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Transmission Mechanisms of Monetary Policy in Nigeria A Dynamic Stochastic Approach

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ABSTRACT

This study examines the role of transmission mechanism of monetary policy in an emerging economy with a rapidly developing financial system. Specifically, we examine whether the central bank of Nigeria monetary policy influence economic activity (output) in Nigeria. Using a SVAR model, impulse response functions and forecast error variance decomposition analysis was performed to identify the relative strengths of different channels in transmitting the monetary pulses. The results show that one of the monetary channels (the reserves and not deposits) is more important than credit channel (loans) and the exchange rate channel. This implies that in less developed financial markets, monetary policy influence economic activity by varying the reserve availability than its loans.

1. INTRODUCTION

In recent decades there has been a surge of economic literature on monetary policy transmission mechanisms that is, the channel through which changes in monetary policy are transmitted into the economy. The most traditional view is characterised by the interest rate channel. Expansionary (contractionary) monetary policy lowers (raises) money market interest rates, thereby reducing (increasing) borrowing costs and boosting (reducing) loan demand, investments and consumption. Moreover, theory offers several other transmission channels, including the exchange rate, asset price and credit channels (Juurikkala et al., 2009). The credit channel, formalised by Bernanke and Blinder (1988), can be further decomposed into the asset price and bank lending channels. The bank lending channel, which includes an important role for banks in the transmission process, is of special interest in this study.

An obvious, but generally overlooked issue in the policymakers' discussion of monetary policy is the fact that transmission mechanisms depend for a significant part on market imperfections. These imperfections range from the primary effects of short-run monetary policy on real market interest rates at various time terms (the starting point of virtually every mechanism described herein) to the information asymmetries among economic agents that play a crucial role in the so-called credit channel.

In an economy with instantaneous price adjustment, perfect information and complete financial markets, monetary policy would be neutral even in the short run, playing no other role than determining the inflation rate and, through it, the demand for real monetary balances. In such a scenario, altering the structure of the economy to increase the "effectiveness" of monetary policy would be absurd from a welfare perspective.

In that sense, an increase in the capacity of monetary policy to affect the real sector, for a given economic structure and its associated degree of effectiveness, is not necessarily desirable, even if monetary actions are optimally conducted. With the same logic, observing a diminishment on the central bank's capacity to affect the economy may not be worrisome, but an indication that the economy's overall structure is becoming more efficient and flexible.

For example, the success of monetary policy in smoothing the adjustment of a credit-constrained economy to an adverse demand shock is a second-best solution, since the first best would probably be to have a more complete financial market and the economy adjusting automatically. The lost of monetary "effectiveness" would be a desirable outcome if it is the result of phenomena such as increased financial development, better information systems or more flexible contracts.

The Improvement in the performance of economy is possible if the authorities can opt better target variables as a result of enhanced awareness of transmission mechanism. Though there is almost a consensus that in the short run, monetary policy affects the real performance of the economy, agreement upon how actually it does so i.e., the famous black box monetary transmission mechanism is not found in the literature. The studies have mainly focused on the Nigeria economy. What follows, the literature review discussed briefly in section 2, while, the model specification and estimation strategy are describe in section 3. Section 4 discusses the empirical results in the study and section 5 concludes with a brief.

2. REVIEW OF LITERATURE

There is voluminous literature on the transmission mechanism of monetary policy. Identifying the relationship between policy instruments and target variables is vital for the conduct of monetary policy for many reasons. It not only improves our understanding of the effects of monetary policy but also gives information that how important aggregate demand and supply shocks are in any economy, which then help the monetary authorities to formulate better policy response. There are several transmission channels (e.g. the interest rate, bank lending, balance sheet, and exchange rate channels) that have been identified in the literature. The importance of each of these channels is influenced by the economic, legal and financial structure prevailing in the specific country (Shabbir, 2008). Thus differences in the structure of the financial markets across countries would mean differences in the transmission mechanisms. An important requirement in the design of appropriate monetary policy therefore is an understanding of the major transmission channels for the specific economy.

The traditional mechanism, which works through the liability side of the banking system states that a tight monetary policy reduced the banks' reserve and their ability to lend weakens. Given the money demand, the interest rate or the cost of capital in the economy swells which dries up expenditure on consumer durables, housing business fixed investment and on inventories. Accordingly, the actual output falls, following a plunge in the aggregate demand. This mechanism working through the liability side of the banks assumes that banks are not able to shield transaction balances from reserve changes and there is no close substitute for money.

Bernanke and Gertler (1995) and (Shabbir, (2008) have suggested another mechanism of monetary transmission i.e., credit channel, as the traditional channel has been unable to explain the following two observed phenomena. First, spending has been found insensitive to the interest rate. Second, why monetary policy has large effects on long-lived assets which respond to real long-term rates, given the fact that policy must have strongest effects on short-term rates and weakest effect on long-term rates. This credit channel, which in fact is not a separate channel rather amplify the traditional channel, has two separate channels i.e., the balance sheet channel or broad lending channel and the bank lending channel. The balance sheet channel explains that asymmetric information and moral hazards problems create external financial premium i.e., a wedge between the cost of funds raised externally (by issuing equities) and the opportunity cost of funds raised internally (by retaining earnings).

In developing economies where most of the projects are financed by bank loans, the bank lending channel is more effective in explaining the variation in output. A monetary policy which restrict the banks' ability to lend, forces the investors to restrict their spending as alternative sources of finance are not available. A tight monetary policy raises the internal rate that will move the external finance premium in the same direction, thus restricting the firms' ability to obtain funds externally by deteriorating its credit worthiness and net worth (or deterioration in balance sheets of the firms). Thus this channel enhances the traditional monetary channel by explaining the firm's inability in raising funds and consequently reducing investment spending in the wake of the interest rate hike.

In the exchange rate channel of monetary policy, Taylor (1995) indicates that a rise in domestic interest rate causes inflow of capital. This, under floating exchange rate regime, causes an appreciation of domestic currency and a fall in net exports and output. If the country is following a fixed exchange rate, the resultant inflow of capital will be sterilized by an increase in the money supply in an attempt to minimize the fluctuation in the parity. This may make the initial expansion in money supply redundant and impact of policy will not be transmitted into exchange rate. However, in the presence of black market or parallel market, pulses of the policy will be transmitted into the economy via black market trade.

Accordingly, it is that belief that an increase in the real effect of monetary policy shocks a desirable development. The potential impact of monetary policy on the economy - and the channels through which it operates, has been at the core of macroeconomic discussion for decades. However, besides agreement on basic issues such as the long-run neutrality of money, no clear consensus has been achieved. A number of arguments have been proposed, particular or general, complementary or contradictory, to explain how monetary policy decisions could be transmitted to prices and to the real sector (Lucas, 1972; Taylor, 1979; Ball, Mankiw, and Romer, 1988), as well as to describe the intensity and efficiency of this transmission.

In an emerging economy like Nigeria, bank loans are typically short-term and hence may speed up the transmission process. Moreover, informational frictions between individual banks are likely to be more pronounced in a banking system characterised by a large number of small banks, relatively frequent bank failures, short credit histories, and slowly improving regulation. We therefore feel that examining the monetary policy transmission in Nigeria should be especially fruitful. A successful monetary policy strategy requires an understanding of the relationship between operating instruments of monetary policy and the ultimate goals such as output and price stability. Monetary policy affects these macroeconomic variables through monetary transmission channels.

3. MODEL SPECIFICATION AND ESTIMATION STRATEGY

What variables are considered as potential determinants of monetary transmission or of the coefficient associated to the monetary shock? The included variables are as follows: Exchange Rate, Reserves, Deposits and Loans, while GDPN is a proxy for economic activities.

To obtain some rough estimates of the magnitude of the effects of monetary transmission on output level in Nigeria, we regress, measure of economic activity on the potential determinants of monetary transmission. We followed Blanchard, Olivier and Danny Quah (1989), sequential method of scoring (analytic derivatives) of structural and unrestricted VAR estimates. The dynamic relationships between variable are modeled empirically as a vector autoregression (VAR) while a simple structural model based on economic theory is used to model the contemporaneous relationships. The advantage of using VAR is that we need to impose minimal restrictions while incorporating the monetary shocks. The lack of agreement about how monetary transmission mechanism operates also favors the use of VAR. Moreover, this methodology also take care the simultaneous movements in economic variables resulting from monetary policy variation as well as the developments in monetary policy as a result of changes in economic variables.

To estimate the hybrid model, we estimate by an unrestricted VAR of the form.

$$Y_t = C_0 + \sum_{i=1}^{k} C_t Y_{t-1} + y_t \ . \qquad (1)$$

The reduced from VAR is identified using a contemporaneous, recursive system where it is assumed that innovations are orthogonal and is the lower triangular (Sims, 1980). It is plausible to order the policy variable first in the recursive system, if it is not getting influenced by the other variables in the system.

The (*n x 1*) vector Y_t contains *n* variable in the system, which is list of vector of endogenous variables that includes. The vector Y_t contains Deposits (DEP_t), exchange rate (EXR_t), Reserves (REV_t), Loans (LNS_t), Nominal Gross Domestic Product ($GDPN_t$). C_0 is a vector that contains the constant terms. The (*n x 1*) vector y_t contains the residuals from the VAR and is a vector of serially uncorrelated shocks. The contemporaneous

relationship between the residuals from the VAR can be modeled as a system of simultaneous equations of the form:

$$y_t = \beta_0 y_t + e, \quad (2)$$

Where the (n x n) matrix β_0 is the same as in equation (2)

In order to identify the contemporaneous parameter matrix, β_0, we us the following simple structural VAR (SVAR) estimate model. The main purpose of structural VAR (SVAR) estimation is to obtain non-recursive orthogonalization of the error terms for impulse response analysis. This alternative to the recursive Cholesky orthogonalization requires the user to impose enough restrictions to identify the orthogonal (structural) components of the error terms. The structural VAR (SVAR) estimate model could be specified in these formats below:

Model: $Ae_t = Bu_t$ where E[uu']=I
Identification restriction type: short-run text form

$$e_{5t} = \beta_1 e_{1t} + \beta_2 e_{2t} + \beta_3 e_{3t} + \beta_4 e_{4t} + \beta_5 u_{1t} \quad (3)$$

Where (exogenous and endogenous variables list),
e_{1t} represents REV_t residuals (rev_t)

e_{2t} represents DEP_t residuals (dep_t)

e_{3t} represents EXR_t residuals (exr_t)

e_{4t} represents LNS_t residuals (lns_t)

e_{5t} represents $GDPN_t$ residuals ($gdpn_t$)

The special key symbols "e_1", "e_2", "e_3," "e_4," "e_5" in equations (3), represent the first, second, third, fourth and fifth elements of the e_t vector (the e_i's represent exogenous structural shocks to the various equation, except e_{6t}), while "u_1" represents the element of the u_t vector ($u_{i\square}$ captures a set of other explanatory factors). In this model, all unknown elements of the *A* and *B* matrices are represented by elements of the β coefficient vector (where $\beta_{i\square}$ are parameters to be estimated) and the subscript *t* will be used for time series data.

The (*n x 1*) vector Y_t contains *n* variable in the system, which is list of vector of endogenous variables that includes. The vector Y_t contains Reserves (REV_t), Deposits (DEP_t), Exchange rate (EXR_t), Loans (LNS_t), and Gross Domestic Product (GDPN)

The model given by equations (3) is a static macroeconomic model that consists of aggregate production and various transmission channels that is uniquely related to the economic. Contemporaneous reaction functions for reserves, deposits, exchange rate, loans and consumer price index and contemporaneous response to economic activity as captured by gross domestic product. Equation (3) implies the reaction of gross domestic product to monetary policy changes, this equation (3) describes the contemporaneous effect of monetary policy changes on economic activity.

Since equations (3) constitute a simultaneous equation among other model (not presented in this work), we use, following Blanchard, Olivier and Danny Quah (1989), sequential method of scoring (analytic derivatives) of structural and unrestricted VAR estimates. With optimization control to estimate the parameter matrix of A*e* = B*u* where E[uu']=I. The economic activity equation (3) is estimated by method of scoring (analytic derivatives) of the structural VAR estimates (SVAR). Since all the right-hand variables are assumed to be uncorrelated with the error term u_{1t}. We identify the response of GDPN to monetary policy shock using the structural decomposition method. The overall relationship between the GDPN and its explanatory variables are expected to be negative or positive. We use annually data from the CBN bulletins (CBN, 2009). Owing to data limitations, we restrict our estimation to the sample period 1970 to 2009. Economic activities are measured by quantity of money in the economy.

4. ESTIMATION OF RESULTS

In order to ensure stationarity of the data, all the variables are in terms of first differences of logarithms (growth rates) and none at level. Our estimation technique consists of two steps procedure. First, a vector autoregression estimate, using Iterative Weighted Least Squares simultaneous regression method (including a constant term) is run over the

sample period 1970-2009. The lag length of one was chosen based on the Akaike Information. Once the VAR was estimated, and the residuals from the structural VAR (SVAR) are then used to estimate the structural models given in (3) among other models and with 15 structural coefficients, the SVAR is just-identified. Estimation of the structural model based on the residuals from the SVAR (see Table 1).

Table 1: Coefficient Estimates of Structural Model

Structural VAR Estimates				
$e_{5t} = \beta_1 e_{1t} + \beta_2 e_{2t} + \beta_3 e_{3t} + \beta_4 e_{4t} + \beta_5 u_{1t}$				
	Coefficient	Std. Error	z-Statistic	Prob.
β_1	0.337250	0.160615	2.099750	0.0358
β_2	-0.005312	0.046506	-0.114215	0.9091
β_3	-0.001503	0.002129	-0.706321	0.4800
β_4	-0.048573	0.153492	-0.316454	0.7517
U_1	-0.161925	0.018334	-8.831761	0.0000

The study focuses on finding the relative strengths of different channels that are important in transmitting the monetary effects into the real sector. In Table 1, we report the vector Structural autoregression estimate (simultaneous regression method) for the variables including the standard errors.

An examination of these results indicates that all the explanatory variables have significant direct and inverse contemporaneous effect on output. With reserves (0.34%), deposits (-0.005%), exchange rate (-0.02%), loans (-0.05%), the result shows that only one of the monetary channels (Reserves) play an important role in explaining the output variation in Nigeria, while the other monetary channel (deposit), and the credit channel (Loans) and exchange rate channels are not significant in transmitting the monetary pulses in the economy.

The study focuses on finding the relative strengths of different channels that are important in transmitting the monetary effects into the real sector. It is surprisingly that deposits, exchange rate and credit (loans) channel does not play any role in the variation of output in the short run. The results show that Reserves has the highest significant contemporaneous effect on output variation in Nigeria.

Impulse Response and Variance Decomposition

The estimated coefficients of the VAR and contemporaneous model indicate the direct effects on the measure of output. Yet, we are also interested in the total effects (direct and indirect effects) that these variables will have on output. Thus, in Tables 2 and 3, we present the results from the impulse response and variance decompositions for the level of output. The actual impulse response function and variance decompositions are based on the initially estimated model of the structural vector autoregression (SVAR) estimate using the actual data. The decomposition method used is structural decompositions.

Table 2:Impulse Response of Output to Structural One S.D. Innovations

Period Horizon	REV Shock	DEP Shock	EXR Shock	LNS Shock	GDPN Shock
1	0.063555	-0.004554	-0.017695	-0.008205	0.161924
2	0.095486	-0.066015	-0.005570	-0.029077	0.130987
3	0.118539	-0.078508	-0.002200	-0.045949	0.123196
4	0.135228	-0.082156	-0.004680	-0.060468	0.123119
5	0.147605	-0.085278	-0.010847	-0.073081	0.125691
6	0.157035	-0.088853	-0.019252	-0.084004	0.129059
7	0.164374	-0.092525	-0.028943	-0.093418	0.132472
8	0.170154	-0.095915	-0.039297	-0.101501	0.135602
9	0.174710	-0.098811	-0.049899	-0.108414	0.138308
10	0.178260	-0.101134	-0.060467	-0.114300	0.140534
Factorization: Structural					

Impulse Response Function (IRF)

An IRF traces the effect of a one-time shock to one of the innovations on current and future values of the endogenous variables. A shock to the one variable not only directly affects another variable but is also transmitted to all of the other endogenous variables through the dynamic (lag) structure of the VAR. Our innovations are assumed to contemporaneously uncorrelated after a transformation.

The IRF results in Table 2 traces out the response or describe how output react over time to exogenous impulses' (shocks) of the monetary variables. The results show that output is affected contemporaneously by the shocks from other variables (columns two to five). The response is also portrayed graphically, with horizon (period) on the horizontal axis and

response on the vertical axis (see Appendix A). The second column is the response of output to the reserves, the third column is the response of output to deposits, the fourth column is the response of output to exchange rate shock and the fifth column is the response of output to the credit channel of the monetary transmission mechanisms.

The output response to structural one innovation appears to be greater in reserves than other exogenous variables. Monetary policy shock to reserves effect is stronger on the output at longer horizon (from the second to tenth years) and is less than output to itself in first period. One innovation in inflation show large percentages of output response. Reserves innovations play an important role in variation of output in long run than they do in the short run. Indeed, for the ten period horizons aggregate reserves shocks explain a greater proportion of the variation in output. Thus, from the results in Table 2, it appears that other variables are less sensitive to the output variation shocks.

Table 3:: Structural Decomposition for the Level of Output

Percentage of Forecast Variance Decomposition Explained by Innovations

Horizon	S.E.	REV Shock	DEP Shock	EXR Shock	LNS Shock	GDPN Shock
1	0.201206	13.17461	0.067640	1.021238	0.219591	85.51692
2	0.284729	21.16304	7.043226	0.553538	1.468259	69.77194
3	0.356317	27.29632	10.57627	0.350102	3.033866	58.74344
4	0.425139	31.69260	12.04579	0.258359	4.653761	51.34949
5	0.492880	34.70534	12.67064	0.251997	6.200849	46.17118
6	0.559332	36.70271	12.95744	0.342973	7.615804	42.38108
7	0.624084	37.98266	13.09711	0.541787	8.877742	39.50071
8	0.686863	38.76290	13.16079	0.849391	9.986611	37.24031
9	0.747534	39.19583	13.17605	1.258893	10.95258	35.41665
10	0.806050	39.38646	13.15510	1.758835	11.79001	33.90960

Factorization: Structural

Variance decomposition

The resulting variance decompositions of the effect of monetary transmission mechanism of the monetary policy on output are presented in Tables 3. The decompositions are also portrayed graphically, with horizon on the horizontal axis and percent on the vertical axis (see Appendix B).The results indicate that monetary channel (Reserves and Deposits) play an important role in explaining the output variation in Nigeria, while the credit channel

(Loans) is less significant in transmitting the monetary pulses in the economy. The exchange rate channel does not play any role in the variation of output either in the short run or in the long run.

The result shows that from the 4^{th}-10^{th} periods because, most of the variability in output appears to be due to innovations in the monetary channel (Reserves and Deposits). Reserves effect is stronger on the Output at longer horizon (10 years) and is larger than Deposits. Innovations in Reserves consistently explain relatively large percentages of Output forecast errors (36.99% average between 4^{th}-10^{th} year horizons). Reserves and Deposits innovations play a larger role in explaining output forecast error variance in the long run than they do in the short run**.**

Innovations in the credit channel explain relatively small proportions of the forecast variance of output and its effect is more after the 9^{th} year's horizon, the long run. Thus, variability in and exchange rate channel appears to be less sensitive to shocks than other variables and it appear not to be very important in explaining output in either the short or long run. Overall, it appears that a policy shock to monetary channel play an important role in explaining the output variation in Nigeria. The variance of decompositions of the other variables in the system does not indicate significant feedbacks effects by Output on the rest of the macroeconomy. Looking at the recent monetary policies in Nigeria, it is evident that Nigeria monetary policies are used accurately.

5. CONCLUSION

The study focuses on finding the relative strengths of different channels that are important in transmitting the monetary effects into the real sector. This paper used a stochastic model to analyze different channels of monetary policy transmission in the Nigerian economy. We find results consistent with other researcher on contemporaneous impacts.

The principal finding of this paper is that the monetary channel is more important in explaining the output variation in Nigeria than the credit channel both in the short and long run. The estimates also reveal that, variability in exchange rate appears not to be very important in explaining output variation in either the short or long run, because the

magnitude of the coefficient is considered to be relatively too small. This information is helpful to the monetary authorities who want to ensure high economic activity and the lessons learnt can help the policy makers of developing economies in formulating the monetary policy.

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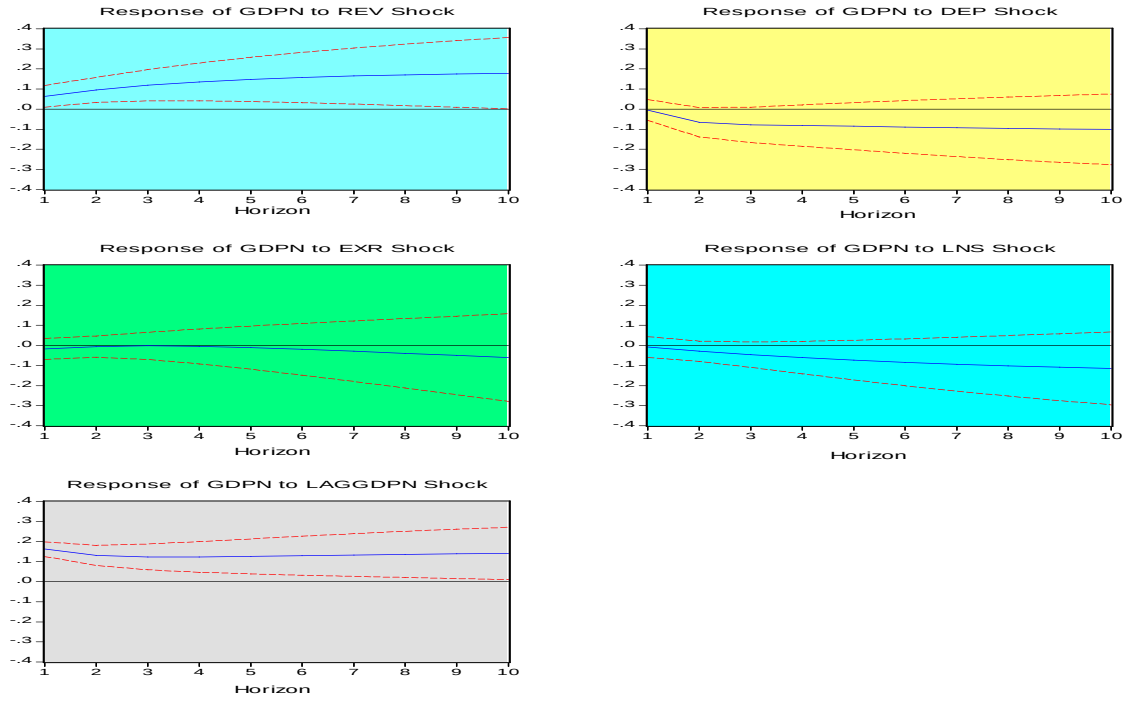
Appendix A: Response to Structural One S.D. Innovations ± 2 S.E.



Appendix B: Variance Decomposition