Monetary Policies and Nigerian Economy:Simulations from Dynamic Stochastic General Equilibrium(DSGE)Model

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MONETARY POLICIES AND NIGERIAN ECONOMY: SIMULATIONS FROM DYNAMIC STOCHASTIC GENERAL EQUILIBRIUM (DSGE) MODEL

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1.0 INTRODUCTION

Indeed, the task of monetary management is usually performed by the monetary authority on behalf of government. Here, the tool for monetary management is monetary policy, which is the use of some combinations of instruments by the central bank to influence the availability and cost of credit and money in the domestic economy with a view to achieving macroeconomic balance. In performing their task of monetary management, monetary authorities apply their discretionary powers of influencing the money stock and interest rate. However, a key challenge in monetary management is how to deal with uncertainty.

Thus, for this purpose, the central bank of Nigeria (established in 1957) is the sole monetary authority in Nigeria.

During the for formative years (1959 – 1962), the most active policy instrument was the interest rate and notable actions taken during this period included the issuance of the Nigerian currency and introduction of the first money market instrument (treasury bills). Yet, the first era of the period (1962 – 1975) witnessed the amendment Act of 1962 that strengthened the central bank for effective monetary policy promotion.

Unfortunately, the 1970 Nigerian – Biafran Civil War propagated high inflation rates and the central bank consequently embarked on some direct control measures in order to restore stability in the economy. Again, the period (1975 – 1992) has been described as the direct control era (where monetary authority imposed quantitative interest rate and credit ceilings on the money deposit of banks and sustained the sectoral credit allocation policy to preferred sectors).

Yet, this period of the control regime equally experience an impaired effectiveness of monetary policy (Ajayi and Ojo, 1979; Nnanna, 2002).

However, direct controls, pervasive government intervention in the financial system resulting in the stifling of competition and resource misallocation, necessitated the introduction of Structural Adjustment Programme (SAP). The SAP reforms which focused on structural changes, monetary policy, interest rate administration and foreign exchange management, encompass both financial market liberalization and institutional building in the financial sector. Yet, between 1986 and 1993, the central bank made efforts to create a new environment for the introduction of indirect approach to monetary management. Here, a major action taken as part of the monetary reforms programme was the initial rationalization and eventual elimination of credit ceilings for selected banks. Equally, the CNB liberalized the interest rate regime and adopted the policy of fixing only its minimum rediscount rate to indicate the desired direction of interest rate.

Following the promulgation of CBN decree 24 and the banks and other financial institutions decree (BOFID) 25 of 1991, the period of indirect instrument of monetary control commenced. Specifically, in 1994, direct interest rate control was restored. Unfortunately, as these and other controls had negative economic effects, total deregulation of interest rates was again adopted in last quarter, 1996. As part of the reforms, the foreign exchange market was liberalized with the reintroduction of the Dutch Auction System (DAS) in 2002, with the objectives of realigning the exchange rate of the naira, conserving external reserves, enhancing market transparency and curbing capital flight from the country.

Again, in 2005, the central bank launched a new monetary policy framework and its objectives include continued drive to achieve lower (single digit) inflation rate, gradual reduction in the cost of borrowing, maintenance of monetary stability and sustaining

exchange rate stability. However, the period 2006 – 2008 (referred to as the period of post – banking consolidation) was characterized by the gradual run – down of the central bank of Nigeria holding of treasury bills. As at December 2006, the monetary policy committee of the CBN adopted a new Monetary Policy Rate (MPR) to replace the Minimum Rediscount Rate (MRR). Where as the committee arrangement was enshrined in the central bank acts of the countries where this was the practice, it was not until 2007 that the MPC was enshrined in the CBN Act 2007.

Indeed, the outcomes of monetary policy in Nigeria have been influenced by the general macroeconomic environment such as the stance of fiscal policy. Unfortunately, over the years, there has been the problem of fiscal dominance which often hampers the effective implementation of monetary policy. In fact, from inception, the CBN has implemented two major monetary policy frameworks exchange rate targeting (1959 – 1973) and monetary targeting (1974 – 2012). Here, two broad policy regimes were adopted in the implementation of monetary policy frameworks: direct and indirect monetary control regimes. Notably, these policy regimes operated on short term basis (annual) up to 2001 and subsequently transited to medium term monetary policy framework as at present. Yet, as at 2010, monetary management was conducted within the framework of monetary targeting; and the major instrument of monetary policy remained open market operations, discount window operations and foreign exchange market interventions.

However, monetary growth was sluggish despite the monetary easing policy maintained by the bank. Here, the stance of monetary policy was to inject liquidity into the economy and restore confidence in the Nigerian financial system. The measures taken included the continuation of guarantees on inter bank transactions

and the purchase of non-performing loans from the deposit money banks (DMBS) by AMCON (Asset Management Corporation of Nigeria) in order to strengthen the balance sheets of the banks and facilitate their ability to extend credit to the domestic economy. As part of the ongoing reform in the Nigerian Banking sector, the CBN reviewed the universal banking model which encouraged banks to act as financial super markets. The new banking model re-introduced the categorization of banks into commercial, merchant and specialized banks (n0n-interest banks, microfinance banks, development banks and mortgage banks). In general, the model was designed to ensure the evolution of a financial landscape that would be capable of providing the platform for sustainable economic growth and development. As a t 2011, the comprehensive structure of the Nigerian financial system include CBN, AMCON, SEC (Securities and Exchange Commission), NAICOM (National Insurance Commission), PENCOM (National Pension Commission), (24) deposit money banks, (5) discount houses, (866) microfinance banks, (108) finance comprise, 690 security brokerage firms, (13) pension fund administrators, (5) Pension Fund custodians, (1959) Bureau – de – change, one (1) Commodity and Security Exchange, (101) Primary Mortgage Institutions, (5) Development Finance Institutions and (73) Insurance Companies (CBN, 2010). However, an assessment of the health of the banking sector indicated that only sixteen banks met the stipulated minimum capital requirements. On the other hand, the external came under pressure as reflected in the huge import bills, a drawdown on external reserves and a declining foreign direct investment. Again, the overall BOP deficit increased while inflationary pressures remained above single digit in 2010.

Consequently, the use of monetary policy for macroeconomic stabilization in Nigeria poses a number of challenges that have not

been fully analyzed. These include the need to coordinate monetary and exchange rate policy with fiscal policy in order to manage large volatile aid inflows and government revenues from natural resource exploitation. In particular, economic policy needs to consider the potential adverse effects of such shocks on the tradable sector (called Dutch disease problem) as well as the traditional objectives of inflation and output stabilization. In such an environment, the current monetary policy setting in Nigeria may be viewed as an interim stage in a more towards wider adoption of formal inflation targeting practices in which inflation (expected inflation) is an intermediate target (goal), instead of either some monetary aggregate or the exchange rate; and where the interest rate rather than base money is the operational target. Thus, the relevant policy questions are not wholly those concerned with how, and over what horizon, Nigeria may make the more towards formal inflation targeting; they must also include how best the available instruments of monetary policy be deployed ins shock prone mature stabilizers. It is therefore the basic thrust of this paper to evaluate monetary policy – trade offs in Nigeria using a dynamic stochastic general equilibrium (DSCE) model estimated on data for Nigeria (mature stabilizer in sub-Saharan Africa) taking into xxx the sources of major exogenous shocks, transmission mechanisms, and level of financial development.

2.0 **OBJECTIVES OF STUDY**

The fundamental aim of this research project is to build a specific structural dynamic stochastic general equilibrium model of the Nigeria Economy. This objective requires us to carry out the following steps:

(1) To analyze the tradeoffs of both foreign exchange sales and open market operations in the conduct of monetary policy in Nigeria.

(2) To compare three different rules for how the central bank deploys its available instruments:

   (a) Under the first rule, the central bank stabilizes the exchange rate

   (b) Under the second rule and third rules, the central bank is set to stabilize some measure of inflation around a target.

(3) To consider the case where monetary policy seeks to stabilize CPI inflation as well as a policy that stabilizes inflation in non – traded goods.

(4) And to consider the best response, in terms of minimizing macro economic volatility of alternative monetary policy rules in response to foreign aid and numerous other exogenous shocks that are important in Nigeria.

3.0 THEORERICAL AND METHODOLOGICAL FRAMEWORK

Following Adam and O' Connell (2005), Buffie et. Al. (2004), Peiris and saxegaard (2010), we develop a macroeconomic model for monetary policy analysis in Nigeria. That is, we intend to conduct our analysis within the context of a micro founded DSGE Model. Operationally, this model is expected to be solved using recent methods in computational economics which makes it feasible to compute higher order approximations to the equilibrium conditions in dynamic general equilibrium models. Indeed, DSGE models are structural in the sense that each equation has an economic interventions and their transmission mechanism can therefore be clearly identified, thereby facilitating a discussion of alternative policies. Again, DSGE models are micro founded in the sense that they are explicitly derived from the optimizing behavior of households and firms in the economy. Thus, they describe the behavior of the agents in the economy in terms of parameters that are structural because of the fact that one would not expect them to change as the result of changes in economic policy; thereby validating the analysis of alternative policies. DSGE models are equally stochastic in the sense that they explicitly discuss how random shocks such as fiscal policy affect the economy.

There models are also forward looking in the sense that agents optimize, form rational or model consistent forecasts about the future evolution of the economy. However, a traditional weakness of DSGE models has been the difficulty in parameterizing those using economic data. Particularly, this problem is severe in African countries such as Nigeria, where data series are short or (in many causes) lacking.

Thus, in order to overcome this problem, research often resorts to calibrating the parameters of the model using information from

previous studies or characteristics (such as data volatility). Yet, the difficulty of explicitly relating the model to the data seriously undermines its use. Therefore, in order to overcome the problem of the parameterising the data, this research paper will make use of recent advances in Bayesian Econometrics. Within this framework, the kalman filter will be used to allow inferences about the unobserved variables in the model and prior empirical or theoretical knowledge about the parameters of interest is used to increase the efficiency of the estimation, thereby overcoming the problem of short data series.

Obviously, the use for Bayesian inference allows us to incorporate prior empirical or theoretical knowledge about our parameters of interest. Similarly, Bayesian inference provides a natural framework for parameterising and evaluating simple macroeconomic models which are likely to be fundamentally misspecified.

Using Kollman (2002) and Saxegaard (2006) the basic structure of our open – economy DSGE model consists of perfectly competitive firms that produce a final non-tradable good which is consumed by a representative household and the fiscal authorities (in addition to being used for investment). Here the inputs used in the produced domestically or imported by mono politically competitive intermediate goods firms. On the other hand, the domestically produced goods, which are produced using capital, labor and borrowing from a financial intermediary as inputs, are sold either in the domestic market or exported overseas. However, we assume that the capital account is closed and the markets for capital, labor, and commercial bank loans are competitive. In order to provide a rationale for monetary and fiscal stabilization policy, four sources of inefficiency are included in the model: Monopolistically competitive product markets; sluggish price adjustment in the domestic economy; capital adjustment costs and investment adjustment

costs; and adjustment costs in commercial bank reserves and an interest rate spread which depends on the net worth of companies. In fact, this framework captures many of the rigidities that are important to describe the dynamics in the data and serves as a useful starting point for developing a DSGE model for Nigeria.

HOUSE HOLD BEHAVIOR BLOCK

The objective of the consumer is to maximize the expected value of the discounted sum of period utility functions. Here, we assume habit formation in consumption and that capital account is closed. The consumer budget constraint and consumer's problem are therefore specified with relevant first order conditions for consumption, labor, money, deposits, capital and investment.

FINAL GOODS PRODUCTION BLOCK

The final good producers produce a good Z_t by aggregating over a continuum of domestically and imported intermediate goods, indexed by SE (0, 1). Here, the aggregating technology is given by the CES aggregate for some elasticity of substitution. However, profit maximization implies the standard demand functions for intermediate goods with an associated cost – minimizing price index.

INTERMEDIATE GOODS PRODUCTION BLOCK

In this block, we incorporate learning by doing in the production function as well as credit constraints. The credit constrains are incorporated by assuming that intermediate good firms use an intermediate good input that is funded by borrowing from a financial intermediary. Equally, we assume that firms borrow to pay for

intermediate goods inputs as opposed to wages or capital because it is equivalent to using the loan as a variable in the production function and it generates more dynamics in the model. Here, the production technology is Cobb Douglas and we assume productivity that is affected by both the size of the tradable sector and amount of government expenditure on capital goods. Again, we allow productivity to follow a stochastic autoregressive process and specified function embodies the technology whereby government spending on investment goods produces the productivity enhancing public good. It also satisfies and captures the degree of learning by doing.

Therefore, the problem facing the firm is to minimize costs subject to satisfying demand while assuming for the moment that the firm takes prices as given. On the other hand, we assume that each domestic firm sells its output both on the domestic and export market good had the same structure as domestic demand.

INTERMEDIATE GOODS PRODUCERS: PRICE SETTING BLOCK

The intermediate goods producers faces quadratic adjustment costs in setting prices measured in terms of the intermediate good. Here, we assume that the cost of price adjustment is related to the change in inflation relative to the past observed inflation rate. Essentially, this allows for more realistic inflation dynamics in the model with a backward-looking term in the solved out Phillips Curve. Again, we assume that the law of one price holds in the export market and importing firms are assumed to be owned by risk – neutral foreigners who purchase goods at the exogenous world price and re-sell them in the domestic market. On the other hand, we assume that changes in the exchange rate are passed through

immediately to the import price given shock to the terms of trade of the economy.

FINANCIAL INTERMEDIARY BLOCK

Indeed, the financial sector is assumed to convert deposits from households into loans to intermediate goods firms and the public sector bank reserves.

Thus, for a given level of bank reserves, an increase in the amount of deposits at the financial intermediary reduces the amount of money in circulation as well as the utility from liquidity services. Here, deposits are assumed to earn the same rate of interest as the interest on government bonds. Again, lending to intermediate good firms earns an interest which is a markup over the interest rate on deposits where the markup is a function of firms beginning of period net worth (the value of their capital stock over their liabilities). Commercial banks are also assumed to maintain reserves equal to required reserves in steady – state and to use reserves to smooth movements in their net liabilities.

PUBLIC SECTOR BLOCK

Operationally, the central banks balance sheet is

$$\Delta M_t^c + \Delta R_t = e_t \Delta Z_t + \Delta B_{t+1} \qquad (3.1)$$

Where e_t is normal exchange rate; Z_t are international reserves and B_{t+1} are government securities held by the central bank maturing next period we further assume that no interest is earned on international reserves; and under the assumption that profits of the

central bank are transferred to the fiscal agent the public sector's budget constraint takes the form:

$$\Delta B_{t+1} + \Delta B_t^{p}{}_{+1} = P_t G_t + i_{t-1} B_t^{p} - T_t - e_t A_t \qquad (3.2)$$

Where A_t is aid and B_t^{p} are bonds issued to the financial sector which we assume earn the same rate of interest as household deposits. Here, a share μ_i of government spending is spent on a productivity enhancing investment good:

$$G_t = \mu_t G_t^{k} + (1 - \mu_t) G_t^{c} \qquad (3.3)$$

Then consolidated budget constraint is then:

$$M_t^{o} + B_t^{p}{}_{+1} - e_t Z_t = M_t^{o}{}_{+1} + (1 + i_{t-1}) + B_t^{p} - e_t Z_{t+1} + P_t G_t - T_t - e_t A_t \qquad (3.4)$$

Where M_t^{o} is base money defined as $M_t^{o} = M_t^{c} + R_t$

As such, volatility in aid inflows and interest payments on bonds issued to the financial sector transmits into volatility in the path of expected future seigniorage (like currency in circulation).

FISCAL AND MONETARY POLICY RULES

Operationally, in this model, the fiscal and monetary authorities have access to four different instruments of which three can be used independently. Here, the fiscal agent controls government spending, taxation and net domestic borrowing while the monetary authority controls the level of international reserves. Consequently, we can analyze the fiscal policy rules of the form:

$$T_t = T - (1 - \int) \omega (e_t A_t - eA) \qquad (3.5a)$$

$$P_tG_t = PG + \int \omega (e_tA_t - eA) \qquad (3.5b)$$

Where ω and ∫ determine the fraction of aid used to reduce taxes and increase expenditure and thus increase the primary fiscal deficit (before grants).

A ω less than one unambiguously lower the primary deficit after grants.

If ω equals zero, the primary deficit after grants falls by the amount of aid.

If ω is between zero and one so that part of the aid is spent, ∫ determines the allocation of that spending between the private and public sector

If ∫ equals zero, the increased spending is carried out by the government whereas
If ∫ is one, the increased spending is done by the private sector.

We further assume that the fiscal regime remains unchanged and is fully spent. Yet, the effect of a shock to aid on international reserves and the monetary base will depend on the actions of the central bank. Using the specification of the central bank policy rules, foreign exchange rate intervention is governed by

$$\Delta Z_t = Z_t (Z - Z_{t-1}) + (1 - Z_2 \omega)(At - A) + Z_3 \log \left(\frac{e_t / e_{t-1}}{\pi / \pi^x} \right) + Z_4 \log \left(\frac{\pi_t}{\pi} \right) + U_t^2 \qquad (3.6)$$

Where Z_1 governs the authorities' commitment to a constant level of reserves

Z_2 determines the commitment to an absorb as you sp0end scenario whereby the sale of foreign exchange is conducted in line with government spending increases financed by the aid inflows

Z_3 Determines the extent to which the sales of foreign exchange reserves are used to achieve a given target of the inflation rate π.

U_t^2 Is a shock to foreign currency reserves.

Therefore, any foreign exchange rate intervention will have an impact on the monetary base and the exchange rate with possible implications for inflation and output volatility. Here, the authorities have the option of conducting open-market operations on a temporary basis and thus we have:

$$\Delta B_t^p = b_1 e_t \Delta Z_t + b_2 \log\left(\frac{\pi t}{\pi}\right) + b_3 \left(Y_{t-r} - Y\right) + b_4 \left(B^p{}_{t-1}\right) + U_t^B$$

Where b_1 governs the extent to which bond operations are used to sterilize the impact of foreign exchange interventions on the monetary base;

B_2 determines the commitment to the inflation target;

B_3 Governs the effect of output gap considerations in the conduct of monetary policy

B_4 >O entails that all bond operations are unwound over time

U_t^{BP} Is a shock to domestic bonds

MARKET CLEARING / AGGREGATION

In general equilibrium, supply equals demand in the intermediate and final goods market at posted prices. Yet, the model can alternatively be closed using the balance of payments identity.

STOCHASTIC SHOCKS

Essentially, a number of stochastic shocks are included in the model in order to ensure that the model is not stochastically singular and in order to be better able to reproduce the dynamics in the data. Specifically, the number of exogenous shocks must be at least as large as the number of observed variables in order to estimate the model using classical maximum likelihood or Bayesian methods. With the exception of the shock to the markup (which is assumed to be white noise process) all shocks are assumed to follow a first order process.

4.0 DATA SOURCES AND COLLECTION

Operationally, the major sources of data for the proposed study will be the published data of the central bank of Nigeria as well as the unpublished data from the various ministries, parastatals and agencies in Nigeria.

Other supplementary sources of data will include the statistical publications of the World Bank, United Nations and International Monetary Fund. Here, efforts will be made to collect annual data on the variables of the research study. We shall also search the various intranets, extranets and internet websites accordingly.

5.0 RESEARCH RESULTS AND DISSEMINATION

Essentially, the result output is expected to contribute to public policy making for central bank of Nigeria, Federal Ministry of Finance, National Planning Commission, National Assembly Committees and Allied Ministries. This is in addition to contributing to existing knowledge and future Research in the economics of dynamic stochastic general equilibrium model. Also, we intend to publish our research output (especially in REPEC and SSRN Network Outlets) as well as disseminating to the various professional economics and policy makers in the region. We shall equally present and discuss our research findings before the various academic and professional economists' network meetings.

6.0 STUDY DURATION AND BUDGET

This study is expected to be carried out within a period of twenty months. In the first six-months, we shall be concerned with literature exploration, collection and review. In the subsequent five months, the model data will be collected and analyzed using

computing technology. In the last six months, the study will be completed and submitted to the funding agency as appropriate.

Operationally, the expected costs of the research project are as follows:

(A)	PERSONNEL COSTS (PRINCIPAL RESEARCHER AND SUPPORT STAFF)	=	$5,000.00
(B)	FIELD WORK COST (LITERATURE SEARCH DATE BATHERING AND COMPUTING RESOURCES)	=	$9,000.00
(C)	MATERIALS AND SUPPLIES (OFFICE MATERIAL PRINTING AND COMMUNICATIONS)	=	$2,500.00
(D)	FINAL REPORTS REPRODUCTION (PRODUCTION AND DISSEMINATION)	=	$2,500.00
(E)	MISCELLANEOUS EXPENSES	=	$1,000.00
(F)	TOTAL BUDGETED EXPENSES	=	**$20,000.00**

7.0 TENTATIVE STUDY OUTLINE

SECTION ONE: INTRODUCTION

(I.I) RESEARCH PROBLEM

(I.2) OBJECTIVES OF STUDY

(1.3) SIGNIFICANCE OF STUDY

(1.4) STUDY COVERAGE

(1.5) ORGANIZATION OF STUDY

SECTION TWO: ECONOMIC POLICIES AND PERFORMANCE

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