economy which prompts the monetary authority to often review the *modus operandi* of monetary policy. Although, parameter instability, can in some cases, be attributed to variable omission, but visual inspection of the recursive estimate in the Appendix shows, for instance, that the estimated monetary policy negatively reacts to external reserves (C3) at the beginning of the sample period, but turns positive in 2003, thereafter, became almost flat throughout the remaining part of the sampled period. Similar changes in the pattern of monetary policy reaction, although in different directions, were observed in all the variables throughout the sample period. This type of variations in the parameters in the recursive estimation can in some cases be interpreted to mean policy inconsistency.

The most often used techniques of cumulative sum (CUSUM) and CUSUMSQ tests were adopted to test the stability of the equation and of the estimated parameters.

Figure 1: Cumulative Sum (CUSUM) of Recursive Residual Test

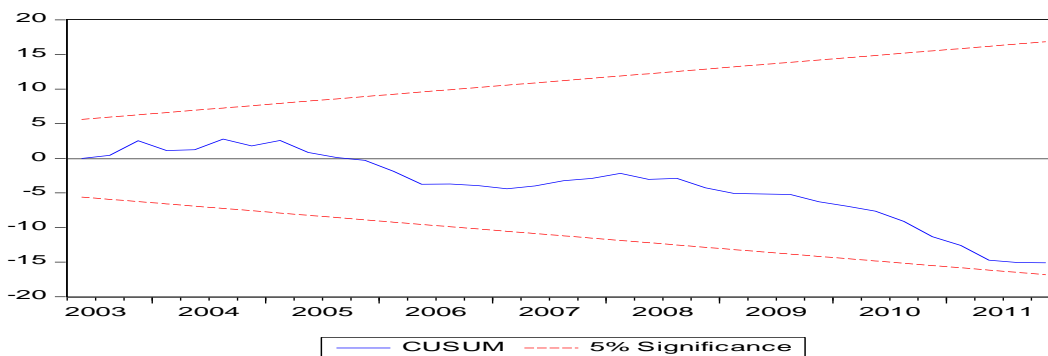
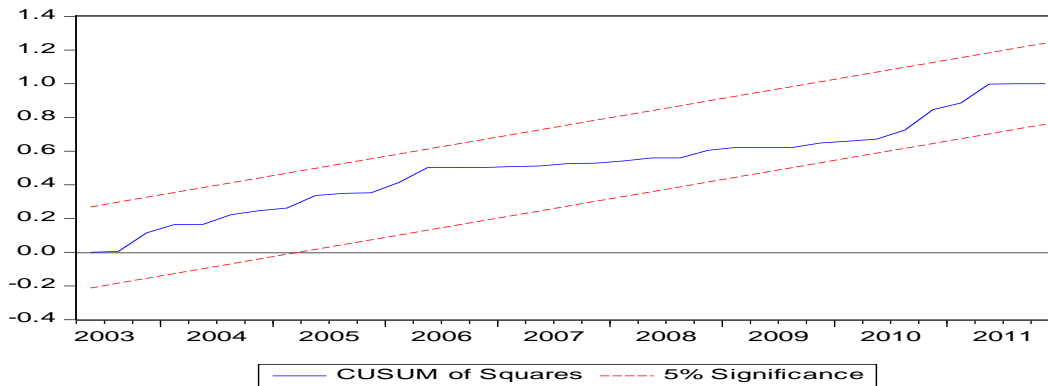


Figure 2: Cumulative Sum of Squares (CUSUMSQ) of Recursive Residual Test

CUSUM test is based on the cumulative sum of the equation errors in the regression. The software represents graphically the cumulative sum of errors together with the critical lines of 5.0 per cent. On the other hand, CUSUMSQ instead used recursive double errors. The equation parameters are considered unstable if the whole sum of recursive errors gets outside the two critical lines. By and large, graphs of CUSUM and CUSUMSQ show that the parameters of the analysed equation are stable given that the recursive errors lie within the two critical lines of both the CUSUM and CUSUMSQ tests.

V. Conclusion

The study applied an Autoregressive Distributed Lag (ARDL) approach to an extended version of the Taylor-type rule to estimate the response of monetary policy in Nigeria to both domestic and external variables, with special emphasis on external reserves. The results show that the Central Bank of Nigeria reacts to changes in the level of external reserves and exchange rate, in addition to output gap, thereby rendered the cogent conventional Taylor rule inadequate to assess the monetary policy reaction function of the Central Bank of Nigeria. This justifies the modification of the rule to incorporate other variables in addition to inflation and output to capture the reaction of monetary policy to developments in the economy. The study validates the interest rate smoothing behavior, showing that the CBN is concerned with costs associated with interest rate variability.

The reaction of the CBN to external reserves is attributed largely to the rapidly increasing influence of external factors on the domestic economy which lures the monetary authority into considering other external sources of vulnerability in the system on the monetary policy decision making process.

It is important to note that monetary policy reaction to variables other than output and inflation does not necessarily imply that monetary policy targets the variables. The inclusion of the variables in the model simply implies that they transmit information about potential output/inflation in the economy.

Finally, there is therefore, the need for the CBN to consider external variables, particularly external reserves and exchange rate when formally designing/building a rule/model for the country's monetary policy.

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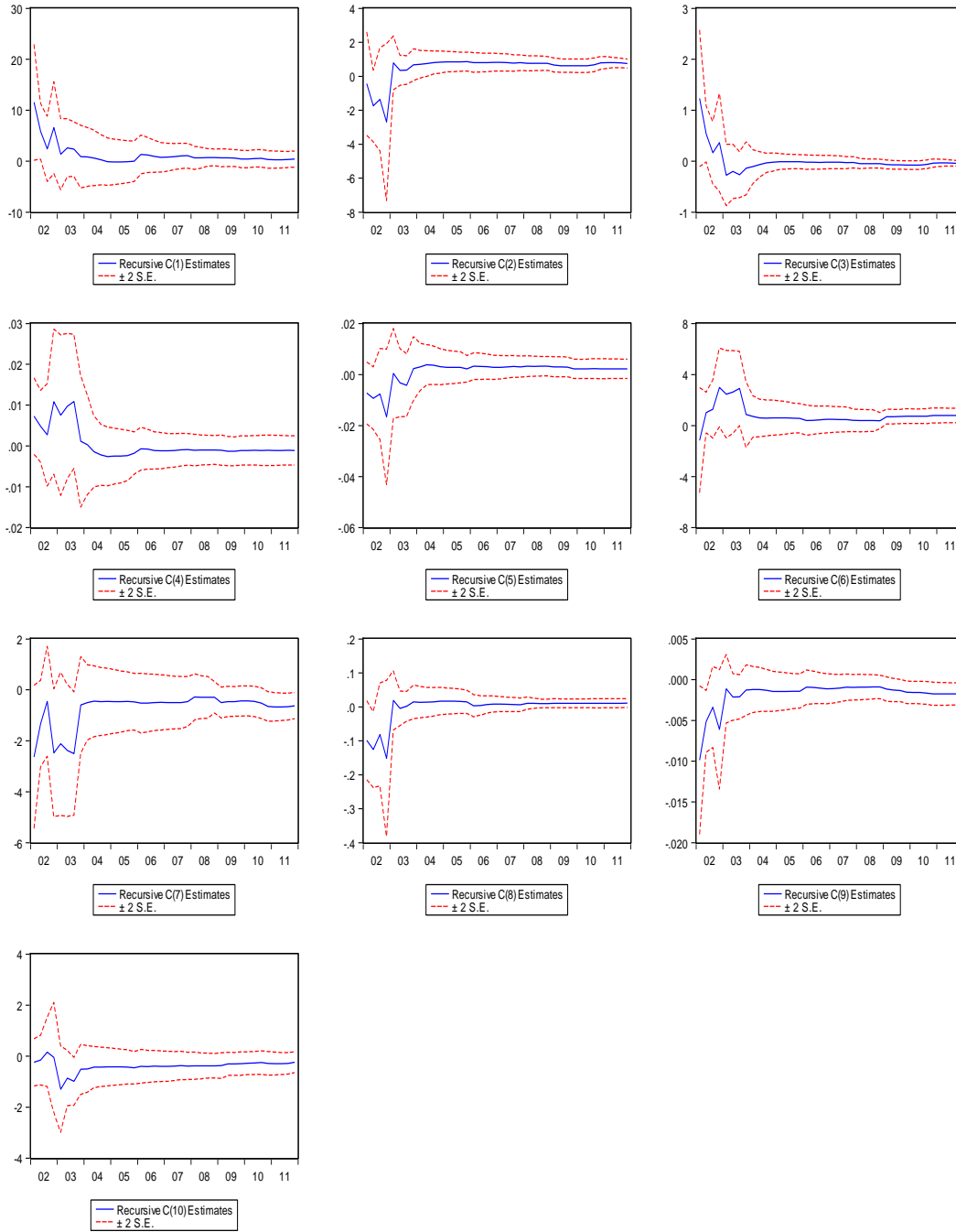
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Appendix 1. Recursive Estimates of the Monetary Policy Reaction Function



Appendix

Consider a linear filter $G(L)$ which is a linear transformation of a time series x_t with weights g_l at lag l .

$$G(L) = \sum_{l=a}^b g_l L^l, \quad a \leq 0 \leq b, \quad (6)$$

Where L is the lag operator $L^k = x_{t-k}$. To produce the filtered series x_t , the filter is applied to y_t :

$$x_t = G(L)y_t = \sum_{l=a}^b g_l y_{t-l} \quad (7)$$

The effect of the application of the filter is reflected in the frequency response function (FRF) of the filter. This is represented as:

$$G(e^{-i\omega}) = \sum_{l=a}^b g_l e^{i\omega l} \quad (8)$$

The growth of the amplitudes of y_t is caused by the linear filter.

$$\text{Gain}(\omega) = |G(e^{-i\omega})| \quad (9)$$

While the shift of its position with regards to the phase shift is:

$$\text{Phase}(\omega) = \frac{\arg(G(e^{-i\omega}))}{(2\pi)} \text{ at frequency } \omega \quad (10)$$

Equations (9) and (10) are respectively the gain shift and phase shift of the filter.

If $g_l = g_{-l}$ for $l > 0$, implying that weights are symmetrical, the linear filter will not cause any phase shift.

However, since phase shift causing filters can lead to either wrong or spurious lead-lag relationships between/among variables, according to Hens and Kai (2011), it therefore, follows that the gain function of the ideal band pass filter is a perfect rectangular function, given as:

$$\text{Gain}(\omega) = \begin{cases} 1 & \text{for } \omega_1 \leq \omega \leq \omega_2 \\ 0 & \text{for } \omega < \omega_1 \text{ or } \omega > \omega_2 \end{cases} \quad (11)$$

Note that the phase shift function is a constant zero.

Now, to derive the weight of the ideal band pass filter, we have:

$$g_l = \begin{cases} \frac{\sin(\omega_2 l) - \sin(\omega_1 l)}{\pi l} & \text{for } l \neq 0 \\ \frac{\omega_2 - \omega_1}{\pi} & \text{for } l = 0 \end{cases} \quad (12)$$

However, according to Hens and Kai (2011), the ideal band pass filter is practically not feasible, because, of the infinite nature of the weights, In other words, to calculate such a filter an infinite-order moving average is necessary which requires a data set of infinite length and this is practically not available. Therefore, some form of approximation is required, thus making the contributions of Baxter and King (1999) and Christiano and Fitzgerald (2003) highly relevant⁷.

Christiano-Fitzgerald⁸ approximation, uses alternative loss criterion, as well as, the assumptions on the underlying process of y_t they yielded, to adjust the weights to take account of the missing values. The extrapolation of the sample is done by using what is referred to as 'an assumed model' and the extrapolation overlaps the observed sample. Now, following Hens and Kai (2011), if we assumed a random walk for series y_t , the following simple adjustment is required:

$$\check{g}_0 = \frac{g_0}{2} \quad (13)$$

$$\check{g}_1 = \frac{-g_0}{2} \quad (14)$$

$$\check{g}_l = \frac{-g_0}{2} - \sum_{k=1}^{l-1} g_{1,k}, l \geq 2 \quad (15)$$

Where g_l in equation (15) is the weight of the ideal filter, as represented in equation (12). The \check{g}_l is the adjusted weights and are used on the end points y_1 and y_T . In between are the observations that are weighted by the unmodified weights g_l .

⁷Emphasis in on Christiano-Fitzgerald approximation.

⁸ For detailed exploration on the derivation of BK and CF filter, see Hens and Kai (2011) and Christiano and Fitzgerald (2003)

Ratings Game¹ - A Review

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I. Introduction

Post-2008 global financial crisis placed the search light on the activities of global rating agencies, especially in the United States and Europe. The article discussed the regulatory role played by private credit rating agencies and their impact on the financial system. The author attempts to draw attention to the conflict of interests between the objectives of private credit agencies and the regulatory role they play. A synopsis of the article is presented in section II below, while comments and lessons for Nigeria are discussed in section III.

II. Overview of Article

The article noted that credit rating agencies have become an integral element of the financial system in which they operate. The role of these agencies center on the provision of information on the credit-worthiness of a potential borrower and risk of default associated with a financial instrument. Put simply, they perform credit-risk assessment. The substantial reliance by individuals, firms, governments and regulatory authorities on the ratings by these agencies in making key credit, regulatory and investment decisions was pointed out by the author. According to the author, use of the ratings of these agencies has meant {i} less reliance on “static and fixed percentages” to more “dynamic scores” in credit risk assessment {ii} Private credit rating agencies are now seen to perform a regulatory role. Both of these outcomes introduce complexity in the financial system. First, the use of more dynamic percentages could lead to misleading risk assessments. Second, the fact that these private credit rating agencies seem to have been provided with license to regulate the financial sector, a role often seen as a public function introduces, *ab initio*, a conflict of interest problem.

The author traced the increased role of credit rating agencies to the introduction of the Basle II Accord which stipulated risk and capital adequacy requirements for financial institutions to enable them mitigate potential risk. He further added that increased borrowing opportunities and the difficulty of ascertaining full

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information on potential borrowers associated with an expanding financial market had also expanded the activities of the rating agencies. Some positive benefits of the activities of credit rating agencies, as highlighted by the author, were: (i) economies of scale derived in the provision of borrower's information; (ii) it narrows the information asymmetry between a borrower and a lender; (iii) improves the access of credit-worthy borrowers to low-cost financing and improves liquidity as information asymmetry is narrowed. The author was however of the opinion that the "institutionalized" role of private credit rating agencies in banking sector regulation meant that they most often influence assets values, capital requirements, eligibility of collateral in central bank operations as well as investment decisions of publicly controlled funds such as pension funds. Thus, in the author's words, the participation of credit rating agencies in banking regulation has replaced the need for due (regulatory) diligence, amounts to privatization of the regulatory process and has meant government's abdication of its key regulatory role, while retaining responsibility for the overall outcome.

The continued reliance on such ratings, according to the author, may not be a feasible alternative to due regulatory diligence, in the long-run mainly due to (i) divergent motives between a private organization and a public institution- while a private agency's major objective is profit maximization, the regulatory body is charged with providing information for the public interest. (ii) Ratings, often times, depend on judgment and most rating agencies (perhaps in a bid to disassociate themselves from any negative outcome) provide a disclaimer on any public consideration of their ratings as an investment advice. (iii) Licensing and regulation of credit rating agencies are often based on market recognition, rather than a standardized system of utilizing regulatory requirements. (iv) Possibility of the credibility of the rating and regulatory process being undermined since a private rating agency is confronted with conflict of interest between the provision of accurate information and its "institutionalized" public regulatory role.

In an attempt to provide elements of a post-crisis regulatory reform aimed at achieving less conflict of interest and improved accuracy of ratings, the author postulated:

- (i) Modification of existing regulatory rules, which could require rating agencies to be more transparent about how they operate.
- (ii) A possible regulation of fees of rating agencies to help resolve conflicts of interest.
- (iii) Establishment of investor boards to delineate rating agencies from their clients.
- (iv) To establish and evaluate the rating methodologies adopted by the rating agencies

- (v) The regulation of private credit rating agencies to the point that they become public utilities.
- (vi) A possible exclusion of private agencies from performing the regulatory role or replaced by a new public rating agency
- (vii) A return to the use of predetermined capital rules. This could improve transparency, eliminate errors in judgment, and reduce conflict of interest
- (viii) Eliminate the reliance on credit ratings: this can be done through a market-pricing process whereby the market, rather than rating agencies determine the quantum of capital that a financial institution must hold to back an asset.

Nevertheless, the author was quick to raise potential questions that arise from some his recommendations. For instance, establishing a new public rating agency raises the important question of who rates the Sovereign? Thus, conceding that not all aspects of the public-private conflict of interest would be resolved. In addition, the use of simpler and predetermined percentages may not capture or differentiate the inherent risks and could lead financial institutions to engage in riskier lending and could even curtail lending.

III. Comments and Lessons for Nigeria

The author introduced an often overlooked dimension in the discourse of credit rating agencies into the literature by drawing readers' attention to the divergence of interest between the profit maximization objective of a credit rating agency and the regulatory function, which they subtly perform without trying to minimize the challenge of conflict of interest that arises between credit agencies and the companies that hire them.

The rating industry is relatively new and evolving in Nigeria when compared to its widespread patronage in advanced economies. At end-March 2011, the number of domestic credit rating agencies, (CRA's) registered by the Securities and Exchange Commission stood at five (5). As part of the efforts to reduce the menace of non-performing credits, reduce overexposure to debtors and boost the credit culture in Nigeria, the Central Bank of Nigeria introduced the Credit Risk Management System which acts as a public credit database, introduced the know-your-customer (KYC) initiative for deposit money banks and further issued operational and regulatory guidelines as well as licenses for credit bureaus {a.k.a, credit reference companies (CRC's)} to, among other functions, provide credit information services. With these infrastructures, the rating emphasis seems to be on "scoring" borrowers with emphasis on ascertaining their creditworthiness for loan creation purposes and not on rating financial debt instruments or their issuers per se, which is the prerogative of the private credit rating agencies.

Lessons gleaned from the events of the post-2007 global financial crisis have indicated that a slight perception of misleading or inaccurate rating can lead to a loss of confidence in the market and is costly to restore investors' confidence. The demand for rating services seems to be driven by international obligations and regulatory bodies, which often permit and mandatorily require debt issuers, including sovereigns to obtain these ratings and credit report from licensed private agencies. It has also been argued that as the financial system develops in breadth and depth, the demand for rating services is bound to increase. This, in itself, enhances the need to strengthen regulatory, supervisory and oversight parameters of the CRAs and CRCs. Global discourse has shown that there are no easy solutions to reduce the reliance on the privately issued credit ratings. It would, however, seem that since 2010, investors have relied less on ratings and attached more weights on political pronouncements, which seem to affect developments in the markets. Whether this is the new norm or a transitory development remains to be ascertained.

The business of credit rating of borrowers or financial instruments thrives on availability, accuracy and accessibility of sometimes privileged information. Building a credit profile is often times based on historical and current credit standing. In Nigeria, the ability of a creditor to obtain full information about potential debtors, is not necessarily constrained by a growing financial market or increased borrowing opportunities as in developed economies, but rather by the lack of unique identifier on clients that is commonly accepted, apathy to full disclosure of information by clients, outdated client data/information, and low use of ICT in requesting for client information due to, amongst other challenges, the perceived mistrust of the authenticity of the sender. The lack of a unique national identifier that is commonly accepted by all service providers in the economy is very critical to the survival of the credit bureaux, especially within a system where it costs next to nothing to assume multiple identities which are hardly verifiable. These invariably lead to an abuse of the system by potential borrowers since credit is not linked to a national identity number. Consequently, intervention measures should aim at addressing the issues above. One of such measure is the Know-Your-Customer (KYC) initiative by the Central Bank of Nigeria. Anecdotal evidence, however, indicated that the implementation of this initiative was fraught with some challenges including the inability of bank customers' to provide personal information to branches of their banks' as clients were being referred to visit their bank branches where their account was domiciled to update their details, misunderstanding of the KYC initiative by some staff of financial institutions, man-hour lost due to required physical presence to provide these information and in some cases, clients' concerns about data protection as well as potential loss of confidentiality.

Post-implementation challenges of government initiatives such as the KYC, national identity card scheme should be reviewed periodically. In gauging the performance and acceptability of the CRCs and CRAs, accuracy of ratings of existing CRAs as well as access to the credit database registry in terms of number of visitors (online and offline) should be assessed. In addition, consistency, quality of services provided and integrity of ratings are factors that could determine the future development of the industry.

The overriding objective of a lending institution such as a bank or finance company is to make profits which calls to question the assurances that a lending institution will issue credit to a potential debtor who always pays outstanding debts in record time with little or no prospect of the bank earning an interest income? Therefore, certain concerns that need to be addressed revolve around ensuring that the credit scoring systems gives more weight to the inherent risk rather than profit. For instance, some deposit money banks conduct “name check” and have developed cautious approach towards issuing debt to politically exposed persons. Potential lenders should also move beyond ascertaining how desirable it may be to lend money to a borrower and examine the legitimacy of the application for credit. In some jurisdictions, a broad review of the CAMELS ratings system has been proposed in order to generate ratings that reflect risks in all components. Consumer education on the role of credit bureau and rating agencies is further recommended to aid consumer understanding of their products and further develop the industry. Value-added services would need to be introduced as the industry expands. The need to reverse the upward trend of “trust deficit” in the system cannot be over-emphasized in order to assure consumers that their data is protected. Furthermore, the current approach by lending financial institutions to mandatorily require that a periodically funded account must be domiciled and maintained in their bank before a client can be considered for a loan facility needs to be revisited. This situation begets questions such as (i) what is the purpose of establishing a credit bureau (ii) what is the essence of giving one's bankers a standing instruction to credit a designated account in the lending institution without having to move accounts. Finally, there should be continuous research and update of rating practices, harmonization of methodologies (while accounting for industry specifics), and regular update of rating models and CRAs code of conduct to reflect current and evolving realities.

Reference

Gayras, P. (2012), “Ratings Game”, *IMF Journal of Finance and Development*; March

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