SEASONALITY OF ECONOMIC GROWTH: EFFECT OF PERIODIC MONEY SUPPLY IN NIGERIA

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ABSTRACT

This paper seeks to establish annually predictable changes in economic activities owing to periodic variation in the total stock of money available for circulation in Nigeria using quarterly money supply and gross domestic product extracted from the Central Bank of Nigeria statistical bulletin for thirteen years. The coefficient of determination and correlation matrix at lag 0 were used to determine the interaction between gross domestic product and money supply. The result reveals that the money supply in Nigeria is positively related to economic performance. The constant recurring pattern of crests and troughs in the time series plot of gross domestic product and the significant spikes at the seasonal lags of the autocorrelation function of gross domestic product establish the seasonality of economic growth. Augmented Dickey-Fuller tests indicate the presence of unit roots in the bivariate series. Consequently, appropriate transformations were carried out to ensure that the bivariate time series is stationary and that the univariate seasonal time series model justifiably fits the gross domestic product and confirms the seasonality of economic growth in Nigeria.

Keywords: *Correlation matrix, Model, Gross domestic product, Money supply and Seasonality***.**

INTRODUCTION

Several empirical statistical analyses and modelling of money supply and gross domestic product over time by researchers have revealed some specific relationships between the volume of money in circulation and the economic growth of Nigeria. Money supply (MS) positively impacts economic growth in Nigeria (Inam, 2014; Ogunmuyiwa and Ekone, 2017). *The broad money supply is associated with the economic growth of Nigeria (Akujuobi and Chikesie, 2022;* Omankhanlen *et al., 2022). Scholars have established a long-run relationship between MS and economic growth (*Galadima and Ngada, 2017; Gatawa et al., 2017; Odumusor, 2019; *Akujuobi and Chikesie, 2022;* Omankhanlen *et al., 2022).* Although *Akujuobi and Chikesie (2022) revealed the positive impact of MS on economic growth in the short run,* Galadima and Ngada (2017) and Odumusor (2019) observed no interaction between MS and economic growth in the short run. Hussain and Haque (2017) observed the relationship between money supply and Bangladesh's per capita growth rate. None of them has established the seasonality of economic growth due to periodic alteration of money available in circulation in the Nigerian economy, which this paper seeks to establish.

This paper is further organized as follows: Section 2 covers the methodology. Data analysis and results are captured in Section 3, section 4 discusses the findings, while Section 5 concludes the study.

METHODOLOGY

Simple linear regression analysis, correlation matrix of the bivariate time series and three-stage iterative procedures proposed by Box *et al.* (2016) will be used in the empirical analyses of GDP and MS in Nigeria.

THE MODEL

Seasonal Autoregressive Integrated Moving Average (SARIMA) Process Seasonal time series with period s are observations that are s interval (Box *et al*, 2016). According to Brockwell and Davis (2002), If d and D are positive integers, then

$\{R_t\}$ is a seasonal ARIMA $(p, d, q) \times (P, D, Q)_S$ process with period s if the differenced series $Z_t = (1-B)^d(1-B^s)^D R_t$ is causal ARMA process defined by

$$\zeta(B)\xi(B^S)Y_t = \lambda(B)\Lambda(B^S)\nu_t \qquad (1)$$

where $\{\nu_t\} \sim \mathrm{WN}(0, \sigma^2)$,

$\varsigma(B) = 1 - \varsigma_1 B - \ldots - \varsigma_p B^p$

$\lambda(B) = 1 + \lambda_1 B + \lambda_2 B^2 + \ldots + \lambda_q B^q$

$\xi(B^S) = (1 - \xi_1 B^S - \xi_2 B^{2S} - \cdots - \xi_P B^{PS})$

$\Lambda(B^S) = (1 + \Lambda_1 B^S + \Lambda_2 B^{2S} + \cdots + \Lambda_P B^{QS})$

$\{Z_t\}$ is causal if and only if $\zeta(B) \neq 0$ and $\Lambda(B^S) \neq 0$ for $|B| \leq 1$.

Identification of Seasonal Model

Seasonal models are identified by choosing suitable values for d, D, p, P, q and Q, the degrees of the polynomial operators in (1). The first step in identifying seasonal ARIMA (SARIMA) models for a possibly transformed data set is to find d and D so as to make the differenced observations $Z_t = (1-B)^d(1-B^s)^D R_t$ stationary in appearance. The next step is to examine the sample ACF and PACF of $\{Z_t\}$ at lags that are multiples of s for an indication of the orders P and Q in (1).

Coefficient of Determination (r^2)

r^2 is a summary measure that describes how well the sample regression line fits the data. It measures the percentage or proportion of the total variation in dependent variable explained by the independent variable.

Symbolically,

$$r^2 = 1 - \frac{RSS}{TSS} \qquad (2)$$

The coefficient of correlation $r = \pm\sqrt{r^2}$ measures the degree of association between two variables.

Where RSS is the residual sum of squares and TSS is the total sum of squares.

DATA ANALYSIS AND RESULTS

DATA

Quarterly MS and GDP in Nigeria drawn from Central Bank of Nigeria (CBN) for thirteen years are used for empirical illustrations.

Preliminary Analysis

Based on Table 1, $r^2 = 0.602735$ indicates that money supply explain about 60% of the variation in quarterly GDP. Also, $r = \rho_{12}(0) = 0.776350$ of the correlation matrix at lag 0 shown in Figure 1 reveals that MS and GDP are positively correlated.

Table 1: Ordinary Least Squares Estimation of Regression Parameters using GDP as Independent Variable

Parameter	Estimate	Standard Error	t-Ratio	P-Value
β_0	15352.5	391.432	39.2215	<0.00001
β_1	1.63348e-05	3.50587e-06	4.6593	0.00002

R-squared	0.602735

$$\begin{array}{c c} & \begin{array}{cc} \text{MS} & \text{GDP} \end{array} \\ \begin{array}{c} MS \\ \text{GDP} \end{array} & \begin{bmatrix} 1 & 0.776350 \\ 0.776350 & 1 \end{bmatrix} \end{array}$$

Figure 1: Correlation Matrix at Lag 0

The presence of constant upward recurring pattern of crests and troughs in the time series plot of GDP which is connected to quarters of the year shown in Figure 2 signifies seasonality and trend. Also, the presence of significant spikes at the seasonal lags of the correlogram shown in Figure 2 confirms the seasonality of economic growth.

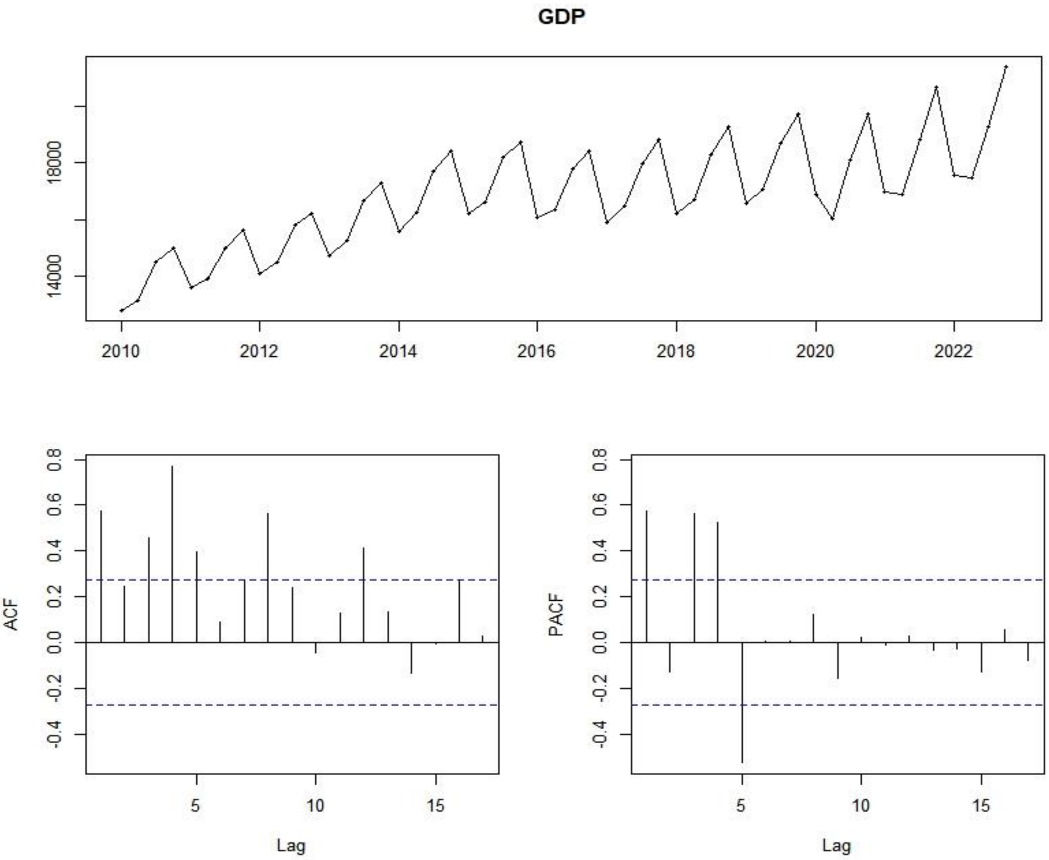

Figure 2: Time Series Plot, Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) of GDP.

The time series plot of money supply in Nigeria shown in Figure 3 indicates rising trend, while its ACF shows significant spike at lag 4.

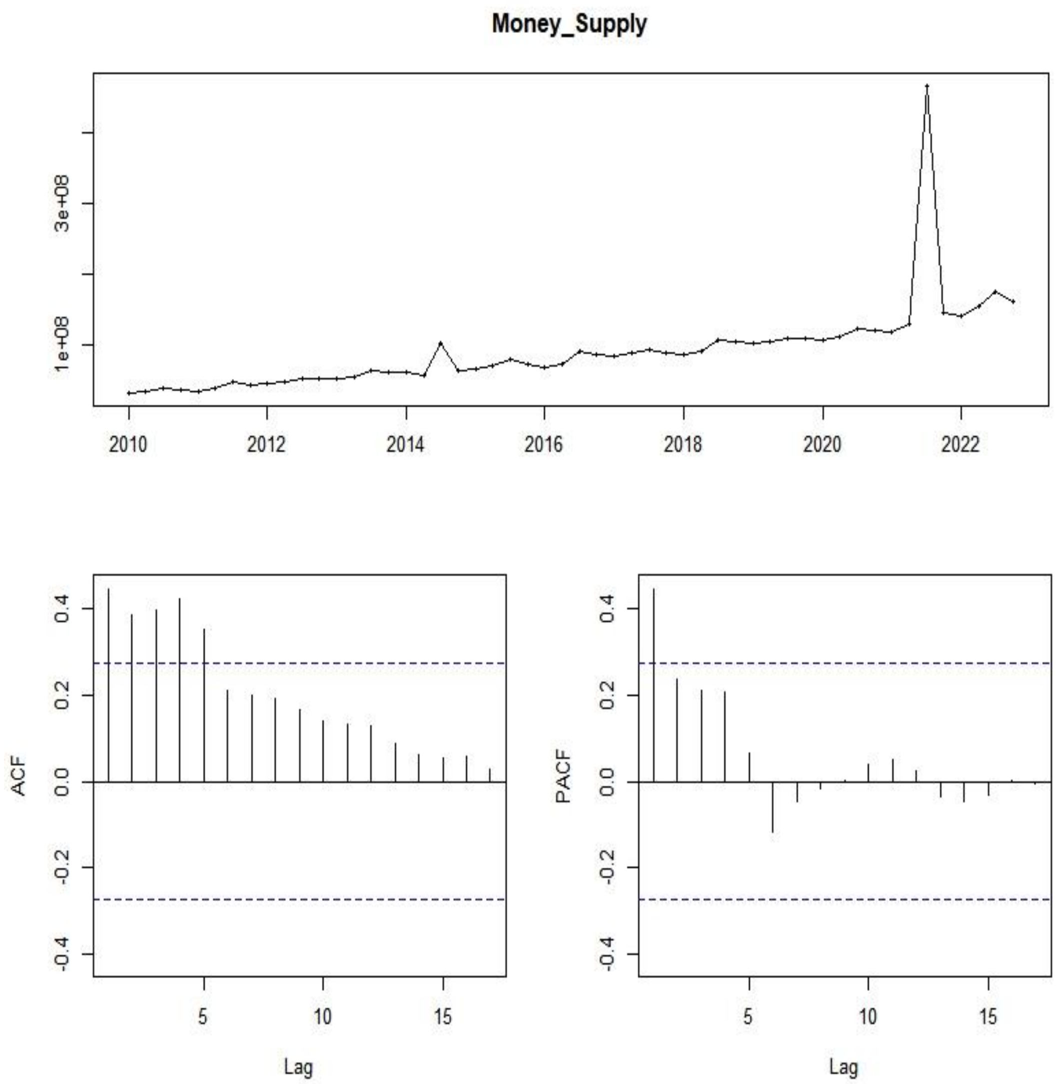

Figure 3: Time Series Plot, ACF and PACF of MS

Based on Table 2, augmented Dickey fuller (ADF) tests for the bivariate series indicate the presence of unit roots since the p-value$= 0.6268 > 0.05$ and p-value$= 0.09536 > 0.05$ for GDP and MS, respectively, but stationary by differencing since the p-values (0.01423 and 0.01 for differenced series of GDP and MS, respectively) < 0.05.

Table 2: The Outcomes of Augmented Dickey-Fuller Tests

Variable	Original series (Level)			Transformed series	
	Dickey Fuller Statistic	ρ- Value	Lag Length	Dickey Fuller Statistic	ρ- Value
GDP	-1.8698	0.6268	3	-4.0845,	0.01423
MS	-3.209	0.09536	3	-5.2913	< 0.01

Identification, Estimation and Diagnostic Checking of the Univariate Seasonal Models

Seasonal models are fitted to each of the univariate series based on the pattern of ACF and PACF of the transformed series. The parameter estimates of the univariate models are shown in Table 3. In accordance with Table 3, the Box-Pierce statistics for both $\text{SARIMA}(3,1,0)(1,1,0)_4$ and $\text{SARIMA}(1,1,0)(0,1,0)_4$ models indicate no lack of fit.

Table 3: Parameter Estimates of Seasonal Models

Variable	Model	Parameter	Estimate	Statistic: Box-Pierce Statistic	Statistic: RMSE	Statistic: Residuals' Standard Error
MS	SARIMA (3,1,0)(1,1,					
		ζ_1	-0.8895 (2.458e-15)			
		ζ_2	-0.8124 (1.472e-08)	0.080712 (0.7763)	47633971	8385029.6
		ζ_3	-0.6945 (8.477e-06)			

		Λ_1	-0.5507 (0.003185)			
		Drift	3158035 (0.020201)			
MS	ARIMA (1,1,0)(0,1,(	ϕ_1	).020329 0.8892)	.0001344 0.9908)	3931.3132	95167

The values in the parentheses are p-values of estimated parameters

DISCUSSION OF FINDINGS

Quarterly MS and GDP in Nigeria were obtained from CBN for thirteen years and used for empirical illustrations. The coefficient of determination that established a positive relationship between MS and GDP is not far from Inam's (2014) and Ogunmuyiwa and Ekone's (2017) work. A constant upward recurring pattern of crests and troughs in the time series plot of GDP signifies seasonality and trend. Also, significant spikes in the seasonal lags of the correlogram confirm the seasonality of economic growth. The time series plot of money supply in Nigeria indicates a rising trend, while its ACF shows a significant spike at lag 4. Augmented Dickey fuller (ADF) tests for the bivariate series indicate the presence of unit roots

since the p-value and p-value, respectively, became stationary after first differenced (p-values of differenced series of GDP and MS are 0.01423 and 0.01, respectively. Seasonal models were fitted to each univariate series based on the pattern of ACF and PACF of the transformed series, and the fitted models indicated no fit based on Box-Pierce statistics.

5 Conclusion

The volume of money in circulation affects Nigerian economic performance. Economic growth in Nigeria is seasonal, possibly due to other reasons, such as periodic alterations in the volume of money in circulation in Nigeria.

RECOMMENDATION

The Central Bank of Nigeria (CBN) should implement an excellent monetary policy to stimulate the Nigerian economy and increase economic growth.

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