REVISED SMALL MACRO-ECONOMETRIC MODEL OF THE NIGERIAN ECONOMY[1]

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Abstract
The first operational small-scale macro-econometric model of the Nigerian Economy was developed in 2013. Ever since, the country has witnessed significant changes owing to oil price shock which culminated in internal and external imbalances. Addressing these challenges among others, informed the revision of the model. Thus, in the revised model, provisions are made for unemployment and the role of expectations and uncertainty surrounding the oil and foreign exchange markets. By simulating three alternative policy scenarios using oil price, monetary policy rate and cash reserve ratio, some striking results are obtained with implications for monetary policy in Nigeria. Alternative method was applied in the disequilibrium model of demand and supply of primary and intermediate inputs by Guisan (2011, 2013), this further supports the potential of monetary policy in addressing macroeconomic variables through interest rate channel.

Keywords: Macro-econometric models; Policy simulation; Nigerian economy
JEL Classification: C50; E27; E58

1. Introduction

The small scale macro-econometric model of the Nigerian economy, was adopted by the Central Bank of Nigeria (CBN) as one of its suite of models for policy analyses. Since no single model is capable of proffering answers to all policy questions, Central Banks often resort to having a suite of models with each tailored to addressing specific policy issues. Other macro-econometric models of the CBN include, but not limited to, sectoral models, covering monetary, fiscal and external sectors; Dynamic Stochastic General Equilibrium (DSGE) model with friction; and Factor Augmented Vector Autoregressive (FAVAR) models. These models serve as a basis for critical evaluation and meaningful prediction of monetary policy measures and their outcomes. The design of the small scale macro-econometric model was intended to facilitate the monetary policy decisions of the Monetary Policy Committee (MPC), track and forecast key macroeconomic variables, trace out sectoral linkages and, provide a basis for sound policy design and implementation.

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It has been observed that in spite of the efficient and robust nature of the model, it has some inherent short-comings namely: (a) failure to capture current developments in the financial sector; and (b) exclusion of the labor market. Besides addressing these shortcomings, the revised model is more compact but detailed in terms of evaluating the dynamics in the financial sector; thereby, circumventing the challenges associated with large scale models. There is also the inclusion of uncertainty for better tracking of linkages in the system of equations. Consequently, this revised version is intended to address the shortcomings of the existing model as much as possible, and meet the current needs and challenges of the CBN in the conduct of monetary policy.
The first version of the model was published in 2013 (see Olofin et al., 2014). Ever since, the country has witnessed significant changes owing to oil price shock which culminated in internal and external imbalances. Therefore, the main objective of the study is to update the existing macro-econometric model of the Nigerian economy. The model is designed to guide the monetary authorities in monetary policy formulation, financial sector monitoring, and evaluation of the potential impact of alternative policy measures and their outcomes. It is meant to assist in the simulation and forecasting of the direction of economic policy. It equally addresses the relationship between monetary policy and the real sector of the economy, and the likely response of key macroeconomic variables to potential major shocks such as the recent oil price shocks.
For the CBN to continue functioning effectively as an important player in economic management in Nigeria, it has the need for an adequate and up-to-date knowledge of the workings of the economy. It therefore, follows that any effort directed at understanding the way the Nigerian economy works will assist the CBN in no small measure in achieving its monetary policy goals and objectives.
The study is structured into six sections. Following the introduction, Section 2, provides a brief review of the theoretical and empirical literature on macro-econometric modeling and also identifies the emerging issues in macroeconomic modeling. The theoretical framework and model specification are considered in Section 3. In Section 4, the estimated equations are presented. Model simulations, covering policy analysis based on alternative monetary rules and conduct constitutes the focus of Section 5. Section 6 summaries and concludes the paper.

2. Literature Review

Generally speaking, some form of macro-modeling has played crucial roles in the formulation and implementation of policies in government circles as well as in central banks dating back to the 1940s. However, of late, owing to the progress made in introducing micro foundations to macroeconomic analysis, the discussion of macro-econometric models has declined both in the academia and in policy circles. By and large, attempts at modeling macroeconomic dynamics is evident in both the developed and developing economies. Examples include Laubach et al. (2014) for the US; Umeda (2015) for Japan; Batini and Haldane (1999) and Garratt et al. (2003) for the UK; Morana (2005), Dreger and Marcellino (2007) and Doménech et al. (2001) for the European Monetary Union; Martínez et al. (2002) for Mexico; Stone et al. (2005) for Australia; Cagas et al. (2006) for Philippine economy; Kasimati and Dawson (2009) and Asteriou et al. (2011) for Greece; Andersen et al. (2005) for Lithuania; and Grech et al. (2013) for the Maltese economy.

In Nigeria, modeling effort geared towards macro-econometric models is still emerging[2]. Recent contributions are provided in Adenikinju, Busari and Olofin (2009). The macroeconomic models reviewed include the Input-Output (I-O) models, MEMs and CGEMs. On the I-O models, while Adenikinju *et al.* (1993) acknowledge that significant achievements have been made in the area of constructing I-O tables for Nigeria, prominent among which include Carter (1960), Clark (1968), Aboyade (1981), Olayide, *et al.* (1981) and Iyaniwura and Olofin (1988), they however, argue that only few attempts have been made to develop I-O models with Oshikoya (1989) and CEAR (1992) being prominent.
With regard to macro-econometric models, two categories have remained dominant namely; individual efforts and institutionally supported projects. Among the former category are Ojo (1972), Adamson (1974), Gosh and Kozi (1978), Olofin (1977), Uwujaren (1977), Olofin (1985), Jerome, Olofin and Adenikinju (2002), Soludo (2002), Adenikinju and Jerome (2006), Akanbi and Du Toit (2009) and Olofin et al (2014)and the latter category include the World Bank (1974), UNCTAD (1973), NISER (1983, 1987), CBN (2010) and models by CEAR (CEAR Model-MAC III and IV and CEAR Link model) and the African Institute for Applied Economics (AIAE).
Akanbi and Du Toit (2009) developed a macro-econometric model aimed at providing insights into growth-poverty divergence, evidently persistent, in the Nigerian economy by supplying long-run supply-side characteristics of the economy. Based on the structure of the economy, four major sectors were modeled: real, external, and monetary and government sectors. The production function followed endogenous growth theories and was disaggregated into two functional forms: oil sector and the rest of the economy. The Kalman filter estimation technique was applied to the production function to make the technological progress time variant. The model comprised 17 equations and 5 identities. Estimation of the behavioral equations was carried out using data from 1970 to 2006 and the Engle-Granger two-step co-integration technique was employed to capture long-run relationships and short-run dynamics of the Nigerian economy. The model was applied to testing hypothesis of existing structural supply constraints versus demand-side constraints impeding the growth and development of the country. Based on the historical performance of the economy and the simulation results of different policy measures, the study concluded that a model capturing structural supply constraints will be appropriate for the Nigerian economy in addressing the high and sticky level of poverty.
In a more recent study, Olofin et al. (2014) constructed a small-scale macro-econometric model of the Nigerian economy to analyze the effects of monetary policy scenarios involving the monetary policy rate. The model is based on the New Keynesian monetary model and comprised 5 equations – the IS, LM, aggregate supply, exchange rate and the monetary policy rate. These equations were estimated simultaneously using different techniques as the ordinary least squares, two-stage ordinary least squares, three-stage ordinary least squares and the full information maximum likelihood methods. Policy simulation and forecast generation were executed using the OLS results. Forecasts statistics such as the Theil's inequality coefficient and the Root Mean-Squared Percent Error (RMSPE) revealed that the model tracks each of the macroeconomic variables reasonably well.

[2] See Adenikinju, Afeikhena and Olofin (1993) for a comprehensive review of early contributions to macroeconomic models in Nigeria.

3. Methodology

3.1 Data Issues, Sources and Description

The data for this study were obtained from the Central Bank of Nigeria database and the IMF financial statistics. The choice was to ensure that the various variables in the model were based on a consistent and verifiable scalar. The domestic data were obtained from the CBN while the foreign components were curled from the IMF Financial Statistics.
Quarterly data ranging from 1985Q1 to 2016Q2 were utilized to estimate a macro-econometric model of the Nigerian economy. The variables include output, inflation, interest rate, money supply, monetary policy rate, cash reserve requirement, index of energy prices, credits to private sector, export, imports, exchange rate, unemployment, government expenditure, US interest rate, US output, US index of industrial production and oil price. A brief description of these variables is contained in the appendix.
Given the classification of the variables into nominal and real variables, the choice of the variables in each equation was based on the nature of the predictive models/variables. Nonetheless, the variables in the equations were chosen, based on their expected impact in each equation and in the model as a system of equations. Furthermore, some of the data were transformed while the ones expressed in ratios were converted to growth rates, to ensure that the estimates obtained from the equations are amenable to simple interpretation and make economic sense.

3.2 Model Specification

3.2.1 Exchange Rate Equation.

The framework for the exchange rate equation relies on the monetary theory of exchange rate determination. This equation is regarded as a "standard workhorse" in international macroeconomics (Frankel and Rose, 1995). Despite its weaknesses, the determinants reflected in the equation are consistent with those from recent micro-founded exchange rate models (Bianco, et al., 2012). While there are variants of the model (such as Dornbusch, 1976; Frankel, 1979, 1982; Hooper and Morton, 1982; Kang, Ratti and Vespignani, 2016, Burns, 2016), it relies on stable money demand functions with continuous stock equilibrium in the money market. The model assumptions are threefold: purchasing power parity, uncovered interest parity, and existence of stable money demand functions for the domestic and foreign economies (see also Civcir, 2003; Bianco, et al., 2012; Engel, 2016).

3.2.1.1 Frenkel-Bilson Model - The Flexible-Price Monetary Model

In the Frenkel-Bilson flexible price model, the fundamentals of exchange rate determination consist of the growth of money supply, output growth and the short-term interest rate. A priori, exchange rate is positively related to monetary growth and negatively related to interest rate and economic growth. In other words, in full equilibrium, increasing the money supply inflates prices and thus raises the exchange rate. Also, an increase in the level of output or raising the rate of interest lowers the exchange rate[2]. The long-run and short-run versions of the model are in equations (1) and (2) respectively.

$$s_t = c + \beta\left(m_t - m_t^*\right) + \delta\left(y_t - y_t^*\right) + \lambda\left(i_t - i_t^*\right) + \psi \text{uncertainty}_t + \varepsilon_t \qquad (1)$$

$$\beta > 0;\ \delta < 0;\ \lambda < 0;\ \psi > 0$$

$$\Delta s_t = c + \phi_1 s_{t-1} + \beta_1\left(m_{t-1} - m_{t-1}^*\right) + \delta_1\left(y_{t-1} - y_{t-1}^*\right) + \lambda_1\left(i_{t-1} - i_{t-1}^*\right) + \psi_1 \text{uncertainty}_{t-1}$$
$$+ \sum_{j=1}^{N1} \phi_{2j} \Delta s_{t-j} + \sum_{i=0}^{N2} \beta_{2i} \Delta\left(m_{t-i} - m_{t-i}^*\right) + \sum_{i=0}^{N3} \delta_{2i} \Delta\left(y_{t-i} - y_{t-i}^*\right)$$
$$+ \sum_{i=0}^{N4} \lambda_{2i} \Delta\left(i_{t-i} - i_{t-i}^*\right) + \sum_{i=0}^{N5} \psi_{2i} \Delta \text{uncertainty}_{t-i} + \varepsilon_t \quad (2)$$

where s_t is the logarithm (log) of the exchange rate (Naira/\$); m_t is the log of the domestic nominal money supply, y_t is the log of real output, i_t is the interest rate while the corresponding foreign variables (using US data)3 are denoted by an asterisk, c is an arbitrary constant, and ε_t is a disturbance term. An uncertainty variable was included to capture volatility and leverage effects in the Nigerian foreign exchange market (see equations (1) and (2)). This variable is measured using the EGARCH framework that allows for nonlinearities as well as asymmetries in the series in question.

In the literature, a number of studies have demonstrated a stable long-run relationship between nominal exchange rates and monetary fundamentals (see for example, Chinn and Meese, 1995; Mark, 1995; MacDonald, 1999; Groen, 2000; Mark and Sul, 2001; and Rapach and Wohar, 2001; Civcir, 2003; Engel, 2016; Kang et al., 2016). Most of the existing studies also find that nominal exchange rate forecasts based on the monetary model are generally superior to forecasts of a naive random-walk model (see also Moosa and Burns, 2014; Burns, 2016).

3.2.1.2 Dornbusch-Frenkel Model - The Sticky-Price Monetary Model

In the sticky price model, the exchange rate is specified as a function of the growth of money supply between two successive periods, output growth, the short-term interest rate, long-term interest rate and inflation rate. The theoretical expectation is for the exchange rate to respond positively to monetary growth and expected inflation[4] but negatively to interest rate and output growth. The equations for long run and short run versions of the model are specified below:

$$s_t = c + \beta\left(m_t - m_t^*\right) + \delta\left(y_t - y_t^*\right) + \lambda\left(i_t - i_t^*\right) + \vartheta\left(\pi_t - \pi_t^*\right) + \psi \text{uncertainty}_t + \varepsilon_t \quad (3)$$
$$\beta > 0;\ \delta < 0;\ \lambda < 0;\ \vartheta > 0;\ \psi > 0$$

$$\Delta s_t = c + \phi_1 s_{t-1} + \beta_1\left(m_{t-1} - m_{t-1}^*\right) + \delta_1\left(y_{t-1} - y_{t-1}^*\right) + \lambda_1\left(i_{t-1} - i_{t-1}^*\right) + \vartheta_1\left(\pi_{t-1} - \pi_{t-1}^*\right)$$
$$+ \psi_1 \text{uncertainty}_{t-1} + \sum_{j=1}^{N1} \phi_{2j} \Delta s_{t-j} + \sum_{i=0}^{N2} \beta_{2i} \Delta\left(m_{t-i} - m_{t-i}^*\right) + \sum_{i=0}^{N3} \delta_{2i} \Delta\left(y_{t-i} - y_{t-i}^*\right)$$
$$+ \sum_{i=0}^{N4} \lambda_{2i} \Delta\left(i_{t-i} - i_{t-i}^*\right) + \sum_{i=0}^{N5} \vartheta_{2i}\left(\pi_{t-i} - \pi_{t-i}^*\right) + \sum_{i=0}^{N6} \psi_{2i} \Delta \text{uncertainty}_{t-i} + \varepsilon_t \quad (4)$$

Where, π_t is the inflation rate while all the other variables are as previously defined.

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[3] The US dollar accounts for about 75% of foreign exchange utilization in Nigeria (CBN, 2015). Thus, the Naira-Dollar exchange rate may be influenced by some macroeconomic fundamentals driving the US dollar.

[4] However, the relationship between exchange rate and expected inflation is hypothesized to be insignificant by Bilson (1978) and Dornbusch (1976) but positive by Frenkel (1976).

3.2.1.3 Hooper-Morton Model

The Hooper-Morton's variant of the monetary model includes trade balance as in other fundamentals that characterize the monetary model. The model assumes that the purchasing power parity only holds for tradable goods. A priori, the exchange rate will be negatively related to growth, interest rate and current account balance but positively related to monetary growth and inflation.

$$\begin{aligned} s_t &= c + \beta\left(m_t - m_t^*\right) + \delta\left(y_t - y_t^*\right) + \lambda\left(i_t - i_t^*\right) + \vartheta\left(\pi_t - \pi_t^*\right) \\ &\quad + \eta\left(B_t - B_t^*\right) + \psi \text{uncertainty}_t + \varepsilon_t \\ &\quad \beta > 0;\ \delta < 0;\ \lambda < 0;\ \vartheta > 0;\ \eta < 0,\ \psi > 0 \end{aligned} \tag{5}$$

$$\begin{aligned} \Delta s_t &= c + \phi_1 s_{t-1} + \beta_1\left(m_{t-1} - m_{t-1}^*\right) + \delta_1\left(y_{t-1} - y_{t-1}^*\right) + \lambda_1\left(i_{t-1} - i_{t-1}^*\right) + \vartheta_1\left(\pi_{t-1} - \pi_{t-1}^*\right) \\ &\quad + \psi_1 \text{uncertainty}_{t-1} + \eta_1\left(B_{t-1} - B_{t-1}^*\right) + \sum_{j=1}^{N1} \phi_{2j} \Delta s_{t-j} \\ &\quad + \sum_{i=0}^{N2} \beta_{2i} \Delta\left(m_{t-i} - m_{t-i}^*\right) + \sum_{i=0}^{N3} \delta_{2i} \Delta\left(y_{t-i} - y_{t-i}^*\right) + \sum_{i=0}^{N4} \lambda_{2i} \Delta\left(i_{t-i} - i_{t-i}^*\right) \\ &\quad + \sum_{i=0}^{N5} \vartheta_{2i}\left(\pi_{t-i} - \pi_{t-i}^*\right) + \sum_{i=0}^{N6} \eta_{2i}\left(B_{t-i} - B_{t-i}^*\right) + \sum_{i=0}^{N7} \psi_{2i} \Delta \text{uncertainty}_{t-i} + \varepsilon_t \end{aligned}$$

3.2.2 Macroeconomic Models for Inflation

3.2.2.1 Richards-Stevens Model: Mark-up Model of Prices

The theoretical framework used in this research for the empirical determination of inflation in Nigeria is the mark-up model. The choice of this framework is not unconnected with the model's universality of application and its centrality in many other models. In particular, the empirical model derived thereof can theoretically reflect features of the Phillips curve and the purchasing power parity, the two important models in explaining the inflation determination process. The mark-up model proposes that the domestic price level, in the long-run, is a mark-up over total unit costs. In the model, the relationship among the determinants of the long run domestic prices is assumed to be linearly homogeneous of degree one (sum of the elasticities is equal to one) with the nominal unit labor costs, import prices and energy cost entering the equation. In other words, each of the model elasticities is equal to or greater than zero. Consequently, the log-linear function of the model clarifies how the model links to three markets namely labor, foreign and energy markets. The model, in real prices, reflects the purchasing power parity arising from the real import prices, while the inclusion of the output gap to track how the mark-up adjusts over the business cycle ties the mark-up to the Phillips curve. A priori, all the elasticities are assumed to be positive. The static and dynamic versions of the model are represented in equations (7) and (8) respectively.

$$\begin{aligned} p_t &= c + \gamma ulc_t + \phi ip_t + \lambda pet_t + \varepsilon_t \\ &\quad \gamma > 0;\ \phi > 0;\ \lambda > 0 \end{aligned} \tag{7}$$

$$\begin{aligned} \Delta p_t &= c + \rho_1 p_{t-1} + \gamma_1 ulc_{t-1} + \phi_1 ip_{t-1} + \lambda_1 pet_{t-1} \\ &\quad + \sum_{j=1}^{N1} \rho_{2j} \Delta p_{t-j} + \sum_{i=0}^{N2} \gamma_{2i} \Delta ulc_{t-i} + \sum_{i=0}^{N3} \delta_{2i} \Delta ip_{t-i} + \sum_{i=0}^{N4} \lambda_{2i} \Delta pet_{t-i} + \varepsilon_t \end{aligned} \tag{8}$$

3.2.2.2 The Augmented Phillips Curve

The Augmented Phillips Curve (APC) is an improvement on the Traditional Phillips Curve (TPC) that establishes a negative relationship between unemployment and inflation. The TPC was first observed by Phillips (1958) and further complemented by Samuelson and Solow (1960). However, the TPC was vehemently criticized on the grounds that it is only valid in the short run; implying that the unemployment rate is inflation neutral in the long run. This view was first echoed by Friedman (1968), demonstrating that rather than the negative relationship, there could be possibility of stagflation where a concurrence of high unemployment and high inflation at the same time exist. The probable incidence of stagflation reinforces the role of expectations in the unemployment-inflation trade-offs. In essence, once private agents understand the orientation of the monetary policy authority in relation to unemployment (that is, to reduce unemployment using expansionary monetary policies); they begin to form expectations for higher inflation rates, thereby resulting in increased demand for high wages (by workers) and higher prices of goods and services (by producers/employers) near the anticipated inflation. Consequently, unemployment begins to rise back to its previous level, but now with higher inflation rates (Stagflation). This further justifies why the issue of unemployment and inflation targeting is usually considered a short run phenomenon to achieve superior outcomes; and if these targets are pursued in the long run, they may become self-defeating.

On the basis of these shortcomings of the TPC, the augmented accounts for inflationary expectations in the empirical framework thus making the APC more prominent in the literature than the TPC. The APC is regarded as the modern version of the TPC and it allows for both short run and long run Phillips Curves. In the short run, the inverse relationship is anticipated, while in the long run, the relationship breaks down and the economy eventually returns to the natural rate of unemployment regardless of the inflation rate. Technically, the short run version of the APC is described as the expectations-augmented Phillips curve (Friedman-Phelps version) while the long run version is the Non-Accelerating Inflation Rate of Unemployment (NAIRU) (*Modigliani-Papademos* version). The Short run Phillips Curve also appears to mimic the New Keynesian Phillips Curve (Roberts version) indicating that increased inflation can lower unemployment temporarily, but cannot lower it permanently (see also Clarida et al., 1999; Blanchard and Gali, 2007). Since, in the long run, unemployment is inflation neutral (in other words, the rate of unemployment is monetary policy neutral in the long run); we are focusing on the short run version within which the Central Bank of Nigeria can influence the level of unemployment. The Short run version (expectations-augmented Phillips curve):

$$\pi_t = c + \rho\pi_t^e + \delta(\mathrm{U}_t - \mathrm{U}_t^{NAT}) + \varepsilon_t$$
$$\rho > 0;\ \delta < 0 \tag{9}$$

The Short run version (The New Keynesian Phillips Curve):

$$\pi_t = c + \beta E_t\left(\pi_{t+1}\right) + \beta y_t + \varepsilon_t \tag{10}$$

3.2.2.2 The Monetary-Keynesian Theory of Inflation

Equations (11) and (12) represent the static and dynamic functional forms of the monetarist-Keynesian model of price determination. In each of the schools of thought, rational expectation is assumed except that in the latter case, the effect of fiscal policy is captured. Consequently, in the monetarist-Keynesian model, the price level is expressed as a function of the contemporaneous and expected money supply. Also, the inclusion of government deficits in nominal terms in the model tracks clearly the effects of fiscal policy hitherto subsumed in money supply, and hence prices. Further, in a standard Keynesian framework, the actual money supply which reflects the equilibrium between demand and supply of money is determined by income, prices and interest rate. The inclusion of the exchange rate in the model captures the pass-through effect with the theoretical underpinnings of the purchasing power parity and uncovered interest rate parity in an open economy. Thus, the price level is hypothesized to relate positively to money supply $(0<\gamma\leq 1)$, fiscal deficit (with a zero coefficient suggesting the absence of fiscal effects in the price level for strictly monetarist model), and exchange rate and negatively to interest rate.

$$p_t = c + \gamma m_t + \phi i_t + \lambda s_t + \tau D_{t-1} + \varepsilon_t$$
$$\gamma > 0;\ \phi < 0;\ \lambda > 0;\ \tau > 0 \qquad (11)$$

$$\Delta p_t = c + \rho_1 p_{t-1} + \gamma_1 m_{t-1} + \phi_1 i_{t-1} + \lambda_1 s_{t-1} + \tau_1 D_{t-1} + \sum_{j=1}^{N1} \rho_{2j} \Delta p_{t-j} + \sum_{i=0}^{N2} \gamma_{2i} \Delta m_{t-i} + \sum_{i=0}^{N3} \delta_{2i} \Delta i_{t-i} + \sum_{i=0}^{N4} \lambda_{2i} \Delta s_{t-i} + \sum_{i=0}^{N5} \tau_{2i} \Delta D_{t-i} + \varepsilon_t \qquad (12)$$

3.2.3 Money Demand Model: The Standard Keynesian Theory of Money Demand

The underlying theoretical framework of the Keynesian demand for money function hinges on Keynes liquidity preference theory (Keynes, 1936). In the framework, the transaction, precautionary and speculative motives are the main reasons for holding money. Laidler's criticism (Laidler, 1977) suggested that Keynes speculative theory highlights a negative relationship between the demand for money and interest rate. A reformulation by Friedman (1956) modeled the demand for money to include asset and transactions theory based on a neoclassical theory of consumer and producer demand within the quantity theory of money. To Friedman, the velocity of money can be predicted, while the demand for money is stable and not sensitive to interest rates. To evaluate stability and sensitivity to interest rate and asset prices, the demand for money is specified to depend on prices, interest rate and exchange rate. The static and dynamic forms are given in equation (13) and (14).

$$m_t = c + \gamma p_t + \phi i_t + \lambda s_t + \delta y_t + \varepsilon_t \qquad (13)$$

$$\Delta m_t = c + \rho_1 m_{t-1} + \gamma_1 p_{t-1} + \phi_1 i_{t-1} + \lambda_1 s_{t-1} + \delta y_{t-1} + \sum_{j=1}^{N1} \rho_{2j} \Delta m_{t-j} + \sum_{i=0}^{N2} \gamma_{2i} \Delta p_{t-i} + \sum_{i=0}^{N3} \delta_{2i} \Delta i_{t-i} + \sum_{i=0}^{N4} \lambda_{2i} \Delta s_{t-i} + \sum_{i=0}^{N5} \delta_{2i} \Delta y_{t-i} + \varepsilon_t \qquad (14)$$

3.2.4 Output Determination

The output model is hinged on the Keynesian IS framework (see also Berg et al, 2006) and can be represented as:

$$y_t = \eta + \psi_1 y_{t-1} + \psi_2 \left(i_{t-1} - \pi_t^e\right) + +\psi_3 \log(rexr_{t-1}) + \gamma' Z + \varepsilon_t \quad (15)$$
$$\psi_2 < 0, \quad \psi_3 < 0$$

We also have the output gap version of equation (15) which captures the deviation of actual output from its potential.

$$\left(y_t - y_t^p\right) = \eta + \psi_1 \left(y_{t-1} - y_{t-1}^p\right) + \psi_2 \left(i_{t-1} - \pi_t^e\right) + +\psi_3 \log(rexr_{t-1}) + \gamma' Z + \varepsilon_t \quad (16)$$
$$\psi_2 < 0, \quad \psi_3 < 0$$

where $\left(y_t - y_t^p\right)$ denote the output gap; y_t is the log of real GDP; y_t^p is the potential output measured using the Hodrick-Prescott approach; i_t is the nominal interest rate, π_t^e is the expected inflation, $\left(i_{t-1} - \pi_t^e\right)$ is the real interest rate (lagged); $rexr_{t-1}$ which is the lagged real exchange rate; and Z is a vector of control variables. The level of real economic activity is expected to respond negatively to the real interest rate since a higher level of interest rate discourages investment activities. A depreciation in $rexr_t$ is expected to increase the level of real output and therefore, $\psi_3 < 0$. This can be justified on the grounds that depreciation in the real exchange rate enhances the attractiveness of exports to foreign purchasers, while it renders imports more expensive to domestic purchasers (see also Batini and Haldane, 1999).

Other variables included in equations (15) & (16) as control variables are share of intermediate imports in GDP $(mshare_t)$, infrastructure (infra_t) proxied by power generated) and domestic credit to the economy $(credit_t)$. Therefore, equations (15) & (16) can be extended as follows:

$$y_t = \eta + \psi_1 y_{t-1} + \psi_2 \left(i_{t-1} - \pi_t^e\right) + +\psi_3 \log(reexr_{t-1}) + \psi_4 mshare_t + \psi_5 \log(\text{infra}_t) + \psi_6 \log(credit_{t-1}) + \varepsilon_t \quad (17)$$

$$\left(y_t - y_t^p\right) = \eta + \psi_1 \left(y_{t-1} - y_{t-1}^p\right) + \psi_2 \left(i_{t-1} - \pi_t^e\right) + +\psi_3 \log(rexr_{t-1}) + \psi_4 mshare_t + \psi_5 \log(\text{infra}_t) + \psi_6 \log(credit_{t-1}) + \varepsilon_t \quad (18)$$
$$\psi_2, \psi_3 < 0; \quad \psi_4, \psi_5, \psi_6 > 0$$

3.2.5 Unemployment Determination

The employment utilized in the primary, secondary and tertiary sectors of the economy is influenced by the demand for and supply of goods and services which equally affect wage and price levels. The specification of the employment equation is derived from the Okun's Law (OL thereafter). The OL is important for both theoretical and empirical reasons. From a theoretical point of view, OL, which is rooted in old and new Keynesianism along with the Phillips curve, is a key element to derive the aggregate supply curve from an empirical perspective (see Villaverde and Maza, 2009). In addition, it has been used in macroeconomic models (see for example, Dreger and Marcellino, 2007; Pierdzioch et al., 2009; Mitchell and Pearce, 2010; and Rulke, 2012). The strong empirical support for

OL has led Blinder (1997) to suggest that Okun's law should be viewed as one of the cornerstones of modern practical macroeconomics (Rulke, 2012).
In the OL framework, a negative relationship is postulated between the unemployment rate and the growth rate of real output (Okun, 1962 and 1970) and the model, augmented with relevant control variables, can be expressed as:

$$\Delta u_t = \alpha + \beta \Delta y_t + \delta' Z + \varepsilon_t ;\ (\beta < 0) \tag{19}$$

where $\Delta u_t = u_t - u_{t-1}$ and $\Delta y_t = y_t - y_{t-1}$. y_t is the log of real output at period t; u_t is the observed unemployment rate; and Z is a vector of control variables. The latter include tertiary enrolment, share of import of intermediate inputs in GDP, and share of export in GDP (see Sousa et al, 2012). The parameter α is the intercept, β is the Okun's coefficient which measures how much changes in output produce changes in unemployment rate, and ε_t is the disturbance term. Equation (19) is a first-difference model and is a widely used approximation of OL. The model is built upon the assumption that both the natural rate of unemployment and the growth rate of potential output are constant (see also Rulke, 2012).
Equation (19) can be extended to include the mentioned control variables:

$$\Delta u_t = \alpha + \beta \Delta y_t + \delta_1 ter_t + \delta_2 xshare_t + \delta_3 mshare_t + \varepsilon_t \tag{20}$$

$$\beta, \delta_1, \delta_2, \delta_3 < 0$$

Another specification of the OL is a 'gap' model and can be expressed as:

$$u_t^{gap} = \alpha + \beta y_t^{gap} + \delta' Z + \varepsilon_t ;\ (\beta < 0) \tag{21}$$

where $u_t^{gap} = u_t - u_t^n$ and $y_t^{gap} = y_t - y_t^p$. u_t^n is the natural rate of unemployment; y_t^p is the log of potential output and Z is as earlier defined. u_t^{gap} and y_t^{gap} represent the unemployment gap and output gap respectively. In other words, the difference between the observed and potential real GDP captures the cyclical level of output. Likewise, the difference between the observed and natural rate of unemployment represents the cyclical rate of unemployment. As previously noted, data on u_t^p and y_t^p are not readily observable; therefore, the Hodrick–Prescott (HP) filter is employed to estimate the series. Given the modifications to equation (19) as reflected in equation (20), equation (21) can also be expanded to account for the control variables:

$$u_t^{gap} = \alpha + \beta y_t^{gap} + \delta_1 ter_t + \delta_2 xshare_t + \delta_3 mshare_t + \varepsilon_t \tag{22}$$

$$\beta, \delta_1, \delta_2, \delta_3 < 0$$

3.2.6 Determination of Interest Rate (Short)

The interest rate model follows the standard forward-looking version of the Taylor rule5. The model has been empirically validated to be consistent with the behavior of short term interest rate in Nigeria (see for example, Olofin et al., 2014). The θ parameter in (23) demonstrates the importance of policy inertia, which is evident in Nigeria particularly with respect to the use of monetary policy rate. The forward looking (or expected) inflation depicts how current interest rates respond to expected future trend in inflation. The model

[5] See Clarida et al. (2000) for a detailed theoretical exposition of the model.

is augmented to capture the role of monetary policy rate in the determination of interest rate and it also serves as monetary policy shocks in the model since the natural path of interest rate can be altered with this policy instrument (see also Olofin et al., 2014). Unlike the aggregate demand and supply shocks, monetary policy shocks are assumed to be uncorrelated over time (see Clarida et al., 2000). The interest rate model is specified below:

$$i_t = \theta i_{t-1} + (1-\theta)\left(\kappa_\pi \pi_{t+1}^e + \kappa_y \left(y_t - y_t^p\right)\right) + \lambda_1 mpr_t + \lambda_3 rexr_t + \varepsilon_t \quad (23a)$$

$$i_t = \theta i_{t-1} + (1-\theta)\left(\kappa_\pi \pi_{t+1}^e + \kappa_y \left(y_t - y_t^p\right)\right) + \lambda_1 crr_t + \lambda_3 rexr_t + \varepsilon_t \quad (23b)$$

where mpr_t is the monetary policy rate and (crr_t) is the cash reserve ratio; other variables have been previously defined. Theoretically, if banks anticipate a higher level of inflation; they are more likely to raise their interest rates to adjust for the higher inflation, ceteris paribus. Similarly, if private agents expect higher output in the future, they raise current consumption and current output; which may consequently encourage banks to raise their interest rates. Thus, a positive relationship is also hypothesized between interest rates and output (see also Clarida et al., 2000). The indicators of monetary policy shocks are monetary policy rate and cash reserve ratio and they are hypothesized to have a positive relationship with interest rate. Finally, a depreciation in $rexr_t$ is expected to drive a higher level of interest rate as the monetary policy authorities may have to raise the policy rate in order to attract more foreign exchange inflows.

3.3 Estimation Procedure

Given the stochastic properties of time series data and the inherent challenges associated with the resulting estimates, preliminary and diagnostic tests such as unit root tests were carried out using the Augmented Dickey Fuller (ADF), the Phillip Perron (PP) test, and the KPSS test. The rationale was to determine the order of integrations of the series and the possibility or otherwise of the existence of long-run relationship among the series. Similarly, co-integration test was conducted to establish the probable existence of long run equilibrium in the model. On the basis of the unit root tests, the estimation of the equations follows the Autoregressive-distributed lag (ARDL) approach. The application of the ARDL model is also guided by the fact that some of the series were of order zero (0) while some were integrated of order 1. The estimation of the ARDL model also helped in the choice of optimal lag for the series. Nonetheless, since, the models were specified in a structural form, the Ordinary Least Squares (OLS) method was used to estimate the system equations, in line with Olofin et al. (2014). On the estimation technique, there are many competing techniques in macroeconomic modeling with each having its relative strengths and weaknesses. This makes the appropriate estimation technique at times difficult and not straight-forward (Olofin et al. (2014). While assessment of the examination of the goodness of fit of the models and coefficient estimates of individual variables is important for good macro-econometric modeling, good statistical properties in individual equations do not necessarily imply a good performance of the model as a whole. Rather, good forecasting performance of the model depends on the quality of data, how well the behavioral equations are linked and how economically meaningful the coefficient estimates are.

In addition, some diagnostic tests were done to check the robustness of the estimates and their goodness of fit. These include the satisfaction of some a priori values of estimated coefficients and the plotting and evaluation of the actual against the simulated values of the endogenous variables. Also, reported is the evaluation of the model using relevant forecast performance measures. Given $\pi_i^f(n)$ as the models ith forecast for the endogenous variable for n steps into the future and π_i^a as the realized endogenous variable, these forecast performance measures are specified in equations 24 and 25. There are two of them considered in this study namely the Theil's U statistic and the Root Mean Square Error (RMSE) statistic.

$RMSE(n) = \sqrt{(T)^{-1}\sum_i^T[\pi_i^a - \pi_i^f(n)]^2}$ (24)	$THEIL's\ U\ \ Statistic = \dfrac{\sqrt{(T)^{-1}\sum_i^T[\pi_i^a - \pi_i^f(n)]^2}}{\sqrt{(T)^{-1}\sum_i^T[\pi_i^a - \pi_i^*(n)]^2}}$ (25)

The value of the Theil's U statistic ranges between 0 and 1. If U statistic is closer to 0, it indicates good forecast performance of the model. A value closer to 1 is an evidence of a model that has very little potential as a forecasting tool. Also, the forecast performance becomes more accurate as the RMSE statistic becomes smaller. Following the estimation of the various specified models of exchange and inflation rate equations to determine the models that reflect the features of the Nigerian economy, the estimates indicate that the Dornbusch-Frenkel Sticky-Price model best explains the behavior of the exchange rate market better. Again, the Roberts' Augmented Phillips Curve model is also chosen for the aggregate supply equation. The model's fundamentals (as previously highlighted) align well with the core determinants of prices in Nigeria. Thus, this paper documents the results of these models as appropriate for the system estimation of the macro-econometric model of the Nigerian economy. The results are presented in the next section.

3. Empirical Analysis

3.1 Exchange Rate Equation:

The coefficients of the explanatory variables are all significant except for trade balance. The results show that the key drivers of nominal exchange rate movement in Nigeria are money supply (positive), output differential between Nigeria and the United States (negative), inflation rate differential between Nigeria and the United States (positive), international price of oil (negative) and volatility/uncertainty/expectations (positive) in the naira/dollar exchange rate. All the variables have their a priori signs. Even though, trade balance has the right sign it fails to be significant thereby suggesting that an increased level of the variable may not be sufficient to bolster the value of the naira in the foreign exchange market. Of particular relevance is the role of uncertainty in the Nigerian foreign exchange market, which is likely being fueled by policy changes, militants' associated crisis in the oil producing states, political uncertainty, and the ups and downs in international oil prices. It therefore follows that the monetary authorities can stabilize the naira/dollar exchange rate by focusing on variables within its remit. This will mean that the Central Bank should control money supply (through the instrumentalities of the monetary policy rate, cash reserve ratio and liquidity ratio) and domestic price levels, stimulate output and ensure policy consistency/stability to stabilize/manage the naira/dollar exchange rate.

3.2 The Unemployment Equation

All the coefficients in the equation are both rightly signed and significant. The explanatory variables are output, lagged unemployment level and time trend. It is interesting to know that output has a negative effect on unemployment thus reinforcing the widely held notion that increased output has what it takes to make a big dent on unemployment in Nigeria. In short, the 'a prori' expectation of Okun's law is thus confirmed in the light of results obtained here.

3.3 The Demand for Money Equation

The demand for money is specified as a function of prices, treasury bills rate (TBR) and exchange rate. The explanation for the inclusion of price level and TBR still holds, while the exchange rate is included to capture the feature of the Nigerian economy as a small open economy (Horváth et al., 2011 and Salisu et al., 2013). It is only the coefficients attached to price level and TBR that have the a priori signs while it is only the one for the former variable that is significant. This shows that the general price level is a key determinant of the level of money demand while TBR rate plays some minor role (negative) in people's desire to hold money in Nigeria. The wrong negative sign assumed by the nominal exchange rate coefficient suggests that periods of high exchange rate (naira depreciation) are associated with periods of low demand/supply of money. This may be explained to a certain extent by the measures often taken by the monetary authorities to reduce money supply to control/stabilize the naira exchange rate during periods of excess liquidity.

3.4 Output Equation

The results show that the central variable influencing output is the real exchange rate. There is also the role of credit which is positive but insignificant. The main implication of the findings here lies in the role played by the real exchange rate, which if well controlled/managed can boost production activity in the economy. Given the negative (a priori) sign of the coefficient of the real exchange rate, it means that naira appreciation will reduce output and this will be through the channels of reduction in exports (non-oil in particular) and increment in imports (which represent outflows from the economy).

3.5 The Interest Rate Equation

The explanatory variables in the equation are the inflation rate (lagged), interest rate (lagged), output (lagged), monetary policy rate (MPR), real exchange rate (lagged). It is only the coefficients of inflation rate and monetary policy rate that are significant, besides their correct signs, which are both positive. The inflation rate also exerts some impact (positive) on interest rate or cost of loanable funds but to an insignificant extent. The basic implication of the results is that the MPR and inflation rate are the central variables that can be controlled to influence the direction of cost of loanable funds in the financial sector.

3.6 Inflation Equation:

Inflation in the model is explained by expected inflation, output gap and energy index. While the coefficients attached to the variables have the a priori signs, it is, however, that of the expected inflation that is statistically significant. The results suggest that inflationary pressure in Nigeria is better controlled by addressing people's expectations about the impact of current and proposed policies. This can be achieved by explaining the details of the impact of current and proposed policies that may have some bearing on the general price level.

Table 1: Estimation Output - System Equations (82 observations)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.103032	0.180321	-0.571382	0.5680
C(2)	0.159269	0.020730	7.683044	0.0000
C(3)	-0.205202	0.018008	-11.39482	0.0000
C(4)	0.004533	0.001257	3.606214	0.0003
C(5)	0.583779	0.114935	5.079212	0.0000
C(6)	-0.091184	0.041985	-2.171801	0.0304
C(7)	-2.07E-08	2.30E-08	-0.900136	0.3685
C(8)	-5.296780	6.406188	-0.826822	0.4088
C(9)	1.211705	0.094864	12.77307	0.0000
C(10)	-2.300304	4.087809	-0.562723	0.5739
C(11)	0.819357	1.393170	0.588124	0.5567
C(12)	7.286346	0.536732	13.57538	0.0000
C(13)	2.108026	0.078269	26.93317	0.0000
C(14)	-0.003421	0.005822	-0.587559	0.5571

C(15)	-0.218411	0.163242	-1.337964	0.1816
C(16)	5.413654	2.576983	2.100772	0.0362
C(17)	0.678168	0.220178	3.080093	0.0022
C(18)	-0.031970	0.112356	-0.284547	0.7761
C(19)	0.011307	0.008428	1.341540	0.1804
C(20)	-0.340001	0.164520	-2.066628	0.0393
C(21)	0.025462	0.033631	0.757108	0.4494
C(22)	-1.122679	1.034196	-1.085558	0.2782
C(23)	-10.29683	5.680845	-1.812552	0.0706
C(24)	0.887088	0.051733	17.14743	0.0000
C(25)	0.037826	0.016927	2.234680	0.0259
C(26)	-7.564104	11.39854	-0.663603	0.5073
C(27)	0.009762	0.011771	0.829330	0.4073
C(28)	0.812493	0.059324	13.69586	0.0000
C(29)	0.476709	0.616890	0.772762	0.4401
C(30)	0.107166	0.033318	3.216441	0.0014
C(31)	0.731178	0.968127	0.755251	0.4505
Determinant residual covariance		1.10E-05		
Equation: LOG(S)=C(1)+C(2)*LOG(M)+C(3)*(LOG(Y)-LOG(GYSTAR))+C(4)				
*(PIE-PIESTAR)+C(5)*VOL+C(6)*LOG(OILPD)+C(7)*TBN				
R-squared	0.944905	Mean dependent var		4.912963
Adjusted R-squared	0.940497	S.D. dependent var		0.282134
S.E. of regression	0.068822	Sum squared resid		0.355231
Durbin-Watson stat	0.724750			
Equation: PIE=C(8)+C(9)*EPIE+C(10)*LOG(Y/YPOT)+C(11)*LOG(PET)				
R-squared	0.680607	Mean dependent var		12.00671
Adjusted R-squared	0.668322	S.D. dependent var		6.197071
S.E. of regression	3.568983	Sum squared resid		993.5360
Durbin-Watson stat	1.759377			
Equation: LOG(M)=C(12)+C(13)*LOG(P)+C(14)*TBR+C(15)*LOG(S)				
R-squared	0.980149	Mean dependent var		15.04072
Adjusted R-squared	0.979385	S.D. dependent var		1.347846
S.E. of regression	0.193521	Sum squared resid		2.921129
Durbin-Watson stat	0.207849			
Equation: LOG(Y)=C(16)+C(17)*LOG(YPOT)+C(18)*LOG(Y(-1))+C(19)*I(-4)				
+C(20)*LOG((S(-4)*USP(-4))/P(-4))+C(21)*LOG(CREDIT(-4))				
R-squared	0.930994	Mean dependent var		11.90594
Adjusted R-squared	0.926454	S.D. dependent var		0.358588
S.E. of regression	0.097246	Sum squared resid		0.718722
Durbin-Watson stat	2.007235			
Equation: U=C(22)+C(23)*LOG(Y/Y(-4))+C(24)*U(-1)+C(25)*@TREND				
R-squared	0.959764	Mean dependent var		16.06012
Adjusted R-squared	0.958216	S.D. dependent var		7.775282
S.E. of regression	1.589347	Sum squared resid		197.0300
Durbin-Watson stat	1.628489			
Equation: I=C(26)+C(27)*PIE(-1)+C(28)*I(-1)+C(29)*LOG(Y(-1))+C(30)				
*MPR_0+C(31)*LOG((S(-1)*USP(-1))/P(-1))				
R-squared	0.916771	Mean dependent var		18.54463
Adjusted R-squared	0.911295	S.D. dependent var		2.516561
S.E. of regression	0.749515	Sum squared resid		42.69472
Durbin-Watson stat	1.458716			

Source: Computed by the authors. Note: Quarterly data ranging from 1985Q1 to 2016Q2

4. Model Appraisal and Simulation

4.1 Model Appraisal

In Figures 1 to 3, we show the actual and simulated values of endogenous variables which provide evidence on the good performance of the model. A cursory examination of the charts indicate that the model tracks the time paths and turning points of the endogenous variables reasonably well. This is a good indication that the model captures the workings of the Nigerian economy with respect to the behavior of the variables of interest and, suggesting its suitability for policy simulations and forecasting.

Figure 1: Output and Exchange Rate

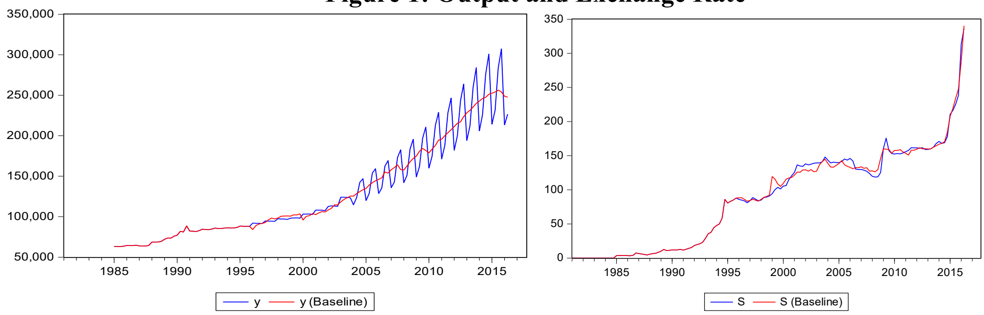


Figure 2: Inflation and Unemployment Rate

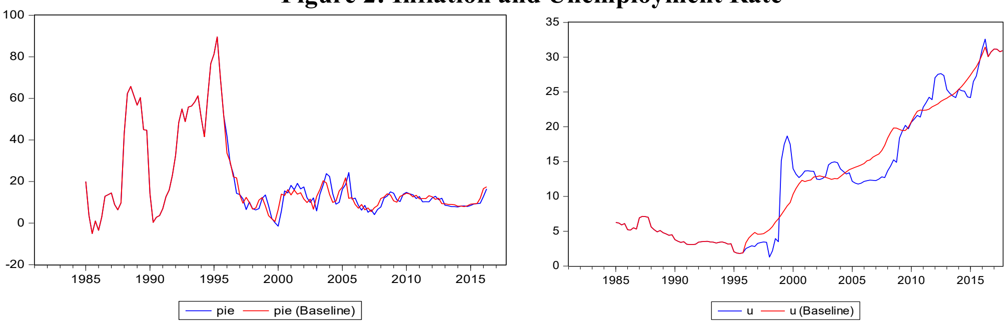
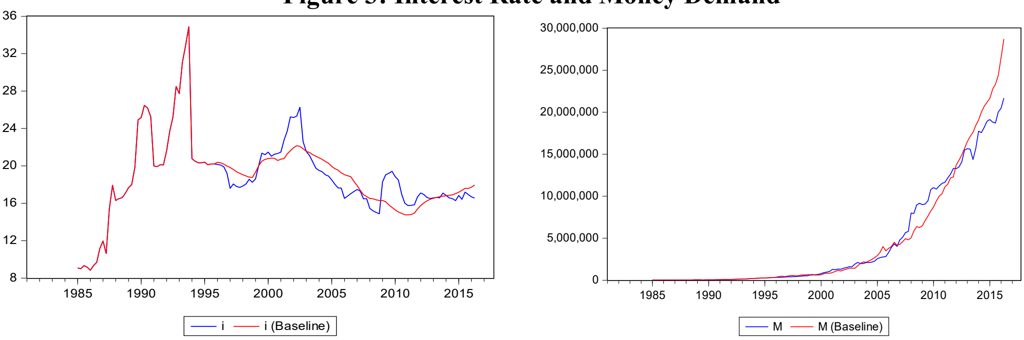


Figure 3: Interest Rate and Money Demand



4.2 Model Simulation

Given the above tests and the level of satisfactory performance observed in many of the variables and equations, this section, included in the Annex, attempts to provide some scenario analyses on possible outcomes of changes in selected variables. The process is to introduce shocks in selected policy variables and trace their impacts given the relationships in the model.

5. Application of Disequilibrium Model of Demand and Supply

The significance of capturing inter-sectoral relationship and the impact of industry and foreign trade on economic growth has been discussed in the literature. This cannot however be captured in our model, whose focus in predominantly monetary policy analysis. This study, thus, applies disequilibrium model of demand and supply of primary and intermediate inputs. The disequilibrium model was first introduced by Barro and Grossman (1971), and has been extended and applied by researchers in macroeconometric modeling (see for example; Guisan and and Cancelo (2002), Guisan, 2006; 2007; 2011 and 2013).

In applying disequilibrium model of demand and supply in this study, we adopt the approach of Guisan (2013). However, we modify Guisan (2013) model by endogenizing interest rate (measure of credit financing), and by introducing crude oil price and real exchange rate into the model. These modifications are necessary to allow for the analysis of monetary policy impact and to successfully analyze the empirical case of Nigeria. Apparently, Nigeria is an oil dependent country, with oil accounting for more than 80 percent of government revenue and more than 90 percent of the country's foreign exchange. Given the significance of oil in determining government spending, which contributes immensely to the country's aggregate demand, is may not be exaggerating to assume that modeling macroeconomic performance of Nigeria with accounting for the role of oil price will be misleading. In the same vein, the introduction of monetary policy channel in the Guisan (2013) model allow for comparison of the role of monetary policy in the Nigerian economy. This is in addition to analysis of the economic significance of inter-sectoral relationship and foreign trade that characterized the disequilibrium model of demand and supply. Table 3 presents the results obtained from the disequilibrium model of Demand and Supply of primary and intermediate inputs. The table provides detailed description of each equation, and the model identities are defined following Guisan (2013). The data for all the variables are obtained from World Development Indicator (WDI) database, with the exception of monetary policy rate (MPR) obtained from the Central Bank of Nigeria and WTI crude oil price obtained from the United States Federal Reserves (FRED) database. The model was estimated using Ordinary Least Squares estimator. The in-sample graphs for the nine endogenous variables and three identities are presented in Appendix 5[6]. Evidence from the presented results shows that crude oil price has positive and significant impact on export of goods (see equation 8). This indicates the significant role of crude oil price in determining Nigeria's proceed from export. Further results Labour supply in Nigeria is significantly determined by changes in potential supply of labour and changes in population with economic activity. This result is party similar to that obtained by Guisan (2013) on the panel of 6 OECD countries. Trade openness was used in equations (5) and (6), as against import of goods and export of goods. While trade openness was not found to influence output of manufacturing sector significantly, it has significant influence on output of service sector. This indicates removing restrictions of Nigeria's trade with foreign countries would promote the country's service sector. Import of goods in the model depends largely on the availability of credit to finance import, while export of goods depends on crude oil price. More so, agricultural sector was found to have significant impact on both manufacturing and service sector. This suggests that there is forward linkage value chain from agriculture to manufacturing and services sectors in Nigeria.

[6] The EView program file for modeling is available on demand from authors.

Table 3: Results from the disequilibrium model of Demand and Supply of primary and intermediate inputs

Param.	Variables	Coefficient	Std. Error	t-Statistic	Prob.
Equation 1: Labour					
C(10)	Constant	-0.0705	0.0209	-3.3739	0.0009
C(11)	Lagged labour	1.0029	0.0010	1041.79	0.0000
C(12)	Δ in desired labour (L*)	1.3565	0.1705	7.9584	0.0000
C(13)	Δ in Population with activity	0.3900	0.1374	2.8390	0.0049
Equation 2: Private Consumption					
C(20)	Constant	1.1110	1.1058	1.0047	0.3160
C(21)	Lagged Private Consumption	0.9557	0.0434	22.02	0.0000
C(22)	Δ in real GDP (Qs2)	1.5378	0.5542	2.7746	0.0059
C(23)	Δ in lending rate (CFin1)	0.0044	0.0071	0.6203	0.5356
Equation 3: Gross Capital Formation, GCF (GFCF+VS, Variation stock)					
C(30)	Constant	0.5918	1.4757	0.4010	0.6887
C(31)	Δ in real GDP (Qs2)	1.0312	0.9181	1.1232	0.2624
C(32)	Δ in Credit to Private Sector	0.0104	0.0165	0.6315	0.5283
C(33)	Lagged GCF	0.9752	0.0616	15.82	0.0000
Equation 4: Wages					
C(40)	Constant	-0.0064	0.3022	-0.0212	0.9831
C(41)	Lagged wages	1.0018	0.0321	31.18	0.0000
C(42)	Δ in Productivity of Labor	0.5167	0.2100	2.4604	0.0146
Equation 5: Value Added (output) by manufacturing sector					
C(50)	Constant	2.8228	1.7963	1.5714	0.1174
C(51)	Lagged manufacturing output	0.8014	0.0862	9.2981	0.0000
C(52)	Δ in output of service	0.4830	0.1835	2.6328	0.0090
C(53)	Δ in trade openness	-0.0012	0.0018	-0.6765	0.4993
C(54)	Lagged agric. sector output	-0.4176	0.1846	-2.2619	0.0246
C(55)	Δ in real effective exchange rate	-0.0746	0.0438	-1.7009	0.0902
Equation 6: Value Added (output) by service sector					
C(60)	Constant	-0.2872	0.2424	-1.1851	0.2371
C(61)	Lagged service sector output	0.7842	0.0497	15.79	0.0000
C(62)	Δ in output of industry	0.0518	0.1092	0.4741	0.6359
C(63)	Δ in trade openness	-0.0014	0.0007	-2.0963	0.0371
C(64)	Lagged agric. sector output	0.2358	0.0514	4.5847	0.0000
C(65)	Δ in real effective exchange rate	0.0041	0.0161	0.2539	0.7998
Equation 7: Import of Goods					
C(70)	Constant	0.2003	1.0130	0.1978	0.8434
C(71)	Lagged import of goods	0.9922	0.0436	22.77	0.0000
C(72)	Δ in credit to finance import	0.5652	0.0884	6.3964	0.0000
C(73)	Private consumption	0.2167	0.3432	0.6314	0.5284
Equation 8: Export of Goods					
C(80)	Constant	13.8190	2.4058	5.7439	0.0000
C(81)	Lagged export of goods	0.2303	0.1305	1.7648	0.0788
C(82)	Δ in output of industry	0.5280	1.0833	0.4873	0.6264
C(83)	Crude oil price	1.2606	0.2198	5.7358	0.0000
Equation 9: Lending rate (Cfin1)					
C(90)	Constant	26.2914	27.0841	0.9707	0.3326
C(91)	Lagged lending rate	0.1152	0.1173	0.9824	0.3269
C(92)	Lagged real GDP	-0.1917	0.9391	-0.2041	0.8384
C(93)	Lagged real eff. exchange rate	-2.7830	0.9006	-3.0902	0.0022
C(94)	Lagged inflation rate	0.0296	0.0211	1.3985	0.1632

C(95)	Monetary policy rate	0.5734	0.1048	5.4726	0.0000

Source: Computed by the authors

More importantly, the result from the disequilibrium model of demand and supply of primary and intermediate inputs appears to support the result from our Keynesian model in the explanation of the role of monetary policy. As evident, the effect of monetary policy rate on interest rate is positive and significant (see C(94) in equation 9, Table 3). This is similar to the coefficient of MPR in our Keynesian model (see C(30) on Table 2). The existence of positive and significant relationship between MPR and lending rate in Nigeria indicates that monetary policy could be used to influence macroeconomic indicators through interest rate channel. By implication, our simulation analysis conducted with the use of Keynesian model is supported by the disequilibrium model of demand and supply of primary and intermediate inputs by Guisan (2011; 2013).

6. Summary and Conclusion

This study attempts to revise the existing CBN Macro-econometric model to reflect the changing structure of the Nigerian economy by capturing the key sectors of the economy, as well as labor market dynamics. Thus, a medium-sized macroeconomic model anchored on six behavioral equations was developed and estimated for Nigeria, using quarterly data ranging from 1985Q1 to 2016Q2.

There are six equations, comprising exchange rate, inflation, unemployment, output, money demand and interest rate equations. The exchange rate equation is developed from the Dornbusch Sticky price version of exchange rate determination, while the inflation and unemployment equations are derived from theoretical framework emanating from the augmented Philips curve and the Okun's law. The output and money demand equations are also anchored on the dynamic Keynesian IS and LM framework, while the interest rate equation is anchored on the Taylor rule methodology.

The equations are linked, based on economic theory a priori expectations and intuitions on the workings of the Nigerian economy. The equations are estimated using the ordinary least squares technique. Furthermore, in-sample performance was conducted to ascertain the suitability of the model for policy simulations, while the Autoregressive Distributed lag approach was applied to determine the optimal lag for the series. The results indicate that the performance of the model is good and that the model well captures the workings of the Nigerian economy. Following the evaluation of the model's performance, the dynamic simulations (out-sample forecasts) are conducted and the results show that the endogenous variables conform to a priori expectations.

In general, the results provide some striking implications for monetary policy. For example, the results show that the key drivers of the nominal exchange rate movement in Nigeria are money supply, output differential, and inflation rate, uncertainty in the naira/dollar exchange rate and the changes in international oil market. Similarly, unemployment has an inverse relationship with output growth, implying that declining growth will raise the unemployment rate. The result also reveals that the real exchange rate plays a significant role in influencing output, while inflation in the model is explained by expected inflation, output gap and energy index.

Evidence from the policy simulations indicate that monetary policy tightening, using the MPR as a policy instrument, could stabilize the exchange rate and moderate inflationary pressures while a reduction of the CRR will be counter-intuitive. For example, reduction in output arising from a reduction in the CRR can be explained by the behavior of economic agents, where the DMBs often use the excess liquidity at their disposal to attack the naira. Oil price has significant impact on the exchange rate, while output growth appreciates the naira. The implication is that policy makers should focus on policies that are capable of stimulating output, thereby enhancing the prospects for stabilizing the exchange rate. Alternative method was applied in the disequilibrium model of demand and supply of primary and intermediate inputs by Guisan (2011; 2013), this further supports the potential of monetary policy in addressing macroeconomic variables through interest rate channel.

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Appendix 1: Data Requirement [1985q1 – 2016q2]

S/N	Variable	Definition	Measurement
1	s	Exchange Rate (BDC)	Naira/US$
2	sofficial	Official exchange rate	Naira/US$
3	m	Money Supply	(N'million)
4	mstar	US Money Supply	(N'million)
5	y	Output	(N'million)
6	ygap	Output Gap	
7	ystar	US Output	(N'million)
8	i	Interest Rate (short-term)	Percentage %
9	istar	US Interest rate	Percentage %
10	pie	Inflation	Percentage %
11	piestar	US inflation	Percentage %
12	pt	Price of Tradable	
13	pn	Price of Non-tradable	
14	ptstar	US price of tradable	2010=100
15	f	Foreign reserves	N'Million
16	fstar	US foreign reserve	N'Million
17	p	CPI	2009Month11=100
18	usp	US CPI	2009Month11=100
19	ulc	Unit labor cost	
20	ip	Import price tariff	Percentage %
21	pet	Energy price/Energy production index	2010=100
22	u	Unemployment rate	Percentage %
23	ugap	Unemployment gap	
24	uNAT	Natural Unemployment	
25	D	Government Deficit	N'Million
26	gdpr	Growth Rate	Percentage %
27	mshare	Share of intermediate imports in gdp	Percentage %
28	reexr	Real exchange rate (parallel)	N'Million
29	infra	Government Capital Expenditure	N'Million
30	credit	Credit to the domestic economy	N'Million
31	xshare	Export share of gdp	Percentage %
32	ter	Tertiary enrolment	
33	epie	Inflation expectation	Percentage %
34	ppi	Producer price index	
35	oilpd	Oil Price	US$/Barrel
36	olipn	Oil Price	N/Barrel
37	intimp	Intermediate Imports	N'Million
38	nipi	Nigeria Industrial production Index	Percentage %
39	vol	Uncertainty (volatility)	
40	mpr	Monetary Policy Rate	Percentage %
41	crr	Cash Reserve Ratio	Percentage %
42	tbn	Trade Balance (Nigeria)	
43	tbnus	Trade Balance (US)	

44	ypot	Potential Output	
45	tbr	Treasury Bill Rate	Percentage %
46	mlr	Maximum Lending Rate	Percentage %
47	gystar		
48	pms	Pump price	Naira
49	tbn	Trade Balance (Nigeria)	N'Million
50	ftbn	Trade Balance (US)	US$million
51	ftbnus	Trade Balance (US)	N'Million

Appendix 2: Simulation Results: Changes in Monetary Policy Rate

Interest rate					
	Baseline	Scenario 1	Scenario 2	Devsc1	Devsc2
2016Q2	17.54	17.54	17.54	0.00	0.00
2016Q3	17.90	18.11	18.11	0.21	0.21
2016Q4	18.04	18.42	18.42	0.38	0.38
2017Q1	18.26	18.77	18.77	0.51	0.51
2017Q2	18.53	19.15	19.15	0.62	0.61
2017Q3	18.84	19.55	19.54	0.71	0.70
2017Q4	19.19	19.97	19.95	0.78	0.76
Money demand					
	Baseline	Scenario 1	Scenario 2	Devsc1	Devsc2
2016Q2	28704980	28704980	28704980	0.000	0.000
2016Q3	25740700	25719730	25670230	-0.082	-0.275
2016Q4	25759300	25762490	25663430	0.012	-0.374
2017Q1	25548400	25575570	25428200	0.106	-0.473
2017Q2	24842990	24892780	24701720	0.200	-0.572
2017Q3	23754960	23823550	23591990	0.288	-0.691
2017Q4	23226950	23317520	23043470	0.388	-0.796
Exchange rate					
	Baseline	Scenario 1	Scenario 2	Devsc1	Devsc2
2016Q2	340.84	340.84	340.84	0.00	0.00
2016Q3	277.17	273.71	274.74	-1.26	-0.89
2016Q4	321.14	315.93	315.75	-1.65	-1.71
2017Q1	376.48	369.93	368.13	-1.77	-2.27
2017Q2	434.88	429.03	425.11	-1.36	-2.30
2017Q3	479.06	471.28	465.10	-1.65	-3.00
2017Q4	555.27	545.58	535.94	-1.78	-3.61

Inflation rate					
	Baseline	Scenario 1	Scenario 2	Devsc1	Devsc2
2016Q2	17.47	17.47	17.47	0.00	0.00
2016Q3	13.91	13.91	13.91	0.00	0.00
2016Q4	15.03	15.03	15.03	0.00	0.00
2017Q1	15.88	15.88	15.88	0.00	0.00
2017Q2	15.74	15.74	15.74	0.00	0.00
2017Q3	15.14	15.12	15.12	-0.02	-0.01
2017Q4	15.52	15.50	15.50	-0.02	-0.02
Unemployment					
	Baseline	Scenario 1	Scenario 2	Devsc1	Devsc2
2016Q2	29.03	29.03	29.03	0.00	0.00
2016Q3	31.52	31.52	31.52	0.00	0.00
2016Q4	34.69	34.69	34.69	0.00	0.00
2017Q1	35.66	35.66	35.66	0.00	0.00
2017Q2	36.95	36.95	36.95	0.00	0.00
2017Q3	37.56	37.49	37.50	-0.07	-0.06
2017Q4	38.49	38.32	38.33	-0.16	-0.15
Output growth					
	Baseline	Scenario 1	Scenario 2	Devsc1	Devsc2
2016Q2	246197.9	246197.9	246197.9	0.00	0.00
2016Q3	244968.9	244968.9	244968.9	0.00	0.00
2016Q4	242277	242277	242277	0.00	0.00
2017Q1	231946.6	231946.6	231946.6	0.00	0.00
2017Q2	224446.2	224446.2	224446.2	0.00	0.00
2017Q3	236051.7	237636.5	237335.1	0.67	0.54
2017Q4	225737.8	227923.1	227983.4	0.96	0.98

Appendix 3: Simulation Results of Changes in Crude Oil Price

Exchange Rate							
	sf_0	sf_1	sf_2	sf_3	%Δsf1	%Δsf2	%Δsf3
2016-2	340.836	340.836	340.836	340.836	0.0000	0.0000	0.0000
2016-3	277.1692	273.7119	274.7353	277.1689	0.8858	-0.87813	-0.00011
2016-4	321.1422	315.934	315.7548	321.3736	1.7795	-1.67757	0.072055
2017-1	376.4762	369.9251	368.1292	377.999	2.6811	-2.21714	0.404488
2017-2	434.8765	429.0265	425.1121	440.3763	3.5906	-2.24533	1.264681
2017-3	479.055	471.5143	465.3308	486.6131	4.5736	-2.86485	1.57771
2017-4	555.2671	546.0701	536.4256	566.2623	5.5621	-3.39323	1.980164

Money Demand							
	mf_0	mf_1	mf_2	mf_3	%Δmf1	%Δmf2	%Δmf3
2016-2	28704980	28704980	28704980	28704980	0.0000	0.0000	0.0000
2016-3	25670230	25740700	25719730	25670230	-0.1925	0.1928	0.0000
2016-4	25667470	25759300	25762490	25663430	-0.3845	0.3702	-0.01574
2017-1	25450630	25548400	25575570	25428200	-0.5762	0.4909	-0.08813
2017-2	24769620	24842990	24892780	24701720	-0.7675	0.4972	-0.27413
2017-3	23670170	23752340	23823550	23591990	-0.9720	0.6480	-0.33029
2017-4	23137830	23222390	23317520	23043470	-1.1753	0.7766	-0.40782

Output Growth						
	yf_0	yf_1	yf_2	yf_3	%Δyf1	%Δyf2
2016-2	246197.9	246197.9	246197.9	246197.9	0.0000	0.0000
2016-3	244968.9	244968.9	244968.9	244968.9	0.0000	0.0000
2016-4	242277	242277	242277	242277	0.0000	0.0000
2017-1	231946.6	231946.6	231946.6	231946.6	0.0000	0.0000
2017-2	224446.2	224446.2	224446.2	224446.2	0.0000	0.0000
2017-3	236051.7	237061.3	237335.1	236051.8	0.4277	0.5436
2017-4	225737.8	226941.7	227983.4	225682.5	0.5333	0.9947

Unemployment Rate							
	uf_0	uf_1	uf_2	uf_3	%Δuf1	%Δuf2	%Δuf3
2016-2	29.02	29.02	29.02	29.02	0.00	0.00	0.00
2016-3	31.51	31.51	31.51	31.51	0.00	0.00	0.00
2016-4	34.69	34.69	34.69	34.69	0.00	0.00	0.00
2017-1	35.66	35.66	35.66	35.66	0.00	0.00	0.00
2017-2	36.95	36.95	36.95	36.95	0.00	0.00	0.00
2017-3	37.56	37.51	37.52	37.56	-0.11	-0.08	0.00
2017-4	38.48	38.39	38.40	38.48	-0.24	-0.22	0.01

Inflation Rate							
	pief_0	pief_1	pief_2	pief_3	%Δpief1	%Δpief2	%Δpief3
2016-2	17.47055	17.47055	17.47055	17.47055	0.0000	0.0000	0.0000
2016-3	13.90716	13.90716	13.90716	13.90716	0.0000	0.0000	0.0000
2016-4	15.03163	15.03163	15.03163	15.03163	0.0000	0.0000	0.0000
2017-1	15.87624	15.87624	15.87624	15.87624	0.0000	0.0000	0.0000
2017-2	15.7378	15.7378	15.7378	15.7378	0.0000	0.0000	0.0000
2017-3	15.13543	15.12561	15.12853	15.13543	-0.06488	-0.04559	0.0000
2017-4	15.52393	15.5117	15.51109	15.5245	-0.07878	-0.08271	0.003672

Interest rate

	if_0	if_1	if_2	if_3	%Δif1	%Δif2	%Δif3
2016-2	17.54474	17.54474	17.54474	17.54474	0.0000	0.0000	0.0000
2016-3	17.89508	17.89508	17.89508	17.89508	0.0000	0.0000	0.0000
2016-4	18.03846	18.02928	18.03201	18.03846	-0.05089	-0.03576	0.0000
2017-1	18.25841	18.23899	18.2408	18.25893	-0.10636	-0.09645	0.002848
2017-2	18.53319	18.50458	18.50249	18.53657	-0.15437	-0.16565	0.018238
2017-3	18.8435	18.81035	18.80195	18.85543	-0.17592	-0.2205	0.063311
2017-4	19.19179	19.1552	19.13814	19.21294	-0.19065	-0.27955	0.110203

Appendix 4: Simulation Results of Changes in Cash Reserve Ratio

Scenario 2a: Reduction of the CRR by 250 basis points

Interest Rate			**Money Demand**			**Exchange Rate**			**Unemployment Rate**			**Output**			**Inflation**		
Baseline	**Forecast**	**% □**	**Baseline**	**Forecast**	**% □**	**Baseline**	**Forecast**	**% □**	**Baseline**	**Forecast**	**% □**	**Baseline**	**Forecast**	**% □**	**Baseline**	**Forecast**	**% □**
17.68	17.68	0.0000	28,704,980	28,704,980	0.0000	340.84	340.84	0.0000	29.03	29.03	0.0000	246,198	246,198	0.0000	17.47	17.47	0.0000
18.22	18.19	-0.0236	25,670,230	25,670,230	0.0000	277.17	277.17	0.0000	31.52	31.52	0.0000	244,969	244,969	0.0000	13.91	13.91	0.0000
18.44	18.40	-0.0437	25,667,470	25,667,470	0.0000	321.14	321.14	0.0000	34.69	34.69	0.0000	242,277	242,277	0.0000	15.03	15.03	0.0000
18.83	18.77	-0.0608	25,451,020	25,451,020	0.0000	376.45	376.45	0.0000	35.66	35.66	0.0000	232,026	232,026	0.0000	15.88	15.88	0.0000
19.37	19.29	-0.0752	24,771,310	24,771,310	0.0000	434.74	434.74	0.0000	36.93	36.93	0.0000	224,784	224,784	0.0000	15.73	15.73	0.0000
20.02	19.93	-0.0876	23,674,020	23,673,730	-0.0012	478.70	478.73	0.0056	37.51	37.51	0.0027	236,897	236,833	-0.0268	15.13	15.13	0.0006
20.77	20.67	-0.0981	23,142,490	23,141,980	-0.0022	554.75	554.81	0.0101	38.39	38.40	0.0074	226,740	226,630	-0.0486	15.51	15.51	0.0011

Scenario 2b: Reduction of the CRR by 450 basis points

Interest Rate			Money Demand			Exchange Rate			Unemployment Rate			Output			Inflation		
Baseline	Forecast	% □	Baseline	Forecast	% □	Baseline	Forecast	% □	Baseline	Forecast	% □	Baseline	Forecast	% □	Baseline	Forecast	% □
17.68	17.68	0.0000	28,704,980	28,704,980	0.0000	340.84	340.84	0.0000	29.03	29.03	0.0000	246,198	246,198	0.0000	17.47	17.47	0.0000
18.22	18.17	-0.0425	25,670,230	25,670,230	0.0000	277.17	277.17	0.0000	31.52	31.52	0.0000	244,969	244,969	0.0000	13.91	13.91	0.0000
18.44	18.36	-0.0787	25,667,470	25,667,470	0.0000	321.14	321.14	0.0000	34.69	34.69	0.0000	242,277	242,277	0.0000	15.03	15.03	0.0000
18.83	18.72	-0.1094	25,451,020	25,451,020	0.0000	376.45	376.45	0.0000	35.66	35.66	0.0000	232,026	232,026	0.0000	15.88	15.88	0.0000
19.37	19.23	-0.1354	24,771,310	24,771,310	0.0000	434.74	434.74	0.0000	36.93	36.93	0.0000	224,784	224,784	0.0000	15.73	15.73	0.0000
20.02	19.86	-0.1576	23,674,020	23,673,500	-0.0022	478.70	478.75	0.0100	37.51	37.51	0.0050	236,897	236,783	-0.0481	15.13	15.13	0.0011
20.77	20.59	-0.1765	23,142,490	23,141,570	-0.0040	554.75	554.86	0.0182	38.39	38.41	0.0134	226,740	226,542	-0.0874	15.51	15.52	0.0020

Annex to 4.2

4.2 Model Simulation

Given the above tests and the level of satisfactory performance observed in many of the variables and equations, this section attempts to provide some scenario analyses on possible outcomes of changes in selected variables. The process is to introduce shocks in selected policy variables and trace their impacts given the relationships in the model. The aim is to examine what would happen to selected macroeconomic variables if a particular policy instrument is altered. There are two approaches to answer these type of questions: ex-post and ex-ante impact simulation. The ex-post approach compares the baseline and alternative scenarios of the macroeconomic variables of interest provided after introducing the shock. This section focuses on ex-post simulation and some of the issues for which some alternative scenarios are considered include:

(1) The response of macroeconomic variables to monetary policy shocks; and

(2) The effect of oil price shocks on macroeconomic variables.

Overall, there are three policy variables used for the simulation: crude oil prices, CBN Monetary Policy rate (MPR) and cash reserve ratio (CRR). Consequently, the scenario analyses are further structured as follows:

(i) Scenario 01:- Changes in the monetary policy rate (MPR)
   (a) An increase in the MPR by 100 basis points from 14%
   (b) An increase in the MPR by 200 basis points from 14%

(ii) Scenario 02:- Changes in Cash Reserve Ratio (CRR)
   (a) A decrease in the CRR by 250 basis points from 22.5%
   (b) A decrease in the CRR by 450 basis points from 22.5%

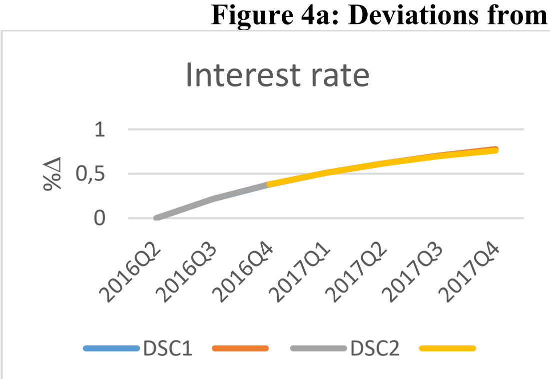
(iii) Scenario 04:- Changes in the price of crude oil.
   (a) Price of crude oil remains at \$50.05 pb
   (b) Price of crude oil increases by 5.0 per cent
   (c) Price of crude oil decreases by 5.0 per cent

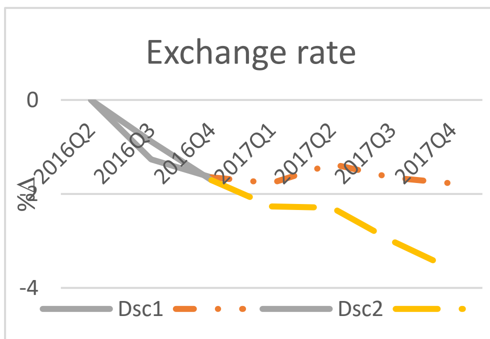
4.2.1 Simulation Results

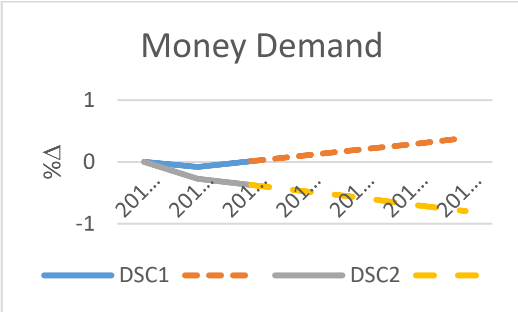
4.2.1.1 Scenario 1: Changes in the Monetary Policy Rate

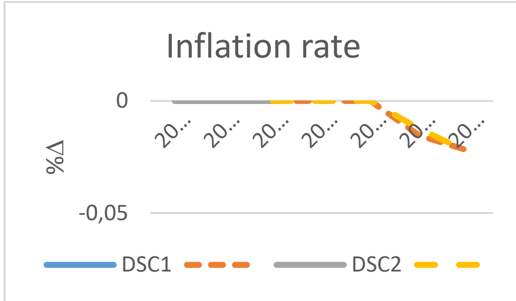
The policy simulation result using the various MPR scenarios provided striking implications for monetary policy decisions (see Figures 4a&b). For example, the baseline forecast indicates that if the MPR remains unchanged over the forecast horizon, interest rate would maintain a gradual uptick in its path with possible depreciation of the naira and sustained inflationary pressure up till 2017Q4. However, an increase in MPR by 100 basis points raises the interest rate slightly, appreciates the naira and reduces inflationary pressure. On the other hand, higher interest rate reduces the money demand in the economy and output growth with greater oscillation in unemployment rate. This is in conformity with theory, particularly if the objective of the policy maker is to moderate the pressure on the naira.

Figure 4a: Deviations from MPR Baseline Scenario



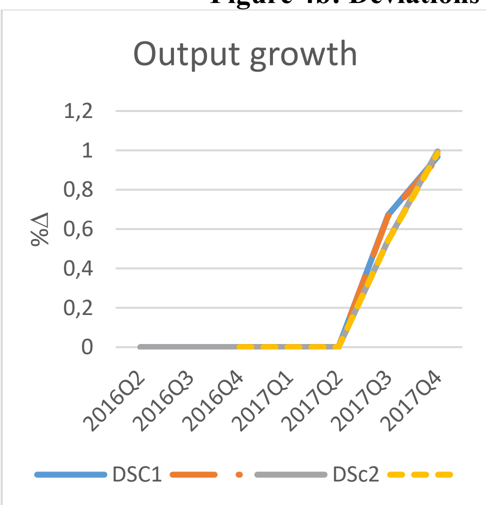


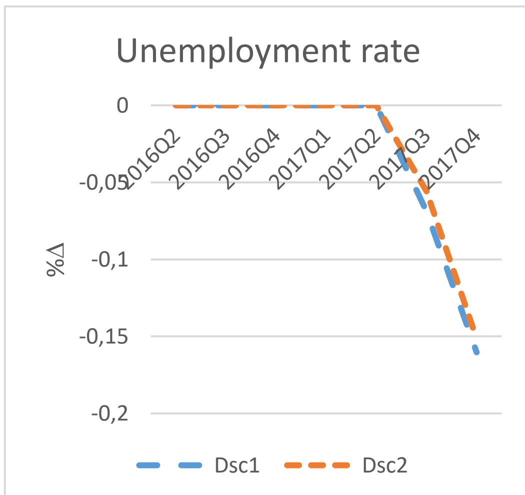




Furthermore, an increase in the MPR by 200 basis points follows similar pattern with a 100 basis points increase though with greater magnitude in terms of impact on the endogenous variables (Appendix 2). The result shows a strong relationship between MPR, exchange rate, money demand and output growth. Evidently, an increase in the policy rate by 200 basis points reduces money demand and appreciates the naira as well as dampens inflation. It is also expected to sacrifice output growth for inflation and elevate unemployment, arising from the increase in the user cost of capital. Thus, this result justifies the often assumed potency of the policy rate in stabilizing the foreign exchange market and moderating inflationary pressures. It is imperative to state that a particular policy instrument may not be sufficient to solve all problems (i.e. unholy trinity). Therefore, if the objective of the policy maker is to moderate prices, raising the MPR may be a potent instrument, while it could be detrimental to growth and employment generation.

Figure 4b: Deviations from MPR Baseline Scenario

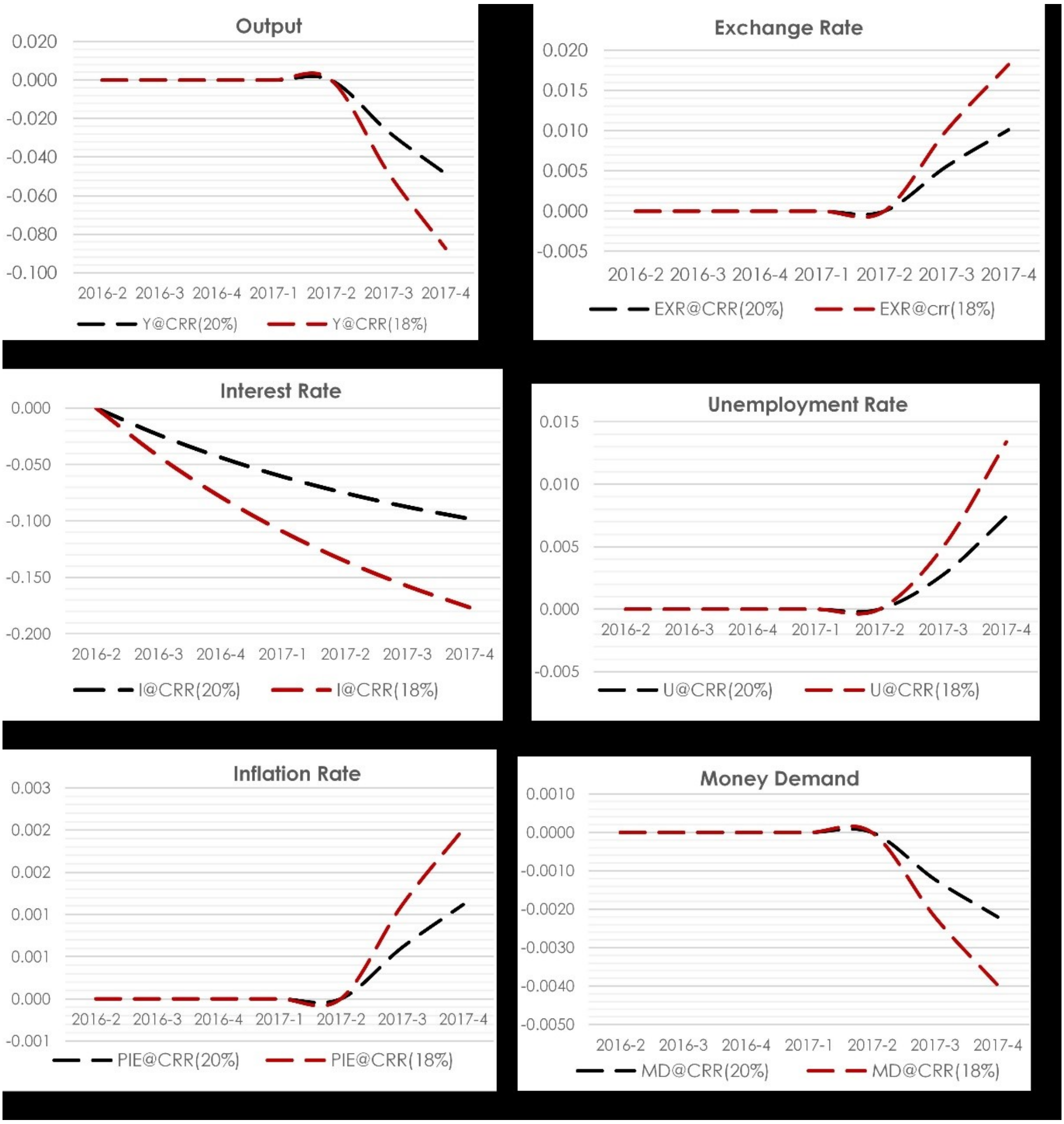




4.2.1.2 Scenario 2: Changes in Cash Reserve Ratio (CRR)

A reduction of the CRR by 250 basis points leads to a gradual depreciation of the exchange rate as well as a modest decline in money demand over the forecast horizon (see Figure 5). This may be explained by structural issues inherent in the economy where economic agents (individuals and banks alike) engage in speculative attacks on the foreign exchange market in search of short-term profits, instead of proper financial intermediation. This phenomenon, as evident in the results, hampers output and employment, albeit not instantaneously. In addition, a reduction in the CRR brings a about marginal decrease in interest rates as well as being inflationary over the horizon. This is in line with relevant economic theory. Similar results emerge from the simulation results of a 450 basis-point reduction in the CRR, though the magnitudes are more severe.

Figure 5: Deviations from CRR Baseline Scenario



Source: Compiled by the authors

Appendix 5: In-sample graphs from the Disequilibrium model of Demand and Supply of primary and intermediate inputs

Figure 1: Gross Domestic Product

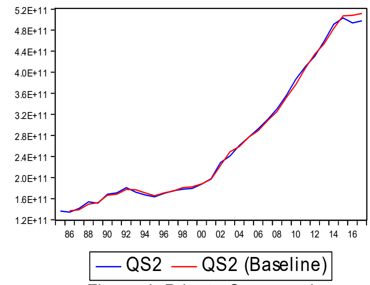


Figure 2: Value Added by Manufacturing Sector

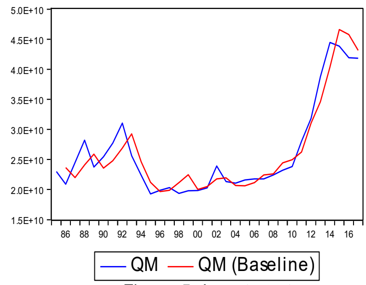


Figure 3: Value Added by Service Sector

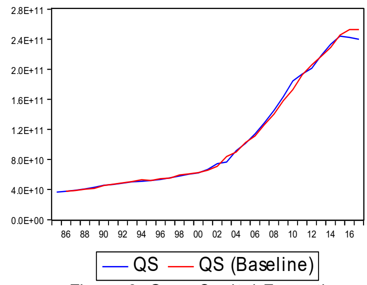


Figure 4: Private Consumption

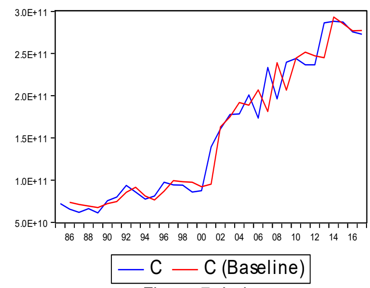


Figure 5: Investment

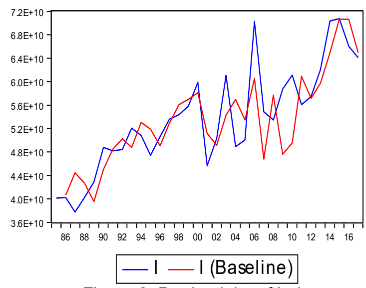


Figure 6: Gross Capital Formation

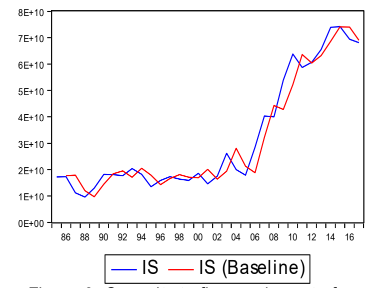


Figure 7: Labour

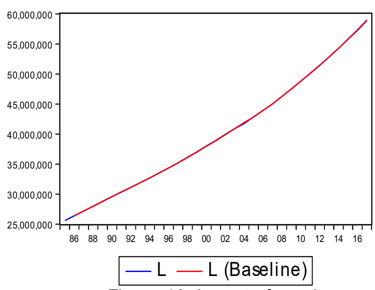


Figure 8: Productivity of Labour

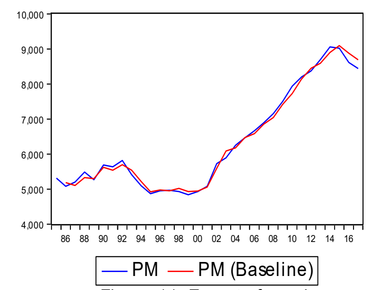


Figure 9: Capacity to finance import of goods

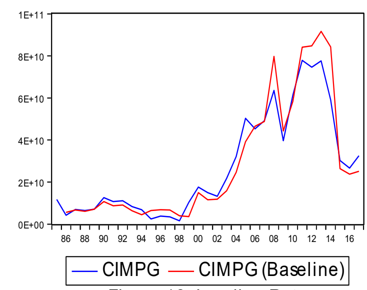


Figure 10: Import of goods

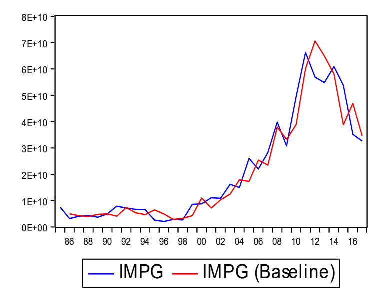


Figure 11: Export of goods

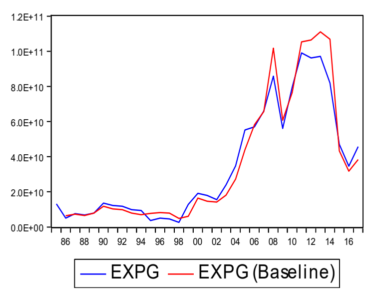
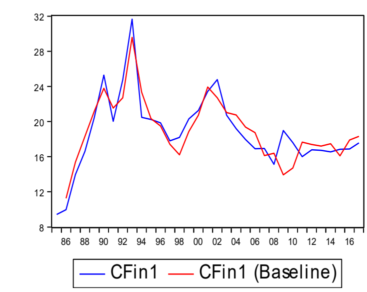


Figure 12: Lending Rate



Source: Compiled by the authors