Effects of Shocks to Money Supply on Exchnage Rate in Nigeria: A Vector Error Correction Approach

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Abstract

This paper examines the effects of shocks to money supply on exchange rates in Nigeria for the period 1986 – 2013, by applying the vector error correction approach. The choice of this period is to enable us focus strictly on the post SAP period when exchange rate management was conducted under the flexible exchange rate regime. The central bank's balance sheet identity was used to link the processes that generate both the money supply and exchnage rate. The VEC result suggests that money supply is found to have immediate depreciating effect on the exchange rate and that exchange rate depreciation influences money supply more in the long run. It is recommended that the Central Bank of Nigeria should avoid foreign exchange intervention when movements in exchange rates are non-transient.

Key words: *money supply, exchange rate, inflation rate, balance sheet, vector error correction.*

1. Introduction

Exchange rate which is also known as the foreign-exchange rate, forex rate or FX rate between two currencies is the rate at which one currency will be exchanged for another. It is also regarded as the value of one country's currency in terms of another currency Sheffrin (2003). The central Banks manage the exchange rate from time to time especially during periods of exchange rate volatility which may affect the Central bank's money supply target. To ensure stable exchange rate, stable inflation and reasonable economic growth, the Central Bank managed and manipulates money supply in the country.

The central bank substantially controls the quantity of money that circulates in an economy, the money supply.Money Supply is the back bone of all economic activities and so has powerful effects on theeconomic activities of any nation. An increase in Money Supply puts more money in the hands ofproducers and consumers and thereby stimulating increased investment, consumption and leads to depreciation in domestic currency.Consumers increase purchases and business firms respond to increased sales by ordering formore raw materials and other resources to achieve more production, the spread of businessand capital goods. As the economy goes buoyant, Stock Market prices rise and firms issuemore equity and debt instruments. As the Money Supply expands, prices begin to rise

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(inflation),especially if output growth reaches full capacity. Lenders insist on higher interest rates to offsetexpected decline in purchasing power over the life span of their loans. Opposite effectsoccur when the Money Supply falls or when there is decline in its growth rate, economicactivities decline.

The monetary authorities participate in foreign exchange market in order to manage the exchange rate. This participation is in form of sterilized and unsterilized. The unsterilized monetary intervention has influence on money supply. This can be achieved through changes in money supply. When central bank lowers interest rate, domestic money supply will increase which lead to depreciation in domestic currency which could be inflationary. On the other hand, the central bank can raise the interest rate; domestic money supply will be low which will also appreciate the domestic currency. The monetary authorities can also intervened by buying and selling foreign currency or assets to banks.

The used of monetary policy to achieve domestic objective is increasingly being challenged particularly in an open economy such as Nigeria, where the capital account is increasingly being liberalized in a managed floating or pegged exchange rate regime. Monetary authorities cannot control the nominal money supply in a fixed exchange rate regime since such control entails foreign exchange intervention, the sterilization of which cannot continue indefinitely. In an attempt by the authorities to achieve exchange rate stability via foreign exchange intervention, money supply targets are potentially threatened.

This study attempts to analyze the effects of shocks to money supply on the exchange rate in Nigeria.It cover the period of 1986 to 2013, The choice of this period is to enable us focus strictly on the post SAP period when exchange rate management was conducted under the flexible exchange rate regime. The study also adopted the Vector Error Correction Mechanism (VECM) whichhas become popular in economic analysis in recent time. The paper is structure intofive: section one is on general background of the study; review of related literature and theoretical framework in section two; section three is on methodology of the study. While section four present and discuss estimated results; section five is on conclusion and recommendation.

2. Theoretical Framework and Literature Review

The simplified balance sheet of the Central Bank and the consolidated balance sheet of the commercial banks are used to understand the relationship between money supply and exchange rateDornbusch (1993). The balance sheet records the assets and liabilities of both the Central Bank and Commercial Banks Bruno (1993). The Central Bank assets include the net foreign assets of the authority and the net domestic assets which is the sum of loads to Commercial Banks and government while the liabilities are deposits of Commercial Banks and the currency in circulation which they issue. The commercial assets include the Commercial Bank’s reserve help by the Central Bank and the short term bank

credit; on the liability side we have the demand deposit which is help by the public.

Table 1a: Central Banks

Assets	**Liabilities**
Net foreign assets (NFA)	Bank Reserves (BR)
Net domestic assets (NDA)	Currency (CU)

Monetary base or high-powered money (H)

Table 1b: Commercial Banks

Assets	**Liabilities**
Bank Reserves (BR)	Demand deposits (DD)
Short-term bank credit (BC)	

Suppose the Central Bank purchases foreign exchange from the forex market using domestic currency, this will initially raise CU and NFA, hence raise H. this implies that a rise in the money supply. An unsterilized purchase of forex by the Central Bank will therefore cause increase in money supply and increase demand of foreign currency in the forex market and cause the domestic currency to depreciate.

Al-Omar (1997) examined the impact of money supply and exchange rate on consumer price index in Kuwait for the period of 1976 – 1990 by using the granger causality test on the variables to determine the nature of causality among them and also vector autoregression to analyze the impact of money supply and exchange rate on consumer price index. The results show that consumer price index affect both money supply and exchange rate and that exchange rate is statistically insignificant in influencing consumer price index.

Jimoh (2004) examined the relevance of monetary Approach to the floating exchange rate regime in Nigeria between 1987-2008 using the cointegration and granger Causality tests. The results indicate that increase in domestic money supply relative to foreign money supply causes the exchange rate to depreciate.

Okhiria and Saliu (2008) examined the impact of exchange rate on inflation in

Nigeria from 1979 – 2007 with the used of Johansen cointegration test. The variables used are government expenditures, money supply, oil revenue, exchange rate and inflation. The result indicated that exchange rate and money supply are cointegrated.

Rapach (2001) measured the long-run effects of relative money supply disturbances on real exchange rates using G-7 country's data. The result indicated that long-run monetary neutrality specifies that nominal disturbances do not affect long run real exchange rates.

Owoye and Onafowora (2007) examined broad money supply targeting, stability of real broad money supply demand, and effects of deviations of actual real broad money supply growth rates from targets on real GDP growth and inflation rate on Nigeria economy from 1986Q1- 2001Q4 through the use of cointegration and vector error correction mechanism. The result showed that long-run relationship exists between the real broad money supply and expected inflation rate.

Ndung'u (1999) assessed whether the exchange rate is affected by monetary policy in Kenya and whether these effects are permanent or transitory. Causality tests were performed between several measures of monetary shocks and the cyclical components of real exchange rate. The results indicated that excess money supply predict each other with the cyclical movements of the real exchange rate. Also, the nominal exchange rate over the period is determined by real income growth, the rate of inflation, money supply growth, the cycles in the exchange rate movements, the cointegration vectors and shocks.

3. Research Methodology

The paper used analytical tools which include stationarity, Vector error correction model, impulse response function and variance decomposition to analysis the effects of shocks to money supply on exchange rate in Nigeria using quarterly data for the period 1986Q1 – 2013Q4. The variables used are exchange rate, broad money supply and inflation rate.

3.2 Model Specification

To analyze the shocks to money supply on exchange rate in Nigeria, the vector error correction model is applied as follows:

$exr_t = f(exr_{t-i}, ms_{t-i}, inf_{t-i}, U_{ti})$----------1

$ms_t = f(ms_{t-i}, exr_{t-i}, inf_{t-i}, U_{ti})$----------2

$inf_t = f(inf_{t-i}, exr_{t-i}, ms_{t-i}, U_{ti})$----------3

Where

exr_{t-I} = exchange rate at time $_{t-I}$ ms_{t-I} = Broad money supply at time $_{t-I,}$

inf_{t-i} = inflation rate at time $_{t-i}$

The structural form is:

$exr_t = \alpha o + \alpha_1 exr_{t-i} + \alpha_2 ms_{t-i} + \alpha_3 inf_{t-i} + U_{ti})$----------6

$ms_t = \alpha o + \alpha_1 ms_{t-i} + \alpha_2 exr_{t-i} + \alpha_3 inf_{t-i} + U_{ti})$----------7

$inf_t = \alpha o + \alpha_1 inf_{t-i} + \alpha_2 exr_{t-i} + \alpha_3 ms_{t-i} + U_{ti})$----------8

It is expected that a positive relationship would exist between money supply and exchange rate.

4. Presentation and Analysis of Results

4.1 Unit Root Test

Before proceeding with the vector Autoregressive model, it must be established that the variables are integrated processes of the same order. The standard tests for stationarity, the ADF and PP were used to establish the order of integration of each variable. Both tests indicate that all the variables are integrated of order one. This finding implies that unless they are cointegrated, it is appropriate to estimate the unrestricted VAR in first difference.

Table 2: Unit-root test results

	LEVEL		***FIRST DIFFERENCE***		***COMMENTS***
VARIABLE	***ADF***	***PP***	***ADF***	***PP***	
M̄S	-	-	-	-	I(1)
EXR	-	-	-	-	I(1)
INF	-	-	-	-8.6672*	I(1)

Note: for the levels, we included trend and intercept, the 5% critical value is -3.4602. For the first difference, only intercept is included, the 5% critical value is -2.8943. (*) indicates rejection of unit root at 5%.

4.2 Cointegrated Test Results

Having confirmed that all the variables included in the model are integrated processes of (I (1)), the Johansen's cointegration test is then conducted. We determined the optimal lag length using the three traditional model selection information criteria (AIC, SIC, and HQIC), the final prediction error and the likelihood ratio from the estimates of an unrestricted VAR in levels. We find the optimal lag length that makes the residuals free from autocorrelations to be one.

The test for cointegration suggests that there is the evidence of cointegration. This is true from both trace and maximum-eigen value statistics. The trace suggests one cointegration equation at both 5% and 1% level while the maximum-eigen value suggests one cointegration at 5% level. By normalizing the cointegrating vector (CV) on EXR, the CV is then identified as the long run relationship between EXR and its determinants.

Table 3: Cointegration Test Result

Trace Rank				
Hypothesis	r = 0*	r ≤ 1	r ≤ 2	
Trace statistics	68.24	37.28	24.30	
95%Quantiles	59.32	30.79	26.52	
99%Quantiles	62.13	46.76	31.15	
Maximum-Eigen Rank Test				
Hypothesis	r = 0*	r ≤ 1	r ≤ 2	
Max Eigen statistics	42.36	23.98	22.33	
95%Quantiles	38.18	31.08	25.18	
99%Quantiles	43.35	36.63	29.74	
Estimate of the long run equation				
Variables	EXR	MS	INF	C
CV/{t.stat}	1.00	-1.18{-7.83}	0.07{3.85}	8.94
Adj.a	-0.18	0.009	3.17	
S.E/ {t.stat}	0.073{2.54}	0.008{1.41}	0.294{3.13)	

The cointegrating relation can be identified as the long run relationship between the exchange rare and other variables in the model because all the elements in the cointegrating vector have the theoretical expected signs except the adjustment coefficient in the exchange rate equation that is negatively signed and statistically significant. The result indicates that growth in money supply (MS) has dominants long run positive effects on the exchange rate (EXR).

4.3 **Vector Error Correction Model**

To investigate the dynamic relationship in the model, we specified the error correction model in order to capture both the short and the long run relationships. The VEC was estimated with an optimal lag of one. The estimated specification suggests that the speed of adjustment to the long run equilibrium is low as about 18% of the disequilibrium errors which occurred in the previous period are corrected in the current period. The short run adjustment models indicates that past changes in exchange rate and money supply are negatively related to current changes in exchange rate. This means that in the short run an increase in money supply in the last period is followed by decrease (appreciation) of currency in the period.

Table 4: Error Correction Results

Regressor	**Coefficient**	**t-values**
Intercept	0.02	2.3745
Exchange rate (-1)	-0.13	-0.1677
Money supply (-1)	-0.68	-2.4253
Inflation rate (-1)	0.10	0.3642
ECM (-1)	-0.18	-2.5374

Adj.R-square = 0.246, S.E = 0.2131, f-stt = 4.7808

4.4 **Impulse Response Analysis**

The figure below shows the response to generalized one standard deviation innovations in the variables within a horizon of ten quarters. The responses are for a particular variable to a one time shock in each of the variable in the system. The response of money supply to exchange rate shock is interesting. A shock to the exchange rate depreciation is first followed by a rise in money supply in the first quarter, but the effect immediately declined but remained positive. Generally, it indicates that a shock to money supply will lead to increase in the exchange rate depreciation. However, the effect declines in the second quarter. This seems to capture the response of monetary authorities to reduce money supply, whenever the exchange rate is observed to be depreciating.

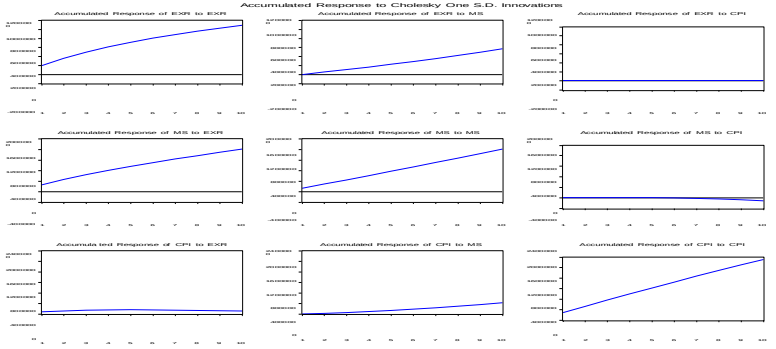

Fig.1: Accumulated Response to Generalized one S.D Innovation

4.5 **Variance Decomposition**

The variance decomposition provides information on the dynamic behaviour of the variables in the system. Exchange rate owns shocks constitute a significant source of variation in exchange rate forecast errors declining from 78% in the first period to 35% in the tenth period. Money supply and inflation accounts for 1.74% and 9.02% source of exchange rate variation.

The money supply owns shocks constitute a significant source of variation from 98% to 73% in period ten. This mean that changes in money supply is persistent. Inflation and exchange rate accounts for 14.52% and 9.4% variation respectively as indicated in the table below:

Table 5a: Variance Decomposition of EXR

Period	EXR	MS	INF	S.E
T = 1	78.1629	4.3074	0.0000	0.3230
T = 2	77.1307	3.2587	1.0064	0.3786
T = 4	65.3178	2.5424	1.7643	0.4539
T = 6	53.4618	2.1208	3.7402	0.5131
T = 8	42.4583	1.9726	6.6753	0.5692

T = 10	35.3017	1.7464	9.0254	0.6020

Table 5b: Variance Decomposition of MS

Period	EXR	MS	INF	S.E
T = 1	14.85387	98.1053	0.0000	1.6457
T = 2	13.0468	88.2178	8.3867	1.2074
T = 4	12.7368	85.7576	11.2925	0.9356
T = 6	11.2084	84.3270	12.2061	0.8464
T = 8	10.7360	79.5467	13.9360	0.7463
T = 10	9.4364	73.7463	14.5282	0.5263

5. **Conclusion and Recommendations**

In conclusion, from the cointegration and vector error correction techniques used, we discovered that growth in money supply has dominant long run effects on the exchange rate. The impulse response function revealed that exchange rate depreciation has an expansionary effect on money supply and that money supply expansion leads to the depreciation of the currency. The variance decomposition results show that exchange rate depreciation leads to monetary expansion both in the short run and long run. The implication of our findings is that money supply is found to have immediate depreciating effect on the exchange rate and that exchange rate depreciation influences money supply more in the long run. The Central Bank of Nigeria should avoid foreign exchange intervention when movements in exchange rates are non-transient.

References

Al-Omar, H. (1997): "The effect of money supply and exchange rate on inflation in the economy of Kuwait". King Saudi University Journal Digital Library, Administrative sciences Volume 9, No.2

An, L. and Sun, W. (2008): "Monetary policy, foreign exchange intervention and exchange rate: The case of Japan". International Research Journal of Finance and economics , ISSN 145-2887, issue 15 (2008) © Eurojournals publishing Int'I 2008

Bernhofen, D. M., Xu, P. (2000),Exchange Rates and Market Power: Evidence from the Petrochemical Industry, Journal of International Economics.

Bessler DA (1984). "Relative Prices and Money: A Vector Autoregression on Brazilian Data". Am. J. Agric. Econ.

CBN (2008): "CBN Communique" Monetary policy meeting, February 2008 CBN (2009): "CBN Communique" Monetary policy meeting, December 2009 CBN (2010): "CBN Communique" Monetary policy meeting, December 2010 CBN (2011): "CBN Communique" Monetary policy meeting, December 2011 CBN (2012): "CBN Communique" Monetary policy meeting, December 2012 CBN (2013): "CBN Communique" Monetary policy meeting, December 2013 CBN (2013): "CBN Statistical bulletin, 2013

Dornbusch, Et al. (2005): macroeconomics. Tata McGraw-Hill publishing company Ltd.

Frankel, J.A. (2005): "Foreign Exchange": The Concise Encyclopedia of Economics. Library of Economics and Liberty, coryright © 2008, Liberty Fund Inc.

Jimoh, A. (2004): "The Monetary Approach to exchange rate determination: Evidence from Nigeria" *Journal of Economic cooperation* 25, 2 (2004) 109-130

Ndung'u, N.S. (1999): "Monetary and exchange rate policy in Kenya". AERC RP94 ARCHIV 330 (b) A37, IDRC-Lib 114243 African economic research consortium, Nairobi March 1999

Okhiria, O. and Saliu, T. (2008): "Exchange rate variation and inflation in Nigeria (1970-2007)". University essay from HogskolanIskovde

Owoye, O. and Onafowora, O.A. (2007): "M2 Targeting, money demand and real GDP growth in Nigeria". UDK339. 743:336. 748. 12 JEL Classifications E30, F31, Department of Economic, Delta State University, Abraka, Nigeria

Papell, D. H. (1994), Exchange Rates and Prices: An Empirical Analysis,International Economic Review, 35(2), 397-410.

Rapach, D. (2001): "Monetary Shocks and Real Exchange Rate Hysteresis: Evidence from the G-7 Countries". Review of International Economics, Volume 9, Issue 2, pages 356-371, May 2001

Sheffrin (2003): "Economics: Principles in action". Upper Saddle River, New Jersey 07458: Pearson Prentice Hall. pp. 458