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Inflation Forecasting in Nigeria: An Application of ARIMA Model

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Abstract

This study focused on time series analysis of the inflation rate in Nigeria from 1992 to 2020. Auto Regressive Integrated Moving Average (ARIMA) model was used in fitting the data sets and model (1,1,5) indicates the best optimal model for the data sets. The results of the study reveal that inflation in Nigeria is likely to decline based on the forecasted data. In order to address the problem of inflation in Nigeria, three main policy prescriptions such as proper monetary management, consideration of the supply-side policies such as Privatization, deregulation, unemployment; price instability; high importation and unfavourable balance of payment equilibrium, which negatively affect the level of economy growth and development have been suggested and are envisioned to assist policy makers in stabilizing the Nigerian economy. This paper forecasted a drop in inflation, if all the aforementioned parameters are kept in check. The ARIMA model used in fitting this economics data serves as one of the best model in describing economic data and therefore recommend the use of ARIMA econometric tools to government agents and all other stakeholders in charge of monetary management of Nigeria economy for proper prediction and forecast of the economy status at every point in time, as this will enhance proactive economic planning and implementation.it also recommends the use of the model for addressing other economic indicators which might have negative effect on economic growth and development.

Keywords: *Inflation, Forecasting, Policy, ARIMA*
JEL Classification: E44, E52, E31

1.0 Introduction

Inflation is known as a general increase in the level of price sustained over a long period in an economy; it is seen as a persistent rise in the price levels of commodities and services, leading to a fall in the currency's purchasing power. Inflation can be defined as the persistent and continuous rise in the general prices of commodities in an economy (Nyoni & Bonga, 2018). In today's world, the knowledge of what helps forecast inflation is important (Duncan & Martínez-García, 2019). Policy makers can get prior indication about possible future inflation through inflation forecasting (Nyoni, and Bonga 2018).

It is possible to attribute the high rate of inflation in Nigeria to factors such as low output growth rate, high prices of imported products, depreciation in the exchange rate, bad road networks to and from the ports for easy movement of both imported and exported goods to areas of need and probably external factors like crude oil price. Since, price stability is one of

the key objectives of monetary policy (Hadrat, Isaac & Eric, 2015), while another is to maintain a persistent economic growth along with low inflation (Islam, Ghani, Abidin, & Rayaiappanm 2017); it is up to the policymakers to be forward – looking. Good forecasting ability is germane to achieving price stability (Hadrat *et al*, 2015).

The history of high inflation rate in Nigeria could be traced to the Udoji Commission of 1974 that proposed an enhanced salary structure for civil servants, the so-called "Udoji Award"; without considering the aftermath, as well as, the unfortunate civil war of 1967 to 1970 (Green, 1975). Any adjustment policy that does not take into account the role of money and credit is likely to fall short of the overall goal of non-inflationary economic growth. During the Civil War, labour strikes were forbidden and increase in wages were restricted. Therefore, immediately after the War in 1970, the Udoji Commission was set up to look into the income structure in Nigeria. Since profit had been increasing at the expense of wages and, since one of the objectives of the government was economic 'equity'; then the Commission recommended an unprecedented wage increase for all workers in the country.

The magnitudes of the wage increases were very disturbing, since some wages actually doubled at a time that inflation was high. This, then, explained why the money supply had to be expanded so that the government could have money to pay for all these wage increases. However, the effect of the wage increase was to increase demand while output was not increasing as fast, and as a result led to an increase in inflation (Adamsons, 2000). Recent events such as the COVID-19 pandemic, Border closure and High level of insecurity has immensely contributed negatively to the social economic condition of Nigeria. The covid-19 pandemic is not left out in its negative effect on the social economic condition in the country, as it has led to income reduction of households coupled with hike in the prices of food and other basic needs. (Obayelu, Obayelu, Bolarinwa, & Oyeyinka, 2021). Various sectors of the economy experienced scarcity of hired labour that were required for the production processes, especially during the 2020 farming season. Low salary earners in the economy also suffered loss in income as a result of restriction in movement that emanated from international border closure, importation and exportation of goods and services were halted, hence there was persistent increase in the prices of goods and services. Insecurity, ranging from Banditry, insurgency, kidnapping, arm robbery and terrorism are also major contributors to high level of inflation in Nigeria as some sub factors of production such as traders, transporters, farmers have directly and indirectly shy away from their daily production due activities, as it involves high risk, this in turn leads to low productivity and investment resulting to high inflation in country.

Inflation has been one of the most persistent economic challenges in the world, especially in developing countries (Jere & Siyanga, 2016). Nigeria has been facing this challenge for so many years now. The monetary authorities in Nigeria are confronting two challenges-maintaining stable inflation and ensuring high growth in the economy. As a result of the political upheaval characterized by intermittent political turmoil and economic crises since independence. Political life has been scarred by conflict along ethnic, geographical, and religious lines, and corruption and misrule have undermined the state's authority and

legitimacy. Nigeria's human development indicators are among the world's lowest, and a majority of the population faces extreme poverty. Years of social unrest, criminality, and corruption in the oil-producing Niger Delta have hindered oil production, delayed the southern region's economic development, perceived neglect and economic marginalization also fuel resentment in the predominately Muslim north. Thousands have been killed in periodic ethno-religious clashes in the country that have the potential to threaten both state and regional stability and thus affects global prices both internally and externally this in turn leads to high prices of commodities (agro and non- agro), the inflation rate surged to 57.16% in 1993. It further increased to 72.83% in 1995. However, in 1997, it reduced by 64.33% to 8.5% due to political stability in government and consistent stability in the rate of exchange which was officially ₦21.89 to $1.00 and ₦84.58 to a $1.00 in the parallel market, this remained same until 1999.There was no economic booms as businesses changed, higher price to cope with increase wages and other cost, the economy became cool and joblessness arose and this led to decline in inflation. it is one thing to declare that the naira is worth 22 naira to $1. It is quite another thing to be able to satisfy all the people who will demand to buy dollars at that price. Given that oil prices were below $20 a barrel in this period, there was a very limited amount of dollars available (whatever was left after those in charge had helped themselves).

Inflation remained on a single digit from 1997 to 2000. Having achieved single digit inflation, the Nigerian government and the monetary authority couldn't sustain the trend as inflation increased to 19% due to rise in exchange rate that geometrically increased to ₦109-₦113 officially and ₦122 -₦140 parallel market in 2002, and as a result of increase in oil price in the global market, leading to government fiscal recklessness that resulted in deficit financing can also cause an increase in inflation as it contradicts the fundamental monetary policy objective of price stability. Between 2003 and 2009, the inflation rate averaged 11.42%. The country recorded its lowest inflation rate (5.38%) in 2007 as a result of the appreciating value of the naira over the dollar coupled with the policy formation and implementation by the government of the day championed by late president Musa Shehu Yara'dua. The political status of the country was stable as the various economic units started building confidence on the democratic train and in turn yield positive productivity in both domestic and foreign alike as foreign investment was boosted, this cut down the level of high importation.

The inflation rate was 8.47%, 8.05%, 9.01% and 15.69% in 2013, 2014, 2015 and 2016 respectively. As of December 2017, the inflation rate had dropped to 15.37% (National Bureau of Statistics, 2018). History of inflation in Nigeria is filled with its own ups and downs. For example, in the middle of 1970s when there was oil boom in the economy, the rate of inflation went out of its way. The military government of that time did not help matters with its inflationary policies such as the Udoji awards that unnecessarily put money in the pockets of civil servants.

The short-spanned military government of Buhari tried to bring the rate of inflation down after the excesses of civilian administration of Shagari. But, the later introduction of Structural Adjustment Program (SAP) by Babangida, despite its much-popularized potential benefits left the macroeconomic environment destabilized. Despite the apparent economic benefits of return

to democracy in 1999, the rate of inflation in much of this period has remained high, further undermining government efforts to entrench macroeconomic stability. The debt reduction policies of Obasanjo from 1999-2007 have to some extent help to reduce the hike in the inflation rate. But, Obasanjo's poor budgetary discipline did not help matters. Corruption and depreciation of infrastructures throughout this period have seriously undermined efforts by few of his cabinet members to restore macroeconomic stability.

One noticeable weakness of the immediate past regime of President Jonathan is its inability to maintain fiscal discipline and bring down current increase in national debt, several factors lead to an increase in government's expenditures, such as different forms of military expenses, not keeping up with revenues growth of expenditures for several reasons such as tax evasion, financial and administrative corruption. Other reasons include incapability of collecting government's funds from different agencies that are bound to repayments, over dependent of government on importation and reduction in exportation have negative effect on trade equilibrium and budget of the government. One other factor is long term- loans that carry interests that lead to draining the country's economic capabilities. Already the habitual resort to domestic borrowing by President Jonathan's regime helped in crowding out private sector borrowing and made cost of borrowing high due to the resulting increase in the interest rate in the economy.

The year (2021) budget is the biggest in the history of this country. Most of the revenues for financing the budget come through borrowing, further putting pressure on the inflation rate. Federal government has made 2021 budget look like budget of country in war. What was experienced during the Second World War when Keynesian expansionary policies were adopted by European governments was persistent high rise and uncontrollable inflation (Blinder, 2008). But, Nigeria is not in war. Therefore, this inflationary budget is not justifiable.

Currently, there is a motion in the Nigeria national assembly to cut the powers of the Central Bank and with it, reduce its independence. Already, there are warning voices coming from the IMF and the past governor of the apex bank, Charles Soludo. They warned that removing CBN autonomy would affect the bank's ability to perform its monetary functions and seriously affect the performance of the economy. One wonders what the national assembly wants to achieve with this agenda. Are they envious of the Central Bank Governor current independence, unlike other government institutions where the national assembly interferes with their functions as they like? Because of the independence of the apex bank, both the executive and legislative arms of the government cannot unnecessarily summon the apex bank governor and ask him why he does what he does, unlike say the Chief of Army Staff or the Inspector General of Police, who does not enjoy such immunity.

The history of Central Bank monetary independence did not start with Nigeria, it started elsewhere around the world when rate of inflation seemed uncontrollable and politicians were tempering with it in order to achieve electoral victories. Today, most of the central banks in the world enjoy independence in terms of monetary policies implementation, including the Federal reserve of the US and the Bank of England. It will be of great benefit to the country (Nigeria) if those at the helm of affairs can leave the apex bank alone to carry out its duties efficiently

and effectively so that their personal interest and envy will not affect the longer-term prospects of our great economy. No nation can develop when her policy makers and others that matter cannot separate their personal interest from what their professional ethics demand.

The prime position held by apex bank governors and how they are respected in society is not unique to Nigeria; the same obtains in other countries of the world. Inflation is one of the problematic macroeconomic variables that occupy a central place in the management of most economies. This is so because it is mostly used as one of the indicators of the performance of a country's economy. Policy inconsistencies have often made it difficult for some policy makers to achieve the targeted rates of inflation in their countries, thus allowing the living standards at the devastating whims of inflation. Nigeria is one of the countries whose economy has suffered the devastating effects of high inflation. Accordingly, inflation is a problem because it lowers incomes, discourages saving, makes productive inputs more expensive and may act as disincentive to hard work, thereby leading to sub-optimal per person real output growth or economic development (Kyereme, 2004).

Maintaining a reasonable degree of price stability and ensuring an adequate expansion of credit to foster steady and sustainable economic growth have been the primary goals of monetary policy. A challenging problematic macroeconomic issue confronting nation states and monetary authorities today is tracking and predicting the movement in the general price level. Nigeria, like most developing countries, has had significant gaps between policy formulation, policy implementation and policy targets.

In most cases, policy goals lag behind targets and are often unattainable due primarily to the prevalence of policy inconsistencies driven by the inability of monetary authorities to predict inflation and its real determinants. Inflation is a major monetary policy performance indicator and is a useful indicator in informing the public about trends in the movement of leading and lagging macroeconomic indicators. The knowledge of these indicators drives inflationary expectation and therefore serves as a nominal anchor for bargaining process and fixed contracts (Rumler, Moser, and Scharler, 2004). Generally, a clear understanding of inflation forecasting techniques is crucial for the success of monetary policy in tracking the movement of macroeconomic aggregates and in maintaining stable and sustainable economic growth.

2.0 Literature Review

Datta and Mukhopadhyay (2011) projected that economic growth depends primarily on the rate of capital formation and the rate of capital formation depends on the rate of savings and investment. World economic growth and inflation rates have been fluctuating. Likewise, inflation rates have been on the dominating end when compared with economic growth rates in virtually many years (Madhukar & Nagarjuna, 2011) and relationship between inflation and economic growth continued to be one of the most challenging macroeconomic problems. Similarly, Ahmed (2010) maintain that this relationship has been argued in various economic literatures and these arguments show differences in relation with the condition of world economic order. In accordance with these policies, increases in the total demand caused increases in production and inflation too. However, inflation was not regarded as a problem in

that period; rather, it was considered as a positive impact on the economic growth which was widely accepted. Amid these views, Jayathileke and Rathnayake (2013) cited "Philips curve" being the first to hypothesize that high inflation positively affects the economic growth by lowering unemployment rates. Nigeria economy experienced many internal and external shocks. All sectors of the economy were affected by shocks, whose manifestations were, among others, large budget deficits and an imbalance between productive and non-productive activities. The signs closely associated with these were high rates of inflation, large balance of payments (BOP) deficits, declining domestic savings, growing government expenditure, falling produce and decreased utilization of industrial capacity which, in turn, hindered economic growth. There have been extensive theoretical and empirical researches to examine the relationship between inflation and economic growth in Nigeria and other countries.

The Nigeria economy has undergone fundamental structural changes over the last five decades. Evidence shows that the dramatic structural shifts that occur did not result in any appreciable and sustained economic growth and development. The economy exhibits negative growth rates which indicates depressed economic situation partly caused by the worldwide economic recession of the early 80s, and partly by over dependence of the Nigeria economy on oil proceeds and gross mismanagement of the economy by successive governments (Biobaku, 2004). Both at the empirical and theoretical levels, economists have differed in their analysis of the causes of inflation. As a result, their prescribed solutions for inflation have also differed. Specifically, the debate about the causes of inflation is generally between the monetarists and the structuralists. The monetarists hold the view that sustained money growth in excess of the growth of output produces inflation (Meltzer, 2002). Udoh, and Isiaiah, (2019) worked on predictive model for inflation in Nigeria using quarterly data spanning 1995 to 2016 and concluded that previous values of interest rate (IR) and money supply (MS) are significant in predicting future inflation rates in Nigeria. Musa and Maijama, (2021) investigated the causal association among domestic oil price, exchange rate and inflation rate for the sample period of 1985 to 2019 in Nigeria.

They recommended that the country monetary policies should target both inflation and exchange rate alongside maintaining a stable petroleum pump price in order to curtail the high increase of inflation. Olasunkanmi and Oladipo, (2020) investigated factors (domestic and external) affecting inflation in Nigeria. It was noted that average fuel premium motor spirits (PMS) prices, total rainfall and any shocks to either food and core inflation or both has an instantaneous impact on the headline inflation with the external factor effect on fuel prices measured by bureau-de-change (BDC) Naira (N/$) exchange rate being significant.

3.0 Methodology

Autoregressive Integrated Moving Average (ARIMA) is a trendy method to analyze stationary univariate time series data. There are generally three main stages to build an ARIMA model, with model identification, model estimation and model checking, of which model classification is the most crucial stage in building ARIMA models. Thus, the survey provides an insight into the various time series prediction and forecasting models with reference to ARIMA. Also, a lot of real-world applications conducted by various authors were studied and it has come to prove

that ARIMA is a real-world tool for time series prediction, forecasting and analysis with accuracy. Common models for time series data, can have many forms and stand for different stochastic processes. There are two commonly used linear time series models in literature, viz. Autoregressive (AR) and Moving Average (MA) models. Combining these two, the Autoregressive Moving Average (ARMA) and Auto Regressive Integrated Moving Average (ARIMA) models have been proposed in literature. The Autoregressive Fractionally Integrated Moving Average (ARFIMA) model generalizes ARMA and ARIMA models. For seasonal time series forecasting, a variation of ARIMA, viz. the Seasonal Autoregressive Integrated Moving Average (SARIMA) model is used. ARIMA model and its different variations are based on the well-known Box-Jenkins principle and so these are also broadly known as the Box-Jenkins models. An ARIMA (p, q, d) model is a combination of AR (p), I (d) and MA (q) models and is suitable for univariate time series modelling. After describing different time series models, the next issue of concern is how to select an appropriate model that can produce accurate forecast based on explanation of historical pattern in the data and how to determine the optimal model instructions. Statisticians George Box and Gwilym Jenkins developed a realistic approach to build ARIMA model, which best fits to a given time series and also assures the parsimony principle. Their concept has fundamental importance on the area of time series analysis and forecasting. The Box-Jenkins methodology does not assume any particular pattern in the past data of the series to be forecasted. It uses a three-step iterative approach of model identification, parameter estimation and diagnostic checking to verify the best parsimonious model from a general class of ARIMA models. This three-step process is repeated more than a few times until a satisfactory model is finally selected. Then this model can be used for future forecasting values of the time series.

The mathematical formulation of the $ARIMA_{(p,d,q)}$ model is given below:

$$Y_t = (1-L)^d X_t \tag{1}$$

$$\left(1-\sum_{i=1}^{p}\varphi_i L^i\right)Y_t = \left(1+\sum_{i=1}^{q}\theta_j L^j\right)\varepsilon_t$$

$$\therefore Y_t = \delta + \varphi_1 y_{t-1} + \varphi_2 y_{t-2} + \ldots + \varphi_t y_{t-p} + \varepsilon_t - \theta_1\varepsilon_{t-1} - \theta_2\varepsilon_{t-2} - \theta_q\varepsilon_{t-q} \tag{2}$$

Where;

$\theta_1, \ldots, \theta_q = fixed\ constants\ of\ MA_{(q)}\ process$

$\varphi_1, \ldots, \varphi_q = fixed\ constants\ of\ AR_{(q)}\ process$

$L = lag\ operator$

$d = differencing$

In terms of structure, $ARIMA_{(p,d,q)}$ models are the same as $ARMA_{(p,q)}$ models where the time series as first been transformed by differencing.

3.1 Box-Jenkins ARIMA Model

In 1976, Box and Jenkins, give a methodology in time series analysis to find the best fit of time series to past values in order to make future forecasts.

The methodology consists of four steps:

i. Model identification.

ii. Estimation of model parameters.

iii. Diagnostic checking for the identified model appropriateness for modeling

iv. Application of the model (i.e. forecasting).

The most important analytical tools used with time series analysis and forecasting are the Autocorrelation Function (ACF) and the Partial Autocorrelation Function (PACF). They measure the statistical relationships between observations in a single data series. Using ACF gives big advantage of measuring the amount of linear dependence between observations in a time series that are separated by a lag k. The PACF plot is used to decide how many auto-regressive terms are necessary to expose one or more of the time lags where high correlations appear, seasonality of the series, trend either in the mean level or in the variance of the series (Pankratz, 1983). In order to identify the model (step 1), ACF and PACF have to be estimated. They are used not only to help guess the form of the model, but also to obtain approximate estimates of the parameters (Box, and Jenkins, and Reinsel, 1976).

As identifying a tentative model is completed, the next step is to estimate the parameters in the model (step 2) using maximum likelihood estimation. Finding the parameters that maximize the probability of observations is main goal of maximum likelihood.

The next is checking on the adequacy of the model for the series (step 3). The assumption in the residual is a white noise process and that the process is stationary and independent.

Model diagnostic checking is accomplished, in this work, through careful analysis of the residual series, the histogram of the residual, sample correlation and a diagnosis test (Ljung, and Box, 1978). Ljung-Box, Q-test, is used to check the assumptions of model residuals and could be written as:

$$Q = n(n+2)\sum_{k=1}^{h}\frac{r_k^2}{n-k} \tag{3}$$

Where:

h= the maximum lag being considered, n=the number of observations in the series and rk =the autocorrelation at lag k.

The statistic Q has a chi-square (χ^2) distribution with degrees of freedom (h-m) where m is the number of parameters in the model which has been fitted to the data, the chi square value has been compared with the tabulated values; in order to evaluate the valid model otherwise the model will be rejected.

For successful models, it should be noted that a model with the less number of variables gives the best forecasting results, i.e. for a time series having more than one successful ARIMA model, in this case it should be consider the model with less variables (number of AR and/or MA), this is achieved by using Akaike's Information Criterion (AIC) (Akaike, 1974), in order to select the best ARIMA model among successful models. The smallest value of AIC should be chosen.

Akaike's Information Criterion (AIC) and bayesian information criterion (BIC) may be written as:

$$AIC = -2\ \log_e(L) + 2(p + q + P + Q + C)$$

$$AIC = \ln(SSE) + \frac{2k}{n}$$

$$BIC = \ln(SSE) + \frac{k}{n}\ln(n)$$

Given that

$$SSE = \frac{\sigma_e^2}{n}\ and\ p = \frac{k}{n}$$

Then the Akaikes information criterion (AIC) and the Bayesian information criterion (BIC) can be written as:

$$AIC = n\ln\left(\frac{\sigma_e^2}{n}\right) + 2p$$

$$AIC = 2k - 2\ln L \tag{4}$$

$$BIC = n\ln\left(\frac{\sigma_e^2}{n}\right) + p + p\ln n$$

$$BIC = k\ln(n) - 2\ln L \tag{5}$$

Where:

L= Maximum likelihood, p= non-seasonal Autoregressive order,

q= non-seasonal Moving average order, P= seasonal Autoregressive order,

Q= seasonal Moving average order, C= constant of the model, n refers to the random sample size, p is the number of parameters in the model and σ_e^2 is the sum squared residuals.

4.0 Result, Finding, and Discussion

The plot of the original data shows a random order with the highest figure occurring in 1998, but has since been having a fluctuating occurrence. From the ACF (Autocorrelation function) and PACF (partial Autocorrelation function) there is a significant spike at lag 1 and lag 2 for the ACF while there is a significant spike at lag 1, lag 2 and lag 5 for the PACF. The model checking plots of ACF and PACF of the residual of ARIMA (1, 1, 5) and the Ljung- Box test on the residual of ARIMA (1, 1, 5) model performed shows there exists serial correlation in the residual. From the ACF and PACF plot of residual from ARIMA (1, 1, 5) model shows that all correlations are within the threshold limits indicating that the residuals are behaving like white noise. A Ljung-Box test returns a small p-value (0.6201), also suggesting that the model is adequate.

Table 1: Ljung-Box test on Residuals of ARIMA (1, 1, 5)

ARIMA	TEST STATISTIC	P-VALUE
(1, 1, 5)	1.3253	0.6201

Table 2: Model estimation and prediction

Model: ARIMA, using observations 1991-2018 (T = 28)
Dependent variable: (1-L) INFLATION
Standard errors based on Hessian

	Coefficient	*Std. Error*	*Z*	*p-value*	
Const	-0.864672	0.728929	-1.1862	0.23553	
phi_1	-0.530486	0.200318	-2.6482	0.00809	***
theta_1	0.961538	0.205075	4.6887	<0.00001	***
theta_2	-0.0221023	0.367928	-0.0601	0.95210	
theta_3	0.0221045	0.374252	0.0591	0.95290	
theta_4	-0.961536	0.384121	-2.5032	0.01231	**
theta_5	-0.999996	0.387276	-2.5821	0.00982	***
Mean dependent var	0.278571		S.D. dependent var		12.75976
Mean of innovations	1.284564		S.D. of innovations		7.452179
Log-likelihood	-101.6631		Akaike criterion		219.3262
Schwarz criterion	229.9839		Hannan-Quinn		222.5844

Table3

	Real	*Imaginary*	*Modulus*	*Frequency*
AR				
Root 1	-1.8851	0.0000	1.8851	0.5000
MA				

Root 1	-0.9960	0.0897	1.0000	0.4857
Root 2	-0.9960	-0.0897	1.0000	-0.4857
Root 3	1.0000	0.0000	1.0000	0.0000
Root 4	0.0152	-0.9999	1.0000	-0.2476
Root 5	0.0152	0.9999	1.0000	0.2476

Figure 4 shows the ACF (Autocorrelation function) and PACF (partial Autocorrelation function) the plot explains that there is no significant spike at the ACF and the PACF. This implies that the model is accurate and better for predicting the inflation of the country.

Figure 4: plot for original data and forecasted data

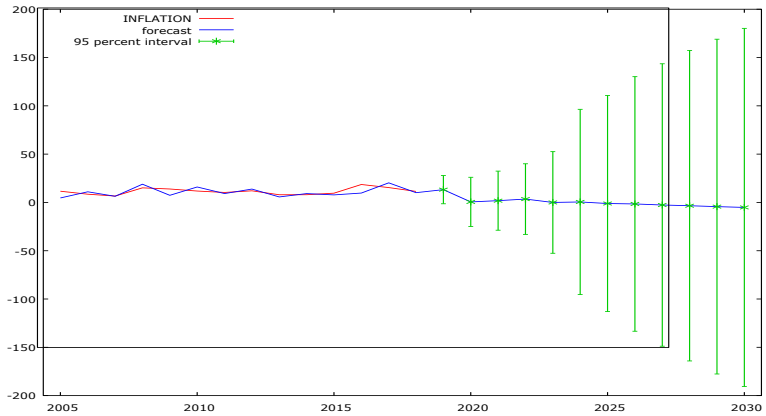

Table 4: Autocorrelation function (ACF) and Partial Autocorrelation function (PACF)

LAG	ACF	PACF	Q-stat.	[p-value]
1	0.1084	0.1084	0.3658	[0.545]
2	-0.0338	-0.0461	0.4028	[0.818]
3	-0.0324	-0.0239	0.4381	[0.932]
4	-0.0185	-0.0139	0.4500	[0.978]
5	-0.1372	-0.1378	1.1371	[0.951]
6	-0.0836	-0.0572	1.4042	[0.966]
7	-0.0294	-0.0271	1.4388	[0.984]
8	0.0082	-0.0004	1.4417	[0.994]
9	0.0798	0.0723	1.7231	[0.995]
10	-0.1346	-0.1779	2.5687	[0.990]
11	0.0905	0.1199	2.9731	[0.991]
12	-0.1573	-0.2220	4.2722	[0.978]

Source: Author(s') computation

Table 5: Predicted values for inflation

YEAR	PREDICTION
2021	13.22
2022	5.2
2023	1.81
2024	3.46
2025	-4.0
2026	4.9
2027	-1.12
2028	-1.59
2029	-2.66
2030	-3.41

Source: Author(s') computation

4.1 Discussion of Findings

Figure 1 shows the original time series plot for the observation. The result explains that there is a fluctuation in the rate of inflation. The plot also explains that inflation in the country has not been predicted as it shows no particular pattern of increase or decrease over the years. Figure 2 shows the ACF and PACF of inflation, in order to obtain linear predictability and to determine the model combination. Figure 3 shows the ACF and PACF without any significant spike and hence is used for predicting the inflation of the country. Figure 4 explains the prediction and forecasted data for inflation. The statistical measure of the ARIMA model shows that based on the data for inflation from (1992-2020), the ARIMA model (1, 1, 5) was seen to have a better fit and thus was used for prediction. This implies that the model (1, 1, 5) is the best and superior as it performed best among other models. Based on the Ljung- Box test on the residual of ARIMA (1, 1, 5) model to check if there exists a serial correlation in the residual. From the ACF and PACF plot of residual from ARIMA (1, 1, 5) model shows that all correlations are within the threshold limits indicating that the residuals are behaving like white noise. A Ljung-Box test result in Table 1 returns a large p-value (0.6201), also suggesting that the model is adequate. The estimated predicted values in Table 5 shows an irregular pattern with increase and decrease in the nature of the output projected, this indicates a reduced negative and drop in inflation by the year 2030.

5.0 Conclusion and Recommendations

The forecasts from the model suggests that ARIMA model may be efficient in forecasting or predicting inflation in Nigeria after the process has been set in motion as the predictions get closer to the observed values with increases in the horizon. However, given the long lag of the model (1,1,5), it can be stated that inflation within 2008 to 2010 has a long memory (history) because inflation within those period have no significant change and that it can take a period of 12 months to bring inflation to a stable state.

Considering the prediction and forecasted data for inflation as shown in figure 4, it is clearly observed that based on the data for inflation from (1992-2020), the ARIMA model (1, 1, 5) is best and superior among other models with reference to Ljung- Box test on residual of ARIMA (1, 1, 5) model, used to check the existence of serial correlation in the residual. It is also observed in this paper that the ACF and PACF plot of residual from ARIMA (1, 1, 5) model, all correlations are within the threshold limits, the value of p (0.6201) in figure 1makes the model adequate for inflation prediction and the irregular pattern with increase and decrease in the prediction value noticed in Table 5, indicates a rising fall in inflation by the year 2030 if proactively monitored. Nevertheless, an inflationary process must first be set in motion by a (some) variable(s) before past values can be used for forecasting. Again, given the current inflation and other information set (past inflation), future inflation is predictable. Thus, inflation as per our model can be likened to a martingale process.

Consequent upon the above findings and discussion, it could be recommended that: The government and all stake holders, managing the economic affairs of the country, should engage on proper monetary management through the use of ARIMA econometric tools in predicting and forecasting the state of the economy at a particular point in time, specifically in addressing the problem of inflation. The monetary authority (CBN) in the country could have well-meaning direction for the use of contractionary fiscal and monetary policies whereby there is a reduction of government spending and inflationary pressures in Nigeria for proper economic growth and development. Policy makers in the country could ensure effective consideration of the supply-side policies such Privatization and deregulation in order to improve long-term competitiveness, productivity and innovation that will in turn lower inflation. In addition, it is recommended that other researchers to make of the ARIMA model to address other economic indicators such as unemployment; price instability; high importation and unfavourable balance of payment equilibrium, which negatively affect the level of economy growth and development.

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