Money Supply, Price Level and Output: Evidence from Short and Long run Vectors in an Error Correction Model

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Abstract:
The paper examines the relationship between money supply, price level and national output in Nigeria using quarterly time series data spanning the period of 1986Q1 to 2016Q2. The data was mainly sourced from the IMF International financial statistics and CBN Statistical Bulletin. Using Johansen`s co-integrated test, the study suggests there is evidence of long run relationship between money supply, price level and national output in Nigeria. In the long run, the paper reveals existence evidence of positive relationship between long run vectors of money supply and national output, and as well, price level and national output. The result also suggests in the short run the first lag of LGDP is positive and statistically significant at 1% level. The result also found an inverse relationship between second lag of money supply and national output in the short run, although, the vector of the relationship is statistically insignificant. This means while national output of the immediate past year has exert positive and statistically significant influence on current national output (LGDP), the influence of money supply of the past two year has a negative and insignificant effect on national output. Since the policy implication of the results of this paper is very clear, the paper suggests money supply should be treated with caution in the short-run. In the long run however, the paper is of the view that when applying monetary policies to foster growth, there is a need for monetary authorities to always estimate the demand for money to avoid high inflation for the economy. This suggests there is a clear need for monetary authorities to implement credible policies that would in the long run greatly tamed the effect of inflationary pressure on the economy.

Keywords: Money supply, Price level, Output, Quarterly time series data, Nigeria

INTRODUCTION

The linkage between money supply, price level and output has long been subject of interest for a very long time in the monetary economics literature, and it has led to different findings and conclusion at many fronts. Starting from theoretical front,

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three conflicting arguments are well known. The first argument is related to classical economists who are of the view that increase in quantity of money supply would generally increase price level rather than income and employment. The second argument is related to Keynesian economists who postulated that a change in money supply is determined by either price level or purchasing power (income), or by both the price and income levels. The last argument is related to the monetarists who emphasises on the significant of money supply in controlling inflation. These theoretical arguments clearly suggest conflicting conclusion built from different perspectives.

Following arguments and debates from these theoretical school of thought, a lot of empirical studies have been conducted to examine the relationship between either money supply and price or money supply and output (Urbanovsky, 2016; Nguyen, 2015; Masih and Abdulkarim, 2014; Adebayo 2013; Akanbi and Ajagbe, 2012; Olatunji, Sunday, and Omolara, 2012; Nwosa and Oseni, 2012; Akinbobola, 2012; Onyeiwu, 2012; Ahmed, 2011). A review of some of these studies suggests, there is, however, no general consensus on this relationship as contradictory results are still being reported which further renewed interest of scholars of monetary economics into revisiting the area of research with view to provide leading argument in resolving the conflicting findings and conclusion being recounted in the monetary economics literature.

The main objective of this paper is to re-examine the relationship between monetary supply, price level and national output in Nigeria. The goal is to build on existing empirical and theoretical literature and contribute to growing research and interest on how monetary policy can be used to achieve price stability and sustained economic growth in Nigeria. One of the major motivations for this paper is the argument that monetary authorities are always working towards fostering economic growth and keeping inflation on a low level. It is a well-known fact that a very high inflation can affect the economy drastically but there is also evidence as observed by Temple (2000) that suggests moderate inflation also slows down growth. This paper contribute to the literature by incorporating money supply, price level and output into a dynamic model using a quarterly data that spanned from 1986Q1 to 2016Q2 to evaluate the relative effect of both money supply, price level on national output Nigeria. The paper would also show the relevance of both short-run and long-run vectors of money supply and price level in explaining level of national output within the economy for empirical and policy inferences.

After this introduction, the paper is organized as follows: Section 2 will consist of literature review of some empirical studies then followed by the methodology of the paper in section 3. The results and discussion are reported in section 4. The final section consists of conclusion and recommendations.

LITERATURE REVIEW

There are number of studies looking at effectiveness of monetary policy towards some macroeconomic variables in monetary economics literature. From perspective of this study two types of studies can be identified. On the one hand, there are group of studies interested in the impact of monetary policy on inflation. These types of studies include researches conducted by Masih and Abdulkarim (2014), Nwosa and Oseni (2012), and Akinbobola (2012). In all these studies, there are evidently conflicting arguments and conclusion, while Masih and Abdulkarim (2014) conclude that monetary policy should be used to control inflation by setting inflation target which act as a guide to the equilibrium path, Jan, Khan, Ahmed and Mohammad (2012) for Pakistan argued money supply is not neutral but rather the main sources of inflation.

On the other hand, there are group of studies that looked into the impact of monetary policy on economic growth as a proxy to national output. These include studies carried out by Okoro (2013), Fasanya, Onakoya and Agboluaje (2013), Olatunji et al (2012), Onyeiwu (2012), Akanbi and Ajagbe (2012). Although, Okoro (2013), Onyeiwu (2012), and Ahmed (2011), all for Nigeria suggests monetary policy instruments derive growth in Nigeria, Olatunji et al (2012) for Nigeria, and Ahmed (2011) for Ghana found the effectiveness of money supply on output as neutral phenomena. This means it cannot be used as stabilization tool to control increase in output for these countries.

The forgoing reviewed literature suggests apart from studies conducted by Olatunji et al (2012), Amassoma, Nwosa and Olaiya (2011), and Chimobi and Uche (2010) to examine the impact of money supply, inflation and economic growth in Nigeria, there is relatively limited studies conducted in Nigeria. On the basis of this development, this paper is aimed at building on these studies by first overcoming some of their shortcomings. For example, Amassoma et al`s (2011) study was carried out using ordinary least square for an annual time series data covering the period 1986 to 2009. Chimobi and Uche (2010) relied on Granger causality to show the relationship between variables of interest. One study that is almost similar with this research study is that of Olatunji et al., (2012). However, unlike Olatunji et al`s (2012) study that is conducted using annual time series data, this paper would relied on high frequency quarterly data from 1986q1 to 2016q2. The underlying interest is to provide both short and long run vectors that would explain relative impact of both money supply and price level on economic growth in Nigeria using error correction model.

METHODOLOGY

The paper utilizes time series data with a quarterly frequency spanning the period 1986Q1 to 2016Q2. The goal is to examine the relationship between monetary policy, piece level and output in Nigeria. The data was sourced from IMF International financial statistics and CBN Statistical Bulletin.

Model Specification

The model of this paper is meant to examine the relationship between monetary policy, price level and output in Nigeria, the model is specified as:

$$LGDP = f(LMSS, PRL) \quad (1)$$

Where;
LGDP = log of GDP (proxy for national output or economic growth)
LMSS = log of money supply (proxy for monetary policy);
PRL = Consumer price index (proxy for Price level).

Unit Root Test

The paper utilizes two unit root tests. They areAugmented Dickey Fuller (ADF) and Philips-Perron (PP) unit root. The tests mainly used the null hypothesis of non-stationarity of a given time series. The general forms of these tests as shown in Ismail and Kabuga (2016) are stated below:

$$\Delta Y_t = \alpha_0 + \alpha_i t + \delta_{t-1} + \alpha_i \sum_{i=1}^{\rho} \Delta y_{t-1} + v_t \quad (2)$$

$$y_t = \alpha_0 + \alpha_1 t + \alpha_1 y_{t-1} + \delta_t \quad (3)$$

In this case α implies parameters of the model, v_t and δ_t are assumed to be a white noise, Δy_t denotes lag differences of the variable under consideration with p lag. The following hypothesis as also observed by Ismail and Kabuga (2016) tests the stationarity of the variables.

For ADF $H_o : \delta_1$ (*Null hypothesis*), $[where\ \delta_1 = \rho - 1 = 0]$

$H_a : \delta_1 < 0$ (*Alternative hypothesis*)

For PP $H_0 : \delta_2 = 0$ (*Null hypothesis*)

$H_a : \delta_2 < 0$ (*Alternative hypothesis*)

The goal of using these tests is to find the stationarity of the series. Once it is confirmed, or non-stationary variables have been normalized by taking first difference, one go ahead to test for the existence of co-integration between non-stationary variables (Ismail and Kabuga, 2016; Adamu et al., 2015; Kabuga and Hussaini 2015).

Co-integration Technique

The renown Johansen`s (1988) cointegration method is also used to confirm long run relationship among the variables of interest. The cointegration technique can be used if two series are integrated of the same order. The cointegration approach

is based on maximum likelihood estimation of the vector error correction model (VECM):

$$\Delta z_t = \delta + \Gamma_1 \Delta z_{t-1} + \Gamma_2 \Delta z_{t-2} + \cdots + \Gamma_{p-1} \Delta z_{t-p+1} + \pi z_{t-p} + \Psi x_t + u_t \qquad (4)$$

where z_t is a vector of I(1) endogenous variables, $\Delta z_t = z_t - z_{t-1}$, x_t is vector of I(0) exogenous variables, and p and Γ_i are (n×n) matrices of parameters with $\Gamma_i = -(I - A_1 - A_2 - \ldots - A_i)$, (i=1,…,k-1), and $p = I - p_1 - p_2 - \ldots - p_k$. This specification provides information about the short-run and long-run adjustments to the changes in z_t through the estimates of $\hat{\Gamma}_i$ and $\hat{\pi}$ respectively. The term πz_{t-k} provides information about the long-run equilibrium relationship between the variables in z_t. Information about the number of cointegrating relationships among the variables in z_t is given by the rank of the p-matrix: if p is of reduced rank, the model is subject to a unit root; and if $0<r<n$, where r is the rank of p, p can be decomposed into two (n×r) matrices a and b, such that $p = ab'$ where $b'z_t$ is stationary. Here, a is the error correction term and measures the speed of adjustment in Dz_t and b contains r distinct cointegrating vectors that are the cointegrating relationships between the non-stationary variables.

RESULTS AND DISCUSSION

The paper begins the empirical estimation and analysis of quarterly data series by determining order of integration of the variables of interest. The result ADF and PP tests are displayed in Table 1 which shows that each variable is integrated of order one at 1% significant level.

Table 1: ADF and PP Unit Root Tests

Variable	ADF Test t – statistic	PP Test t – statistic
LGDP	-2.26	-1.04
LMS	-3.2	-2.32
PRL	-2.53	-2.32
ΔLGDP	-4.44***	-6.62***
ΔLMS	6.53***	5.71***
ΔPRL	-5.6***	5.54***

Source: Researchers` estimation using E-views 9.0

Note:*** denotes rejection of null hypothesis at 1% and 5% level of significance respectively.

The result in Table 1 indicates that, all the variables are found not to be stationary at levels but stationary in their first difference at 1% level of significance. This obviously implies, we have rejected the null hypothesis that the individual series have unit root. We therefore, accept the series are integrated of order one (I(1)). This provides us with opportunity to test for the long run relationship between monetary supply, price level and output using Johansen cointegration test.

Table 2: The Johansen Co-integration Test Results

The cointegration test results are presented in Table 2 and 3. The result suggests there is long run relationship between monetary supply, price level and output in Nigeria as evident in the cointegration test using both t-statistic and the maximum eigen value where it was reported in Table 2 and 3 that there exist at least one co-integrating equation at 5% level of significance.

Table 2: Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.542189	79.36727	39.65832	0.0000
At most 1	0.534102	17.3602	19.3528	0.3201
At most 2	0.032316	0.56738	3.35110	0.7561

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

Table 3: Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.542189	67.52832	28.53729	0.0000
At most 1	0.534102	15.432663	14.26460	0.2341
At most 2	0.032316	0.423140	3.841466	0.7651

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Since it is possible to reject the null hypothesis of no cointegration on the basis of the result in Table 2 and 3, it suggests there is co-movement between monetary policy, price level and output. That is to say that if a set of variables are cointegrated, the effects of a shock to one variable spread to the others, possibly with time lags, so as to preserve a long run relationship between the variables.

Table 4: The Result of Long Run Vectors

LGDP	C	LMS	PRL
1.000000	12.34	0.215	-0.473
		(0.051)	(0.094)
		[4.220]	[-5.032]

Source: *Estimated output using E-views 9*

Looking at the numerical values of the long cointegration vectors in Table 4, the result suggests there is a positive relationship between money supply (MS) as proxy to monetary policy and output (GDP) a proxy to economic growth. In other words, this implies a 1 percent increase in money supply would have a positive effect on national output by at 0.22% in the long run.

With respect to price level (PRL) the result suggests a negative relationship between price level and national output in Nigeria. In the long run, this means as the price of commodities in Nigeria goes up by at least 1%, the nation output would be negatively affected by 0.5% in the long run.

The motivation behind the short run analysis is to examine how national output (GDP) responds to its own lagged value and the lagged value of money supply and price level in the short run. This is with the view to find whether the short run dynamics are influenced by the estimated long run equilibrium conditions, that is, the cointegration vectors.

Table 4: the Result of the Vector Error Correction Model

Estimates for Error Correction				
Variables	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
ECT	-0.015235	0.006438	-2.366418	0.0009
D(LGDP(-1))	0.637432	0.265210	2.403499	0.0005
D(LGDP(-2))	-0.042175	0.102352	-0.412058	0.6423
D(LMSS(-1))	-2.92E-24	4.65E-22	-3.541561	0.0002
D(LMSS(-2))	-7.61E-14	8.68E-13	-0.087623	0.9309
D(PRL(-1))	-0.365410	0.153672	-2.377856	0.0009
D(PRL(-2))	-0.087121	0.134539	0.621250	0.3574
Constant	-0.275765	0.054016	-5.105246	0.0000

R-squared	0.534902
Adjusted R-squared	0.502832
S.E. of regression	5.324032
Sum squared resid	3124.254
Log likelihood	-123.422
F-statistic	3.340043
Prob(F-statistic)	0.000021

Source: *Researchers` estimation using E-views 9.0*

The results in Table 4 suggest in the short run, the first lag of LGDP is positive and statistically significant at 1% level. This means national output of the immediate past year has a positive and significant influence of about 0.64% on current national output (LGDP). Although, a negative relationship between second lag of LGDP and national output is found, the effect is not significant. For money supply, the short run elasticity coefficient suggests an inverse relationship between money supply and national output. This implies money supply in the immediate past year has a negative and significant effect on economic growth. However, this is not the case for second lag of money supply on national output or economic growth as the effect is found not to be significant.

From Table 4, the error correction term is found to be correctly signed and significant. It represents the speed of adjustment from disequilibrium towards long run equilibrium defined in cointegration equation. The coefficient which is negative suggests speed of adjustment per annum year is 1.5%. The joint coefficient of significance (F- Statistics) shows that the variables are jointly significant in explaining outpu53 variations in Nigeria. The coefficient of determination of fitness of the model (R^2) has also shown that 65% of the variations are explained in the model.

CONCLUSIONAND RECOMMENDATIONS

This study has re-examined the relationship between money supply, price level and output in Nigeria through Johansen`s cointegration and vector error correction model. Evidence from the cointegration test suggests national output and its determinants i.e. money supply and price level are cointegrated. This implies that the variables are moving together in the long run. On one hand, the long run cointegrating vectors shows that the effect of both money supply on output, and price level on output are positive and statistically significant at 1 percent level. On the other hand, the short run elasticity coefficient suggests an inverse relationship between money supply and national output. This implies, money supply in the last year have significant negative effect on economic growth.

On the basis of these findings, the paper suggests in the short-run should treat monetary policies with caution and they should be tailored towards stimulating growth process in accordance with a given monetary objective. In the long run, the paper is of the opinion that when applying monetary policies to foster growth, monetary authorities should be careful at money supply because they can contribute to high inflation for the economy. This suggests the need for monetary authorities to implement credible policies that would greatly tamed the effect of inflationary pressure on the economy in the long run.

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