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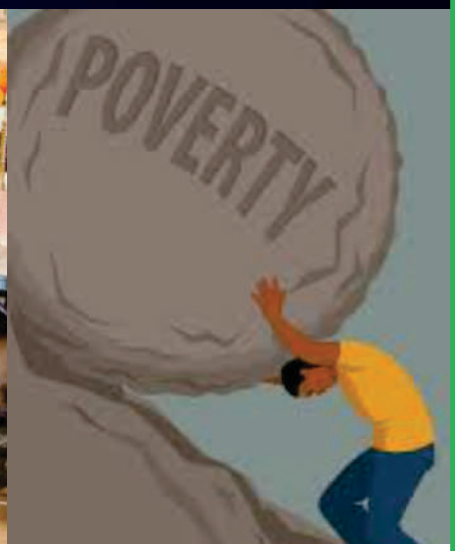

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CALL FOR ARTICLES IN THE BULLION THEMATIZED EDITION

The Editorial Board is pleased to announce that our third quarter 2023 Bullion will be a Thematized/Special edition. Consequently, we invite original articles of high quality on the Theme: Rising Global Inflation and the Nigerian Economy.

The Board has also outlined the following sub-themes as expected areas of concentration for authors:

a. Inflation and Cost of living crisis
b. Fiscal Policy and inflation
c. Inflation Pass-through Effects
d. Inflation Control measures: Effectiveness and Policy issues, etc.
e. Revisiting the exchange rate pass-through to domestic inflation in Nigeria
f. Does fluctuation in crude oil price induce inflation in Nigeria?
g. Imported food and Inflation in Nigeria: Is there a link?
h. Global food commodity price and Nigeria's food inflation.
i. Spill-over effects of rising global food and energy prices in Nigeria
j. supply chain disruptions and rising global inflation: Nigeria's experience
k. Nigeria's policy choices in the context of rising global inflation
l. Threshold Inflation effect and economic growth
m. Determinants of inflation and fiscal policy
n. Structural issues and inflation control measures
o. Revitalizing the real sector and inflation control

Please note that entries are not limited to the sub-themes above.

Structure

Papers should be compiled in the following order: title page; abstract; keywords; main text introduction, materials and methods, results, discussion; acknowledgments; declaration of interest statement; references; appendices (as appropriate); table(s) with caption(s) (on individual pages); figures; figure captions (as a list).

Please use British (-ise) spelling style consistently throughout your manuscript.

Use single quotation marks, except where 'a quotation is "within" a quotation'.

Note that long quotations should be indented without quotation marks.

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Kindly note that the plagiarism benchmark for this edition is 10%.

Please note that authors of selected articles will be entitled to an honorarium.

There are no submission fees, publication fees or page charges for this journal.

All entries should be submitted not later than May 31st, 2023.

All other requirements in the Guidelines for writing articles in Bullion apply

Assessment of Fuel Prices as Determinants of Inflation in Nigeria: A VECM Approach

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Abstract

This study examines the effect of petroleum price on the direction of inflation in Nigeria - whether or not movement in prices of other goods and services responds to increase in pump price of premium motor spirit (PMS) otherwise known as petrol in Nigeria. The study employs the Vector Error Correction Model (VECM) and Granger causality tests to estimate the long-run relationship between petrol price and inflation as well as direction of causality for the 1991-2021 period. Data for the study were sourced from the National Bureau of Statistics (NBS) and World Bank data indicators covering inflation, pump-price of premium motor spirit (PMS) and automotive gas oil (AGO) for the period under review. Findings of the study reveal that petroleum pump price has a significant positive relationship with inflation in Nigeria. The study recommends that the Nigerian authorities should consider a gradual step-by-step petrol subsidy removal as a policy tool to stem the tide of inflation resulting from incessant increases in the pump price of petrol.

1. Introduction

Inflation has been a topical economic issue in Nigeria for decades. The relationship between inflation and the wellbeing of the citizenry is reflected in the consumption of goods and services by the populace. Inflation is viewed as the persistent and continuous rise in general price level (Lim & Sek, 2015). Inflation occurs when the supply of money exceeds the quantity of good and services available for purchase. It also arises when government resorts to deficit financing for its fiscal activities.

This is because a government deficit budget may be financed through the central bank creation of additional money. The reduction in the standard of living due to high inflation reduces the purchasing power and impacts the low-income groups and further exacerbates inequality in the society (Asekunowo, 2016). Inflation also affects the wealth of the affluent and their capacity to invest and make appreciable capital gains. As a whole, the country suffers erosion of its Gross Domestic Products, which greatly affects the capacity for capital acreage.

Central Banks have the arduous tasks of maintaining a balance between economic growth through interest rates management and inflationary pressures. Prior to the 1980s, financial literature has tended to treat inflation as outside the influence of monetary policies of the Central Banks. According to Hetzel (2004), inflation derives from factors that are outside the purview of the monetary policy: investors' speculation resulting in investment expansion and government budget overspending lead to demand pull inflation; while cost-push inflation is a result of application of the dominance of commercial sector's power.

In addition, unforeseen forces of nature and government controls or limitations on oil exports by Organization of Petroleum Exporting Countries (OPEC) may lead to supply-shock inflation; while wage-price-spiral inflation arises from the

prospects inflation that are not connected to the monetary policy of the central banks. In financial literature, the theoretical underpinnings of the cause of inflation are anchored on well-known cost-push and demand-pull inflation hypotheses. However, the causes of the costs and demands vary according to each country. In Nigeria, consumer goods are transported through the roads by trucks and vehicles whose movements are directly influenced by the availability and the cost of fuel, that is, diesel and petrol.

Thus, transportation costs form a major part of the cost of production. These costs are reflected in the prices of wares or goods that are then passed on to the consumers by the merchants. Due to increase in petroleum product prices in the past, there have been rapid increase in transport fares as well as sharp increase in production costs, which has always led to increase in food prices (Gbadamosi et al., cited in Isaac, 2017).

These costs push prices up leading to inflation across board. Various studies have been done on the determinants of inflation in Nigeria using different variables such as interest rates, money supply, international oil price shock and others. However, studies on the role of fuel prices as the determinants of inflation in Nigeria have not been fully explored.

Given that the major goals of government in the modern economy are price stability and full employment and inflation is one of the important indicators of macroeconomic stability, it is imperative to look into the influence of fuel prices on inflation in Nigeria using vector error correction model.

2. Literature Review

2.1 Conceptual Literature

The concepts of inflation are as diverse as there are opinions on it. According to Reynolds (1979), various explanations of inflation confuse the symptoms for the causes. Increase in food prices are merely exhibiting sensitivity to excess demand and tend to rise during any period of inflation; interest rates rise as a premium factor in anticipation of impending inflation; while exchange rate decrease evinces contractionary policy and higher inflationary rates.

2.1.1 Consumer Price Index

According to the US Bureau of Statistics (USBS, 2020), Consumer Price Index (CPI) is the estimate of the average change in the prices of goods paid by urban consumers for a proxy of basket of consumer goods and services. The index estimates the rise of prices of goods and services from the perspective of the real daily condition of the people. It reflects the changes in the prices of goods and services that households expends which affect their real purchasing power and standard of living. CPI can be traced to the usage in the 1870s as Laspeyeres and Paasche indices, which was meant to off-set inflationary effect for fixed regular earners by prorating the wage rates for changes in the CPI, also referred to as indexation [International Labour Organisation, (ILO), 2004].

2.1.2 Imported Inflation

Imported inflation is a concept of transmitting inflation from a particular country to another. This happens as result of the international trade that happens between various countries of the world. Inflation is identified to be transmitted through price effects, which directly transmit inflation through import from the international markets under a fixed exchange regime. Also, it is effected through demand, where excess demand overflows from one country to the other. Imported inflation also occurs via liquidity effect, where the ineffective management of foreign exchange reserves increases money supply, hence an inflationary pressure in the economy. In the case of Nigeria, import is a veritable cause for domestic inflation (Awerbuch & Sauter, 2004).

High import dependent nature of the Nigerian economy portrays the contribution of imported inflation to the overall inflationary trend in Nigeria.

2.2 Theories of Inflation

2.2.1 The Demand Pull Inflation

Demand-pull inflation is caused by excess demand for goods. When demands outstrips supply of goods in an economy – aggregate supply is at full (or nearly full) employment level – especially an economy that has experienced a very high positive growth, it leads to excess money in the hands of the customer to purchase only few goods available, which invariably leads to increase in prices (Agba, 1994; Bakare; 2000, Hayes, n.d.).

The demand-pull inflation theory finds its proponent in the Keynesian school of thought. John Maynard Keynes (1883-1946) argued that increase in aggregate demand, which consist of household consumption; corporate investments; and public expenditure are the main cause of inflation. Certain socio-economic changes such as increase in population, rising income or increase in wages, changes in consumption pattern, positive net export and depreciation of local currency have been found to be correlated with inflationary pressure (Keynes, 2016). In effect, high inflation can be mitigated by policies aimed at suppressing the elements responsible for the increase in aggregate demand. Reduction in government fiscal deficit financing has been proposed as an efficient method of curbing inflation.

2.2.2 Cost–Push Theory of Inflation

Cost-push inflation arises as an effect of the push for wage increase by the unions in an economy has been found to cause inflation. In the 1950s and 1970s economists started to take critical look at the phenomenon of money wages rapidly rising than workers output (Kibritçioğlu, 2002). Agitations by the unions for employers to raise wages for workers leads to increase in cost of production, which producers effectively pass on to the consumers. Cost-push inflation can also be a result of few producers adjusting their prices to offset rising wages and cost of production in an imperfect competitive market. The theory was propounded by structuralists, post-Keynesians and neo-Marxists and disequilibrium economists. According to Humphrey (1998), cost-push inflation ascribed inflation to supply-side effects that altered the unit cost and profit margin components of the prices of individual products.

2.2.3 Modern Monetary Theory and Inflation

The modern monetary theory (MMT) postulated by Stephanie Kelton (1969) asserts that a sovereign country with control over its own money supply is not limited in its fiscal borrowing by the capital markets because the central bank can acquire government debts by printing money to pay for the debts. Further, the central bank impose zero-interest rate on debt instrument acquired in order to reduce the cost of government borrowing (Globerman, 2020). The theory proposes that negative consequences of public debt financing and printing of currency such as inflation, national insolvency and crowding-out effect are not a concern for a sovereign country (Forstater; Mosler cited in Prinz & Beck 2021).

2.2.4 Quantity Theory of Inflation

The quantity theory of inflation contends that the rate of inflation in an economy is determined by the changes in the volume of money in circulation. The theory has influenced the thoughts on inflationary discussions in the last century. The first clarity on the thought were presented by David Hume (1711-1776) and David Ricardo (1772-1823), both of whom illustrated how changes in money supply affect prices and quantity of goods produced. Ricardo opined that the influence of monetary changes on inflation is limited to short-run and become insignificant in the long run (Ricardo, 2009).

According to the line of thought, the British inflation during the Napoleonic Wars (during which Britain left the gold standard for paper standard) was a result of the reckless issuance of currency by the Bank of England. The traditional argument that infusion of money into circulation engenders employment and productivity was not considered by Ricardo (Totonchi, 2011). Latter contributors to the quantity theory of inflation,

Irvin Fisher (1976-1947) and Arthur Cecil Pigou (1877-1959) introduced new elements into the argument. Fisher's MV=PT equation correlated with the Cambridge cash balance equation in introducing quantitative techniques to determine that fractional central banking system could accomplish monetary authority through the control of the supply of money originating from external sources.

2.2.5 Monetary Theory of Inflation

Monetary theory of inflation holds that monetary policy is more powerful to stabilize the economy than fiscal policy. Monetary economics is attributed to the work of Milton Friedman (1912-2006) and Anna Schwartz (1915-2012) who opined that inadequate monetary policy of the Federal Reserve was instrumental to the Great Depression in the 1930s. Monetarists postulated that the best way to implement monetary policy is to target the growth rate of the money supply (Jahan & Papageorgiou, 2014). Hence, inflation is an event that occurs as a result of rapid increase in the aggregate money supply rather than total production.

2.3 Empirical Literature

Salim, Leng, Yusof, Yahya and Mamat (2021) investigated the factors that cause inflation in 10 Asian countries of Bangladesh, Hong Kong, India, Indonesia, Korea, Malaysia, Philippines, Sri Lanka, Thailand and Vietnam for 2006-2015. Variables for the model include consumer price index (CPI) as the dependent variable, while interest rate (IR), gross domestic product (GDP), money supply (MS) and public expenditure (PE) as independent variables. From the results of fixed effect panel regression tests, IR and MS show significant but negative relationship with inflation. The study concluded that MS is shown to be the main determinant of inflation in these ten countries.

Sakanko, Adejor and Adeniji (2021) assessed the influence of domestic pump price of petrol on CPI in Nigeria. The study employed nonlinear autoregressive distributive lag technique for estimation. Data for CPI (dependent variable) and premium motor spirit (PMS), automotive gas oil (AGO) and dual purpose kerosene (DPK) (independent variables) were collected for the period 1980-2020. Findings revealed that a long run equilibrium exists between CPI and the explanatory variables. The study concluded that there is an asymmetric relationship between the dependent variable and the independent variables. Ahamba, et al (2020) used autoregressive-distributed lag (ARDL) to assess the macroeconomic determinants of inflation in Nigeria for the period 1981-2017.

Inflation was the dependent variable in the study while gross domestic product, money supply, general government expenditure, imports of goods and services, exchange rate, wages, interest rate, pump price of premium motor spirit and unemployment rate were used as the explanatory variables. The study employed two inflation models based on the traditional "demand-pull" and "cost-push" theories respectively. The results of the test show that there is a long run relationship among the variables in the presence of structural break in the series. The short-run and long run results that the variables are significant determinants of inflation in Nigeria. Conclusively, the study revealed that both demand-pull and cost-push factors are determinants of inflation in Nigeria.

Babalola and Salau (2020) analysed the effect of petroleum pump price on consumer price index using time series data for 2000-2019 period. The research was aimed at finding empirical justification to remove or retain government subsidy on petroleum subsidy. It uses prices of petrol, kerosene and diesel to represent PPP while CPI represent inflation. The methods of estimation employed in the study include panel pooled regression/ARDL cointegration techniques.

The results of the study showed that the price of petrol has significant impact on consumer prices in the short-run. On the contrary, prices of kerosene

had a significant negative effect on consumer prices in the short-run, but positive in the long run. Conclusively, the study found that prices of petrol and diesel exert significant positive effects on the manufacturing sector.

Ogbebor, Oguntodu and Oyinloye (2020) employed time series data on inflation and human development index (HDI) to examine the relationship between inflation and poverty in Nigeria for the period 1998-2017. The results of the Auto Regressive Distributed Lagged (ARDL) tests revealed that a long run relationship exists between inflation and HDI; with a negative and significant relationship between the two variables.

Okoye, Olokoyo, Ezeji, Okoh and Evbuomwan (2019) used autoregressive distributed lagged (ARDL) technique to estimate the effect of external debt, exchange rate, fiscal deficits, money supply and economic growth on inflation in Nigeria. The study found that there is significant impact of the explanatory variables on the dependent variable. Conclusively, the study found that interest rate does not exert any significant impact on inflation in Nigeria.

Bawa, Abdullahi and Ibrahim (2016) studied the operational characteristics of inflation in Nigeria in the period 1981-2015 using consumer price index (CPI) as dependent variable, while explanatory variables such as average rainfall, money supply, oil prices and output gap serve as the independent variables. The study used bound test to determine the cointegration between the variables; the long run relationship was estimated using Auto Regressive Distributed Lag Model (ARDL) and the short-run equilibrium was determined by error correction model (ECM). The results of the study revealed that while CPI was stagnant, past inflation and average rainfall are seen to be the determinants of inflation in Nigeria.

Asekunowo (2016) studied the effect of inflation in Nigeria for the period 1974-2013. The study was aimed to ascertain both the traditional and institutional inflation factors that influence rises in price as well as the degree of each variable's contribution to inflation. The study employed ARDL bound test to determine the long run relationship between the variables. The results of the study showed that there exist long run relationships between the variables. Conclusively, the study found that inflation was as a result of transfer cost of import prices to domestic prices by companies in order to increase their profit margin.

Following the controversy over the proposal to introduce N5000 single denomination to the Nigerian economy, Otto and Ukpere (2016) assessed the determinants of inflation in Nigeria. The study evaluated thirteen variables; corruption, incidence of multiple taxation, productivity constraints, poor work ethics, inadequate social infrastructure, deficit financing by government, unplanned wage increases, inadequate storage facilities, import dependence, weak distribution mechanism, high cost of borrowing, extra economic factors and currency redenomination; to determine the influence each one has on inflationary pressure in Nigeria. It concluded that each of the variables affect inflation in varying degree.

Alexander, Andow and Danpome (2015) investigated the factors that decide inflation in Nigeria using data for the period between 1986-2011. The study employed VAR and Granger causality tests to estimate the relationship between rate of inflation as a dependent variable and fiscal deficits, exchange rates, import, money supply, lending rate as well as agricultural outputs as the explanatory variables. The result showed that there is a long-run equilibrium relationship between the rate of inflation and the exogenous variables.

Lim and Sek (2015) examined the determinants of inflation in 28 selected countries across Africa, Europe, the US, Australia and Latin America. The study sourced data from IMF database. The results of the Error Correction Model test using the

Autoregressive Distributed Lag (ARDL) revealed that GDP growth and imports have significant influence on inflation in low inflation countries, while money supply, national expenditure and GDP growth account for the determinants of inflation, with long run influence, in high inflation countries.

3. Research Methodology

The cost-push theory of inflation put forth by structuralists in the 1970s served as the basis for the model used in this study (Kibritçioğlu, 2002). According to this theory, an increase in production costs ultimately results in an increase in product prices; as a result, the price that marketers charge for liquefied goods is determined by the cost of getting them to final consumers. This suggests that inflation is a function of the general level of prices. Mathematically, the following can be said:

Inflation = *f*(general price level).....(3.1)

While the cost of production determines the overall price level. Also, mathematical, this relationship can be expressed as:

General price level = *f*(cost of production).....(3.2)

The study measured petrol prices using the pump price per litre of premium motorist spirit (PMS) and automotive gasoline oil (AGO) in an effort to evaluate the rise in petrol prices as a factor in inflation. The study uses a time series of secondary data that covered the thirty-one (31) year period from 1991 to 2021 and was derived from the National Bureau of Statistics (NBS) and World Bank data indicators, 2021. The following is a mathematical description of the study's model:

INF = f(PMS, AGO).....(3.3)

Statistically, it can be stated as:

$$\Delta LINFt = a_0 + \Sigma^{p}_{i=1}\, a_{1i}\, \Delta LINF_{t-i} + \Sigma^{q}_{i=1}\, a_{2i}\, \Delta LPMS_{t-1} + \Sigma^{q}_{i=1}\, a_{3i}\, \Delta LAGO_{t-1} + \lambda ECM_{t-1} + e_t \quad \text{.....(3.4)}$$

Where:

INF = Inflation rate
PMS = Premium motorist price
AGO = Automotive gasoline oil
ect = residual adjustment
β_0 = Intercept
β_1 - β_3 = coefficients of the estimates
ε = Stochastic error term

Descriptive statistics, Augmented Dickey-Fuller (ADF) and Phillip-Peron (PP), Johansen's cointegration, Vector Error correction (VECM) mechanism, and Granger causality were used to analyse the data and estimate the relationship in the model. Since ADF is a better method for analysing time series data, it was used to determine the stationarity of the time series. Due to the non-parametric nature of the ADF test, the 1988 Phillips-Perron unit root test was also used to avoid loss of observation. The Multicollinearity test, the Serial-correlation test, and the Heteroscedasticity test were used to gauge the model's fitness.

4. Results and Discussion of Findings

Table 1: Summary Statistics

	INF	PMS	AGO
Mean	18.40588	0.863793	0.528966
Median	12.87658	0.920000	0.640000
Maximum	72.83550	1.140000	1.130000
Minimum	5.388008	0.430000	0.010000
Std. Dev.	16.51682	0.218557	0.374360
Skewness	2.127815	-0.465951	0.006880
Kurtosis	6.423410	2.066499	1.743505
Jarque -Bera	38.53059	2.102339	1.907922
Probability	0.000000	0.349529	0.385212

Source: Authors Computation (2022)

Table 1 indicates that the mean is greater than the standard deviation for all the variables, which indicates that the data point tends to be closer to the mean of each variable. The maximum and minimum of the variables indicate that INF (inflation rate) and AGO (the price of automotive gas oil) are widely dispersed while PMS (the price of premium motorist spirit) is narrowly dispersed. The skewness indicates that INF and AGO are

positively skewed while PMS is negatively skewed. While the kurtosis indicates that INF is leptokurtic (6.4 > 3), PMS and AGO are platykurtic (2.1, 1.7, < 3) ceteris paribus. The Jarque-Bera probability indicates that INF does not follow a normal distribution (0.00<0.05) while PMS and AGO are normally distributed (0.34, 0.38, > 0.05).

Table 2: Stationarity Test

Variable	Unit Root Statistics				Prob. Value				Integration Order	
	ADF		PP		ADF		PP		ADF	PP
	Levels	1st Diff	Levels	1st Diff	Levels	1st Diff	Levels	1st Diff		
INF	-2.5235	-5.3620	-2.7917	-7.9381	0.3154	0.0008 ***	0.2109	0.0000 ***	I(1)	I(1)
PMS	-0.6774	-4.0956	-0.6145	-4.8689	0.9644	0.0210 **	0.9693	0.0038 ***	I(1)	I(1)
AGO	-0.1678	-0.2345	0.1733	-12.640	0.9903	0.0002 ***	0.9902	0.0000 ***	I(1)	I(1)

Notes: (*)Significant at the 10%; (**)Significant at the 5%; (***) Significant at the 1%.

Source: Authors' Computation (2022)

Table 2 lists the results of unit root tests carried out using the variables' differenced values at both the level and the first differences of the lag series using Akaike Information Criterion (AIC) automated lag selection. All the variables are stationary at first difference 1(1). This is the necessary condition for the use of vector error correction model.

Table 3: Optimal Lag Selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	13.44610	NA	8.09e -05	-0.908357	-0.760249	-0.871108
1	59.79900	76.58305*	3.18e -06*	-4.156435*	-3.564003*	-4.007440*
2	64.03953	5.899869	5.05e -06	-3.742568	-2.705812	-3.481827

Source: Authors' Computation (2022)

The recommended lags by the various information criteriia are presented in table 3. All the information criteria recommended lag 1 as the preferred lag for the model; hence, the study adopts lag 1 for the estimations.

Table 4: Cointegration Test

Hypothesized No of CE(s)	Trace Statistic	Critical Value (5%)	Max -Eigen Statistics	Critical Value (5%)
None*	53.04669	29.79707	41.23776	21.13162
At most 1	11.80893	15.49471	11.74136	14.26460
At most 2	0.067573	3.841466	0.067573	3.841466
Normalized cointegrating coefficients (standard error in parentheses)				
LINF	LPMS		LAGO	
1.000000	0.461268		-0.095957	
	(0.10258)		(0.04648)	

Source: Authors' Computation (2022)

Table 4 presents the Johansen cointegration test result and the normalized cointegrating coefficients. The trace statistics and max-eigen statistics indicate that there is at least one cointegrating equation among the variables. Specifically, the 5% critical value is less than both the trace and max-eigen statistics; the trace statistics coefficient of 53.04669 is greater than 29.79707 while the max-eigen coefficient of 41.23776 is greater than 21.13162.

Thus, confirming that there is a cointegrating equation between the variables. Further, the normalized cointegrating coefficients indicate that PMS has a negative effect on INF in the long run, indicating that an increase in PMS, in the long run, will cause a decrease in the INF; while AGO expresses a positive effect on INF in the long run, indicating that an increase AGO will cause INF to increase in the long run.

Hence, the null hypothesis that there is no cointegration among the variables is rejected in place of the alternative.

Table 5: VECM Result

Variables	Coefficient	Standard Error	T-statistics
D(PMS(-1))	0.900656	0.44680	2.01580
D(AGO(-1))	0.059111	017599	0.33588
ECT_{t-1}	-0.737167	0.21573	-3.42637
C	0.031161	0.02822	1.10442
R^2 = 0.704681; Adj R^2 = 0.545663.			

Source: Authors' Computation (2022)

Table 5 presents the VECM result for the study. The ECT having a negative coefficient and a t-stat value of -3.42637 indicate a significant short-run relationship in the model. Based on the coefficient of the ECT, the previous year deviation is corrected in the current at an adjustment speed of 73.7%. Further the short-run individual relationship indicates that PMS has a significant positive effect on INF, which connotes that a unit increase in PMS will cause INF to increase by 0.900656; while AGO has an insignificant positive effect on INF, which indicates that AGO does not affect INF in the short-run. Also, the value R^2 (R-square) which is 0.705 is a sign that 70.5% of the changes in INF in attributed or explained by the pump prices of premium motorist spirit and pump price of automotive gasoline oil.

Table 6: Granger Causality Test

Null Hypothesis:	Obs	F-Statistic	Prob.
LPMS does not Granger Cause LINF	26	0.04778	0.8289
LINF does not Granger Cause LPMS		0.48846	0.4916
LAGO does not Granger Cause LINF	26	5.14044	0.0331
LINF does not Granger Cause LAGO		0.39353	0.5366
LAGO does not Granger Cause LPMS	26	0.27678	0.6039
LPMS does not Granger Cause LAGO		0.05734	0.8129

Source: Authors' Computation (2022)

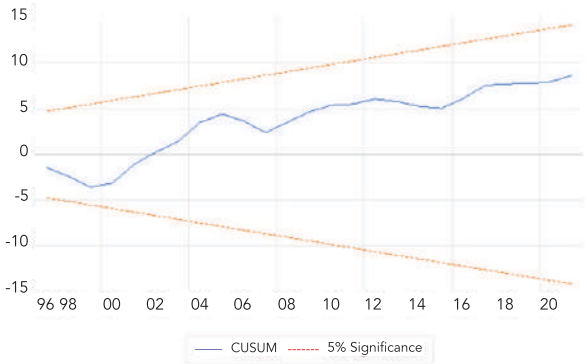
The result of the causality relationship among the variables is presented in table 6. Based on the result; PMS and INF share a bidirectional causal relationship; AGO and INF share a unidirectional relationship, AGO granger causes INF; also, while the causal relationship between AGO and PMS indicates that there is no causal relationship between them, suggesting that AGO does not granger cause PMS and PMS does not granger cause AGO.

Table 7: Diagnostic Tests

Tests	Probability
Serial -Correlation	0.0630
Heteroscedasticity	0.1014
Normality	0.470572
Multicollinearity	1.001188 (Mean VIF)

Source: Authors' Computation (2022)

Figure 1: Stability Test



Source: Authors' Computation (2022)

Table 7 presents the diagnostics tests. Based on the serial-correlation test with a probability test of 0.0630, there is no serial correlation in the model at 5 per cent significance level. Similarly, the heteroscedasticity test indicates that the model is homoscedastic with a probability value of 0.1014. Further, the residuals follow a normal distribution

with a probability value of 0.4. Moreso, the multicollinearity test indicates that the explanatory variables are independent of each other with a mean VIF of 1.01188. Finally, Figure 1 indicates the stability test for using CUSUM test. From the figure the CUSUM line did not stray out of the 5% significance level, which indicates that the model is stable. The model is fit and the explanatory variables are fit to be regressed on the dependent variable.

The findings of the study indicate that the pump price of PMS has a positive and significant effect on inflation, which signifies that an increase in the pump price of PMS will incite the rate of inflation in the economy. This supports the study of Babalola and Salau (2020), which found that the price of PMS has a positive and significant effect on inflation. This outcome can be linked to the cost-push theory which indicates that an increase in the cost of production will lead to an increase in the price of products (in the instance, the pump price of PMS); similarly, a sense of increment in the prices of the PMS triggers speculation that leads to stockpiling and hoarding of the products by the retailers in the downstream as well as the end users, which itself leads to demand-pull inflation. However, the pump price of AGO has a negative but insignificant effect on the inflation rate. This signifies that the pump price of AGO does not exert any effect on inflation rate in Nigeria in the period under study.

5. Conclusion and Recommendations

This study assesses fuel prices as determinants of inflation in Nigeria. In particular, the study analyses the effects of petroleum products price increase on the rate of inflation. Based on the results of vector error correction model of regression analysis, the study shows that the pump price of premium motor spirits has a positive and significant effect on inflation rate in Nigeria, while the pump price of automotive gasoline oil (otherwise known as diesel) has a negative and insignificant effect on the inflation rate in Nigeria. The coefficient of determination (R^2) shows that the explanatory power of the independent variables is very high in the short run with a coefficient of 0.704681, which implies that 70.5 percent of the variation in inflation rate is caused by the selected fuel prices. Also, the diagnostics test conducted proves that the model is robust with the model passing all the tests conducted to check its compliance with assumptions of error term.

The study concludes that fuel prices are determinants of inflation in Nigeria. This could be attributed to the various attempts at removing government subsidy payments on premium motor spirit that has been a major expenditure item of government and exacerbates budget deficit. In addition, the insignificant negative effect of diesel prices on inflation could be ascribed to the moderate consumption of the product, relative to the aggregate fuel consumption in the country, as well as the consequence of total removal of government subsidy, which allows for variations in the price to be systematically factored into the prices of goods and services without any shock.

The study recommends that the Nigerian authorities should consider a gradual step-by-step petrol subsidy removal as a policy tool to stem the tide of incessant increases in the pump price of petrol. This would prevent speculation and hoarding of the products by retail marketers and as a result combat the exploitative increase in the prices of petrol in the economy to avoid the rising level of prices of goods and services.

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Big Data Analytics, AI and Machine Learning For Central Banks: What it Portends For Emerging Economies in Africa

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Abstract

In order to evaluate the status of the economy, policymakers and the private sector have relied on statistics produced by official statistical institutes for decades. These data must be gathered with great effort, and publishing frequently takes months or years to complete. However, both the amount of data that is readily available and the tools and software used to analyse it have grown dramatically over the past few years. These changes have increased interest in big data and machine learning among central banks.
The application of big data and machine learning in central banking is examined in this study. The bulk of central banks hold formal discussions about big data within their organisations. In many fields, such as research, monetary policy, and financial stability, big data and machine learning applications are used. Furthermore, central banks report leveraging big data for regulation and monitoring (suptech and regtech applications). The legal uncertainty around data privacy and confidentiality is a major concern for central banks, as are issues with data quality, sampling, and representativeness. Several institutions report difficulties in building the necessary IT infrastructure and human capacity. Collaboration between government entities could improve central banks' capacity to gather, store, and analyse massive data.

Keywords- Artificial Intelligence, Machine Learning, Big Data, Public Policy

1.0 INTRODUCTION

New web-based services that impact every aspect of modern economic and financial activities have been made possible by information and internet technologies. This generates large amounts of "big data," which is defined as "the massive volume of data that is generated by the increasing usage of digital tools and information systems." These data are generated in real time, in a variety of formats, and by several organisations and people. For their part, central banks are dealing with an increase in "financial big data sets," which are the consequence of a combination of new, quickly emerging electronic footprints and substantial, expanding financial, administrative, and commercial records.

This situation offers more full, immediate, and detailed information as a supplement to "conventional" macroeconomics factors, which has the potential to boost analysis for decision-making. A variety of methods, frequently referred to as "big data analytics" and "machine intelligence," are being developed to this purpose (AI). When compared to standard statistical procedures and analysis, these promise quicker, more comprehensive, and more integrated insights. To investigate these concerns, a growing amount of central banks have started specific big data programs.

• It's not easy for policymakers to maximise the benefits of these recent changes. Like other public agencies, central banks encounter a number of difficulties, particularly when handling and utilising this new data for policymaking. Large and complicated data sets in particular frequently need enormous resources, yet the returns on such expenditures are not always obvious. How much should complex procedures be employed, for instance, to handle this kind of information? What advantages do these methods have over more established ones, and how should the outcomes be interpreted? How can the accompanying insights be shared with the public and

incorporated into the current decision-making processes? Finally, what are the most effective tactics for central banks looking to fully utilize the new big data information and analytical capabilities, especially taking resource limitations and other objectives into consideration? The chance to reflect on the many big data pilots carried out by the central bank community as well as the expanding application of big data analytics and related AI approaches to support public policy proved to be a worthwhile one. The following interesting details were emphasised:

• In addition to more conventional sorts of statistics, big data provides additional types of data sources. These sources include Google searches, online displays of home and consumer prices, and mood and expectation indications from economic agents (eg social media).

• Because of advancements in IT, new techniques are now accessible for gathering data (such as web scraping), processing text data (such as text mining), matching data sources (such as fuzzy matching), extracting pertinent information (such as machine learning), and interacting or showing key metrics (eg interactive dashboards).

• Big data tools, such as decision trees, may offer particularly insightful insights into how economic agents make decisions, such as how investors act in the financial markets. Another illustration would be the use of economic instability indicators gleaned from news items to explain changes in macroeconomic indicators. This demonstrates how big data may offer insights into both what really occurred and prospective future events as well as their causes.

• These fresh perspectives can then help central banks with their policies in a variety of areas, including market information (such as credit risk analysis), economic forecasting (such as nowcasting), evaluations of financial stability (such as network analysis), and external communication (such as measuring agents' perceptions). It's intriguing that the method can be quite specific, aiding in the targeting of particular markets, institutions, instruments, and places (like zip codes), as well as, in particular, supporting macro-prudential policies. Furthermore, big data indicators are frequently more current than "conventional" statistics; for instance, labor indicators can be drawn practically instantly from online job postings.

• As a word of warning, central bank pilot project feedback frequently emphasises the intricate privacy implications of working with big data, as well as the related reputational dangers. Furthermore, although big data applications like machine learning algorithms might do exceptionally well in terms of prediction, they can be more useful for describing what is happening than for understanding why. As a result, when these insights are employed to support policy decisions, they may be subject to public criticism.

• Big data samples are frequently not representative (for example, hardly everyone uses Facebook, and even fewer use Twitter), therefore they might not be as trustworthy as they first appear. Finally, there is a chance that privacy rules or shifting market participants will make it more difficult to collect and manage massive data. It is important for relevant authorities to work together so they can take use of big data analytics without jeopardising the privacy and confidentiality of user data.

The connected presentations, to which this article and the introduction both make reference, examined various elements of the central bank's use of big data and related methods. They address three key areas.

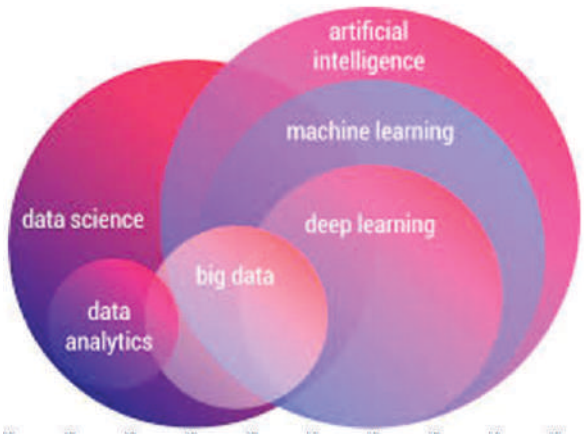
1. A review of the primary big data sources and related analytical methods that are applicable to central banks.
2. The benefits of big data for economic policy, with a summary of specific central bank initiatives to enhance statistical data, macroeconomic research and forecasting, financial market surveillance, and financial risk

assessment.

3. The application of big data to the development of central bank policy, including organisational elements and associated difficulties.

2.0 Literature Review

Big data has been dubbed by some as the new oil of the twenty-first century, and policymakers shouldn't pass up the potential it offers (The Economist, 2017). Big data sets are not typically produced by public organisations, and some of this data may not be very useful to them in their day-to-day operations. But "financial big data" sources are something that central banks are having to deal with more and more as they conduct a variety of operations. Thanks to "big data analytics," which broadly refers to the general analysis of these data sets, and "artificial intelligence" (AI), which is defined as "the theory and development of computer systems capable of carrying out tasks that customarily have needed human intellect," volume of data have increased along with the creation of specific techniques for their analysis. As indicated in Fig 1, these two concepts can technically be relatively different from one another (for example, one can create tools to analyse large data sets that are not based on AI techniques).



Big data analytics actually don't differ all that much from conventional econometrical methods in practice, and they even incorporate several tried-and-true general statistics approaches and techniques, such as principal component analysis, which was created around the turn of the 20th century. They are used to contemporary data sets, which can be both are very huge and complex, and this is another important characteristic. Depending on the sort of information involved, obtaining pertinent information from various sources is not always easy and frequently calls for a specific set of abilities. As a result, machine learning, text mining, network analysis, agent-based modelling, and other statistical/modelling approaches are included in big data analytics and AI methodologies.

This paper will offer the chance to review the main big data sources pertinent to central banks as well as the main methods for analysing big data that have emerged recently. The methods will focus on the categorisation and clustering of data derived from sizeable quantitative data sets, with machine learning, text mining, and network analysis all playing significant roles.

2.1 Big data information for central banks

Big data comes from three main sources, according to [3]. These groups are associated with

1. Social networks (information derived from human sources like blogs and searches);

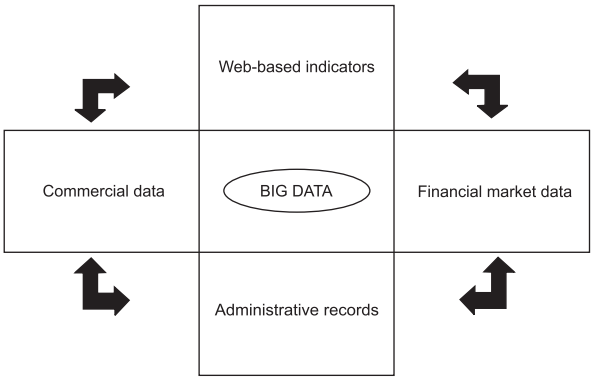
2. Business systems that have been around for a while (process-mediated data, like files produced by business transactions, e-commerce, and credit card operations); and

3. The internet of things (machine-generated data; for example, data from traffic/pollution sensors, mobile devices, computer logs, etc.). These are quite broad categories, and big data will actually consist of a variety of diverse data sets that are drawn from these three key sources.

Four types of data sets, which are typically referred to as financial big data, are notably relevant to central banks (see Fig. 2): internet-based indicators, commercial data sets, financial market indicators, and administrative records. [4]

Fig 2.

Graph 2: Four main types of financial big data set



It's possible that central banks employ web-based indicators less frequently than the private sector[5], particularly when it comes to unstructured data like photographs. Nevertheless, a number of initiatives are being worked on to leverage online data collection to aid in the formulation of monetary and financial policy. Additionally, a significant factor relates to the easier accessibility of digitalised information, which takes into account the fact that both "traditional" printed documents can now be easily digitalised, searched, and analysed in a manner similar to web-based indicators, as well as the fact that ever more textual information has become available on the internet (for example, on social networks).

But in practice, the majority of the financial big data sets that are relevant to central banks are composed of the increasingly large and detailed records of commercial transactions, financial market changes, and operating processes. As a result, central banks now have very specific data on the financial system at their disposal, including information on particular organizations, transactions, or securities.

2.2 Extracting knowledge from large quantitative data sets: classification and clustering

New statistical tools have been developed in tandem with the growth of big data sources to cope with them. These big data strategies fall into two categories: the first, and most significant, is to extract summary data from enormous quantitative data sets. Given that it does not include the handling of unstructured data, this field is quite close to "conventional statistics" (eg text, images). Since many enormous data sets are actually well-structured, statistical techniques created for numerical data sets can be used to handle them in the right way. The fundamental objective is to produce summary indicators by reducing the vast quantity of data points that are available, essentially by identifying commonalities between them (via categorization) and grouping them (through clustering).

So-called machine learning is used in a lot of these procedures. The definition of this subset of AI techniques is "a method of constructing a sequence of activities to solve a problem that optimise automatically via experience and with little or no human interaction." Despite having three unique qualities, this approach is relatively similar to conventional econometrics. First, machine learning is frequently more concerned with making predictions than with determining a cause-and-effect relationship. Second, rather than choosing an algorithm based on a theoretical model, the goal is to find one that matches the real data that has been observed. Third, and related to the preceding point, the approaches are chosen less by the more conventional statistical tests employed in econometrics and more by their goodness-to-fit.

Machine learning is divided into a number of categories that fall into two primary categories. An algorithm is "fed" a set of "training" data in supervised machine learning that contains labels on the observations. The objective is to categorize specific data points by determining which class (or group of observations) a new observation belongs to among a number of classes. The examination of a sample of historical observations, or the training data set, for which their group (category) is known, leads to the conclusion that they do. Based on a fresh observation's properties, the algorithm's goal is to anticipate its category. An example would be to forecast whether a new loan will be granted ("yes" or "no," depending on its characteristics and in comparison with an observed historical data set of loans that have

been approved or denied); or whether a company is likely to default in a few months. Several algorithms, such as logistic regression methods, linear discriminant analysis, Naive Bayes classifier, support vector machines, k-nearest neighbours, decision trees, random forests, etc., can be used for this purpose.

Unsupervised machine learning, in which "the data presented to the system do not contain labels," is the second category. As a result, the algorithm must identify clusters by grouping data for which it discovers comparable traits or "patterns," meaning that categories have not been determined control parameters for a particular collection of observations. Clustering and dimensionality reduction algorithms are two well-known examples. By grouping together the observations that are most similar in an agglomerative manner, clustering aims to uncover the underlying groupings that exist in the granular data set, such as groups of clients or businesses that have certain traits (bottom-up approach).

Of course, there are more categories of algorithm. One is reinforcement learning, which provides extra information feedback to unsupervised learning, such as through human involvement. One more is deep learning (also known as artificial neural networks), which is based on data representations that are motivated by how neurons in the brain function. Recent tests indicate that deep learning can outperform traditional classification techniques when working with unstructured data like texts and images. This is in part because traditional quantitative algorithms have difficulty working with unstructured data because they require it to be converted into a numerical format. Deep learning techniques, on the other hand, can be applied to deal directly with the original raw data.

A Nave Bayes classifier, for example, would be suitable when the variables are considered to be independent and follow a Normal curve. Because of this diversity, the choice of a particular method would depend on the assumptions being made regarding the characteristics of the given dataset of interest. In actual practice, data scientists must decide which algorithm is the most efficient for the given problem, which frequently requires a thorough and repetitive procedure of experimentation; this is often as much an art as a science.

It's crucial to establish an evaluation metric before selecting the appropriate "model". A single algorithm's fit should be evaluated, and the performance of different algorithms should be contrasted. Accuracy of the model, which is just the proportion of data for which the algorithm correctly forecasts the category variable, is the simplest statistic for classification (this will usually be done by comparing the result of the algorithm with what a human evaluator would conclude on a specific data sample). However, an accuracy metric might not be appropriate for all activities, especially if the distribution of the classes is imbalanced.

An extremely naive model that assumes all transactions are valid, for instance, may be used to determine if a transaction is legitimate or fraudulent. While this model's accuracy would appear to be quite high because most transactions, by definition, are not fraudulent, its practical application would be quite limited. Therefore, when the distribution of classes is very imbalanced, it is necessary to find other metrics for algorithm evaluation. [7] Another strategy is to address the problem of class imbalance at the observational level, for example, by replicating (over-sampling) elements from the minority class or, in the other direction, by excluding (under-sampling) those from the dominant class.

2.3 Text mining

Text-mining, or the analysis of semantic information, is another rapidly growing area of big data analytics. It involves the automated analysis of significant amounts of natural language text and the detection of lexical or linguistic patterns with the goal of extracting insightful information. While the majority of empirical work in economics focuses on numerical indicators like prices and sales data, a growing amount of textual data is also produced by economic and financial activities, including internet-based activities (like social media posts) as well as a wider range of textual data from things like company financial reports, media articles, public authorities' deliberations,

etc. Policymakers now have a strong interest in analysing this unstructured data, not least because of the significance of "soft" indicators.

Text analysis typically begins with some common pre-processing techniques, such as tokenization (splitting into words), stopword removal (throwing away very common/off-topic words, such as "a," "the," and "to"), stemming or lemmatizing (converting words into their root forms, for example "prediction" and "predicted" into "predict"), and merging words within a common message (for example, "Bank" and "Nigeria" grouped. After that, the original document can be converted into a document-term matrix, which shows the frequency of a term in each individual text (or non-appearance). This vectorial text representation is composed of numerical values that may be examined by quantitative algorithms, such as when comparing related matrixes to gauge how similar two documents are (Fig. 3).

The Latent Dirichlet Allocation is a well-known approach for handling textual data (LDA). [8] This presupposes that subjects, which are dispersed by keywords, are the primary unit of distribution for papers. According to the number of words reflecting this topic distribution, one document might combine a "monetary" topic and a "employment" topic for a respective 20% and 80% (i.e., 20% of them related to words like "inflation" or "interest rate," and the remaining 80% related to words like "jobs" and "labor"). These computations can be used to create an indicator that tracks the frequency of a given topic over time, such as the frequency of messages mentioning the "recession," which might be helpful for tracking the health of the economy.

For the analysis of text data, simpler dictionary-based methods can also be used in addition to quantitative algorithms. It is possible to choose a group of keywords that are pertinent to the subject of interest, such as "business confidence" as one such example. The subject indication can then be evaluated by creating an index based on how frequently these chosen keywords appear in a particular document (eg the evolution of business sentiment). The Economic Policy Uncertainty (EPU) is a well-known example; by the end of 2018, more than 20 country-specific EPU indexes had been constructed. The EPU estimates the level of uncertainty based on the appearance of a set of economic-, policy-, and uncertainty-related keywords in news items.

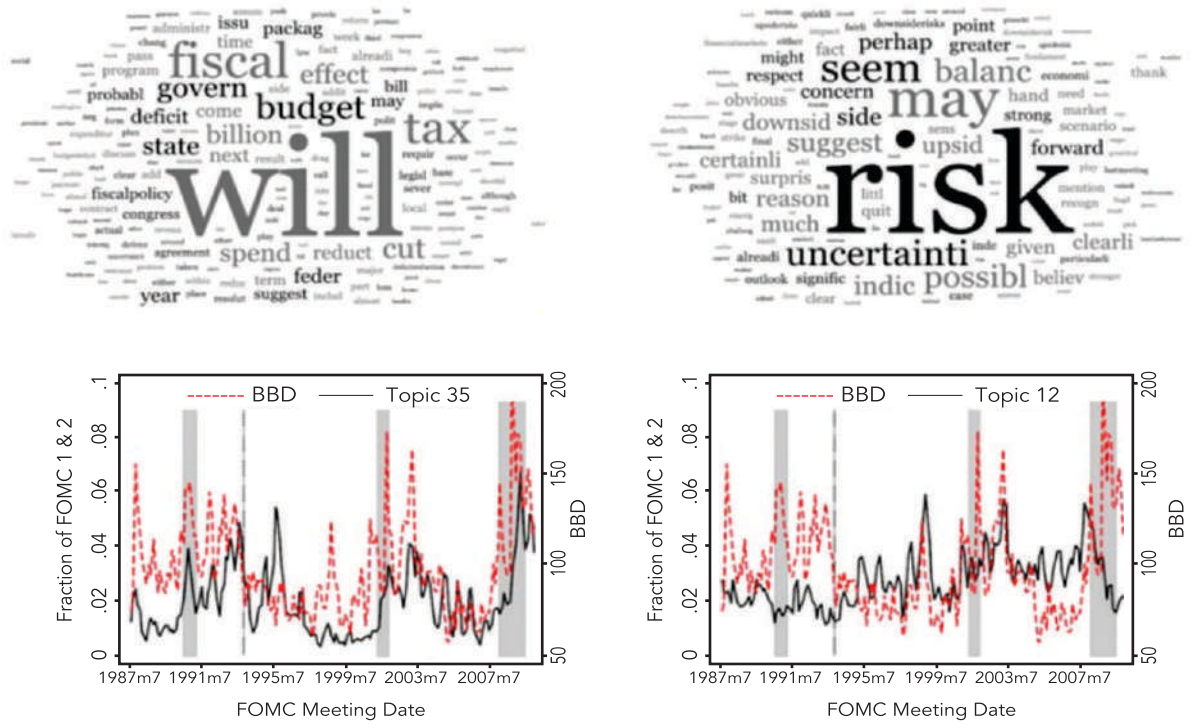


Fig.3 Topic distributions obtained from text-mining techniques

2.4 Network analysis

Financial network analysis, which can be thought of as an examination of the connections between the many components of the financial system, is a third significant field of big data analytics.

Graphical approaches and representations are used to get insights into how this "network" operates. Financial Network Analytics (FNA) shown how this method can quantify how data is linked to other data, make clear why these connections important, and demonstrate how complex systems change over time. The method can be especially useful for large data sets, allowing for the representation of complicated systems with intricate interactions between its constituent parts.

The four main types of analyses are top-down approaches (such as the analysis of system-wide risk), bottom-up analyses (such as the analysis of connections between particular nodes of the system), network feature analyses (such as the analysis of transmission channels), and agent-based modelling, which involves the analysis of particular agents involved in the network, such as the central counterparties (CCPs) in the financial sector. The task will often be divided into three phases: analysis (data visualisation and the detection of potential threats), surveillance (e.g., real-time detection methods), and simulation (eg scenarios and stress tests).

A network is actually made up of units (called nodes) that are connected to one another both

directly and indirectly. Several different types of graphs can be used to depict this. Centrality is a key idea that refers to the significance of nodes (or links) in a network and may be quantified using particular metrics. Another is community discovery, which uses particular machine learning methods to arrange nodes into clusters and filter noise in order to simplify the visualisation of a big and complicated network (see above).

For example, by mapping the global value chain between nations and industries or the different types of exposure experienced by financial institutions, this style of research is especially well adapted to depicting interconnectedness within a system. [12] A recent study that examined the linkages between CCPs and other financial organisations, such as banking groups, in particular by taking into account subsidiary-parent relationships, is one example of how to assess the role of CCPs in the financial system. This can help to illuminate the potential effects of a disruption coming from just one CCP on its clearing members and subsequent CCPs.

3.0 Opportunities for central banks

As policymakers increasingly realise, big data may significantly improve the caliber of economic analysis and research. In order to measure economic variables like pricing, labor market conditions, the housing market, company sentiment, etc. in a novel way, the IMF is looking into big data (Hammer et al., 2017). A lot of central banks are currently exploring how

to leverage the traits of financial big data sets to carry out their mandates (Coeuré, 2017).

According to the list of its "Vs," which stand for volumes, variety, velocity, veracity, and value, big data provides several benefits in terms of specifics, flexibility, timeliness, and efficiency; for more information, see Laney (2001) and Nymand-Andersen (2016).

1. The process of creating statistical data.
2. Macroeconomic forecasting and analysis.
3. Monitoring the financial markets and
4. Evaluating financial risk.

Graph 4: Relative advantages of designed versus organic data

	Designed data	Organic data
Structure	Geographic and socio-economic	Behaviour
Representative	Yes	No
Sample selection	Response rates deteriorating	Extreme
Intrusive	Extremly intrusive	Non- intrusive
Cost	Large	Small
Curation	Well studied	Unclear
Privacy	Well protected	Large violations of privacy

3.1 More and enhanced statistical information

Big data has the potential to be a helpful tool for enhancing the official statistical system. First, by providing access to a larger range of data, especially those that are "organic" in nature, it can be a creative source of support for the existing creation of official statistics. These data, as opposed to statistical surveys and censuses, are frequently the consequence of other operations and are not typically collected ("planned") for a specific statistical purpose (Groves, 2011). They cover a wide variety of commercial, financial, and administrative indicators, as well as transactional data (such as pricing entered online) and aspirational data (such as social media posts and online product evaluations).

Additionally, they offer statistical compilers a number of benefits, including their quick accessibility and relative simplicity in collection and processing when using current computing techniques (see Fig. 4). It should be noted, however, that actual access to such sources, whether private or public, may be limited due to business and/or confidentiality considerations.

Organic data can be utilised to improve already-done statistical operations, especially when the coverage is lacking. For example, in some developed economies, direct web-scraping[13] of price data from online shops can be used to more accurately gauge the cost of fresh food and other specialised components of inflation. [14] In extreme cases, this data can take the role of conventional indicators in nations with undeveloped official statistical systems. One example is the Billion Prices Project[15], which enables inflation indices to be built for nations that lack an official and/or comprehensive index, as mentioned by Roberto Rigobon (MIT Sloan School of Management). Similar to this, a number of central banks in developing market nations have created rapid price estimates for particular commodities and properties by immediately scraping the data that is available on the web, as opposed to designing tailored surveys that can be time- and resource-intensive.

Second, by bridging the gaps in time before these statistics become accessible, big data can facilitate the dissemination of official data more quickly. In example, the data produced instantly by a variety of web and electronic devices, such as search queries, gives high-frequency indicators that can aid in the quicker tracking of current economic changes (ie through the compilation of advance estimates). A further goal of the Billion Prices Project is to deliver in-depth data on inflation in a variety of nations, including developed economies, and more frequently—for example, daily rather than monthly, as with a consumer price index (CPI).Moving on to the real economy, it is now possible to estimate in advance (or "nowcast") the real-time evolution of some "hard" measures, such as GDP, using web-based data paired with machine learning algorithms. Big data sources' high velocity makes it possible to deliver information more quickly, which might be crucial in times of crisis.

Third, and as was stressed, new types of statistics are provided to supplement "conventional" statistical data sets. Here, it's vital to observe two recent events. One is the increased accessibility of textual data that has been digitalized, which enables the analysis of "soft" variables like the

sentiment and expectations of economic agents - gleaned, for example, from social media posts. This kind of data can also be obtained by conventional statistical surveys, but these studies tend to concentrate on certain topics, such as firms' output expectations and consumer confidence. Internet-based sources, however, can cover a considerably wider range of subjects. Additionally, they are less invasive than in-person surveys, which may allow them to more accurately depict real behaviors and ideas. The expanded use of huge granular data sets to enhance the compilation of macroeconomic aggregates and provide a better understanding of their dispersion has been a second crucial factor. [16]

3.2 Macroeconomic forecasting with big data

Big data sets are already being utilized by many central banks for macroeconomic forecasting. In fact, the above-discussed nowcasting applications can be seen of as a particular kind of forecasting activity. With a lead time of several weeks over the actual publishing dates, short-term projections of estimates of car sales in the euro area can be made using Google Trends data. For example, Google Trends,[17] uncertainty metrics like the EPU index (see above), or credit card activities, in addition to more conventional indicators, can all be utilized with big data to forecast headline indicators. However, because the devil is in the details, statisticians must employ a variety of strategies. However, because the devil is in the details,

statisticians must employ a variety of strategies. For instance, some metrics may perform well when used to anticipate GDP now (i.e., its growth rate over the most recent quarter), but less so when used to forecast its future development (say, GDP growth one year ahead). Another thing to keep in mind is that there are other sources of indicators that can be employed in this situation besides the internet; in fact, some web-based indicators might perform worse in exercises involving nowcasting and forecasting than do conventional business confidence surveys.[18] A key word might be chosen from Google Trends data if it met a variety of requirements, including generality, popularity, robustness, sensitivity to tiny semantic changes, predictive value, correlation with macroindicators, and whether the link being examined makes sense economically.

3.3 Financial market forecasting and monitoring

Similar to the macroeconomic sphere, big data analytics have also shown promise in tracking and predicting changes in the financial sector, a crucial area for central banks. Numerous developments in this field make it easier to process vast amounts of quantitative data seen in massive financial data sets. Using a variety of technical trading rules and machine learning approaches, returns in a number of developing sovereign bond markets can be anticipated in order to evaluate their robustness as well as the relative contributions of various foreign (such as US monetary policy) and domestic factors.

Other project kinds examine less structured data. To gauge public expectations for the path of interest rates in Nigeria, a text-mining algorithm could be used [19]. To be more precise, a classification algorithm is trained to determine whether a particular text sample suggests an expectation for the tightening, loosening, or stability of the central bank policy rate in the future. An index of policy rate expectation is created by compiling all the newspaper stories that mention probable changes in the policy rate from two weeks previous to monthly policy meetings. This index has made it easier to analyze how policy rate expectations are formed, helpfully completing previous sources (eg Bloomberg surveys of market participants). In order to forecast equity returns, the informational content of news stories was divided into a number of categories using a "emotion dictionary sample." It may be advantageous to take into account additional textual information kinds, such as social media posts and official public announcements. Experience from a number of central banks demonstrates that new big data sources can also aid in explaining financial market changes and illuminating their possible future course. The assessment of market liquidity in the government bond market and, consequently, the risk of future

rapid price fluctuations, has been made easier by the use of high-frequency "tick data." Similar to the Bank of England, the foreign exchange market dynamics and liquidity are identified through specific projects during periods of significant market action.

3.4 Financial risk assessment

For both those in charge of microfinancial supervision and those primarily concentrating on financial stability issues and macrofinancial supervision, big data sources and methodologies can help with the financial risk assessment and monitoring activities that are at the core of central banks' mandates (Tissot, 2019). In particular, the emergence of big data analytics has created exciting opportunities for utilizing the enormous volumes of data included in granular financial data sets to evaluate financial risks.

To predict the default for each ongoing debt, a deep learning technique and a particular classification algorithm[20] were applied. This approach was supplemented with a dimensionality reduction algorithm to lessen the amount of variables that needed to be taken into account, which facilitated policy monitoring work.

Big data analytics can also improve current methods for assessing the financial sector by expanding traditional approaches and offering new insights, such as financial sentiment analysis, early warning systems, stress-testing, and network analysis.

For instance, Financial Network Analytics offered a variety of scenarios, including the use of network analytics for systemic risk measurement, the use of text analysis techniques to corporate e-mails and news for risk assessment, the monitoring of interconnection to identify risk concentrations in CCPs and contagion effects, the identification of liquidity and solvency concerns in payment systems, and the modeling of a financial institution's operational collapse. The significance of having a solid theoretical framework to analyze the signals offered by diverse sources as well as to spot unexpected, weird patterns in the data was highlighted by these various experiences. A multidisciplinary approach is advantageous, and they also emphasized the significant IT and labor expenditures involved, as well as the significance that model simplicity and transparency played in the success of these programs.

4.0 The use of big data in crafting central bank policy: organisation and challenges

Experience with central banks indicates that there may be major opportunities offered by big data sources and related analytical approaches, supporting a variety of policy areas of interest. But how should central banks set themselves up to take full advantage of these chances? And what are the main difficulties?

4.1 Organisational issues

Big data has enormous potential to help central banks with a wide range of activities. For instance, as observed by Per Nymand-Andersen (ECB), central bankers require near-real-time and higher-frequency pictures of the macro economy's current, its possible future development, and the risks connected with this view (eg early warning indicators and assessment of turning points). They need to be able to zoom in and gain micro-level insights due to their interest in financial stability concerns.

Information systems that can accommodate this variety of techniques are therefore highly valued.

To provide flexible and creative services to a wide spectrum of internal users, this necessitates a multidisciplinary and granular data platform. The French central bank's data lake platform project will offer essential data management services supporting a variety of initiatives, including data collection, supply (access), quality monitoring, storage, sharing, analytics, and dissemination.

The creation of a suitable information system is just one part of a more all-encompassing approach to maximizing the potential of big data at central banks, which is a critical lesson to be

learned. The "Central bank Digital Supervision" effort mainly utilizes text mining, natural language processing, machine learning, and visualization methods. It is also supported by a comprehensive staff training program on data analytics. Iman van Lelyveld also gave the Netherlands Bank's data science department as an illustration. In certain market segments, stress testing and use cases for credit risk, contagion risk, and CCP risk have all been created there.

5.0 Challenges and limitations

Practical difficulties still exist, particularly when processing and utilizing huge data sources and methodologies.

Big data handling may be resource-intensive, particularly when gathering and accessing the data, which may call for brand-new, pricey IT hardware as well as cutting-edge data protection. The experience recorded by the Bank of Japan suggests that staff expenses shouldn't be undervalued either. First, it is frequently necessary to correct big microdata sets on financial transactions for false characteristics, missing points, outliers, etc. (Cagala, 2017); this cleaning task may frequently eat up the majority of the time of statisticians working with these data.

Second, there is a chance of a "talent war" when trying to recruit the best people, especially in comparison to private sector companies who are significantly investing in big data; public remuneration and career structures may not be well suited for this level of competitiveness. How to incorporate the gathered data into a complete

and cohesive information model is also a crucial organizational factor, as can be seen from the discussion above. Making the best use of data that are readily available but were not initially intended for specific statistical objectives and might be overwhelming (with the potential of too much "fat data" and too little meaningful information) is a problem for central bank statisticians. In most cases, this calls for intensive planning and adherence to sound data governance principles, which include data quality management procedures (such as the removal of redundant data), the establishment of adequate documentation (such as metadata), the assignment of precise duties (such as "who does what for what purpose"), and controls.

Public agencies have additional difficulties when using large data. The information's inherent quality, as mentioned above, is one major constraint. The wide range of big data formats can make this problem much more difficult, particularly if the information being gathered is poorly organized. Furthermore, correlation analysis, which may reveal both coincidence and causation patterns, is commonly used in large data analytics. [21] Additionally, the accuracy of the data gathered can turn out to be insufficient. Unlike traditional statistical surveys, big data sets frequently include whole populations, therefore there is typically little sampling error to compensate for. Big data sets are enormous, yet a prevalent misconception among the general public is that this inherently makes them representative of the relevant population. However, this is not a given, and in fact, the composition bias can be fairly noticeable, especially when compared to much smaller conventional probabilistic samples (Meng, 2014). For instance, it is important to understand that not all transactions take place online while comparing costs online. The measuring bias might be troublesome if people buy different things online than they do offline or if online pricing differ noticeably from those seen in physical locations.

Two distinguishing characteristics of central banks—the first being their independence and the value they place on maintaining public confidence—complement these difficulties. Big

data sets may not meet the requirements for official statistics, therefore "misusing" them as the foundation for policy decisions might pose moral, reputational, and efficiency concerns. The public's faith in the authorities' ability to gather, analyze, and disseminate information derived from big data as well as to make policy judgments inferred from such data might also be undermined if the confidentiality of the data examined is not rigorously preserved.

This suggests that central banks would typically

aim to give confidence that data are used exclusively for proper purposes, that only a small number of workers may access them, and that they are maintained securely. The continuing effort to gain access to more specific data (sometimes down to the level of individual transactions) highlights the need of carefully weighing the need to protect the privacy of the persons and businesses involved.

Another characteristic is that central banks are entities that make policy; as such, their decisions affect the financial system and the data gathered about it. As a result, there is a feedback loop between the financial big data gathered, its use in the development of policy measures, and the responses given by market players. Because of this, every attempt to quantify a phenomena might cause the underlying reality to alter, demonstrating the need of the renowned Lucas criticism for decision-makers (Lucas, 1976).

6.0 Conclusion

These demonstrate how policymakers might benefit in a variety of ways from new informational and analytical methods connected to big data. Big data is still viewed as an addition to current statistical frameworks rather than their replacement. It presents several challenging issues, not the least of which are those related to truth, openness, secrecy, and ethical considerations. Both the sources of big data and the strategies being developed for its interpretation have these constraints. The black-box nature of big data analytics is one of its main

flaws, which is exacerbated by the frequent use of fancy titles even for basic concepts (or "buzzwords"). This might be difficult for policymakers who want to be as honest as possible in explaining the thinking behind their analyses and choices. Furthermore, there are still a number of significant unknowns about the usage of cloud-based services and the creation of new procedures (such as encryption and anonymisation techniques) to make it easier to use micro-level data without sacrificing confidentiality.

It's critical to keep in mind that central banks don't function independently while discussing these issues. The general public must be made aware of the ways in which the new data may be used to create better policies, such as through collecting new knowledge of how the financial system operates, identifying its shifting structure, improving policy design, and evaluating the effects of policy actions (Bholat, 2015). They must, however, also publicly address the risks involved and make clear the safeguards provided in terms of data governance, access control, and confidentiality.

The same quality criteria and processes that apply to conventional official statistics should be utilised if big data is to be used for policymaking, including transparency of sources, methodology, dependability, and consistency through time. This will be essential for enabling both the effective sharing of this new information amongst public agencies and its increased utilisation. [22]

The analysis of data has always received greater attention from central banks than data gathering. In addition to the growing significance of financial channels in economic activity, they are now spending more time on statistical activities (van de Ven and Fano, 2017). One such activity is the central banks' significant contribution to the compilation of financial accounts, a crucial component of the SNA framework. They are therefore in a perfect position to guarantee that big data can be converted into usable information to help policy as they are both data producers and users.

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Poverty and Poverty Alleviation Policies in the North Central Zone of Nigeria

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Abstract

The paper examined poverty situation in the north central and the poverty alleviation policies of government as they affect the people of the north central zone in particular and Nigeria generally. This study was carried out in the face of the fact that poverty has characterized the Nigerian society such that over 70% of her citizens live below poverty line predicated by hunger, unemployment, poor housing, poor health care and other deprivations in spite of numerous government policies and programs aimed at alleviating or eradicating poverty in Nigeria since independence. Data for the study were generated through both the primary and secondary sources. While the secondary data were generated from essential documents aries, the primary data were generated through the administration of questionnaires. Those data were analyzed using the qualitative-descriptive method of data analysis, consisting of content analysis, inferences and logical arguments. The essence was to interpret the opinion of respondents on the impact of government's poverty alleviation policies on their lives and what is most needed to lift them out of poverty. The study found that government's poverty alleviation policies have had limited impact on the people of the North Central zone because the people were not 'empowered' through support for education and loans to do business, instead, they were given 'hand outs' such as distribution of free food and payment of welfare packages. Hence the study recommended implementation of policies that will help boost economic activities and create jobs such as empowerment through support for education and loans to do business

Keywords: Poverty, Development, poverty alleviation, poverty alleviation policy, North-central

1.0 Introduction

Poverty is a global problem that affects socio-economic and political aspects of lives of about 2 billion people across the globe (Oshewolo, 2010). Each region of the world has different yardsticks for measuring the level of poverty based on people's ability to have access to basic things of life namely: food, clothing and shelter, hence a complex and multi-dimensional phenomenon. The different parameters and indices of measuring poverty from region to region all over the world, all refers to a state of lack, poor standard of living, and limited access to basic necessities of life. However, this state of lack is most prevalent in the third world countries of Latin America, Asia, Africa and the Caribbean.

Paradoxically, the Third World Countries are naturally endowed with natural and human resources, yet they remained underdeveloped. Authors such as Amin (1974), Amin (1976), Andre Gunder Frank, (1972), Rodney (1972) Nnadozie, (2006 and 2010) have blamed the plundering of the resources of these countries during the period of colonialism for this present condition.

Some other authors of contemporary times like Emeh (2013), Ghanaian Chronicle, (2000), Kolawole, (2012), Kyari, (2008) and Ope-Agbe (2007) have refuted the above argument, instead citing the relentless and pervasive corruption, driven by a culture of primitive accumulation of indigenous leaders of these countries as what led to the sordid state of poverty in these countries.

The above assertion does not foreclose some developmental efforts and achievements of these third world countries especially the African countries such as Nigeria but their path to development has been mired by the fact that over 50% of them are living below poverty line.

Ironically, Nigeria is referred to as the poverty capital of the world, whereas it is a country with

abundant human resources (population of about 208,664,556 as at January 2021 (Worldometer (2021)), the biggest oil exporter in Africa, with the largest natural gas reserves in the continent (World Bank, 2015); yet the country has remained in a state of underdevelopment and high level of poverty, far from expectations. Expectedly, Nigeria is supposed to be too rich to be poor, but presently, the country has become too poor to be rich with over 70% of her citizenry living in near abject poverty. Bakare and Edozie (2015) put it that the alarming rate of poverty in the country has reached a worrisome dimension where 'ignorance, unemployment, malnutrition, malady and inadequate access to credit schemes are apparent among the citizens.

Abiola and Olaopa (2008 ,page number) state that the scourge of poverty in Nigeria is an incontrovertible fact, that has produced hunger, ignorance, malnutrition, disease, unemployment, poor access to credit facilities, and low life expectancy as well as a general level of human hopelessness.

Ordinarily, Nigerians have no business being poor considering the country's rich natural endowment and numerous governments policies and programs to alleviate or/and eradicate poverty in Nigeria. Unfortunately, the number of those living in poverty has continued to increase" (Ogwumike, 2001; Ujumadu, 2016). The prevalent nature of the poverty trend in Nigeria is mostly felt in the Northern parts of Nigeria. Thus, while the aim of the study is to identify the root causes of endemic poverty in North Central Nigeria for the purpose of fashioning out effective policies to reverse the trend, the objectives of the study are to:

a. highlight the manifestations of poverty in North Central Nigeria;

b. identify the causes of poverty in North Central Nigeria;

c. unravel the nature of poverty alleviation programs carried out by government, and ascertain the poverty alleviation policy preferences in North Central Nigeria

2.0 Literature Review

2.1 What is Poverty?

Poverty is a phenomenon that has characterized the human society from time immemorial. No country of the globe can be said to be immune from the scourge of poverty – whether in developed or underdeveloped societies. Individuals or communities within these societies (developed or underdeveloped) can be poor, and a whole nation can be said to be poor. Most poor nations are categorized within the third world in continents like Asia, Africa, Latin America, and Oceania. Though poverty across all spheres, manifests in various ways and can be recognized in different dimensions of political, social, economic or even psychological manifestations, it is commonly viewed as a situation of low income or low consumption. It is a state of deprivation of the basic necessities of life such as food, shelter and clothing as well as a good state of wellbeing. It can also be described as a social condition characterized by inadequate access to basic human needs (food and non-food) to the sustenance of socially acceptable minimum standard of living in a given society.

Poverty, according to Akintola and Yusuf (2001, page number), "refers to the inability of an individual to attain the minimum standard of living." Some of these basic determinants of well-being include adequate food, shelter, portable water, health care, education and employment opportunities. Therefore, poverty is the "incapability to gain access to the essential needs of life such as foods, cloth, shelter and the inability to meet up with other social and economic responsibilities" (Ijaiya, 2015, page number). The World Bank (1999, page number), "defines poverty as shortage of food, lack of shelter, being ill, and not being able to go to school, not being able to read, fear for the future, not having a job, not being able to speak correctly, losing a child due to illness brought about by dirty water, lack of representation, powerlessness, not being able to

speak correctly and inadequate freedom." The World Bank definition of poverty clearly points out the ills that affect individual's wellbeing and happiness against the background of the fundamental human right to enjoy basic necessities of life; even though this paper does not see "not having job" as a yardstick for being poor.

Not having a job does not constitute poverty in the real sense of it rather; it is the inability to convert inate potentials and acquired skills/knowledge into money and wealth, that breeds poverty. In another Report, the World Bank (2011, page number), conceived poverty as 'distinct deprivation in the living condition which comprises of multiple dimensions, these include inability to have access to basic needs, low income necessary for human existence'. Poverty entails poor health and sanitation, lack of education, lack of access to clean water, insufficient physical protection, denial of expression and inadequate ability and opportunity to live a better life".

Poverty is also seen as a situation of "inadequate infrastructure, nutrition, health, self-esteem, intellectual underdevelopment, inability to articulate and low per head income" (Aliyu & Chukwudi, 2015, page number). Poverty has political and economic, social and environmental dimensions. Poverty as it relates to the political and psychological manifestations refers to the inability of individuals to meet up certain basic amenities of life due to deliberate or otherwise incapacitation of certain member groups of the society or individuals which make it impossible for them to be able to access political power or participate actively in governance or influence government decision.

Psychologically, the mental or emotional state of such people or individuals categorize them as poor, unprivileged, unfortunate, disempowered, deprived and even sometimes depraved. Poverty is complex and multi-dimensional, encompassing not only lack of income but also "lack of assets, poor health status, and vulnerability to economic and natural shocks and lack of voice in decision making" (World Bank, 2002, page number).

Poverty means more than being impoverished and more than lacking financial means. It is an overall condition of inadequacy, lack and scarcity, disempowerment, and deficiency of economic, political and social resources.

2.2 Public Policies and Development in Nigeria

Public policies are as old as governments. No government, no public policy. Whatever be the form of government - oligarchy, monarchy, aristocracy, tyranny, democracy etc., whenever and wherever governments have existed, public policies have been formulated and implemented. To cater for basic human needs and meet demands for basic human rights of the people, government has to come up with solution, processes and resources in form of public policies. Elaborating further, Roberts and Edwards cited in Olaniyi, (1998) posit that a policy is a set of decisions taken by a political actor concerning the selection of goals and the method of attaining them relating to a specified situation.

The concern of policy is in the making of decisions regarding a course of action to be followed by government in dealing with a problem or matter of concern. It is also important to underscore the power dynamics of public policies to avoid unnecessary conflicts in policy statements. Public policy is a tool of resource allocation channeled through meeting governmental goals and objectives. Thus, Roberts and Clark (1982) submit that public policy is a series of steps taken by a government to solve problems, make decisions, allocate resources or values, implement policies and, in general, do things expected of them by their constituencies.

However, it is not only decisions of government that constitute public policy option. In this sense, Dye (1972) defines public policy as whatever governments choose to do or not to do. It is important to bear in mind that inaction is also an

action; thus, failure to make decisions is a public policy in itself, since the resultant effect of

government's inaction or refusal to make certain decisions affects the public. Another important point is that whatever governments choose to do or not to do should not be borne out of a critical analysis of the issues in relation to the objectives and goals of government.

Though, no unanimity can be found on a precise definition, Public Policy consists of the overall framework within which government actions are undertaken to achieve public goals. This is a good working definition of public policy for our purposes, being the study of government decisions and actions designed to deal with a matter of public concern, in this case, Poverty. Public policies are filtered through a specific policy process, adopted, implemented through laws, regulatory measures, courses of government action, and funding priorities, and enforced by a public agency Okeke (2001) thus surmises that the whole gamut of definitions of public policy revolves around government-governmental actions, governmental decisions, governmentally proposed actions.

Okeke (2001), referring to the principles that guide the policies of economic recovery in Nigeria says that poverty eradication in Nigeria involves lots of brainstorming and that policy formulation is a rational outcome of detailed data analysis with choices optimized to suit existing circumstance. Policy formulation is influenced and guided by a combination of philosophy, goals, strategies and resources targeted at the achievement of specific or general goals of government. Policies are not rushed; they are holistic. According to him, the guiding elements in the formation of public policy are that policy must be fundamentally structured by the basic philosophy of governance of any administration; It must set a goal it seeks to achieve; It must be predicated upon a clear strategy for it to achieve its set goals; and it must address the quantum and nature of resources which it requires to achieve its objectives.

On the other hand, all policies of government in one way or the other are expected to improve the

development of the country. Unfortunately, policies of government in Nigeria over the decades cannot be said to be commensurate with the level of development on ground.

According to Ajagun (2003), development is a state of advancement which makes life more meaningful in its various aspects, including the economic, administrative, political, social, cultural and religious aspects. This implies that development is not about a particular aspect, but it is all encompassing. Adamolekun (2007) highlighted some indicators of development to include "a higher quality of life, higher income, better education, higher standards of health and nutrition, less poverty in society, a cleaner environment, more equal opportunities, greater individual freedom and richer cultural life amongst citizens of a given state" thus stressing that development has to do with improving the living conditions of people.

In Nigeria, the process of achieving the above national development indices highlighted by Ajagun (2003) and Adamolekun (2007), has been through the national development plans, policies and programs of government which started before the country got her independence in 1960. Various policies of government aimed at improving the welfare and state of the nation in all ramifications including alleviation of poverty in the country which will eventually improve other aspect of the society have been initiated by successive governments. In spite of numerous policies, the nation is still groping in the dark tunnel of poverty and underdevelopment, amidst plenty natural resources bestowed on the country by manifest destiny. Some of the government programs and policies include, Vision 2010, Vision 2020:20, National Poverty Eradication Program (NAPEP), National Economic Empowerment and Development Strategy (NEEDS), the Seven Point Agenda, National Transformation Agenda, and many others. Poverty alleviation remains the

major debated subject in most policies of government and national development plans in Nigeria.

2.3 Government Poverty Alleviation Policy and Development in the North Central Nigeria

Over the years, poverty has been a serious challenge to governments in Nigeria. Governments in Nigeria have persistently initiated policies and programs to alleviate poverty in Nigeria. Despite this, evidence in Nigeria show that "the number of those living in poverty has continued to increase" (Ogwumike, 2001). As a country, over the years, the Nigerian governments have launched various programs ostensibly targeting poverty reduction, and these programs are meant to cut across all the regions of the country, including the north central zone.

Some of these programs before the fourth republic, include, Universal Primary Education (UPE) of 1976, Operation Feed the Nation (OFN) of 1976, Green Revolution (GR) of 1979, National Accelerated Food Production Program of 1972, Nigerian Agricultural and Cooperative Bank of 1972, National Directorate of Employment (NDE) of 1986, Directorate of Foods, Roads and Rural Infrastructure (DFRRI) of 1986, Better Life for Rural Women of 1987, Family Support Program (FSP) of 1994, and Family Economic Advancement Program (FEAP) of 1998. However, these programs have largely failed to overcome the three reasons for this persistent poverty: Income inequality, ethnic conflicts and political instability (Edoh, 2003).

With the return of democratic rule in 1999, the government of Chief Olusegun Obasanjo introduced some major policy initiatives that were very germane to poverty reduction. The Universal Basic Education which was in line with the MDG stipulation of free and compulsory education in the first nine years of life was a major initiative towards poverty alleviation. Education has been universally proven to help lift peoples out of Poverty. The fourth republic has witnessed a number of exciting government policies to eradicate poverty in the country. Some of which include National Poverty Eradication Program (NAPEP) of 2001, National Health Insurance

Scheme (NHIS) of 2004, National Economic Empowerment Strategy (NEEDS) of 2004, Youth Enterprise with Innovation in Nigeria (YOUWIN) of 2011, Subsidy Reinvestment and Empowerment Program (SURE-P) of 2012, and National Social Investment Program (NSIP) of 2015. The various blueprints of these governments were tagged as the 7 Point Agenda under the Yar'Adua administration, The Transformation Agenda under Jonathan, and the Change Mantra under General Muhammadu Buhari.

These programs individually or collectively failed to have any meaningful impact on the lives of Nigerian citizens. The relevant question to ask is why these programs have failed to reduce poverty and better the lives of Nigerians. Alimeka (2001) argued that poverty reduction programs in the country have only benefited those who designed and implemented them while the poor are left "drier" Many observers unanimously agree that these programs have failed to achieve the objectives for which they were established" (Ovwasa, 2000; Adesopo, 2008; Omotola, 2008). With an escalating population growth, the scourge has assumed seeming intractability and the World Bank conclusion that "poverty is widespread and increasing in Nigeria" (World Bank Report, 2016).

The high-level manifestation of poverty in the North Central zone is despite the fact that the region is endowed with rich natural resources and large expanse of arable land with vegetation for planting and growth of yam, cassava, rice, maize, beans, guinea corn, soya beans and millet. The large expanse of land translates to the people being majorly farmers, albeit not on commercial scale. Other major occupations of the people are mining, fishing, dyeing, weaving, carving and blacksmithing.

The other mineral resources in the region such as

tin, marble, coal, iron ore, and semi-precious stones offer potential for economically viable industrial and agricultural development projects. Ironically however, the zone has continued to reflect the deprivations of the nation's poor state.

According to Nzewi (2000:page number) Nigeria's poverty-alleviation programs "have failed to address the cause or causes of poverty and are not consistent and sustainable overtime with regards to finance, interest as well as institutional arrangements" He further states that "the programs do not incorporate implementation measures in their design….., do not incorporate adequate targeting mechanisms so as to correctly identify and target the real poor" and also that "the programs are neither indigenous nor designed to naturally enlist the support and participation of the intended beneficiaries".

3.0 Theoretical Framework

The theoretical frame upon which analysis in this study is based is the elite theory. The elite theory enunciates the scheming, maneuvering and political machinations of the elites in the process of the acquisition and manifestation of political and economic influence. Some of the proponents of the elite theory like Gaetano Mosca, Vilfredo Pareto, Robert Michels and Max Weber, all agreed that the society anywhere in the world is polarised into two – the selected few elites and the vast majority masses. Though Karl Marx may not have been classified under the elite theory proponents, his class theory from the political economy view of the society, aptly pointed out that the society is categorised into two – the bourgeoisie and the proletariat, the rich and the poor. In the same vein, Pareto emphasized the psychological and intellectual superiority of elites, believing that they were the highest accomplishers in any field. This may be why people like Mosca, Pareto are convinced that all societies are ruled by organized minorities as in parliamentary democracies, and that only the elites are responsible for change, not the masses. Mosca (1939, page number) also argues that:

In all societies that are underdeveloped and have barely attained the dawnings of civilization. Down to the most advanced and powerful societies two classes of people appear - a class that rules and a class that is ruled. The first class always the less numerous, performs all political functions, monopolizes power and enjoys the advantages that power brings whereas the second, the more numerous class is directed and controlled by the first in a manner that is now more or less arbitrary and violent and supplies the first in appearance at least with the instrumentalities that are essentials to the vitality of the political organism.

In general terms, the role of the ruling class in determining the actions or inactions of government in the area of policy making and implementation is critical and cannot be taken for granted. Nigeria's developmental stages from inception has been guided and straddled by some few powerful forces, also known as the elite. The high level of poverty in Nigeria is as a result of the decisions of the elite to perpetually enrich themselves through all available means and public resources, thereby making the rest of the citizens poorer. The elite theory is apt here because it focuses on the disparities (economic, political and socio-political) that exist between the elite (a few minorities) and the poor masses which are a vast majority of the population and how the elites in the society frustrate and subvert policies for their own selfish advantage.

In the case of Nigeria, the elites' manipulation of the masses, as against general public good, is unimaginably pronounced. Those who are themselves, the decision makers in the policy making process are also the beneficiaries, acting on selfish and self-serving interests. The interest of the majority or poorer population are subjugated under the policy makers own personal goals and objectives which could be political, business or other personal objectives. The elite factor has been found to be the cause of many failed policy decision and implementation processes because in a world of competing interests and scarce

resources, bureaucratic, business and political elites are under pressure to ensure that their interests are protected and this comes at the expense of the poor masses. When programmes are made to alleviate poverty for the poor masses, the programmes end up being diverted or manipulated for the benefit of the elite or to advance the political agenda of those of them in power. Hence, the country has a situation whereby, the rich are getting richer, and the poor, are getting poorer!

The elite cut across all spheres of the Nigerian society, and they are not characterized with poverty. At the economic, political, socio-cultural and religious level, those who find themselves in this class, live above poverty. They are stakeholders in the area of policy and decision making as they have established institutions to keep the masses in check. For instance, the religious elites put their "members" or followers in check through religious doctrines and teachings. They could manipulate the consciousness of their members to believe that poverty and their predicament is orchestrated by God, hence, they have to be patient, for their labour on earth, will probably be rewarded in Heaven. This is why Marx saw religion as the opium of the masses, an instrument of oppression and a soul of the souless condition. They use religion as a tool to create disparity and widen the gap between the rich and the poor.

The political elite who are the key actors in governance have used all instrument to keep the masses in check ranging from state security outfits, hijacking of labour unions to persistent propaganda and colourful policy statements that might never be implemented or operationalized. Sometimes programmes are introduced which could accommodate few members of the masses as a way of to pacifying or conversely dividing the ranks of those who intend to counter the status quo.

It is obvious that Nigeria has experienced a whole lot of manipulation engineered by elites and this has led to various crises in the land, from religious crises, ethnic crises, militancy and even the present day terrorist activities that can also be traceable to poverty and frustration.

No doubt poverty shares an umbilical cord with the existing socio-economic, cultural and political crisis Nigeria is faced with today. The elite theory proposes that the composition of leaders regulates the level of resources and subjects the poor to more hardship. In Nigeria, the dominant ruling class represented by political, religious and business elites have over the years mismanaged the public resources and created unnecessary chaos without due consideration of the people, hence the country finds itself in the current quagmire. Decisions on the allocation of wealth, appointments, opportunities, revenue and even employment are concentrated in the hands of the aforementioned elite. Their actions which translate to the misuse of state resources by a small minority of the population have effectively denied the masses or ordinary citizens the right to access basic needs. Therefore, the elite theory may be used to suggest that the situation of poverty in Nigeria can be attributed to the attitude, ineptitude and utter misrule of its leaders.

4.0 Research Methodology

This research adopted both secondary and primary sources of data collection. The research design is the sample survey method and is designed in such a way as to collect relevant data and adequate information through interview from four states in the North Central of Nigeria. The secondary source is from both published and unpublished materials such as books, official publications, reports, internet materials, journals, monographs, seminar and conference papers, magazines, as well as dailies that are relevant to the area of study in question, while the primary source of data collection is the administration of research questionnaires.

The research population of this study is the total number of the entire population in the four states selected from the North Central zone which are: FCT, Niger, Nasarawa and Kogi. According to National Bureau of Statistics (2012), the total population in the four states is 15,331,620. The

figures are represented in Table 3 below:

Table 1. Population Estimates for 2015

States	Population
FCT, Abuja	3,195,116
Niger	5.358,381
Nasarawa	2,444,499
Kogi	4,333,624
Total	15,331,620

Source: National Bureau of Statistics, 2012

To ascertain the sampled population from the above population sample of 15,331,620, the Taro Yamane formula is used. The Yamane (1973) formula has 95% confidence level. Therefore, the Yamane formula for determining the sample size is given as follows:

n=N/1+N (e)2
Where n= Sample Size
N= Population Size
e= Margin of Error (0.05)
1= Constant

Therefore, Sampled Population for FCT is;

n=N/1+N (e)2

n=3,195,116/1+3,195,116 (0.05)2

n=3,195,116/1+3,195,116 (0.0025)

n=3,195,116/1+7,987.79

n=3,195,116/7,988.79
n=399.9
Therefore, n=400

From the Yamane formula derived above, the sampled population from each of the selected states is computed at 400. Total number of questionnaires distributed in four States of the North central was 1,600. The data collected through the primary source is analysed through the use of simple percentages. Poverty in the North Central was assessed using key areas of Food, Employment and Education as clear indicators of the presence or otherwise of poverty.

The table below shows the analysis of the administration of questionnaires along different social groups where a total of one thousand, six hundred questionnaires (1,600) were administered and distributed equally across the four states in line with the sample sizes determined by the Taro Yamane formula. Out of this a total 1160 representing were retrieved and analysed using the qualitative-descriptive method of data analysis, consisting of content analysis, inferences and logical arguments

Table 2: Questionnaires retrieved along different Social Groups

Occupation	Niger	Nasarawa	Kogi	FCT	Total Frequency	Percentage (%)
Women	65	118	67	108	358*	31%
Disabled	24	32	27	34	117	10%
Youth	58	45	35	47	185	16%
Elderly/ Retired (Over 60yrs)	28	35	28	41	132	11.4%
Traders/ Artisans	55	56	60	51	222	19%
Civil Servants	22	34	44	46	146	12.6%
Total	252	320	261	327	1160	100%

Source: Fieldwork (2018)

*This figure includes women from the other five social groups

5.0 Data presentation and Analysis

As stated in the method of data analysis section, data for the study generated through the questionnaire is analyzed using the qualitative-descriptive method of data analysis, consisting of content analysis, inferences and logical arguments. This study is guided by the specific objectives of this study which are to:

a. To highlight the manifestations of poverty in the North Central Nigeria;
b. Identify the causes of poverty in the North Central Nigeria; and

c. to unravel the nature of poverty alleviation programs carried out by government, and ascertain the poverty alleviation policy preferences in the North Central Nigeria

The essence of the objectives stated above is to answer fundamental questions of:

i. What are the manifestations of poverty in the North Central Nigeria?

ii. What are the causes of poverty in the North Central Nigeria?

iii. What are the nature of poverty alleviation programmes carried out by government as well as poverty alleviation policy preferences in the North Central Nigeria?

5.1 Analysis of Research question 1: What are the manifestations of poverty in the North Central Nigeria?

Manifestations of poverty in the north central Nigeria is assessed based on the three key areas of Food, Employment and Education. This is because food, employment and education are at the heart of human survival.

Again, when people have access to food, education and employment, they can rarely be regarded as poor hence it can be argued that they have the basic necessities of life, as whoever has food, education and employment should be able to afford shelter and healthcare facilities.

The tables below showcased the manifestations of poverty through the key areas of food, education and employment in the North central Nigeria.

Table 3: Unaffordability of Basic Food items

	NIGER STATE								NASARAWA STATE							
CATEGORY	S.A	%	A	%	N	%	D	%	S.A	%	A	%	N	%	D	%
MARKET WOMEN	20	30.	30	46.	10	15.	5	7.7	54	46.	35	30.	9	7.7	20	15.
DISABLED	6	25	14	58	2	83	2	8.	8	25	14	43	7	5	15	15
YOUTH	29	3	23	3	2	3.	4	6.	25	3	13	2	9	8	1	2
ELDERLY	18	6	9	3	0		1	3.	22	6	8	2	2	2	3	8.
TRADERS	12	21.	34	61.	6	10.	3		23	41.	24	42.	6		3	5.3
CIVIL SERVANTS	10	45.	8	36.	2	9.1	2	9.1	18	53.	10	29.	3	8.8	3	8.8
	KOGI STATE								FCT							
CATEGORY	S.	%	A	%	N	%	D.	%	S.	%	A	%	N.	%	D.	%
MARKET WOMEN	36	53.	20	30.	8	10.	3	4.6	66	61.	33	30	4	3.1	5	4.6
DISABLED	6	22.	16	59.	1	3.7	4	14.	10	29.	13	38.	2	5.9	9	26.
YOUTH	18	51	14	40.	2	5.7	1	2.8	26	55.	15	32.	2	4.2	4	8.5
ELDERLY	20	7.	6	2.	1	3.5	1	3.5	32	78.	7	17.	1	2.4	1	2.4
TRADERS	22	36	29	48	5	8.	4	6.	22	43	15	29	7	13	7	13
CIVIL SERVANTS	22	50.	16	36.	3	6.8	3	6.8	27	58.	17	36.			2	4.3

Source: Fieldwork (2018)

In all the States, over 70% of respondents either Strongly Agree or Agree that the prices of these food items are very high, beyond reach of the common man on the streets of the North Central Zone. The general responses reveal that the North Central states is still grappling with 'hunger' as majority indicated Strongly Agree or Agree that they find prices of basic food items such as rice, beans and any form of protein (Meat or Fish) to be beyond their reach.

It is observed that the highest percentage of concurrence of 78% was recorded among the elderly in the Federal Capital Territory, Abuja.

On average about 90% of the respondents in Abuja either strongly agree or agree that food prices are very high and not affordable, a factor which surely contributes to the poverty level observed in the FCT especially as evident in the settlements outside the main metropolis.

Table 4: The incidence of high unemployment among the youth of the North Central Zone

	NIGER STATE								NASARAWA STATE							
CATEGORY	VH	%	H	%	L	%	VL	%	VH	%	H	%	L	%	VL	%
WOMEN	35	53.	25	38. 5	2	3.1	3	4.6	29	44. 9	47	39.	4	3.4	14	11. 9
DISABLED	10	41.7	6	25.0	4	16.7	4	16.7	10	31.2	13	40.6	2	6.2	7	21.9
YOUTH	36	62.	18	31. 0	1	1.7	3	5.1	29	64. 5	11	24.	2	4.5	3	6.6
ELDERLY	19	67	8	28 .6	1	3.	0		22	62 .8	11	31	2	5. 7	0	0
TRADERS	33	60	14	25 .4	2	3.	6	10	29	51 .7	18	32	3	5. 4	6	10 .7
CIVIL SERVANTS	13	59.1	6	27.2	1	4.5	2	9.1	14	41.2	12	35.2	5	14.7	3	8.8
	KOGI STATE								FCT							
CATEGORY	VH	%	H	%	L	%	VL	%	VH	%	H	%	L	%	VL	%
WOMEN	33	49.2	29	43.3	1	1.5	4	6.2	75	69.4	27	25.0	3	2.8	3	2.8
DISABLED	11	40.7	12	44.4	1	3.7	3	11.1	18	52.9	10	29.4	3	8.8	2	5.9
YOUTH	21	60.0	8	22.8	2	5.7	4	11.4	29	61.7	14	29. 7	3	6.4	1	2.1
ELDERLY	17	60.	9	32. 1	2	7.1	0	0	28	68. 3	12	29. 3	1	2.4	0	0
TRADERS	29	48.	17	28. 3	5	8.3	9	15. 0	25	49. 0	20	39. 2	1	1.9	5	9.8
CIVIL SERVANTS	32	72.	8	18. 2	4	9.1	-	0	25	54. 3	11	23. 9	7	15. 2	3	6.5

Source: Fieldwork (2018)

Between 70% to 80% percentage of the respondents in most categories indicate that there is Very High or High level of unemployment in the Zone. This is depressing because almost all the poverty Alleviation Schemes of government, from NAPEP to NDE and others have continued to target the issue of unemployment in Nigeria

It was observed that the highest percentage of 72.7% concurrence on the issue of unemployment was recorded from Kogi State showing that out of the four states surveyed, unemployment may be more endemic in Kogi State.

Table 5: Access to free education from Primary to Junior Secondary School

	NIGER STATE				NASARAWA STATE				KOGI STATE				F.C.T			
CATEGORY	Yes	%	No	%	Yes	%	No	%	yes	%	No	%	Yes	%	No	%
WOMEN	1	1.5%	64	98.5%	4	3.4%	114	96.6%	2	2.9%	65	97.1%	1	0.9%	107	99.1%
DISABLED	3	1.25%	21	98.75%	1	3.1%	31	96.9%	2	7.4%	25	92.6%	4	11.8 %	30	88.2%
YOUTH	-	0	58	100%	1	2.2%	44	98.8%	-	0	35	100%	1	2.1%	46	97.9%
ELDERLY	1	3.6%	27	96.4%	-	0%	35	100 %	1	3.6%	27	96.4%	2	4.9%	39	95.1%
TRADERS	-	0	55	100%	-	0%	56	100%	-	0	60	100%	-	0	51	100%
CIVIL SERVANTS	3	13.6%	19	86.4%	1	2.9%	33	97.1%	2	4.5%	42	95.5%	4	9.1%	42	90.9%
TOTAL	8	3.2%	244	96.8%	7	2.2%	313	97.8%	7	2.7%	254	97.3%	12	3.7%	315	96.3%

Source: Fieldwork (2018)

From the Table above, 100% of Youths in Niger and Kogi State indicated that they never benefited from any free education program. Also 100% among the Traders/ Artisan group across the entire four states indicate that they have not benefitted. It is appalling that almost all the respondents (over 96% in all the states) indicated that neither they nor any of their relatives are beneficiaries of any free education scheme of government. This near total absence of the effect of the free education policy indicates that to a very large extent, the target population who are supposed to be beneficiaries of the policy have not benefited from it or do not believe that there is free education. This is in spite of the fact that free education in one form or the other has been one of the most acclaimed effective poverty alleviation policies of successive governments in Nigeria

5.2 Analysis of research question 2- What are the causes of poverty in the North Central Nigeria?

Having identified the ways poverty manifest in the North central zone of Nigeria, the next question that comes to mind naturally is what the root causes of the poverty are. However, for an in-depth comprehensibility, a glance at the history of the zone suffices. While Nigeria is described herself as the giant of Africa, as it were, it is equally identified as one of the most poverty-stricken nations around the globe. In fact, it has been often referred to as the poverty capital of the world.

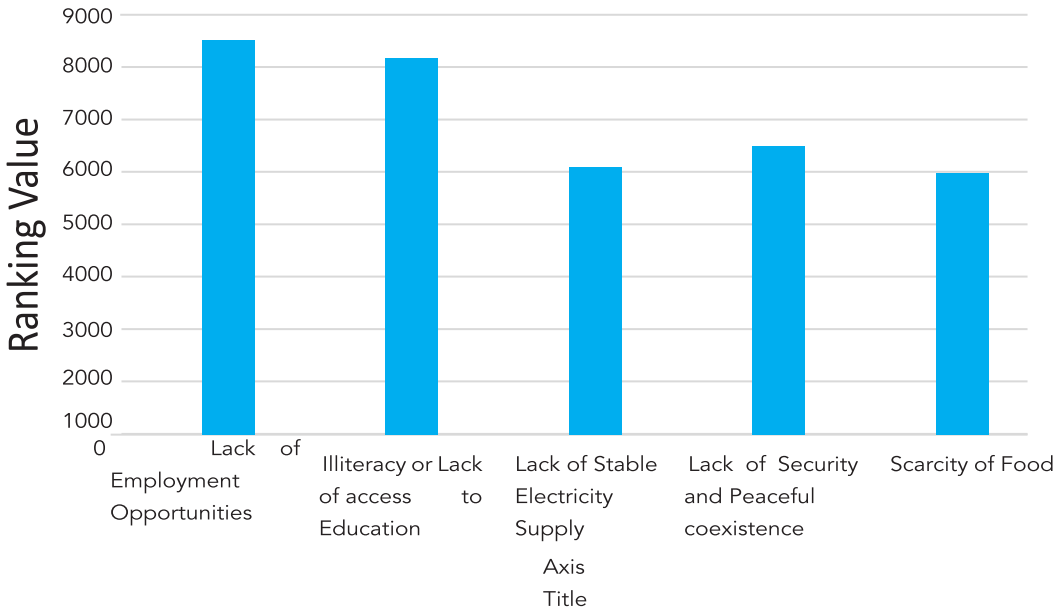
Ample evidence has shown that the poverty menace is most critical in the Northern part of Nigeria. This Northern region has 19 States, and these States are politically delineated into three (3) zones- North East, North West and North Central. The North Central consists of the six states of Kogi, Nasarawa, Niger, Benue, Kwara and Plateau. Apart from the FCT, the other five (5) states consist of mostly rural and peripheral populations made up of the original indigenous natives of the area. The table below and the subsequent figure display the root causes of poverty in North Central Nigeria.

Table 6: Ranking of Causes of Poverty

Items	Niger State	Nassa rawa State	Kogi State	FCT	Total Score	Bar chart score -10000
Lack of Employment Opportunities	689 (2)	651 (1)	368 (1)	612 (1)	2317 (1)	7683
Illiteracy or Lack of access to Education	530 (1)	744 (2)	612 (2)	782 (2)	2668 (2)	7332
Lack of Stable Electricity supply	1123 (3)	1240 (5)	1193 (4)	1224 (3)	4780 (4)	5220
Lack of Security and Peaceful coexistence	1123 (3)	930 (3)	1071 (3)	1258 (4)	4382 (3)	5618
Scarcity of Food	1218 (4)	1115 (4)	1346 (5)	1224 (3)	4903 (5)	5097

Source: Fieldwork (2021)

The Survey shows that lack of employment opportunities was ranked number one out of the five possible factors put forward to the people as to what could be most responsible for their poverty state



5.3 Analysis of research question 3- What are the preferred poverty alleviation policies in the North Central Nigeria?

The various governments in Nigeria especially at the federal government level have put up some policies and programs geared towards eradicating the poverty situation of Nigerians in general and the North central geopolitical zone is not left out.

These efforts of the government are well documented and most times acknowledged hence the tabular presentation of some of these policy programs for easy referencing.

Table 7: Government Poverty alleviation policies and programmes (2000- Date)

Program	Year Established	Target Group	Nature of Intervention
Poverty Alleviation Programme (PAP)	2000	Unemployed Youths	Reduce unemployment and crime wave; creating a credit delivery system for farmers; increasing adult literacy rate and healthcare delivery; training and settlement of university graduate; developing small industries;
NAPEP	2001	The Underprivileged in the society	Youth Empowerment Scheme (YES); Rural Infrastructure Development Scheme (RIDS); Social Welfare Service Scheme (SOWESS); Natural Resources Development and Conservation Scheme (NRDCS).
National Health Insurance Scheme (NHIS)	2004	The entire society	To provide easy access to health services
National Economic Empowerment strategy (NEEDS)	2004	The poor and Underprivileged in the society	Government reformation, growing private sector, access health education, welfare, employment, empowerment, security, and participatory governance
Home Grown School Feeding Programme (HGSFP)	2004	School Children	To encourage and Improve education of children
Conditional Cash Transfer Program	2007	The Poorest of the poor and Unemployed	To benefit poor and vulnerable households with a monthly stipend
Youth Enterprise with Innovation in Nigeria (YOUWIN)	2011	Youths with Entrepreneurial Skill	To finance winning business plan
Subsidy Reinvestment and Empowerment Program (SURE-P)	2012	The entire society	To carry out Infra structural projects and provide employments for unemployed youths
N-Power	2016	The Nigerian Youths	Empowering Nigerian Youths

Source: Author's Compilation

These well documented efforts of the government have existed side by side with the colossal incidence of poverty in the country and especially the North central sphere of the nation hence the need to ascertain the policy preferences of the people to mitigate the impact of poverty on them and by extension eradicate poverty in their lives.

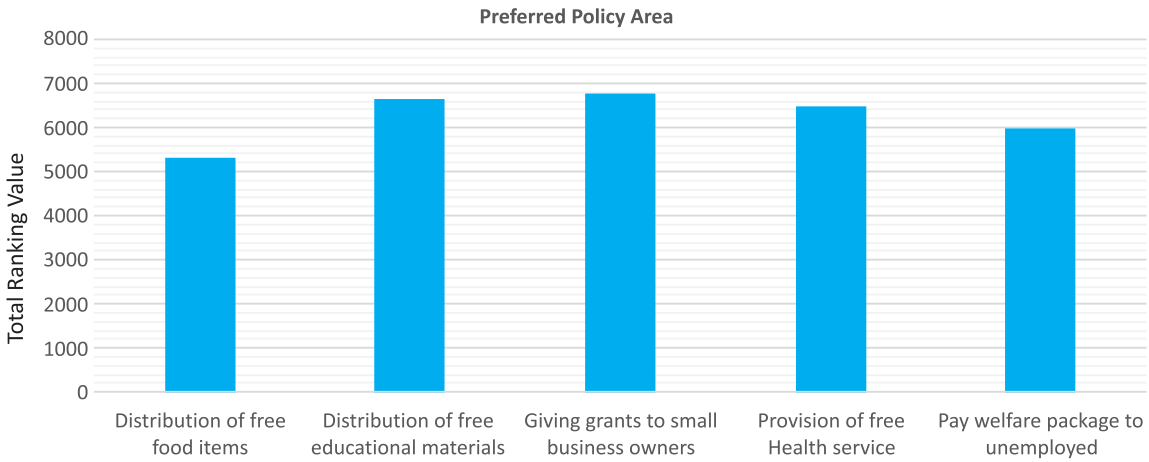
The table below is a presentation and representation of the preferred government policy efforts and initiatives for the eradication of poverty in the North central sphere of Nigeria.

Table 8: Ranking of Preferred Policy Area

Items	Niger State	Nassarawa State	Kogi State	FCT	Total Score	Bar chart score - 10000
Distribution of free food items	1123 (5)	1147 (5)	1346 (5)	1088 (4)	4704 (5)	5296
Distribution of free educational materials	874 (2)	837 (2)	704 (1)	952 (2)	3367 (1)	6633
Giving grants to small business owners	624 (1)	868 (3)	918 (4)	986 (3)	3396 (2)	6604
Provision of free Health service	967 (3)	806 (1)	826 (3)	918 (1)	3517 (3)	6483
Pay welfare package to unemployed	1092 (4)	992 (4)	796 (2)	1156 (5)	4036 (4)	5964

Source: Fieldwork (2018)

Fig. ii. Extrapolation of the preferred poverty alleviation policy options for North Central Nigeria



When the overall total scores given to each policy area are cumulated across the four states, support for education comes out as having been ranked higher than other areas of intervention. This is followed closely by grants to small businesses and free healthcare services.

6.0 Summary of Findings

This study made three findings alongside the three objectives of the study. Firstly, it was found that poverty in the North Central Nigeria manifest mostly in the unaffordability of food items, lack of access to education and lack of employment opportunities. In general terms, it can be said that many people in the North Central zone find it difficult to afford three square meals a day, a most basic need of life, as majority of the people cannot afford the prevailing high prices of most food stuff such as rice, beans and tomatoes, talk less of cooking oils, milk and sugar. This has been blamed largely on the agrarian lifestyle of the people of the other five states outside the FCT. The implication of this is that government still has a lot to do in the area of support for agriculture and improvement of the economic welfare of the

people. Such support for the farming population will help to alleviating the pervasive poverty in the area.

In the area of education, most respondents indicated that they have not benefited from the free education policies of government. An overwhelming 96% of all the respondents across the region indicated that neither they nor their relatives were beneficiaries of government's much touted free education policy. There can be no meaningful development or social upliftment without giving proper attention to the issue of education.

What can be most blamed as being the major cause for the poverty state in the North Central.? The study found that though the causes of poverty in the north central zone are multidimensional, from the responses received and what was observed on the ground, unemployment is the leading cause of poverty in the zone. Unemployment surely contributes to the misery index of the Zone. Graduates of many years are roaming the streets in search of jobs. Lack of an enabling environment for businesses to thrive as well as lack of Foreign Direct Investments (FDI) in the area has worsened the situation as government alone cannot provide jobs for everyone.

This issue of unemployment or lack of jobs is major cause of concern because it leads to other socio-economic vices such as kidnapping, racketeering of all sorts, militancy, thuggery, general insecurity and other violent crimes. About 21.7 million Nigerian youths are on the street suffering all manners of dehumanization in a country in their quest to get a paid job, unfortunately, the unemployment rate been on the increase (Anyebe, 2016,; Yomi, 2020). For instance, within 27 days of opening its portal, the Police Service Commission (PSC) received 806,646 applications of potential recruits into the Nigeria Police Force. In another setting, about 800,000 graduates submitted applications to the Independent National Electoral Commission seeking to fill only 1,500 available job slots in the commission. The effect of this increase in the rate of unemployment has further exacerbated the poverty situation of the people of the North Central Zone. That unemployment levels remain very high simply indicates that government policies have been ineffective in the area of job creation.

Poverty Alleviation Policy preferences indicate that the people are not as interested in 'hand outs' such as distribution of free food or payment of welfare packages as in support for education and grants to small businesses. This implies that in the fight against poverty people recognize that education holds the key to lifting them out of poverty. Lack of education can also be directly linked to the issue of unemployment because without basic education there is a limit to employability and the ability to develop any high-level skills; education remains key.

8.0 Conclusion and recommendations

The embarrassing paradox of poverty in the midst of plenty in Nigeria suggests the compelling need for a single-minded pursuit of the objective of poverty alleviation and its eventual elimination. This means that government at all level must do more in terms of formulation, proper implementation and funding of its poverty alleviation policies and programs. The research was able to establish that the causes of poverty in the North Central zone are multifarious and multidimensional and interconnected. Basic human needs such as food and are still posing a challenge in the zone owing mostly to the high rate of unemployment. Unemployment is at an unacceptable level in Nigeria and must be targeted and tackled holistically by government Employment in this case goes beyond the issue of working a paid job. Unemployment is not joblessness. Tackling the alarming rate of unemployment will require creating a social and economic environment that

can get our youth employed in wealth creating ventures which can provide for their daily needs. Also the free basic education policy of government must be vigorously pursued as this is the basis of all meaningful development efforts. The study is a wakeup call, to dealing with these areas that contribute to poverty of the majority.

On the other hand, critical infrastructure like electricity, water supply and healthcare centres and others that would have served as catalyst for economic growth and poverty alleviation, remain in very poor state of lack and decay and as such aggravate the poverty condition across the country. Adequate infrastructure serves as the needed catalyst for any economic growth and poverty alleviation. Infrastructure and other social services lay the needed foundation upon which to build any meaningful poverty alleviation effort. These are not even there. Instead the elite in the society and policy makers in government and some few powerful individuals, politicians and business moguls have hijacked the system and get all the benefits. As described by other researchers such as Jacob and Onwughalu (2005), the situation is a process marred by corruption, misplacement of aims and objectives, unnecessary duplication, declarative statements without a rigorous political will, nepotism and cronyism leading to waste of resources

Poverty alleviation policies have failed to reduce poverty in the North-Central geopolitical zone. The various poverty alleviation programs enunciated and implemented by successive governments could be said to be akin to mere window dressing as their impact on the target population have left much to be desired. This failure is already dealing dire consequences in increased rates of armed robbery, kidnapping, banditry and even terrorism. The people must be empowered and urgently too. Government may not be able to do this alone and should therefore concentrate on creating an enabling environment for private investors, for Public Private Partnerships, and Foreign Direct Investments.

These will promote economic activities, agricultural production, artisanship and overall economic development as well as provide jobs and employment which will improve the economic wellbeing of the people of the North Central Zone and the nation in general.

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Impact of Fiscal and Monetary Policies on the Performance of the Nigerian Stock Market

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Abstract

This paper examines the impact of the interaction between fiscal and monetary policy on Nigeria's stock market performance for the period 2011:M11 – 2019:M12. Bounds test results indicate a long run relationship among the variables. Further results indicate that the Nigeria's all share index is increasing in government expenditure in the short- and long-run but increases with interest rate in the short run only. Government revenue has a negative impact on ASI in the short run suggesting that the revenue generating activities of government cause a crowding out effect in the market. The study therefore recommends the synchronization of both policies in any model intended for formulating stock market policy because the interactions of both policies affect the behavior of the stock market in Nigeria.

Keywords: Autoregressive distributed lag, Fiscal policies, impact, monetary policies, stock market,

JEL Classification: C01, C22, E12, E42, G14, G38

1.0 Introduction

Nigeria is the largest economy in Africa; ranked twenty-seventh amongst the world's economy based on nominal GDP (World Bank, 2020). A major contributor to the development of the economy is the capital market. As an example, market capitalization was less than 4 trillion naira in 1996 but has grown to over 20.330 trillion naira by week ended April 9, 2021 (CBN, 2021). The capital market is critical for long-term economic growth, and wealth distribution (Balami, 2015). It is the bridge that connects the real and financial sectors. It is vital for economic growth as it facilitates real sector activities through long-term financial intermediation in the economy (Cytonn Report, 1999; Osaze, 2000).

Fiscal and monetary policies are two major macroeconomic policy management tools often use to achieve set macroeconomic objectives. (Ilori, 2013). At the center of the argument of fiscal-monetary policy is the proposition that there exist externalities or spillovers between both policies to the effect that a change in one of them would influence the position and overall effects of the other. Externalities can be positive or negative; a negative externality occurs when a cost spills over while positive externality occurs when a benefit spills over. For example, an expansionary fiscal policy can be a negative externality to a contractionary monetary policy regime and vice versa. Two channels were explained as being responsible for the existence of these externalities: how expansionary fiscal policy (monetary stance) impacts on monetary policy instruments and targets (fiscal policy) (Oye and Alege, 2018). The existence of these externalities is the reason why several authors (Chatziantoniou Dugft, and Fillis, 2013, and Nwaogwugwu (2018) amongst others) have argued that neither monetary policy nor fiscal policy should be investigated in isolation and that both policies influence stock market behaviour.

The impact of monetary policy on stock return is via five channels, viz: credit, interest rate, exchange rate, wealth and monetary aggregate (Mishkin, 2001; Bernanke & Kuttner, 2005; Agnello & Souse, 2010). According to the Keynesian economics, fiscal policy affects the stock market by supporting aggregate demand, thereby advancing the economy, and increasing stock prices. Conversely, in the view of classical economics, fiscal policy instruments effects in terms of crowding out the loanable funds market, can hamper the real sector and drive down stock prices.

This study investigates the interaction effect of fiscal and monetary policies on stock returns in Nigeria, and the individual effect of each policy on stock market performance. To achieve this objective, the autoregressive distributed lag (ARDL) bounds test approach to cointegration is adopted. The impact of monetary and fiscal policy interaction on stock market performance is not new in literature, though; the current study contributes to extant literature by using higher frequency data, specifically monthly data and focuses on Africa's largest economy. The currency of this study puts it in a vantage point to provide clue to government whether to continue current lines of action or chart a new path.

The remainder of the study is structured as follows: Section 2 is literature review; Section 3 is data and methodology; Section 4 has the results and discussion, and Section 5 concludes and provides policy recommendations.

2.0 Literature Review

As mentioned previously, policies from monetary authorities can affect stock market behavior through five avenues: monetary, wealth, and credit, as well as interest and exchange rates. In addition, there are three aspects of the theory on the relationship of fiscal policy and stock market: Keynesian positive effects; the crowding out effect (COEH); and the Richardson neutrality hypotheses (RNH) (Lawal et al., 2018).

The literature identifies two transmission channels, the nexus between inter-temporal budget constraint and monetary policy; and fiscal policy-monetary variable nexus as the two main channels through which fiscal-monetary policy interaction affects the stock market (Chowdhury, 1994; Darrat, 2008; Chatziantoniou, et al. 2013). As also stated earlier, neither monetary policy nor fiscal policy should be investigated in isolation from each other as both policies exert influences on the performance of the stock market as such, they can best be studied by investigating the interactions between them.

2.1 Theoretical Literature

Theoretically, monetary policy shock affects the behavior of the stock market through interest rate, credit, wealth, exchange rate, and Tobin's q channels, with the stock market providing useful signal for monetary policy through economic agents' expectation formation about future changes in macroeconomic fundamentals (Lawal, et al., 2018).

The interest rate channel explains how perturbations to interest rate affect firms' cost of capital and transmits into stock prices by altering the discounted net cash flows. For instance, a tight monetary policy results in rise in interest rate and induces lower stock prices through a decline in the discounted cash flows of the firm.

The credit channel recognizes that altering interest rate affects investment and stock prices. It works through the level of corporate investment and postulates a positive relationship between corporate investment future cash flow and firms' market value. Another transmission channel is the wealth channel, which explains how monetary policy affects stock market performance. The approach rests on interest rate as the driver of stock prices such that increasing interest rate reduces stock prices.

For exchange rate channel, higher interest rate induces exchange rate appreciation and leads to higher import demand as foreign goods become

cheaper, and lower export demand and eventual decline in domestic output. This results in decrease in the value of the form, and lower stock prices.

The Tobin's q investment theory postulates a negative relationship between interest rate and stock prices. When interest rate rises, household income reduces. They sought to reduce expenditure and one way is withdraw funds from equity market resulting in decline in the demand for equities/stock, leading to lower trading activities in the stock market thus, putting a downward pressure on stock prices.

Darrat (1988), Shah (1984), Blanchard (1981), and Tobin (1969) laid the theoretical foundation of the relationship between fiscal policy and stock market performance. The framework is in three perspectives: first, the Keynesians who advocate a positive relationship between the two. Fiscal authorities can use some discretionary measures to favorably change rate of interest, and improves stock market performance; second, the classicists argue that a negative relationship between fiscal policy and stock market performance. This is caused by the crowding out of loanable funds in the market, which deters the activities of private agents; finally, Richardson neutrality hypothesis takes a middle ground position that the ability of fiscal policy to affect aggregate demand, is hampered by the lack of equilibrium that exists between borrowing by the fiscal authority, and savings of rational household agents.

There are two strands of argument regarding fiscal-monetary policy interaction effect (Lawal et al., 2018). The first strand is the co-movement effect and sees monetary and fiscal policies as being complementary or substitute to the other. The contradictory or the competing effect is the second strand. Proponents of this strand see fiscal and monetary policy as being opposed to one another, moving in opposite directions. These movements have general implications for the economy, including the stock market. Melitz (1997) argue that when fiscal and monetary policies move in opposite direction easing (tightening) of one implies tightening (easing) of the other. In the same vein, Wyplosz (1999) argues that the outcome of countercyclical policies when fiscal and monetary policies move in the same direction with stable prices is that one will take the lead, and the other plays a complementary role.
The two channels through which policy interaction affects the stock market are discussed here (Wallance,1981; Chowdhury, 1994; Sargent and Sargent, 1999; Buti et al., 2001; Dedi and Yavas, 2016).

The first strand argues that the nexus between fiscal-monetary policy interaction and the stock market is through the relationship between intertemporal budget constraint and monetary policy, thus recommends tax, debt or seigniorage as the plausible sources of financing fiscal deficits. However, a strong relationship between unsustainable fiscal policy and complementary monetary policy weakens the efficacy of monetary policy instruments, especially insolvent fiscal system with inflationary pressure.

The second is through fiscal-monetary variables nexus. The effect is through exchange rate risk. Exchange rate depreciation increases debt burden and leads to inflationary pressures, which causes interest rate to rise and negatively influences stock prices.

2.2 Empirical Literature

Ojeyinka and Yinusa (2020) adopted the generalized method of moment to study how fiscal and monetary policy interaction affect some macroeconomic variables for the period 1981 to 2018, with focus on Nigeria. From results obtained, the interaction of both policies affected output and inflation negatively and was statistically significant. The study recommended the need for proper policy coordination in Nigeria.
Akwe, Garba, and Dang (2018) focused on twenty-five most capitalized equity firms in Nigeria from 2007 to 2016 and adopted ex post facto research

design with a panel model. The study shows that increasing inflation rate and money supply reduces stock returns in the country.

Ibor et al. (2018) examined the public sector expenditure - capital market development nexus from 1990 to 2015. Using the ordinary least squares technique, the study showed that capital, recurrent and total government expenditure significantly impact on market capitalization, and value of transaction.

Lawal et al. (2018) covered, the period January 1985 to December 2015 and adopted ARDL and EGARCH models to examine fiscal-monetary policy interaction, volatility and stock market returns in Nigeria. The results reveal a long run relationship between stock market, and both policies. Findings from EGARCH shows sensitivity of stock return volatility to volatility in the interactions of fiscal and monetary policy. Nwaogwugwu (2018) employing ARDL bounds testing approach from 1970 to 2016 revealed significant impact of monetary and fiscal policy on the stock market in Nigeria.

Bodunrin (2016) studied how economic growth in Nigeria during the period 1981 – 2015 was affected by both monetary and fiscal policies, first by using VAR and VEC model. Results from a VAR model showed that fiscal policy affected economic growth, though the effect was transient, while monetary policy's impact was insignificant. Results from a VEC model show that both policies had a significant and lasting effect on growth.

Chatziantoniou et al. (2013) adopting an SVAR model and focusing on Germany, the United Kingdom (UK), and the United States (US) for the period 1991Q1 - 2010Q4 reveal that both fiscal and monetary policy measures significantly affected stock markets in these countries.

Ilori (2013) examined the fiscal-monetary policy interactions in Nigeria and how these interactions affect the effectiveness of both policies within the confines of the New Keynesian framework for the period 1970 – 2011 and adopting VAR approach. Results from the study show that both policies appear counteractive for the greater part of the study period, but there is also evidence of accommodativeness at some points. Overall, the study discovered the existence of fiscal dominance in Nigeria.

Evidence from studies in extant literature, especially for Nigeria appears to show that both policies had a significant effect on the economy. It was observed that none of the studies considered the impact of government revenue on the economy in general and the stock market in particular. This is surprising because the stock market is often considered as a forward-looking predictor of future economic performance.

3.0 Data and Methodology

The study data, which spanned the period 2011M11-2019M12 were obtained from the Central Bank of Nigeria (CBN) statistics database. Deviating from what obtains in extant literature, the study used government expenditure (GEX) and government revenue (GR) as proxy for fiscal policy, Money Supply (M2), interest rate (INT), and exchange rate (EXR) for monetary policy, and All Share Index (ASI) for stock market performance. These variables are chosen based on the transmission channels of fiscal and monetary policy. All the data were adjusted for seasonality and the first difference of their log was obtained and used except for interest rate.

The mathematical model is specified as follows:

$$SM = f(FP, MP)$$

where: SM is the stock market behavior with ASI as proxy, MP is monetary policy instruments and FP represents fiscal policy instruments.

This is derived from equation 1 as:

$$\Delta lnASI = \beta_0 + \beta_1 \Delta lnM2 + \beta_2 \Delta INT + \beta_3 \Delta lnEXR + \beta_4 \Delta lnGR + \beta_5 lnGEX + \mu_t \quad \ldots 2$$

Where: $\beta_0 \cdots \beta_7$ are parameters to be estimated; Δ is difference operator (forward); μ_t is error term; and other variables remained as previously defined. Following Lawal et al. (2018), the study adopts a double log model allow for interpretation of

coefficients as elasticity.

3.2 Estimation Procedure

The study employs the autoregressive distributed lag (ARDL) bounds testing approach to cointegration. First, the series were tested for unit root using the Augmented Dickey-Fuller (ADF) and Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) approaches to test for unit root in the series. The essence of the test is to ensure that variables integrated of order higher than one, that is I(2) and above do not enter the model.

Next, we estimate the ARDL bounds testing model. Pesaran and Shin (1999) and Pesaran et al. (2001) developed the ARDL model. The ARDL model was adopted for its flexibility and ability to accommodate mutually integrated series, that is variables that are I(0) and I(1)). It also allows predictors to enter the model with different lags. Another advantage of ARDL approach is that it is comparatively more efficient when dealing with small samples (Babajide et al., 2016; Babajide & Lawal, 2016; Bekhet & Matar, 2013; Ozturk & Acaravci, 2010 and 2011).

The ARDL framework for this study is specified as:

$$(\Delta lnASI_t) = \beta_{01} + \sum_{i=1}^{n1} \beta_{1i}(\Delta lnASI_{t-i}) + \sum_{i=0}^{n2} \beta_{2i}(\Delta lnM2_{t-i}) + \sum_{i=0}^{n3} \beta_{3i}(\Delta INT_{t-i}) + \sum_{i=0}^{n4} \beta_{4i}(\Delta lnEXR_{t-i}) + \sum_{i=0}^{n5} \beta_{5i}(\Delta lnGEX_{t-i}) + \sum_{i=0}^{n6} \beta_{6i}(\Delta lnGR_{t-i}) + \gamma_{11} lnASI_{t-1} + \gamma_{12} lnM2_{t-1} + \gamma_{13} INT_{t-1} + \gamma_{14} lnEXR_{t-1} + \gamma_{15} lnGEX_{t-1} + \gamma_{16} lnGR_{t-1} + \varepsilon_{t1} \quad (4)$$

where: ln is the log operator, β_{01} is intercept; $\sum_{i=1}^{n1}\beta_{1i}$ to $\sum_{i=1}^{n1}\beta_{6i}$ are parameters that measure the short run impact of the predictor variables, $\gamma_{12} \cdots \gamma_{16}$ are long run components; γ_{11} is the speed of adjustment to equilibrium and lies between -1 and 0; $n_1 \ldots n_6$ are lag lengths and ε_{t1} is the white noise error term; other variables remained as previously defined. We test the hypothesis of no cointegrating relation (i.e. $H_0: \delta_1 = \delta_2 = \delta_3 = \cdots = \delta_6 = 0$) against the alternative of co-integration (i.e. $H_0: \delta_1 \neq \delta_2 \neq \delta_3 \neq \cdots \neq \delta_6 \neq 0$). If cointegration exists, then the F-statistics will be greater than the upper bound critical value at 5 per cent level, otherwise there is no cointegration. In the presence of cointegration, we estimate the error correction model, which incorporates the short run dynamics and the long-run relationship into a single framework as follow:

$$(\Delta lnASI_t) = \beta_{01} + \sum_{i=1}^{n1} \beta_{1i}(\Delta lnASI_{t-i}) + \sum_{i=0}^{n2} \beta_{2i}(\Delta lnM2_{t-i}) + \sum_{i=0}^{n3} \beta_{3i}(\Delta INT_{t-i}) + \sum_{i=0}^{n4} \beta_{4i}(\Delta lnEXR_{t-i}) + \sum_{i=0}^{n5} \beta_{5i}(\Delta lnGEX_{t-i}) + \sum_{i=0}^{n6} \beta_{6i}(\Delta lnGR_{t-i}) + \phi ECM_{t-1} + \varepsilon_{t1} \quad (5)$$

The speed of adjustment, ϕ which is expected to be statically significant lies within the range $-1 < \phi < 0$.

3.3 Diagnostic Test

We evaluate the stability and adequacy of the mode using the Ramsey Reset for linearity, the Breusch-Godfrey LM and Ljung-Box Q-Statistics for Serial Correlation, Jarque-Bera test for normality and the CUSUM and CUSUM of squares tests for model stability.

4.0 Results and Discussion

4.1 Descriptive statistics and Pre estimation Tests

Preliminary analysis was carried out on the logged variables and the results are presented in Table 1. The dataset has 97 observations spanning November 2011 to December 2019. From the mean and median values, it is observed that all the data are symmetric, with the exception of GEX and INT. Both GEX and INT are skewed to the left, which explains why their respective means are greater than their median. From the standard deviation, it is apparent that there is no much variability in the data except for INT.

Table 1: Descriptive statistics

	ASI	EXR	M2	INT	GEX	GR
Mean	0.0011	0.0030	0.0036	27.5405	0.0010	0.0011
Median	-0.0010	0.0002	0.0045	26.9123	-0.0102	0.0079
Maximum	0.0658	0.1043	0.0215	31.4761	0.5678	0.8139
Minimum	-0.0747	-0.0080	-0.0151	23.0534	-0.4661	-0.4255
Std. Dev.	0.0241	0.0136	0.0083	2.7848	0.1924	0.1839
Skewness	-0.1539	5.6971	-0.1832	0.1199	0.3817	0.8184
Kurtosis	4.0535	38.7151	2.7806	1.5633	3.7062	6.6421
Jarque-Bera	4.8687	5680.1330	0.7371	8.5747	4.3708	64.4403
Probability	0.0877	0.0000	0.6917	0.0137	0.1124	0.0000
Sum	0.1095	0.2863	0.3534	2671.4240	0.1010	0.1103
Sum Sq. Dev.	0.0557	0.0179	0.0066	744.4849	3.5554	3.2484
Observations	97	97	97	97	97	97

Table 2 reports the unit root test results. Except for INT, which became stationary after first difference, the other variables are all stationary at levels.

Table 2: Unit Root Tests

	ADF		KPSS		
	LEVEL	1ST DIFFERENCE	LEVEL	1ST DIFFERENCE	
Variables	t-statistics	t-statistics	t-statistics	t-statistics	Order (I(d))
Δ(lnGR)	-9.423393*		0.146967*		I(0)
Δ(lnGEX)	-10.24835*		0.295925*		I(0)
Δ(lnM2)	-10.06030*		0.122689*		I(0)
Δ(lnEXR)	-6.415820*		0.111794*		I(0)
INT	2.26324	-8.323762*	1.240729	0.106883*	I(1)
Δ(lnASI)	-8.574768*		0.264171*		I(0)

Note. * represents 1% level of significance. The Asymptotic critical value form KPSS is 0.739000 at 1% level of significance while it is -2.589273 for ADF.

Table 3 presents the bounds test results and it suggests the existence of a long run relationship among the variables. This result agrees with the theory of financial accelerator (Lawal et al., 2018).

Table 3: Bounds Test to Integration

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	12.54424	10%	2.26	3.35
k	5	5%	2.62	3.79
		2.5%	2.96	4.18
		1%	3.41	4.68

4.2 Long- and Short-run Results

Results for the long and short-run relationships are presented in Tables 4 and 5, respectively. The results show that exchange rate is positive but has no significant effect on stock return. This is in tandem with the Asset Market model, which says that there is no interaction or very weak association between the exchange rate and stock market and this could be due to reasons that they may be driven by different factors (Suriani et al. 2015).

Table 4: (Long run dynamics)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXR	-0.085925	0.193326	-0.444456	0.6579
GEX	0.068490	0.034948	1.959792	0.0535
INT	-0.001090	0.000982	-1.110631	0.2701
GR	0.054589	0.041880	1.303455	0.1962
M2	0.369354	0.362424	1.019122	0.3113

For GEX, the coefficient turned out positive but with a borderline statistical significance. The results suggest that a percentage increase in government expenditure growth causes the ASI to grow by 0.06% in the long run. According to (Razin, 2007), government expenditure affects capital market mainly through its effects on the activities of the private sector. This result supports the Keynesian hypothesis. Interest rate turned out negative but statistically not significant indicating that increase in the interest rate, decrease stock market returns in Nigeria. The sign conforms to the Pilinkus and Boguslauskas (2009).

The long run coefficient for government revenue (GR) is statistically not significant, though it has positive sign, suggesting that a percentage increase in government revenue would increase stock market by 0.05 per cent. Lastly for Money supply (M2), the coefficient has a sign but statistically not significant. A 1-percentage increase in M2 would increase stock market by about 0.4 per cent. This is in line with the liquidity hypothesis, suggesting increase in money supply leads to a higher demand for equity and due to its promised higher return over bonds, causing increase in the stock price.

Table 5 presents the results for the ECM model. The coefficients of D(INT(-1)) and D(GR(-1)) are negative and statistically significant.

Table 5: ECM (Short run dynamics)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.024253	0.003919	6.188844	0.0000
D(GEX)	0.027811	0.007771	3.578728	0.0006
D(INT)	0.007197	0.007557	0.952453	0.3438
D(INT(-1))	-0.003948	0.008499	-0.464517	0.6436
D(INT(-2))	0.018118	0.009900	1.830067	0.0710
D(INT(-3))	0.020095	0.010265	1.957636	0.0538
D(GR)	-0.014184	0.011006	-1.288759	0.2012
D(GR(-1))	-0.027193	0.011487	-2.367233	0.0204
CointEq(-1)*	-0.933772	0.104380	-8.945896	0.0000

The elasticities of interest rate in the short run are less than unity; the implication is that policies on interest rate play important role in stock market performance, which supports Lawal et al. (2018). Albeit the impact of INT comes with three months lag. As mentioned earlier, ASI and GEX have a positive nexus with stock market performance both in the long- and short-run. This suggests that if GEX increases, it will most likely generate revenue in the stock market, supporting Ibor et al. (2018), and Lawal et al. (2018). This finding agrees with the position of Keynesian total expenditure. A negative nexus exists between government revenue and ASI, and as explained in sub-section 3.1, this could imply that the revenue generating activities of government caused a crowding out effect in the market with regards to loanable funds,

and this negatively impacted the productive sectors of the economy; which then affected their performances and drove down the prices of their stocks in the short run. In conformity with theory, the ECT is negative and statistically significant. The results indicate that 93.3 percent deviation from long run equilibrium is corrected in the next period.

4.3 Diagnostic Tests

Following Lawal et al. (2018), and Abraham and Ogbonna (2019), this study employs the CUSUM (Cumulative Sum of Recursive Residuals), and CUSUMSQ (Cumulative Sum of Squares) to ascertain stability of the model parameters. For a model with stable parameters over the study period, the CUSUM and CUSUMSQ plots should lie within the 5 per cent critical bound. The plots in Figures 1 and 2, suggest that the coefficients in the model are indeed stable, hence, suitable for long run decisions.

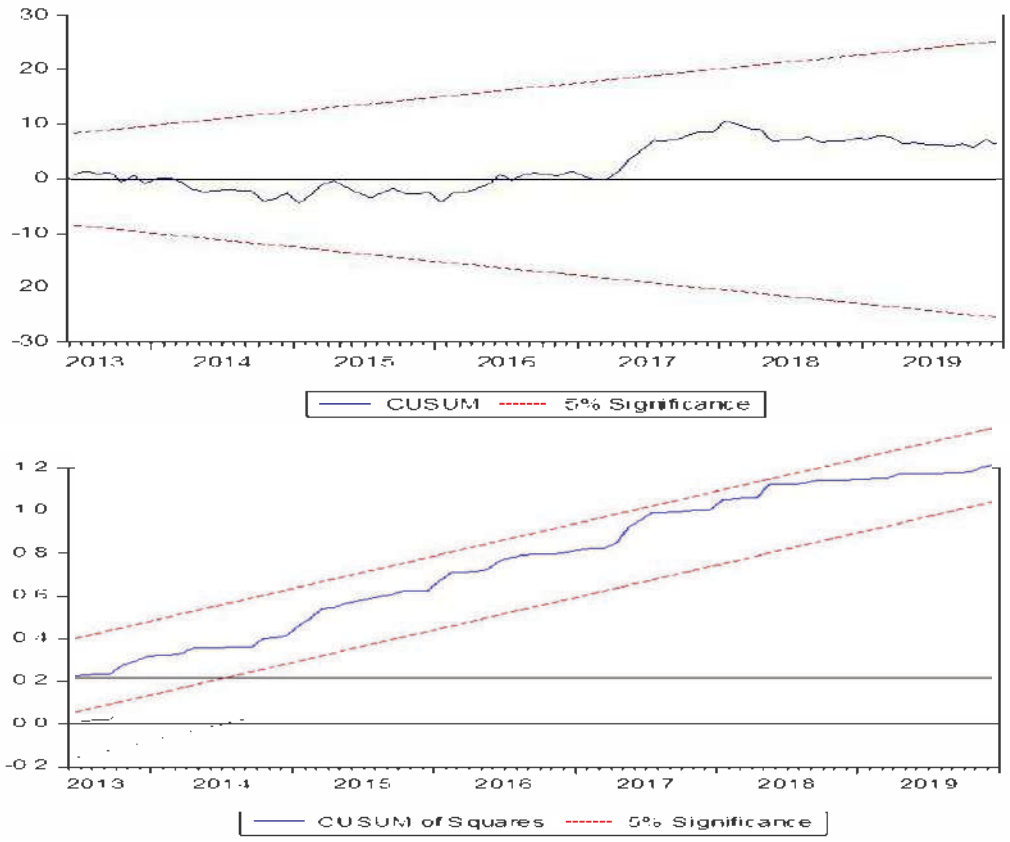
Figure 2: CUSUM of Squares Test

Table 5: Ramsey RESET Test for Linearity

	Value	df	Probability
t-statistic	1.593268	78	0.1151
F-statistic	2.538503	(1, 78)	0.1151

The Ramsey RESET is used to test for model misspecification or linearity in the model parameters. From Table 5, we cannot reject linearity. Homoscedasticity is an important assumption in regression analysis. The Breusch-Pagan-Godfrey test is often used to test homoscedasticity (Table 6) hence the model error variance is homoscedastic. The Breusch-Godfrey LM and Ljung-Box Q-Statistics tests cannot reject the null of no serial correlation (Tables 6) suggesting the absence of serial correlation. Jarque-Bera tests suggest that the model residuals are normally distributed (Figure 3).

Table 6: Serial Correlation and Heteroskedasticity Tests



Lag	Q-stat	Q-squared Stat
1	0.014 (0.907)	2.591 (0.107)
5	1.935 (0.858)	7.293 (0.200)
10	14.492 (0.152)	11.434 (0.325)
BG	0.558 (0.757)	
BPG	16.547 (0.221)	

BG is Breusch-Godfrey langrage multiplier test for serial correlation. The BG test was carried out at lag 2; Q-stat and Q-squared stat are the Ljung-Box Q and Q-squared residual tests for serial correlation. The results are reported for selected lags of 1, 5, and 10; BPG is Breusch-Pagan-Godfrey heteroskedasticity test; Values in parenthesis () are probability values.

5.0 Conclusion and Policy Recommendations

This study investigates the nexus between fiscal-monetary policy interaction and stock market in Nigeria using monthly data from November 2011 to December 2019.

Findings from the ARDL bounds test show that there exists a long run relationship between monetary and fiscal policy and stock market in Nigeria. To this end, the study recommends the incorporation of both policies in any model formulated for stock market policy as their interactions affect stock market in Nigeria.

These findings are in line with works by (Chatziantoniou et al, 2013, Lawal et al. 2018 among others). Further studies can be done to accommodate cross-country analysis in the West African Region.

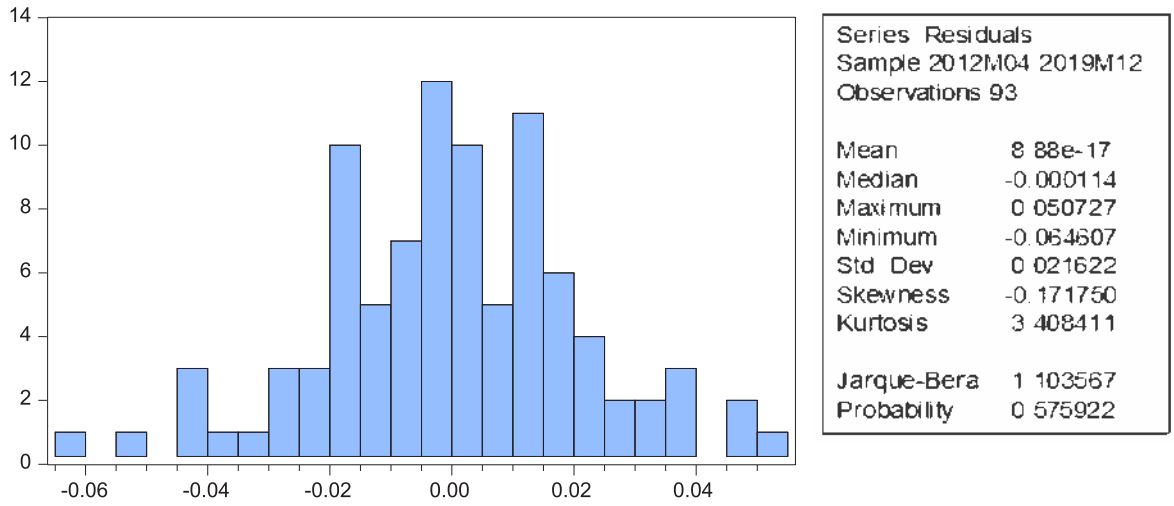


Figure 3: Test for Normality

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Modeling and Forecasting Inflation Rate in Nigeria: A Comparison of Regression with ARIMA Errors and ARIMA Method

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Abstract

The paper aimed to determine the most appropriate method for forecasting inflation rate in Nigeria between Regression with Autoregressive Integrated Moving Average (ARIMA) errors and Autoregressive Integrated Moving Average (ARIMA) method. This study uses annual data for the period 1990-2021 from World Bank. One response variable and three predictor variables are adopted. The best ARIMA method was selected from the competing ARIMA methods using Akaike Information Criterion Corrected (AICC), while the root mean squared error (RMSE) and mean absolute percentage error (MAPE) are used to select the best forecast method between the two methods of interest. The result of this study showed that regression model with ARIMA (0,0,0) errors method is the best method for predicting inflation. The finding further revealed that the inflation rate in Nigeria will rise by 20.08 percent in 2030 and by 2040 it will reduce to 10.00 percent. This study suggests that the government should narrow down an Exchange policy that will help reduce fiscal gap, enhance government revenue, and bride the savings investment gap.

Keywords: Inflation Rate, Regression with ARIMA error, ARIMA, Forecasting, Nigeria

1.0 Introduction

Inflation has been for many years in Nigeria and in many countries in the world an issue of great concern, where complaint from consumers, producers and entrepreneurs, and employees are rising every day. The primary objective of any monetary policy is to stabilize the prices of goods and services, and to make sure there is a sustainable economic growth. In fact, one of the macroeconomic variables that has been difficult to stabilize by many governments of many nations, especially the Nigerian government is price stability. However, individuals, group of people, organizations, and governments have taken it as a responsible on their shoulders to ensure that the persistent increase in prices of goods and services do not interfere with its programmes. All over the world, the Central Banks of nations have the primary obligation in maintaining stability in the prices of goods and services. In the less developed countries, price instability and inflation have been structured in a way that it is regarded as a culture, where the citizens no longer regarded them as a disturbing event.

Inflation rate is the continues rise in the prices of goods and services within a given period of time in a nation (Ojo, 2000; Bayo, 2004), where the rise is constant, enduring and sustained, and all commodities are affected. Inflation can also be seen as a persistent increase in a nation's exchange rate and a continuous fall in the country's domestic currency (Fatukasi, 2012). For many years now, inflation has been a crucial macroeconomic problem that has been affecting the living standard of the citizenry, the economic growth of the country, and various administrations in Nigeria. Inflation has been a major monetary challenge facing developing countries (Jere and Siyanga, 2016). Many researchers such as Paula (2016) and Bawa et al (2016) argued that inflation is caused by external factors such as fluctuations in demand and supply of goods and services and in exchange rate.

Fatukasi (2012) examined the determinants of

inflation in Nigeria for the period 1981-2003. The findings of the study showed that all the predictor variables – money supply, interest rate, exchange rate, and fiscal deficits impact inflation rate significantly; and that the predictor variables accounted for 72 percent changes in inflation rate. Olatunji et al. (2019) investigated the trend of quarterly inflationary rate in Nigeria, using consumer price index for food sector from January 2009 to July 2019. This study adopted the methods of Box-Jenkins, and the findings revealed that ARIMA (1,2,0) and ARIMA (1,2,0) (1,0,0) [12] models were selected as the bests models for forecasting inflation, and that ARIMA (1,2,0) (1,0,0) [12] was more parsimonious and more adequate for forecasting consumer price index.

Rachel and Bahati (2021) examined the trend of inflation and its key determinants in Tanzania, using monthly data from January 1970 to December 2020. Their study adopted three predictor variables – Gross Domestic Product (GDP), Exchange rate, and Money Supply, and a dependent variable Inflation rate. The study applied vector auto regressive model to determine the relationship between the two variables. The study also adopted Granger causality test to determine causal-effect relationship between the variables. The findings of this study showed that both exchange rate and Money supply (M3) have positive impact on inflation rate.

The aim of this study is to obtain the best model that will be used for forecasting inflation rate in Nigeria. The specific objectives were to fit autoregressive integrated moving average (ARIMA) model to the inflation rate, and to also model regression with ARIMA errors to the inflation rate and the predictor variables employed in this study.

2.0 Materials and Methods

The data used in this study are annual inflation series for the period 1990-2021, sourced Central Bank of Nigeria (CBN) Statistical Bulletin and official website of the World Bank.

The paper applied the method of ordinary least square and the Box-Jenkins (autoregressive integrated moving average). Three steps are carried out in order to achieve the aim of this study. Firstly, multiple linear regression is fitted on the data, and since the data are time series, the assumption underlying the regression model when applied to time series data are violated, that is because the error term contains autocorrelation. Secondly, the autoregressive integrated moving average (ARIMA) is applied on the residuals, and finally, a second model that combines the multiple linear regression and autoregressive integrated moving average (ARIMA) with errors is applied.

2.1 Regression analysis

In general, the linear regression model is given as $y_t = \beta_0 + \beta_1 x_{1,t} + \cdots + \beta_k x_{k,t} + \varepsilon_t$ ..... (1) where y_t is a linear function of the k predictor variables $(x_{1,t}, \cdots, x_{k,t})$ or the predictor variable $x_{1,t}$ and ε_t is a white noise (usually assumed to be am uncorrelated error term), and $(\beta_0, \beta_1, \cdots, \beta_k)$ are the parameters. The predictor variables employed in this study are exchange rate (EXHR), interest rate

$$IFR_t = b_0 + b_1(EXHR)_t + b_2(INTR)_t + b_3(GDPR)_t + \varepsilon_t \quad (2)$$

where b_0, b_1, b_2 and b_3 are the parameters in the model and ε_t is the error associated with the data. The b_0, b_1, b_2 and b_3 are estimated by $\hat{b}_0, \hat{b}_1, \hat{b}_2$ and $\hat{b}_3$ respectfully using the Least Squared Method, and the resultant estimated model is defined

$$IFR_t = \hat{b}_0 + \hat{b}_1(EXHR)_t + \hat{b}_2(INTR)_t + \hat{b}_3(GDPR)_t \quad (3)$$

These estimates $\hat{b}_0, \hat{b}_1, \hat{b}_2$ and $\hat{b}_3$ can be obtained using the matrix method as follows, by letting

(x_1), $INTR$ be (x_2) and $GDPR$ be (x_3) and IFR be (y_t)

$$\hat{b}_i = \begin{pmatrix} b_1 \\ b_2 \\ \vdots \\ b_k \end{pmatrix} = (X'X)^{-1}X'Y \quad (4)$$

where

$$X'X = \begin{pmatrix} n & \sum(EXHR) & \sum(INTR) & \sum(GDPR) \\ \sum(EXHR) & \sum(EXHR)^2 & \sum(EXHR)(INTR) & \sum(EXHR)(GDPR) \\ \sum(INTR) & \sum(INTR)(EXHR) & \sum(INTR)^2 & \sum(INTR)(GDPR) \\ \sum(GDPR) & \sum(GDPR)(EXHR) & \sum(GDPR)(INTR) & \sum(GDPR)^2 \end{pmatrix} \quad (5)$$

$$X'Y = \begin{pmatrix} \sum IFR \\ \sum(EXHR)(IFR) \\ \sum(INTR)(IFR) \\ \sum(GDPR)(IFR) \end{pmatrix} \quad (6)$$

2.2 Unit Root Test (Stationarity Test)

In order to investigate the time series data, it must first of all be tested if there is need for stationarity. Thus, if the unit root test is not conducted, and analysis is carried on the time series, the estimates will be wrong. In addition, if the series is stationary without differencing, then, the series is integrated of order zero. A time series is said to be stationary if its mean and variance are time invariant. There are many tests for non-stationarity that have been developed such as Dickey-Fuller (DF), Augmented Dickey-Fuller (ADF), and Phillips and Perron (PP) tests. However, for the purpose of modelling, there is need to test the time series for stationarity. This study employs Augmented Dickey-Fuller (ADF) Unit Root Test.

2.3 Autoregressive Integrated Moving Average (ARIMA) method

ARIMA model is a linear time series model that is applied only on non-stationary data (i.e., data that change with respect to time factor). The "AR" stands for autoregressive process, and is expressed as a function of its past values, the "MA" stands for the moving average process and it is a regression of the random errors on its past values, while "I" stands for integrated.

Stationary AR process: The pth order of AR process denoted as $AR(p)$ can be written as

$$y_t = \delta + \varepsilon_t + \sum_{j=1}^{p} \phi_j y_{t-j} \quad (7)$$

Stationary MA process: The qth order of MA process denoted as $MA(q)$ can be written as

$$y_t = \mu + \varepsilon_t + \sum_{i=1}^{q} (-\theta_i \varepsilon_{t-i}) \quad (8)$$

where y_t is the stationary response variable at times t, $y_{t-1}, \cdots, y_{t-p}$ are response variable at times $t-1, \cdots, t-p$ respectively, $\phi_1, \cdots, \phi_p$ are the parameters of the model AR; ε_t is white noise, $\theta_1, \cdots, \theta_q$ are the weights for the MA process.

However, if the time series data are stationary, there will be no need for differencing. The resultant model will be an ARMA model denoted as $ARMA(p,q)$ and is defined as

$$y_t = c + \varepsilon_t + \sum_{j=1}^{p} \phi_j y_{t-j} + \sum_{i=1}^{q} (-\theta_i \varepsilon_{t-i}) \quad (9)$$

And if the series are non-stationary, then, the data need to be differenced or transformed in order to attain stationarity. The resultant model is an ARIMA model denoted as $ARIMA(p,d,q)$ and is defined as

$$\nabla^d y_t = c + \varepsilon_t + \sum_{j=1}^{p} \phi_j y'_{t-1} + \sum_{i=1}^{q} (-\theta_i \varepsilon_{t-i}) \quad (10)$$

the stochastic process, and is obtained using

$$\nabla^d y_t = (1-B)^d y_t = \sum_{k=0}^{d} \binom{d}{k} (-1)^k y_{t-k} \quad (11)$$

In ARIMA model fitting, the following steps are put in play:

- Plot the graph of the data, then observe for stationarity. If not stationary, then we difference using equation (9).
- Computing the sample ACF and PACF
- Model identification: this involves using Akaike information criterion corrected (AICC) to select the least parsimonious forecast method
- Then carryout a forecast using the selected model

The AICC is obtained as follows:

$$AICc = AIC + \frac{2p(p+1)}{n-p-1} \; ; \; AIC = -2lnL + 2p \quad (12)$$

where L is given as the likelihood in the series, p is the number of parameters in the selected method, AIC is the Akaike Information Criterion, and n is the sample size.

2.3 Regression model with ARIMA errors

Since the error term in equation (2) has time series characteristics, the new equation is given as

$$IFR_t = \beta_0 + \beta_1 (EXCHR)_t + \beta_2 (INTR)_t + \beta_3 (GDPR)_t + \eta_t \quad (13)$$

η_t

$$\eta_t = \delta + \phi_1 \eta_{t-1} + \cdots + \phi_p \eta_{t-p} + \varepsilon_t + \theta_1 \varepsilon_{t-1} + \cdots + \theta_q \varepsilon_{t-q} \quad (14)$$

where the white noise is given as

2.4 Measures of forecast adequacy

This study adopts two measures of forecast accuracies root mean squared error (RMSE) and mean absolute error (MAE) for selecting the required method between the regression model with ARIMA error and ARIMA. RMSE and MAE are written as

$$RMSE = \sqrt{\frac{1}{N}\sum_{t=1}^{N}(y_t - \hat{y}_t)^2} \; ; \; MAE = \frac{1}{N}\sum_{t=1}^{N}|y_t - \hat{y}_t| \; ; \; MAPE = \frac{1}{n}\sum_{t=1}^{t=n} 100 \left|\frac{y_t - \hat{y}_t}{y_t}\right| \quad (15)$$

3.0 Results/Findings

3.1 Time plot and descriptive statistics

Figure 1 shows the time plot for the inflation rate and predictor variables the exchange rate, gross domestic product growth rate and the interest rate, the descriptive statistics of the predictor variables are shown in Table 1. highest interest rate was observed in 1995 as 72.84%, by 2000 it reduced to 6.93%, by 2010 it rose to 13.72%, and by 2021 it rose further to 16.95%. The gross domestic product growth rate was very low because of the covid-19 pandemic.

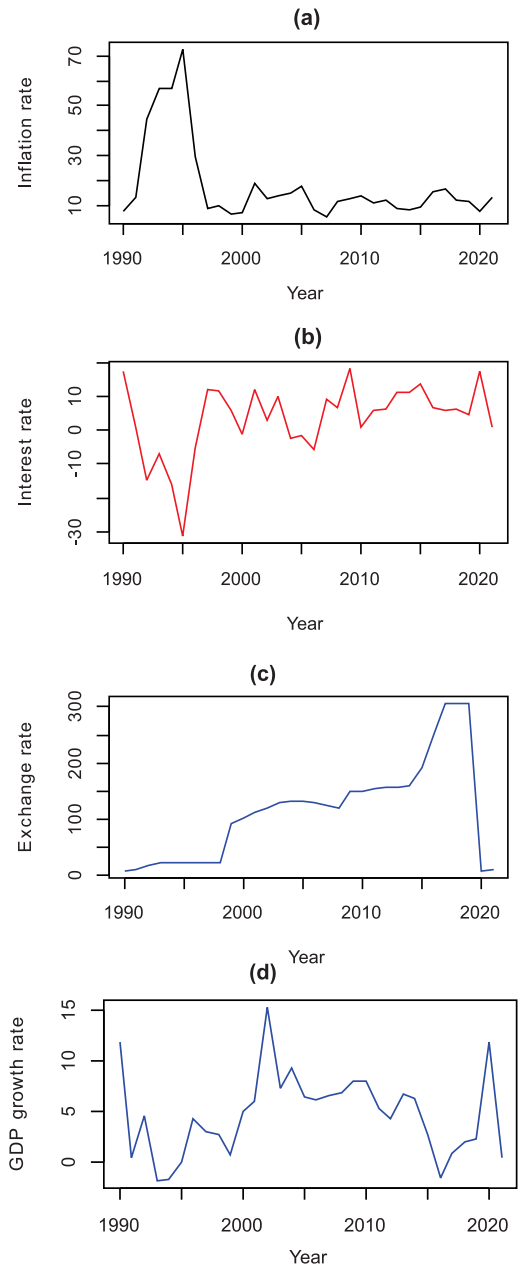


Figure 1. (a) Time plot of inflation rate; (b) time plot of exchange rate; (c) time plot of interest rate; (d) time plot of GDP growth rate for period 1990-2021

Table 1. Descriptive statistics for the predictor variables

	INFR	EXHR	INTR	GDPR
Mean	18.06	137.90	3.518	4.400
Median	12.72	128.94	6.050	4.319
Standard Deviation	16.3656	107.1769	10.4174	4.0130
Skewness	2.1871	0.6192	-1.4016	0.4568
Kurtosis	3.9854	-0.0302	2.7497	0.5939
Jarque-Bera	2.3653	3.1166	1.1533	1.9459
Probability	0.3065	0.2105	0.5618	0.3780

The descriptive statistics of the predictor variables (EXHR, INTR, and GDPR) and the response variable (INFR) in Table 1 shows that the value of the standard deviation in EXHR higher, indicating very high degree of variation in the data. INFR, EXHR, and GDPR have positively skewed distribution, while INTR has a negatively skewed distribution.

The value of the Kurtosis shows that INFR is Leptokurtic because its Kurtosis is greater than 3, while the distribution of the variables EXHR, INTR, and GDPR is Platykurtic (that is because their Kurtosis are less than 3).

Jarque-Bera test for normality states that a distribution is normal if Jarque-Bera probability is greater than 0.05. However, the variables INFR, EXHR, INTR, and GDPR are normally distributed

3.2 Analysis of Multiple Linear Regression

Table 2. Unit Root Test Results

Variables	ADF Value	P-value	Order of Integration	Remark
INFR	-4.2207	0.0141	I (0)	Stationary
EXHR	-5.4647	0.0100	I (1)	Stationary
INTR	-3.6157	0.0480	I (1)	Stationary
GDPR	-4.9085	0.0100	I (1)	Stationary

In ADF test in Table 2, the null hypothesis is that a particular variable contains a unit root. The p-values of the variables are all less than 0.05, however, the null hypothesis is rejected, and this implies that the variables are stationary. In addition, the predictor variables EXHR, INTR, and GDPR are stationary after first differencing.

Table 3. Estimated multiple linear regression coefficient

	Estimate	Std. Error	t value	Pr(>|t|)
Intercept	29.09430	3.45907	8.411	3.79e-09 ***
EXHR	-0.02182	0.01665	-1.311	0.2006
INTR	-1.10774	0.17733	-6.247	9.45e-07 ***
GDPR	-0.95554	0.43435	-2.200	0.0362 *

$\sigma^2 = 8.912$; multiple $R^2 = 0.7321$; Adjusted $R^2 = 0.7035$
F – statistic = 25.51; p – value = $3.672e-08$

Based on the results of the analysis in Table 3, the estimated regression model is given

$$\widehat{IFR}_t = 29.0943 - 0.02182(EXHR)_t - 1.10774(INTR)_t - 0.95554(GDPR)_t \quad (16)$$

The predictor variables EXHR, INTR, and GDPR in Table 3 accounts for 73.21 percent variations in the inflation rate, while the remaining 26.79 percent variations are accounted by other variables not applied in this study. Equation (16) indicates that EXHR, INTR, and GDPR have negative impact on the INFR.

3.3 Analysis of ARIMA method

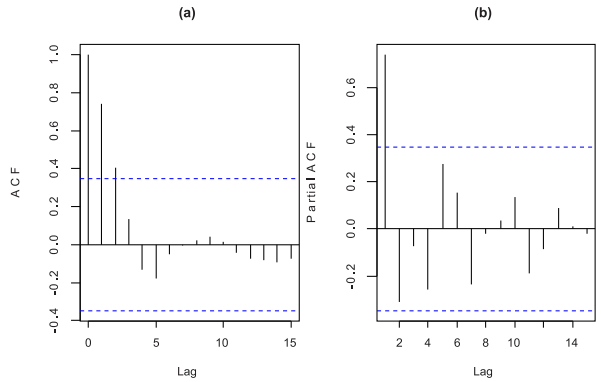


Figure 2. (a) ACF plot for inflation rate (b) PACF plot for inflation rate

In Figure 2a, there is a quick fall of lags at lag 2 as the number of lags increases. This indicate that INFR is stationary. ARIMA (0,1,0) a naïve model in Table 4, has the lowest Akaike Information Criterion Corrected (AICC), making it the best ARIMA model amongst other competitors.

Table 4. ARIMA model selection

ARIMA methods	AICC
ARIMA (2,1,2) with drift	Infinity
ARIMA (0,1,0) with drift	244.9274
ARIMA (1,1,0) with drift	246.6665
ARIMA (0,1,1) with drift	246.5644
ARIMA (0,1,0)	242.6442
ARIMA (1,1,1) with drift	Infinity

Table 5 Estimated coefficients of ARIMA (0,1,0) method

ARIMA (0,1,0)		
$\sigma^2 = 137.1$;	log likelihood = -120.25	
$AIC = 242.51$;	$AICc = 242.64$;	$BIC = 243.94$
$RMSE = 11.52272$;	$MAE = 6.582417$	$MAPE = 100.000$

From results in Table 5, the estimated ARIMA model is given as

$$\widehat{IFR}_t = IFR_{t-1} \quad (17)$$

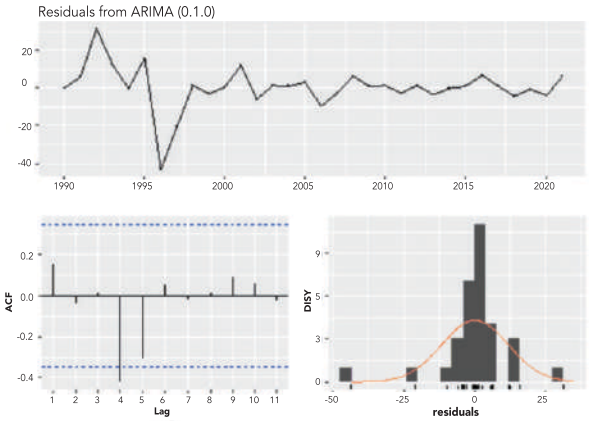


Figure 3. Model adequacy check for ARIMA (0,1,0) method

Table 6. Box-Ljung test for serial correlation

Q statistic = 11.76; degree of freedom = 6; p – value = 0.06715

The plot of the forecast errors in Figure 3 shows evidence of stationarity (that is the variance is constant over time), and the histogram presents a normally distributed forecast error with a zero mean. Even though there is a significant lag in the ACF plot of the forecast errors in Figure 3, the Box-Ljung result in Table 6 shows that there is no evidence of serial correlation in the forecast errors at 5 percent error of significance. With this ARIMA (0,1,0) is considered adequate for predicting inflation.

3.4 Analysis of regression model with ARIMA errors

Table 7. Regression model with ARIMA errors selection

Regression with ARIMA errors methods	AICC
ARIMA(2,0,2) with non-zero mean	Infinity
ARIMA(0,0,0) with non-zero mean	225.1256
ARIMA(1,0,0) with non-zero mean	226.2991
ARIMA(0,0,1) with non-zero mean	226.1742
ARIMA(0,0,0) with zero mean	261.2345
ARIMA(1,0,1) with non-zero mean	229.474

In Table 7, the regression model with ARIMA (0,0,0) has the least akaike information criterion corrected (AICC) of 225.1256 among the competing models. However, it is selected as the least parsimonious regression model with ARIMA error to predict the future inflation. Since the

residuals are ARIMA (0,0,0) process, it can be noted that regression model with ARIMA error is likely to be equivalent to the multiple regression model. Table 8 is the estimated coefficients of regression model with ARIMA (0,0,0) error.

Table 8. Estimated coefficients of regression with ARIMA (0,0,0) method

Regression with ARIMA (0,0,0) errors				
Coefficients:				
	Intercept	EXHR	INTR	GDPR
	30.1953	−0.0357	−1.0906	−0.9210
s.e.	3.3736	0.0189	0.1687	0.4234
σ^2 = 80.86:		log likelihood = −106.31		
AIC = 222.63,		AICc = 225.13:		BIC = 229.63
RMSE = 8.371406,		MAE = 6.362241		MAPE = 95.6621

$$\widehat{IFR}_t = 30.1953 - 0.0357(EXHR)_t - 1.0906(INTR)_t - 0.9210(GDPR)_t \quad (17)$$

The estimated regression model with ARIMA error is given as

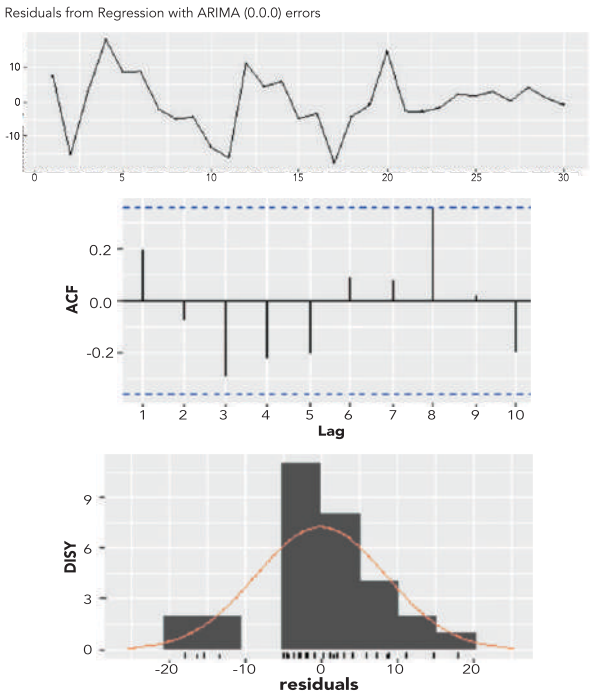


Figure 4. Model adequacy check for regression model with ARIMA (0,0,0) error

The plot of the forecast errors in Figure 4 shows evidence of stationarity (that is the variance is constant over time), and the histogram presents a normally distributed forecast error with a zero mean. The ACF plot of the forecast errors that shows no significant lag and the Box-Ljung result in Table 9 is an evidence that there is no serial correlation in the forecast errors. With this regression with ARIMA (0,0,0) error is considered adequate for predicting future inflation.

Table 9. Box-Ljung test for serial correlation

Q statistic = 8.6865; degree of freedom = 3; p − value = 0.06376

Table 10 . Forecast method comparison

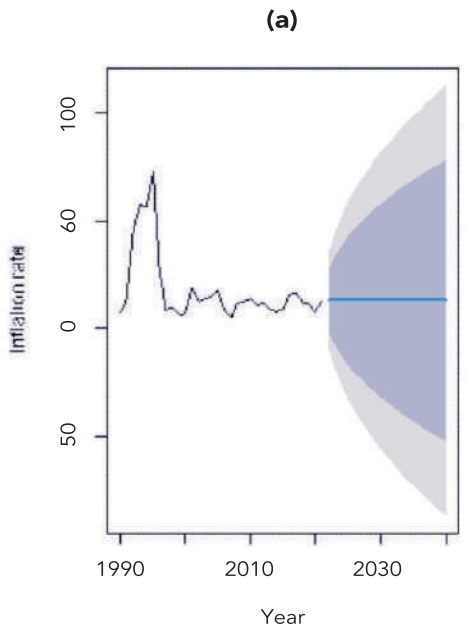
Model	Measures of Forecast Accuracy		
	RMSE	MAE	MAPE
Regression model with ARIMA(0,0,0) errors	8.371406	6.362241	95.6621
ARIMA(0,1,0)	11.52272	6.582417	100.000

In Table 10, the regression model with ARIMA (0,0,0) errors has the least RMSE, MAE and MAPE compared to the ARIMA (0,1,0). Thus, it is considered more appropriate for predicting the inflation in Nigeria.

Table 11 shows the value of the predicted inflation using ARIMA (0,1,0) and regression model with ARIMA (0,0,0) errors. Forecastings INFR using the naïve method in equation (17), the immediate past INFR automatically becomes equal to the immediate past INFR, which forms the baseline inflation forecast.

Table 11. Inflation prediction using ARIMA (0,1,0) and Regression with ARIMA (0,0,0) error

Year	ARIMA (0,1,0) method	Regression model with ARIMA (0,0,0) error
2022	10.271	-0.04
2023	10.271	28.38
2024	10.271	41.70
2025	10.271	39.00
2026	10.271	48.41
2027	10.271	63.90
2028	10.271	31.33
2029	10.271	13.55
2030	10.271	14.48
2031	10.271	19.81
2032	10.271	23.16
2033	10.271	7.60
2034	10.271	8.53
2035	10.271	8.07
2036	10.271	19.73
2037	10.271	21.36
2038	10.271	26.10
2039	10.271	9.60
2040	10.271	12.40



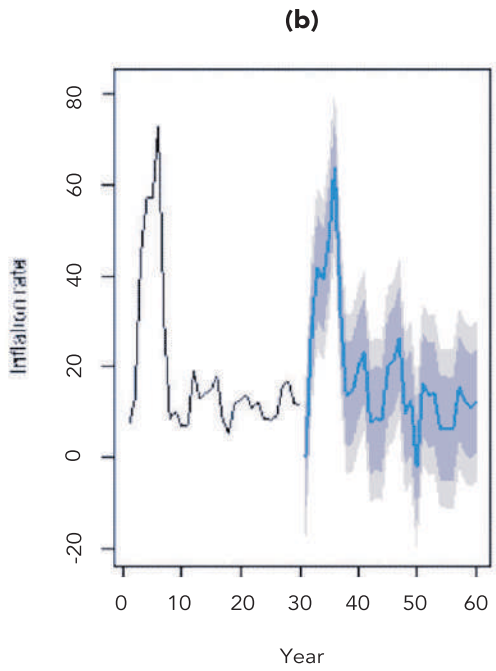


Figure 5. (a) Inflation prediction using ARIMA (0,1,0); (b) inflation prediction using regression model with ARIMA (0,0,0) error

4.0 Conclusion

This paper aims at modeling and forecasting inflation using annual data from 1990 to 2021, and also comparing the performances of two linear time series models. The study identified ARIMA (0,1,0) as the best parsimonious model from the specified ARIMA models, while the regression model with ARIMA (0,0,0) errors is selected as the most parsimonious model among the specified regression models with ARIMA errors. The study however identified regression model with ARIMA (0,0,0) error as the most appropriate model for predicting inflation.

This study recommends that the government should narrow down an Exchange policy that will help reduce fiscal gap, enhance government revenue, and bright the savings investment gap.

And that government should apply policing method in order to ensure that only those with good intention and core values to the real sector would be given attention in the foreign exchange market.

By doing so, this will help in reducing exchange rate. Again, government should establish a good distribution network that will help control price tags on good and services in the market, this will help eliminate distributors that influence price tags on their goods and services by increasing them.

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Rethinking the "Phillips Curve" in Nigeria: Assessing the Unemployment-Inflation Nexus in a Non-Linear Framework

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Abstract

The need to boost economic growth through policies that will simultaneously enhance employment and price stability cannot be overemphasized for a developing economy like Nigeria. This study thus seeks to ascertain the nexus between unemployment and inflation in Nigeria utilizing unemployment, and other control variables between 1980 and 2020 within a nonlinear framework, the study invalidated the inverse relationship. The study thus proposed that government should formulate and implement policies that will stimulate growth through an unemployment-inflation decelerating trajectory.

Keywords: hypothesis, Phillips curve, inflation NARDL, unemployment
JEL classification: C15, C22, E31,

1.0 Introduction

Economies around the world have struggled to contain rising prices and unemployment rate simultaneously through the years. With unemployment and inflation ravaging economies around the world, the phenomenon of the Phillips curve hypothesis (henceforth PCH) has featured in several economic discussions and policy formulations. The Phillips curve postulates inverse unemployment-inflation nexus (Phillips, 1958). The hypothesis proposes a trade-off between the two variables in the short run. The PCH also depicts the trade-off that exists between employment and price stability, which constitutes the primary objective of central banks globally. In an attempt to positively stimulate the economy through expansionary fiscal policies which boost aggregate demand, with rising prices. Firms' revenue will grow as demand and the price of their finished product rise, causing a boom in labor demand. With increased demand for labor, the unemployment rate decreases. The Phillips curve's preposition is therefore justified.

Inflation and unemployment have adversely ravaged the Nigerian economy through the years. As depicted in Figure 1, unemployment rate has been on a rising trajectory through the years. The movements and interactions between these two variables had resulted in several studies in Nigeria (Efayena & Olele, 2020; Aliyu & Jelilov, 2018; Buba & Aljadi, 2017; Kairo et. al., 2019; Anoke et. al., 2021; Salisu et. al., 2018; among others) since a close look at Figure 1 that on the average, unemployment rate and inflation rate are increasing. Global oil market crisis between 2014 and 2016, as well as the ravaging Covid-19 pandemic has triggered a re-appraisal of the PCH in Nigeria.

Figure 1: Nigeria Inflation and Unemployment Rates

Source: Author's computation

There have been conflicting prepositions as regard the unemployment-inflation nexus within the PCH precept. While some studies have found a negative relationship (Aliyu & Jelilov, 2018; Buba & Aljadi, 2017), others have found a positive relationship (Kairo et al., 2019; Anoke et al., 2021) thereby invalidating the PCH in Nigeria.

The contrasting findings have several policy implications for Nigeria. It is important to ascertain the shape or trajectory of the Phillip curve since it is central to policy making. As in the case of most studies in Nigeria, the Phillips curve has generally been specified and estimated linearly. However, with studies such as Callen and Laxton (1998) and Sin-Yu and Iyke (2019), there is need to consider the possibility of estimating the Phillips curve with a nonlinear framework. In fact, even the main proponent of the Phillips curve hypothesis supported the nonlinearity approach.

The philosophy behind the PCH stems from the fact that when labour demand is high and there are few individuals employed, it is expected that employers will raise wage rates quickly, with each firm and sector willing to pay a little in excess of prevailing wage rates in order to attract qualified labour from rival competitors. Meanwhile, soaring unemployment accompanied by low labour demand result in hesitancy on the part of labour to provide service(s) at a rate below the market price. This results in wages rates falling slowly. Thus, according to Phillips (1958), "the relationship is therefore likely to be highly nonlinear" (p. 283).
This clearly shows that a non-linear estimation of the Phillips curve is expected to show the true position of the unemployment-inflation nexus. In addition, the presence or otherwise of the PCH in an economy is better captured in a nonlinear framework.

In spite of these empirical findings, much is left in doubt about the true nature of the unemployment-inflation relationship in Nigeria. The underlying factor is that most empirical estimations of this relationship in Nigeria have adopted a linear technique. The debate that most economic relationships are non-linear in nature has thus motivated the approach of the study. Following this brief introduction, the second section reviews literature thematized along theoretical and empirical literature; section 3 presents methods and data source. While the results are discussed in section 4, the final section proffers policy recommendations.

1.0 Literature Review

1.1 Theoretical Literature

This study hinges on the Phillips curve hypothesis expressed in Phillips (1958) and popularized in Samuelson and Solow (1960). This hypothesis was propounded during the 1950s and 1960s; a period with relative low inflation rate. Since inflation rate oscillated around zero during this period, the hypothesis was of the view that expected inflation will equal zero in the future. The model was thus expressed as:

$$\pi_t = (\varphi + z) - \tau u_t, \quad (1)$$

$$\pi_t{}^e = 0$$

Where;
π_t = actual inflation rate
π_t^e = expected inflation rate
ϕ = mark-up
z = vector of factors influencing wage
u = unemployment rate
τ = coefficient measuring the effect of unemployment rate on inflation rate.

Eq. 1 is the traditional Phillips curve. However, with changes in time have resulted in changes in the expectation of inflation across economies. Ceteris paribus, inflation in the current year is expected to continue into future periods. Employment rate is expected to impact change in inflation rate and not current inflation. This is given as;

$$\pi_t = \pi_t^e + (\varphi + z) - \tau u_t \quad (3)$$

Imposing the assumption that "actual inflation rate" (π_t) equals expected inflation rate (π_t^e) in the presence of a natural unemployment rate, Eq. 3 becomes;

$$(\varphi + z) - \tau u_n = 0 \quad (4)$$

Thus,

$$u_n = \frac{\varphi + z}{\tau} \quad (5)$$

The expression above showed that higher φ (mark-up) and z (wage determinants) results in increased natural unemployment rate. Recall that;

$(\varphi + z) - \tau u_n = 0$. Therefore;

$$(\varphi + z) = \tau u_n \quad (6)$$

Substituting Eq. 6 into Eq. 3 yields:

$$\pi_t - \pi_t^e = -\tau(u_t - u_n) \quad (7)$$

Taking a futuristic view of Eq. 7, expected inflation rate can be captured by the lagged inflation rate (π_{t-1}). Thus, Eq. 7 can be expressed as;

$$\pi_t - \pi_{t\ 1} = -\tau(u_t - u_n) \quad (8)$$

Eq. 8 clearly shows that, ceteris paribus, changes in inflation (π_t - π_{t-1}) relies on the difference between u_t and u_n. The coefficient, τ, shows that the inflation-unemployment nexus is negative under the PCH.

1.2 Empirical Literature

A plethora of empirical studies on PCH in both developed and developing economies with wide variant of methodologies and results. For example, using data of 1975 to 2009, Zaman et al. (2011) validated the PCH in Pakistan. Taking an appraisal of countries in the Eurozone, Sin-Yu and Iyke (2019) estimated short run and long run Phillips curves in 11 Eurozone economies between January 1999 and February 2017. The study found a nonlinear relationship, with an initial negative nexus which subsequently became positive when employment was between 5 percent and 6.54 percent. Beyond the threshold of 6.54 percent, unemployment and inflation are unrelated. This was not different from the study of Villavicencio and Mignon (2013) which found the PCH validated among six developed economies.

Bleaney and Francisco (2017) investigated if the Phillips curve is different in poor countries utilizing a pooled OLS estimation technique. Employing data of between 1990 and 2012 among economies classified on the basis of income, the study found that in high-income economies there is strong evidence of the traditional PCH. Meanwhile, the correlation was relatively weak and statistically insignificant for middle-income and low-income countries. The Phillips curve was also found to be valid in the United States by Ball and Mazumder (2011). Their study established a flattened Phillips curve in the 1984 to 2007 period. Eliasson (2001) confirms a non-linear Phillips curve in Sweden. This is also confirmed in the study of Liargovas and Psychalis (2020) in Greece economy.

However, the study of Zayed, Islam and Hasan (2017) invalidated the PCH in the Philippines, although an earlier study carried out in the Philippines produced a different conclusion.

Fumitaka, Qaiser and Hanafiah (2013) used the data on inflation and unemployment between 1980 and 2010 in the Philippines to investigate the Phillips curve existence or otherwise. Employing the dynamic OLS and the Hodrick-Prescott Filter techniques, the study validated the PCH, clearly indicating the Phillips curve in the Philippines. The study of Lipsa (2012) produced mixed results at both runs. Using the Generalized Method of Moment estimation, the PCH was validated only in the short run in India between 1970 and 2010.

Interestingly, Esu and Atan (2017) carried a study on 29 countries in sub-Saharan Africa between 1991 and 2015. Utilizing a panel data analysis technique, the study found no significant unemployment-inflation nexus, thus showing that the Phillips curve is invalidated in sub-Saharan Africa.

Several studies in Nigeria have adopted various methodologies and have arrived at several conclusions and policy implications as regard the Phillips curve. Most of the studies showed the presence of the Phillips curve. This was exactly the findings of Efayena and Olele (2020) and Rasaki (2017), with each study employing the Generalized Method of Moments (GMM) technique.

Although fairly unstable in nature, Chuku et al. (2017) validated the Philips curve in Nigeria between 1960 and 2009. The empirical study employed the Hansen's hetero-corrected bootstrap technique. Abu (2019) applied a conglomerate of techniques to investigate the PCH in Nigeria between 1980 and 2016. The study establishes a significant trade-off in the inflation-unemployment nexus, and thus in the long run, higher unemployment lowers.

Various studies showed insignificant relationship as was the case of Ogujiuba and Abraham (2013) who employed the generalized error correction model using data of 1970 to 2010 in Nigeria. The outcome was insignificant in the short run. This was also the conclusion reached by Aliyu and Jelilov (2018) and Jelilov et al. (2016).

Buba and Aljadi (2017) also analyzed the long-run inflation-unemployment nexus in Nigeria between 1977 and 2011. As was found in Jelilov et al. (2016), the study validated the Phillips curve hypothesis.

The study of Emmanual (2019) adopted a different methodology in appraising the Phillips curve theory in Nigeria between 1981 and 2017. Via empirical appraisal, the PCH was fully validated. This conclusion was also reached by Goluwa et al. (2019), which employed data between 1985 and 2019 with the OLS framework.

Conversely, utilizing 1980 to 2018 data, the study of Kairo et al. (2019) found that the PCH failed to hold in Nigeria. This finding was corroborated by Anoke et al. (2021). In the same vein, Salisu et al. (2018) also investigated the relationship between inflation and unemployment between 1961 and 2015. There was no significant trade-off. An earlier study by Orji, Anthony-Orji and Okafor (2015) that utilized data between 1970 and 2011 was also in consonance.

From the above debates across economic spheres, it is therefore essential to re-appraise the PCH in Nigeria using nonlinear framework in order to validate its existence or otherwise. Ceteris paribus, this study will have a wide application especially as regards economic policies affecting unemployment and inflation reduction. The need to re-examine the Phillips curve hypothesis in Nigeria along the spectacles of non-linearity comes to the fore given several studies (Ball & Mazumder, 2011; Villavicencio & Mignon, 2013; Sin-Yu & Iyke, 2019; Mladenovic & Nojkovic, 2012; Eliasson, 2001). Since there is no theoretical consensus, this study will employ a non-linear model technique without involving intricacies and complexities of preliminary assumptions regarding functional forms.

3.0 Methodology

3.1. Empirical Model.

The study employed the non-autoregressive distributed lag model (NARDL) to establish non-linearity in the estimation of the Phillips curve in Nigeria. The NARDL shows the linearity or otherwise via partial sum decompositions (Shin et al., 2014; Pesaran et al., 2001). The method conventionally performs beyond other existing techniques such as the Error Correction Model (ECM), Markov-switching ECM and others given that it jointly determines cointegration dynamics and asymmetric movements even in small samples (Katrakilidis & Trachanas, 2012; Romilly et. al., 2001). Further, variables that are stationary at level I(0) or first difference I(1) can be utilized in NARDL estimation.

We first estimate a specification with inflation (dependent variable) unemployment rate, growth in GDP and trade openness as explanatory variables. The specification is expressed as:

$$INF_t = \beta_0 + \beta_1 UNEMP_t + \beta_2 OPN_t + \beta_3 GDPG_t + \varepsilon_t \quad (9)$$

Where;

INF = inflation rate

UNEMP = unemployment rate

OPN = degree of openness

GDPG = growth in GDP

We thus estimated the following NARDL equation:

$$\Delta INF_t = \mu + \rho_i INF_{t-1} + \rho_u UNEMP_{t-1} + \rho_o OPN_{t-1} + \rho_g GDPG_{t-1}$$

$$+\sum_{i=1}^{p} b_i \Delta INF_{t-i} + \sum_{i=1}^{p} c_i \Delta UNEMP_{t-i} + \sum_{i=1}^{p} d_i \Delta OPN_{t-i} + \sum_{i=1}^{p} e_i \Delta GDPG_{t-i} + v_t \quad (10)$$

Where;

Δ = operators in first differences

b_i, c_i, d_i, e_i = short-run coefficients. It should be noted that the decomposition of unemployment rate will determine the asymmetric pass-through of unemployment rate to inflation. Unemployment rate has both negative and positive components. The partial sums of positive change ($UNEMP^+$) and negative change ($UNEMP^-$) are calculated thus;

$$UNEMP_t^+ = \sum_{j-1}^{t} \Delta UNEMP_j^+ = \sum_{j-1}^{t} \max(\Delta UNEMP_j^+, 0)$$

$$UNEMP_t^- = \sum_{j=1}^{t} \Delta UNEMP_j = \sum_{j=1}^{t} \min.(\Delta UNEMP_j, 0) \quad (11)$$

The short run and long run asymmetric relationships are given thus:

$$\Delta INF_t = \mu + \rho_i INF_{t-1} + \rho_a^{+} UNEMP_{t-1}^{+} + \rho_a UNEMP_{t-1}^{-} + \rho_i OPN_{t-1} + \rho_g GDPG_{t-1} + \sum_{i=1}^{p-1} \lambda_i \Delta INF_{t-i} + \sum_{i=0}^{q-1} (\pi_i^{+} \Delta UNEMP_{t-1}^{+} + \pi_i \Delta UNEMP_{t-1} + d_i \Delta OPN_{t-i} + e_i \Delta GDPG_{t-i}) + v_t \quad (12)$$

Where ρ_a^{+}/ρ_i and $L_{UNEMP} = \rho_a/-\rho_i$ are positive and negative coefficients of unemployment rates to inflation, respectively. $L_r = \rho_r/-\rho_i$ and $L_g = \rho_g/-\rho_i$ represent the long-run coefficients of openness and GDPG to inflation. According to Equation (12), long run and short run asymmetries are captured separately by a disaggregation. The expressions below clearly show these;

Short-run asymmetry

$$\Delta INF_t = \mu + \rho_i INF_{t-1} + \rho_a UNEMP_{t-1} - \rho_a OPN_{t-1} - \rho_g GDPG_{t-1} + \sum_{i=1}^{p-1} \lambda_i \Delta INF_{t-i} + \sum_{i=0}^{q-1} (\pi_i^{+} \Delta UNEMP_{t-i}^{+} - \pi_i \Delta UNEMP_{t-i}^{-} + d_i \Delta OPN_{t-i} + e_i \Delta GDPG_{t-i}) + v_t \quad (13)$$

Long-run asymmetry

$$\Delta INF_t = \mu + \rho_i INF_{t-1} - \rho_a^{+} UNEMP_{t-1}^{+} + \rho_a UNEMP_{t-1} + \rho_i OPN_{t-1} - \rho_g GDPG_{t-1} + \sum_{i=1}^{p} \lambda_i \Delta INF_{t-i} + \sum_{i=0}^{q} (\pi_i^{-} \Delta UNEMP_{t-i}^{+} + d_i \Delta OPN_{t-i} + e_i \Delta GDPG_{t-i}) + v_t \quad (14)$$

The bound test will ascertain long run asymmetric cointegration among the cointegrating relationships in Eq. 12, Eq. 13 and Eq. 14. While the Wald test will test long run and short run asymmetries. A rejection of the null hypothesis of asymmetric establishes that the model is asymmetric. In that case, the asymmetric dynamic multiplier in terms of change in unemployment, $UNEMP^+$ and $UNEMP^-$ is given as;

$$m_h^{+} = \sum_{j=0}^{h} \frac{\partial INF_{t+j}}{\partial UNEMP_t^{+}}; m_h^{-} = \sum_{j=0}^{h} \frac{\partial INF_{t+j}}{\partial UNEMP_t^{-}}, with\ h = 0,1,2 \ldots \quad (15)$$

In the above expression,

$$h \to \infty, m_h^{+} \to L_{UNEMP}^{+}, and\ m_h^{-} \to L_{UNEMP}^{-}$$

captures the positive and negative asymmetric long-run coefficients, respectively.

3.2 Data

The study employs data on unemployment rate, inflation rate, growth in GDP and trade openness. The data spans from 1980 to 2020. The choice of this period is to enhance the applicability of inferences drawn from the study. Data were elicited from secondary sources (World Bank database and the Central Bank of Nigeria).

4.0 Results

4.1 Descriptive Statistics

The stochastic properties of the variables are shown in Table 1:

Table 1: Descriptive Statistics

	GDPG	INF	OPN	UNEMP
Mean	6 88	2 75	3 92	4 71
Median	6.11	2.41	3 86	4.06
Maximum	7.04	22.15	4 34	33 31
Minimum	-2 79	6 03	1 09	6 24
Std. Dev.	0.24	0 74	0 34	0 69
Skewness	0 53	0 82	-0 61	0 76
Kurtosis	1.60	2.58	2 27	2.63
Jarque-Bera	4.31	4.87	3 18	4.07
Prob	0 11	0 10	0 17	0 13
Observations	41	41	41	41

Source Authors' compilation

A cursory look of Table 1 shows that GDPG has the highest mean value. This is closely followed by UNEMP, OPN and INF, sequentially. Other than OPN, all other values are positively skewed. The data are normally distributed as seen in the Jarque-Bera statistics.

4.2 Econometric Analysis

The estimated results from the specified model are present in Table 2. For better comparison, we included a symmetric ARDL estimation in addition to the asymmetric unemployment-inflation model. We presented the asymmetric model in three components: long run (LR); short run (SR); and long run & short run asymmetry.

Estimates from the ARDL estimation (Panel 1) show that the unemployment-inflation nexus is positive in the long run. Specifically, at the 5 per cent significance level, a 1 per cent upward movement in unemployment rate spurs inflation rate by 0.69 per cent.

In the short run, a 1 percent growth in unemployment rate increases inflation rate by 0.31 percent and 0.07 percent in the first two periods, respectively. In both short run and long run, degree of openness and GDPG negatively impact inflation rate, although the coefficient was positive for GDPG in the second period.

Table 2: NARDL Unemployment-Inflation Estimation Results

	NARDL			
Variable	Panel 1 Symmetric ARDL	Panel 2 LR Asymmetry	Panel 3 SR Asymmetry	Panel 4 SR & SR Asymmetry
C	-11.92***	-8.43***	-14.06***	-10.05***
	(-3.59)	(-2.82)	(-3.99)	(-3.02)
INF (-1)	-0.49	-0.20	-0.09	-0.71*
	(-0.83)	(-0.71)	(-1.11)	(-1.81)
OPN (-1)	-0.62**	-0.81*	-0.27	-0.01
	(-2.40)	(-1.83)	(-0.91)	(-0.65)
GDPG (-1)	-0.88*	-0.07	-0.57**	-0.15
	(-1.77)	(-0.11)	(-2.84)	(-1.21)
UNEMP	0.69**			
	(2.58)			
UNEMP (-1)	0.03*		0.15**	
	(1.91)		(2.47)	
ΔINF(-1)	-0.19*	-0.18	-0.02	-0.84*
	(-2.01)	(-0.16)	(-0.81)	(-1.90)
ΔINF(-2)	-0.05	0.49	0.09	0.33
	(-1.28)	(1.10)	(1.40)	(1.10)
ΔOPN(-1)	-0.41	0.06	-0.80	-0.58
	(-1.08)	(1.87)	(-1.92)	(-1.26)
ΔOPN(-2)	-0.53*	-0.61	0.55	-0.67**
	(-1.99)	(-0.95)	(-0.72)	(-2.73)
ΔGDPG (-1)	-0.60	-0.02*	-0.42	0.77
	(-0.31)	(-1.78)	(-1.17)	(1.08)
ΔGDPG (-2)	0.33	0.05	-0.82*	-0.37
	(0.72)	(1.13)	(-1.888)	(-0.16)
ΔUNEMP (-1)	0.31**			
	(2.09)			
ΔUNEMP (-2)	0.07**			
	(5.23)			
UNEMP (-1)		1.51*		0.82**
		(1.96)		(2.91)
UNEMP (-1)		1.17**		1.05**
		(2.53)		(2.61)
ΔUNEMP (-1)			2.38**	1.07**
			(3076)	(2.71)
ΔUNEMP (-2)			1.07**	0.04
			(2.54)	(1.99)
ΔUNEMP (-1)			2.80*	0.31*
			(1.89)	(2.01)
ΔUNEMP (-2)			0.26**	0.01***
			(2.61)	(3.07)
L_{UNEMP}	6.08**		7.59***	
	(2.64)		(4.08)	
L_{UNEMP^+}		4.39**		6.48**
		(2.66)		(2.35)
L_{UNEMP^-}		4.02*		2.24
		(1.89)		(0.19)

Source: Author's compilation

Note: *, **, *** signifies statistical significance at 10 percent, 5 percent and 1 percent respectively_ Value in bracket are t-statistics

The long-run asymmetry NARDL estimates presented in Panel 2 is based on the AIC criterion. Based on this criterion, the NARDL (2, 2) specification estimates showed some interesting issues. Both short run and long run period results showed that unemployment rate impacted inflation rate asymmetrically, with $UNEMP^{+}$ and $UNEMP^{-}$ representing positive and negative change of unemployment rate, respectively. Both are statistically significant. A cursory examination showed an asymmetric positive long-run coefficient (1.17), statistically significant at 5 per cent significance level, while that of the asymmetric negative long run coefficient (1.51) shows a statistical significance at the 10 per cent level. These results implied a negative unemployment-inflation nexus in the long run. From Panel 2, the overall model showed an asymmetric positive and negative long-run of 4.39 and 4.02, respectively. The results in Panel 2 also implied a positive unemployment-inflation nexus in the short run in both the first and second periods.

Panel 3 which is the short-run asymmetry estimation showed that unemployment rate impacts inflation positively in the long run, but the impact showed a negative trajectory in the first period of the short-run. In the second period of the short-run, the impact was positive. The results also showed that as was the case in the previous estimations, degree of openness and GDPG negatively affected inflation rate. A combination of the long run and short run asymmetry presented in Panel 4 showed that both long run positive (1.05) and negative (0.82) asymmetries are statistically significant. In all the model shows that inflation asymmetrically responds to unemployment rate.

The findings of this study corroborate with previous studies (Kairo et al., 2019; Orji et al., 2015). A possible reason for this is the adoption of similar methods. In the case of Orji et al. (2015), the study employed the ARDL on data ranging from 1970 to 2011. Comparatively, the findings of this study contrast those of Efayena and Olele (2020). The possibility of this might span from the use of quarterly data as the case of Efayena and Olele (2020). The non-linear estimation is another possible factor responsible for the contrast. This study has clearly shown that the PCH is invalidated in Nigeria when specified in a non-linear framework. The implication of this is that increases in unemployment rate will result in further increase in inflation rate. The findings of the study are highly plausible given that behavior of exchange rates is more appropriately captured in a nonlinear framework since such there are possibilities of the long- and short-run asymmetries (Anderl and Caporale, 2021). In other words, there is a possible possibility of asymmetric adjustments and nonlinearities in most econometric models to long run equilibrium. The nonlinear framework allows for long run cointegrating nexus among the variables as well as short run dynamics, thus allowing the regressors to be decomposed employing the partial sum of negative and positive changes. Another advantage of the nonlinear framework is that it tends to correct for weak endogeneity of non-stationary regressors.

4.3. Diagnostic Tests

The diagnostic tests results were presented in Table 3. The values of the results were satisfactory. The Breusch-Godfrey test showed the absence of serial correlation; the Ramsey RESET showed that there were no omitted variables and the model is functionally formed; the values of the ARCH test showed that the residuals are homoscedastic; while the Jarque-Bera test showed that the residuals are normally distributed;

Table 2: Diagnostic Results

	NARDL			
Variable	Panel 1 Symmetric ARDD	Panel 2 I.R Asymmetry	Panel 3 SR Asymmetry	Panel 3 SR & I.R Asymmetry
Jarque-Bera Test	2.42	1.17	2.37	3.04
	(0.31)	(0.48	(0.30)	(0.41)
ARCH	0.95	0.56	0.89	0.79
	(0.55)	(0.33)	(0.57)	(0.61)
Ramsey RESET	1.14	0.02	0.19	0.06
	(0.27)	(0.91)	(0.84)	(0.54)
Breusch-Godfrey	0.53	0.97	0.19	0.23
	(0.60)	(0.71)	(0.57)	(0.39)

Source: Author's compilation

Note: Value in bracket are p-values

5.0 Conclusion

This study investigated the PCH in Nigeria within a non-linear framework. This was necessitated by sporadic increase in both inflation rate vis-a-vis unemployment rate in Nigeria. The study utilized data of unemployment, inflation, growth in GDP as well as degree of openness in Nigeria between 1980 and 2020. The study utilized the NARDL model to analyze the data. The results clearly showed that the PCH was invalidated in a non-linear modeling framework. The results implied no significant unemployment-inflation trade-off.

It is therefore essential that the Nigerian government pursues employment-generating projects and programmes in order to reduce unemployment directly and the increasing inflation rate indirectly. The government should also adopt fiscal policies that will help improve the level of openness of the economy. One way to actualize this is through export promotion programmes. Such programmes will reduce the output gap in the economy, thus reducing fiscal deficit which might drive price up in the long run.

Due to idiosyncratic nature of the Nigerian economy, efforts should be made to create sustainable and continuous self-employment opportunities in all regions of the country. This can by restructuring the agricultural system through smallholder sub-sector expansion; introduction of appropriate business incentives (financial packages, tax incentives, etc); and capacity building through training and technical assistance. Government should encourage financial institutions to direct resources to the micro sector.

The government should change from a state-driven development strategy to a market-oriented one by harnessing private sector participation as well as diversifying the economy's productive base. In addition, Nigeria should pursue policies that stimulate modern infrastructure such as transport facilities, water and power. This will help develop industrial capacity that will boost exports and generate revenue.

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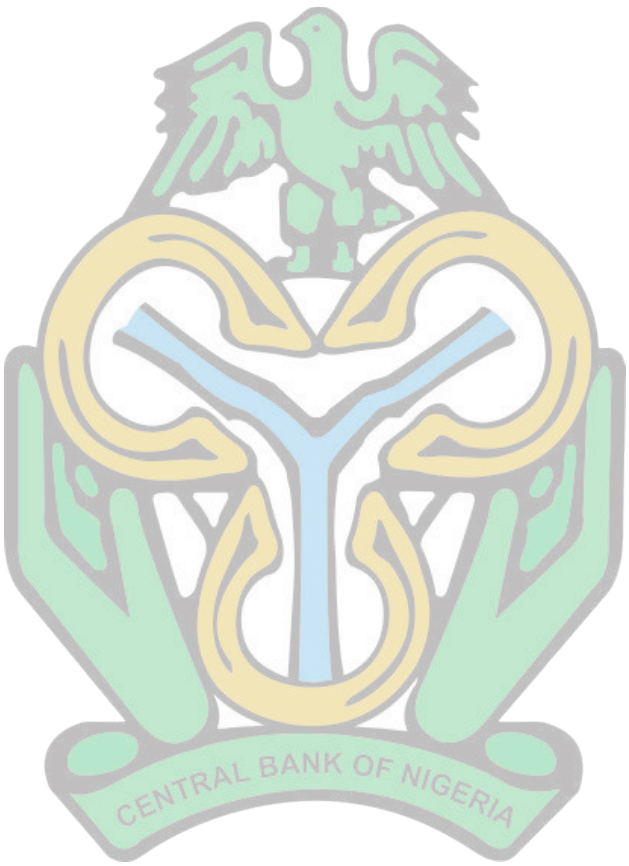
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