PROSIDING PERKEM VII, JILID 1 (2012) 509 - 524
ISSN: 2231-962X

The Dynamic Casuality Between Money and Macro Economic Activity: Empirical Evidence from Nigeria Based on VECM Approach (1960-2011)

Tajudeen Mukhtar Olatunji
School of Economics, Faculty of Economics and Business
Universiti Kebangsaan Malaysia

Adedokun Adebayo Sunday
Department of Economics, Faculty of Social Science
University of Lagos, Nigeria

Yaqub Jameelah Omolara
Department of Economics, Faculty of Social Science
Lagos State University, Nigeria

ABSTRACT

The main objective of this paper is to examine the dynamic causality between money and macroeconomic activity such as output, interest rate, exchange rate and prices in Nigeria from 1960 to 2011. The methodology adopted are descriptive statistics, stationarity test using unit root methods such as Augmented Dickey-Fuller approach and Philip-Perron method, followed by multivariate cointegration test developed by Johansen (1988), and Johansen and Juselius (1990), Granger causality test in vector error correction model (VECM), impulse response function and variance decomposition method. The results of the cointegration test indicates that a long run relationship exist among the macroeconomic variables. The vector error – correction model results revealed that in the short-run exchange rate and price stand out econometrically exogenous, the presence of causal relationship among the variables shows that money supply is neutral in the short-run and cannot be efficient in the stabilization of both output and price level. The unidirectional short run relationship among the variables suggested that exchange rate contains better information about the source of shocks affecting the economy than others variables and that exchange rate is helpful in predicting the current and future growth rate of output and interest rate in Nigeria economy.

One standard deviation shock in broad money and exchange rate respectively has positive impacts on all variables. Considering the definitions of money stocks, broad money (M2) appears to have the strongest causal effect on real output than narrow money (M1). Thus if the main objective of the government is to sustain high economics growth rate and curb inflation rate, exchange rate targeting will be the most suitable measure to adopt based on the results of the variance decomposition function and also supported by Granger causality test results.

Key words: Nigeria, Cointegration, Granger causality, Error correction model, and monetary policy.

INTRODUCTION

One of the important concern of economists , researchers and policy makers is the investigation of the causal relationship between money and other macroeconomic aggregates such as income, price, interest rate, and exchange rate . This relationship is crucial because it reveals the appropriateness and effectiveness of monetary policy especially in a small open economy like Nigeria , with a history of double digits inflation and epileptic output performance. Different schools of thought in economics have postulated various relationships between money and macroeconomic aggregates. The Keynesians', the monetarists , the new classical and new Keynesians agree that monetary shocks have positive effect on output, they however disagree on the nature and transmission channels of these positive effects. While the Keynesians postulated that a positive monetary shock would increase both economic activity and price level through interest rate and investment, the monetarists disagree with a long run positive effect of monetary shocks in line with the classical reasoning . The new classical economists decomposed the effect of monetary shocks on the basis of anticipated monetary expansion. They opined that it is only unanticipated monetary expansion that would lead to increase in output.

The new Keynesians postulated non- neutrality of money, at least, in the short run because of rigidities in prices and wages; and market failure and imperfection (Erjavec, Natasa and Boris Cota, 2003). The real business cycle postulated that monetary shock has no positive effect on output but will only raise interest rates and price level . According to this theory , money supply is endogenous and output is determined exogenously and primarily , by technology .

The existing macroeconomic paradigm imply that the dynamic causal relationship among money , and macroeconomic aggregates (such as output , price level) is ambiguous and unresolved. In view of these theoretical arguments, it is essential to reexamine the issue of causality among money, income and price level as well as the short run and long run relationships among them.
During the period under consideration, four episodes of high inflation exceeding 30% were recorded. The first occurred in 1975, the second and third occurred in 1984 and 1987 through 1989 respectively, while the fourth episode occurred in 1993 through 1995. The first high inflationary trend was attributed to excessive monetarization of the oil revenue. The second episode was linked to supply- side factors while the third and the fourth episodes were attributed to fiscal and monetary expansion.

The trend in monetary policy in Nigeria between 1971 and 1986, was based on fixed exchange rate policy. This was followed by a dual exchange rate system where both fixed exchange rate (for official transactions) and market determined exchange rate (for other items) coexisted. The two markets were unified later on, into a single foreign exchange markets. The foreign exchange market was eventually deregulated in 1992 with complete floating of the naira (Nigerian domestic currency). Although, there was a reversal of the complete float in 1994 because of continuous depreciation of the naira , the naira was eventually allowed to float from 1999 with occasional intervention of the central bank of Nigeria , to smooth the volatility of the exchange rate.

The purpose of this paper therefore is to test the dynamic casual relationship between money and other macroeconomic aggregates such as output, price level , interest rate and exchange rate for a small open economy like Nigeria. The exchange rate is incorporated in the analysis because of the dynamic interactions of these variables s with the foreign trade sector.

LITERATURE REVIEW

This section provides a thorough review of literature and theoretical issues underpinning the current research. The issue of money supply and macroeconomic aggregates are well documented in literature across several strands of opinions. Erjavec, Natasa and Boris Cota (2003) In their work investigated the causal relationships between money and other macroeconomic variables such as output, interest rate, prices and exchange rate using time series data of Croatian economy, the methodology involves Granger- causality analysis in a vector autoregression model with application of variance decompositions and impulse response functions to establish the direction of causality between money and other macroeconomic variables. The result showed that short-run variables interest rate and nominal exchange rate stand out econometrically exogenous. In the empirical period these variables were relatively the leading variables. They were initial receptors of exogenous shocks to the long run equilibrium. The causal relationships detected among the variables suggest that money supply is neutral at least in the short run.

Ahmed and Suliman (2011) investigated the long-run relationships between three macroeconomic variables (real Gross Domestic Product (GDP), money supply (MS) and price level (CPI)) for the Sudanese economy using annual time series data spanning 1960 to 2005. The methodology involves the Granger causality techniques, co-integration tests in order to establish the long run relationship or otherwise between real GDP and macroeconomic prices and money supply. The result first showed that the direction of causation between real GDP and prices is uni-directional that is causality runs from real GDP to Consumer Price Index (CPI) without feedback. Second, causation runs likewise from Money supply to price and not from price to money supply. Lastly, there is no causality between real GDP and Money supply variable, however, real GDP, Money supply and Consumer Price Index were co integrated, meaning there exist a long run relationship between these variables in the case of Sudan within the time frame investigated.

Kotlowski (2005) examined the long run causality behaviour between money and prices in the Polish economy during the transition period. The study makes use of the monetary inflation model known as the P-star model, originally developed by the FED economists, using seasonal cointegration, developed by Hylleberg, Engle, Granger and You, the results of the research give the evidence of the existences of a long-run causality relationship between money and prices (long-run cointegration relationship), which follows the assumptions of the P-star inflation model. The results also indicate that

there are no seasonal Cointegrating relationships in the P-star inflation model, which can be interpreted as the money demand equations.

Balogun (2007) examine the monetary and macroeconomic stability perspective for entering into monetary union, using data available on WAMZ countries. He tests the hypothesis that independent monetary and exchange rate policies have been relatively ineffective in influencing domestic activities (especially GDP and inflation), and that when they do, they are counterproductive. The methodology employed involves basic econometrics, the result show that, domestic monetary policy, as captured by money supply and credit to government hurt real domestic output of these countries. Indeed, rather than promote growth, it was a source of stagnation. The results also show that although expansion in domestic output dampened aggregate consumer prices (inflation), it was however, not sufficient enough to dampen the fuelling effects of past inflation. This was highlighted by money supply variable (MS2) and exacerbated by exchange rate variable which are mostly positive, confirming the a priori expectations that rapid monetary expansion and devaluations fuels domestic inflation.

Money, Income and Macroeconomic prices play a very important role in any economy. Perhaps, they represent important variables for which a country's economic health is measured. Federal Reserve Bank of New York (1962) asserted that 'A country is known by the money it keeps. Healthy money and healthy economy as a rule go hand in hand'. The state of a country's economic health is determined primarily by the country's monetary variable and it influence on the economy as a whole as well as its transmission channel through which monetary policy made translate into concrete effects on the economy.

THE ORETICAL FRAMEWORK

Generally speaking, macroeconomic variables such as aggregate demand or national income, money supply, prices such as exchange rates, consumer price index and others are very important variables when analyzing the economic performance of a country. The interdependence and interactions between these variables largely determines the movements of the economy either towards growth path which is desired by government and other development partners. The debates on the role play by money in any economy remain largely inconclusive as there are several strands of literature in this regard. The Keynesian economists postulated that money does not play any important role in determining income and prices as changes in income necessitate changes in money stock through a higher demand for money. The monetarists on the other hand postulated that money is all that matters in determination of income and prices. They opined that money play a very crucial role in determining the level of income and prices in the economy. In other words, changes in income and prices in an economy are primarily due to changes in money stocks. Therefore, the direction of causation runs from money to income and prices without any feedback.

Sims (1972) used the United States data to test for causality between money and income using the Granger causality approach. The result found evidence in support of causality that runs from money to income; this provides an empirical support for the monetarists view that money determines both income and prices in the economy. Lee and Li (1983) in a similar development examine the causal relationship between money, income and prices for Singapore and found evidence in support of a bi-directional causality between money and income and uni-directional causality between money and prices without feedback. Joshi and joshi (1985) examine causality between income, money and prices using time series data on India and found that there is a bi-directional causality that runs from income to money with a feedback from money to income.

Abass (1991) examine the causality between money and income for some Asian countries and found a bi-directional causality in the case of Pakistan, Malaysia and Thailand. Theoretical issues based on the extension of the classical Quantity Theory of money were examined by Fisher and Seater (1993), King and Watson (1997) and Grauwe and polan (2005) their work form a large quantum of literature on theoretical issues underpinning the relationship between income and money in an extended model.

The theoretical basic of this study is based on the monetary growth model of previous studies by Masih and Masih (1996); and adopted by Erjavec, Natasa and Boris Cota (2003); Ghazali, Amin, Muhammad, and Sabah (2008); Fahlino Sjuib (2009).

ECONOMETRIC METHODOLOGY

The research methodology of this study employs the multivariate cointegration analysis and Granger causality test within the error correction model to analyze the causal relationship between money supply and macroeconomic variables in Nigeria. To capture the causal relationship between money and macroeconomic variables, the study adopted annual time series data from 1960 to 2011. There are five variables included in the analysis such as: the nominal money supply measured by (narrow money (M1) and broad money (M2)), output measured by gross domestic product (GDP), nominal exchange rate (EXH) measured by the domestic currency /US Dollars (EXH), price measured by the consumer price index (CPI), and nominal interest rate measured by prime lending rate (INT).

All variables were transformed into logarithms except interest rate that is measure in percentage. Thus, the model expresses the logarithms of output (LGDP) as a function of logarithms of narrow money (LM1) and broad money (LM2) respectively, interest rate (INT), logarithms of price (LCPI), and logarithms of exchange rate (LEXH). The methodology adopted in this paper follows the methodology that were used in previous studies by Masih and Masih (1996); Erjavec, Natasa and Boris Cota (2003); Ghazali, Amin, Muhammad, and Sabah (2008); and Fahlino Sjuib (2009). They all examined the dynamic causal chain among macroeconomic variables such as output, money, interest rate, price and exchange rate. Masih and Masih (1996) examined the dynamic causal relationship among macroeconomic activity such as real output, money, interest rate, inflation, and exchange rate in both Malaysia and Thailand, used annual data from 1955 to 1991; Erjavec, Natasa and Boris Cota (2003) investigated the causal relationship between money and macroeconomic variables in Croatia, used monthly data from 1994(10) to 2001(10); Ghazali, Amin, Muhammad, and Sabah (2008) examined the relationship between money and price in Malaysia used monthly data from January 1974 to September 2006; and Fahlino Sjuib (2009) investigated the causal relationship among macroeconomic variables in Indonesian, used annual data from 2001 to 2008.

DATA SET

The data for these variables were mainly obtained from the Central Bank of Nigeria (CBN) statistical bulletin various years and Nigeria Bureau of Statistics (NBS) various years. The analysis started with descriptive statistics, stationarity test using unit root methods such as Augmented Dickey-Fuller approach and Philip-Perron method, followed by multivariate cointegration test developed by Johansen (1988), and Johansen and Juselius (1990), Granger causality test in vector error correction model (VECM), impulse response function (IRFs) and variance decomposition(VDCs) method.

Step 1: Test For Descriptive Statistics

Descriptive statistics summarize the characteristics of a sample of data and is not only useful for data exploration but also useful for data cleaning. Various data errors can be identified through the descriptive tools and can be corrected before any further analysis. There are two kinds of descriptive statistics, measure of central tendency and measure of dispersion (variation). Measure of central tendency consists of mean, median and mode while measure of dispersion (variation) consists of range, inter-quarter range, variance/standard deviation. This study utilized mean, median, maximum average, minimum average, standard deviation, kurtosis, and jarque –bera.

Step 2: Test For Stationarity

Stationary series can be defined as one with a constant mean, constant variance and constant auto covariance for each given lag. Unit root tests are important in observing the stationarity of a time series data and prevent spurious regression that results from the use of non-stationary data. In addition, model with unit roots, shocks (which may be due to policy changes) have persistent effects that last forever, while in the case of stationary models, such shocks can only have a temporary effect. A series that is stationary without differencing is said to be denoted by 1(0), after being differentiated once is said to be integrated of order 1(1), after being differentiated twice is said to have a higher order of unit root 1(2). In general a series that is stationary after being differenced d time is said to be integrated of order d, denoted by 1(d). This study utilized Augmented Dickey-Fuller test and Phillips –Perron test on individuals stochastic structures, these two tests are frequently used for time series data.

Step 3: Cointegration And Granger Causality

The main purpose of cointegration is to examine the existence of a long run relationship between or among variables. According to Granger, if there is evidence of cointegration between two or more variables, then a valid error correction model should also exist between the two variables. Granger (1969, 1986, 1988) and Sim (1972) further stated that, if two variables are co-integrated, causality must exist in at least one direction, either unidirectional or bidirectional.
Co-integration indicates the presence or absence of Granger causality but does not indicate the direction of causality between or among variables. The direction of the causality can only be detected through the vector error-correction model (VECM) derived from the long run Cointegrating vectors. . We employed (Johansen, 1988, and Johansen and Juselius, 1990) approach to determine whether any of the variables are co-integrated.

In Granger causality, the statistical significance of the t-tests of the lagged error-correction term(s) will imply a long-term causal relationship while the non-significance of the lagged error-correction terms will affects the long-term relationship and may be a violation of theory. The F-test of the explanatory variables (first differences) indicates the short-run causal effects. The non-significance of both the t-test(s) as well as the F-tests in the VECM will indicate econometric exogeneity of the dependent variables. VECM helps to indicate the Granger exogeneity or endogeneity of the dependent variable and also gives an understanding of the Granger causality within the sample period but provide no indication of the dynamic properties of the system or relative strength of the variables beyond the sample period (M.Masih et al, 1996).

In order to analyze the dynamic properties of the system and the dynamic interaction of the various shocks in the post sample period, Variance decompositions test (VDCs) and the Impulse response functions (IRFs) were computed.

Step 4: Vector Error-Correction Modelling (VECM) and Exogeneity

Vector error-correction model enable us to distinguish between short-run and long-run Granger-Causality, and also indicates the direction of causality among variables. The statistical significance of the t-test of the lagged error-correction term(s) or the F-tests applied to the joint significance of the sum of the lags of each explanatory variables will indicates the Granger causality (or endogeneity of the dependent variable). The non-significance of both t-test (s) and F-tests in the VECM will imply econometric exogeneity of the dependent variable. The F-test of the differenced explanatory variables indicates the short-run causality effects while the long-run causality relationship is implied through the significance or otherwise of the t-test of the lagged error-correction term.

Step 5: Variance Decompositions Test (VDCs) and Relative Exogeneity

Variance decompositions test (VDCs) indicates the percentage of forecast error variance for each variable that can be explained by its own shocks and to fluctuation in the other variables. VDCs may be termed as causality tests outside the estimation time period (Bessler and Kling, 1985). VDCs decompose variation in an endogenous variable into the component shocks to the endogenous variables in the VAR. The Choleski decomposition method is used to orthogonalize all innovation/error, though the method is very sensitive and depends on the order of variables. For this study, the order were chosen based on previous studies by Masih and Masih (1996); Cota and Erjavec (2003); Ghazali, Amin, Muhammad, and Sabah (2008); and Fahlino Sjuib (2009). The order used is output (GDP), money supply M1 (M2), interest rate (INT), price (CPI) and exchange rate (EXH). Since, we have identified the ordering of the variables there is no need for a generalized impulse response functions (GIRFs).

Step 6: Impulse Response Function (Irfs)

Impulse response function like the VDCs are obtained from the Moving Average (MA) model obtained from the unrestricted VAR model. Impulse response traces out the responsiveness of the dependent variables in the VAR to shocks to each of the variables. In order to trace out the dynamic effects of various shocks, the estimated VECM is reparameterized to its equivalent formulation in levels. The reparameterized error correction term are incorporated into the first period lagged terms of autoregression. The model is then inverted to obtain the impulse response function in order to capture the effects of deviations from long run equilibrium on the dynamic path followed by a variable in response to initial shocks. That is, the IRF shows how the future path of those variables changes in response to the shock.

ESTIMATION RESULTS

Table One, gives the descriptive statistics of variables used in the estimation. Consumers' price index (CPI) average is ♯ 40.892 and varies from a minimum price of ♯ 0.138 to a maximum of ♯ 225.4 and this represent over 500 percent increment in price from 1960 to 2011. Exchange rate (EXH) average is ♯ 36.1, Nigeria currency to a US Dollar ranges from a minimum of ♯ o.544 to a maximum of ♯ 156.2. A Nigeria currency to a US Dollars from 1960 to 2011 indicates over 240 percent devaluation of the domestic currency to a US Dollar with a standard deviation of 54.8. Interest rate has the smallest average of 13.361 with a minimum of 6.000 and maximum of 29.800. Gross domestic product (GDP) mean is ♯ 4268708 million with a minimum of ♯ 2233 million and maximum of ♯ 36639973 million. Narrow money (M1) average is ♯ 699926.4 million with a minimum of ♯ 217.606 million and maximum of ♯ 6768426 million while broad money (M2) mean is ♯ 1328969 million with a minimum of ♯ 272.396 and maximum of ♯ 13300339. Gross domestic product (GDP) has the highest average of ♯ 699926.4 million followed by broad money average (M2) of ♯ 1328969 million, Narrow money average (M1) of ♯ 699926.4 million, Consumers' price index average (CPI) of ♯ 40.892, Exchange rate average (EXH) of ♯ 36.1, and Interest rate average (INT) of 13.361 percent.

TABLE 1: Descriptive Statistics

Variables	CPI	EXH	GDP	INT	M1	M2
Mean	40.89207	36.11268	4268708.	13.36053	699926.4	1328969.
Median	1.981154	2.158100	68527.77	11.50000	13719.20	26833.70
Maximum	225.4000	156.2000	36639973	29.80000	6768426.	13300339
Minimum	0.139026	0.544500	2233.000	6.000000	217.6060	272.3960
Std. Dev.	65.96283	54.89190	8595856.	6.651265	1561144.	3108640.
Skewness	1.571732	1.180524	2.257626	0.507716	2.612034	2.731400
Kurtosis	4.215369	2.574358	7.184623	2.099586	8.846752	9.367761
Jarque-Bera	24.61006	12.47072	82.11356	3.990675	133.1967	152.5129
Probability	0.000005	0.001959	0.000000	0.135968	0.000000	0.000000

Source: Self computed.

The results of the stationarity test in table two indicate that all variables are stationary at first difference in both Augmented Dickey-Fuller test and Phillips –Perron test. The variables are all integrated of order one, *1*(1). Since the variables are integrated with order *1*(1), we test whether there is a long run relationship among the four variables using the Johansen co-integration test (see table three).

TABLE 2: Results Of The Unit Root Tests

Variables	ADF Test		PP Test	
	Constant without Trend	Constant with Trend	Constant without Trend	Constant with Trend
Levels				
LGDP	1.1125	-2.4613	0.9390	-2.5022
LM1	1.3296	-2.9095	1.1023	-2.7221
LM2	0.5936	-3.0544	1.2039	-2.7133
INT	-1.3146	-1.7939	-1.7841	-3.1411
LCPI	-0.0738	-1.6343	0.2019	-1.7274
LEXH	0.4387	-1.9058	0.2543	-1.9602
First Differences				
ΔLGDP	-5.5363	-5.6321	-5.5360	-5.6321
ΔLM1	-4.8445	-4.8942	-4.8291	-4.8437
ΔLM2	-4.7178	-4.7652	-4.5669	-4.5649
ΔINT	-11.2464	-11.1450	-11.2912	-11.2099
ΔLCPI	-5.3616	-5.2976	-5.4136	-5.3514
ΔLEXH	-5.9038	-5.9849	-5.9339	-5.9779

Source: Self computed.

MULTIVARIATE COINTEGRATION ANALYSIS

The multivariate cointegration technique was developed by Johansen and Juselius (1990) to examine the existence of a long run relationship among variables that have same order of integration. From the unit root results reported in table two, all variables are stationary at first difference and there is a need to conduct cointegration test to examine the existence of linear combination of integrated variables that are stationary. If cointegration exists among the variables, VECM will be the better model specification.

Prior to the test for cointegration, we examined the lag order selection criteria because the results of the cointegration model depend on the number of lags used in the model.

TABLE 2 (a): Lag Order Selection Criteria for (GDP, M1, CPI, INT, and EXH)

Lag	Log like hood	LR	FPE	AIC	SC	HQ
0	-283.7138	NA	0.257271	12.83172	13.03246	12.90656
1	-29.35098	440.8955	9.70e-06	2.637821	3.842263*	3.086825
2	-9.892128	29.40449	1.29e-05	2.884095	5.092238	3.707268
3	20.55937	39.24860	1.14e-05	2.641806	5.853650	3.839149
4	52.37468	33.93633	1.06e-05	2.338903	6.554449	3.910416
5	110.0614	48.71320*	3.76e-06	0.886161	6.105408	2.831844
6	156.5463	28.92394	3.09e-06*	-0.068723	6.154225	2.251130
7	204.2771	19.09232	4.63e-06	-1.078980*	6.147669	1.615042*

Notes: * indicates lag order selected by the criterion.

TABLE 3 (b): Lag Order Selection Criteria for (GDP, M2, CPI, INT, and EXH)

Lag	Log like hood	LR	FPE	AIC	SC	HQ
1	-25.00482	461.3385	7.99e-06	2.444659	3.649101*	2.893663
2	-4.182332	31.46510	1.00e-05	2.630326	4.838469	3.453499
3	23.25372	35.36202	1.01e-05	2.522057	5.733901	3.719400
4	60.22226	39.43311	7.45e-06	1.990122	6.205667	3.561635
5	113.2932	44.81543*	3.26e-06	0.742526	5.961773	2.688209
6	161.0838	29.73642	2.52e-06*	-0.270393	5.952556	2.049460
7	216.8134	22.29182	2.65e-06	-1.636150*	5.590500	1.057872*

Notes: * 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

The results of the lag selection criteria for both M1 and M2 was based on likelihood ratio test (LR), Akaike Information Criterion (AIC), and Hannan-Quinn Information criterion (HQ). The result for both models indicates that seven years lag length is more appropriate (see table 3a and 3b). The next step is to conduct cointegration test among the variables, and the results is reported in table four.

TABLE IV Johansen's Test for Multiple Cointegrating Vectors

Variables: LGDP,LM1,INT, LCPI, LEXH (p = 6)					
Null	Alternative	Maximum Eigenvalue	Critical Value 95%	Trace	Critical Value 95%
r =0	r ≥ 1	77.05855**	33.87687	164.5856**	69.81889
r ≤ 1	r ≥ 2	37.91956**	27.58434	87.52703**	47.85613
r ≤ 2	r ≥ 3	31.77096**	21.13162	49.60747**	29.79707
r ≤ 3	r ≥ 4	17.60470*	14.26460	17.83651*	15.49471
r ≤ 4	r ≥ 5	0.231812	3.841466	0.231812	3.841466

Variables: : LGDP,LM2,INT,LCPI, LEXH (p = 6)					
Null	Alternative	Maximum Eigenvalue	Critical Value 95%	Trace	Critical Value 95%

r =0	r ≥ 1	78.46552**	33.87687	168.1341**	69.81889
r ≤ 1	r ≥ 2	38.62625*	27.58434	89.66855**	47.85613
r ≤ 2	r ≥ 3	35.27207**	21.13162	51.04230**	29.79707
r ≤ 3	r ≥ 4	15.25631*	14.26460	15.77023*	15.49471
r ≤ 4	r ≥ 5	0.513914	3.841466	0.513914	3.841466
BETA (Transposed)					
LGDP	LM2	INT	LCPI	LEXH	
1.000	-1.421	0.095	0.195	0.290	
LGDP	LM1	INT	LCPI	LEXH	
1.000	-0.829	0.03	-0.191	-0.040	
Testing restriction on beta:					
BETA (Transposed)					
LGDP	LM2	INT	LCPI	LEXH	
1.000	0.000	-0.090	-0.972	-0.068	
LGDP	LM1	INT	LCPI	LEXH	
1.000	0.000	0.059	-1.166	-0.202	

Notes: r value indicates the number of co-integrating vectors.
** and * indicates rejection at the 99% and 95% critical values.
(p) indicates the optimal lag –structure for each model and was determined through the likelihood-ratio test reported in table two.

The Johansen multivariate co-integration test results for both M1 and M2 indicates the rejection of null hypothesis of zero cointegration at 95 percent critical level. The test result shows that both trace and maximum eigen-value statistics indicates that a long run relationship exist among the macroeconomic variables.

TABLE V Granger Causality Tests based on Vector Error-Correction Model

M1 Model	ΔGDP	ΔM1	ΔINT	ΔCPI	ΔEXH	ECT_{t-1}
Dependent variables	F – Statistics (significance levels)					t - statistics
ΔGDP	-	0.8147	1.0768	1.1759	2.1079*	2.6723**
ΔM1	3.4282***	-	0.7416	0.4731	0.8128	5.3522***
ΔINT	0.6791	1.6429	-	0.9946	4.3442***	0.7939
ΔCPI	1.1262	0.6977	1.6036	-	1.6351	0.5892
ΔEXH	1.0531	0.9645	1.6412	1.4735	-	1.3299
M2 Model	ΔGDP	ΔM2	ΔINT	ΔCPI	ΔEXH	ECT_{t-1}
Dependent Variables	F – Statistics (significance levels)					t - statistics
ΔGDP	-	1.4603	1.0768	1.1759	2.1079*	4.3801***
ΔM2	2.6557**	-	0.8723	0.8471	0.7212	7.1730***
ΔINT	0.6791	1.3780	-	0.9946	4.3442***	0.9566
ΔCPI	1.1262	1.0701	1.6036	-	1.6352	0.8028
ΔEXH	1.0531	1,0401	1.6412	1.4735	-	1.3560

Notes: All variables are in the first differences (denoted by Δ**)** with the exception of the lagged error-correction term ECT_{t-1} generated from the Johansen's cointegration test conducted in table four above. The error-correlation term ECT_{t-1} was derived by normalizing the four cointegration vectors on GDP. Stationarity test was conducted on the residual and was found to be stationary. Different diagnostic tests conducted are test for multicollinearity, test for heteroscedasticity, normality test, and model specification test were found to be satisfactory (not reported).
***, **, and * indicate significance at the 1%, 5%, and 10% levels respectively.

Table five reports the Granger Causality result based on VECM with uniform lag structure of six determined by the likelihood ratio test reported in table two. A significant F statistics indicate that the independence variables granger cause the dependent variable, the results from table five shows that there is a unidirectional short run causal affect running from output growth rate to narrow money supply, from output growth rate to broad money supply, from exchange rate to output growth rate, and from exchange rate to interest rate. These findings is contract to the results from previous studies such as Masih and Masih(1996) and Sjuib (2009) that found short run causality running from interest rate to exchange rate in their studies of Thailand and Indonesian economy respectively.

The unidirectional short run relationship among the variables suggests that exchange rate contains better information about the source of shocks affecting the economy than others variables and that exchange rate is helpful in predicting the current and future growth rate of output and interest rate. This finding provides justification from shifting away from monetary policy targeting to exchange rate targeting in the short-run. Exchange rate targeting keeps inflation under control and provides an automatic rule for the monetary policy. This policy work well when the central bank is able to checkmate the economy to shocks from anchor country.

The presence of causal relationship among the variables shows that money supply is neutral in the short-run and cannot be efficient in the stabilization of both output and price level in the Nigeria economy. Though, we cannot rule out the significance of the error correction term which indicates that the burden of the short run endogenous adjustment (to the long-term trend) to bring the system back to its long-run equilibrium has to be taken by money supply and output. The VECM results indicates that in the short-run exchange rate and price stand out econometrically exogenous as evidence in the statistical significance of the t-test of the lagged error correction term or F-tests of the independent variables.

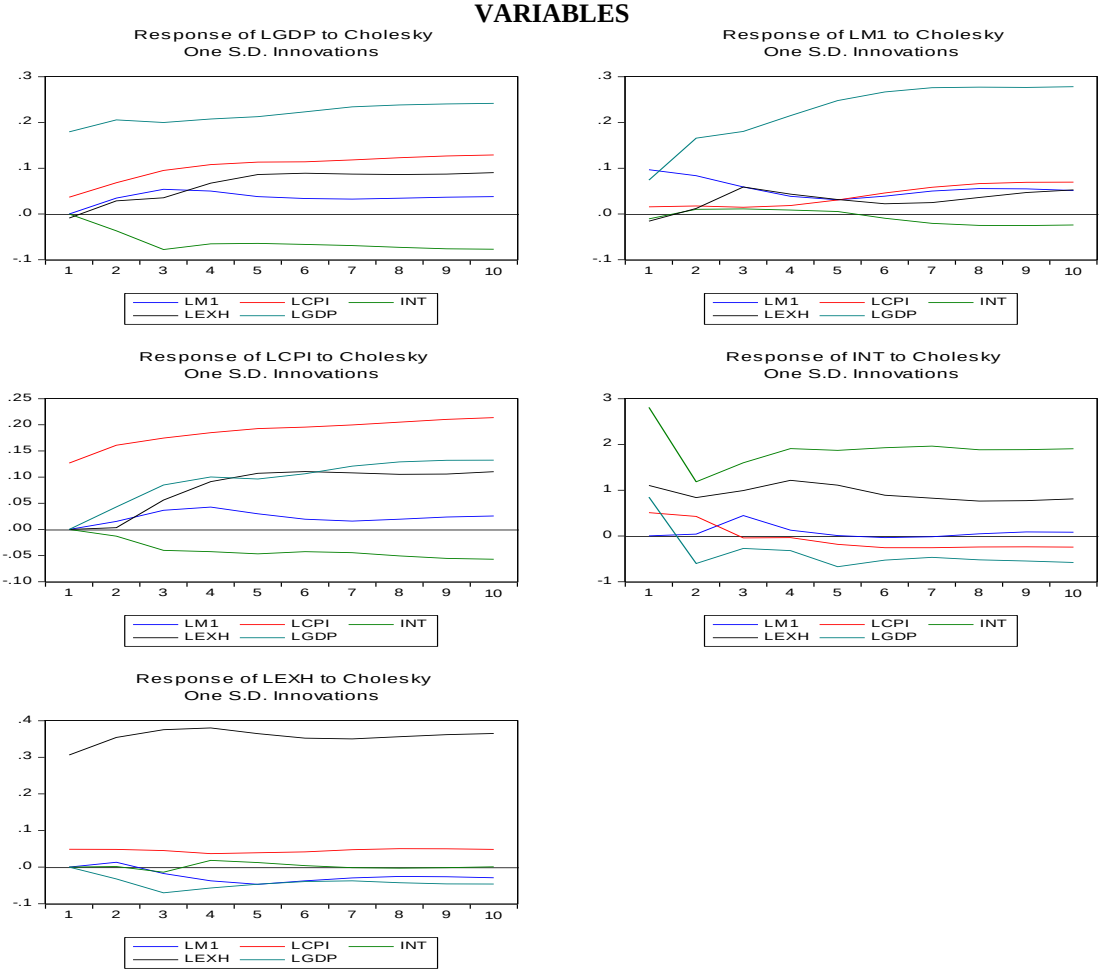
The results of the IRF are presented in figure one. Ten years horizon is employed in order to allow the dynamic of the system to work out. One standard deviation shock in output growth has a positive impact on prices and narrow money, and negative effect on exchange rate and interest rate respectively. A shock to narrow money would lead to persistence increases in prices for the first five years, increases in exchange rate for the first two years, and persistence increases in output for the first three years and later falls throughout the period.

A shock to price has small positive response on narrow money and also small positive response to exchange rate but the impact is not persistence and almost stabilized throughout the period.

One standard deviation shock in exchange rate has positive response in output growth, narrow money, price stabilization in the first period and persistence falling throughout the period. Interest rate has statistically significant effect on other variables. One standard deviation shock on interest rate has positive response on narrow money, negative responses from price and output respectively.

IMPULSE RESPONSES OF ALL VARIABLES TO A ONE – STANDARD DEVIATION SHOCK TO LGDP, LM1, LCPI, INT and LEXH

VARIABLES



One standard deviation shock in broad money (M2) has positive impacts on all variables except interest rate in the second and seventh period. A shock in CPI has persistence positive impacts on both output and current price, positive impact on both exchange rate and broad money except from the second to the fourth period in M2, and persistence negative impact on interest rate except in the second period. One standard deviation shock in interest rate has persistence negative impacts on output, price, exchange rate, and broad money except in the second period of M2, and positive impact on current interest rate. A shock in exchange rate has positive impact on all variables except output in the first period. One standard deviation shock in output has persistence positive impact on both broad money and price, positive impact on current output, negative impacts on both exchange rate and interest rate except in the first period of interest rate.

IMPULSE RESPONSES OF ALL VARIABLES TO A ONE – STANDARD DEVIATION SHOCK TO LGDP, LM2, LCPI, INT and LEXH VARIABLES

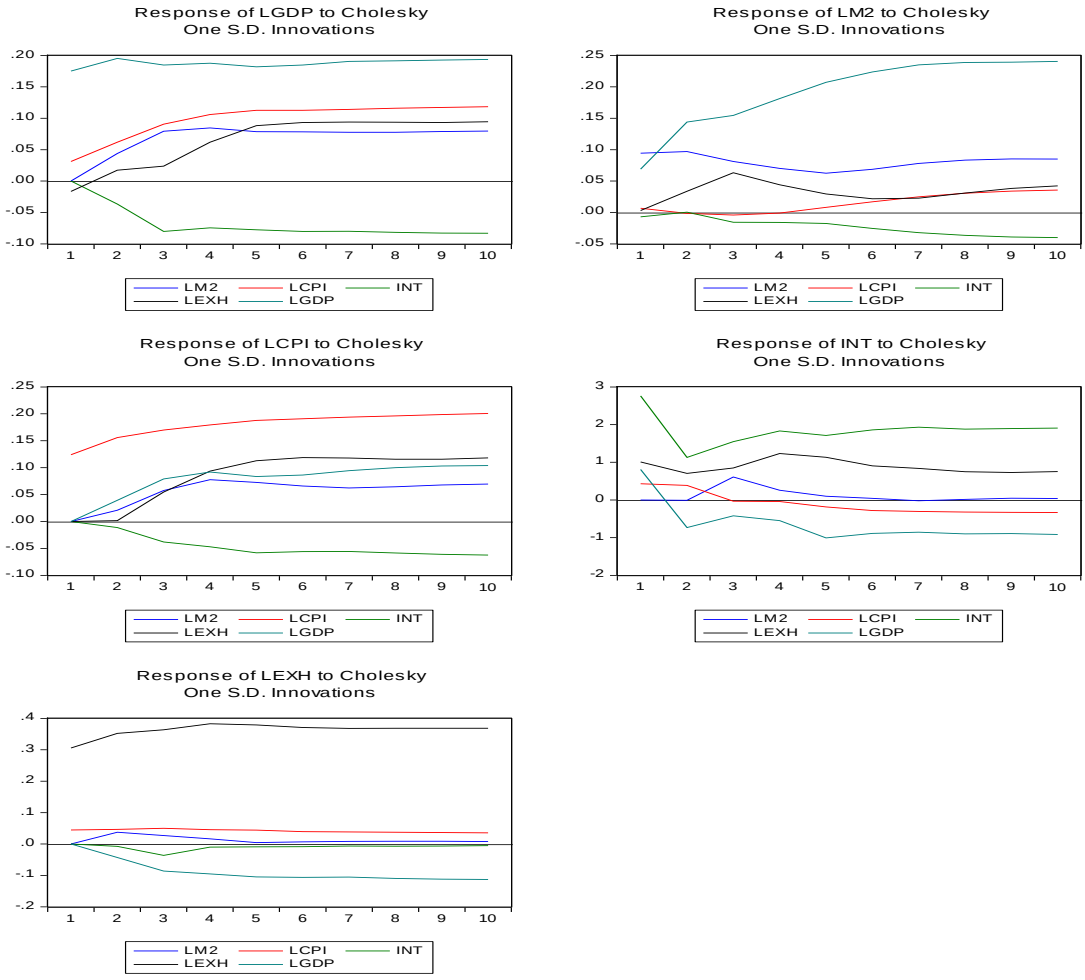


TABLE VI : Decomposition Of Variance: Ordering (DLGDP, DLM1, DINT, DLCPI, DLEXH)

Variance Decomposition of Output (GDP)						
Relative Variance in	S.E.	ΔLGDP	ΔLM1	ΔINT	ΔLCPI	ΔLEXH
1ΔLGDP	0.1832	100.0000	0.0000	0.0000	0.0000	0.0000
2	0.2896	94.3622	1.3286	0.1668	0.8952	3.2473
3	0.3782	87.0026	2.9759	1.2636	2.9010	5.8569
4	0.4573	82.9688	3.0865	1.0065	4.1374	8.8009
5	0.5292	80.2445	2.6835	0.7912	4.8847	11.3960
10	0.8386	76.6481	1.7196	0.5240	6.0207	15.0876
Variance Decomposition of Money Supply (M1)						
Relative Variance in	S.E.	ΔLGDP	ΔLM1	ΔINT	ΔLCPI	ΔLEXH
1ΔLM1	0.1240	37.7125	62.2875	0.0000	0.0000	0.0000
2	0.2245	65.6416	31.3145	1.4185	0.7376	0.8878
3	0.3004	71.1852	20.0977	2.6354	1.1740	4.9078
4	0.3744	77.8365	13.5861	2.3442	1.3232	4.9099
5	0.4521	83.2053	9.6072	1.8659	1.1459	4.1757
10	0.7900	89.8738	4.8265	0.6560	0.4481	4.1956
Variance Decomposition of Interest Rate (INT)						
Relative Variance in	S.E.	ΔLGDP	ΔLM1	ΔINT	ΔLCPI	ΔLEXH
1ΔINT	3.1785	7.6250	1.9645	90.4105	0.0000	0.0000

2	3.5708	8.3680	1.8278	87.9185	1.1657	0.7200
3	4.0695	7.0798	1.53625	89.0379	1.1204	1.2257
4	4.6698	6.0405	1.4127	89.8421	1.0549	1.6498
5	5.1988	6.9582	1.5363	88.7394	1.1235	1.6426
10	7.0974	7.3987	1.6015	88.2238	1.8837	0.8923
Variance Decomposition of Price (CPI)						
Relative Variance in	S.E.	ΔLGDP	ΔLM1	ΔINT	ΔLCPI	ΔLEXH
1ΔLCPI	0.1268	4.01184	0.0012	1.2298	94.7572	0.0000
2	0.2103	13.9022	0.6043	0.6438	84.5783	0.2715
3	0.2966	22.0982	1.5647	0.3972	69.6883	6.2517
4	0.3798	25.3254	1.8233	0.5268	60.4142	11.910
5	0.4530	25.7262	1.5016	0.5936	56.4251	15.7534
10	0.7526	31.2704	0.6930	0.5353	47.8215	19.6798
Variance Decomposition of Exchange Rate (EXH)						
Relative Variance in	S.E.	ΔLGDP	ΔLM1	ΔINT	ΔLCPI	ΔLEXH
1ΔLEXH	0.3101	0.0280	1.4901	14.0313	1.5106	82.9401
2	0.4747	0.6961	1.0570	14.3490	1.4369	82.4609
3	0.6115	2.0566	1.6597	12.8935	1.4895	81.9007
4	0.7245	2.3182	2.5754	13.6529	1.2891	80.1644
5	0.8148	2.3024	3.3310	13.7788	1.2127	79.3752
10	1.1519	2.0738	3.6837	13.2837	1.3546	79.6041

Notes:the figures in the first column refer to the time horizons (i.e., number of years). All figures are approximated to four decimal places, rounding errors may prevent a perfect percentage decomposition in some cases. The alternation of the fiscal variables appearing prior to output did not change the results because the variance – covariance matrix of residual are near diagonal, estimated through the Choleski decomposition in order to orthogonalize the innovations across equation.

The VDC of GDP revealed in table 6.0 indicates that 100 percent of GDP variance can be explained by current GDP in the first period, and the percentage is still significant at the end of the tenth periods reaching 76.6 percent. At the end of the ten years period, money supply (M1) contribute a neglectable amount of 1.7 percent to the variation in the forecast error of GDP while exchange rate and price accounts for 15% and 6% respectively of the variation in the forecast error of GDP. Finally, this analysis indicates no significant relationship between the variance of GDP and interest rate.

The variance of money supply (M1) reveals that about 10 percent of the forecast error variance of current money supply (M1) is explained by its own shock after a five years period. Exchange rate contributes 4 percent for the variation in the forecast error of money supply (M1). A significant part of money supply (M1) variance is caused by GDP and increased from 83.2 percent in the fifth period to 89.9 percent by the end of the ten years. Finally, both price and interest rate are not significantly influenced by money supply (M1).

The variance of price (CPI) indicates that about 57 percent of the forecast error variance of current price is explained by its own shock after the five years period. Both GDP and exchange rate accounts for 31 and about 20 percent of the variation in the forecast error of price, while money supply and interest rate could not establish any significant influence impact on price. Both money supply and price contributes very little for the variation in the forecast error of interest rate.

The variance of interest rate indicates that about 89 percent of the forecast error variance of current interest rate is explained by its own shock. Finally, exchange rate has no significant impact on interest rate.

About 80 percent (even after the five years period) of exchange rate forecast error variance is explained by the innovations in current exchange rate variable. Interest rate account for about 14 percent of the variation in the forecast error of exchange rate after the five periods, while both GDP and money supply contributes very little. Finally, we could not establish any significant influence of price on exchange rate.

TABLE VII Decomposition Of Variance: Ordering (Dlgdp, Dlm2, Dint, Dlcpi, Dlexh)

Variance Decomposition of Output (GDP)						
Relative Variance in	S.E.	ΔLGDP	ΔLM2	ΔINT	ΔLCPI	ΔLEXH
1ΔLGDP	0.1786	100.0000	0.0000	0.0000	0.0000	0.0000
2	0.2784	93.1758	3.0183	0.3581	1.2964	2.1514
3	0.3648	82.7288	7.2324	2.1299	4.1795	3.7293
4	0.4427	75.8966	9.3394	1.8940	6.2129	6.6571
5	0.5117	70.6003	10.0659	1.6106	7.6458	10.0774
10	0.7865	61.7142	10.8587	1.1373	9.8159	16.4739
Variance Decomposition of Money Supply (M2)						
Relative Variance in	S.E.	ΔLGDP	ΔLM2	ΔINT	ΔLCPI	ΔLEXH
1ΔLM2	0.1173	33.9965	66.0035	0.0000	0.0000	0.0000
2	0.2122	52.4868	43.4168	0.7806	1.0888	2.2269
3	0.2824	55.9354	34.9129	0.6855	1.4817	6.9845
4	0.3461	62.3805	28.4061	0.4982	1.6588	7.0565
5	0.4097	68.7765	23.1566	0.3566	1.5267	6.1836
10	0.7022	78.4457	15.7690	0.2420	0.6031	4.9403
Variance Decomposition of Interest Rate (INT)						
Relative Variance in	S.E.	ΔLGDP	ΔLM2	ΔINT	ΔLCPI	ΔLEXH
1ΔINT	3.0784	6.3349	0.1279	93.5372	0.0000	0.0000
2	3.4552	9.3113	0.1284	89.0141	1.2742	0.2720
3	3.9506	8.7003	2.1754	87.8125	1.0246	0.2873
4	4.5663	8.5916	1.8933	87.7152	0.8400	0.9599
5	5.1109	11.6972	1.5345	84.8054	0.7889	1.1740
10	7.1912	15.6063	0.7932	81.4352	1.52014	0.6452
Variance Decomposition of Price (CPI)						
Relative Variance in	S.E.	ΔLGDP	ΔLM2	ΔINT	ΔLCPI	ΔLEXH
1ΔLCPI	0.1240	3.0511	0.2990	0.9292	95.7207	0.0000
2	0.2044	11.3985	0.5767	0.4492	87.4762	0.0994
3	0.2909	17.9346	4.1719	0.2467	72.7347	4.9121
4	0.3771	19.6233	7.1563	0.2579	62.7547	10.2077
5	0.4537	18.8238	7.9681	0.2245	58.5297	14.4539
10	0.6928	19.5689	7.6902	0.2252	52.4354	20.0803
Variance Decomposition of Exchange Rate (EXH)						
Relative Variance in	S.E.	ΔLGDP	ΔLM2	ΔINT	ΔLCPI	ΔLEXH
1ΔLEXH	0.309033	0.444332	0.817766	14.16508	1.617746	82.95508
2	0.474370	2.166469	2.475712	13.21418	1.824101	80.31954
3	0.607865	4.567569	2.521568	10.97599	2.209087	79.72579
4	0.726458	5.966292	2.252019	11.11911	2.180037	78.48254
5	0.827326	7.081498	1.951308	11.15477	2.162439	77.64998
10	1.196920	9.735536	1.520070	11.30533	1.970842	75.46823

Narrow money (M1) and broad money (M2) respectively accounts for 76.6 and 61.7 percents of the variation in the forecast error of output (GDP) after the ten periods. Narrow money (M1) and broad money (M2) accounts for 1.6 percent and 0.7 percent of the variation in the forecast error of interest rate while M1 and M2 contributes 0.6 and 7.9 percent of the variation in the forecast error of price respectively. Interest rate contributes very little for the variation in the forecast error of output (GDP). Broad money and price contributes very small for the variation in the forecast error of exchange rate and interest rate respectively. Narrow money (M1) contributes very little for the variation in the forecast error of all variables, while broad money (M2) contributes largely for the variation in the forecast error of all variables except interest rate and exchange rate.

TABLE VIII

Percentage of forecast variance explained by innovation in:					
M1 Model Effect upon	ΔLGDP	ΔLM1	ΔINT	ΔLCPI	ΔLEXH
ΔLGDP	76.64	1.72	0.52	6.02	15.08
ΔLM1	89.87	4.83	0.65	0.45	4.19
ΔINT	7.39	1.60	88.22	1.88	0.89
ΔLCPI	31.27	0.69	0.54	47.82	19.68
ΔLEXH	2.30	3.68	13.28	1.35	79.38
Percentage of forecast variance explained by innovation in:					
M2 Model Effect upon	ΔLGDP	ΔLM2	ΔINT	ΔLCPI	ΔLEXH
ΔLGDP	61.71	10.86	1.14	9.82	16.47
ΔLM2	78.45	15.77	0.24	0.60	4.94
ΔINT	15.61	0.79	81.44	1.52	0.65
ΔLCPI	19.57	7.69	0.23	52.44	20.08
ΔLEXH	9.74	1.52	11.31	1.97	75.47

Notes: the variance decomposition shows the percentage of the ten years forecast error of all variables in the M1 and M2 models.

Considering the definitions of money stocks, broad money (M2) appears to have the strongest causal effect on real output with 10.86 percent of forecast error variance compared with 1.72 percent of narrow money (M1).

CONCLUSION

The main objective of this study is to examine the dynamic causal relationship between money and macroeconomic activity such as output, interest rate, price, and exchange rate in a small open economy (Nigeria) from 1960 to 2011. The methodology adopted uses descriptive statistics, stationarity test using unit root methods such as Augmented Dickey-Fuller approach and Philip-Perron method, followed by multivariate cointegration test developed by Johansen (1988), and Johansen and Juselius (1990), Granger causality test in vector error correction model (VECM), impulse response function and variance decomposition method in order to capture both within and outside sample Granger causality among macroeconomic activity.

The results of the cointegration test indicates that a long run relationship exist among the macroeconomic variables. This implies that these (co-integrated) variables will have short-term or transitory deviations (or departures) from their long term common trend (s), eventually forces will be set in motion that will drive them together again. The empirical results of this study show that money supply is neutral in the short-run and cannot be efficient in the stabilization of both output and price level in the Nigeria economy. The variation in price level is mainly caused by its own lagged values and from output and exchange rate while the variation in output is also mainly caused by its own lagged value and from exchange rate.

In contrast to most previous studies, the results of this study indicates that exchange rate contains better information about the source of shocks affecting the economy than others variables and that exchange rate is helpful in predicting the current and future growth rate of output and interest rate. This finding provides justification from shifting away from monetary policy targeting to exchange rate targeting in the short-run. Exchange rate targeting keeps inflation under control and provides an automatic rule for the monetary policy. This policy work well when the central bank is able to checkmate the economy to shocks from anchor country.

The VECM results indicate that in the short-run exchange rate and price stand out econometrically exogenous. In the empirical period, these variables were relatively the leading variables and they are initial receptors of exogenous shocks to the long run equilibrium. Though, we cannot rule out the significance of the error correction term which indicates that the burden of the short run endogenous adjustment (to the long-term trend) to bring the system back to its long-run equilibrium has to be taken by money supply and output. The results of the relative contribution of the explanatory variables in explaining the variation in the dependent variable in the post sample era confirm the conclusion obtained from within the sample by VECM analysis. Considering money stocks, broad money (M2) contributes largely for the variation in the forecast error of all variables than narrow money (M1) except in the case of interest rate and exchange rate.

Thus if the main objective of the government is to sustain high economics growth rate, exchange rate targeting will be the most suitable measure to adopt. However, if the objective of the government is to curb inflation rate, output (GDP) targeting has a more causal effect on price in the narrow money model while exchange targeting also has more influence to curb inflation in the broad money model than other variables. The granger causal chain implied by our findings is consistence with real business cycle theory than other economic paradigms, exchange rate, output, and interest rate respectively leads money supply and price. Therefore, monetary policy alone is insufficient to achieve sustainable economic growth and price stability.

REFERENCES

Ahmed Elsheikh M. Ahmed and Suliman Zakaria Suliman (2011). The Long–Run Relationship Between Money Supply, Real GDP, and Price Level: Empirical Evidence From Sudan Journal of Business Studies Quarterly Vol 2 no 2 (2011) PP 66-79.

Balogun, ED (2007). Monetary policy and economic performance of West African Monetary Zone Countries Online at http://mpra.ub.uni-muenchen.de/4308/MPRA Paper No. 4308, posted 07. November 2007 retrieved on March 28th 2012, 3:45pm.

Central Bank of Nigeria (2011). Annual Report and Statement of Accounts 31st Dec. 2011, Abuja.

Central Bank of Nigeria (1997). Statistical Bulletins various issues 31st Dec. 1997, Abuja.

Central Bank of Nigeria (2010). Statistical Bulletins various issues 31st Dec. 2010, Abuja.

Chris Brooks (2008). Introductory Econometrics for Finance (2nd edition), Cambridge University Press.

Erjavec, Natasa and Cota Boris (2003). Macroeconomic Granger-causal dynamics in critia: evidence based on vector error-correction modelling analysis, *Ekonomski pregled*, 54 (1-2), 139 – 156 pp. 139 – 156.

Fahlino Sjuib (2009). Causal Chain in Macroeconomic variables: Evidence from recent experience in Indonesian, International Journal of Finance and Economics, Issue 25(2009), 1450-2887.

Feridun M and Adebiyi M.A. (2005). Forecasting inflation in developing economies: the case of Nigeria, *International Journal of Applied Econometrics and Quantitative Studies*, Vol. 2 -4, pp 103 – 132.

Federal Reserve Bank of New York (1962). Money and Economic Balance: Selection Number 133 Study Materials for Economics Education in the Schools, the joint council of Economics Education, New York, N.Y.

Granger, C.W.J.(1969). Investigating Causal Relations by Econometric Models and Cross Spectral Methods, Econometrica 37:424-438.

Gujarati DN(2009). Basic Econometrics 5th. Ed. (Tata McGraw- Hill Edition) p320-538 New Delhi: Tata McGraw- Hill Publishing Company Ltd.

Jacek Kotlowski (2005). Money and prices in the Polish economy. Seasonal cointegration approach Working Papers Series Warsaw School of Economics Warszawa, Poland Working Paper No. 3-05 Paper presented to the 32nd Conference Macromodels'2005, Kliczków, December 2005.

Johansen, S. (1988). Statistical Analysis of Cointegration Vectors, Journal of Economic Dynamics and Control 12:231-254.

Johansen, S. and Juselius, K. (1990). Maximum Likelihood Estimation and Inference on Cointegration – with Applications to the Demand for Money, *Oxford Bulletin of Economics and Statistics* 52, 169-210.

Masih,A.M.M., and Masih, R.(1996). Empirical Tests to Discern the Dynamic Causal Chain in Macroeconomic Activity: New Evidence from Thailand and Malaysia based on a Multivariate Cointegration/Vector Error-Correction Modeling Approach, Journal of Policy Modeling 18(5): 531-560.

Mishra P.K., Mishra U.S. and Mishra S.K (2010). Money, Price and Output: A Causality Test for India , *International Reasearch Journal of Finance and Economics* – Issue 53. Pp 26 -36.

Natasa Erjavec and Boris Cota (2003). Macroeconomic Granger Causality Dynamics in Croatia: Evidence Based on a Vector Error Correction Modelling Analysis EKONOMSKI PREGLED, 54 (1-2) 139-156 (2003).

Sims, Christopher A (1972). **Money, Income, and Causality**," American Economic Review, American Economic Association, vol. 62(4), pages 540-52, September.

Tajudeen, M. and Adedokun, A. (2010). Econometrics analysis of the impact of Fiscal Stance on Economic Growth in Nigeria, working paper.

Yaqub, J.O. (2010). *Exchange Rate, Output and Inflation in Nigeria,(1970 – 2007),* Unpublished Ph D Thesis, University of Ibadan, Ibadan, Nigeria.