Output, Real Exchange Rate and Interest Rate Response to Excess Liquidity in Nigeria

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This study investigates the responses of output, real exchange rate and interest rate to shocks to excess liquidity in Nigeria. Following Joao and Andrea (2006), the authors used structural VAR to estimate the model. The results show that GDP responds to shocks to excess liquidity in a relatively quick fashion and assume downward trend right from the first quarter. However, the negative impact on the economy starts from the second quarter lasting throughout the period. This result reveals that excess liquidity is detrimental to real output according to expectation. It also shows that shocks to excess liquidity depreciates the real effective exchange rate and reduces interest rate in the domestic economy. The result implies that speculators immediately react to shocks to excess liquidity taking advantage of excess monetary expansion for speculative activities which further depreciate the exchange rate in Nigeria. The paper recommends contractionary monetary policy and prudent use of monetary instrument to mop-up liquidity that is detrimental to economic growth.

Keywords: Excess Liquidity, Real Effective Exchange Rate, Interest Rate, Gross Domestic Product, and Impulse Response.
JEL Classification: E43, E51, E52, E58

I. Introduction

Globally, there have been concerns about excessive accumulation of liquidity. Policy-making institutions and independent economic analysts have repeatedly pointed out the possible implications of an increase in monetary aggregate leading to excess liquidity in the domestic economy. Data from the IMF indicated that broad money worldwide in 2004 and 2005 was growing at its fastest rate since the late 1980s. The growth of broad money in

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Nigeria has been high and becoming conspicuous. The outcomes in monetary aggregates (M2) in 2001, 2003, and 2007 were 27.0, 24.1 and 30.9 as against the targeted level of 12.2, 15.0, and 24.1, respectively. The reasons for the surge in monetary aggregates include, among others, monetization of the oil receipts and the fiscal dominance of the government (CBN Annual Report, 2005). To control the rapid growth in monetary aggregates, the monetary authorities, the Central Bank of Nigeria (CBN), employs its monetary policy instruments especially open market operations (OMO) to mop-up excess liquidity and to stem its attendant negative effects on the domestic economy. Excess liquidity stimulated by an increase in monetary aggregates in turn induces variations in real exchange rate, interest rate and other variables which could have serious effects on the Central Bank's balance sheet and on its ability to conduct a prudent monetary policy. For instance, changes in real exchange rate would lead to fluctuations in short term capital flows. These fluctuations would then have an effect on the Central Bank's net foreign assets. A change in the volume of net foreign assets would lead to changes in the volume of currency in circulation on the liability side of the balance sheet. Thus, a change in the volume of currency in circulation would necessitate the management of the liquidity fluctuations in the economy through the utilization of monetary policy tools by the Central Bank, whose ultimate objective is price stability.

The problem of excess liquidity caused by an expansion in monetary aggregate goes beyond threat of price instability; several authors have observed that excess liquidity is likely to have adverse consequences on the ability of monetary policy to influence demand conditions and, thus, to stabilize the economy. Nissanke and Aryeetey (1998) argue that in the presence of excess liquidity, it becomes difficult to regulate the money supply using the required reserve ratio and the money multiplier, so that the use of monetary policy for stabilization purposes is undermined. In other words, one would expect excess liquidity to weaken the monetary policy transmission mechanism.

Despite the concerns expressed about the impact of excess liquidity on the effectiveness of monetary policy and economic performance as a whole, there has been no attempt to formally test this hypothesis in Nigeria. The aim of this paper therefore, is to examine the responses of output, real exchange rate and interest rate to monetary disturbances (excess liquidity) in Nigeria. The rest of the paper is structured as follows. After this brief introduction, section II reviews the relevant theories and the existing literature in order to shed some light on the possible channels through which shocks to excess liquidity could be transmitted. Section III outlines the methodology for the study, section IV presents the empirical results. Section V gives the conclusion and policy recommendations.

II. Theoretical and Empirical Literature Review

Active- Passive Money View theory

According to an active-money view, the quantity of money is subject to the independent influence of the central bank. This influence, among other things can lead to a real quantity of money holdings that is larger (smaller) than desired. In contrast to the passive money view, the attempt to eliminate these excess balances is considered to have an important role in the transmission of monetary policy. The interpretation of a nominal "monetary shock" highlights the distinction between the two views. According to the passive-money view, a monetary shock is the consequence of a change in the demand for money caused by an output shock, for example, that is accommodated by the central bank as it targets short-term interest rates. In contrast, the active-money view interprets a monetary shock as the consequence of a change in the supply of money induced by the central bank that is unanticipated by agents. If there is a positive shock, initially, agents have to hold the additional nominal balances. Over time, individuals perceive that the nominal quantity of money they hold corresponds to a real quantity that is larger than desired at current prices, and that this is not a temporary condition. That is, individuals are "off" their long-run demand for money function. However, all individuals cannot collectively dispose of the aggregate excess nominal balances. Nonetheless, the attempt to do so has economic effects: the increase in expenditure leads to an increase in nominal spending, an increase in economic activity, and ultimately an increase in prices.

The Mundell-Fleming framework

The framework asserts that an expansionary monetary policy shock, which is represented by a central bank-induced increase in the supply of money, leads to a reduction of the domestic interest rate, which, in turn, triggers a depreciation of the home currency through the resulting capital outflows to other countries of the world. As a result, spending is directed towards domestic goods and output increases. This shows that expansionary monetary policy raises domestic output at the expense of foreign output.

Direct Transmission of Price Shocks.

This channel of transmission affects cost of production directly through a cost-push shock. The argument is that, if prices rise through currency depreciation, the marginal cost of firms increases directly (through trade in intermediate products); changes in marginal costs are then transmitted to inflation (Kollmann 2001). Depending on the extent to which domestic inflationary pressures are accommodated or not by the central bank, an expansionary monetary shock can raise the domestic price level more or less permanently.

The Classical Interest Rate Theory

Under the classical view of the transmission channel, interest rate influence economic activity by affecting various relative prices in the economy. These occur through the relative prices of capital and future consumption in terms of current consumption, and the relative price of domestic goods in terms of foreign goods. The effects of interest rate are divided into three parts. First, movements in the policy rate affect fixed investment through the user cost of capital. Higher interest rates raise the required return from investment projects and reduce the rate of business investment. Inventories are affected in much the same way; higher interest rates increase the 'user cost' of holding inventories and lead firms to economize on them. Second, interest rates also represent the price of future consumption relative to current consumption. Higher interest rates cause households to substitute present for future consumption. Interest rate movements also have an income effect on households. Provided that households are net debtors, higher interest rates reduce the value of lifetime income, further depressing consumption. By affecting the value of financial assets such as stocks and bonds, in which household wealth is held, interest rate movements can have a wealth effect on private sector spending. Third, interest rate movements lead to a change in the exchange rate thereby altering price competitiveness and affecting net exports. Under sticky domestic prices and producer currency pricing, the real exchange rate appreciation raises the relative price of domestic goods in terms of foreign goods, and induces an 'expenditure switching' from domestic to foreign goods. Under local currency pricing, exchange rate fluctuations are absorbed in firms' margins. This affects the value of firms' equity and, via the wealth effect, aggregate demand.

Empirical Literature

Empirical literature reveals a number of methods for examining the response of real exchange rate and output to shocks in excess liquidity which include the popular vector autoregressive model (VAR), Canneti and Greene (1991), Ndung'u (1999), Lastrapes and Selgin (1995), Hendry (1995), Faik and Douglas (1998), Eichenbaum and Evan (1995), Kim (2001), Olivier and Thepthida (2005), Holman and Neumann (2002), Joao and Andrea (2006) and Canova (2005), employed Structural VAR (SVAR) and VAR models for their estimations, which is a major methodology for measuring the responses of variables to shocks. Other approaches apart from VAR include the ordinary least squares and two stage least squares estimation and general equilibrium model.

VAR findings revealed that money supply growth drives nominal exchange rate movements, and directly explains the movements in the real or nominal exchange rate (Canneti and Greene, 1991). Obadan (1994) found that monetary expansion appreciates the real effective exchange rate (REER), lowers interest rates (nominal and real), and boosts the domestic demand for non-traded goods, thereby causing the real effective exchange rate (REER) to appreciate. Lastrapes and Selgin (1995) found that permanent money supply shock generates a temporary fall in interest rate, while Hendry (1995) found that monetary policy shock disturbs the relationship between money and its long-run demand so as to create a long-lasting monetary disequilibrium; he, however, noted that such monetary gaps are eliminated over time as prices gradually adjust.

Faik and Douglas (1998) indicated that contractionary monetary policy shocks lead to transitory appreciation of the real and the nominal exchange rate. Exchange rate appreciations that are related to a temporary contractionary shock to monetary policy lead to a short-lived improvement in the trade balance which is then followed by a deterioration. Eichenbaum and Evans (1995) found that a contractionary shock to U.S. monetary policy leads to persistent appreciations in nominal and real U.S. exchange rates. Kim (2001) found that an expansionary US monetary policy shock leads to an increase in activity in the US.

Holman and Neumann (2002) analyzed the transmission of monetary shocks between the US and Canada, and found that a monetary expansion in one country leads to a slight and statistically insignificant monetary contraction in the partner country. Bruggeman et al. (2005) discovered that a positive shock to these liquidity aggregates results in an increase in euro area prices, output and in the monetary aggregate M3. Canova (2005), found that a US monetary shock has a strong impact on macroeconomic developments in US. After a contractionary US monetary policy shock, interest rates are found to rise, which attracts capital inflows and pushes aggregate demand up, not down.

The empirical findings from ordinary least squares, two stage least squares and general equilibrium model include Ndung'u (1999), Omoruyi (1999), Kisukyabo (2000), and Olivier and Thepthida (2005). Ndung'u (1999) showed that excess money supply feed into the cyclical movements of the real exchange rate. In addition, the cyclical movements of the real exchange rate impact on short−term capital flows which in turn affect money supply growth. Omoruyi (1999) also found that real exchange rates respond in the short and medium run to monetary and fiscal disturbances i.e. expansionary monetary policies usually generate real exchange rate movements; and if these movements of the RER from its log-run equilibrium are sustained, it usually results in real exchange rate misalignment. Kisukyabo (2000) investigated the main determinants of real exchange rate in Malawi and South Africa and found a positive relationship between real exchange rate and excess liquidity; it implies that excess liquidity causes the real exchange rate to appreciate. Olivier and Thepthida (2005) discovered that real exchange rate fluctuations arise from two sources: changes in the relative price of traded goods, and movements in the relative price of traded to non−traded goods across countries. In the framework, they shed light on the propagation mechanisms through which monetary shocks affect the real exchange rate and concluded that the two components respond in opposite directions to monetary disturbances. They argued that the introduction of non−traded goods would not alter the predictive power of monetary shocks because the presence of non−traded goods magnifies the response of the deviation from the law of one price.

Joao and Andrea (2006) constructed a global monetary aggregate for the G5 economies (US, Euro area, Japan, UK, and Canada), and analyses its indicator properties for global output and inflation. Using a structural VAR approach they found that after a monetary policy shock output declines temporarily, with the downward effect reaching a peak within the second year, and the global monetary aggregate drops significantly. In addition, the price level rises permanently in response to a positive shock to the global liquidity aggregate. Their results are similar to those found in other studies using a global monetary aggregate as a summary measure of worldwide monetary trends.

III. Methodology (A Structural VAR Model Approach) Model Formulation and Sources of Data

Joao and Andrea (2006) highlighted several advantages in relying on the structural VAR (SVAR) methodology for the analysis of the effects of monetary policy changes. According to the authors "SVAR allows modelling non-recursive structures of the economy with a parsimonious set of variables and it facilitates the interpretation of the contemporaneous correlations among disturbances". The SVAR methodology suggests imposing restrictions on the contemporaneous structural parameters only, so that reasonable economic structures might be derived. The act that only contemporaneous restrictions are imposed, however, does not imply that there is no feedback among variables. In the SVAR structure the lagged values enter each equation and thus all variables are linked together. Drawing from the works of Joao and Andrea (2006), we conceptualized a modified methodology for Nigeria.

In this section we described the construction of the structural VAR model of the Nigerian economy. The linkage between excess liquidity and economic growth occupied a central place in the economic literature. In examining this relationship using the Nigerian data, we assume a simple model for the Nigeria economy with four endogenous variables namely excess liquidity (ECXL), real effective exchange rate (REER), interest rate (INTT) and real growth rate of output (GDP). We measure excess liquidity as the excess of growth in monetary aggregate to growth in the nominal GDP. We generate the log of all the variables except excess liquidity ECXL and interest rate INTT. The choice of variables is influenced by insights from prior research. Each variable is explained by a structural equation that has an error term associated with it. The error term for each equation is interpreted as representing a particular innovation or shock. These shocks are labeled according to the structural equation from which they derive. Appropriate specification and estimation of the system of four equations capture the systematic effect of excess liquidity and other relevant variables in the model. The paper uses quarterly data for the period 1980Q1 to 2007Q4. All the data required were obtained from various issues of the CBN Statistical Bulletin and the IMF International Financial Statistics.

Model Specification

We start by specifying a simple unrestricted VAR model. In matrix form, the VAR model is

$$Y_t = AY_{t-1} + et$$

Where Y is a vector of variables and A is a matrix of polynomials in the lag operator and et is a vector of random errors. In order to transform the original VAR into a model in which disturbances are orthogonal, the SVAR approach proposes to start from the "true" structural form model

Estimation Procedure

Our objective therefore is to transform the original VAR into a model in which disturbances are orthogonal; we incorporate restrictions on the interactions and dynamics of the model to produce sensible response. We begin by examining the properties of the data, such as optimum lag length, normality test, autocorrelation test, unit root test, group stationary test and stability test. Then, we proceed to imposed restriction on the error term and generate the SVAR.

Optimum Lag Length Test

To determine the optimum lag length, we started with a lag length of eight since we employed quarterly data for the estimation. The results of all the test statistics which include Sequential Modified LR test, Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC) and Hannan

Quin Information Criterion (HQ) are diverse. The AIC, SIC and HQ indicate lag length of four, while LR and FPE indicate lag length of three. At lag length of four, the model was unstable, we, therefore, choose lag length of three. See the table 1 below.

Table 1: VAR Lag Order Selection Criteria

Endogenous variables: EXCL INTT LREER LGDP. Exogenous variables: C						
Sample: 1980 2007						
Included observations: 23						
Lag	Log L	LR	FPE	AIC	SC	HQ
0	-66.95401	NA	0.005620	6.169914	6.367391	6.219579
1	-4.569008	97.64609	0.000102	2.136435	3.123822	2.384760
2	12.08099	20.26957	0.000112	2.079914	3.857209	2.526898
3	54.92318	37.25407*	1.66e-05*	-0.254190	2.313015	0.391455
4	81.27630	13.74945	1.98e-05	-1.154461*	2.202653*	-0.310156*
* indicates lag order selected by the criterion						
LR: sequential modified LR test statistic (each test at 5% level)						
FPE: Final prediction error						
AIC: Akaike information criterion						
SC: Schwarz information criterion						
HQ: Hannan-Quinn information criterion						

Test for Autocorrelation

At lag 3, the Residual Serial Correlation LM test shows that there is no problem of autocorrelation in the model.

VAR Residual Serial Correlation LM Tests

H0: no serial correlation at lag order h

Sample: 1980 2007

Included observations: 24

Lags	LM-Stat	Prob
1	11.15601	0.7998
2	25.90992	0.0553
3	20.42168	0.2018
4	13.78130	0.6150
5	34.37465	0.0048
6	23.04936	0.1124
7	18.22831	0.3107
8	22.68784	0.1223
9	17.54530	0.3512

Probs from chi-square with 16 df.

Result of Unit Root Test

In order to check the time series properties of the variables used in the model, we apply the unit root test. It is important to determine the order of integration of the series. The result showed that all the variables were integrated of order one (1) except excess liquidity which is of order zero I (0). Studies have shown that these tests often lack power in small samples, however recent studies now give more credence to the Philips-Perron (PP) test because of its strong validity even if the disturbances are serially correlated and heterogeneous, while the ADF tests require that the error term be serially uncorrelated and homogenous. In spite of these shortcomings of these tests, we cannot overemphasize their importance for empirical modeling because they show the order of integration among variables, having satisfied the McKinnon (1996) condition for integration.

Variables	Levels				First Differences			
	ADF1	PP1	ADF2	PP2	ADF1	PP1	ADF2	PP2
INTT	-1.805108	-1.819610	-3.111394**	-3.188648**	-5.585120*	-5.712785*	-5.436370*	-5.539062*
LREER	-2.901770***	-3.061315**	-3.725753*	-3.768195*	-9.226264*	-8.413689*	-9.924695*	-8.838317*
LGDP	0.880514	0.864852	-2.377789	-1.685742	-3.160623	-3.012201	-5.498322*	-3.153060
EXCL	-5.275408*	-5.294159*	-6.075365*	-6.459142*	-8.150322*	-12.11854*	-7.903020*	-11.73668*

Notes: ADF1 and PP1 = Unit root tests with constant, and ADF2 and PP2 = Unit root tests with constant and trend.
, **, and * indicate statistical significance at the 1%, 5% and 10% level respectively.*
With constant only: McKinnon (1996) critical values are: -3.699871(1%), -2.976263(5%), and -2.627420(10%). With constant and trend: MacKinnon (1996) critical values are: -4.339330(1%), -3.587527(5%) and -3.229230(10%).

Group Stationary Test

Since it has been observed from the unit root test that some variables are stationary while some contain unit root, we conducted a group unit root test on the variables to ensure the usage of the data in VAR model. The result of the group unit root indicated that the variables as a group do not contain unit root and that they can be used at their levels.

Stability Test

To ensure the reliability of the impulse response and variance decomposition coefficients, we employed AR root stability test. The estimated VAR is stable if all roots have modulus less than one and lie inside the unit circle. The result of AR root stability test satisfies the stability condition of the model.

Roots of Characteristic Polynomial

Endogenous variables: EXCL INTT LREERLGDP.

Exogenous variables: C

Lag specification: 1 3

Root	Modulus
0.998682	0.998682
0.273246 - 0.871922i	0.913735
0.273246 + 0.871922i	0.913735
-0.878274	0.878274
0.572991 - 0.449427i	0.728219
0.572991 + 0.449427i	0.728219
-0.123242 - 0.711485i	0.722080
-0.123242 + 0.711485i	0.722080
0.559738 - 0.377589i	0.675189
0.559738 + 0.377589i	0.675189
-0.598934 - 0.082295i	0.604562
-0.598934 + 0.082295i	0.604562

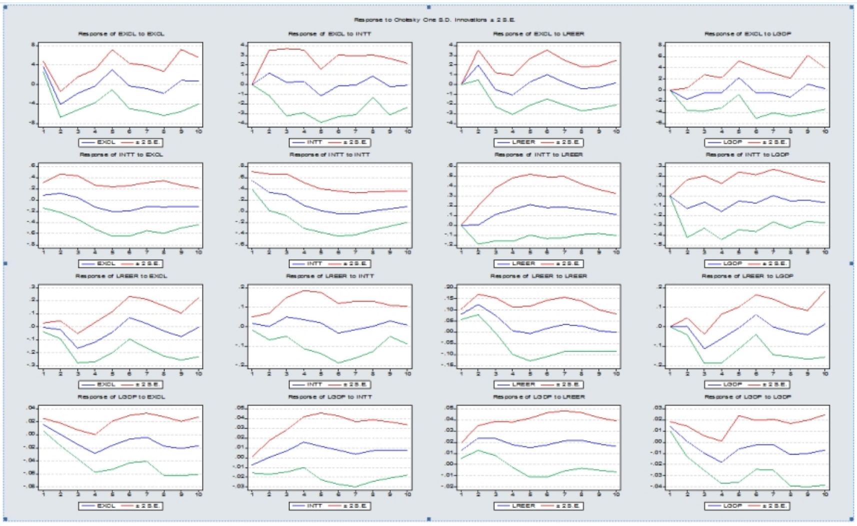
No root lies outside the unit circle.

VAR satisfies the stability condition.

Imposing Short-run Restrictions to Generate the Structural VAR

We impose the Choleski decomposition which assumes that shocks or innovations are propagated in the order of EXCL, INTT, LREER, and LGDP. The identifying restrictions are imposed in terms of the e's which are the residuals from the VAR estimates, and the u's, which are the fundamental or “primitive” random (stochastic) errors in the structural system.

Figure 1: Impulse Response



IV. Interpretation of Results

Impulse Responses Findings

The impulse responses of the SVAR model, which includes the real effective exchange rate (REER), interest rate, real GDP (LGDP), and excess liquidity (ECXL), are presented. The result indicates the responses of real effective exchange rate, interest rate and real output to shocks in excess liquidity in the domestic economy.

The response of real GDP to shock in excess liquidity can be observed from the graph above (column 1, row 4). The Gross Domestic Product (GDP) responds in relatively quick fashion to the shock in the excess liquidity, the direction of the GDP immediately assume downward trend right from the first quarter. The negative impact on the economy starts from the second quarter lasting throughout the tenth quarter. The speed of adjustment after the disturbance seem to be reached in the seventh quarter but later diverge and become more negative for the rest of the period. This result implies that excess liquidity is totally detrimental to the Nigerian economic growth.

Response of real effective exchange rate to shocks in excess liquidity begins from the first quarter (column 1, row 3). Excess liquidity depreciates the real exchange rate right from the first quarter to the fifth quarter. The effect was reversed between the fifth and seventh quarter, as it appreciates the real exchange rate during the period. However, from the seventh quarter, appreciation reverts to depreciation of the rate. The result shows that speculators immediately react to shocks in excess liquidity and take the advantage of excess monetary expansion for speculative activities which further depreciates the exchange rate in the foreign exchange market.

The result shows that the response of interest rate to excess liquidity in Nigeria is sluggish (column 1, row 2). Though the response of interest rate was according to expectation, the fall in interest rate was gradual from the first quarter to the third and became noticeable after the third quarter and lasted throughout the period. The result indicates that the monetary transmission mechanism in Nigeria is slow.

V. Summary and Policy Recommendations

This paper measures the response of real output, real effective exchange rate and interest rate to shocks in excess liquidity in Nigeria. SVAR model was estimated, and impulse responses were obtained from the model. The findings from the study reveal that excess liquidity in the domestic economy is detrimental to the performance of the economy according to expectations. Increase in excess liquidity decreases output. The conclusion confirms the earlier findings that excess liquidity is detrimental to the economy and offer significant challenges to policy formulation in Nigeria.

Monetary policy directions must, therefore, focus on achieving sustainable economic growth in both short to medium term to engender confidence in the economy. This paper, therefore, calls for the following: contractionary monetary policy and prudent use of monetary instrument especially open market operation (OMO) to mop-up excess liquidity in the domestic economy.

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