

# Contents

## **Building Dynamic Stochastic General Equilibrium Models for Monetary Policy Analysis**

*Charles N. O. Mordi and Michael A. Adebisi, Ph.D...* ... .. 1

## **Global Oil Prices and the Nigerian External Sector: An Empirical Investigation**

*Abwaku Englama, Ph.D, Newman C. Oputa, Ganiyu K. Sanni, Maaji U. Yakub, Oladunni Adesanya and, Zainab Sani ... .. 25*

## **Measuring Competition in the Nigerian Banking Sector**

*Ozoemena S. Nnaji, Ph.D.....* ... .. 45

## **Empirical Investigation of Agricultural Export Trade in Nigeria (1975 - 2008): A Case Study of Cocoa and Palm Kernel**

*Daramola Dare Samuel...* ... .. 66

## Review/Communications

### **Face to Face with Productivity**

*Phebian N. Omanukwue...* ... .. 90

### **Too Big to Ignore**

*Jimoh S. Adeleke...* ... .. 96



# Building Dynamic Stochastic General Equilibrium Models for Monetary Policy Analysis

**Charles N.O. Mordi and Michael A. Adebisi, Ph.D\***

*Dynamic Stochastic General Equilibrium (DSGE) models are powerful tools that provide a coherent framework for policy discussion and analysis. In principle, they can help to identify sources of fluctuations, answer questions about structural changes, help to forecast and predict the effect of policy changes, and perform counterfactual experiments. Against this background, this paper aims at providing an insightful discussion on DSGE models by developing a simplified version of the models to explain the behavior of key macroeconomic variables in Nigeria namely: the growth rate of gross domestic product (GDP), headline inflation, exchange rate and the monetary policy rate.*

*The estimated results highlight the central role of expectations in the transmission of shocks and policy impulses in DSGE models. The main lesson that we derive from the study is that management of expectations provides an effective approach to controlling inflation.*

**Keywords:** DSGE Models, Monetary Policy Analysis, Impulse Response Functions, Forecasting, Nigeria

**JEL Classification Numbers:** E37, E47, E50, E51, E52

**Authors' e-mail:** [cnomordi@cbn.gov.ng](mailto:cnomordi@cbn.gov.ng); [mikebiyi@cbn.gov.ng](mailto:mikebiyi@cbn.gov.ng)

## I. Introduction

**M**acroeconomic models embody two important sets of hypotheses about the role of monetary policy. The first is concerned with the operation of policy, or how the policy instrument reacts to wider economic developments. This aspect of model design involves assumptions about the choice of instrument, the form of decision-rules relating instruments to objectives and the operational meaning of a 'no policy change' assumption with respect to monetary policy. The second embodies a range of hypotheses about how changes in policy-related variables influence the economy as a whole.

In the last two decades, modelling efforts had been concentrated on building

---

\*Charles N. O. Mordi is the Director of Research and Michael A. Adebisi is a Deputy Director with the Central Bank of Nigeria. The authors are grateful to Messrs E. T. Adamgbe and O. O. Evbuomwan of the Research Department, Central Bank of Nigeria, for their editorial assistance and comments.

models with little or no scope for monetary policy. This had compelled the policymakers to rely on ad-hoc models such as Mundell-Fleming that lacked adequate treatment of expectations and stock-flow relationships. However, in recent years, considerable efforts have been put to building simple, coherent, and plausible models capable of merging empirically motivated IS/LM models with dynamic stochastic general equilibrium (DSGE) methodologies, to explain monetary policy transmission. These models, which consist of an aggregate demand (or IS) curve, a price-setting (or Phillips curve) mechanism and a policy reaction function (Taylor's rule), are built on solid microeconomic foundations and incorporate expectation variables.

This class of models is useful for the following reasons. First, they serve as a guide to policy makers to know whether an inflation target could be met in the future given the contemporaneous stance of monetary policy and the output gap or not. Second, they help in determining whether exchange rate pass-through is lower than in the past or not. Third, they help in determining sacrifice ratio (that is the amount of output to be forgone to achieve a given permanent reduction in the rate of inflation). Lastly, they shed light on the implications of following alternative policy rules.

Against this background, the goal of this paper is to provide an insightful discussion on dynamic stochastic general equilibrium models and show how they could be used as tools for monetary policy analysis. Following this introduction, section 2 provides a brief literature review covering the importance of DSGE models for monetary policy and basic structure of DSGE models, while Section 3 presents the methodology, which covers data, model set-up, its description and calibrations. Section 4 provides the results and interpretations, while Section 5 summarises, provides policy implications and conclusion.

## **II Brief Review of Literature and Theoretical Underpinning**

### **II.1 Monetary Policy in DSGE Models**

The importance of DSGE models in monetary policy analysis cannot be overemphasized. They provide a consistent analytical framework for conducting a positive and counterfactual historical analysis. For example, Sahuc and Smets (2007) and Christiano *et al.* (2007) propose DSGE models with multiple shocks which make it possible to interpret differences in the policies applied by the central banks

as resulting essentially from the economic conditions prevailing in these banks.

Progressively, the behaviour of central banks in the analysis of monetary policy using DSGE models has been described to follow a monetary policy rule. The rule, in which the central banks are assumed to adjust the nominal interest rate, is based on several indicators, including the deviation of inflation from its target and the output gap (Taylor, 1993). It has been demonstrated theoretically that if a central bank does not adjust its monetary policy instrument sufficiently enough to respond to changes in the price level, it could cause undesirable economic fluctuations. In the same vein, it has been demonstrated that, under certain conditions, the effectiveness of monetary policy may be hindered by a loose fiscal policy and thus, the DSGE models can help in moderating these conditions and guiding policymakers to avoid the zone of economic instability (Leeper, 1991).

DSGE models can also aid the monetary authorities on how to anchor uncertainty into their decision-making processes. Central banks do this by expressing their preferences via a criterion – e.g. maximising a social welfare function just like other agents - and then hypothesise that their perception of the economy through the models is potentially subject to error that may hinder the realisation of their preferences.

## **II.2 A Simplified Microfoundation of DSGE Models<sup>1</sup>**

The new Keynesian model follows the earlier rational expectations models of Lucas (1972) and Sargent and Wallace (1975) in which the role of expectations in the monetary transmission mechanism is underscored. The model also takes advantage of the powerful microeconomic foundations by building expectations into the optimizing behavior of households and firms through the real business cycle model (Kimball, 1995; Kydland and Prescott, 1982). While the policy implications of the New Keynesian model was traced out by Clarida, Gali, and Gertler (1999) and Woodford (2003), the open-economy extension, in which the exchange rate and the interest rate channel of monetary transmission operates together, was developed by Obstfeld and Rogoff (1995). Bernanke, Gertler, and Gilchrist (1999) extended the New Keynesian model to account for the balance

---

<sup>1</sup>This section benefited immensely from the work of Sbordone et.al. (2010)

sheet channel of monetary transmission.

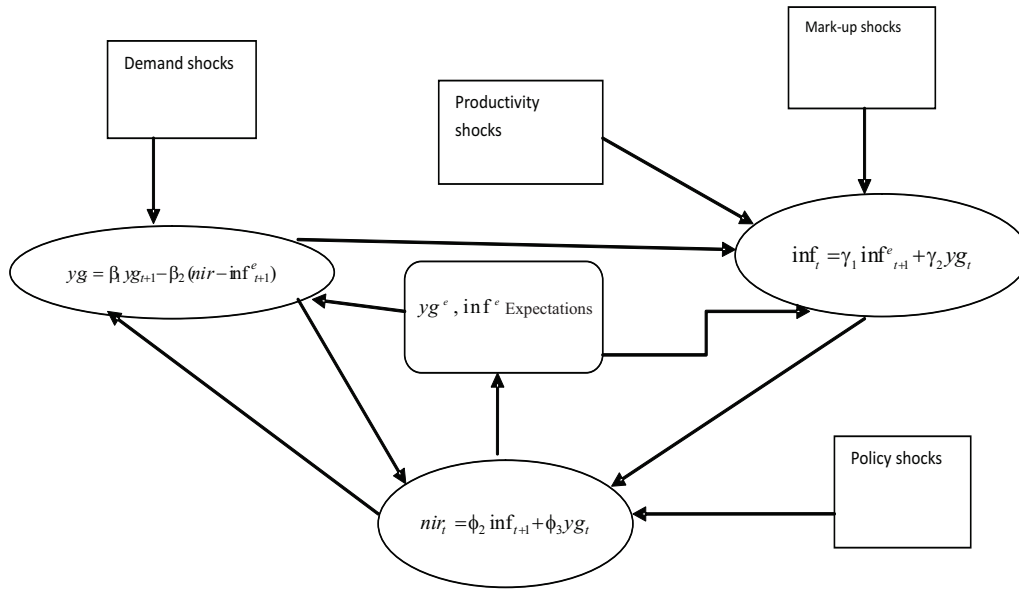
The workings of the traditional Keynesian interest rate channel within the framework of DSGE model have been discussed in the literature (Sbordone et al, 2010). The discussion focuses on the assumptions that economic agents - consumers, producers and government - always consider rational expectations in the formulation of their decisions.

Fischer (1977) and Phelps and Taylor (1977) demonstrated that anchoring the role of expectations on nominal price or wage rigidity, it is possible to reverse the impotency of policy associated with Lucas (1972) and Sargent and Wallace (1975).

The derived and simplified version of DSGE models are micro-founded and are built on the assumptions of rational expectations of the economic agents - the household, the producers/firms and the government. The interaction of these agents in the markets gives room for market clearance and the fulfillment of the "general equilibrium" condition.

Figure 1 illustrates a simplified version of the basic structure of the DSGE models consisting of three blocks - a demand block, a supply block, and a monetary policy block. The blocks contain three equations and three variables.

**Figure 1: A Schematic Representation of the Basic DSGE Model**



**Source:** Sbordone, et. al. (2010).

From the demand block, it is obvious that output ( $yg_t$ ) today is linked to its expected future value ( $yg_{t+1}$ ) and to the ex-ante real interest rate. From the linkage, it is obvious that when real interest rates are temporarily high, households are willing to spend less of their current incomes and firms would rather save than invest. The line connecting the demand block to the supply block reveals that the level of activity ( $yg_t$ ) and expectations of future inflation ( $inf_t^e$ ) are key input in the determination of current inflation ( $inf_t$ ). The supply block shows that high level of economic activities encourages firms to raise wages so as to motivate employees to work longer hours. This action raises marginal costs and puts pressure on prices, thereby raising the current and expected inflation.

The monetary policy block is an interest rate rule for monetary policy that is similar to the type suggested by Taylor (1993). The block shows that central bank systematically adjusts the short-term nominal interest rate in response to movements in inflation and output. This description of monetary policy in terms of

interest rates shows that most central banks conduct monetary policy using targets for the interest rate as opposed to any of the monetary aggregates. From the standard New Keynesian model, monetary policy works through the conventional Keynesian interest rate channel. For instance, a shock to interest rate (by reducing the monetary policy rate) reduces the short-term nominal interest rate, which transforms into a reduction in the real interest rate arising from costly or staggered price setting (Ireland, 2008). This reduction encourages consumers to increase their current consumption or spending, which raises output and price with gradual adjustment after the shock.

The role of expectations in the conduct of monetary policy and the dynamic interactions among the variables are visible in Figure 1. The figure shows that the conduct of monetary policy has a large influence on the formation of expectations and that expectations are the main channel through which policy influences the economy. This is consistent with the perception of the financial markets and the general public on the pronouncements of central banks and their likely course of action. It is also visible from the figure the existence of shocks, which creates uncertainties in the evolution of the economy. In every period, the steady states in each block are perturbed and uncertainties are injected, thereby generating economic fluctuations.

### **III. Methodology**

#### **III.1 Data, Model Set up and Description<sup>2</sup>**

In the estimation of the model parameters, quarterly data spanning 1985:Q1 to 2011:Q2 is employed on seven macroeconomic indicators: domestic real output ( $y$ ); foreign real output, proxied by the US real GDP ( $y^f$ ); domestic headline inflation ( $inf$ ); domestic interest rate ( $i$ ); nominal exchange rate ( $s$ ); foreign inflation rate, proxied by the US inflation ( $inf^f$ ) and foreign interest rate ( $i^f$ ). The data are filtered,

---

<sup>2</sup>Benefited immensely from the work of Adebisi and Mordi (2010b)



converted into logs, then growth rates and gaps are computed.

In line with the work of JVI/IMF (2010) a reduced form new-Keynesian model is adopted. The model is made up of four basic behavioral equations- aggregate demand and supply, uncovered interest rate parity, monetary policy rule and some identities- as shown in equations 1 to 6:

$$yg_t = a_1 yg_{t-1} - a_2 mci_t + a_3 yg_t^f + \varepsilon_{ygt} \quad (1a)$$

$$mci_t = a_4 z_t + (1 - a_4) r_t \quad (1b)$$

$$inf_t = b_1 inf_{t-1} + (1 - b_1) inf_{t+1}^e + b_2 rmc + \varepsilon_{inf_t} \quad (2a)$$

$$rmc_t = b_3 yg_t + (1 - b_3) z_t \quad (2b)$$

$$s_t = e_1 s_{t+1}^T + (1 - e_1) (s_{t+1}^e + (i_t^f - i_t + prem_t) / 4) + \varepsilon_{st} \quad (3a)$$

$$s_{t+1}^T = s_{t-1} + 2/4 (inf_t^c - inf_t^e + \Delta z_e) \quad (3b)$$

$$i_t = f_1 i_{t-1} + (1 - f_1) (i_t^n + f_2 (inf_{t+1}^e - inf_t^T) + f_3 yg_t) + e_{it} \quad (4)$$

## Identities

$$z_t = s_t + inf_t^f - inf_t \quad (5)$$

$$i_t^n = r_t^t + inf_{t+1}^e \quad (6)$$

Where  $yg_t$  is the output gap in period  $t$ ,  $yg_t^f$  is the foreign output gap in period  $t$ ,  $mci_t$  stands for the real marginal condition index in period  $t$ ,  $z_t$  is the real exchange rate in period  $t$  defined as nominal exchange rate deflated by relative prices, and  $\Delta z_e$  is the change in the equilibrium real exchange rate in period  $t$ ,  $s_t$  is the nominal interest rate in period  $t$ ;  $inf_t$  represents inflation rate in period  $t$ ,  $rmc_t$  is real marginal cost in period  $t$ ,  $inf_{t+1}^e$  stands for expected inflation rate in period  $t$ ,  $inf_t^T$  represents optimum or equilibrium inflation rate in period  $t$ ,  $prem_t$  stands for exchange rate premium in period  $t$ ,  $i_t$  is the domestic nominal short-term interest rate in period  $t$ ,  $i_t^f$  is the foreign nominal short-term interest rate in period  $t$ ,  $i_t^n$  represents the natural rate of interest in period  $t$ ;  $t-1$  represents the lag of relevant variables,  $t+1$  stands for the

lead of relevant variables; and  $a$ ,  $b$ ,  $e$  and  $f$  are all parameters to be estimated.

Aggregate spending relationship corresponds to the open economy version of the traditional IS curve and is explained in equation 1. In calculating the present value of spending and wages, interest/policy rate is incorporated. The lag of output gap ( $yg_{t-1}$ ) is included to give room for some degree of habit persistence in consumption or adjustment costs of investment (Pongsaparn, 2008). Considering Nigeria as a small open economy, real exchange rate gap ( $z_e$ ) is included as a variable that influences economic activities through the prices of imports and exports (Adebiyi and Mordi, 2010b). The relative weight of the real interest and real exchange rates is explained by the monetary condition index (MCI) in the IS curve. Also, foreign output gap ( $yg'_t$ ), proxied by US gross domestic product, is added as a determinant of export demand. The influence of other explanatory variables such as oil prices, fiscal policy and other demand shocks are captured in the residual term.

The aggregate supply equation (the Phillips curve) is defined in Equation 2. The supply relationship incorporates the behavior of the both the domestic producers and importers (JVI/IMF, 2010). The inclusion of equation 2(b) justifies small open economies, like Nigeria, that usually have a potent exchange rate channel of monetary transmission. The equation is the real marginal cost (rmc), which is the weighted average of the output gap (domestic producers) and the gap in real exchange rate (importers) with the coefficient representing the weight of imported goods in the consumer basket (JVI/IMF, 2010). Attempt is made to model expectations to include forward and backward-looking elements. The equation shows that inflation rate is influenced not only by past inflation but also by inflation expectations, demand pressures, and external supply shocks captured by  $z_t$ . From this equation, current inflation depends on its expected future value and its own lagged value. The inclusion of the lagged term shows the persistence of the inflation - the more persistent inflation, the higher the  $b_1$  and vice versa. The relative weight of output and real exchange rate gaps in the firm's real marginal costs is captured by  $b_2$ .

The relationship with the world is captured by the uncovered interest parity (UIP) in Equation 3.  $i_t$  and  $i_t^f$  are the domestic nominal and foreign short-term interest rates, respectively. The UIP shows the link between exchange rate and interest rates. In reaction to a depreciation of the exchange rate, for example, the monetary authority is expected to raise interest rates subsequently. With this version of the UIP, the trend values for the real exchange rate appreciation and the trend values of domestic and foreign real interest rates are bound together (JVI/IMF, 2010).

The model is closed by a policy reaction function of monetary authority in equation 4. From this equation, a monetary authority is assumed to respond to deviations of the next-period inflation from its target and to the output gap. It is assumed that credit markets transmit the changes in the policy rate into money-market rates without any hindrance.

### III.2 Techniques for Estimation and Forecast<sup>3</sup>

Five steps are involved in the estimation and forecast of the model. First, is the preparation of the data base, which requires that the historical data are stored in the excel file (csv format). The second stage is the calibration of the specific parameter values. In the model calibrations, consideration is given to the validity of economic theory, stylized facts about the economy and observation, facts and existing empirical literature (see Table 1). The priors for Phillips curve and the IS curve estimates were obtained from the work of Adebisi and Mordi (2010b). The parameter of output lag of 0.72 was considered appropriate by Laxton and Scott (2000). They claimed that the sum of the parameters of real interest rate and real exchange rate should be smaller than that of the output gap, largely owing to the limited effect of the interest rate and exchange rate on output because of significant lags in monetary transmission mechanism in most economies.

---

<sup>3</sup>Benefited immensely from JVI/IMF (2010)

**Table 1: The Model Calibration and Parameterization**

Equation	Parameter	Definition	Value	Comments	Linear Homogeneity Condition
IS Curve (Output Gap)	$y g_t = a_1 y g_{t-1} - a_2 m c i_t + a_3 y g_t^f + \varepsilon_{y g} \quad (1a)$				
	$m c i_t = a_4 z_t + (1 - a_4) r_t \quad (1b)$				
	$a_1$	Lag of output gap	0.72**	Measures output gap persistence; lies between 0.1 and 0.95	$0 < a_1 < 1$
	$a_2$	Marginal condition index	-0.10*	Measures the pass through from monetary condition to the real economy. It varies between -0.1 to -0.5	$-0.1 < a_2 < -0.5$
	$a_3$	Foreign output gap	0.12*	Measures the impact of foreign demand on domestic output; varies between 0.1 (low impact) to 0.7 (strong impact)	$0 < a_3 < 1$
	$a_4$	Real exchange rate gap	0.5*	Shows the relative weight of the real interest and exchange rates in real monetary condition; varies between 0.3 (open economy) to 0.8 (closed economy)	$0 < a_4 < 1$
Phillips Curve	$i n f_t = b_1 i n f_{t-1} + (1 - b_1) i n f_{t+1} + b_2 r m c + \varepsilon_{i n f} \quad (2a)$				
	$r m c_t = b_3 y g_t + (1 - b_3) z_t \quad (2b)$				
	$b_1$	Lag of inflation rate	0.62**	Measures inflation persistence. It varies between 0.4 (low persistence) to 0.9 (high persistence)	$0 < b_1 < 1$
	$b_2$	Real marginal costs	0.31**	Pass-through from real marginal cost to inflation. It measures sacrifice ratio. It varies from 0.05 to 0.4	$0 < b_2 < 1$

	$b_3$	Exchange rate changes	0.70**	Ratio of domestically produced goods in the consumer basket. It varies between 0.9 and 0.5	$0 < b_3 < 1$
Uncovered Interest parity	$s_t = e_1 s_{t+1}^e + (1 - e_1) (s_{t+1}^e + (i_t^f - i_t + \text{prem}_t) / 4) + \varepsilon_s \quad (3a)$ $s_{t+1}^e = s_{t-1} + 2/4 (\text{inf}_t^e - \text{inf}_e^f + \Delta z_e) \quad (3b)$				
	$e_1$	Lag of expected exchange rate	0.1**	$e_1$ captures either exchange rate persistency or central bank's interventions; varies between zero to 0.9 (tight control of the exchange rate)	$0 < e_1 < 1$
Policy Rule	$i_t = f_1 i_{t-1} + (1 - f_1) (i_t^n + f_2 (\text{inf}_{t+1}^e - \text{inf}^T) + f_3 y g_t) + \varepsilon_i \quad (4)$				
	$f_1$	Lag of monetary policy rate	0.70**	policy persistence, value varies from 0 (no persistence) to 0.8 ("wait and see" policy)	$0 < f_1 < 1$
	$f_2$	Deviation of inflation from potential	1.50**	Measures the weight put on inflation by the policy maker; value has no upper limit but must be always higher than 0 (the Taylor principle)	$f_2 > 0$
	$f_3$	Output gap	0.50**	measures the weight put on the output gap by the policy maker; value has no upper limit but must be always higher than 0	$f_3 > 0$

**Note:**\* the values are obtained from expert judgment (see JVI/IMF Institute (2010)). \*\* the values are obtained from Adebisi and Mordi (2010b)

We assume all exogenous variables follow AR (1) processes (Adebisi and Mordi, 2010). The coefficients of the AR(1) processes are set as follows: persistent shock to risk premium, 0.5; persistent shock to the real exchange rate, 0.8; GDP trends, 0.8; foreign GDP, 0.95; persistence in foreign interest rates, 0.8; speed of inflation

potential adjustment to the medium-term inflation, 0.5 (JVI/IMF, 2010).

The "steady-state" values are calibrated as follows: domestic inflation target, 10.00; foreign inflation target, 2.35; trend level of domestic real interest rate, 10.71; trend change in the real exchange rate (negative number is real appreciation), 5.11; potential output growth, 6.29; and trend level of foreign real interest rate, 1.26 (JVI/IMF, 2010).

The third step is the calibration of shocks, which is done by filling the respective databases with the shocks' values for the start point of the simulation. For simplicity, all shocks are set to 1 per cent. The fourth step is the in-sample forecast, which involves the selection of historical time series for computing the model's forecasting properties. It is essential to identify the start date of the sample, the start date for the first simulation and the end date of the known history.

The last step is the ex-ante (out-of-sample) forecast. In carrying out the out-of-sample forecast, three steps were taken into consideration: (1) obtained initial conditions from the historical data; (2) created forecasts of key equilibrium variables that were exogenous in the model, which included: the inflation target (announced by monetary authorities), potential output, and equilibrium real interest and exchange rates (by smoothing the original series and/or judgment-based assessments); and (3) ran the program to generate the forecasts by simulating the model forward. This was done by reading the model and historical data from the database (JVI/IMF, 2010).

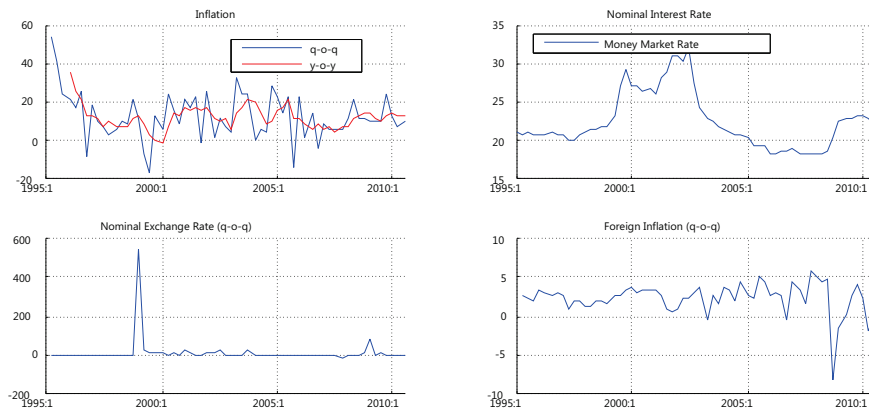
#### **IV. Estimation Results**

A good model is not judged primarily by how well its parameters are chosen or how well the model fits the data. Rather, the adequacy of a model for policy analysis depends significantly on how well it captures the key aspects of the monetary policy transmission mechanism. For example, a good model provides reasonable estimates of: first, how long it takes a shock to the exchange rate to feed into the price level (exchange rate pass-through); second, the amount of output that must be foregone to achieve a given permanent reduction in the rate of inflation (the sacrifice ratio), and three, how the inflation rate responds to the shock in output.

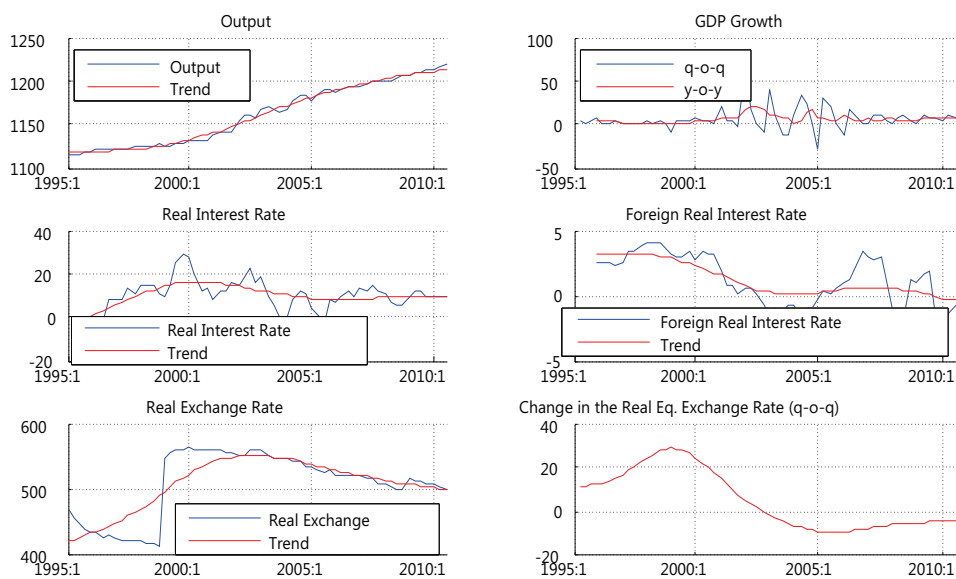
### IV.1 Stylized Facts

Figures 2, 3 and 4 display the nominal, real/trends and gaps variables, respectively. These figures show the trends and behavior of economic variables between 1985:1 and 2010:2. The graphs reflect various changes in economic policies, structural breaks and regime shifts. They also show the difference between actual and potential variables of interest.

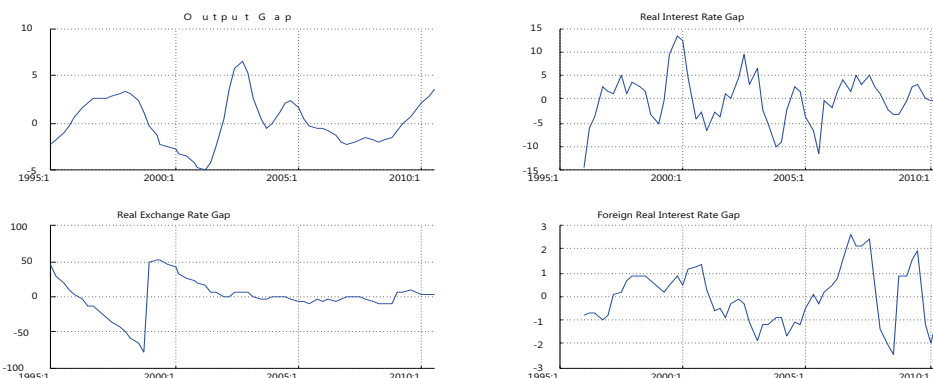
**Figure 2: Stylized Facts - Nominal Variables**



**Figure 3: Real Variables and Trends**



**Figure 4: Gaps**

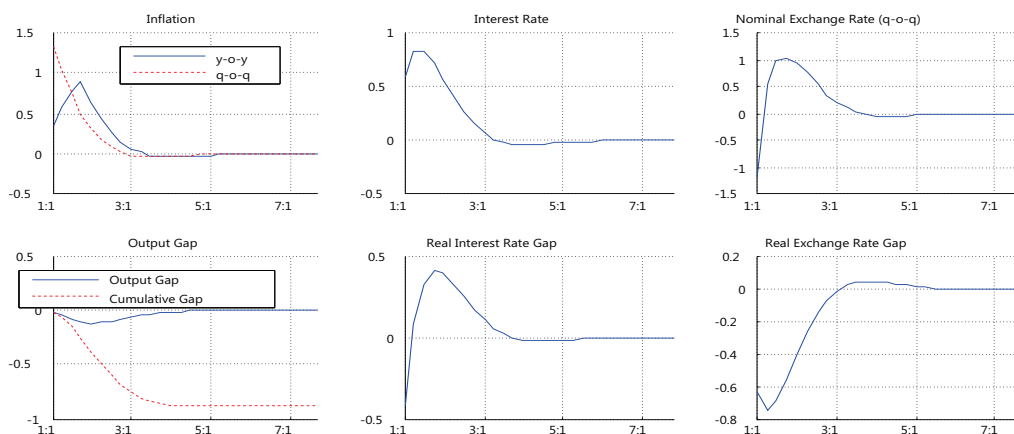


**IV.2 Model Properties- Impulse Response Functions<sup>4</sup>**

**IV.2.1 Response of Inflation and Output to 1% Price shock**

Figure 5 shows the aggregate supply shock and illustrates the dynamic impact of inflation rate on the economy. It indicates that a positive shock to price leads to an increase in inflation rate due to the dynamics of inflation arising from both backward and forward-looking components. An increase in inflation consequently leads to an appreciation of the naira by 1.0 per cent. This causes the marginal cost of imported input to increase, thereby resulting in output reduction and fall in price. The speed of reversion to steady state, arising from the shock, was about four years (16 quarters) for most of the variables.

**Figure 5: Response of Inflation and Output to 1% Price Shock**



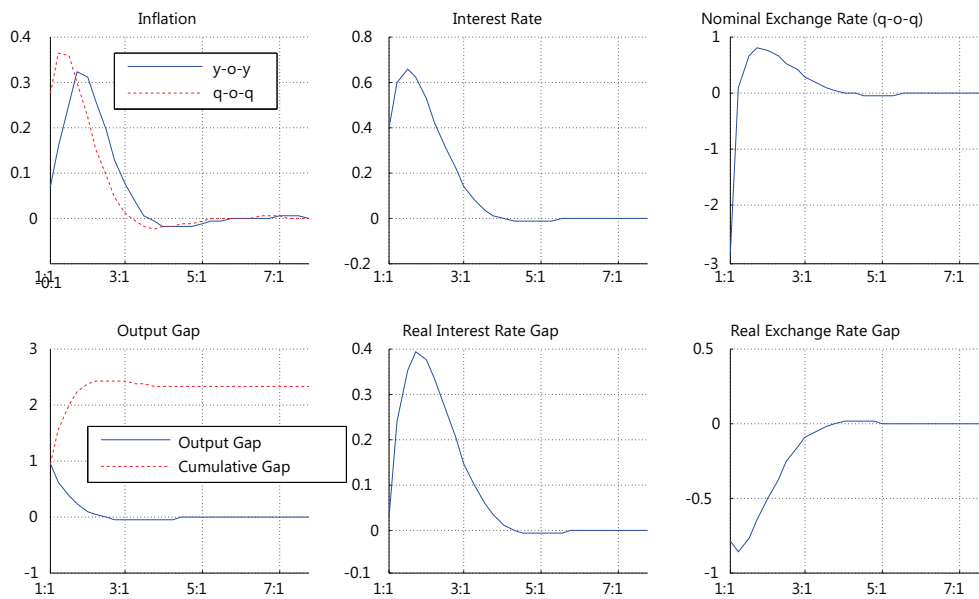
<sup>4</sup>The work benefited immensely from the work of Central Bank of Nigeria (2010), Adebisi and Mordi (2010b)



#### IV.2.2 Response of Inflation and Output to 1% Aggregate Demand shocks

Figure 6 explains the aggregate demand shock. A 1 percent shock to aggregate demand immediately raises the year-on-year inflation by 0.08 percent, through the increase in marginal cost of input (real interest rate) by 0.05 percent, which consequently leads to an appreciation of the currency by 2.5 percent. With aggregate demand shocks, the exchange rate appreciates in response to increased policy rate in the first quarter and thereafter depreciates between year 1, quarter 1 and year 3, quarter 3 before reaching its steady state level in year 4. The erratic exchange rate behavior is due to the forward-looking component. In general, shocks to output generate disequilibrium in the economy which last for about 4 - 5 years before reverting to equilibrium.

**Figure 6: Response of Inflation and Output to 1% Aggregate Demand Shock**



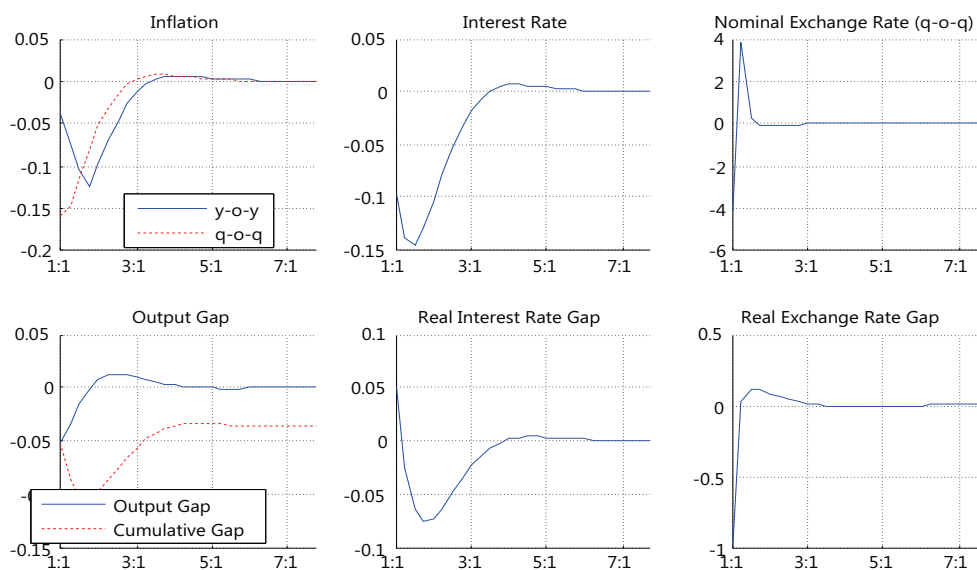
#### IV.2.3 Response of Output and Price to 1% Exchange Rate Shock

As shown in Figure 7, year-on-year and quarter-on-quarter inflation declined by about 0.05 and 0.15 percent, respectively, in the first quarter, while output gap falls by only 0.05 percent over the same period and thereafter rebounds to a value above its potential before it dies off in year 4 quarter 2. The effect of the nominal

appreciation on output is weakened probably due to a smaller decline in domestic inflation relative to foreign ones.

Although this may suggest that a large appreciation may not be harmful to real economic activities, its impact on inflation is quite substantial. This probably reflects Nigeria's trade structure that relies increasingly on large imports of raw materials, refined oil products, and other energy products, in addition to its reliance on intermediate goods for the manufacturing sub-sector. In general, exchange rate shock increases real interest rate, which reduces output and inflation.

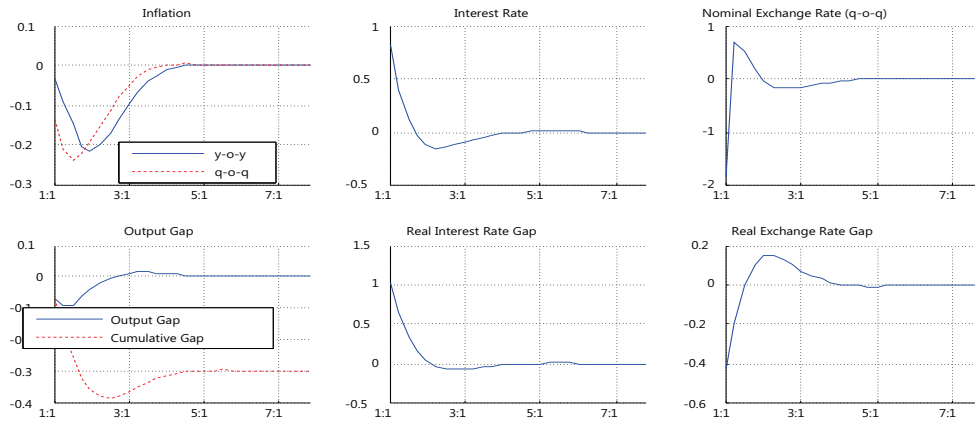
**Figure 7: Response of Output and Price to 1% Exchange Rate Shock**



#### IV.2.4 Response of Inflation and Output to 1% Interest Rate Shock

As shown in figure 8, an unanticipated tightening of monetary policy, by altering the relative returns on domestic assets vis-à-vis foreign assets, induces portfolio adjustments, which results in an appreciation of the Naira. The adjustment in the exchange rate affects inflation directly, given the cost structure of domestic output and the ratio of tradeables to non-tradeables in domestic consumption. This is complemented by the dampening effect of the constraint on aggregate demand, arising from the higher interest rates.

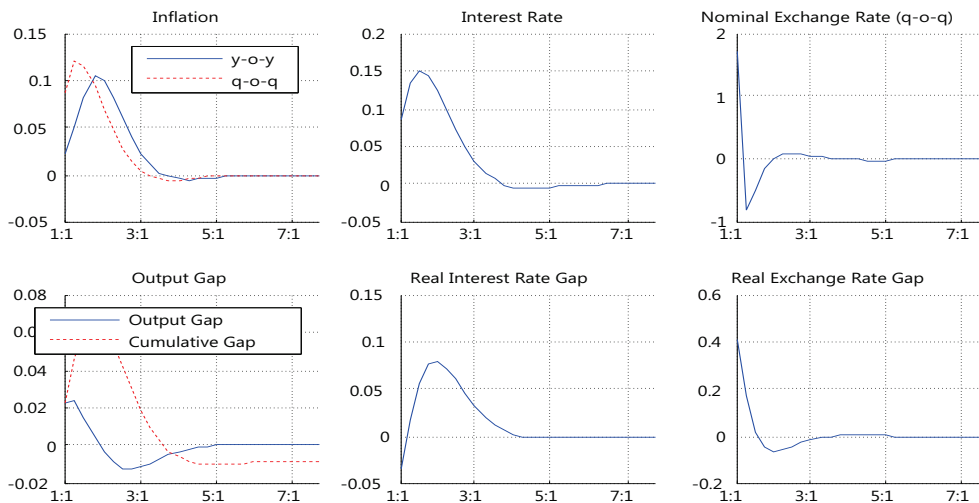
**Figure 8: Response of Inflation and Output to 1% Positive Interest Rate Shock**



**IV.2.5 Response of Output and Price to 1 % Risk Premium Shock**

Figure 9 represents a shock to risk premium, which is explained by the uncovered interest rate parity equation. In the Figure, a positive shock to the risk premium leads to a depreciation of the naira immediately by 1.5 per cent. The depreciation encourages exports and discourages imports, thereby causing an immediate increase in output gap by 0.02 per cent, interest rate by 0.1 per cent and inflation by 0.03 per cent. The speed of reversion to steady state, arising from the shock, was about four years (16-20 quarters) for most of the variables.

**Figure 9: Response of Inflation and Output to 1% Risk Premium Shock**



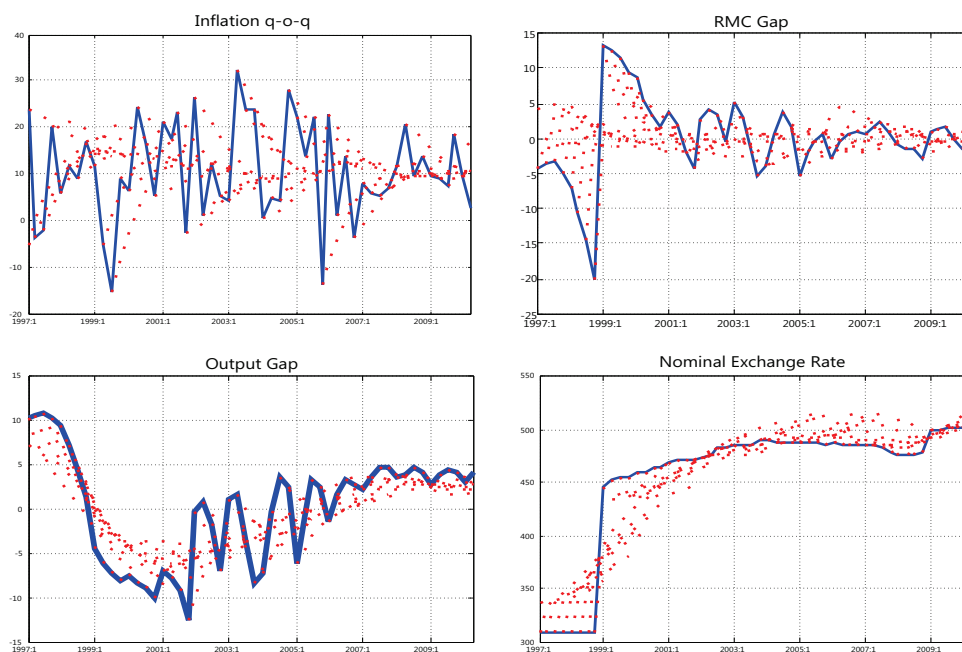
### IV.3 Model Forecast

A model by itself does not make forecast. The forecast comes from some combination of several sources: forecasting models of various sorts, market expectations, judgment of senior policymakers, and, most importantly, interactions with the stakeholders (Berg et. al, 2006). The quality of forecast depends on model parameterization (calibration), data preparation and ex-post (in-sample) simulation.

#### IV.3.1 Recursive (in-Sample) Forecast

Recursive forecasts mean that you run the model for each quarter of the sample. The in-sample forecasts in Figures 10 are done for 8 quarters without the model being updated for actual data, except for the foreign variables (JVI/IMF, 2010).

**Figure 10: In-sample Simulations**



#### IV.3.2 Ex-ante (Out of Sample) Forecasts-Main Indicators

From Table 2, we observe that the inflation forecast converges to the targeted inflation within the transmission period of 8 quarters in 2012 with some initial fluctuation (arising from the unconditional forecast). At this point of convergence,

nominal interest rate was 22 per cent. The most interesting variable was the trajectory of nominal interest rate set by the monetary authority rather than the forecast of the interest rate, which reflects the policy reaction given the past data and model structure. The values of real interest rate and exchange rate gaps show the tightness in the monetary stance to meet the inflation target and the cost of this stance in terms of real economic activities (output).

**Table 2: Forecast- Main Indicators and Decomposition**

		Forecast - Main indicators										
		2009:4	2010:1	2010:2	2010:3	2010:4	2011:1	2011:2	2011:3	2011:4	2012:1	2012:2
CPI	% y-o-y	11.2	11.3	9.8	8.5	4.6	3.2	3.9	5.1	6.5	8.1	9.5
	% q-o-q (AnnualL)	18.9	9.8	2.9	2.5	3.1	4.2	5.7	7.3	8.9	10.3	11.4
Target	% y-o-y	9.5	9.5	9.5	9.8	9.9	9.9	10.0	10.0	10.0	10.0	10.0
Real GDP	% y-o-y	7.1	7.6	7.3	5.7	7.4	9.3	8.9	10.3	9.1	9.1	7.4
	% q-o-q (AnnualL)	5.5	3.4	11.1		12.4	10.9	9.5	8.4	7.6	7.0	6.6
Nominal interest Rate												
Market Rate	%	23.2	23.2	22.7	18.3	16.5	16.4	17.6	19.5	21.5	23.4	23.4
Policy Neutral Rate	%	26.9	19.1	13.1	13.9	15.1	16.5	18.1	19.7	21.1	23.1	
Nominal Exchange Rate												
Naira/Dollar	% y-o-y	21.7	2.1	1.6	3.4	6.8	9.0	11.1	9.6	9.9	11.4	13.5
	% q-o-q (AnnualL)	-2.6	-0.1	0.5	15.8	11.0	8.7	8.6	10.0	12.2	14.7	17.0
	level	150.0	149.9	150.1	156.2	160.5	164.1	167.7	171.9	177.3	183.9	191.9
Risk Premium	% of Exchange Rate	8.3	6.8	5.5	5.0	4.9	4.8	4.7	4.6	4.6	4.5	4.5
Monetary Conditions												
Real Monetary Conditions	%	3.2	8.4	12.0	8.3	6.3	5.5	5.4	5.6	5.9	6.2	6.4
Real Interest Rate Gap	%	-3.7	4.1	9.6	4.4	1.4	-0.1	-0.5	-0.2	0.4	1.3	2.3
Real Exchange Rate Gap	%	-10.1	-12.7	-14.5	-12.3	-11.3	-11.1	-11.3	-11.4	-11.4	-11.1	-10.5
Supply Side Assumptions												
Real Exchange Rate Trend	% q-o-q (AnnualL)	2.7	2.7	2.8	3.2	3.6	3.9	4.1	4.3	4.5	4.6	4.7
Real Interest Rate Trend	%	11.2	11.2	10.9	10.8	10.8	10.8	10.8	10.8	10.8	10.7	10.7
Potential GDP	% q-o-q (AnnualL)	7.1	7.2	7.2	7.0	6.9	6.8	6.7	6.6	6.5	6.5	6.4
		Forecast -Decomposition										
		2009:4	2010:1	2010:2	2010:3	2010:4	2011:1	2011:2	2011:3	2011:4	2012:1	2012:2
External Development												
Foreign Output Gap	%	8.2	8.2	8.1	7.7	7.3	7.0	6.6	6.3	6.0	5.7	5.4
Foreign Inflation	% q-o-q (AnnualL)	4.1	2.3	-2.0	-1.1	-0.4	0.1	0.6	0.9	1.3	1.4	1.6
Foreign Nominal Interest Rate	%	3.3	3.3	3.3	2.8	2.6	2.4	2.4	2.4	2.5	2.6	2.7
Output Gap Decomposition												
Output Gap	%	4.2	3.2	4.2	3.1	4.5	5.5	6.2	6.7	6.9	7.1	7.1
Output Gap Lag	pp	3.3	3.0	2.3	3.0	2.2	3.2	4.0	4.5	4.8	5.0	5.1
Real Monetary Conditions	pp	-0.3	-0.8	-1.2	-0.8	-0.6	-0.6	-0.5	-0.6	-0.6	-0.6	-0.6
Foreign Output Gap	pp	1.0	1.0	1.0	0.9	0.9	0.8	0.8	0.8	0.7	0.7	0.6
Output Gap Decomposition												
Inflation	% q-o-q (AnnualL)	18.9	9.8	2.9	2.5	3.1	4.2	5.7	7.3	8.9	10.3	11.4
Inflation Lag	pp	4.7	11.7	6.1	1.8	1.5	1.9	2.6	3.5	4.5	5.5	6.4
Inflation Expectation	pp	3.7	1.1	0.9	1.2	1.6	2.2	2.8	3.4	3.9	4.3	4.4
Real Marginal Costs	pp	-0.0	-0.5	-0.4	-0.5	-0.1	0.2	0.3	0.4	0.4	0.5	0.6
Interest Rate Decomposition												
Interest Rate	%	23.2	23.2	22.7	18.3	16.5	16.4	17.6	19.5	21.5	23.4	24.7
Interest Rate Lag	pp	16.1	16.2	16.3	15.9	12.8	11.5	11.5	12.3	13.6	15.1	16.4
Policy Neutral Interest Rate	pp	8.1	5.7	3.9	4.2	4.5	5.0	5.4	5.9	6.3	6.6	6.7
Policy Rule	pp	-1.8	-2.6	-2.1	-1.7	-0.9	-0.9	0.7	1.2	1.6	1.7	1.6

The forecast decomposition provides a breakdown of the contributing factors to the forecasts based on the relevant equations. For example, the aggregate

demand (the IS curve) is a function of the past output gap, real monetary conditions, and external demand. These variables are provided in the second block of Table 1 under output gap decomposition. Similarly, the Phillips curve breakdown is enumerated in the third block (inflation factor decomposition).

All these information provide economic facts in analyzing inflation scenarios. For example, it is observed from table 2 that lag of output gap contributes significantly to output gap. The contribution increases from 3.0 per cent in 2010:3 to 5.1 per cent in 2012:2. On the other hand, the contribution of foreign output gap declines from 0.9 per cent in 2010:3 to 0.6 per cent in 2012:2. This implies that the contribution of foreign output to the Nigerian economy declines with time.

Similarly, the decomposition of inflation factor in the Phillips equation shows that the contributions of both the lag of inflation and inflation expectation increase with time. Their contributions increase from 1.8 and 1.2 per cent in 2010:3, respectively to 6.4 and 4.4 per cent in 2013:2.

## **V. Summary, Policy Implications and Conclusion**

DSGE models are powerful tools that provide coherent framework for policy discussion and analysis. In principle, they can help to identify sources of fluctuations, answer questions about structural changes, forecast and predict the effect of policy changes, and perform counterfactual experiments (Berg, Karam and Laxton, 2006). Such features and the rapid advances in the academic literature have attracted the attention of central banks across the globe, some of which have already developed and employed these models for policy analysis and forecasting.

This paper provides an insightful discussion on dynamic stochastic general equilibrium models and show how they could be used as tools for monetary policy analysis. A simplified version of DSGE models is developed to account for the behavior of three key macroeconomic variables, namely: GDP growth, headline inflation, and the monetary policy rate. This model focuses on the nominal interest

rate as the policy instrument and embodies the key principle that the role of monetary policy is to anchor inflationary expectations. It captures most of the channels through which policymakers believe monetary policy acts in a small open economy with a managed floating exchange rate regime.

The main lessons that we learnt from the empirical results are as follows. First, the responses of most of the variables to policy shocks conform to economic theory. For example, a positive shock to price leads to an increase in inflation rate due to the dynamics of inflation arising from both backward and forward-looking components. This shock consequently leads to an appreciation of the naira by 1.0 per cent, which cause the marginal cost of imported input to rise, thereby resulting in output reduction and fall in price.

Second, shocks to most of the variables generate disequilibrium in the economy, which has lasted for about 4 - 5 years before reverting to equilibrium. Third, the out-of-sample forecast indicates that the inflation forecast converges to the targeted inflation within the transmission period of 8 quarters in 2012 with some initial fluctuation and this corresponds with nominal interest rate of 22 per cent.

Fourth, the variance decomposition shows that lags of output, interest rate and inflation rate contribute significantly to their contemporaneous values. For example, the contribution of output lag to its contemporaneous values increases from 3.0 per cent in 2010:3 to 5.1 per cent in 2012:2. However, the contribution of foreign output gap to domestic output declines from 0.9 per cent in 2010:3 to 0.6 per cent in 2012:2. This implies that the contribution of foreign output (i.e. the US output) to the Nigerian economy declines over time.

Fifth, the study highlights the central role of expectations in the transmission of shocks and policy impulses in the model. It shows that the most effective approach to controlling inflation is through the management of expectations in addition to actual movements of policy instruments. Lastly, the findings explicitly reveal how models could help in structuring policy discussion and provide a framework for assessing risks and alternative scenarios.

## References

- Adebiyi, M.A. & C.N.O. Mordi (2010a). Estimating Small Scale Macroeconometric Model (SSMM) For Nigeria: A Dynamic Stochastic General Equilibrium (DSGE) Approach. *EcoMod 2010-International Conference on Economic Modelling*. Istanbul, Turkey, July 7-10, 2010.
- Adebiyi, M.A. & C.N.O. Mordi (2010b). Estimating Small – Scale Macroeconometric Model (SSMM) For Nigeria: A Dynamic Stochastic General Equilibrium (DSGE) Approach. *Central Bank of Nigeria Occasional Paper*, No 39, pp 1-65.
- Berg, A. Karam P. and D. Laxton (2006). "A Practical Model-Based Approach to Monetary Policy Analysis- Overview". *IMF Working paper, WP/06/80*, pp1 - 43.
- Bernanke, B.S., Gertler, M. and Gilchrist, S. (1999). The Financial Accelerator in a Quantitative Business Cycle Framework. In J.B. Taylor and M. Woodford, Eds. *Handbook of Macroeconomics*. Amsterdam: Elsevier.
- Bils, M., and P. J. Klenow. (2004). "Some Evidence on the Importance of Sticky Prices." *Journal of Political Economy* 112, no. 5
- Calvo, G.A. (1983). "Staggered Prices in a Utility-Maximizing Framework", *Journal of Monetary Economics* 12, 383-398.
- Central Bank of Nigeria (2010). Monetary Policy Transmission Mechanism in Nigeria. *Research Department, Central Bank of Nigeria*
- Christiano, Lawrence J., Martin Eichenbaum, and Charles L. Evans (2005). "Nominal Rigidities and the Dynamic Effects of a Shock to Monetary Policy." *Journal of Political Economy*, 113(1): 1–45.
- Christiano (L. J.), Motto (R.) and Rostagno (M.) (2007). *Shocks, Structures or Monetary policies? The EA and US After 2001*, Mimeo, Northwestern University
- Clarida, R., Gali, J. and Gertler, M. (1999). "The Science of Monetary Policy: A New Keynesian Perspective". *Journal of Economic Literature* 37, 1661-1707.
- Dixit, A. K., and J. E. Stiglitz. (1977). "Monopolistic Competition and Optimum Product Diversity." *American Economic Review* 67.
- Eichenbaum, M. and C. Evans (1995). Some empirical evidence on the effects of shocks to monetary policy on exchange rates. *Quarterly Journal of Economics*, 110, 975– 1010.
- Fischer, S. (1977). Long-Term Contracts, Rational Expectations, and the Optimal Money Supply Rule. *Journal of Political Economy* 85, 191-205.
- Ireland, P.N. (2008): Monetary Transmission Mechanism, *The New Palgrave Dictionary of Economics*, Second Edition, 2008, Edited by Steven N. Durlauf and Lawrence E. Blume



- JVI/IMF (2010). An IMF Course on Monetary Policy Analysis (JVIO.16\_MPA), Organised by *Joint Vienna Institute/IMF Institute*, Vienna, Austria, July 26-August 6, 2010.
- Kimball, M.S. (1995). The Quantitative Analytics of the Basic Neo-monetarist Model. *Journal of Money, Credit, and Banking* 27, 1241-1277.
- Kydland, F.E. and Prescott, E.C. (1982). Time to Build and Aggregate Fluctuations. *Econometrica* 50, 1345-1370.
- Laxton, D. and A. Scott (2000). "On developing a structured forecasting and policy analysis system designed to support inflation-forecast targeting (IFT)", in: *Inflation Targeting Experiences: England, Finland, Poland, Mexico, Brazil, Chile* (Ankara: The Central Bank of the Republic of Turkey), 6-63.
- Leeper (E. M.) (1991). "Equilibria under 'active' and 'passive' monetary and fiscal policy", *Journal of Monetary Economics*, 27, p. 129-147
- Lucas Jr., R.E. (1972). "Expectations and the Neutrality of Money", *Journal of Economic Theory* 4, 103-124.
- Mordi, C. N. O. (2009). "Overview of Monetary Policy Framework in Nigeria", *Central Bank of Nigeria Bullion*, Volume 33, Number 1, pp. 1-22.
- Nakamura, E., and J. Steinsson. (2008). "Five Facts about Prices: A Reevaluation of Menu Cost Models." *Quarterly Journal of Economics* 123, no. 4 (November): 1415-64.
- Obstfeld, M. and Rogoff, K. (1995). Exchange Rate Dynamics Redux. *Journal of Political Economy* 103, 624-660.
- Phelps, E.S. and Taylor, J.B. (1977). Stabilizing Powers of Monetary Policy under Rational Expectations. *Journal of Political Economy* 85, 163-190.
- Pongsaparn R. (2008). A Small Semi-structural Model for Thailand: Construction and Applications, *Modeling and Forecasting Team, Monetary Policy Group, Bank of Thailand*. Available at: [http://www.bot.or.th/Thai/MonetaryPolicy/Understanding/Documents/Paper\\_SmallModel.pdf](http://www.bot.or.th/Thai/MonetaryPolicy/Understanding/Documents/Paper_SmallModel.pdf) Working paper No 07/282
- Rotemberg, J.J. (1982). "Sticky Prices in the United States". *Journal of Political Economy* 90, 1187-1211.
- Sahuc (J. G.) and Smets (F.) (2007). "Differences in interest rate policy at the ECB and the Fed: an investigation with a medium-scale DSGE model", forthcoming in the *Journal of Money, Credit and Banking*
- Sargent, T.J. and Wallace, N.(1975). "Rational" Expectations, the Optimal Monetary Instrument, and the Optimal Money Supply Rule. *Journal of Political Economy* 83, 241-254.
- Sbordone, A.M., Tambalotti, A., Rao, K and K Walsh (2010). "Policy Analysis Using DSGE Model: An Introduction". *FRBNY Economic Review* (forthcoming)

Smets, Frank, Wouters, Raf (2003). "An Estimated Dynamic Stochastic General Equilibrium Model for the Euro Area". *Journal of the European Economic Association*, vol. 1, No. 5, September, pp. 1123–1175.

Taylor, J.B. (1993). Discretion versus Policy Rules in Practice. *Carnegie-Rochester Conference Series on Public Policy* 39, 195-214.

Woodford, M. (2003). *Interest and Prices: Foundations of a Theory of Monetary Policy*.

# Global Oil Prices Shocks and the Nigerian External Sector: An Empirical Investigation

**Abwaku Englama, Ph.D, Newman C. Oputa, Ganiyu K .Sanni, Maaji U. Yakub, Oladunni Adesanya, and Zainab Sani**

*Oil price shocks have a stagflationary effect on the macro economy of an oil - importing country. The effect of such shocks is determined by the size of the shock, both in terms of the percentage increase in oil prices and the real price. The dependence of the Nigerian economy on oil makes it susceptible to the vagaries of oil price shocks in the international market. This paper empirically investigated the effects of the cyclical global oil price shocks on Nigeria's external sector using Vector Autoregressive (VAR) model covering the period 2000:Q1 and 2008:Q4. The outcome of the VAR model and Pearson correlation revealed that oil price shocks largely influence the performances of the Nigerian external sector. Reserves (RES) exhibit upward trend right from the first quarter to the sixth quarter. After the sixth quarter it started moving toward the origin. External reserves increased by 0.05 per cent in the third quarter and, thereafter, continued to increase. The positive response of external reserves to oil price shocks persisted in the subsequent quarters. This implies that the level of external reserves was influenced by oil price shocks. However, the response of current account balance to oil price shocks revealed that the current account balance declined by about 0.05 per cent in the eighth quarter and remained negative due to oil price crash in 2008.*

**Keywords:** Oil shocks, Oil prices, External sector

**JEL Classification:** F01, F41

**Authors' e-mail:** [aenglama@cbn.gov.ng](mailto:aenglama@cbn.gov.ng), [ncoputa@cbn.gov.ng](mailto:ncoputa@cbn.gov.ng), [gksanni@cbn.gov.ng](mailto:gksanni@cbn.gov.ng), [muyakub@cbn.gov.ng](mailto:muyakub@cbn.gov.ng), [oadesanya@cbn.gov.ng](mailto:oadesanya@cbn.gov.ng) and [zsani@cbn.gov.ng](mailto:zsani@cbn.gov.ng)

## I. Introduction

Primary commodity producing countries most often face large swings in the price of goods they export. Such fluctuations contribute to increased volatility in their revenue profile which eventually affects the growth of output (GDP). Macroeconomic effects of terms of trade shocks can be very significant in developing countries, as documented by Agenor, et al. (2000). These shocks are major sources of aggregate economic volatility and they have large impact on both private and public savings, in part

---

<sup>1</sup>Abwaku Englama and Newman C. Oputa are Deputy Directors, Ganiyu K .Sanni and Maaji U. Yakub are Principal Economists while Oladunni Adesanya (Mrs.) and Zainab Sani (Mrs.) are Economists in the Research Department.

because of their large income effects (Agenor and Azenman, 2003). They are also associated with global business cycles manifested by sharp volatility in foreign exchange earnings of primary producing economies such as Nigeria. Such developments usually result in macroeconomic instability, inefficient allocation of resources and low output growth.

Oil price shocks have preceded several global economic recessions notably 1974-1975, 1980-1981, 1990-1991, 2001 and 2007-2009. Oil price shocks may have a stagflationary effect on the macro economy of an oil importing country. The effect of such shocks is determined by the size and persistence of the shock, the dependency of the economy on primary products and the policy response of monetary and fiscal authorities (Roubini and Setser, 2004). The sharp rise in the price of crude oil in the past two years has resulted in positive terms of trade to the oil exporters in emerging markets.

Nigeria is the 8<sup>th</sup> largest producer of crude oil in the world and the 6<sup>th</sup> largest producer of natural gas with abundant deposit of solid minerals which are largely untapped, including coal, limestone, marble, columbite, iron ore and gold. The Nigerian economy is largely driven by the external sector, as the share of oil in total exports averaged 92.4 percent between 1990 and 2009. Thus, developments in the global economy such as oil price shocks have serious implications for the economy. In Nigeria, oil receipts constitute more than 75.0 per cent of total revenue, thereby, providing an enormous opportunity for growth. It is evident that at times of high oil prices the accrued revenue promoted higher levels of consumption, which are unsustainable due to the volatile nature of these prices.

Nigeria experienced another oil boom from 2006 – 2008 before the oil price crash, which began in June 2008, among other factors. A major outcome of the boom is an unprecedented growth of stock of external reserves from US\$42.3 billion in 2006 to US\$53.0 billion at end-December 2008 and subsequent appreciation of the nominal average exchange rate of the Naira to N118.53 per US\$1 in 2008 from N132.15 per US\$1 in 2005. The boom and burst cycle of the oil sector have serious implications for Nigeria's external sector viability, which is the main focus of the paper.

The main objective of the paper, therefore, is to analyse the implications of global oil price shocks on the external sector for the period 2000Q1-2008Q4 with a view to drawing policy issues for strengthening the external sector. The rest of the paper is divided into five parts. Part 2 presents the theoretical issues and review of relevant literature. Part 3 analyses the trends in selected external sector indicators. Part 4 focuses on the empirical investigation, while Part 5 highlights the lessons for the Nigerian external sector viability. Part 6 concludes the paper and proffers some policy recommendations.

## **II. Theoretical Background and Literature Review**

No country is immune to unexpected external economic shocks which cause fluctuations in national income, output and employment. The term business or economic cycle refers to economy-wide fluctuations in production or economic activity over several months or years. These fluctuations occur around a long-term growth trend, and typically involve shifts over time between periods of relatively rapid economic growth (expansion or boom), and periods of relative stagnation or decline (contraction or recession). These fluctuations are often measured using the growth rate of real gross domestic product. Despite being termed cycles, most of these fluctuations in economic activity do not follow a mechanical or predictable periodic pattern.

A shock is an event that causes an outcome radically different from what was generally expected. In this respect, the global oil shock could be supply, demand or price shocks. There are two types of shock viz: demand and supply side shocks. External demand shocks arise from the economic difficulties of a country's major trading partners. In other words, it is associated with an economy that is largely driven by external sector. Thus, the recession of a trading partner can have serious impact on aggregate exports and imports and could impact on trading performance of its trading partners.

The transmission mechanisms through which oil prices impact on real economic

activity include both supply and demand channels. The supply-side effects are related to the fact that crude oil is a basic input to production and, consequently, an increase in oil price leads to a rise in production costs that induces firms to lower output. The wider impact of a supply-side shock is similarly dependent on how producers and consumers respond to changing economic circumstances. On the other hand, demand shock is a sudden event that increases or decreases demand for goods or services temporarily. A positive demand shock increases demand and a negative demand shock decreases demand. Change in oil prices also affects demand-side through its effects on consumption and investment and, thus, the disposable income. The presence of demand and supply side shocks require the use of appropriate monetary and/or fiscal policy to actively manage aggregate demand and maintain macroeconomic equilibrium.

Cashin and Pattillo (2000) posits that terms of trade shocks tend to last longer for countries with large shares of petroleum imports in total imports since the duration of oil shocks seems to be larger with small shares of non-fuel commodity exports in total exports (because many non-fuel exports are agricultural commodities, which tend to be subject to short-lived, weather-related supply shocks); and whose exports are highly concentrated in commodities subject to long-lived price shocks. Consequently, a country that is an intensive exporter of non-fuel commodities, is a relatively small-scale importer of petroleum products, and will experience short-lived price shocks. Alternatively, oil-exporting countries will typically experience long - lived shocks to their terms of trade, because oil is subject to long-lived price shocks.

Jin (2008) compared the effects of oil price and real effective exchange rate on the real economic activity in Russia, Japan and China using quarterly data on real GDP, the real effective exchange rate and the international price of crude oil from 1999:01 to 2007:04. The study employed a lag augmented vector autoregressive (LA -VAR), VAR and Vector Error Correction (VECM) models to investigate: oil price shock and exchange rate volatility on economic growth, oil price shocks on real GDP and the short-run dynamics of real GDP. He found that oil price increases negatively impacted economic growth in Japan and China and positively

impacted economic growth in Russia. He further pointed out that an appreciation of the real exchange rate led to a positive GDP growth in Russia and a negative GDP growth in Japan and China.

Ito (2008) tested the effect of oil prices on the Russian economy, particularly real GDP and inflation using the VEC model covering the period between 1997:Q1 and 2007:Q4. The study revealed that a 1.0 per cent increase in oil prices contributes to real GDP growth by 0.25 per cent over the next 12 quarters, whereas that to inflation by 0.36 per cent over the corresponding periods. In addition, the study showed that the monetary shock through interest rate channel immediately affects real GDP and inflation.

On the Philippines economy, Raguindin and Reyes (2005) analyzed the effect of oil price shocks on five key macroeconomic variables: real gross domestic product, consumer price index, real effective exchange rates, real wages and money supply using two sets of vector autoregressive (VAR) models - linear and non-linear oil price specifications. The linear VAR model used oil price measured as the log – first-difference of crude oil price while the non-linear VAR model included separate oil price variables for price increases and decreases. Findings from the linear oil price specification (impulse response) revealed that oil price movements caused significant reduction in aggregate output and increased inflation while the variance decomposition showed that crude oil prices significantly contributed to the variability in real GDP and inflation. On the other hand, the non-linear specifications showed a more persistent contraction in economic activity and worsened inflation.

In analyzing oil price shocks on the Nigerian economy, Omisakin (2008) employed the forecast error variance decomposition from the Vector Autoregressive (VAR) model of seven key macroeconomic variables- real gross domestic product, consumer price index, real oil revenue, real money supply, real government recurrent expenditure, real government capital expenditure and real oil price. Annual data for the periods 1970-2005 were employed in the study. The findings

showed that oil price shocks contribution to the variability in the macroeconomic variables were very minimal. The study also pointed out that the variability in the oil price, apart from its own shock, were explained by output and money supply shocks. Omisakin's work focused more on "internal" macroeconomic variables in order to gauge internal balance. This study is in furtherance to his work as it concentrated on the external sector as a complement to the earlier study.

### **III. Trends in Selected External Sector Indicators**

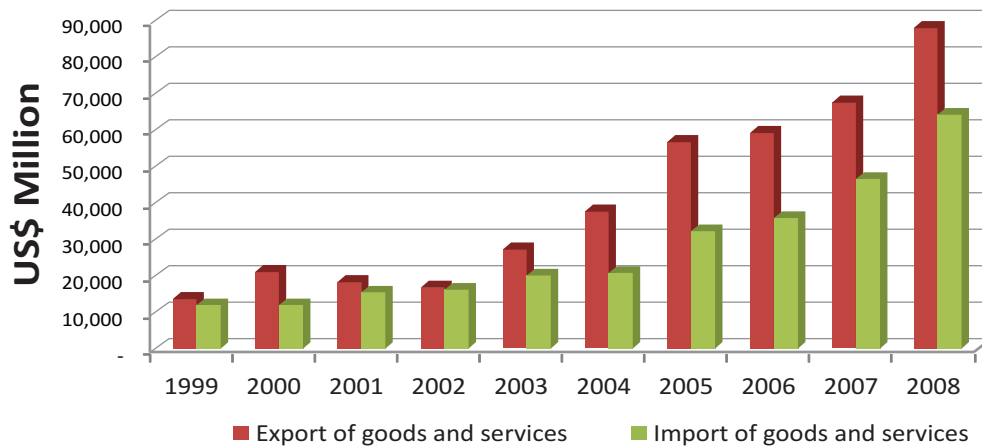
#### **III.1 Developments in the External Sector 1999-2008**

The period 1999-2008 recorded appreciable growth in some of the major external sector indicators such as total trade, overall balance of payments, trade openness, foreign exchange reserves, foreign capital flows, current account to GDP ratio, external debt to GDP ratio, external debt stock, external debt service as well as exchange rate. However, most of the indicators plummeted in 2008 owing to the global financial meltdown.

##### **III.1.1 Total Trade**

Total trade valued at US\$22.22 billion in 1999 rose to US\$26.92 billion in 2004 and to US\$76.46 billion, US\$84.20 billion and US\$102.71 billion in 2005, 2006 and 2007, respectively. Export of goods and services averaged US\$39.39 billion owing largely to the surge in crude oil prices. The aggregate exports of goods and services in 2007 increased significantly over its level in 2006 from US\$61.45 billion to US\$71.46 billion following a rise of 13.08 per cent in crude oil exports in 2007. The development was largely due to increased demand for commodities. Similarly, import of goods and services rose by US\$24.51 billion between 1999 and 2007. During this period, imports analyzed by end-user category, revealed that capital goods and raw materials were the two largest categories closely followed by consumer goods.



**Figure 1: Value of Exports and Imports**

### III.1.2. Overall Balance of Payments

The favourable development in the international oil market relieved the pressure on the balance of payments. In 1999, the overall balance of payments which recorded a deficit of US\$3.547 billion swung to a surplus of US\$3.09 billion in 2000 although the surplus shrank to US\$0.22 billion in 2001. The surpluses turned to deficits in 2002 and 2003. However, the deficits were reversed and the overall balance of payments resulted in surpluses of US\$11.32 billion, US\$14.02 billion, US\$9.04 billion and US\$1.67 billion in 2005, 2006, 2007 and 2008, respectively. This development was largely attributable to the current account surplus reflected in the goods account, particularly oil exports receipts. In addition, invisible inflows particularly home remittances and interest earned on reserves buoyed up the overall balance.

### III.1.3 Trade Openness

The total trade as a percentage of GDP (which measures trade openness) was 8.53 per cent in 1999 but rose to 13.27 per cent in 2002. The huge oil revenue inflows further improved the ratio of total trade to GDP to 71.57 per cent in 2005 although this ratio declined to 61.42 and 56.26 per cent in 2006 and 2007, respectively. However, it increased to 68.0 per cent in 2008 reflecting trade liberalization and integration of the economy into the global market.

### **III.1.4 Foreign Exchange Reserves**

The external reserves at US\$5.4 billion in 1999 rose to US\$7.47 billion, US\$16.96 billion, US\$28.28 billion, US\$42.29 billion, US\$51.33 billion and US\$53.0 billion during 2003 - 2008. The accretion to external reserves was largely due to the improved performance of the oil sector. The number of months of imports cover which averaged 5.0 months during 1986 -1998 rose to an average of 11.6 months during 1999 - 2007 which exceeded the minimum requirement. The buoyant external reserves necessitated the need for an effective external reserve management which influenced the decision of the CBN to allow the deposit money banks to partner with reputable foreign investment managers to manage a portion of the country's external reserves.

### **III.1.5 Current Account**

The current account deficits recorded in 1998 swung to a surplus from 1999 to 2008. The current account surplus as a ratio of GDP was 1.40 per cent in 1999 but rose to 13.7 per cent in 2003. The current account remained impressive owing to positive developments in the international oil market and huge inward current transfers. In value terms, the current account surplus declined from US\$37.23 billion in 2005, to US\$28.57 billion in 2006, rose to US\$31.19 billion in 2007 and further to US\$42.26 billion in 2008.

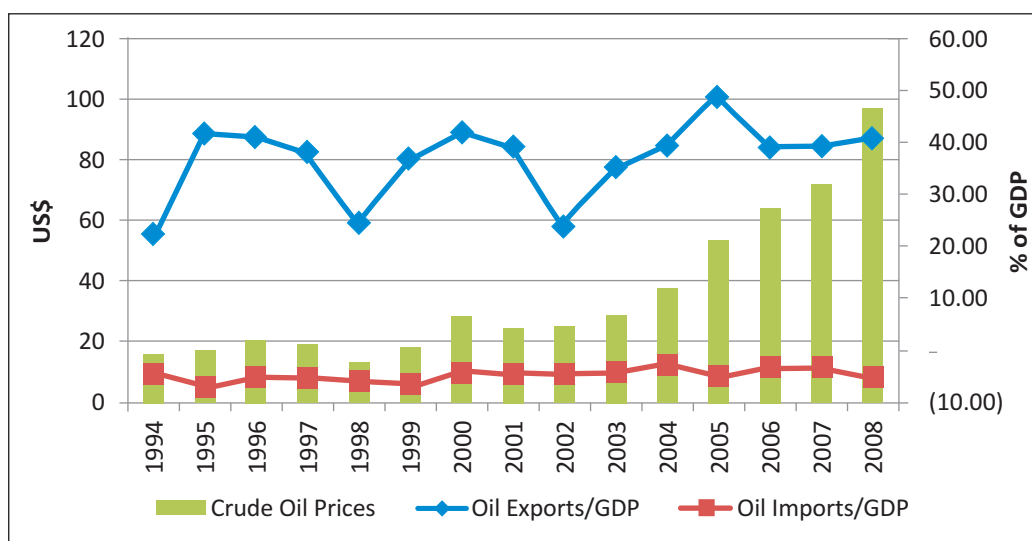
### **III.1.6 Oil Prices Movements and Selected External Sector Indicators**

Oil prices have been found to be more volatile than the prices of any other commodity or asset prices. The recent movement in oil prices can, therefore, be traced to the following factors including the continued crisis in the Middle East, global demand which is influenced by the development in the global scene, emerging markets and developing economies economic growth, supply variations by the members of oil producing countries (OPEC) as well as the crisis in the Niger Delta region of Nigeria. Other factors include gradual erosion of OPEC spare capacity, which incapacitate OPEC to stabilize oil markets and act as a swing producer; shift in the strategy of inventory management by international oil companies - cutting inventories to their lowest level, backwardation (discounting

the value of crude oil in the future); increasing importance of the oil futures market in the current oil pricing system - market expectations about future supply and demand of crude; and deterioration in the quality and timeliness of data on oil-related factors - production and consumption data not ascertained.

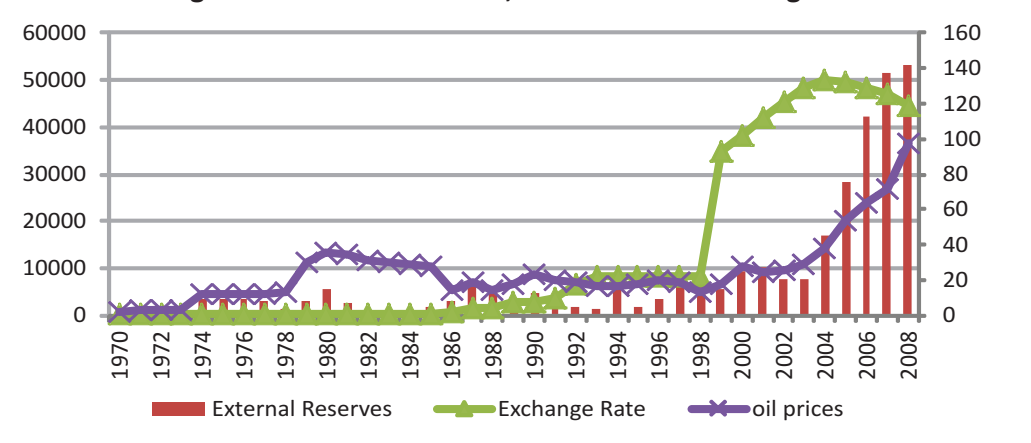
Figure 2 reveals that, the Nigerian economy has continued to be more reliant on oil earnings. The oil prices which were US\$13.5/barrel in 1994 had risen to US\$25.5/barrel in 2000. From 2000 to 2001, oil revenue rose rapidly following increased quota allocation by OPEC, but fell in 2002 as a result of the reduction in OPEC quota. The period 2003 to 2008 witnessed a remarkable improvement in oil revenue due to the persistent rise in the international price of crude oil. From an average price of US\$31.16 per barrel in 2003, crude oil price averaged US\$38.25 per barrel in 2005 and rose to an average of US\$56.97 per barrel in 2006. The price continued its upward trend reaching an average of US\$63.28 per barrel and an unprecedented level of about US\$98.52 per barrel in 2007 and 2008, respectively. This sky-rocketing oil prices was as a result of the energy crisis and increased demand in the industrial countries. Similarly, the figure reveals that, the contribution of oil export to GDP continued to grow from 22.3 per cent in 1994 to 39.8 per cent by 1996, while oil imports to GDP maintained a low level at 4.7 per cent in 1994 and reduced to 3.4 per cent in 2007.

**Figure 2: Crude Oil Prices, Oil Exports and Imports**

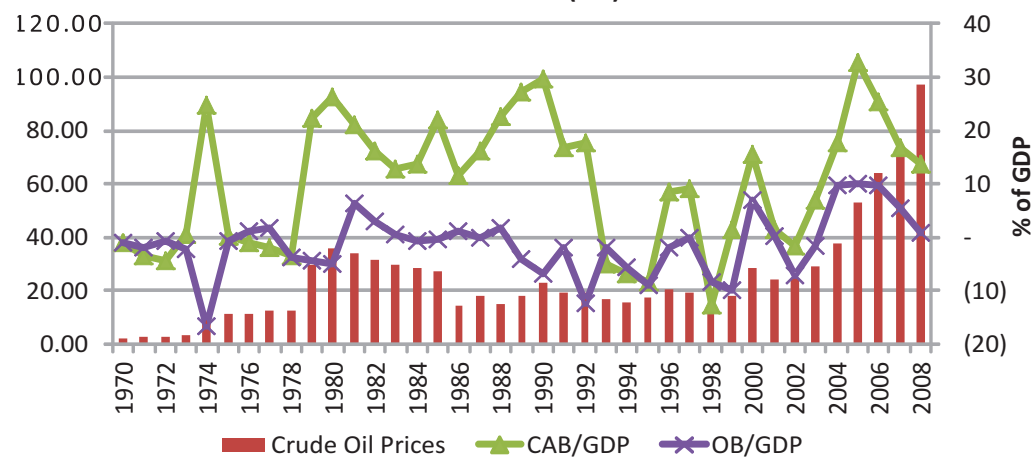


As the international price of crude oil increases, the earnings from crude oil exports increases leading to robust external reserves and subsequent appreciation of the Naira exchange rate (figure 3). Figure 4 indicates that Nigeria's external sector is wholly driven by trends in the movements in oil prices as current account balance and overall balance depicted same trend with oil prices. This lends credence to the vulnerability of the Nigerian economy to oil price shocks. Therefore, for the economy to grow the dependence on oil exports should be substantially reduced.

**Figure 3: External Reserves, Oil Prices and exchange Rate**



**Figure 4: Crude Oil Prices, Current Account Balance (CAB) and Overall Balance (OB)**



## IV. Empirical Study

### IV.1 Methodology

This study empirically investigates the effects of oil price shocks on Nigeria's external sector using the Vector Autoregressive (VAR) model covering the period between 2000:Q1 and 2008:Q4. In order to investigate the effect of oil price shocks on the Nigerian external sector, the study used four variables in their log forms namely: international price of crude oil (OIP), exchange rate (EXR), external reserves (RES) and the current account balance (CAB).

#### IV.1.1 VAR Framework

The time series analysis employed in the VAR framework, as proposed by Sims (1980), can be written as follows:

$$Y_t = k + A_1 Y_{t-1} + A_2 Y_{t-2} + \dots + A_p Y_{t-p} + u_t; u_t \approx i.i.d.(0, \Sigma) \quad (1)$$

where  $Y_t$  is an  $(n \times 1)$  vector of variables,  $k$  is an  $(n \times 1)$  vector of intercept terms,  $A$  is an  $(n \times n)$  matrix of coefficients,  $p$  is the number of lags,  $u_t$  is an  $(n \times 1)$  vector of error terms for  $t= 1, 2, \dots, T$ . In addition,  $u_t$  is independently and identically distributed (*i.i.d*) with zero mean, *i.e.*  $E(u_t)=0$  and an  $(n \times n)$  symmetric variance-covariance matrix  $\Sigma$ , *i.e.*

$$E(u_t u_t') = \Sigma \quad (2)$$

However, if the variables are non-stationary, a vector error correction (VEC) model is generally employed. This is because the VAR in differences contains only information on short-run relationships between the variables. The VEC model developed by Johansen (1988) can be written as follows:

$$\Delta Y = k + \Gamma_1 \Delta Y_{t-1} + \dots + \Gamma_{p-1} \Delta Y_{t-p+1} + \Pi Y_{t-1} + u_t \quad (3)$$

Where  $\Delta$  is the difference operator while  $\Gamma$  denotes an  $(n \times n)$  matrix of coefficients and contains information that reflects the short-run relationships among the variables.  $\Pi$  is an  $(n \times n)$  coefficient matrix decomposed as  $\Pi = \alpha \beta'$ , where  $\alpha$  and  $\beta$  are  $(n \times r)$  adjustment and co-integration matrices, respectively. VAR results are generally analyzed from three standpoints; the regression output, variance decomposition and impulse response functions. The variance decomposition and

impulse response functions provide information about the relative importance of each random innovation in affecting the variables and the effects of a shock to one endogenous variable on the other variables in the VAR respectively. Gujarati (2003) observed that because VAR uses several lags of the variable, each estimated coefficient will not be statistically significant, possibly because of multicollinearity, but, collectively they may be by recourse to F-statistic and R-square.

The choice of measure of oil price shock has been a matter for empirical discourse over the years. The volatility measure is conditional variance of the percentage of the nominal oil price. The conditional volatility of oil price is extracted and modeled as:

$$Z_t = \sigma \boldsymbol{\varepsilon}_t^{(1/2)} h_t; \boldsymbol{\varepsilon}_t \sim iid(0,1) \quad (4)$$

Where

$$h_{t-1} = \pi h_t + \mu_t - NID(0, \sigma^2 \mu) | \pi | \leq 1 \quad (5)$$

The term  $\sigma^2$  is a scale factor and subsumes the effect of a constant in the regression of  $h_t$ .  $\pi$  is a parameter and  $\mu_t$  is a disturbance term that is uncorrelated with  $\boldsymbol{\varepsilon}_t$ .  $\boldsymbol{\varepsilon}_t$  are random disturbances symmetrically distributed about zero. The  $h_t$  equation is a transition equation in the autoregressive form where the absolute value of  $\pi$  is less than unity to ensure that the process is stationary. Thus, equations (4) and (5) represent the stochastic volatility model that generates the conditional volatility of oil price to be used in the VAR.

## IV.2 Empirical Results and Findings

### IV.2.1 Unit Root Tests

The unit root tests employing Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) methodologies were used to test the stationarity of the time series data. Consequently, the ADF and PP tests with and without assumptions of significant drift revealed that all the time series were stationary at first difference (Table 1).

**Table 1: Unit Root Test**

Variables	ADF				PP			
	Without trend		With trend		Without trend		With trend	
	Level	FD	Level	FD	Level	FD	Level	FD
<b>OIP</b>	-1.3222	-3.1639	-2.0325	-2.9856	-1.3811	-2.9065	-2.0019	-2.7785
<b>ER</b>	-2.3318	-3.6489	-1.7731	-3.6651	-2.3134	-3.6679	-1.7855	-3.6600
<b>RES</b>	-0.6531	-3.3420	-1.6651	-3.2432	-0.4104	-3.2111	-1.5331	-3.1016
<b>CAB</b>	2.7825	-5.3636	1.0398	-6.1322	-1.8637	-5.2181	-4.2732	-6.2186

FD=First Difference

McKinnon (1991) Critical Values without trend – 3.6329 (1%), -2.9484 (5%) and -2.6128 (10%)

McKinnon (1991) Critical Values with trend – 4.2528 (1%), -3.5484 (5%) and -3.2070 (10%)

#### IV.2.2 Correlation Matrix Results

The correlation between oil prices, exchange rate, external reserves and current account balance are presented in table 2. The results show that oil price is positively associated with external reserves and current account balance. Therefore, the result of the correlation is in line with the assertion that oil price shocks impact strongly on oil dependent economies.

**Table 2: Pearson Correlation Matrix**

	<b>LOIP</b>	<b>LER</b>	<b>LRES</b>	<b>LCAB</b>
<i>LOIP</i>	1.000			
<i>LER</i>	0.249	1.000		
<i>LRES</i>	0.959	0.254	1.000	
<i>LCAB</i>	0.820	0.333	0.770	1.000

#### IV.2.3 Impulse Response

The estimation of a VAR model requires the explicit choice of lag length. The Akaike Information Criterion (AIC) is used to determine the optimum lag length which selected two lag lengths.

The impulse response functions trace the effect of a one-standard innovation ( $\pm 2$  standard error) to a variable on the current and future values of the other variables. Figure 1 presents the impulse response functions of the VAR model, indicating the impact of oil price shocks on exchange rate, external reserves and current account balance.

##### IV.2.3.1 The Response of International Reserves to Oil Price Shocks

The impulse response of external reserves to oil prices shocks indicated that reserves responded in the same direction with oil prices movement. The variable

reserves (RES) exhibit upward trend right from the first quarter to the sixth quarter. After the sixth quarter it started moving toward the origin. External reserves increased by 0.05 per cent in the third quarter and thereafter continued to increase. The positive response of external reserves to oil price shocks persisted in the subsequent quarters. This implies that the level of external reserves was influenced by oil price shocks.

#### **IV.2.3.2 The Response of Current Account Balance (CAB) to Oil Price Shocks**

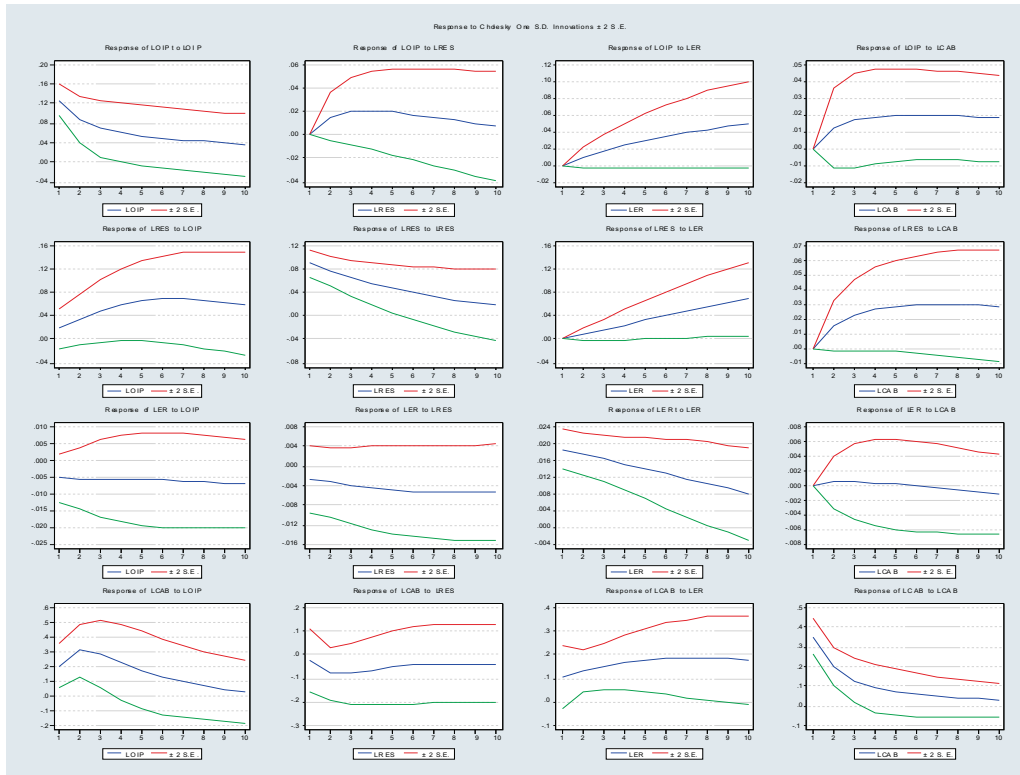
The impulse response of CAB to oil price shocks began from the first quarter. The CAB responded positively to oil price shocks, in a quick fashion, up to the second quarter, before trending down to the origin. The speed of adjustment is one year as the current account position was plunged into deficit after the eighth quarter. In other words, the current account balance worsened by about 0.07 per cent in the eighth quarter. This implies that the current account position reflects developments in the international oil market such that Nigeria attain current account surplus when there was positive terms of trade shocks which corresponded to the period of high prices of crude oil.

#### **IV.2.3.3 The Impulse Response of Exchange Rate to Oil Price Shocks**

The result showed that the exchange rate response to oil price shock in Nigeria was in line with theoretical prepositions. The response of exchange rate was according to expectation, because positive oil price shocks that enhanced foreign exchange inflows resulted in the appreciation of the nominal exchange rate. Thus, a one-standard deviation shock in oil prices led to the exchange rate appreciation of about 0.005 per cent in the second quarter before stabilizing in the fourth quarter and later dampened out in the preceding quarters. This showed that exchange rate responds almost instantaneously to oil price shocks. This outcome reflected the recent experience of Nigeria when the country witnessed huge foreign exchange earnings from crude oil exports for the period of 2006Q1 – 2008Q2 owing to the unprecedented high prices of oil in the global market. However, after 2008Q3, the exchange rate depreciated due to the crash in oil prices from US\$140 per barrel to almost US\$50 per barrel that culminated into lower foreign exchange inflows from oil exports.



**Figure 5: Impulse Response Function (IRF)**



**IV.2.4 Variance Decomposition Interpretation**

The variance decomposition analysis is presented in Table 3:

**Table 3 Oil Price Variance Decomposition**

Period	SE	OIP	ER	RES	CAB
1	0.12	100.00	0.00	0.00	0.00
2	0.15	98.14	0.34	0.94	0.56
3	0.17	95.26	1.20	2.12	1.40
4	0.18	92.09	2.59	3.06	2.24
5	0.19	88.89	4.44	3.67	2.98

**Exchange Rate Variance Decomposition**

Period	SE	OIP	ER	RES	CAB
1	0.01	7.10	91.12	1.77	0.00
2	0.02	7.71	89.84	2.40	0.03
3	0.03	8.14	88.61	3.18	0.05
4	0.03	8.59	87.29	4.04	0.05
5	0.03	9.16	85.85	4.93	0.05

### External Reserves Variance Decomposition

<i>Period</i>	<i>SE</i>	<i>OIP</i>	<i>ER</i>	<i>RES</i>	<i>CAB</i>
<b>1</b>	0.09	3.92	0.00	96.07	0.00
<b>2</b>	0.12	9.45	0.38	88.76	1.39
<b>3</b>	0.15	16.81	1.39	78.65	3.13
<b>4</b>	0.17	24.03	3.02	68.31	4.62
<b>5</b>	0.19	29.94	5.20	59.11	5.73

### Current Account Balance Variance Decomposition

<i>Period</i>	<i>SE</i>	<i>OIP</i>	<i>ER</i>	<i>RES</i>	<i>CAB</i>
<b>1</b>	0.42	23.45	6.19	0.26	70.08
<b>2</b>	0.58	40.51	8.27	1.99	49.22
<b>3</b>	0.68	46.99	10.87	2.82	39.29
<b>4</b>	0.74	48.71	13.97	3.15	34.16
<b>5</b>	1.19	48.27	17.34	3.26	31.11

The oil price variance decomposition analysis revealed that the variation in oil price, apart from its own shock is explained to some extent by external reserves. In the fifth period, oil price accounted for 88.8 per cent while external reserves accounted for about 3.6 per cent. Exchange rate contributed 2.5 and 4.4 per cent to the variation in oil price in the fourth and fifth periods, respectively. Current account balance contributed 2.2 and 2.9 per cent in the fourth and fifth periods, respectively. The variance decomposition of exchange rate is largely explained by itself which accounted for 85.8 per cent in the fifth year and by oil price which contributed 9.1 per cent to the variation in exchange rate in the fifth period.

Variations in external reserves are largely explained by itself and variations in oil price. In the fifth period, external reserves accounted for 59.1 per cent while oil price accounted for 29.9 per cent in the variance decomposition of external reserves. Finally, the variations in current account balance, apart from its own shock which accounted for 31.1 per cent in the fifth period is explained by oil price. In the fifth period, oil price shocks contributed 48.2 per cent to variations in the current account balance. This indicates that oil price shocks significantly affects Nigeria's terms of trade.

## V. Policy Implications and Lessons for the Nigerian Economy

The results of the VAR model and Pearson correlation have shown that oil price

shocks largely influence the performances of Nigeria's external sector proxied by current account balance, exchange rate and external reserves. For instance, a one-standard deviation shock to the oil price led to an exchange rate appreciation of about 0.01 per cent in the second quarter and this revealed that exchange rate responded almost instantaneously to oil price shocks. The external reserves also increased by about 0.05 per cent in the third quarter and thereafter continued to increase due to the oil price shocks. However, the response of current account balance to oil price shocks revealed that the current account balance declined by about 0.05 per cent in the eighth quarter.

This finding is complemented by the result of the Pearson Correlation analysis which indicated a strong positive relationship between these variables and oil prices. The implication of these results therefore is that unless something is done very quickly to reduce the high dependence on oil, the Nigerian economy will remain susceptible to the vagaries of oil price shocks in the international market. The lesson from this analysis is that the viability of the external sector is contingent upon developments in the global oil market and unless the inflows from the oil exports are judiciously utilized on pro-poor programmes that are in line with the Millennium Development Goals (MDG), growth in the economy may be depressed and the poverty level heightened.

## **VI. Conclusion and Recommendations**

The paper has shown that the viability of the external sector is largely dependent on the developments in the oil sector. This has been empirically proven by the results of the VAR model complemented by Pearson correlation analysis. In order to reduce the dependence on oil there is need to use the petro-dollar receipts to develop infrastructure which has been the bane of the poor performances of the non-oil sector. Provision of adequate infrastructure will also encourage the inflows of foreign capital to bridge the financing gap required for optimal output growth.

**References**

- Agenor, P. R. and J. Aizenman (2003): "Savings and the Terms of Trade under Borrowing Constraint", *Journal of International Economics* 63.
- Agenor, P. R., C. J. McDermott, E. Prasad, (2000). "Macroeconomic Fluctuations in Developing Countries: Some Stylized Facts". *World Bank Economic Review* 14, 251-286.
- Cashin, P. and C. Pattillo (2000): "The Duration of Terms of Trade Shock in Sub-Saharan Africa". *Finance and Development*, June 2000 Vol. 37 No. 2
- Collier, P (2008): "Oil, Growth and Governance in Nigeria" in Collier P, Soludo C. C and Pattillo C. (ed.) "Economic Policy Options for a prosperous Nigeria" Palgrave Macmillan, Basingstoke, UK
- Gujarati, D. (2003): "Basic Econometrics", McGraw Hill, 4th Edition
- Ito, K. (2008): "Oil Price and the Russian Economy: A VEC Model Approach" *International Research Journal of Finance and Economics - Issue 17*
- Jin, G. (2008): "The Impact of Oil Price Shock and Exchange Rate Volatility on Economic Growth: A Comparative Analysis for Russia, Japan and China", *Research Journal of International Studies - Issue 8*
- Johansen, S. (1988). "Statistical Analysis of Cointegrating Vectors", *Journal of Economic Dynamics and Control*, Vol. 12, pp. 231-254.
- Krugman, P. R. and M. Obstfeld (1999): "International Economic Theory and Practice". Addison Wesley Longman Inc. 3rd Edition
- MacKinnon, J. G. (1991): "Critical Values for Cointegration Tests" Chapter 13 in R. F. Engle and C. W. J. Granger (eds), *Long-run Economic Relationships: Readings in Cointegration*, Oxford, Oxford University Press
- Roubini, N. and B. Setser (2004): "The Effects of the Recent Oil Price Shock on the U.S. and Global Economy". Paper presented at the Stern School of Business, New York University
- Omisakin, A. O. (2008): "Oil Price Shocks and the Nigerian Economy: A Forecast Error Variance Decomposition Analysis", *Journal of Economic Theory* 2(4): 124-130

Olomola, P. A. (2006): "Oil Price Shock and Aggregate Economic Activity in Nigeria" *African Economic and Business Review* Vol. 4 No. 2, Fall 2006

Raguindin, M. E. and R. G. Reyes (2005): "The Effects of Oil Price Shocks on the Philippine Economy: A VAR Approach". Paper presented at the University of the Philippines School of Economics

Sims C. A. (1980): "Macroeconomics and Reality", *Econometrica*, Vol. 48, pp. 1-48.



# Measuring Competition in the Nigerian Banking Sector

Ozoemena Nnaji, Ph.D\*

---

This paper investigates the impact of banking sector consolidation on competition in the Nigerian banking sector. The study evaluates the degree of competition using *H-statistic* proposed by Panzar and Rosse (1987), and bank level data from Bankscope to measure the degree of competition before and after consolidation in the Nigerian banking sector. It was concluded that while consolidation marginally improved competition, more needs to be done to further improve competition in the sector. *This finding suggests that policy makers should continue to provide level playing field for all participants while simultaneously working to promote stability concerns to support private sector activities and economic growth in the country.*

---

**Keywords:** Bank Competition; Banking Sector Consolidation, Nigerian Banking Sector

**JEL Classification:** N26, G21

**Author's e-mail:** [osnnaji@cbn.gov.ng](mailto:osnnaji@cbn.gov.ng)

## I. Introduction

A major trend in the international financial markets in the last decade is financial sector liberalization. This is based on the general realization that protected market and the associated market power, created by protection, is too costly for the local economy. The growing tendency was to favour market mechanisms or regulatory liberalization and legislative authorities to reap the efficiency gains associated with liberalization. One of the outcomes of the financial sector reform is banking consolidation. Academics and policy makers seem to unanimously accept the view that financial institutions play a crucial role in the effective functioning of modern economies. Thus, suggesting that higher degree of competition in the sector is crucial for financial intermediation and economic growth. A competitive banking sector will be more efficient in terms of allocating funds, more especially in operating as an intermediary between depositors and borrowers. There have been considerable concerns about how ongoing consolidation in financial systems around the world will affect competition. Indeed, much of the recent public debate seems to assume that perfect competition in banking is ideal and should be pursued.

---

\* Ozoemena Nnaji is an Economist and Special Assistant to the Deputy Governor, Economic Policy, Central Bank of Nigeria

Competition in the banking sector has been at the crux of policy debates on financial stability. As in other sectors, competition is usually seen as necessary for an effective banking system as it affects the efficiency and the quality of services offered in the industry. Furthermore, competition in banking has implications for other sectors of the economy. Thus, higher competition in the banking sector is found to be associated with a faster growth of other sectors of the economy that rely on external financing (Claessens and Laeven, 2003). This is because banks advance credit or loans to both firms and consumers and an uncompetitive banking sector will lead to under-provision of such credit. Competition in the banking sector will promote the efficiency required to create a fully functional credit system, and according to the competition-stability theory, will help improve the stability of the system. In addition, Deidda and Fattouh (2002) find that high concentration in banking is negatively related to industrial growth in low-income countries but not in high-income ones, suggesting that emerging economies need a relatively more competitive banking sector in order to promote growth.

Banks are service industries. They contribute to economic growth not by producing real goods, but by providing the financial services to facilitate production in other industries. An efficient banking sector will make the largest contribution to economic growth. Banks, like other firms, sell products to consumers, thus the need to worry about the efficiency implication of a non-competitive banking sector. Banks also act as conduits for monetary policy transmission mechanism; a low level of competition in the banking sector may hinder the effectiveness of the conduct of monetary policy as banks may not respond appropriately to monetary tightening and/or easing (Van Leuvensteijn, et al, 2008).

There is ample evidence in the economic literature that competition in the financial sector is a good thing and should be encouraged. However, the view that competition in financial services is unambiguously good is a naive assumption as recent events in the US<sup>1</sup> have called this assumption to question. Empirical

---

<sup>1</sup>Many have argued that the global financial crisis which started in the United States and spread around the world was as a result of liberalization and deregulation in the US financial system. The policy debate in policy circle even in emerging economies is the issue of financial stability and ways of safeguarding their financial system.



evidence has also cautioned against excessive competition in the financial sector on the ground that it could lead to instability. Specific to the financial sector is the effect of excessive competition on financial stability, long recognized in theoretical and empirical research and, most importantly, in the actual conduct of (prudential) policy towards banks. It has been shown, theoretically and empirically, that the degree of competition in the financial sector has implications (negatively or positively) for access of firms and individual households to financial services, and in turn overall economic growth. Therefore, competition has to be considered as part of a broad set of objectives, including financial sector efficiency, access to financial services for various segments of users, and systemic financial sector stability, the possible trade-offs among these objectives. And since competition depends on several factors, one has to consider a broad set of policy tools when trying to increase competition in the financial sector. Thus, the role of policy in striking a balance between competition and stability especially in an emerging market like Nigerian becomes very important. While the goal of stability should be the foremost objective of policy makers, competitive policies should not be ignored. The objective of this paper is to evaluate the degree of competition in the Nigerian banking sector and the contribution of the recent banking sector consolidation in improving competition in the sector.

The rest of the paper is organized as follows: Section II reviews the literature on competition theory in the banking sector. Section III presents an overview of the Nigerian banking sector. Section IV elaborates on theoretical model of Panzar and Rosse (1987) and some empirical evidence generated from their model. It presents the data and the empirical model used in the analysis and the estimation results of the H-statistic for the pre- and post-consolidation periods. Section V summarizes the paper with some concluding remarks.

## **II. Literature Review**

Recent events have opened up debates on the role of market competition on the banking sector. The common consensus is that restraining competitive forces in

the banking sector would produce welfare losses and should be avoided. Majority opinion are of the view that banks with monopoly power would exercise their ability to extract rents by charging higher loan rates to businesses and paying depositors lower deposit rate. This will affect growth through many channels including distortion or entrepreneurial incentive. There is a huge spread between lending and deposit rates in the Nigerian financial market suggesting a monopolistic banking structure<sup>2</sup>. By charging higher loan rate, banks in effect distort entrepreneurial incentives.

In general, in a competitive environment, only the most efficient and innovative firms survive, therefore, ensuring that the industry remains healthy and that firms pass on the benefits of competition and innovation to their customers. In the financial sector, there might be instances in which competition may have a negative impact on stability, as the least efficient firms may have an incentive to increase their risk in order to reach the industry profitability level. However, the Nigerian financial sector is far from this scenario.

A number of methodological approaches have been used to investigate banking competition. These can be divided into two: the Traditional Industrial Organization Theory and the New Empirical Industrial Organizational Approaches. Within the traditional method is the structure-conduct-performance (SCP) theory originated by Mason (1939) and further popularized by Bain (1951). These models postulate that market structure affects the behavior of firms in the market and hence, their performance. It argues that higher concentration in banking markets causes less competitive bank conduct and leads to higher bank profitability, or lower deposit rate in the deposit market. Although, this approach was criticized for taking market structure as given, it dominated competitive analysis until the 1970s when Demsetz (1973) developed the efficiency Structure theory. The X-efficiency model argued that the positive relationship between market concentration and profitability does not hold because of market power, but is a consequence of the greater efficiency

---

<sup>2</sup>See data from the Financial Market Dealers Association of Nigeria, [www.fmda.com.ng](http://www.fmda.com.ng).

of firms with the largest market share. Banks with superior management and/or production technologies enjoy higher profits and as a result, have more market share. Alternatively, some banks may produce at more efficient scales than others in their industry, leading to higher profit and higher market concentration. Some empirical studies have found evidence supporting the efficiency hypothesis (See Berger, et al. 1995).

The SCP and X-efficiency theories formed the basis for the structural models used in the measure of bank competition today from which the Contestable theory is derived from. The contestable market theory was developed by Baumol, Panzar and Willig (1982). They defined a contestable market as one in which entry and exit is free and costless. The market structure is determined explicitly and simultaneously by output and prices. Whatever industry structures that minimize total cost for the equilibrium output vector must be the only structure consistent with the industry equilibrium in the long run. This theory offers analytical methods for empirical research in banking competition. Panzar and Rosse (1987) presented a reduced form revenue approach using bank level data to distinguish between market structures. The PR methodology investigates the degree of competition by examining the extent to which changes in factor inputs are reflected in equilibrium industry or bank-specific revenues.

In summary, the literature on the measurement of competition can be broadly divided into two branches: the (non-formal) structural approach and the (formal) non-structural approach. The structural approach centers on the Structure-Conduct-Performance paradigm (SCP) or the efficiency hypothesis, according to what they assume to be the main reason for superior market performance. For the SCP, the collusive behavior among large firms due to a highly concentrated market is the main driver of market over performance. On the other hand, the efficiency hypothesis, implicitly assumes the presence of economies of scale through which large firms achieve increased efficiency and improved performance. Thus, if a firm is more efficient than the rest (e.g., due to a lower cost structure) it could gain market share by reducing prices (Molyneux and Forbes, 1995) and hence, market structure is endogenously shaped by firms' performance

so that concentration is a result of the superior efficiency of the leading firms (See Vesala, 1995).

Other offshoots of the approach that is designed to measure the degree of competition introduced by Bresnahan (1982), Iwata (1974) exist and are often referred to as the conjectural variations approach. This method is based on the idea that a bank when choosing its output takes into account the "reactions" of rival banks. Thus, it investigates the degree of competition by examining the conjectural elasticity of total banking industry output to a variation in the output of bank  $i$ - the perceived response of industry to a change in the quantity of a specific bank. Empirical research has used this approach and a discussion of the Panzar and Rosse model is presented below.

New developments in industrial organization and the refinement of formal models of imperfectly competitive markets, as well as the realization of the need to endogenize market structure have led recent empirical work to rely increasingly on non-structural models. In particular, the application of the SCP in the banking literature has been criticized for the one-way causality (from market structure to market performance) that the original model imposed. There are three main non-structural models proposed in the literature: Iwata's (1974), Bresnahan's (1982) and Panzar and Rosse's (1987) models. Of these, Iwata's model has not yet been applied to the banking industry, due to the lack of micro data needed for empirical estimation. Empirical applications of Bresnahan's model are also relatively scarce for developing countries. There are a number of papers that apply this model to the Latin American banking sector. Variations of Bresnahan's conjectural variation approach find competitive markets in Colombia (Barajas, et al, 1999), Brazil (Nakane, 2001) and Argentina (Burdisso, et al., 2001).

The basic idea is that profit-maximization firms in equilibrium will choose prices and quantities such that marginal costs equal their marginal revenue. This will coincide with the demand price under perfect competition and industry's marginal revenue under perfect collusion. This measure varies between full market power to perfect competition at the extreme spectrum.

Many studies have been conducted using different methods to find the level of competition in the banking sector of numerous countries across the world. Most studies applied the Panzar and Rosse approach. Perera, et al. (2006) used the Panzar and Rosse approach on some developing Asian countries including Bangladesh, India, Pakistan and Sri Lanka and found the banking sector in Bangladesh, India and Pakistan to be monopolistic or monopolistic competitive with H- statistics of 0.68, 0.64 and 0.48, respectively. The banking sector in Sri Lanka was, however, found to be more of a competitive structure with H-statistic of 0.71. Additionally, Claessens and Laeven (2003) applied the Panzar and Rosse method on fifty countries around the world, of which thirty one are developing countries (including Nigeria). The result of the Panzar and Rosse H-statistic from the study showed that most developing countries' banking sectors feature between the range of monopolistic and monopolistic competitive structure<sup>3</sup>. Using this method for the Jordanian banking sector and data from 1994 to 2006, Demirguc-Kunt and Martinez-Peria (2010) found that the banking sector in Jordan had become more monopolistic due to greater evidence of market power and, hence, a lower degree of competition in that country's banking sector as the number of banks reduced.

### **III. Banking Sector Performance after Consolidation**

The Nigerian banking system has undergone remarkable changes over the years, in terms of the number of institutions, ownership structure, as well as depth and breadth of operations. These changes have been induced largely by challenges posed by deregulation of the financial sector, globalization of operations, technological innovations and adoption of supervisory and prudential requirements that conform to international standards. As at end-June 2004, there were 89 deposit money banks operating in the country, comprised of institutions of various sizes and degrees of soundness. Structurally, the sector was highly concentrated, as the ten largest banks account for about 50 percent of the industry's total assets/liabilities (see IMF 2008 article IV report on the Nigeria Banking sector).

---

<sup>3</sup>Also see Buchs and Mathise and Claessens and Laeven (2003)

Most banks had capitalization of less than US\$10 million, with the largest bank having a capital base of about US\$240. The small size of most of the banks, each with expensive headquarters, separate investment in software and hardware, heavy fixed costs and operating expenses, and with bunching of branches in few commercial centers, led to a very high average cost for the industry. This in turn has implications for the cost of financial intermediation, the spread between deposit and lending rates, and exerts undue pressures on banks to engage in unethical practices as means of survival. Industry analysts were of the opinion that most of the banks were not engaged in strict banking business of financial intermediation; rather, they resorted to quick-business kind of deals and ignored the main function of financial intermediation (e.g. foreign exchange dealings, lending the oil imports, etc.).

**Table 1: Indicators of Banking Performance after Consolidation<sup>o</sup>**

	Pre-Consolidation	Post-Consolidation
Number of Banks	89	24
No. of Branches	3382	4500
Total Asset of Banks (US\$ billion)	24	51.1
Loan to Deposit Ratio	85	98
Cash Reserve Ratio	59	61
Capital Requirements (Naira billion)	5	25

**Source:** Annual Report of the Banking Supervision Department, Central Bank of Nigeria

<sup>o</sup> Based on 2009 data

The sector was marred by a lot of challenges, including, weak corporate governance, evidenced by high turnover in the Board and management staff, inaccurate reporting and non-compliance as well as regulatory requirements (as evidenced by the CBN forensic investigation done on in 2009 which resulted in the sack of management staff from 9 banks).

Based on this, the Central Bank of Nigeria (CBN) embarked on the consolidation of the banking system that reduced the number of banks from 89 to 25 and raised the capital requirement from N5 to N25 billion. 19 of the banks emerged through mergers and acquisition among 69 banks, while 6 of the banks raised additional capital to meet the new capital requirement. Majority of the banks were under

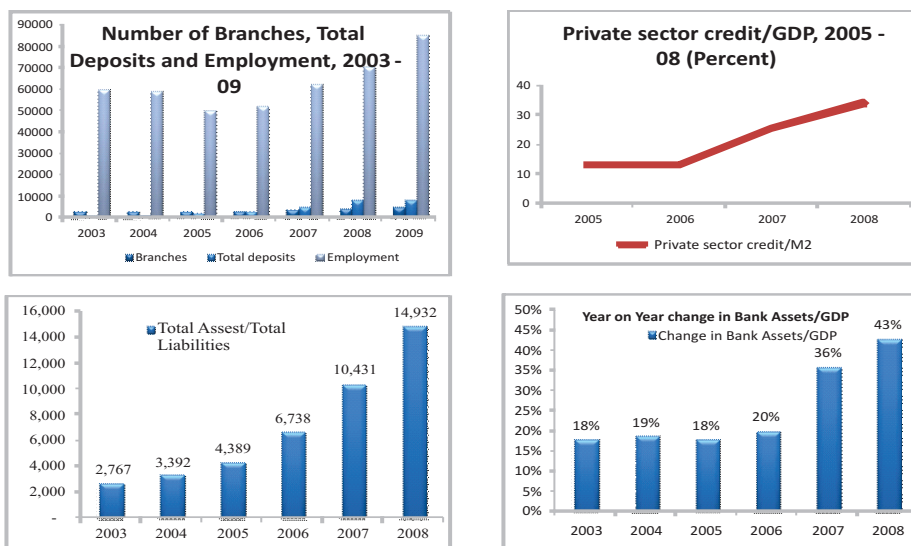
private domestic ownership with the exception of 3 foreign-owned banks operating in the country (Citibank, Stanbic and Standard Chartered). Following the consolidation, banks' balance sheets expanded, most of them venturing into universal banking and expanded cross-border transaction into other African countries, United States and Europe. Credit to the private sector equally increased and all other developmental indicators of the banking sector increased as a result of the consolidation exercise. Financial sector depth (measured by M2/GDP ratio) and intermediation into the private sector (measured by credit to the private sector/GDP) increased substantially (See Table 2 and Figure 1).

**Table 2: Indicators of Financial Development in Nigeria, 2004-2009**

	M2/GDP	Private Sector Credit/GDP	Total NPL	M1/M2
2004	19.8	21	21.9	32
2005	19.3	22	21.6	29
2006	19.8	21	18.2	25
2007	28	31	8.76	20
2008	37	37	6.3	16
June 2009 <sup>4</sup>	44	40	6.6	18

Sources: CBN data and IMF FSI database, 2009

**Figure 1: Financial Development Indicators from Nigerian Banking Sector**



Sources: CBN Annual Reports, various years, author's estimate

<sup>4</sup>Signs of distress in the banking sector are already starting to show as the second round effect of the financial crisis affected the balance sheet of some of the banks.

Credit extension boomed and private sector activities boosted economic growth, underpinned by buoyant oil and non-oil commodity prices<sup>5</sup>. There was a reduction in net interest rate margins driven mainly by reduction in large corporate business and a reduction in Treasury bill rates. Banking sector profitability also declined. Return on assets (ROA) and return on equity (ROE) declined suggesting a more competitive and efficient system.

The banks expanded their balance sheet by more than 60 percent as public confidence in the sector bolstered, evidenced by the increase in deposits. As a result of this growth in the balance sheet and larger capital base, banks were under intense pressure to utilize the funds to provide adequate return to shareholders. The banks established subsidiaries and extended credits in new areas that were previously off limit because of the level of funds required<sup>6</sup>. The banks funded large ticket items that they were not able to fund under the previous capital base. They moved into new untapped areas, banking the unbanked and expanded branch networks. The number of bank branches increased from about 3000 to about 5134 by mid-2009. The ratio of non-performing loans to total loans declined from 18.1 percent post-consolidation to 6.2 at the peak in 2008 and 8.36 in mid-2009 (See Table 2). What happened to competition in the sector?

#### **IV. The Panzar and Rosse Analytical Framework**

In this paper, Panzar and Rosse's (PR) approach is used, which has the advantage of using bank specific data and, therefore, allows control for variables of interest such as size and foreign ownership. The Panzar and Rosse (1977), expanded by Panzar and Rosse (1982) and Panzar and Rosse (1987) methodology uses firm level (bank level) data. It investigates the extent to which a change in factor input prices is reflected in (equilibrium) revenues earned by a specific bank. Specifically, the P-R H statistics is calculated using reduced form of bank revenue equations and measures the sum of the elasticities of the total revenue of the bank with respect to the bank's input prices.

---

<sup>5</sup>The global financial crisis and the subsequent decline in the global food and fuel prices have tempered the growth prospects and prompted the Central Bank to intervene in some banks to maintain financial stability.

<sup>6</sup>Areas such as oil exploration, infrastructure and construction



According to the Panzar-Rosse methodology, it is not just the size of the H-statistics that matters, but its magnitude as well. Under a monopolistic structure, an increase in input prices  $P$  will increase marginal cost, thus reducing equilibrium output  $y^*$  and revenue, thereby implying that the H-statistics value be less or equal to zero. In contrast, in a perfectly competitive setting in the long-run, an increase in input prices  $P$  will increase marginal cost as well as average costs by the same proportion, without under certain assumption changing the equilibrium output of banks. As inefficient banks are forced to exit the market, the increased demand faced by the remaining banks leads to an increase in output prices and revenues in the same proportion as costs, thus implying a H-statistics value of unity. In the case of monopolistic competition, an increase in input prices  $P$  will lead to a less than proportional increase in revenue as the demand for bank loans is inelastic. In this case, H-statistics will lie between 0 and 1.

**Table 3: Interpretations of the Panzar and Rosse's H-statistic**

Values of H-statistics	Implied Market Structure
$H \leq 0$	Monopoly Colluding oligopoly, conjectural variations of oligopoly
$0 < H < 1$	Monopolistic Competition
$H = 1$	Perfect Competition Natural monopoly in a perfectly contestable market

The PR approach has been used in several studies that test competition for the European banking industry and emerging markets' banking sector (Buchs and Mathisen, 2005; Claessen and Leaven, 2003). More recently, the approach has also been applied to emerging markets' banking system and in large cross country studies<sup>7</sup> (Table 4 presents a survey of the main results using this approach).

The test is derived from a general banking model which determines equilibrium output and the equilibrium number of banks by maximizing profits at both the bank level and the industry level. Two critical implications exist for this equilibrium model. The first is that at the bank level, profit maximization is assumed

<sup>7</sup>For example see Claessens and Leaven (2003) used the model to study competition in 50 countries including Nigerian banking system before banking consolidation.

$$R^i(y_i, k, v) - C^i(y_i, f_i, q_i) = 0 \quad (1)$$

$R^i$  is the marginal revenue function,  $C^i$  is the marginal cost function  $y_i$  is the output of bank  $i$ ,  $k$  is the number of banks and  $v_i$  and  $q_i$  are exogenous variables that shift the bank's revenue and cost function while  $f_i$  is a vector of bank  $i$ 's factor input prices. All of the variables are expressed in log form. This also implies that the zero profit constraint holds at the industry level.

**Table 4: Studies that Applied Panzar Rosse Model to Banking Industry**

Author	Period	Banking sector Studied	Results
Shafer (1982)	1979	New York	Monopolistic competition
Nathan and Neave (1989)	1982-84	Canada	Perfect Competition (1982); monopolistic completion (1983-1984)
Lloyds-William et al (1991)	1986-88	Japan	Monopoly
Molyneux et al. (1994)	1986-89	France, Germany, Italy, Spain, UK	Monopoly (Italy); Monopolistic competition (France, Germany, Spain and UK)
Vesala (1995)	1985-92	Finland	Monopolistic competition
Bikker and Groeneveld (2000)	1989-96	EU- 15 countries	Monopolistic competition
Coccoresse (1998)	1988-96	Italy	Monopolistic competition
Rime (1999)	1987-94	Switzerland	Monopolistic Competition
De Brandt and Davis (1999)	1992-96	France, Germany, Italy	Large banks: Monopolistic competition in all countries; Small Banks: Monopoly in France and Germany and Monopolistic competition in Italy.
Jiang, (2004)	1992-2002	Hong Kong	Monopolist competition
Claessens and Leaven (2004)	1994-2001	50 industrialized and developing countries	Monopolistic competition (with larger countries having tending to have lower competition)
Buchs and Mathisen (2005)	1989-2003	Ghana	Monopoly
Pasadila and Milo (2006)	1995-99	Philippines	Large banks: Monopolistic competition; Small banks perfect competition
Greenberg and Simbanegavi (2009)	1992-2007	South Africa	Large Bank: perfect competition; Small banks: Monopolistic competition

**Source:** Claessens and Laeven, 2005, Perera (2006) and author's compilations

Thus the H-statistic is formulated as:

$$H = \sum_{i=0}^n \left( \frac{\partial R}{\partial f_i} \frac{f_i}{R_i} \right) \quad (2)$$

The intuition behind the interpretation of H-statistic rest on economic theory, which

explains how income or revenue reacts to changes in input prices for different market structure. Under monopolistic competition, the change in input prices is greater than the change in revenue, thus H-statistic is expected to be smaller than one but greater than zero. Under perfect competition, the change in input prices leads to an equal change in revenue, therefore H-statistic is expected to be equal to one (see Table 3 above). The P-R method shows that large H values imply a continuous measure of competition.

Two approaches, the “production approach” and the “intermediation approach” have been used in empirical literature in measuring banking sector competition. In this paper, the intermediation approach, which classifies deposits and loan as inputs and output, respectively, is used.

#### IV.1 The Empirical Model

Following Bikker and Haaf (2002), the reduced form revenue model is as follows:

$$\ln(Rit) = \alpha + \beta_1 \ln UPL_{it} + \beta_2 \ln UPF_{it} + \beta_3 \ln UPC_{it} + \gamma \ln RC1_{it} + \gamma \ln RC2_{it} + \delta \ln CUSDEP_{it} \quad (3)$$

where  $R_{it}$  is the ratio of gross interest revenue (or total revenue) to total assets (proxy for output price of loans),  $UPL_{it}$  is the ratio of personnel expenses to total assets (proxy for input price of labor),  $UPF_{it}$  is the ratio of interest expenses to total deposits (proxy for input price of deposits), and  $UPC_{it}$  is the ratio of other operating and administrative expenses to total assets (proxy for input price of equipment/fixed capital). We also include a set of exogenous and bank-specific variables that may shift the revenue schedule. Specifically,  $RC1_{it}$  is the ratio of non-performing loans, and  $RC2_{it}$  is the ratio of net loans to total assets and  $CUSDEP_{it}$  is the ratio of customer deposit to total deposits. All of these variables are in logs, with the coefficients representing their respective elasticities. Based on the model above, the H-statistics can be represented as the sum of:

$$H = \beta_1 + \beta_2 + \beta_3 \quad (4)$$

This measure is based on the idea that competitive firms are price takers and must pass through cost changes to customers, while monopoly can vary output to

maximize profit in the face of higher input prices.

#### **IV.2 Data Description and Definition of Variables**

Annual individual bank level data from Bankscope of 19 out of the 24 deposit money banks (DMBs) in operation from 2000 to 2008 was used. Some banks were dropped due to data unavailability as some of the banks did not exist as an entity prior to the banking consolidation exercise. Given that the data used in the study is from the same industry, operating in the same environment, a common effect model was chosen for the estimation presented in the paper. A panel unbalanced regression was run on pooled cross-section of the 19 banks. All variable used in the regression are in logged form. Specifically, the variables are defined as follows:

$$UPL = \frac{\text{Total Expense}}{\text{Total Assets}}$$

$$UPF = \frac{\text{Interest Expense}}{\text{Total Deposits}}$$

$$UPC = \frac{\text{Other Expense}}{\text{Fixed Assets}}$$

$$RC1 = \frac{\text{Non Performing Loans}}{\text{Total Loans}}$$

$$RC2 = \frac{\text{Net Loan}}{\text{Total Assets}}$$

$$CUSTDEP = \frac{\text{Total Customer Deposits}}{\text{Total Deposits}}$$

The H-statistic test is defined as the sum of the elasticities of equation (3) with respect to input prices (that is, the linear combination of the coefficients ( $\beta_1 + \beta_2 + \beta_3$ ), which are presented along with their joint standard error (SE). In order to test whether there has been a statistically significant increase in competition, the results of the estimation for the pre- consolidation and post-consolidation periods are presented alongside each other with a Wald test of equality of the H-statistics for the two periods. Hausman test suggested that there were no bank-specific

effects, as all banks were operating in the same environment.

### **IV.3. Estimation Results**

The estimation result shows that while consolidation slightly improved the competitive nature of the banking system under the Panzar-Rosse model, the system was not overly competitive. The H-statistics lie between 0 and 1 (see Table 5). Before consolidation, the H-statistics ranged between .45 and .56 depending on the variable included in the study. However, the post-consolidation H-statistics ranged from 0.52 to 0.62, suggesting that consolidation slightly increased competition in the Nigerian banking system, but not to an unhealthy level. This is just with a limited time data after the exercise. A longer term data may likely find higher competition ratio than is currently reported. Consolidation moved the Nigerian Banking sector further in the monopolistically competition region.

This market structure is consistent and similar to what is obtained in similar markets. Studies of the Ghanaian and Kenyan banking sector suggest that they too have H-statistics of .56 and .58 respectively (see Buchs and Mathisen, 2005; Claessens and Laeven, 2003). However, the South African banking sector was found to be more competitive than the Nigerian banking sector, with H-statistics of .75 for all banks and .97 for large banks. Consolidation improved competition slightly allowing banks to perform the important intermediation function of credit extension and other services that promoted economic activities and ultimately growth but not without some imperfection in the system.

The coefficients of the unit prices of labor, capital and funds are all positive, implying the increased factor cost leading to higher revenue for banks. The unit price of labor (UPL) is statistically significant in all specifications with comparable positive elasticities. This suggests that personnel costs are as important as overhead costs, which are relatively high in Nigeria. The over-head cost of the banks operating in Nigeria are relatively high as they have to provide services like power and security, services that are normally public goods provided by the government.

---

<sup>8</sup> See Greenberg and Simbanegavi, (2004) "Testing for Competition in the South African Banking Sector"

The dilapidated state of infrastructure is hampering the competitive nature of the banking system.

The unit cost of funds (UPF) is significant in all specifications and has a higher impact on interest revenue than other revenue in the post-consolidation period, probably reflecting the better market responsiveness of the present system. The unit cost of fixed assets (UPC) is a determinant of total revenue, but not of total interest revenue, which may be partly explained by the importance of private money transfers and investment costs (e.g., in ATMs and branches), that were incurred during the period, for which revenues are fee-based.

The non-performing loans ratio (RC1) has a statistically significant positive effect both in the pre-consolidation and post-consolidation period, although the magnitude in post-consolidation is smaller, suggesting that while progress is being made in the cleanup of non-performing loans, more needs to be done in that regard to improve competition in the system.

**Table 5: Empirical Results of the Panzar-Rosse Model for the Nigerian Banking Sector**  
**Regression results**  
**Sample Period: 2000 2004**      **Sample Period: 2004 2008**

Independent Variables	Before Consolidation Total Revenue/Total Assets			Dependent Variables			
	1	2	3	1	2	3	4
Constant	-.159 (-.49)	-	-	.462* (1.99)	-	-	-
UPF	.311** (5.80)	.322** (6.37)	.328** (6.45)	.270** (5.98)	.301** (6.60)	.302** (6.62)	.290** (6.17)
UPL	.102* (1.30)	.132** (2.94)	.123** (2.84)	.111* (1.84)	.193** (4.19)	.191** (4.18)	.206** (4.27)
UPC	.080* (1.04)	.085* (1.11)	.072 (2.93)	.143** (2.69)	.115** (2.02)	.112** (2.02)	.125** (2.23)
RCI	.056* (1.78)	.056* (1.77)	.060* (1.78)	.024* (1.11)	.028* (1.22)	.028* (1.22)	.023 (.977)
RC2	.259** (2.49)	.272** (2.68)	.278** (2.70)	.266** (3.69)	.296* (4.02)	.300** (4.24)	.275 (3.53)
CUSTDEP	-.37719 (-.65)	-.349 (-.60)	-	.037 (.278)	.031 (.229)	-	.036 (.27)
AR(1)	.309 (1.64)	.339* (1.81)	.382** (2.15)	.275** (2.14)	.340** (2.71)	.351** (2.86)	.32** (2.51)
Size							-.057 (-.82)

H-statistics	.493	.521	.523	.524	.609	.605	.621
<b>Market Structure Wald Test</b>							
<b>Test for H=0</b>	Reject at 5%	Reject at 5%	Reject at 5%	Reject at 5%	Reject at 5%	Reject at 5%	Reject at 5%
F-Test	(P=0.00)	(p=0.00)	(p=0.00)	(p=0.00)	(p=0.00)	(p=0.00)	(p=0.00)
<b>Test for <math>0 \leq H \leq 1</math></b>	Not Reject	Not Reject	Not Reject	Not Reject	Not Reject	Not Reject	Not
Reject	at 5%	at 5%	at 5%	at 5%	at 5%	at 5%	at 5%
F-Test	(p=.5803)	(p=.3765)	(p=.6023)	(p=.5808)	(p=.6032)	(p=.3790)	(p=.7099)
<b>Test for H=1</b>	Reject at 5%	Reject at 5%	Reject at 5%	Reject at 5%	Reject at 5%	Reject at 5%	Reject at 5%
F-Test	(p=0.00)	(p=0.00)	(p=0.00)	(p=0.00)	(p=0.00)	(p=0.00)	(p=0.00)
Adjusted R <sup>2</sup>	.777	.775	.773	.681	.662	.662	.665
DW Statistics	1.52	1.53	1.46	2.22	2.25	2.25	2.26
Number of Observations	38	38	38	72	72	72	72



## **V. Conclusion**

Competition is as important in banking as in any other industry. Competition has implications for efficiency, innovation, pricing, availability of choice, consumer welfare, and the allocation of resources in the economy. The functions of the banking system, including providing a payments and settlements system, mechanisms for borrowing and lending, and pooling and allocation of funds, among others, impinge on all aspects of the economy and are central to the overall performance of the economy. The efficacy of the financial system in performing these functions is a major ingredient of the efficacy of the economy as a whole. Given the pivotal role of banking in an economy, the role of competition in this industry is particularly important. Banks are important for economic development. Therefore, it is imperative that the banking sector faces a reasonable level of competition. This will both help to create a fully functioning credit system as well as strengthen the effectiveness of monetary policy. Banks contribute to economic growth not by producing real goods, but by providing the financial services to facilitate production in other industries. A competitive and efficient banking sector will make the largest contribution to economic growth.

This paper has used the P-R methodology to test for the level of competition in the Nigerian banking sector, before and after banking consolidation exercise. The study suggests that consolidation improved competition only slightly and that competitive policies should continue to remain a focus of policy objective in the Nigerian financial sector to promote economic growth and to create an inclusive financial sector that is able to perform its intermediation functions.

## References

- Bain, J.S. (1951), "Relation of profit ratio to industry concentration: American manufacturing 1936-1940", *Quarterly Journal of Economics*, Vol 65, pp. 293-324
- Baumol, W. J., J.C., Panzar, and R. Willig, (1982) "Contestable markets: An uprising in the Theory of industry structure." *American Economic Review* 73(3), pp. 492-496.
- Barajas, A., R. Steiner, and N. Salazar (1999)." Interest Rate Spreads in Banking in Colombia", 197496. *IMF Staff Papers* 46, 196224.
- Beck, T.; A. Demirguc\_Kunt, and R. Levine (2000), "A New Database on Financial Development and Structure". *World Bank Economic Review*, Pp 1-5.
- Berger, A. N., A. K. Kashyap, and J. M. Scalise (1995), "The Transformation of the U.S. Banking industry: What a long strange trip it's been. ", 2:55-218.
- Bikker, J. A. (2003) "Testing for imperfect competition on EU deposit and loan market with Bresnahan's market power model" *Research Series Supervision*, 52.
- Bikker, J., and K. Haaf, (2001), "Measure of Competition and Concentration." A Review of the Literature. *De Nederlandsche Bank Research Supervision Studies*, No. 27.
- Bikker, J., and K. Haaf (2002), "Competition, Concentration and their Relationship: An Empirical Analysis of the Banking Industry." *Journal of Banking and Finance*, Elsevier, 26(11):2191-2214.
- Black, S. and P. Strahan (2000), "Entrepreneurship and the Structure of the Banking Industry," mimeo
- Bresnahan, T. F. (1982) "The Oligopoly solution is identified" *Economies Letters*, 10:53-89
- Bonaccorsi Di Patti, E., and G. Dell'Arizza, (2000), "Bank competition and firm creation," mimeo.
- Buchs, T and J. Mathisen (2005), "Competition and Efficiency in Banking: Behavioral Evidence from Ghana." *IMF Working Paper: WP/05/17*
- Burdisso, T., M. Catena and L. D'Amato (2001) "Banking Competition in Argentina: 1997-1999" *Central Bank of Argentina Working Paper Number 20*.
- Cetorelli, N. (1999), Competitive Analysis in Banking: An Appraisal of the Methodologies. *Economic Perspectives*, 2-15
- Cetorelli, N., (2001), Does bank concentration lead to concentration in industrial sectors?" *Federal Reserve Bank of Chicago, working paper*, No. WP-2001-01.
- Claessens, S. and L. Laeven (2003), "What Drives Bank Competition? Some International Evidence. *World Bank Policy Research Working Paper* 3113.
- Claessens, S. and L. Laeven (2004), "What drives bank Competition? Some

- international Evidence" *Journal of Money, Credit and Banking* 36:563-583.
- Claessens, S. and L. Laeven (2005), "Evidence Financial Dependence, Banking Sector Competition, and Economic Growth" *World Bank Working Paper WPS 3481*.
- Deidda, L. and B. Fattouh (2002), "Concentration in the Banking Industry and Economic Growth, CRENO's Working Paper, No. 2.
- Dell'Ariccia, G. 2000, "Learning by lending, competition, and screening incentives in the Banking industry," *International Monetary Fund working paper*
- Demsetz, H. (1973) "Industry Structure, Market Rivalry and Public Policy." *Journal of Law and Economics* 16(1):1-9.
- Demirgüç-Kunt, A. and M. S. Martinez Peria (2010). "A Framework for Analyzing Competition in the Banking Sector: An Application to the Case of Jordan". Policy Research Working Paper, World Bank, Washington, DC
- Duncan, D. (2003), "Testing Competition in the Jamaican Banking Sector: Evidence from Bank Level Data. Financial Stability Unit- Bank of Jamaica.
- Greenberg, J. B. and W. Simbanrgavi (2009), "Testing for Competition in South African Banking Sector." *University of Cape Town, Commerce and Economics Working-Paper, 2009*
- Gula, J (1999), "Deregulation, Integration and Market Structure in European Banking." *Journal of Japanese and International Economies*, 50(5):372-396.
- Iwata, G. (1974), "Measurement of Conjectural variations in Oligopoly." *Econometrica*, 42:947-966.
- Hellman, T., K. Murdock, and J. Stiglitz (2000) "Liberalization, moral hazard in banking, and prudential regulation: Are capital requirements enough?" *American Economic Review*, 90:147-165.
- Jayarathne, J., and P. Strahan (1996), "The finance-growth nexus: Evidence from bank branch deregulation," *Quarterly Journal of Economics*, 111:639-670.
- Lau, L. (1982), "On Identifying the Degree of Competitiveness from Industry Prices and Output Data." *Economics Letters* 10:93-99.
- Mason, E.S. (1939), 'Price and production policies of large-scale enterprise', *American Economic Review*, Vol 29, pp 61-74.
- Molyneux, P. and W. Forbes (1995), "Market Structure and Performance in European Banking," *Applied Economics*, Volume 27, Pp. 155-159.
- Nakane, M.,(2001) " A Test of Competition in Brazilian Banking". *Working Paper Series 12*. Brasilia, Brazil: Banco Central do Brazil.
- Nathan, A and E. Neave, (1989), "Competition and Contestability in Canada's Financial System: Empirical Analysis; *Canadian Journal of Economics* 22(3):576-594.
- Pagano, M., (1993), "Financial markets and growth. An overview," *European Economic Review*, 37:613-662.
- Panzar, J. and J. N. Rosse (1977), "Chamberlin vs Robinson: an empirical study for

- monopoly rents" *Bell Laboratories Economic Discussion Paper*
- Panzar, J. C. and J. N. Rosse (1992), "Structure, conduct and comparative statistics", *Bell Laboratories Economic Discussion Paper*
- Panzar, J. and J. N. Rosse (1987), "Testing for Monopoly Equilibrium." *The Journal of Industrial Economics*. 35(4):443-456.
- Perera, S., M. Skully, M., and J. Wickramanayake (2006). Competition and Structure of South Asian Banking: A Revenue Behavior Approach. *Applied Financial Economics* 16, 789-901.
- Schaffer, S. (1982), "Non-Structural Test for Competition in Financial Markets". Bank Structure and Competition Conference Proceedings, *Federal Reserve Bank of Chicago* 225-243.
- Schaffer, S. (1994), "Bank Competition in Concentrated Markets." *Business Review* March/April: 3-16.
- Van Leuvensteijn, M.; C. Kok-Sorensen; J. Bikker and A. van Rixtel (2008), "Impact of Bank Competition on the Interest Rate Pass-Through in the Euro Area." *Working Paper Series*, No. 885- European Central Bank.
- Vesala, J., 1995. Testing competition in banking: Behavioral evidence from Finland, *Bank of Finland Studies*, E: 1, Helsinki. Vives, X., 2001. Competition
- Vives, X. (2001), "Competition in the Changing world of Banking" *Oxford Review of Economic Policy* 17:535-547.
- Zhu, M. (2008), "Revisiting Banking Competition in Developing and Transition Economies." University of Birmingham.

# Empirical Investigations of Agricultural Export Trade in Nigeria (1975 - 2008): A Case Study of Cocoa and Palm Kernel

**Daramola Dare Samuel\***

*The study examined the export performance of two major agricultural commodities (cocoa and palm kernel in Nigeria). It covered the periods 1975 to 2008 and it adopted cointegration and error correction modeling (ECM) methodology. The time series data were obtained from the Central Bank of Nigeria (CBN), National Bureau of Statistics (NBS), Food and Agricultural Organisation (FAO) for the empirical work. Unit root and cointegration tests were conducted which revealed the existence of short and long term equilibrium relationships between the dependent and independent variables in the model. The parsimonious error correction result shows that, virtually all the variables were rightly signed and significant. The result showed that, a 1% increase in producer price, commercial loan to Agriculture and exchange rate will reduce export quantities of cocoa by 0.11, 0.23 and 0.8 per cent respectively, while the result of palm kernel are almost similar to that of cocoa. The empirical findings show that, there is the need to promote expanded production in both cocoa and palm kernel, while at the same time giving greater attention to the packaging and the design of export product to command better prices and patronage at the international market.*

**Key words:** Agricultural Export, Economic Reform, Cointegration, ECM

**JEL Classification:** C12, C32, C50, F14, F40, O40, Q10.

**Author's E-mail:** [dreh\\_s2004@yahoo.com](mailto:dreh_s2004@yahoo.com)

## I. Introduction

In spite of the current dominance of the petroleum sector in Nigeria's economy, agriculture remains a major source of economic survival and sustenance. Agriculture's contribution to the nation's food supply, raw materials export, savings and investment and general price stability have been critical for economic growth since independence. In many developing countries, including Nigeria, agriculture accounts for the largest proportion of total labour employment and, where it is export-oriented it is also a vital source of foreign exchange.

However, the agricultural sector in Nigeria, both in terms of its contribution to import

---

\*Daramola Dare Samuel is a NYSC member of the Macroeconomic Modelling Division of the Research Department, Central Bank of Nigeria. The author is grateful to Dr. M. A. Adebisi, Deputy Director, Mr A. O. Adenuga, Assistant Director and Mr. M. O. Abeng, Senior Economist of the Macroeconomic Modelling Division, Research Department, Central Bank of Nigeria for their helpful assistances and guidance.  
For a discussion of the Nigerian experience see Orubu, (2002)

and export earnings, has recorded persistent declines, occasioned largely by policy neglect and the lack of access to international market. On the other hand, the petroleum sector recorded decline in term of its contribution to GDP since the early 1980s, while agriculture and the informal sector activities have sustained the economy's productive capacity.

Agricultural export trade in Nigeria was expected to be a major beneficiary of the economic policy and structural reforms adopted from 1986 (SAP era). Ten years of implementation of these reforms would seem to indicate that while government has continued to impact on the economy, its overall performance is still below expectation. Nigeria agricultural export trade before has improved noticeably, but research shows that the results were not adequate. Improving Nigeria's agricultural export trade to an acceptable and sustainable level is therefore the challenge to policy makers in government and operators in the private sector.

The study will concentrate on the following objectives: (i) to evaluate the contributions of agricultural exports to the foreign earnings in Nigeria; (ii) to examining the trend of agricultural commodities output and export quantities during the period of the study; and (iii) to make recommendations on how the agricultural sector can be a major source of revenue to the government so as to avoid the over dependence of the Nigeria economy on the oil sector.

For ease of analysis, the study focuses on examining the agricultural export trade from 1975 to 2008 and the effect of regulation and deregulation policy of Government on agricultural export trade on export quantities, producer prices and world prices of cocoa and palm kernel during the period.

The rest of the paper is organized as follow: section 2 reviews the literature, while section 3 presents the methodology. The estimation results are discussed in section 4 and section 5 draws policy recommendations and concludes the paper.

## **II. Literature Review**

The Nigerian agricultural export trade has its foundation in the Neo- Classical factor

endowment theory of international trade postulated by two German economist Heckscher and Ohlin (1919). According to the theory, countries have different and unrelated natural endowment or resources and thus, different production factors/agents in different proportion. In view of this, Nigeria with good climatic condition concentrates on production of agricultural commodities like cocoa, palm kernel commodities and trade with other countries for her input (Adegeye, 1985).

The first theoretical explanation of the relationship/role of agricultural in development and its impact on export is provided by Krugman (1989). This approach argues that agricultural export expansion leads to an increase in the demand for a country's output, which in turn increases real output. Various researches have been undertaken on the impact of commodities export on the speed of development.

Sodersten (1953) in a discussion of the inter-relationship between economic growth and export trade indicated that two schools of thought have emerged. The first, according to him, is the structural school led by Harrod, Spitze, and Allen-Smith (1994) which examined possibilities of changing the structure of production through re-allocation of resources and the opportunities that would emanate thereof. They further examined how a higher rate of export in a country could lead to corresponding increase in the trade of economic development.

The second explanation is the marginal school led by Hick (1979). It implicitly assumes that any change taking place during growth process is marginal in nature, that is, the change occurs because market forces are allowed to operate fully in the system. A more negative concept of the interrelationship between growth and the export trade is adopted. Hence, there is hardly any clear cut conclusion as to how growth leads to a worsened export trade position. While Johnson (1955) regards growth as leading to a worsened export trade situation under a stage of complete specialization, Hicks (1979) considers economic growth as disadvantageous to trade, if the later is concentrated in the export commodities.

According to Chenery (1961), the ratio of export trade to national income rises as an economy grows; the divergence can be removed or narrowed considerably by import substitution. Thus, Kindle (1977) states that export lead to growth, but they need not if they are to do so, there must be capital, technical and re-allocation of resources. The larger the gains from export trade given these processes, the faster and more certainly will growth proceeds.

Moreover, Newmark (1974) claims that in all African territories, export demand had been the underlying basis for economic development. But he fails to specify whether or not a basis can be depended upon for future needs of stimulating further economic growth. There has been some recent work on the role of export in economic development among which Olayide (1969) maintained that export has made positive contributions to the Nigeria economy. These contributions include the systematic provision of foreign exchange for the purchase of capital goods, the orderly importation of capital, the steady and satisfactory supply of the durable and semi-durable consumer goods and the stimulation of expansion in local primary production both for export and internal consumption.

Lipsey (1981) stressed the importance of exports, when he observed that while exports raise national income, imports on the other, hand lowers it and that though exports are injections to an economy, which add to the value of output, they do not add to the value of domestic consumption. If a country achieves surplus in exports over its imports, it will be accumulate claims to foreign exchange, add to foreign exchange reserves and engage in investment abroad.

Douglas (1957) identifies exports as the main drivers of Nigeria's economic growth and hence the principal source of profound changes, which have occurred in the economic structure of the country, including the growth concentration of resources in the hand of government. According to him, exports enhanced capitalization, acceleration of a country's industrialization, as well as ensure increased short run stability in Nigeria. Bello (1994) revealed that trade serves as an engine for growth by facilitating the economic development of the trading



partner. In his view, trade is a veritable and indispensable tool for the acceleration of Nigeria's economic advancement since the wealth of any country is a function of the foreign demand of its products.

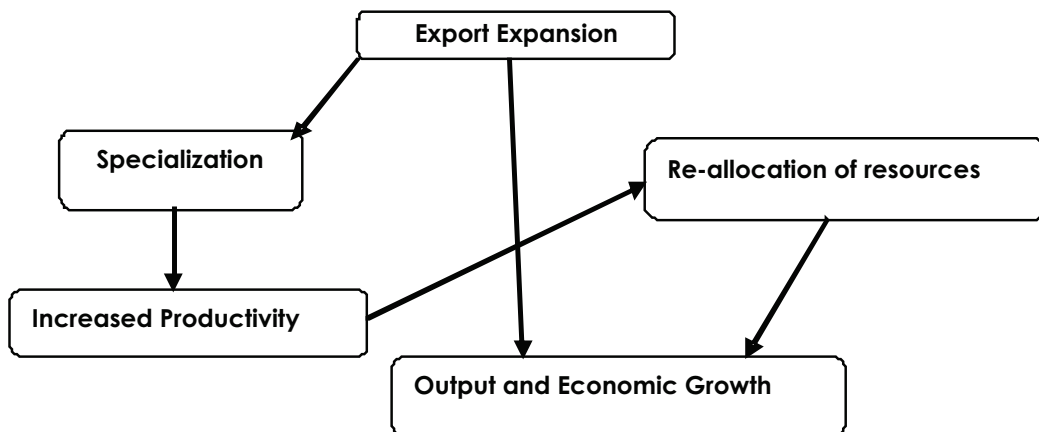
Similarly, Emma (1994), in a lecture delivered on export drive, he narrated that export is a course of economic stability and prosperity. He believed that this can be attained by the encouragement and development of export market. Indeed, experience from most developed countries show that international trade is a major catalyst of economic growth. Olayide and Essang (1976) also believed that tropical agricultural exports have played a pivotal role in multilateral trade system development by the western world and developing countries. Oladele (1987), citing Krugman (1984) in a paper delivered on the role of department of customs and export promotion explained that exports contributed immensely to foreign exchange earnings of a country. Moreover, it gives access to new technologies and new management practices that are essential for economic development.

Yusuf (2000) and Mesike (2006) attributed the decline in Nigeria's agricultural earnings to the discovery of crude oil and rural-urban migration. With the situation in the oil market, it has become apparent the country needed to reconsider its policies towards agricultural commodity export. The study aimed to examine the current position of agricultural exports product in Nigeria, with a view of identifying the factors associated with its growth and discovering the role of some important external variables in determining the nation's competitiveness in the world market for agricultural product.

Mesike and Abolagba (2006), postulated that agricultural sector is vital for any economy that must grow and develop. The export trade sub-sector is even more important to generating foreign exchange to make possible the importation of farm machineries and other capital goods required for industrialization and general development. Similarly, Von Joachim, (2003), also argued that the stunted growth of the less developed countries was a consequence of export instability. In

Nigeria, agricultural exports have played a prominent role in economic development by providing the needed foreign exchange for other capital projects before the 1970s. The main arguments of scholars in favour of export-led economic growth and development are summarized in the diagram below:

**Fig1: A Schematic Description of the Agricultural Export Led Growth Hypothesis**



It is clear from the above that agricultural export trade promotes specialization, which in turn boosts productivity since the country will have access to new technologies and better management practices. The increase in productivity will cause reallocation of the country's scarce resources from relatively inefficient sectors towards more efficient ones and thereby cause growth in an economy.

## II.1 Theoretical Framework

Theories are framework or understanding research work and help to give credence to studies of this nature. The issue addressed in this section is the essential of agricultural export as an agent of development. Non-oil export trade is a development tool identified with economics of abundance which is also associated with the function of guiding production purposefully toward the general wellbeing of the society and the economy. The vital role of optimizing economic growth process can therefore, be credited to export trade. This is

because export trade was instrumental in laying the foundation necessary for rapid development of most developed nations.

Kilpatrick and Miller (1978), relevantly remarked that determinants of export success from Israel, had to do with wages per employee which are strongly associated (positively) with capital per employee, and the study concluded that higher wages per employee, higher value added per production workers, and higher economies of scale, are the main characteristics distinguishing between net exporting and net importing industries in the United States. It has also been argued that most of the benefits derived from exporting, may not be realized if the firms in developing countries do not first meet the home needs of its products or services. Oyanda (1988) observed that it would be misplaced priority to plan to export when domestic demand has not been satisfied. He noted, however that for firms to grow at home, they definitely need to sell their products/services abroad. The conception that a country should only export when it has surplus over domestic demand, undermines the policy of export-oriented development, which the Nigerian government tends to be pursuing.

Similarly, the economic theory of comparative advantage also provides the rationale for economic activity, or another useful reason to be involved in the selling of a country's goods and services across its national boundaries, the theory of comparative advantage states that each country need to specialize in the production of goods and services in which it is comparatively most efficient, and then export the products/services to countries that are comparatively least efficient. The exporting country will in turn import from such other countries' products/services for which it is least efficient comparatively. The theory goes further to postulate that through the re-allocation of resources, with a view to increasing production of goods and services which the country has a comparative advantage, trade will attract for that country a greater total volume of goods/services than could have been obtained directly, provided the current exchange rate between both countries favours the producer of the

goods/services.

## **II.2 Stylised Facts on Cocoa and Palm Kernel Exports in Nigeria**

Agricultural export trade is structurally small and comprise mainly of small scale peasant production that account for over 80 per cent of the total agricultural output while at least over 60 per cent of the country's population earn their living directly or indirectly from agricultural proceeds.

Nigeria's agricultural export has been influenced by varying trade policies ranging from regulatory to deregulatory trade policies. During the regulatory era, the government through her agencies dominated the agricultural export trade. This period started from the late 1940s, precisely, 1947 when marketing boards were established to handle the agricultural export trade.

In 1977, three(3) commodity boards were set up to take over the activities of the marketing boards, which were earlier considered to be inefficient, inadequate in their set up and unorganised in their objective pursuit. The three commodity boards set up were: the Nigeria cotton board, the Nigeria palm produce board and Nigeria cocoa board. These boards were saddled with the following duties/functions.

- Provision of easy access to collection of duties and taxes by the government and serving as a source of capital formation for financing various government undertakings;
- Promoting the development and rehabilitation of producing areas generally and in particular to ensure adequate supply of sprayer, fertilizer, chemical, improved seedlings e.t.c. and ensuring productivities and efficiency of farmers and earning capacity;
- The provision and availability of security to act as a safety guide for the purchase and sales of such commodities; and
- Stabilisation of producers' prices through the accumulation of buffers

Agricultural export trade was expected to be one of the sources of foreign exchange earnings for the nation and Nigeria being a country with good climatic condition and several export commodities was also supposed to feed its teeming population as well as export the excess produce. But research shows that these objectives are far from being achieved as hunger and poverty had been on the increase while export earnings from agricultural had dwindled continuously over the decades. Though agricultural export trade in Nigeria was expected to be a major beneficiary of the economic policy and structural reforms adopted from 1986 (SAP), ten years of implementation of these reforms seem to indicate that its overall performance is still below expectation. Improving Nigeria's agricultural export trade to an acceptable and sustainable level is, therefore, the challenge to policy-makers in government and operators in the private sector.

In Nigeria, the agricultural sector remained the mainstay of the economy in spite of the oil sector. The sector provides the much needed capital formation for economic growth, employs a greater proportion of the labour force, raises the living standard by reducing poverty and serves as the principal source of human and livestock sustenance. It is also a major source of our foreign exchange earnings and provides market for industrial goods. For example, cocoa is processed into food beverages, while agricultural profit taxes are used to finance other sectors of the economy.

Olajide and Olatunbosun (1976) enthused that, prior to the oil boom, export trade of Nigeria was largely dominated by agricultural products such as groundnut, palm produce, cocoa, rubber, cotton, coffee and others. Bond (1987) in a study of primary commodity exports from developing countries indicated that the speed of new technology in the rural sector tends to raise agricultural capacity and raw materials necessary to begin expansion in manufacturing sector. To them, export trade offer great potentials to third world countries against the marginal school of thought which hold the view that export trade has led to international inequality whereby the rich countries have become richer at the expense of the poor countries. Thus, despite the arguments that export trade operated as a

mechanism of international inequality and has related the development of underdeveloped countries, export trade has opened up new opportunities of specialization and development for countries engaged in it, as hypothesised by the structuralist school.

It is no doubt that Nigeria is endowed with abundant arable land, favourable climatic conditions and different vegetation zones which enhance its position as an agricultural economy. These endowments favour the cultivation of various tropical crops including cocoa and palm kernel. Before the oil boom of the 1970s, agricultural products dominated the export of the country, providing employment to about 70 per cent of its labour force and generating about 55 per cent of revenue for government (Malton, 1981). Since the oil boom of the early 1970's, however, crude oil has dominated both total export and government revenue. The fortunes of the traditional exports declined, owing apparently to the neglect of the traditional export sector and development in international commodity markets, especially decline in commodity prices.

Meanwhile, in the agricultural sector, it is clear that the edible crude materials made up of cocoa and palm kernel was increased systematically between 1976 and 1985 when it peaked at 5.4 per cent. This development was attributed to the initial positive impact of the exchange rate depreciation that accompanied liberalization as well as the abrogation of the marketing board system. However, the performance of palm kernel exports since 1989 declined due to the negative effects of the exchange rate depreciation on the cost of agrochemical, high lending rate and partial removal of subsidies, especially on agricultural input such as fertilizer. Akanji and Ukeje (1995) confirms that agricultural export growth has recently been hampered by increased cost arising from the vacuum created by the exit of the marketing boards and the reduction in the activities of those who seized the opportunity of liberalized agricultural export to effect capital flight.

Thus, palm kernel output grew at an average annual rate of 1.9 percent between 1960 and 1965. It reached a peak of 4.2 percent during 1976-1980. For the period

1976 -1985, production showed a relative decline of 0.6 percent while its export fluctuated throughout the period. Like palm kernel, the trend of cocoa export and output has been below expectation. Available information reveals that cocoa production declined with the record low output to 100,000 tonnes in 1987. But it assumed an upward trend from 1986 with an output of 253,000 tonnes which reached a peak of 345,000 tonnes in 1998 before it started declining thereafter. This development was due to the scraping of the commodity boards which signalled the move towards the deregulation of the economy. Despite this high output, the increase in export quantity was minimal, due to low international commodity prices and increase in domestic consumption resulting from the activities of cocoa processors. Moreover, the continuous depreciation of the naira, poor and deteriorating infrastructure facilities along with the dwindling international community aid contributed to the depressing growth of output and exports.

### **II.2.1 SAP and Post-SAP Era (1986 2008)**

Policies formulated and implemented during this era were aimed at reversing the low trend in agricultural production in order to increase farm incomes and the supply of industrial raw materials ( Ojo and Ukeje, 1995). Policies during this period were designed to consolidate existing achievements, and the period witnessed some structural changes such as shifts from an outright deregulation to that of guided deregulation. Various agencies were also created among which were the Directorate of Food, Roads and Rural Infrastructure (DFRRI) and the National Directorate of Employment (NDE). The government adopted a comprehensive package to boost the economic reform programmes. This could have resulted from the absence of an alternative to well-articulated and well-designed agricultural policies as instruments for promoting agricultural growth and productivity. According to Orubu (2002), one effect of depreciation in the SAP package and liberalization argument is an expected increase in non-oil exports, which would be cheaper in terms of foreign currency, and a concurrent increase in the Naira value of exports that should serve as an impetus for producers to produce more for exports.

### III. Methodology

The estimation technique adopted in this study is the Engle-Granger co-integration analysis. The stationarity property of the variables was determined using the Augmented Dickey Fuller (ADF) and Phillips-perron (PP) tests. This becomes necessary in order to avoid the incidence of spurious regression estimates. Economically speaking, cointegration of two or more variables implies a long-term or equilibrium relationship among them, given by their stationary linear combination (called the cointegrating equation).

#### III.1 Model Specification

The model specified quantity exported (the dependent variable) as being explained by producer price, world price, commercial loans to agriculture, average annual rainfall and exchange rate (independent variables).

In the general form, the econometric model is specified as

$$QE = f(PD, WP, CLA, ARF, EXR, U_t)$$

The linear equation is specified as follow:

$$\ln QE = \alpha_0 - \alpha_1 \ln PD + \alpha_2 \ln WP - \alpha_3 \ln CLA + \alpha_4 \ln ARF - \alpha_5 \ln EXR + \mu_t \quad (1)$$

where,

$\ln QE$  = Natural log of export quantity measured in tons

$\ln PD$  = Natural log of producer price

$\ln WP$  = Natural log of world price

$\ln CLA$  = Natural log of commercial loan to agriculture

$\ln ARF$  = Natural log of average annual rainfall in millimetres

$\ln EXR$  = Natural log of exchange rate

$U_t$  = stochastic error term

$\alpha_0 - \alpha_5$  = parameters

The producer price (PD), commercial loans to Agriculture (CLA) and exchange rate (EXR) are expected to have a negative effect on the quantity of cocoa exports and palm kernel produced, while world price (WP) and average rainfall are expected to have a positive sign.

#### III.2 Tests for Stationarity (Unit Root Tests)

In conducting the stationary / unit root tests on the variables, we used the



Augmented Dickey Fuller (ADF) and Phillips-perron (PP) unit root tests on all the variables. The Augmented Dickey fuller approach accounts for the autocorrelation in a series in a parametric fashion by estimating additional nuisance parameters through the addition of the first differences of the series as explanatory variables in the equation.

$$\Delta G_t = \alpha_1 + \alpha_2 + \delta G_{t-1} + \sum_{i=1}^m \alpha_i \Delta G_{t-i} + \varepsilon_t \quad (2)$$

The ADF test entails estimating the following equation:

where:  $G_t$  is the variable of interest;  $\varepsilon_t$  is a pure white noise error term;  $t$  is time trend;  $\Delta$  is difference operator;  $\alpha_1, \alpha_2, \delta$  and  $\alpha_i$  are various parameters.

The unit root test is the first step and the most important in determining the stationarity of time series data. A series  $X_t$  is said to be stationary if it has the following characteristics; constant mean, finite variance, tendency to return to mean value equilibrium when there is a disequilibrium and zero order of integration  $I(0)$ . It is usually expressed as  $X_t \sim I(0)$ . This means that the series ( $X_t$ ) does not need to be differenced, it is stationary at levels. If the series is not stationary, then it means that it is time dependent and its variance is infinite, therefore, the series ( $X_t$ ) has to be first differenced in order to achieve stationarity  $I(1)$ , it said to be integrated of order one, that is  $X_t \sim I(1)$  if it needs to be differenced once to achieve stationarity.

In general term, if the series ( $X_t$ ) need to be differenced ( $d$ ) times in order to achieve  $I(0)$ , then it is said to be integrated of order ( $d$ ) that is  $X_t \sim I(d)$ . The null hypothesis of the existence of the unit root is stated as  $H_0: X_t \sim I(1)$ . If the MacKinnon critical value is less than the ADF test statistics we reject the null hypothesis that  $X_t$  contains a unit root and the alternative hypothesis is accepted that  $X_t$  is stationary. In contrast to the ADF, the Phillips-perron (PP) test does not require that the ARIMA process be specified and would, thus, be less subject to misspecification than the ADF test. The PP test corrects for autocorrelation in a non-parametric fashion.

### III.3 Tests for Co-integration.

Co-integration is said to exist between non-stationary variables if their linear combination, namely the residuals of the co-integrating regression are stationary

(Granger, 1986). Thus, spuriousness can only be avoided if a stationary cointegration relationship is established between the variables. The particular relevance of the error correction form is the modelling of cointegrated series. According to Engle and Granger (1987), when variables are cointegrated there exist a valid error correction model describing their relationship, with the implication that cointegration between variables involved is a precondition for the error correction model. In testing for cointegration, we apply the ADF test to the residuals of the co-integrating regression rather than the levels of the series. If the residuals of the bivariate or multivariate co-integrating regressions are found to be stationary, implying co-integration, we will then specify an error correction model, which is the second step of the Engle-Granger two-step algorithm method.

Following Engle and Granger (1987), the cointegration regression between  $Y_t$  and  $Z_t$  can be specified thus:

$$Y_t = \alpha_0 + \alpha_1 Z_t + \varepsilon_t \quad (3)$$

The residuals of the co-integration equation (3),

$\varepsilon_t = (Y_t - \alpha_0 - \alpha_1 Z_t)$  is simply a linear difference of the non-stationary series (i.e.,  $Y_t Z - t$ ).

The ADF test equation based on the residuals is given as:

$$\Delta \varepsilon_t = \phi + \beta \varepsilon_{t-1} + \sum \lambda \Delta \varepsilon_{t-j} + v_t \quad (4)$$

The test statistic, as indicated earlier, is a t-ratio

For  $\beta = 0$ . If this null hypothesis cannot be rejected against the alternative that  $\beta < 0$ , then the variables are not cointegrated, on the other hand if the null hypothesis is rejected then the conclusion would be that the estimated  $\varepsilon_t$  is stationary (that is, does not have a unit root). In our estimations, multivariate co-integrating regressions were carried out between the export supply of cocoa and the price variables and income to establish the existence of long-run co-integrating relationship. Finally, in stage two, the residuals of the valid multivariate co-integrating regressions were included in the model as an explanatory variable, before it was estimated with the use of ordinary least squares regression.

From equation (3), the error correction mechanism (ECM) can be specified as:

$$\Delta Y_t = \alpha_0 + \alpha_1 \Delta Z - \alpha_2 (Y_t - Z_t)_{t-1} + \varepsilon_t \quad (5)$$

where,

$Z$  = the vector of explanatory variables

$Y_t$  and  $Z_t$  = the co-integrating variables

$\alpha_2$  = the coefficient of the error correction mechanism (ECM)

$\alpha_1$  = the vector of parameters.

### III.4 Data Source

The data for this research are annual and were obtained from several sources. These included the Central Bank of Nigeria (CBN), National Bureau of Statistics (NBS), Food and Agriculture Organisation (FAO) of the United Nations and International Financial Statistics (IFS) of the International Monetary Fund. Precisely, data on producer price, the export price and average rainfall from 1976 to 2008 were collected from the Statistical Bulletin of the CBN. Statistics of export quantities of commodities were sourced from the FAO.

## IV. Estimation Results and Discussion

### IV.1 Unit Root Tests (Cocoa and Palm Kernel)

The results of the Augmented Dickey-Fuller (ADF) and Phillips - Perron (PP) tests are presented in tables 1 and 2 below.

Table 1 shows that in the case of cocoa exports except for LNQE that was stationary at level  $I(0)$ , all other variables, (LNPD, LNWP, LNCLA, LNARF and LNEXR) were stationary at the first differences  $I(1)$  and at 1 per cent statistical significance.

**Table 1: Unit Root tests (Cocoa)**

Variable		ADF Stat	Critical Values		Order of Integration	PP Stat	Critical Values		Order of Integration
			1%	5%			1%	5%	
LNQE	Level	-5.8406	-3.6463	-2.9540	I(0)	-5.8407	-3.6463	-2.9540	I(0)
LNPD	Level	-1.6070	-3.6463	-2.9540	I(1)	-1.5431	-3.6463	-2.9540	I(1)
	First Diff	-6.1059	-3.6537	-2.9571	I(0)	-6.2725	-3.6537	-2.9571	I(0)
LNWP	Level	-3.3128	-3.6537	-2.9571	I(1)	-2.5847	-3.6463	-2.9540	I(1)
	First Diff	-4.4075	-3.6537	-2.9571	I(0)	-4.4251	-3.6537	-2.9571	I(0)
LNCLA	Level	-2.1456	-3.6463	-2.9540	I(1)	-2.3577	-3.6463	-2.9540	I(1)
	First Diff	-6.8068	-3.6537	-2.9571	I(0)	-6.7583	-3.6537	-2.9571	I(0)
LNARF	Level	-1.5903	-3.6463	-2.9540	I(1)	-1.4942	-3.6463	-2.9540	I(1)
	First Diff	-6.7121	-3.6537	-2.9571	I(0)	-6.7121	-3.6537	-2.9571	I(0)
LNEXR	Level	-0.4781	-3.6463	-2.9540	I(1)	-0.5166	-3.6463	-2.9540	I(1)
	First Diff	-4.7075	-3.6537	-2.9571	I(0)	-4.7075	-3.6537	-2.9571	I(0)

**Table 2: Unit Root tests (Palm Kernel)**

Variable		ADF Stat	Critical Values		Order of Integration	PP Stat	Critical Values		Order of Integration
			1%	5%			1%	5%	
LNQE	Level	-0.7258	-3.6463	-2.9540	I(1)	-0.7258	-3.6463	-2.9540	I(1)
	First Diff	-6.2979	-3.6537	-2.9571	I(0)	-6.3674	-3.6537	-2.9571	I(0)
LNPD	Level	-0.8797	-3.6463	-2.9540	I(1)	-0.8544	-3.6463	-2.9540	I(1)
	First Diff	-4.5933	-3.6537	-2.9571	I(0)	-4.7706	-3.6537	-2.9571	I(0)
LNWP	Level	-2.0517	-3.6537	-2.9571	I(1)	-2.2041	-3.6463	-2.9540	I(1)
	First Diff	-5.5720	-3.6537	-2.9571	I(0)	-5.5720	-3.6537	-2.9571	I(0)
LNCLA	Level	-2.1457	-3.6463	-2.9540	I(1)	-2.3577	-3.6463	-2.9540	I(1)
	First Diff	-6.8068	-3.6537	-2.9571	I(0)	-6.7583	-3.6537	-2.9571	I(0)
LNARF	Level	-1.5902	-3.6463	-2.9540	I(1)	-1.4942	-3.6463	-2.9540	I(1)
	First Diff	-6.7121	-3.6537	-2.9571	I(0)	-6.7121	-3.6537	-2.9571	I(0)
LNEXR	Level	-0.4781	-3.6463	-2.9540	I(1)	-0.5166	-3.6463	-2.9540	I(1)
	First Diff	-4.7075	-3.6537	-2.9571	I(0)	-4.7075	-3.6537	-2.9571	I(0)

In the case of palm kernel, table 2 shows that all the variables are non-stationary at level I(1) and that stationarity is only established after first differencing.

#### IV.2 Parsimonious Error Correction Model (Cocoa and Palm Kernel)

The parsimonious error correction model (ECM) was obtained by regressing the variables including the one period lag of the error correction term. To estimate an (ECM), two period lags of the first differenced variable of all the variables were included, while the parsimonious equation was obtained through the sequential elimination of insignificant variables guided by theory. The result is presented in Tables 3 and 4 below.

**Table 3: Parsimonious short run error correction model (cocoa)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.052654	0.075163	0.700550	0.0906
D(LNQE(-1))	0.502640	0.164900	3.048150	0.0057
D(LNPD(-2))	-0.108179	0.082003	-1.319213	0.0081
D(LNWP)	0.489458	0.248642	1.968528	0.0612
D(LNARF(-2))	-0.234289	0.193850	-1.208612	0.0390
D(LNCLA)	-0.234403	0.146894	-1.595735	0.1041
D(LNEXR)	-0.079920	0.283780	-2.395943	0.0251
ECM(-1)	-0.098008	0.214692	-0.456506	0.0023
R-squared	0.746055	Mean dependent var		0.006359
Adjusted R-squared	0.702422	S.D. dependent var		0.397534
S.E. of regression	0.332376	Akaike info criterion		0.852539
Sum squared resid	2.540905	Schwarz criterion		1.222600
Log likelihood	-5.214355	F-statistic		8.844987
Durbin-Watson stat	2.097447	Prob(F-statistic)		0.002199

**Table 4: Parsimonious short run error correction mode (Palm kernel)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.068257	0.073130	0.933416	0.0697
D(LNQE(-2))	0.266947	0.186092	1.434489	0.1649
D(LNPD(-2))	-0.304829	0.243667	-2.482188	0.0079
D(LNWP(-2))	0.157138	0.191093	0.822436	0.0542
D(LNCLA)	-0.080900	0.112187	-0.721119	0.0781
D(LNARF)	0.329061	0.191864	1.715075	0.0998
D(LNEXR)	-0.177958	0.192935	-0.922375	0.0029
ECM(-1)	-0.515965	0.186920	-2.760354	0.0111
R-squared	0.599464	Mean dependent var		0.065092
Adjusted R-squared	0.558130	S.D. dependent var		0.288940
S.E. of regression	0.252201	Akaike info criterion		0.300457
Sum squared resid	1.462925	Schwarz criterion		0.670518
Log likelihood	3.342916	F-statistic		9.339540
Durbin-Watson stat	2.034207	Prob(F-statistic)		0.000425

### IV.3 Analysis of Result

Table 3 shows the parsimonious result for cocoa, the result indicates that the adjusted R-squared ( $R^2$ ) of the model was approximately 70 per cent, implying that the dependent variables was largely explained by the independent or exogenous variables. Almost all the explanatory variables, except commercial loans to agriculture, are statistically significant. Similarly, all the variables including (ECM) are rightly signed, except average rainfall (ARF). The Durbin-Watson statistic of 2.09 is within the acceptable band, indicating the absence of serial correlation among the variables in the model, even as the probability of the F- statistic shows that the model was well-fitted. The coefficient of the lag of producer price of cocoa is rightly signed and significant, showing that a 1% increase in producer price of cocoa, all things being equal, will reduce export quantities by approximately 0.11 per cent. This is in line with evidence that has shown that cocoa output hence export supply has been trending down for many years due to higher cost of producing cocoa in Nigeria.

Onyenweaku and madu (1991) in their study of the supply of Nigeria's cocoa confirmed the evidence of negative output in the face of rising cocoa producer prices. They argue that the price factor has been almost swamped by non-price factors, which are non-agricultural, such as over-reliance on the oil sector. Another probable reason for the negative short-run price elasticity include failure of farmers to replace their old and low-yielding cocoa trees with young high yielding ones. Beyond these, rising production costs especially labour costs are known to partially offset output price increases.

The estimated result also shows that a positive relationship exists between world price and export quantities of cocoa. The result indicates that a 1.0 per cent increase in world price of cocoa increases export of cocoa by as much as 0.49 per cent. This is a clear indication of world price of cocoa being a major incentive for farmers to produce more for the export market.

Similarly, the coefficient of the lag value of average rainfall is negatively signed and significant but is not in line with a priori expectation and adequate rainfall is required for increased cocoa export supply in the country. The coefficients of

commercial loans to agriculture and exchange rate show an inverse relationship with export of cocoa. The result indicates that a 1 per cent depreciation of the exchange rate will reduce cocoa exports by 0.08 per cent. It is observed from the results that the coefficient of the error correction term (ECM (-1)) carries the expected negative sign, less than 1 and it is highly significant at the 5 per cent level. The significance of the error correction term supports cointegration and suggests the existence of a long-run steady-state equilibrium between cocoa export supply and producer price, world price, average rainfall, commercial loans to agriculture and exchange rate. The ECM indicates that should there be disequilibrium in the system, about 10 per cent will be corrected within a year. In other words, the model has an adjustment speed of 10 per cent.

On the other hand, the parsimonious result for palm kernel presented in table 4 shows that the model has a good fit having an adjusted R-squared ( $R^2$ ) of 56 per cent, which shows the relative contribution of the independent variable to the dependent variable. All the explanatory variables including the ECM, except export quantity are statistically significant and rightly signed. Durbin-Watson statistic of 2.03 also is an indication of the absence of serial correlation among the variables in the model while the F-statistic shows that the model was well-fitted and reliable. The coefficient of lag of export quantities is positively signed and the parameter estimate for producer price of palm kernel was negatively signed, in line with the a priori expectation. This means that a 1.0 per cent increase in producer price of palm kernel, all things being equal, will reduce export quantities by 0.30 per cent.

More so, the lag values of world price and coefficient of average rainfall are positive and significant, pointing to the positive relationships that exist between these variables and export of palm kernel in Nigeria. These indicate that a 1.0 per cent increase in world price and average rainfall will increase export quantities of palm kernel by 0.16 and 0.32 per cent, respectively. Similarly, commercial loan to agriculture and exchange rate show an inverse relationship with the export quantities of palm kernel. This means that a 1.0 per cent depreciation of exchange rate will increase export of palm kernel by 0.18 per cent, as the lower exchange

rate will make the product cheaper at international market.

The error correction mechanism (ECM) supports cointegration and suggests the existence of a long-run steady-state equilibrium relationship between palm kernel export supply and producer price, world price, average rainfall, commercial loan to agriculture and exchange rate. The ECM indicates that should there be disequilibrium in the system, about 52 per cent will be corrected within a year. In other words, the model has an adjustment speed of 52.0 per cent.

## **V. Policy Recommendation**

In view of the findings from this study, the following are antidotes for Nigeria's dependency on petroleum that policy makers and Nigerian leaders can work on to revitalize agricultural export trade.

i). The performance of agriculture has not been too impressive even with liberalization measures. Though the exchange rate policy is probably the most likely instrument to induce increased competitiveness of agricultural export commodities in a developing country like Nigeria, parallel market exchange rate premium significantly affects the export performance of palm-kernel, cocoa and other major agricultural products. Thus, critical attention should be paid to such incentives as export promotion because it is believed that export promotion has the potential to stimulate productivity, thrift and entrepreneurship.

ii). Since the main manifestation of the "Dutch Disease" is the crowding out or depression of the non-oil export sector, it follows that the "disease" can be cured by effective implementation of prices aimed at promoting and revitalizing the non-oil export sector. These policies should address not only agricultural exports like cocoa and palm kernel, but also exports of other (non-oil) minerals, manufactured goods and services where Nigeria has comparative advantage.

iii). Conservation and rehabilitation programmes for palm kernel should be organized in areas where degradative processes are about to set in. Also, uncontrolled felling of palm kernel trees should be checked and farmers encouraged through appropriate pricing mechanisms, to replant the cleared and



rehabilitate the old palm kernel trees. The federal government should ensure that there is a margin between the producer price and world price of agricultural product, so that cocoa and palm kernel farmers can benefit substantially from international trade.

## **VI. Conclusion**

The study examined cocoa and palm kernel export trade in Nigeria from 1975 to 2008 using co-integration and error correction approach. The objectives of the study were to estimate short and long-run effects of price change, foreign income and government policy on cocoa and palm kernel production. The result of the study showed that producer price, world price, commercial loans to agriculture, and exchange rate have key roles to play in the export of cocoa and palm kernel in Nigeria. These results showed that cocoa and palm kernel exports have been responding negatively to producer prices on both short and long-run, and also the result showed that there may be an increased in cocoa and palm kernel in long-run, when it would have been possible for harvested hectares to be expanded and the replace low-yielding and aged trees. From the data collected and analysis of the result, it is pertinent to note that a holistic review of agricultural export trade policy is necessary. In summary, an increase in production of both cocoa and palm kernel will stimulate an increase in exportation of the product and more revenue from exportation of these products can be used to finance agricultural sector.

## References

- Adegeye, A.T. (1985) "Essentials of Agricultural Economics, Published by Impact Publishers Nig. Ltd.
- Allen-Smith, J. E. (2004) Food and Agricultural Policy: Economics and Politics. McGraw-hill Inc, London, 1994, pp. 56-97.
- Akanji, O. M. and E.U. Ukeje (1995) "A review and analysis of agricultural price in Nigeria 1977-1993, CBN Economic and Financial review Vol. 33 No1, pg 35-61
- Bello, W. (1994), Dark Victory: The United States, Structural Adjustment and global poverty. London Panos
- Bond, M. E. (1987), An econometric study of primary commodity exports for Developing country. regions to the world, IMF Staff Papers, 34, 191-227.
- Central Bank of Nigeria, Statistical Bulletin and Annual Statement of Accounts several issues
- Chebbi, H. E. and L. Lachaal (2007), Agricultural Sector and Economic Growth in Tunisia: Evidence from Cointegration and Error Correction Mechanism. A paper presented at the I Mediterranean Conference of Agro-Food Social Scientists, Barcelona, Spain, 23-25.
- Chenery, H.B. (1961), "Capital-Labour Substitution and Economic Efficiency," Review of Economic Studies, 43: 225-50.
- Douglas, H.K. (1957), Climate and Economic Development in the Tropics, Published for the Council on Foreign Relations by Harper, New York
- Emma, R. (1994), "Adam Smith and the Invisible Hand", American Economic Review, Vol. 84(2): 319-22.
- Engle, R.F. and C.W.J. Granger (1987) "Cointegration and error correction: Representation, Estimation and testing" Econometric, Vol. 55(2): 251-76.
- Federal Ministry of Agriculture and Rural Development (1988) "Agricultural Policy for Nigeria Pg 1-10
- Federal Office of Statistic (FOS) (1990) Production Year Book
- Harold, G.H. and G.F. Spitze (2000) Food and Agricultural Organisation Year Book
- Harold, G.H., G.F. Spitze, and J. E. Allen-Smith (1994) Food and Agricultural Policy: Economics and Politics. McGraw-hill Inc, London, 1994, pp. 56-97
- Granger, C.W.J (1986) Developments in the study of co-integrated variables, Oxford Bulletin, Economic, Statistic, 48: 213-28
- Heckscher, E and B. Ohmim (1919) "The Effect of Foreign Trade on the Distribution of Income" International Trade Issues and policies journal, Page 224
- Hicks, J. R (1979) Causality in Economics, Basic Books University of Chicago. Press International Trade Issue and Policies, Journal Pg 294
- Iyanda, O. (1988). "Linking Agriculture with Industry" paper presented at Agriculture and allied trade groups seminar on Nigeria economy and Agricultural self-sufficiency, chamber of commerce and industry, Ibadan,

Nigeria.

- Johnson, H. G. (1955), "Economic Expansion and International Trade", Manchester School, 23, 95-112.
- Kilpatrick, J. A. and R.R. Miller,(1978). "Determinants of the Commodity Composition of U.S. Trade: A Discriminant Analysis Approach", Journal of International Business Studies, Vol. 9(1): 25-32.
- Kindle, B. (1977), Economic Development (3rd edition) McGraw Hill, New York
- Koutsoyianis, A. (2005) "Theory of Econometrics," Second Edition, Published by Palgrave Press Ltd, London
- Krugman, P. (1989), "Import Protection as Export Promotion", in H.Kierzkowski (ed.), Monopolistic Competition and International Trade, Oxford: Blackwell.
- Krugman, P. (1984): "Agricultural policy and Department" "Export Led Growth" H. Kierzkowski, 180193. New York: Oxford University Press.
- Lipsey, E. (1981), Foreign Production and Exports in Manufacturing Industries, Review of Economics and Statistics, Vol. (63), pp. 488-494.
- Malton, P. (1981). The structure of production and rural incomes in northern Nigeria Diejomaoh (Ed). Holmes and Meier Publishers Inc, New York.
- Mesike, C.S.(2006), An Explorative Analysis of Factors Determining Rubber Exports from Nigeria. Indian J. Natural Rubber Res., 19: 12
- Mesike, C.S. and E.O. Abolagba, (2006), Trend Analysis and Growth Rate of Rubber Export in Nigeria. Conference Paper presented in Eleventh Agricultural Extension Society of Nigeria held in University of Agriculture Abeokuta, 3rd and 6th of April 2006
- Newmark, T.E. (1974). Carbon sequestration and cocoa production: financing sustainable development by trading carbon emission credits Paper presented at the First international Workshop on Sustainable Cocoa Growing, Smithsonian Tropical Research Institute, Panama.
- Ojo, M. O. and M. O. Akanji 1996). Responsiveness of selected Agricultural Export Commodities to Exchange rate Devaluation in Nigeria: An Econometric Analysis CBN Economic and Financial Review, 34(2): 511-578.
- Ojo, M.O. (1991) "Seminar Papers on "Reforms on Nigeria Agricultural Export Trade" Lagos.
- Ojo, M. O and E.U. Ukeje (1995) "A Comparative View of the Major Option for the Marketing of Nigerian Agricultural commodities", Central Bank of Nigeria, Research Department Occasional Papers No 13 August
- Oladele, A. (1987), An Econometric study of primary commodity export from Developing countries (1987) Marian E. Bond
- Olajide, S.O. and D. Olatunbosun, (1976) Trend and Prospects of Nigeria's Agricultural Exports. NISER Technical Report
- Olayide, S.O. and S.M. Essang (1976), "The role of Commodity Exports in Nigeria Economic Growth", Nigeria Journal of Rural Economic Development,

10:10522

- Olayide, S.O.(1969). Some Estimates of Supply and Demand Elasticities for Selected Commodities in Nigeria's Foreign Trade. *Journal Business Social Studies*, 1: 17693
- Onyenweaku, C.E. and E.N. Madu, (1991) "Perennial Crop Supply Response: The Case of Nigeria Cocoa. Paper Presented at 1st International Conference on Tree Crops, MANR, Imo State
- Orubu, C.O.(2002). Production and Trade in Nigeria: An Overview". Background Paper on Group Study on Prospects of Nigeria Trade Framework. African Capacity Building Foundation/ National Centre for Economic Management and Administration, Ibadan
- Sodersten, B.O. (1953) "International Economy since 1945. Published in Volume 1 of Ageing & Society (part 1:7394). University of Sheffield, UK.
- Spiegel, R (1961), "Schaums Statistical outline series by MC- Graw Inc, United Kingdom Von
- Joachim, B.(2003), Agricultural Economics and Distributional Effects. In: Reshaping Agriculture's Contributions to Society. Proceedings Twenty-fifth International Conference of Agricultural Economics, pp: 229
- Yusuf, S.A., (2000), An Analysis of the Effects of Liberalize Trade and Exchange Rate Policies on Agriculture in Nigeria: Ph. D Thesis of Agricultural Economics. University of Ibadan, Ibadan Nigeria

# Face to Face with Productivity<sup>++</sup> - A Review

Phebian N. Omanukwue\*

## I. Introduction

Factor productivity concerns often dominate the discourse on economic matters especially in developing and emerging markets for the simple reason that productivity and economic prosperity are often linked. The article focused on the factors contributing to slow growth in per capita income amongst Latin American Countries (LACs) and further postulated that declining growth in per capita income was the result of plummeting factor productivity growth within the region, rather than lack of investment or citizen's willingness to work. 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 paper

The article provides an assessment of productivity levels in selected Latin America Countries (LACs) and noted the widening productivity gaps between Latin America and the developed world compared with the fast-paced economies such as China, Japan and Korea. According to the paper, the relative per capita income of Latin America had accounted for 25 percent of the US of America a "half century ago" compared with approximately 17 percent as at today. The authors, however, observed that the poor growth and income levels of Latin America economies were not necessarily due to a lack of investment, but rather resulted from the declining growth of productivity levels. Chile and Costa Rica were identified as regional economies with efficient utilization of resources, but yet accounted for three-quarters of the factor productivity of the US. The authors in a comparative analysis, further pointed out that with the exception of labour productivity in the agricultural sector which compared favorably with the rest of the world (East Asia and developed economies) at a steady rate of >2 per cent annually, the industrial and service sectors within the LAC witnessed a stagnant growth in a period of at least twenty years.

In trying to adapt the industrial revolution approach of the developed economies,

---

\*\*Published in the IMF Finance and Development, March 2011 by Eduardo Lora and Carmen Pagés.  
\*Phebian N. Omanukwue is a staff of the Research Department, Central Bank of Nigeria. This review has benefitted from some World Bank publications. The author thanks anonymous reviewers for their comments and suggestions.

the LAC was faced with much more constraints than their counterparts in the developed economies which were in the form of high tariffs, high migration of workers to city centers and an abundance of small and medium-sized firms which led only to a partial success. According to the author(s) within the LACs, 84 per cent of firms employed 10 workers or less. In Mexico and Bolivia, the authors estimated this figure at more than 90 percent, vis a vis 54 per cent of small firms with similar number of workers in the US. Such structural distortion in the employment structure of firms only further worsens the allocation of physical and human capital resources, as resources that otherwise would have been allocated to most productive firms were shifted to least productive firms (large in number, but with fewer employees). Furthermore, small firms were often limited in their scope of expansion beyond the domestic markets. Rather than shifting workers from agriculture to the more productive industrial manufacturing sectors as in the developed countries, LACs workers found recourse in the service sector which employs more than 60 percent of the labor force, while the manufacturing sector accounted for 20 per cent of the employment of the labor force.

A scenario analysis by the authors indicated that with the assumption that productivity efficiency levels between the US and a typical Latin American country were at similar levels, income per capita of the LACs would be double its current ranking. Factors accounting for the low productivity levels in developing economies were summarized in two forms; "market failures" and "bad policies", which weakened incentives for "innovation, discourage competition, prevent efficient companies from growing and further promote the survival and expansion of less productive firms". In as much as the authors acknowledged that fostering higher productivity was complex, certain factors were identified as germane to the objective of increasing productivity growth. These are efficient resource allocation, improving the credit market, improving tax and social policies and promoting competition. Shifting physical and human capital resources from the less productive to the most productive firms were seen as options to enhance productivity efficiency gains in both the manufacturing and service sectors of the economy. The second critical factor was an improvement in credit systems

especially via expanded range of financial products. According to the authors, some LACs like Brazil were able to make credit more available and found out that sectors whose investment needs made them dependent on credit had the fastest rate of formalized employment.

Other key measures were improvement in financial and tax policies in a simplified manner which did not encourage inefficient behavior. For instance, corporate tax was considered high at 20 percent in LACs compared with 16 percent in advanced economies. These high taxes act as an incentive for firms to evade tax and in some cases constrain firms' expansion beyond a certain threshold due to growing tax concerns. Other areas of improvement include better regulatory oversight and prudential regulation to protect the financial sectors from internal and external credit shocks as well as improvement in credit and property rights supervision.

### **III. Comments and Lessons for Nigeria**

The paper clearly articulated the causes of low per capita income in LACs. The article, however, placed more emphasis at analyzing the factors responsible for and consequences of slow growth in factor productivity with broad, but vague solutions for improving per capita income growth. Thus, more specific solutions in a country or regional context would have been more appropriate.

In Nigeria, the year 1999 commenced a period of progress in economic reforms aimed at increasing the growth prospects of the economy. However, unfolding economic developments in Nigeria have often questioned the impact of the reforms, especially within the context of the widening gap between strong output growth witnessed in the economy and improvement in physical and social wellbeing of the citizen. The productivity level, measured by the growth in gross domestic product has been estimated, on the average, at 6.9 per cent in 2010 and the World Bank has forecast a growth rate of 7.1 percent in 2011 compared with growth forecast for other world regions. Nigeria even maintained a strong growth even in the face of the global crisis, compared with most developed economies in

the world. Available data, further suggests that recent growth performance in Nigeria has been largely driven by the non-oil sector (agriculture, wholesale and retail trade sectors) as well as the structural transformation towards the service sectors led by ICT and construction. A more critical contributor to the growth performance is the increased factor accumulation of capital and labour, albeit with fewer increases in total factor productivity. According to the World Bank (2007), the contribution of TFP to growth declined during 1990 -2002 and any marginal increases witnessed may have been as a result of delayed impact of critical reform decisions embarked upon in 1999 some of which were more focused on the oil/gas and telecommunication sectors with high capacity for earning quick returns. Data from the National Bureau of statistics living standard survey also suggests that about 28 percent of the labor force make up the informal sector, while wage employment further constitutes about 10 percent of the labor force and largely dominated by the public sector. The binding constraints to productivity are well documented in the literature. To mention a few, lack of skilled personnel, distortionary tax and trade regimes, poor controls and standards as well as unreliable and insufficient infrastructure together constitute constraints to productivity. In fact, the Central Bank through the Governor, Sanusi Lamido Sanusi, has often stated categorically that in order to transform the resource potentials of the Nigerian economy, deliberate and strategic investment is required for the development of modern infrastructure that will sustain growth.

What can Nigeria do to address low factor productivity? For starters, the current approach at addressing constraints in the value chain of promising and key sectors of the economy is a measure that could not have been spearheaded sooner by the Central Bank of Nigeria. Most of the value chains are dominated by the large informal sector often characterized by casualisation of workers, low skills level and high substitutability of labor. There is, thus, a need to address these issues holistically either from a public or private sector angle or an enhanced collaboration between the public and private sectors. First, value chain sectors with high employment potentials need to be identified. Literature often suggests ICT, agriculture, wholesale and retail sectors as viable value chains. In Nigeria,



these sectors have already shown potential signs of being a critical source of growth and employment creation. Efforts at supporting value chain should also take account of the value adding and value diverting (constraining) aspects of the value chain processes that need to be addressed to increase efficiency within each value chain. A second approach at improving productivity is skill development initiatives which can be embarked upon by both the public and the private sectors via training, business development support services and transfer of technology.

The productivity of any sector is as good as the level of skills that is obtainable within it. A shortage of skilled labor in most cases leads to the use of what is available; which in most cases are low skilled workers and expatriate workers. Therefore, the educational system needs to be overhauled and reviewed. A situation in which the skewed preference for academic education to the detriment of technical and more practical education persists does not augur well for the Nigerian economy. Therefore, concrete and targeted interventions at enhancing technical skills in employment intensive value chains needs to be designed to address growing skills gap. A first step in this regard will be to develop a systematic framework for assessing the relevance of the educational content offered in our public and private educational institutions. In addition, information on skills demanded or required either on a sector, geographic or state-by-state basis should be made widely available. This will direct interventions at skills development in a much more strategic manner such that local educational/training institutions would be made more responsive to the changing demands and requirements of the labor market and indeed emerging technologies. A second option will be to create stronger linkages between public/ private sector employers and training institutions.

Improvement in the area of infrastructure, supply chain, access to finance and trade/tax regime cannot be overemphasized. The World Bank had estimated that most low income countries (LICs) need at least 9 per cent of their GDP invested in infrastructure to achieve the millennium development goals. Currently, in most

LICs, this accounts for less than 3 per cent of GDP. A persisting situation of restrictive trade policy without any major improvements in the provision and maintenance of critical infrastructure for productive activities will only worsen smuggling activities across the Nigerian borders. In 2007, the Nigerian government under the auspices of the Federal Ministry of Commerce and Industry had published a blueprint on a cluster concept as an acceptable approach for Industrial development strategy in Nigeria. However, the implementation of the proposals in the document is yet to witness any significant progress. Credit incentives by government through the Central Bank to boost supply chain of finance need to be monitored beyond the amount distributed and/or utilized to ensure compliance with performance benchmarks (if any) and that intended results are achieved. Interventions in value chain sectors should also be hinged on their sustainability, relevance and feasibility. These are by no means an exhaustive approach to dealing with the productivity constraints in the Nigerian economy. Some measures are short term in nature, while others are long term in approach. Nevertheless, they all attempt to draw attention to critical issues that are worth addressing if the Nigerian economy must achieve its National Vision (NV) 20: 2020 goals.

### **References**

- Eduardo L. and C. Pagés, (2011). "Face to Face with Productivity", IMF Finance and Development, Vol. 48, No.1. pp. 16-19.
- World Bank (2007). "Nigeria's Competitiveness and Growth", Country Economic Memorandum Report No. 36483 NG, Washington D.C., World Bank.
- World Bank (2010). "Putting Nigeria to Work: A Strategy for Employment and Growth", Washington D.C., World Bank.

# Too Big To Ignore<sup>++</sup> - A Review

*Jimoh S. Adeleke\**

## I. Introduction

The purpose of this paper was to study many of the complex issues and tradeoffs policymakers must put in place in evaluating reforms to the oversight of systemically important banks (SIBs). In particular, the author summarized a range of practical solutions covering two critical dimensions of debate: crisis prevention and crisis resolution. This study is important considering the extensive literature that has documented the impact of government policies on the financial institutions during and after the global financial and economic crises. The author, therefore, supports the notion that government play unprecedented role to shore up financial institution deemed to be too big to fail. He observed that government guarantees of bank debt, capital injections and cleansing of bank balance sheets, trigger a loss of public confidence in the financial system. A summary of the paper is presented below, followed by comments and lessons for Nigeria.

## II. Summary of the paper

The author suggested that policymakers must consider moral hazard in crafting policies to address Too-Big-To-Fail bank, because systemically-important banks encourage their growth and remove some of the consequence of risk behaviour. He also suggested that all national authorities must develop their approach to SIB oversight within the context of their country specific needs. The author believed that it will be a challenge to achieve international and domestic consensus on many issues but identified some common issues for policymakers and regulators in every jurisdiction, to include:

- (i) how to define an SIB
- (ii) whether SIBs should be held to higher regulatory and supervisory standards than non-SIBs and, if so and recognizing the trade-offs they present, what those standards should be; and
- (iii) whether government policies can be developed to make SIBs problems to be solved but limit the effect of that problem on the real economy and financial stability.

---

<sup>++</sup>Published in IMF Finance and Development, December, 2009 by S. Raihan Zamil  
<sup>\*</sup>Mr. Adeleke is a Youth Corp Member in the Research Department, Central Bank of Nigeria.

The author acknowledges that authorities must develop a workable and dynamic definition of systemically important banks. That is the definition of systemic institutions should cover the period of normal as well as times of stress of the institutions.

Therefore, he suggested that policymakers should identify a core group of banks considered SIBs under any conceivable circumstances, and apply higher regulatory and supervisory standard to them.

The paper emphasized that measures like tighter capital and liquidity requirements, heightened risk-management standards, limits on risky activities, improved governance of SIBs by boards of directors, prudent bank compensation programs, and strengthened consolidated supervision of banking groups are set of crisis prevention measures that better regulate and supervise SIBs and have to be adopted by government or policymakers.

It also suggested that authorities must develop more stringent capital and liquidity measures for SIBs to limit excessive growth during good times and allow for greater shock absorption during stressful times.

The author identify the first line of defense against financial instability as strengthening the risk management standards and practices of SIBs in order to rein in excessive risk taking, particularly during good time.

He also suggested that authorities should ensure that SIBs held to a higher standard than non-SIBs to ensure that SIBs' risk-management systems and underlying practices reflect their size, complexity, and role in the economy.

The paper also acknowledge that stronger financial buffers and better risk management alone cannot prevent higher-risk activities from causing another systemic crisis because global financial crisis has demonstrated that SIB's excessive risk taking can be catastrophic. As a result policymakers should set percentage of capital limit on SIBs' high-risk activities.

The author observed that inadequate oversight by SIBs' board of directors was the fundamental cause of financial crisis and, therefore, suggested that regulatory authorities must prescribe more stringent "fit and proper" criteria for board of directors of SIBs so that they can establish or enforce a suitable risk tolerance threshold.

The paper also suggested that a design compensation program that reward longer-term performance and promote sound risk management should be put in place to address the problem of excessive risk taking and reward short-term profits at the expense of longer-term viability as revealed by the financial crisis.

The paper was of the view that the inclusion of more stringent regulation, stronger risk management, and better board of director oversight must be followed by a robust consolidated supervision.

The policymakers must prepare for a death or near-death experience of SIBs in order to save the economy and financial institutions from stress. The author further suggested that policy put in place must allow for orderly unwinding of a failed SIB.

He acknowledged that key management of the bank should be replaced with government- appointed staff and government should have officials to block the payment of contractual bonuses to top management staff of failed SIBs.

The author also suggested that there should be explicit roles regarding who gets paid first and the minimum losses to be shared by creditors.

The author thought that SIBS could be required to pay fees to a resolution funds which would be used to offset some of the costs the government might incur in keeping a failed SIB operational.

The paper concluded that authorities should rethink their mind-set that some banks may be too big to fail.

## **I. Comments**

The paper on "Too Big to Ignore" revealed that no bank is too big to fail but some banks may be too big to liquidate immediately. Therefore, authorities of any economy must formulate policies that will prepare for a death or near- death of an SIB to determine whether to allow an SIB to fail and if it does fail, how to minimize the damage to the real economy and the financial system as a whole.

Although the author did not suggest how countries that lack the technical capabilities to design sound and good policies can avail themselves of the technical assistance available in the institutions, yet the ability of any economy to

withstand global economy crisis still depends on a basket of sound policies put in place by the authorities or policymakers of that economy.

## **II. Lesson For Nigeria**

Important issues emerged from the paper, which the Nigeria authorities could adopt to safeguard the important financial institutions in the economy during and after any economic crisis. Among these were: first, authorities should believe in the reliability of SIBs risk models and sound risk management. Second, they should ensure risk-based supervision at regulatory authorities and market discipline.

Generally, the Nigeria authorities should showcase their perceived strength in areas like economies of scale, access to global wholesale funding, product innovation and application of sophisticated risk management practices and also, a long-term solution to the big-to-fail problems should warrant formulation of intrusive and more conservative regulatory constraint, combined with supervisor's greater willingness.

These preventive measures must be augmented with a credible insolvency regime that improves market discipline on management, shareholders and creditors, if the too big to fail doctrine is to be permanently eliminated.

## **References**

Zamil, S. R. (2009). "Too Big to Ignore", *IMF Finance and Development*, Vol. 46, Number 4, December, 2009. Pp.41 - 44

**SUBMISSION OF MANUSCRIPT TO CBN ECONOMIC AND FINANCIAL REVIEW**

1. Three (3) hardcopies and a softcopy of the original manuscript should be addressed to the:

**Editor-in-chief**  
**CBN Economic and Financial Review**  
**Research Department**  
**Central Bank of Nigeria**  
**P.M.B.0187, Garki, Abuja**

The softcopy of the papers can also be submitted via email as electronic document, preferably Microsoft word document to either of the following email addresses: [cnomordi@cbn.gov.ng](mailto:cnomordi@cbn.gov.ng); [aoadenuga@cbn.gov.ng](mailto:aoadenuga@cbn.gov.ng)

The article should not be more than 30 pages on A4 size paper and should be typed double-spaced with a margin of 1.5 inches on all sides. The manuscript **must** be accompanied with a letter of submission written in English. Submission of a paper is assumed to imply that its contents represent original and unpublished work and is not under consideration elsewhere for publication. Normally, the review process is expected to take not more than three months. There is neither a submission charge nor page fee. A return address (postal/email) should be indicated.

2. Papers may be accepted or returned for specified revisions. A paper is expected to be published approximately six months from the date of acceptance.
3. *Comments on published article/notes* and *reviews* of up to 2,000 words will also be considered for publication. Notes deal with relevant topics not meeting full length articles. Reviews may be about articles published recently by this journal or elsewhere. A copy of the review/comments should be sent to the articles' author for clarification of any points or misunderstandings.
4. All submitted manuscripts are referred to an Editorial Board comprising of an in-house editorial committee and external referees. All comments by the referees will be sent to the author(s) together with a decision of the Editorial Board.

5. The purpose and scope of the article should be clearly stated in an abstract summarizing the article's essential points. The abstract should be typed on a separate page and should be between 80-100 words in length. In addition, the JEL classification code (s) as well as keywords should be clearly indicated on the abstract page.
6. The author's institutional affiliation and necessary background information on the article should appear at the foot of the first page. Footnote to the text should be listed at the end, followed by the list of references
7. References for quotations or statements should be in parentheses in the text, not as notes. E.g. Hess (1906:20) or Cagan (1958) or Majer (1975:35). Where more than three authors are involved, cite senior author and use *et al.*, E.G. Johnson *et al.* (1988).
8. Citations listed under the reference sections must begin on a new page. All entries must be typed double-spaced, listed alphabetically by last name of senior author and chronologically for two or more articles by the same author. The typed layout must conform to the following examples:  
Nnanna, O.J. (2003). "Promoting Savings and Investment Culture for National Development." *CBN Economic and Financial Review*. Vol 41. No. 3 pp. 1-10  
Oresotu, F.O. and C.N.O. Mordi (1992). "The Demand for Money Function in Nigeria: An Empirical Investigation." *CBN Economic and Financial Review*. Vol.30, No.1 pp.32-69.  
Croxtan.,F.E.; F.E. Cowden; and S. Klein, (1968). *Applied General Statistics*. London: Sir Isaac Pitman and sons.
9. All tabular materials should be separated from the text in a series of tables numbered consecutively in Arabic numerals preferably in Microsoft Excel. Each table should be typed double-spaced and identified by a short descriptive at the top. Notes for table should be at the bottom of each table, before the source, and marked by lower case superscript letters. Appropriately placed tables should be indicated in the text.
10. Diagrams, graphs, charts, etc. must be separated from the text and clearly drawn in black ink on a white paper with all axes clearly positioned. They



should be submitted in a form suitable for reproduction without redrawing, preferably in camera-ready artwork.

11. Where mathematical equations and formulae are used, they should be typed clearly. Notations, exponents, etc, which are simple to reproduce should be used. The equations should be numbered consecutively in Arabic numerals. The full mathematical workings necessary for justifying each step of the argument should accompany all the articles of a mathematical nature. This is meant to assist the reviewers and will not be published.