The Journal of Developing Areas
Volume 53 No. 1 Winter 2019

REGIONAL EFFECTS OF MONETARY POLICY ON ECONOMIC GROWTH OF ECOWAS: AN S-VAR APPROACH

Ebenezer G. Olamide
Andrew Maredza
North West University, South Africa

ABSTRACT

The debate on the nexus between monetary policy and economic growth has become an on-going and interesting one both in the academia and among policy makers. More importantly is the relationship based on regional or monetary union, which has not received much attention especially in sub-Saharan Africa as against the much developed economies. In this paper, the Structural-Vector Auto Regressive (S-VAR) model was employed to investigate the interactions between some selected economic variables and growth in the Economic Community of West Africa (ECOWAS) monetary union from 1980:Q1-2015:Q4. These variables are oil price and commodity price volatilities, net domestic credit, inflation rate, exchange rate, money supply, monetary policy and gross domestic product growth rate. To start with, the study tested for the presence of unit roots in order to ensure the stationarity of variables. This was followed by the confirmation of long run relationship among the variables, using the Panel ARDL model. The result of the eight S-VAR variables reveals that oil and commodity price volatilities constitute important exogenous disturbances to monetary policy. The medium through which this works is the exchange rate; and from exchange rate to money supply. Finally, this effect is passed on from money supply to the growth rate of the gross domestic product. In addition, the Impulse Response Analysis and Variance Decomposition outcomes show exchange rate to be playing dominant role in determining the behavior of monetary policy within the ECOWAS region. In this regard, the supply of money is the major transmitter of all the interactions to the growth rate of the gross domestic product as it dictates the behavior of the GDP growth rate more than other variables in the S-VAR model. One policy implication from the results of this study is that the recent monetary policy tightening in most of the ECOWAS countries to mitigate the rise in inflation rate may adversely affect economic growth of the region. This is because investment may be discouraged as a result of high lending rate. Not only that, any monetary shock especially in terms of the exchange rate could have adverse symmetric effect on the economies of the region.

JEL Classifications: C33, E52**,** O47
Keywords: Monetary Policy, Economic Growth, S-VAR, ECOWAS
Corresponding Author's Email Address: Olamideego@yahoo.co.uk

INTRODUCTION

Monetary policy can be described as a programme of actions undertaken by monetary authorities in order to control and regulate the supply of money with the public and the flow of credit with a view to achieving some predetermined macroeconomic goals (Jhingan, 2008). It also refers to the regulation of money supply and interest rate by monetary authorities such that currency depreciation and inflationary pressure does not degenerate to the level of economy-threatening (Sulaiman and Migiro 2014). Being the largest economy within the four major blocs in the sub-Sahara Africa, monetary policy had been used extensively within the countries of the region of Economic Community of West Africa (ECOWAS). The debate on the nexus between monetary policy and economic growth is still an on-going and interesting one, both in the academia and among policy makers. While much can be said on this topical issue in developed countries or continents Peersman and Smets (2005), Georgopoulous (2009), Ridhwan *et al* (2011), Nachane *et al* (2002), little is the case for developing regions such as the ECOWAS. The basic aim of this study is therefore, to investigate the regional effects of some monetary policy variables on growth in ECOWAS, spanning the period 1980:1 to 2015:4. The paper employed Structural VAR model, using the oil and commodity price volatilities as exogenous variables and estimated the impulse responses in order to bring out the effect of monetary policy on growth within the economic sub region. Other variables of interest are money supply, interest rate, exchange rate, inflation rate, GDP growth rate and net domestic credit.

Apart from being one of the important economic blocs in the Sub-Saharan Africa (SSA), ECOWAS constitutes a very large proportion of the SSA total GDP. As a result of data collection challenges, the countries selected are Benin Republic, Burkina Faso, Cape Verde, Cote d'voire, The Gambia, Ghana, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone and Togo. Consequently, this paper is organized into six sections with relevant literature review following this introduction. Under section three, the empirical analysis was captured; followed by the S-VAR structure in section four. In section five, estimated results of the Impulse Response Functions (IRFs), Variance Decomposition (VDC) models and the final analysis were presented. Section six contains the conclusion and recommendations.

LITERATURE REVIEW

The implication of any spill-over effect of policy formulation and implementation in one country to another, which has not been fully brought into the fore especially in ECOWAS, cannot be under estimated. The result of the study by Mirdals (2009) on the effect of some selected monetary variables on the Visegrad group shows that monetary policy has positive changes on output variability of this group. By implication, Gross Domestic Product is very sensitive to monetary policy impulses. In a recent study by Jericinski (2010) on the responses of macroeconomic variables to monetary policy shocks between the Western European countries of Spain, France, Portugal, Italy and Finland and the so called New European countries of Czech Republic, Poland, Hungary and Slovenia, the two groups show similarity with little differences to response. While the response of production were similar, price reactions were not certain in terms of comparison. Similarly, Anzuini and Levy (2007) used VAR model of estimation and revealed that the responses of macroeconomic variables to monetary policy shocks are the same between the countries of Czech Republic, Poland and Hungary.

Within the ECOWAS monetary union, evidences abound on the inter relationship between monetary policy and economic growth both on country and cross-country analyses. Sakyi (2011) investigated the relationship among trade openness, foreign aid and economic growth in Ghana, using the data set for the period 1984 to

2007. The method of estimation of the study was autoregressive distributed lag model. The study revealed positive short run and long run relationship among trade openness, foreign aid and economic growth. It was also discovered that the coefficient of labour participation rate and share of government spending in GDP was significant and negatively related to economic growth in Ghana. Abradu-Otoo *et al* (2003) report for Ghana through a VECM shows that a rise in interest rate during a tight monetary policy regime leads to temporary increase in inflation before it starts to fall at the expense of a fall in output that lasts for 3 to 4 years. Moreover, they show that allowing credit growth impulses GDP growth, reduces inflation and depreciates the exchange rate. According to the study, this occurs because interest rates act as a cost to firms, such that higher interest rates increase costs and lead to higher prices. This was complemented by Epstein and Heintz (2006) analysis. They simulate a monetary expansion of 5% in the money supply for 5 years and show that output could increase by 25% with only 1.2% inflation increase. It was therefore concluded that as against the restrictive monetary stance feature of financial programming with focus on inflation, significant higher economic growth, and then employment creation could be achieved with low inflationary sacrifices.

Dele (2007) employed the Generalized Least Squares (GLS) method in his study of monetary policy and economic performance of West African Monetary Zone Countries namely Gambia, Ghana, Guinea, Nigeria and Sierra Leone from 1991-2004. Using the variables of Money Supply (M2), Minimum Rediscount Rate, Banking System Credit to private sector, Banking System Credit to Central Government and Exchange Rate of the national currency to the US dollar, findings of the study indicate that monetary policy manipulation was a source of stagnation as it hurts real domestic output of these countries. Employing the Structural Variance Decomposition method, Omolade and Ngalawa (2017) revealed a mixed effect of exchange rate on output in Libya and Nigeria. By implication, the study shows exchange rate as an important instrument on growth in Nigeria which operates flexible exchange rate than Libya that operates fixed rate of exchange. The study by Ikhide and Uanguta (2010) on the spillover effect of changes in monetary policy instruments of the South Africa Reserve Bank in terms of price level, credit availability and money supply on the economies of Lesotho, Namibia and Swaziland shows that they instantaneously responded to changes in the repo rate. Using the Vector Autoregressive (VAR) method of estimation, the relevance of SARB repo rate on individual policy of these countries was also established such that these countries are at the mercy of SA in terms of policy formulation and implementation. In essence, these countries will have to take into consideration the SARB repo rate in the formulation of the individual rates. Lohi (2014) tested the relative effects of exchange rate dynamics among the Fixed ERR of non-CFA and the non-CFA, using a simple cross-groups competitive analysis. It was evident from the study that exchange rate variations resulted into a greater loss of output in the CFA countries relative to the non-CFA countries that operate flexible exchange rate; even though, low inflationary rate was experienced by the CFA countries. This finding was in line with the outcome of the study by Sanni *et al*. (2016) where exchange rate variations have more effect on the output of all the countries investigated. Arising from these opinions, this paper aims at shedding more light on the nexus between monetary policy and economic growth within the ECOWAS region, using S-VAR model.

EMPIRICAL ANALYSIS

The major sources of data are the World Development Indicators online database, IMF's International Financial Statistics (IFS) and the data base of Oil Producing Exporting Countries (OPEC). The major variables of interest are Real GDP from each of the selected countries under ECOWAS, Money Supply (Mns), Inflation Rate (Inf), Interest Rate (Int), Exchange Rate (Exr), Net Domestic Credit (Ndc) and the control variables of Oil and Commodity price volatilities. It should be noted that the justification for the inclusion of oil price stems from the fact that Nigeria which is the largest economy in the region is a net oil exporter. The scope of the study is to cover the period 1980 Q1-2015 Q4 as a result of data inadequacy.

The analysis of the study was based on the data collected for the fourteen ECOWAS countries. In essence, we have N = 14, T = 36, N x T = 504 observations. Since T>N, the use of panel data can therefore be justified for the study. The analysis robustness starts with the test for the stationarity of variables using the IPS and ADF unit root tests. As opined by Hoang and Mcnown (2006), the IPS test requires a balanced panel data, hence our choice of this test for the presence of unit root. The results are presented as follows:

PANEL UNIT ROOT TESTS

The results of stationarity tests are presented in Table 1 below:

TABLE 1. IPS AND ADF - FISHER CHI-SQUARE UNIT ROOT TESTS

Variable	IPS unit root test			ADF-Fisher Chi-square unit root test		
	t* Statistics	P Value	Order of Integration	t* Statistics	P Value	Order of Integration
Mpr	-6.3033	0.000***	I (1)	486.3563	0.000***	I (1)
Gdpgr	-5.4769	0.000***	I (0)	385.7930	0.000***	I (0)
Exr	-4.5175	0.000***	I (1)	251.1183	0.000***	I (1)
Inf	-3.7920	0.006***	I (0)	172.5686	0.000***	I (0)
Msgr	-5.1115	0.000***	I (0)	338.8278	0.000***	I (0)
Ndc	-3.9274	0.000***	I (1)	239.8733	0.000***	I (1)
Dum	-5.8310	0.000***	I (1)	294.7543	0.000***	I (1)
Oilpvol	-3.9879	0.000***	I (0)	104.3020	0.000***	I (0)
Compvol	-3.6001	0.000***	I (0)	82.5095	0.000***	I (0)

*"***" "**" and "*" represent statistical significance at 1%, 5%, and 10%, respectively. Each model includes trend and constant terms.*

The above unit root test results show a combination of I(1) and I(0) series. The implication is that PANEL-ARDL is more suitable to be used for the analysis. This follows the fact that the ARDL, according to Pesaran and Smith (1998), is applicable irrespective of whether variables are integrated of the same order or not. Apart from this, it accounts for the problem of non-stationarity of time series data, Laurenceson and Chai (2003). Notwithstanding, the cross-sectional dependence test was further carried out to investigate the pool ability of the cross sectional units as follows:

PANEL CROSS-SECTIONAL DEPENDENCY TEST

The result of the panel cross-sectional dependence test is presented in Table 2 below:

TABLE 2. CORRELATION MATRIX OF RESIDUALS

	--e1	--e2	--e3	--e4	--e5	--e6	--e7	--e8	--e9
--e1	1.00								
--e2	0.81	1.00							
--e3	0.09	0.06	1.00						
--e4	0.84	0.87	0.06	1.00					
--e5	-0.11	-0.35	-0.24	-0.22	1.00				
--e6	-0.12	-0.12	0.11	-0.15	-0.16	1.00			
--e7	-0.10	-0.02	0.01	-0.16	0.12	0.14	1.00		
--e8	0.14	0.13	0.06	0.10	-0.10	0.09	0.05	1.00	
--e9	0.85	0.89	-0.04	0.91	-0.26	-0.05	-0.22	0.16	1.00

Breusch-Pagan LM test of independence: chi2 (36) = 167.510, Prob =0.0000 H_0: There is no cross-sectional dependence.
Source: Authors' Computation

The presence of common factor is confirmed from the cross-sectional dependence test. The implication is that individual country in ECOWAS possesses some characteristics that distinguish them from one another. However, the ADF test has been shown to be capable of removing the effect of cross sectional dependence such that we can go ahead to estimate the dynamic panel model regression. (see Moon and Perron, 2004; Breitung and Das, 2008).

PANEL ARDL COINTEGRATION RESULTS

The Panel ARDL tests the existence of cointegration as well as estimate the dynamic regression model. The result as presented in Table 3 shows that all the variables in the long run have significant impact on the monetary policy rates except money supply. The dominance of oil price volatility, commodity price volatility, GDP growth rate, exchange rate and inflation rate in determining the monetary policy rate is confirmed from the estimated dynamic regression model. The coefficient of GDP growth rate in the estimated model is negative and it is significant. This simply indicates that GDP growth rate shows an inverse significant relationship with the MPR in the ECOWAS region.

Exchange rate coefficient in the estimated model is positive and significant. The implication is that a direct relationship exists between EXR and MPR which means that an upward movement in the exchange rate is capable of exerting upward pressure on the MPR as well. Oil price movement shows a significant positive relationship with MPR. This also indicates that a downward movement in the oil price is capable of exerting downward pressure on monetary policy rate (MPR).

TABLE 3. THE PANEL ARDL DYNAMIC REGRESSION FOR SHORT RUN AND LONG RUN ESTIMATE

Dependent Variable:DMPR
Method: ARDL
Sample: 1980-2015
Model selection method: Akaike Info Criterion (AIC)
Selected Model: ARDL(1, 2, 2, 2, 2, 2, 2, 2)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
		Long Run Equation		
GDP	-0.1017	0.0363	-2.8037	0.0055
EXR	0.0108	0.0006	16.9337	0.0000
INF	0.0482	0.0139	3.4667	0.0006
MNS	0.0029	0.0095	0.3089	0.7576
OILPVOL	0.0554	0.0327	1.6940	0.0415
COMPVOL	0.0684	0.0225	3.0448	0.0026
DUM	0.3562	0.4954	0.7191	0.4728
		Short Run Equation		
COINTEQ01	-0.3194	0.0835	-3.8253	0.0002
D(GDP)	-0.0334	0.0309	-1.0783	0.2820
D(GDP(-1))	-0.0226	0.0293	-0.7698	0.4421
D(EXR)	-2.6339	2.6014	-1.0125	0.3123
D(EXR(-1))	-0.0862	0.1333	-0.6465	0.5186
D(INF)	0.0070	0.0099	0.7069	0.4803
D(MNS)	0.1006	0.0757	1.3299	0.1848
D(MNS(-1))	-0.0114	0.0144	-0.7918	0.4292
D(OILPVOL)	0.0187	0.0141	1.3310	0.1844
D(OILPVOL(-1))	0.0708	0.0533	1.3294	0.1850
D(COMPVOL)	-0.0100	0.0080	-1.2591	0.2092
D(COMPVOL(-1))	-0.0421	0.0297	-1.4183	0.1574
D(DUM)	0.1706	0.6536	0.2610	0.7943
D(DUM(-1))	-0.0772	0.7863	-0.0982	0.9219
NDC	0.0000	0.0000	1.3843	0.1675
C	5.5909	2.0992	2.6633	0.0083

Commodity price volatility has a positive and significant coefficient from the estimated model and thus implying that an upward commodity price movement is capable of also bringing about upward pressure on the MPR. Therefore commodity price movement has also been shown as important determinant of monetary policy dynamics. Inflation rate coefficient is positive and significant. This also indicates that upward inflation rate will put upward pressure on the MPR. The implication is that whenever inflation rate is rising, monetary policy rates are also adjusted upward.Net domestic credit, capital formation and government expenditure appear not to have significant impact on the movement of MPR. This is because their coefficients are not significant in the estimated dynamic model. Moreover in the short run, none of the explanatory variables used have individual significant impact on MPR. This implies that the long run dynamic model of the ECOWAS is more important in the determination of MPR.

Furthermore, the results of the WALD test are presented below:

TABLE 4. WALD TEST FOR THE DYNAMIC PANEL COINTEGRATION

Wald Test
Equation Untitled

Test Statistic	Value	Df	Probability
F-statistic	7.2551	(2, 244)	0.0009
Chi-square	14.5103	2	0.0007

Null Hypothesis: C (1)=0, C(3)=2*C(4)

Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(1)	-0.1017	0.03626
C(3) - 2*C(4)	0.0424	0.02430

The F and Chi-square tests in Table 4 show that the hypothesis of no cointegration is rejected. Hence, the Wald test has confirmed the existence of long run relationship between monetary policy dynamics and economic growth.

MEASURING THE STRENGTH OF THE P-ARDL REGRESSION MODEL

The estimated model is also subjected to strength measurement. The model summary using table criteria is presented in Table 6. It should be noted that AIC is also applied.

MODEL SUMMARY (LAG LENGTH SELECTION USING AIC)

In line with the model summary, the AIC is most suitable for the optimal order of the variables. According to Table 5, it gives the least AIC value of 3.36. Therefore, running the dynamic regression model with the AIC specification as shown in model 2 is actually the best.

TABLE 5. LAG LENGTH SELECTION

Model	LogL	AIC*	BIC	HQ	Specification
2	-536.815	3.358	5.632	4.252	ARDL(1, 2, 2, 2, 2, 2, 2, 2)
4	-526.765	3.374	5.771	4.317	ARDL(2, 2, 2, 2, 2, 2, 2, 2)
1	-638.761	3.434	4.969	4.038	ARDL(1, 1, 1, 1, 1, 1, 1, 1)
3	-628.998	3.451	5.111	4.104	ARDL(2, 1, 1, 1, 1, 1, 1, 1)

THE P-ARDL ERROR CORRECTION MODEL

The results of the Error Correction Model (ECM) is necessary to investigate the short run dynamics among the variables in the model. The result is presented on Table 6.

TABLE 6. ERROR CORRECTION COEFFICIENT

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ECT(-1)	-0.319	0.084	-3.825	0.0002

The panel error correction model shows that the error correction term is negative and significant at 1% level. This means that the disequilibrium in the past is adequately corrected in the present and the speed of adjustment is about 31.9%. However, the error correction model has indicated that adjustment to equilibrium is convergent in nature. Hence a stable equilibrium is possible.

THE PANEL-STRUCTURE VECTOR AUTOREGRESSIVE (PANEL-SVAR)

The study employed the Panel Structural-VAR which has been adjudged the most commonly adopted method when it comes to monetary policy transmission mechanism Davoodi *et al* (2013) and Bjornland and Jacobensen (2010). The structure is premised basically on the major sub divisions according to the variables in our model. The first variables are oil price volatility and commodity price volatility which is a clear departure from what is common in the literature where prices are used instead of their behaviours (fluctuations). Our next sets of variables are the monetary policy instruments of interest rate and money supply. Other policy variables are exchange and inflation rates. The last set of variables in the model are the output variables of net domestic credit which explains the credit channel in the MTM and gross domestic product growth rate.**3**

MODEL SPECIFICATION

The starting point for our model development is the vector auto regression, which can be structured conventionally as follows:

$$Y_t = A_1Y_{t-1} + \ldots + A_2Y_{t-2} + \ldots\ldots\ldots\ldots\ldots + A_pY_{t-p} + \mu_t \quad (1)$$

Here, Y_t represents an (m x 1) vector of endogenous time series variables, A_i *{t = 1, 2….p}* are (m x n) matrices coefficients and μ_t shows an (m x 1) vector that contains error terms. Although, $\mu_t \sim iid\ N$ (O, Ω) represents the error, the possibility for errors to correlate contemporaneously in all the equations is assumed. Furthermore, there are pn^2 parameters in the matrices. Consequently, equation (1) can also be rewritten using the lag operator (L) that is selected via $L^k x_t = x_{t-k}$ where x is a group of exogenous variables and k is the lag length. The equation becomes:

$$A(L)y_t = \mu_t \quad (2)$$

Where $A(L) = A_0L_0 - A_1L^1 - A_2L^2 \ldots\ldots\ldots\ldots\ldots A_pL^p$.

A_0 Represents an identity 1matrix and the required condition for stationarity to be achieved, the $A(L)$ must lie outside the unit circle.

THE VARIANCE DECOMPOSITION AND IMPULSE RESPONSE FUNCTIONS

The variance decomposition and impulse response function are used to carry out the VAR analysis. This is done by re-specifying the Auto Regressive function thus:

$$A\ (L)\ \mu_t = Y_t \tag{3}$$

Where Y_t = the stationary stochastic process in the system, $A\ (L)$ = the finite order lag polynomial and μ_t = the white noise error term. The vector moving average (MA) upon which our VAR interpretation is based can therefore be expressed as follows:

$$Y_t = \emptyset_t + \sigma(L)\mu_t E(\mu_t) = 0 \tag{4}$$

$$E(\mu_t \mu_{t-k}) = Q, |k| = 0 \tag{5}$$

$$E(\mu_t \mu_{t-k}) = Q, |k| = 0 \tag{6}$$

Q in the above equations stands for the covariance matrix sample, $\emptyset_t$ represents the predictable perfection and the matrix of the coefficient is $\sigma(L)$ using lag 0 in our identity matrix. The impulse response function can be generated by normalising equation (7) and also forecast the error decomposition simultaneously. Still, the variance decomposition adopted here is similar to the moving average.

MODEL IDENTIFICATION

In order to identify the orthogonal structural components of the error terms that are in the shocks, the Structural Vector Auto Regressive needs enough restrictions. Non-recursive orthogonalisation of the error terms generated via this means can be used for the impulse response functions as well as the variance decompositions. For the sake of clarity, let us assume that Y_t comprises of the vector of the endogenous variables. $\sum E[v_t \acute{v}_t]$ stands for the covariance matrix residual. Hence, the identification starting point is:

$$Av_t = B\mu_t \tag{7}$$

Here, $v_t$and μ_t represent the vectors with lag length k, v_t is the observed residual while μ_t represents the unobservable structural innovations. The A and B are the $k \ x \ k$ matrices to be estimated while μ_t is expected to be orthogonal in nature and hence the covariance which is a matrix with identity $E[\mu_t \mu_t^t]$ = 1. Here, the orthogonal assumption of μ_t makes the imposition of restrictions on A and B possible and hence we can have:

$$A \sum \acute{A} = B\acute{B} \tag{8}$$

Consequently, the existing relationship between the reduced form and the structural form of the Vector Auto Regressive model can be presented as:

$$B(L)=C_0+B^+(L) \tag{9}$$

$$A(L)=-C_0^{-1}B^+(L) \tag{10}$$

$$\Sigma=C_0^{-1}\Lambda C_0^{-1} \tag{11}$$

Therefore, what divide the structural form into contemporaneous equation is equation (9), i.e. C_0 and $B^+(L)$. The former stands for correlations at lag zero while the later stands for correlations at every stricted lags. Furthermore, eq. (11) separates each of the reduced form coefficient into its structural counterpart $C_{0,}$ identified through the reduced form of $\Sigma = E[\mu_t \mu_t^t]$, while the diagonal covariance matrix of the structural form of $\Lambda = E\ [\upsilon_t\ \bar{\upsilon}_t]$ as depicted in equation (II). In addition, because of the vulnerability of the long run restrictions to serious misspecification problems, we use a contemporaneous restriction on the C_0 matrix to identify the shocks as shown in equation (12) below since our focus is in the short and medium-term responses (Elbourne, 2007).

$$\begin{bmatrix} v_t^{oilpv} \\ v_t^{compv} \\ v_t^{ndc} \\ v_t^{gdp} \\ v_t^{inf} \\ v_t^{mns} \\ v_t^{exr} \\ v_t^{intr} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ f_{21}^0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ f_{31}^0 & 0 & 1 & 0 & 0 & 0 & 0 & f_{38}^0 \\ f_{41}^0 & 0 & f_{43}^0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & f_{53}^0 & f_{54}^0 & 1 & f_{56}^0 & 0 & 0 \\ f_{61}^0 & f_{62}^0 & 0 & 0 & f_{65}^0 & 1 & f_{67}^0 & 0 \\ f_{71}^0 & f_{72}^0 & f_{73}^0 & f & f_{75}^0 & f_{76}^0 & 1 & 0 \\ 0 & 0 & 0 & 0 & f_{85}^0 & f_{86}^0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \mu_t^{oilpv} \\ \mu_t^{compv} \\ \mu_t^{ndc} \\ \mu_t^{gdp} \\ \mu_t^{inf} \\ \mu_t^{mns} \\ \mu_t^{exr} \\ \mu_t^{intr} \end{bmatrix} \tag{12}$$

The above matrix equation contains the eight variables of interest in our S-VAR model. Equation (12) can be expressed thus:

1. Rows 1 and 2 contain our exogenous variables of oil price volatility (*oilpv*) and commodity price volatility (*compv)*. They both put external pressure on any economy that is predominantly dominated by import dependent and primary goods production countries as is the case in many ECOWAS countries, (Demachi, 2012). According to Beckermans, (2005) the transmission of the international shock to the domestic economy can be very rapid. Consequently, oil price volatility shock is the one driving itself while commodity price depends on oil price volatility and its fluctuations as captured by commodity price volatility, (See Kutu and Ngalawa, 2015).

2. In rows 3 and 4, we have the VAR residuals which describe the non-policy variables of GDP and NDC. However, our assumption is that money supply, rate of interest, inflation rate and exchange rate are under the control of the monetary authorities. μ is a vector of reduced form disturbance to all the variables in the model (foreign and domestic variables). The position of the variables in the model describes the way they influence themselves in the identification scheme. As noted earlier, row 1 which belongs to the oil price volatility shows that it responds to its own lagged values while row 2 which is for commodity price

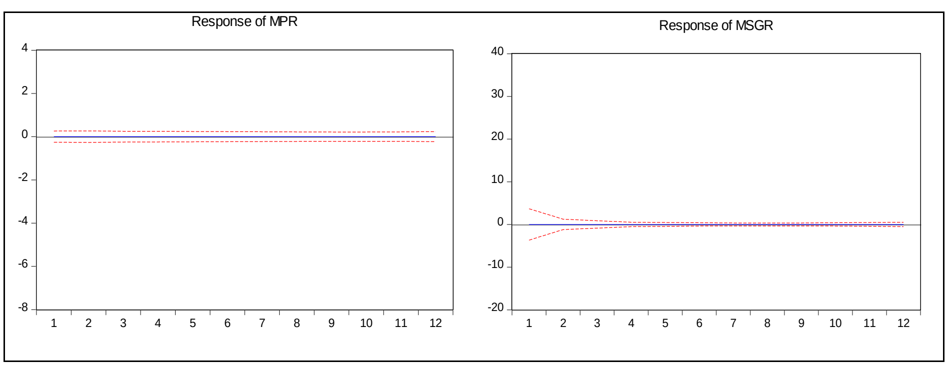
volatility shows that it only responds contemporaneously to oil price fluctuations as indicated by f_{21}^{0}. Again, the two rows further describe how both variables respond slowly to monetary policy shocks which is due to information and planning delays or the expected lags faced by policy makers (See Sims and Zha, 2006 and Berkelmans, 2005). In addition, these two rows describe the positions of net domestic credit and GDP growth rate equations. The large number of zeros described the nominal rigidities (Elbourne, 2008; Elbourne and de Haan, 2006). f_{31}^{0} and f_{38}^{0} indicate that net domestic credit respond contemporaneously to interest rate and oil price volatilities while f_{41}^{0} and f_{43}^{0} describe the contemporaneous responses of GDP growth rate to oil price volatility and net domestic credit (See Kutu and Ngalawa, 2015).

3. Rows 5 and 6 are for inflation rate and money supply growth rate in that order. The coefficients f_{53}^{0}, f_{54}^{0} and f_{56}^{0} give room for the contemporaneous relationships among net domestic credit, GDP growth rate and money supply on one hand, and the rate of inflation on the other hand. . Money supply occupies row 6 and it responds instantaneously only to oil price volatility, commodity price volatility, inflation and exchange rates. The last row which is 7 implies that exchange rate is set in a competitive market which then respond contemporaneously to all the variables in our model. Interest rate which is a policy variable will only respond to inflation rate and money supply growth rate as indicated by f_{85}^{0}, and f_{86}^{0} respectively.

ESTIMATION OF RESULTS

The results of the impulse response functions are explained in figures 1-4 in line with the behaviors of our chosen variables of interest. The broken lines stand for the 90% confidence bands while the continuous line is the point estimate i.e. variables responses to a shock of the impulse response.

FIGURE 1. VARIABLES RESPONSES TO OIL PRICE SHOCK



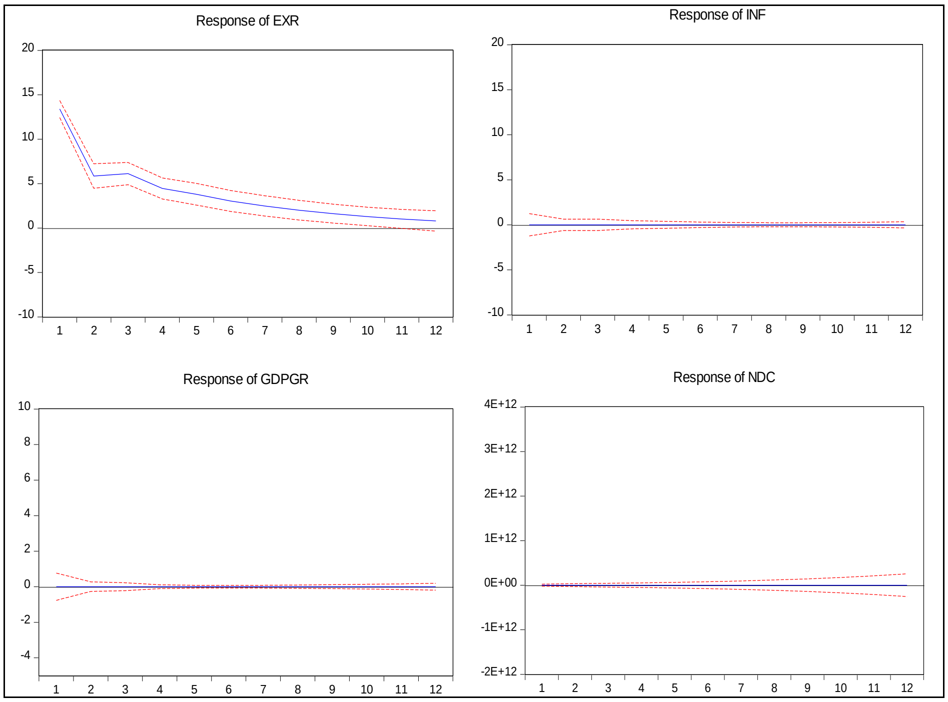
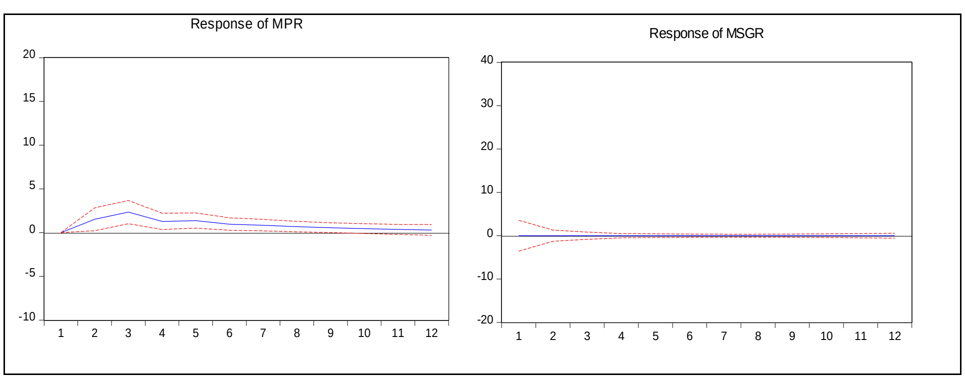
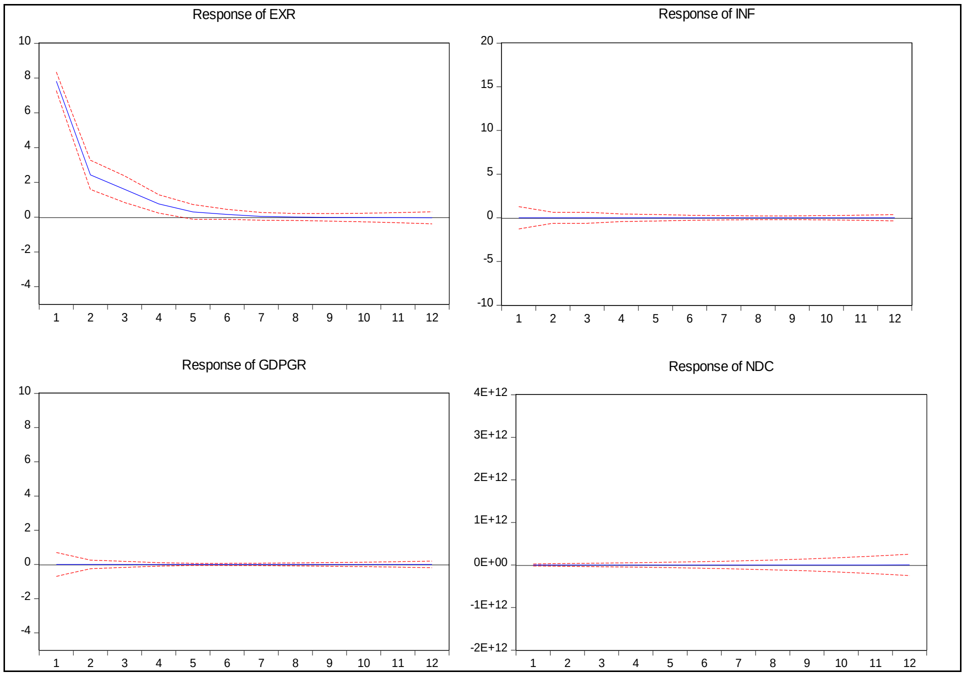


Figure 1 above clearly shows that exchange rate is the only variable that respond significantly to the oil price shock within the region. All other variables response to oil price shock are not significant. The effect is currency appreciation. That is 1% positive shock to oil price is capable of making the currencies in the region appreciate. The reason for this might not be unconnected with the fact that Nigeria which is the largest economy within the region is a major oil producing country.

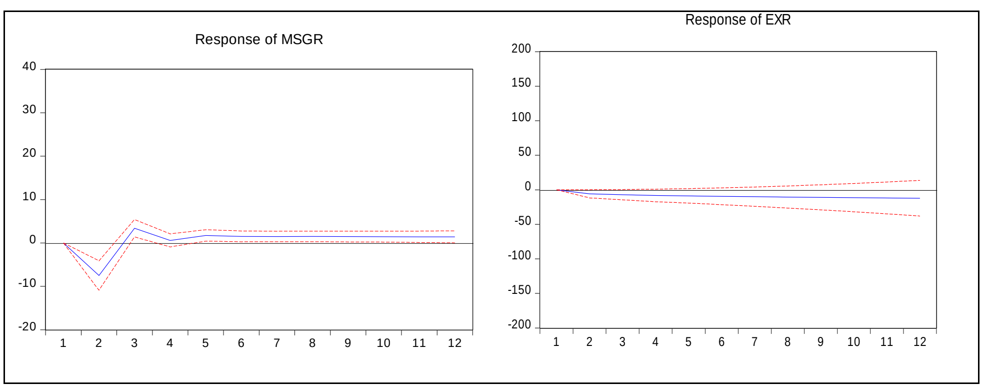
FIGURE 2. VARIABLES RESPONSES TO COMMODITY PRICE SHOCK

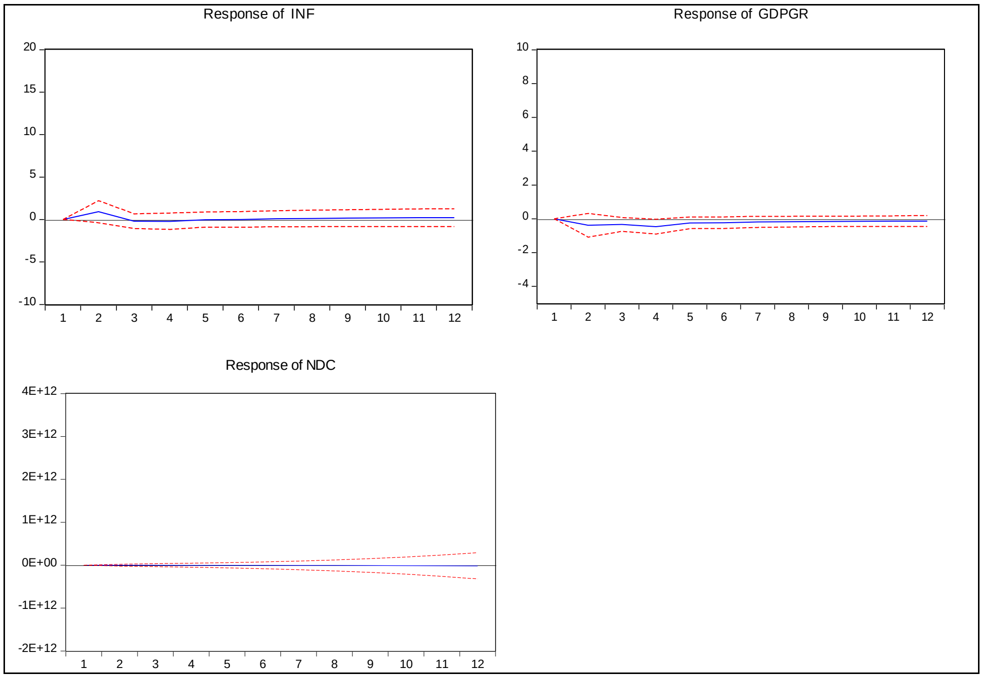




The impulse response function describing the responses of the variables to 1% standard deviation in commodity price is shown in figure 2 above. The responses of exchange rate and monetary policy rate are the most significant. Commodity price shock caused the exchange rate to fall significantly especially in the first half of the year which is currency appreciation. It also caused the monetary policy rate to fall after an initial rise in the first three months within the region

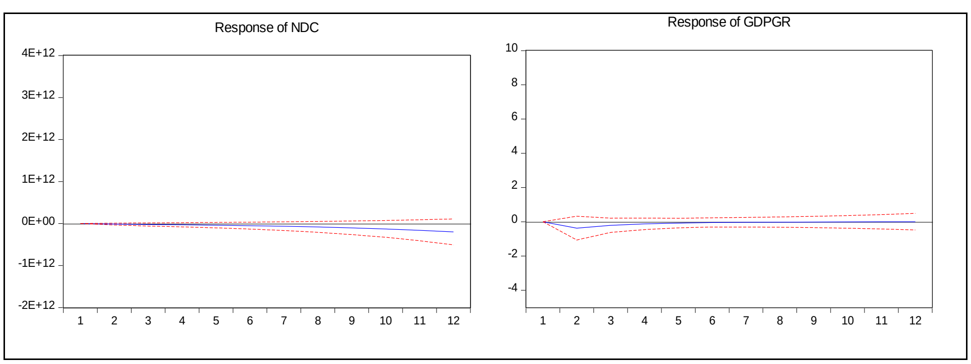
FIGURE 3. VARIABLES RESPONSES TO MONETARY POLICY RATE SHOCK





Money supply growth rate, exchange rate and gross domestic product growth rate are the variables that show some degree of significant response to monetary policy rate shock. Expectedly, money supply which is the second instrument of monetary policy used in the model react most significantly to the shock from the monetary policy rate. It caused money supply to fall in the first two months and later rose gradually. Gross domestic products growth rate does not respond significantly at the beginning but as the period progresses to the middle of the year, the reaction to monetary policy rate becomes more significant. Exchange rate follows the same pattern after the second month of the years.

FIGURE 4. VARIABLES RESPONSES TO EXCHANGE RATE SHOCK



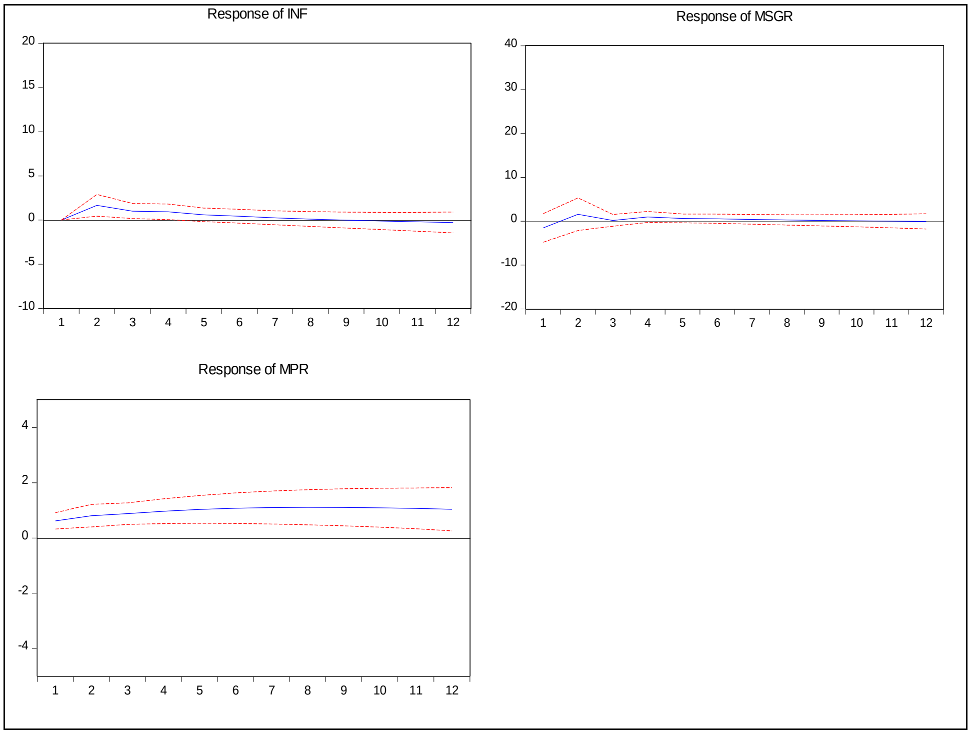


Figure 4 indicates that monetary policy rate react most significantly to exchange rate shock. An upsurge of 1% deviation in exchange rate means sudden fall in the value of the currency. This shock generates an upward reaction from the monetary policy rate significantly starting from the first month to the end of the year. Inflation rate also shows little significant reaction to the exchange rate shock after an initial rise at the beginning of the periods.

VARIANCE DECOMPOSITION ANALYSES

TABLE 7. VARIANCE DECOMPOSITION OF MPR

Period	S.E.	OILP	COMP	NDC	GDPGR	INF	EXR	MNS	MPR
3	5.2665	0.0000	0.0000	0.2159	0.2126	0.4099	6.519	4.2822	88.359
6	7.1132	0.0000	0.0000	0.3975	0.1904	0.6154	9.835	6.3218	82.640
9	8.3972	0.0000	0.0000	0.7939	0.1609	0.6479	12.282	7.1844	78.931
12	9.3783	0.0000	0.0000	1.8636	0.1349	0.6044	13.741	7.5854	76.070

The contributions of each variable to the behavior of monetary policy rate are described by table 7. According to the table, exchange rate and money supply contribute the largest shock to monetary policy rate in ECOWAS apart from self. In other words, the behavior of monetary policy rate is dictated by the exchange rate as well as money supply. In the first three months, exchange rate accounted for 6.52%, 9.83% by half of the year and increased to 13.74% as at the end of the twelfth month. Money supply growth rate recorded a 4.28% during the first three month and increased to 7.59% by the end of the period. Other variables have paltry effects.

TABLE 8. VARIANCE DECOMPOSITION OF EXR

Period	S.E.	OILP	COMP	NDC	GDPGR	INF	EXR	MNS	MPR
3	143.7082	1.223420	1.620355	0.178470	5.28E-05	2.13E-06	96.47429	0.091752	0.411656
6	236.5915	0.545714	3.395307	0.224035	5.13E-05	2.37E-06	94.90941	0.351514	0.573965
9	328.1886	0.316567	4.870405	0.142502	5.15E-05	2.64E-06	93.47347	0.591457	0.605549
12	426.7336	0.222002	5.918394	0.119020	5.26E-05	2.99E-06	92.39484	0.755471	0.590215

Table 8 shows that apart from own shock, the behavior of exchange rate is mostly determined by oil price and commodity price shocks in ECOWAS. Money supply and monetary policy rate also play some paltry important role as well. Commodity price accounted for 1.62% in the first quarter of the period and increased to 5.92% by the end of the year. An increase in the exchange rate signifies depreciation in the currencies of the bloc. This is evident in Nigeria where the government had been battling with the continuous and unabated fall in the exchange rate of late. On the part of the oil price, it accounted for 1.22% in the beginning of the period to 0.22% by the end of the year.

TABLE 9. VARIANCE DECOMPOSITION OF GDPGR

Period	S.E.	OILP	COMP	NDC	GDPGR	INF	EXR	MNS	MPR
3	8.446374	0.651160	0.317330	0.142811	97.04970	0.071878	0.219244	1.245306	0.302568
6	8.528228	0.695824	0.577373	0.382314	96.09799	0.074618	0.219493	1.287178	0.665209
9	8.558627	0.707477	0.653446	0.889272	95.41996	0.084296	0.222139	1.283227	0.740179
12	8.628687	0.702148	0.657819	2.358431	93.88949	0.116705	0.223568	1.275550	0.776287

The behavior of gross domestic product growth rate is mostly affected by money supply growth rate apart from own. This is because it contributes the largest shock to gross domestic product growth rate behavior after the own shock. It maintained an average of 2.26% throughout the period under review. However, the link through which the exogenous shocks affect the economic growth of the ECOWAS are exchange rate and money supply growth rate.

FINAL ANALYSIS

Apart from the fact that this regional bloc is the largest economic bloc in SSA, it also includes the largest economy in Africa, which is Nigeria. Hence the analysis of this economic bloc may have important implication for the whole of SSA economy. Oil price shock attracts significant response from exchange rate. This is an indication that Nigeria which is the largest oil producer in ECOWAS might have influenced this result (See Omolade and Ngalawa 2014). Notwithstanding, commodity price also has additional influence on MPR. Since other economies in the region are not major oil producers but are primary commodity exporters on which their economies depend, hence the significant influence of commodity price shocks on both exchange rate and MPR. In particularly, oil price shock caused the exchange rate to fall significantly that is, currency appreciation. Again, the reactions to monetary policy shocks show that money supply and GDP growth react significantly. It caused both the money supply and GDP to fall steadily. The same chains of reactions are repeated for commodity price shock. Not only that the results further show that MPR reacts most significantly to exchange rate shocks. In other words monetary policy response to exchange rate shock is significant as it causes MPR to rise significantly. The reason for this behavior was further explained by (Kutu and Ngalawa, 2014) that a sharp depreciation in currency will lead to excessive demand for local currency to meet foreign transactions and this will put pressure on interest rate. Another noticeable observation in the analysis is the strong linkage between monetary policy and exchange rate. The variance decomposition of the MPR for the region indicates that exchange rate plays a very important role in determining the behavior of monetary policy. This is also supported by the impulse response function as earlier explained. Additionally, money supply transmits all these interaction to GDP as it dictates the behavior of the GDP more than other variables in the PANEL-SVAR model.

CONCLUSIONS

It can be concluded from the analysis that oil price and commodity price shocks constitute important exogenous disturbances to monetary policy and the medium through which this work is the exchange rate. The exchange rate passes the shock to MPR and from MPR to money supply and finally to the GDP growth rate. By implication, any monetary shock especially in terms of exchange rate could have adverse symmetric effect on the economies of ECOWAS. It is therefore desirable for countries in this region to formulate and implement sound economic and monetary policies that will increase local production of goods and services in order to strengthen the local currencies. This should include diversification of the economic base by looking inward with the aim of boosting the internally generated revenue base. The political will to implement the above should be a major *sine qua non*.

REFERENCES

Abradu-Otoo, P, Amoah, B, and Bawumia, M., "Investigation of the Transmission Mechanisms of Monetary Policy in Ghana: a Structural Vector Error Correction Analysis", 2003, *Bank of Ghana Working Paper Series WP/BOG-03-02*.

Anzuini, A, and Levy, A., "Monetary Policy Shocks in the New EU Members: a VAR Approach" 2007, *Applied Economics*, Vol. 39, pp. 1147-1161.

Berkelmans, L., "Credit and Monetary Policy: An Australian SVAR", 2005, *Reserve Bank of Australia Discussion Paper* 05-06.

Bjornland, C.H., and Jacobensen, D.H., "The Role of House Prices in Monetary Policy Transmission Mechanism in Small open Economies", 2010, *Journal of International Money and Finance*, Vol. 6, pp. 218-229.

Breitung, I, and Das, S., "Testing for Unit Root in Panels with a Factor Structure", 2008, *Econometric Theory*, Vol. 24, pp. 88-108.

Davoodi, H.R, Dixit, S, and Pinter, G., "Monetary Transmission Mechanism in the East African Community: An Empirical Investigation", 2013, *African Department International Monetary Fund Working Paper,* pp. 13-39.

Debrun, X, Masson, P.R., and Pattillo, C., "Should Africa Monetary Unions Be Expanded? An Empirical Investigation of the Scope for Monetary Integration in Sub-Saharan Africa", 2010, *IMF Working Paper,* pp. 10-157.

Dele, B.E., "Monetary Policy and Economic Performance of West African Monetary Zone Countries", 2007, *University of Lagos, Nigeria,* Available http://mpra.ub.unimuenchen.de/4308.

Demachi, K., "The Effect of Crude Oil Price Change and Volatility on Nigerian Economy", 2010, *Munich Personal RePEc Archive-MPRA,* Paper No. 41413.

Elbourne, A., "The UK Housing Market and the Monetary Policy Transmission Mechanism: An S-VAR Approach", 2007, *Journal of Housing Economics,* Vol. 17, pp. 65-87.

Elbourne, A, and De Haan, J., "Financial Structure and Monetary Policy Transmission in Transition Countries", 2006, *Journal of Comparative Economics,* Vol. 34, pp. 1-23.

Epstein, G, and Heintz, J., "Monetary Policy and Financial Sector Reform for Employment Creation in Ghana" 2006, *Political Economy Research Institute Working Paper*.

Goergopoulous, G., "Measuring Regional Effects of Monetary Policy in Canada", 2009, *Applied Economics*, Vol. 41, pp. 4093-2113.

Ikhide, S and Uanguta, E., "Impact of South Africa's Monetary Policy on the LNS Economies", 2010, *Journal of Economic Integration,* Vol. 25, pp. 324-352.

Jarociński, M., "Reponses to Monetary Policy Shocks in the East and the West of Europe. A Comparison", 2010, *European Central Bank, Working Paper,* No 970.

Jhingan, M.L., "The Economic of Development and Planning", 2008, *Vrind Publications (P) Ltd, Mayur Vihar Phase 1, Delhi – 110091*.

Kutu, A.A., & Ngalawa, H., "Monetary Policy Shock and Industrial Sector Performance in South Africa", 2015, *Journal of Economics and Behavioural Studies*, Vol. 8, pp. 26-40.

Laurenceson, J, and Chai, J.C.H., "*Financial Reform and Economic Development in China",* 2003, *Edward Elgar, Cheltenhalm*.

Lohi, J., "Exchange Rate Regimes and Inflation in Inflation in Sub-Saharan Africa", 2014, *Journal of Economics and International Finance*. Vol. 6, No. 8, pp. 173-189.

Mcnown, R., and Hoang, N., "Panel Data Unit Roots Tests Using Various Estimation Methods", 2006, *Working Paper. Department of Economics. University of Colorado at Boulder.*

Mirdala, R., "Interest Rate Transmission Mechanism on Monetary Policy in the Selected EMU Candidate Countries", 2009, *Panoeconomicus*, Vol. 3, pp. 359 – 377.

Moon, HR & Perron, B., “Testing for a Unit Root in Panels with Dynamic Factors”, 2004, *Journal of Econometrics*, Vol. 122, No. 1, pp. 81-126.

Nachane, D.M, Ray, P., and Ghosi, S., “Does Monetary Policy Have Differential State-Level Effects? An Empirical Evaluation”, 2002, *Economic and Political Weekly*, Vol. 37, No. 47, pp. 4723-4728.

Omolade, A and Ngalawa, H., “Oil Revenue and Manufacturing Sector Growth in Africa’s Oil-Exporting Countries”, 2014, *Journal of Economic and Financial Sciences*, Vol. 7, No. 3, pp. 925-944.

Omolade, A., and Ngalawa, H., “Monetary Policy Transmission Mechanism and Growth of the Manufacturing Sectors in Libya and Nigeria: Does Exchange Rate Regime Matter?” 2017, *Journal of Entrepreneurship, Business and Economics,* Vol. 5, No. 1, pp. 67 - 107.

Ridhwan, M.M., De Groot, H.L., Nijkamp, P., and Rietveld, P., “The Regional Impact of Monetary Policy in Indonesia”, 2011, *Tinbergen Institute Discussion Paper,* 11-081/3.

Sakyi, D., “Trade Openness, Foreign Aid and Economic Growth in Post-Liberalizations Ghana: An Application of ARDL Bound Test”, 2011, *Journal of Economics and International Finance,* Vol. 3, pp. 146–156.

Sanni, I.A., Hassan, S., and Hasam, M., “Effects of Exchange Rate Volatility on Output in Some Selected West Africa Countries”, 2016, *International Journal of Development and Economic Sustainability*. Vol. 4 No. 1, pp.1-10.

Sims, C., and Zha, T., “Does Monetary Policy Generate Recessions?” 2006, *Macroeconomic Dynamics*, Vol. 10, pp. 231-272.

Sulaiman, L.A., and Migiro, S.O., “The Nexus between Monetary Policy and Economic Growth in Nigeria: A Causality Test”, 2014, *Public and Municipal Finance,* Vol. 3, No. 2, pp. 35-40.

Tsangarides, C.G., and Qureshi, M.S., “Monetary Union Membership in West Africa: A Cluster Analysis” 2008, *World Development,* Vol. 36, No. 7, pp. 1261-1279.