INFLATION AND UNEMPLOYMENT IN NIGERIA: AN INVESTIGATION OF THE PHILIPS CURVE

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Abstract
The primary objective of the macroeconomics is the realization and actualization of full employment for the citizens as well as creating an efficient platform (stable) environment for optimal business/economic activities. This can be achieved by reducing the rate of unemployment and maintaining inflation rate in the economy, significantly. Sequel to this notion, Phillips (1950) proposed and inverse relationship between unemployment and inflation. The model of Phillips is known as the Phillips curve theory. The research is geared towards investigating existence of the theory in the Nigerian economic system. Several diagnostics tests have been conducted to determine the nature of data to ascertain the method of data analysis. Some of the tests conducted in the study include optimal lag selection, unit root tests (i.e. ADF and PP), Engle co-integration regression as well as autoregressive regression model using actual variables, log difference and log difference transformation of the variables. The try to build different models to ascertain the one that best fit the data (Model with/without constant, linear and quadratic trend). Hence, the autoregressive regression of log transformation of inflation rate data and log transformation of unemployment and money supply at lag one indicated that each of the variables is significantly related to inflation rate. The Engle co-integration also showed significant long-run relationships between the variables log transformation. This implies that unemployment reduction depends on both inflation rate and monetary and fiscal policies. The control of money supply also enhances economic growth and on the long-run help in reducing unemployment rate in Nigeria. Conclusively, from this study's findings, it is concluded that Phillips curve theory holds in Nigeria since there exist is a trade-off link between unemployment and inflation in the period under review, 1980-2018. Based on the findings the study recommends that government should create efficient platform for business opportunities which subsequently can be translated into unemployment reduction hence meeting up with the inflation trend in the nation.
Keywords: *Inflation, Unemployment, Nigeria, The Philips Curve.*

Introduction

Every nation's objective is to ensure security and economic stability for the citizen to freely invest or to carry out commercial activities. The fulfillment of these goals possibly can be reached by providing opportunities for employment to the citizens (principally the youths) and also providing efficient platform for the stabilization of the economic activities. Fulfillment of this economic model entails the actualization of the macroeconomic objectives (Manu et. al., 2018). Olubaduwe (2009) reported that developing countries especially other Sub-Sahara Africa (e.g. Nigeria) have growing unemployment rates proportionally with high level of inflation. From the macroeconomic perspective, it could be unhealthy for a nation to operate direct link between unemployment and inflation; that is lack of employment increasing with respect to inflation. As serious as they may be, several empirical researches were carried out across the globe to examine the impact as well as the kind of relationship existing between them. In Greece, the link between unemployment and inflation was studied by Dritsaki and Dritsaki (2012); Bill and Anindtya (2008) repeated the same study in Russia. For policy makers, their concern is on how inflation relate with unemployment. One by one, these macroeconomic concepts exert dominant and negative effects on the individuals and on the advancement of the economy. Based on this truth, Phillips (1950), making use of data from United Kingdom and the US postulated a theory or model for explaining the relationship between unemployment inflation. The Phillips curve theory is the outcome of that study.

According to Phillips curve theory, inversely relationship between inflation and unemployment. In this case, is either government ensure that the cost of goods such as food items, medical assessment, household, standard of living, etc. are reduce with relatively high unemployment or there is full employment generation with fairly high costs of goods and services (inflation). According to Phillips curve, to maintain the variables of inflation and unemployment in terms of macroeconomic together may be economically detrimental. In fact, it is economically impossible for any system of government guaranteeing low unemployment rate (that is full employment) and low inflation simultaneously.

Continuous price rise in commodities is known as inflation. When there is persistent rise in the price commodities such as foods, accommodations, tax rates, electricity tariffs. The implicit price deflator for Gross National Product (GNP) or the consumer price index (CPI) is the measurement parameter for inflation. Money seems to lose purchasing value during inflation. When a country is hit by inflation, a given number of naira purchasing power over time will be smaller when the economy is undergoing inflation in. For instance, if fourthousand naira can purchase eight clothes in the market at the rate of five hundred naira, when inflation stets in, the buying strength of four thousand naira may only purchase five clothes at the rate of eight hundred naira. The effect of inflation varies on different people. The fall in the value of money is the causative factor.

Unfortunately, in Nigeria the cost is high and the increasing rate of the unemployed which may have a nexus with poverty, low educational attainment among the citizens, poor economic livelihood. This system of economic notwithstanding has ushered in series of social vices such as kidnapping, raping, robbery, drug addition to mention but these, that the nation is currently battling with which are detrimental to our nation's economic growth. Nigeria as a heterogeneous nation is faced with many challenges ranging from crime and insecurity to economic misfortune. That is, where poverty prevail crime rates and other social vices may increase as well. The tendency of the youths indulging in criminal activities could be a direct consequence of high inflation rate and unemployment in the nation. Wherever there is hunger, people become uncontrollable and at that point can do whatever they can in order to survive (fend for themselves). As important as it may, everyone desires food to be put on his /her table on daily bases. Consequently, it can be justified from this perspective why criminal activities seem to increase with respect to poverty, high inflation and high unemployment (Achinulo, 2017).

There are many postulations trying to explain the concept and the basis of

Nigeria's inflation. Some of the explained causes of inflation include wars, tsunamis, earthquakes, epidemics, demand function, costs of production, and increase in electricity tariff plans, increase in taxation, conventional activities such as Christmas, festivity, etc. In each of the cases above, an ordinary man feels the impact of inflation either directly or indirectly. Some tend to benefit from the presence of inflation while others may lose their income. For example, those in the operate fixed income such as landlord and pensioners who dependent on fixed income lose during inflation while the real estate holders, traders, industrialists, businessmen, speculators and others make gains due to variable incomes prices rises. This is because those with free-flowing income can easily increase the price of their commodities or services in relation to the inflation whereas those with fixed income tend to lose because they cannot change in proportion to the increase in price (inflation) at ease. Coupling inflation with persistent unemployment growth rate will place the populace in a difficult situation. On the above premise, it therefore becomes imperative to investigate the Philips curve proposition to ascertain whether meaning macroeconomic policy could be derived from. Also, the other way round, the monetarists viewed fiscal and monetary policies like money supply to be the key predictor of employment generation. Hence, the study is set to investigate the Philips curve postulation in Nigeria using time series data.

Statement of the Problem

Inflation and unemployment are significant predictors of economic growth and social welfare in any country. The two variables determine the propensity of riches in advanced nations and also in developing nations experiencing poverty (Umaru & Zubairu, 2012). So, it becomes necessary to mutually look for low unemployment and constant price stability. It was understood that stability in price would transform into the creation of employment opportunities, alleviation of poverty and economic growth (Mnyande, 2007). Nonetheless, there was no guarantee on the whole that stability in finance only would accomplish macroeconomic goals independently (Mboweni, 2000). Particularly and notwithstanding, this is true since the nation seriously experiencing increased rate of unemployment and poverty regardless of the fact that the nation tries as much as possible to maintain inflation rates with single-digit. The intention of the study is to establish how choices in monetary policy like targeting in inflation have impacted other variables in macroeconomics, particularly the outcome of employment, in the nation.

Following the Phillips curve model, it is imperative and relevant to investigate whether these macroeconomic objectives can be achieved. Globally, several researches were carried out with the primary aim of examining the truthfulness and the possibility of the existence of the curve model as postulated by Phillips. Both developed and emerging economies have tried to use the theory (Phillips curve) to guide their programs in economics. Further, some of the countries were different studies were carried out to investigate the theory include Denmark, Portugal, Sweden, Spain, Japan, Germany, the Netherlands, Italy, Greece, France, Austria, Finland, Belgium, Ireland, the US and the UK particularly referred to as developed economies. For emerging economies, we have Bangladesh Nepal, Myanmar, Iran, Afghanistan, Sri Lanka, India, Indonesia, Maldives, Bhutan, Malaysia, South Africa and Pakistan, Egypt, Ghana, Zimbabwe, Morocco, Cameron and Nigeria.

For instance, Gordon (1990), using the curve as a veritable model, investigated how unemployment relate to inflation using data from the US. The researcher makes use of the Gordon triangular model (GTM) (Niasken, 2001; Sala & Karanassou 2009). Kitov and Kitov (2013) repeated same study in Japan within the period of 1980-2003. From the study it was discovered that unemployment growth result to inflation decline, thereby supports the Phillips curve predictions in its novel form. Fagge (2011) studied how inflation relates to joblessness in Nigeria from1965 to 2009. However, it is obvious that most of the study were done outside the Nigerian economy except Fagge (2011). Notwithstanding, Fagge study could not depict the current scenario of both phenomenon and their trend in Nigeria, hence the rationale for the study. Emphatically, the study will cover period of 1980-2018.

Phillips Curve Evolution

A New Zealand born economist, A.W. Phillips; in 1913-1948 studied the relationships between the rate of joblessness and currency pay rate variations in the UK and in the quarterly Journal of Economica, same was published. In the paper Phillips noted an inverse correlation linking money wage changes and being without a job in the British financial system over the time under study. In other nations, analogous designs were discovered and Paul Samuelson and Solow in 1960 studied Phillips' research making unequivocal the relationship linking unemployment and inflation: an inverse relationship existing between both. (Samuelson and Solow, 1960).

Sometimes after Phillips' paper in 1958, numerous economists in highly developed nations have the belief that his findings showed that there exist a lasting and steady affiliation involving unemployment and inflation. One consequence of this for those in authority course of action remained that they can regulate inflation and unemployment using a Keynesian policy.

The online Business Dictionary (2017) defines the Keynesian theory of joblessness as when low pay proportions, with an objective to cause an increase in employment flops due to the fact that the economy was undergoing difficult times and experiencing recession and goods and services are in low demand. It means from the Keynesian theory, employment rely on demand effectively, which leads output increase. The Keynesian economists maintained furthermore that the number of unemployment is more than the opportunities available. It also means that even if greater percentage of the job seekers were employed, some will remain jobless due to economy and job mismatch. Hence, the economists of the Keynesian theory view lack of demand for employments as possibly resolved by government involvement.

They could endure a realistically high inflation rate because it could result to decrease in joblessness –a trade-off. For instance, fiscal and/or monetary plans may find application in arousing the economy, increasing GDP and depressing the rate of joblessness. Going on the curve, it will result to increment in the rate of inflation, and the price of relishing lesser job loss rates. Forder (2014) contends this view to be false, historically and not even the governments or economists are attuned to the view. He also said that the ‘curve myth' was a1970s creation. From 1974 till date, seven Nobel

Prizes have won for studies that have to do with numerous variations in Phillips curve.

Theoretical Base of Inflation and Unemployment

For this study, the theoretical framework is centered on the Phillips curve theory by means of data (empirical)from US and UK. The theory assumed an inverse link between inflation and joblessness. It implies that when the rate of inflation increases, joblessness decreases, and the other way round. It can be argued that the presence of inflation in a nation brings with it increment in economic actions as producers willingly increase productivity for revenue growth and profit making. To achieve this, more workforce will be engaged by the producers in addition to the existing ones, and this reduces the rate of joblessness. This also goes the way round.

Theoretically and empirically, works on the curve dates back to the 1950s. It has changed with differences and interpretations added since then. The curve suffered setbacks in the 1970s. Entirely fresh interpretations have been proposed to empirically fit the evidence.

Phillips's Basic Correlation

Phillips (1958) was attributed for Ground-breaking work on his curve. He discovered an inverse link between inflation and joblessness while studying data from England unemployment and wage inflation between 1861 and 1957. Between 1913 and 1957, Samuelson and Solow (1960) analyzed the bond between joblessness in the US and price inflation. Phillips curve was the name given to this model. It made harsh extrapolations concerning joblessness and inflation trade-off surrounded by the Keynesian context. Adequate pairs of publicly desired inflation and joblessness aftermaths are what monetary policy prescript. Interestingly, it follows that policy-makers have a list of options to choose from. The authorities can decide to sacrifice joblessness to favor inflation by keeping the later low. The other way round**,** expansionary monetary policy can find usefulness in bringing the rate of being without a job down.

The forecasts and endorsements of the curve (Philip theory) were taken for granted by economic actions in the US in the 1970s. Unforeseen events in the oil and gas industry brought along with it increased inflation and joblessness was supposed to decline by predicted by the Keynesian model. But in reality, stagflation was the consequence and joblessness recorded its highest value at that time since the 1940s. The obvious disappointment of the made Lucas and Sargent (1978) with a host of other economists, considered the model as incapable of offering dependable direction policy formation. Following the obvious inadequacies of the curve, neo-classical economists recommended changes and additions to the model.

Friedman's Monetarist Insight

There were arguments about the model of the Phillips curve being miss-specified, especially by Friedman (1968). His approach gave a vital insight, theoretically that nominal wages are low relative to low inflation in price when demand in excess for labour is small in labour market and the other way round. He argued that joblessness can only be temporarily influence by monetary policy. As an example for instance, in tackling joblessness via monetary enlargement, spending is stimulated by a lesser interest rate, increment in productivity of labour, and in the short term reduces joblessness and output. He also opined that prices are always ahead of wages, consequently reducing real wages. This warrants demand for pay(nominal)increment by employees. Eventually, increment in salaries(nominal)and accrued price upsurges would balance. There would be increase in actual earnings and naturally keeping joblessness as it should be NAIRU. NAIRU means a joblessness rate constant with sustaining a steady inflation rate. He resolved that, temporarily, the guess of an exploitable inflation-joblessness variations with each other holds but not permanently (Fuhrer, et al., 2009).

Umaru and Zubairu (2012) researched, empirically the Phillips curve relationship in Nigeria between 1977 and 2009. The Engle-Granger co-integration assessment was used in the research as well as the GARCH and ARCH methods for volatility testing. From the result there was no evidence of the Phillips curve association in Nigeria within the period.

Using the VECM, Touny (2013) studied the Phillips curve correlation in Egypt from 1974 to 2011. The study used unemployment and inflation data to test the Phillips curve expectations augmented theory. The study intended at investigating if the policy on inflation containment can lessen unemployment in the long-run. The two parameters were established to be cointegrated with a positive association linking both.

Furuoka, et al., (2013) wanted to ascertain or to know if the Phillips curve association subsisted in the Philippines between 1980 and 2010. The work used the Hodrick-Prescott filter and the dynamic ordinary least squares (DOLS) technique. The study established a long-run causal and negative correlation between inflation and unemployment in the period under review.

Katria, et al., (2013) studied the nature of the Phillips curve relationship between 1980 and 2010 in fourteen (14) countries: Afghanistan, India, Pakistan, Sri Lanka, China, Bangladesh, Russia, South Africa, Nepal, Bhutan, Maldives, Iran, Myanmar and Indonesia. Ordinary least squares method was used in the study. The study used gross capital formation, real interest rates, a debt servicing proxy, unemployment rates and inflation rates as parameters. The research established that an adverse connection linked unemployment and inflation rate in the countries studied. And so, the study established that the theory of the Phillips curve association was accurate.

Prasanna and Gopakumar (2011) analyzed economic growth and inflation in India from 1972 to 2008, empirically. The work used the Engle-Granger two-step co-integration test and the unit root test of Phillips-Perron. The investigation discovered a long-run adverse association between GDP and inflation for the time under review.

Al-Zeaud and Al-Hosban (2015) worked empirically on the Jordanian economy to know if the Phillips curve association occurred between 1976 and 2013. The research engaged the straight line and non-linear ordinary least squares methods and the vector error correction model as well. It discovered durable empirical proof of the Phillips curve in Jordan. Negative non-linear connection exists between them within the period.

Aim and Objectives of the Study

The study aims at researching the link or relationship unemployment has with inflation in Nigeria. It will mainly investigate if Phillips curve model holds. In specific term, the objectives include:

1. To decide the stationarity of inflation, unemployment and money supply, using unit root test.
2. To establish inflation trend, unemployment and money supply in Nigeria, using cointegration regression.
3. To examine the reality of Phillips Curve in Nigeria using autoregressive regression model.
4. To explore how money supply and inflation relate.

Research Questions

1. How are the trends of inflation, unemployment and money supply in Nigerian?
2. In Nigeria, does Phillips Curve hold (exist) or how Inflation relates to Unemployment?
3. How does inflation and money supply relate?

Significance of the Study

The study will enable government and economy policy makers realize the trend between the inflation and being without a job in Nigeria so to equip them in making sound economic policies and decisions particularly regarding macroeconomic objectives. The researcher strongly believed that upon the completion of the study, economic policymakers would be equipped with relevant but recent information on the best ways to administer policy on unemployment phenomenon facing the nation. The study will uncover as well to enabling the government to realize the need for maintaining a stable inflation rate in the nation. Besides the above, as concise as the study will be, the research work will become literature documentary to guide and assist subsequent researchers or general readers who may want to explore necessary information regarding macroeconomic policies in Nigeria.

Methodology

This chapter will discuss the method that will be adopted in the study. The will be subdivided into sections. The first section will discuss the sources of data for the study while the second section will specify the model for the study. It will also, specify the theoretical expectations of the parameters' coefficients (appriori expections) from the model. Lastly, the study will present the econometric evaluation of the model; that is, several econometric tests will be conducted to ensure adequacy of the model. Test such a unit root test, co-integration test, Vector Error Correction Method, Granger Causality test.

Research Design

The study adopted correlational design of the ordinary least square (OLS) to institute the link between unemployment and inflation rates in Nigeria. The design was appropriate for the study since the researcher is only examining the influence of unemployment rate on inflation.

Source of Data

This study will used Nigerian data to establish the relationship between inflation, unemployment and money supply for the period 1980-2018. It uses a sample size of 39 observations because of inadequate data from the relevant data agencies. The analysis of the data will be based on Ordinary Least Square (OLS) method for regression analysis. The study will use secondary source of data; hence the data will be sourced from the following sources:

i. Central Bank of Nigeria "CBN" Statistical Bulletin
ii. World Bank data indicators

iii. National Bureau of Statistics (NBS) Annual Digest

Theoretical specification of the Phillips Curve Model

From the theoretical review in previous chapter, it was clear that A.W. Phillips postulated that there is inverse correlation between unemployment and inflation. This punctuates the fact that whenever there is inflationary rate in the economy, unemployment on the other hand will fall down and vice-versa. However, when the rate of unemployment is small, there is an increase in the rates of money wage. It is due to high labour demand and just few unemployed then employees begin to bid the wage rates up expectedly. On this premise, the model for this study will be specified as "Original and Augmented Phillips Curve". These models will be used to establish the inverse relationship between the rate of unemployment and inflation rate postulated by Phillips (1958). Ordinary Least Square method will be adopted for estimation. Ordinary Least Square method was considered appropriate for the study because of its BLUE properties i.e. Best, Linear, Unbiased, and Efficient.

The empirical specification for the traditional or original Phillips curve is INF = f (UNEMP).

$$INF_t = \beta_0 + \beta_1 UNEMP_t + U_t \qquad (1)$$

The model empirical specification works before 1970 because people were anticipating zero inflation. Failure to achieve that in the before the 1970smakes entire system or model to be problematic because of the flexible exchange rate, increase in oil costs and system of deflation instead of zero inflation as analyzed by the Phillips postulation. Hence, augmented Phillips curve was introduced into the economy system to meet the demand of continuous positive inflation rate. Since it was total impossible for people to see zero inflation, then the augmented Phillips Curve introduces the idea of expected inflation. Therefore, we need expected inflation to be added to original Phillips curve in order to become augmented

Phillips Curve such as:

$$INF_t = \beta_0 + \beta_1 UNEMP_t + \beta_2 INF_{exp} + U_t \qquad (2)$$

Where,

$INF_{exp} = (INF_t + INF_{t-1})/2$

INF_{exp} = expected inflation

INF_t= inflation

UNEMP = cyclical unemployment

β_0 = intercept of the model. It is constant

β_1 = the slope and the coefficient of unemployment

β_2 = the slope and the coefficient of the expected inflation

U_t = supply shock/stochastic error term

INF_t = inflation – dependent variable

INF_{exp} = expected inflation – independent variable

$UNEMP_t$= unemployment – independent variable

Theoretical Expectation

The theoretical expectation is $B_1 < 0$. So, the theoretical expectation for original Phillips curve states that inflation and unemployment rates have a inverse relationship. The augmented theoretical expectation for Phillips curve says that even when expected inflation added to the original Phillips Curve, inflation, and unemployment still shows inverse relationship.

Econometric Modeling

To investigate both original Phillips curve and augmented Phillips curve, simple OLS regression equation given as follows:

$INF_t = \beta_0 + \beta_1 UNEMP_t + U_t$ (1) for original Phillips curve.

$INF_t = \beta_0 + \beta_1 UNEMP_t + \beta_2 INF_{exp} + U_t$ (2)
for augmented Phillips Curve.

The econometric modeling strategy is consistent with previous studies. There is necessity using Augmented Dickey-Fuller (ADF) and Phillips-Perron, to test for Unit Root to ensure that the variables satisfy the stationarity.

Unit Root Test (Stationarity)

This study will test for stationarity (no unit root) of the two econometric data. If stationary at the level, it continues OLS estimate at level data. But if not stable at the level, it tests stationary at first difference.

If stationary at a first difference, then it tests for co-integration. In case, if it is not cointegrated, it uses simple OLS regression equation at first difference.

Unit Root and Stationary equations at levels and difference regression can be derived as follows:

$INF_t = \beta_0 + \beta_1 UNEMP_t + U_t$ (1)

The unit root test is given as:

$X_t = \alpha + \rho X_{t-1} + \varepsilon_t$ (3)

Subtracting the 1st lag of X_t from both sides, i.e. X_{t-1}

$Xt – Xt\text{-}1 = \alpha + (\rho Xt\text{-}1 – Xt\text{-}1) + \varepsilon t$

$\Delta X_t = \alpha + (\rho\text{-}1)\, X_{t-1} + \varepsilon_t$

Where,

X_t could be Inflation or Unemployment

H0: $\rho = 1$. It implies that X_t has unit root.

H1: $\rho \neq 1$. It implies that X_t has no unit root.

If t-statistics >ADF and PP, reject H0. It simply means that the variables have unit root but if t-statistics <ADF and PP, H0 is reject. It means that the variables have an absence of unit root. That is, it is stationary.

Co-integrated Estimation Techniques

If INF and UNEMP are stationary (no unit root), then we needed to test for co-integration. If co-integrated, it uses co-integration method but if not co-integrated, it uses simple OLS regression equation. If the Co-integration exists between the variables, this forms the basis for the stipulation of the Vector Error Correction Model (VECM). The co-integration equation and test stated below as follows:

$INF_t = \beta_0 + \beta_1 UNEMP_t + \varepsilon_t$ (1)

$\varepsilon_t = INF_t - \beta_0 - \beta_1 UNEMP_t$ (4)

ε_t is Unit Root on error term

$\varepsilon_t = \alpha + \beta\varepsilon_{t-1} + U_t$

$\varepsilon t - \varepsilon t\text{-}1 = \alpha + \beta\varepsilon t\text{-}1 - \varepsilon t\text{-}1 + Ut$

$\Delta\varepsilon t = \alpha + (\beta\text{-}1)\, \varepsilon t\text{-}1 + Ut$

H0: $\beta = 0$ implies that there is no co-integration between the variables.

H1: $\beta \neq 0$ implies that there is presence of co-integration between the variables.

If t < DF1, reject H0 and conclude that our error is co-integrated. That is, the residual value is stationary. Since there is co-integration between the variables, therefore, Vector Error Correction Mechanism must be established.

Vector Error Correction Method

If the Co-integration exists between the series, we need to conduct the specification of the Vector Error Correction Model (VECM) in which inflation rate is the dependent variable while unemployment and interest rate are independent variables.

$INF_t = \alpha_0 + \alpha_1 \Delta UNEMP_{t-1} + U_t$

(5) Short-run equation.

If it happens that INF_t and $UNEMP_t$ are co-integrated which means the first difference are stationary. It implies that they have some long-run equilibrium value of INF_t that given by some linear combination of $UNEMP_t$.

i.e. $INF_t = \alpha + \beta_1 UNEMP_t$ Equilibrium (6)

Let us include some aspects of LR relationship,

$INF_t = \alpha + \alpha_1 UNEMP_t + \alpha_2 UNEMP_{t-1} + U_t INF_{t-1} + U_t$. (7)

The Vector Error Correction Model, which combines the long-run and short-run, is stated as follows:

$\Delta X_t = \sum_{i=1}^{m} \Gamma i + \Delta X_{t-i} + \Pi X_{t-1} + ECT_{t-1} + \varepsilon_t$ (8)

Where,

Δ indicates a symbol of difference operator.
X_t shows the 2 x 1 vectors (UNEMP, INF).
ε_t shows the 2 x 1 vector of residuals.
ΠX_{t-1} indicates the Error Correction term.
Π can be categorized into two distinct matrices such as $\Pi = \alpha\ \beta$, where α indicates the Error
Correction Coefficients and β indicates the co-integrating parameters. Both are appraising the rapidity of convergence to the long-run changeless state.
ECT_{t-1} indicates the Error Correction Model.
Vector Error Correction Mechanism has proof regarding the short- and long-run modification to alteration in $X_t$via the calculated parameters Π and Γi. If there is a long-run connection between the series, shocks will result in disequilibrium in the short-run before the series return to their long-run equilibrium, and it captures in the Error Correction Term (ECT).

Results And Discussion

Data Presentation

This chapter deals with the analysis of unit root co-integration and autoregressive lag model of the variables collected and presented. The data set consists of the 38 data points from 1980-2018 from the Statistical Bulletin of Central Bank of Nigeria and National Bureau of Statistics Annual Digest.

Data and Analysis Results

This part is divided into three which are, results presentation of the unit root, co-integration regression results and the autoregressive lag models.

Unit Root Tests

The variable test of the unit root was done with the help of EVIEWS and GRETL Statistical software's. The results of the tests of the unit root of the variables are in Appendix B, then it was summarized in tables and interpreted below:

Table 1: Unit root test for Actual data

Variable	Actual		1St Difference		2nd Difference	
	ADF	PP	ADF	PP	ADF	PP
Inflation	-3.849966 (0.0054***)	-3.839981 (0.0056***)	-7.984121 (0.000***)	-14.50089 (0.000***)	-6.358684 (0.000***)	-40.85236 (0.0001***)
Unemployment	1.821902 (0.9996)	4.022398 (1.0000)	2.543545 (1.0000)	-2.589801 (0.1041)	-1.228686 (0.6505)	-7.172924 (0.000***)
Money Supply	1.340350 (0.9984)	7.449655 (1.0000)	0.231549 (0.9709)	-1.058426 (0.7217)	-12.98988 (0.000***)	-14.44078 (0.000**)

***10% level (-2.609066), **5% level (-2.941145), ***1% level (-3.615588)**

Table 1 shows the result of the two unit root tests (Augmented Dickey-Fuller, ADF and Phillips-Perron, PP Tests) conducted on the actual variables, First Difference of the variables and the second difference variable. The Inflation variable unit root test for ADF and PP showed signified, this implied the actual variable was stationary already (that is, at level), then the first and second difference also showed significant at the p-values below 5% level of significance. The unemployment actual variable was not stationary at level is greater than 5% level of significance; consequently, first difference unit root test was conducted on the variable and found that the p-value of the actual unemployment variable was greater than the p-value at 5% level of significance. Notwithstanding, the second difference of the unemployment variable was found stationary for PP test since the p-value of the variable is less than 5% level of significance. Lastly, the unit root test conducted for Money Supply using ADF and PP on the actual and first difference of money supply variable was not stationary since the p-values are greater than the 5% level of significance. However, the secondary difference unit root test of money supply variable was stationary since the p-value of the ADF and PP are less than 5% level of significance.

Next, to stabilize the mean and variance in the data sets, we applied logarithm transformation. Then, applied the two unit root tests considered in this research again (ADF and PP) in Table 2.

Table 2: Unit root test for Lag Variables

Variable	Logarithm of Variables		Logarithm of Variables 1St Difference		Logarithm of Variables 2nd Difference	
	ADF	PP	ADF	PP	ADF	PP
Log(Inflation)	-3.813598 (0.0061***)	-3.804090 (0.0062***)	-5.747126 (0.0000***)	-16.61065 (0.0000***)	-6.184966 (0.0000***)	-38.61178 (0.0001***)
Log(Unemployment)	1.381311 (0.9985)	3.166706 (1.0000)	6.142101 (1.0000)	-0.738596 (0.8241)	1.425092 (0.9987)	-8.340597 (0.0000***)
Log(Money Supply)	0.945699 (0.9950)	6.872210 (1.0000)	0.381945 (0.9793)	-1.203882 (0.6621)	-12.76378 (0.0000***)	-13.95385 (0.0000***)

***10% level (-2.610263), **5% level (-2.943427), ***1%level (-3.621023)**

After Log transformation, ADF and PP unit root tests of Log of inflation was stationary already. The first difference and second difference of the Log transformation of inflation variable was stationary also since the p-values were less than the 5% level of significance. The Log transformation of unemployment variable showed that the unit root tests were not still stationary because the p-values were below 5% level of significance. The first difference of the Log transformation of unemployment was not also stationary at 5% level of significance. Similarly, the Log transformation of money supply was not also stationary even after second difference since the p-value was less than 5% level of significance. Finally, the second difference of the Log transformation of money supply was found stationary since the p-values of ADF and PP were less than 5% level of significance. Hence, it is notice that the log transformation of variables given similarly results as the actual variables unit roots test results.

Co-integrating Regression Models

The Co-integrating Regression Models of dependent variable (Inflation Rate) against the independent variables (Unemployment and Money Supply) were done in Appendix C and summarized Tables

3 to 6. The Co-integrating Regression models with/without constant, with trend (linear trend) and quadratic trend were done in Tables 3, 4, 5 and 6 respectively.

Table 3: Cointegrating Regression Models of Inflation Rate against the independent variables (Unemp and MS) without constant

Model	Parameters	Estimates (Without Constant)	R^2	AIC	SC
Actual	Unemployment (B1)	2.06812 (0.00000625***)	0.588990	332.5366	335.8637
	Money Supply (B2)	-0.000158791 (0.7511)			
Log	Unemployment (B1)	0.894622 (0.00000478***)	0.964484	63.69961	67.02673
	Money Supply (B2)	0.111248 (0.0410**)			
Difference (▼)	Unemployment (B1)	-2.43700 (0.5871)	0.021378	331.5869	334.8620
	Money Supply (B2)	-0.000324221 (0.9321)			
Logarithm Difference (Log▼)	Unemployment (B1)	-0.839804 (0.6006)	0.007999	66.78364	70.05881
	Money Supply (B2)	0.0615743 (0.8923)			

Footnote: *= sig. 10% level **= sig. at 5% level, *= sig. 1% level**

The above table 3 showed co independent variables (unemployment rate and money supply) without constant and trend. From the table, it can be seen that the actual model of unemployment (0.00000625***) was statistically significant while the money supply (0.7511) was not statistically significant. The model fit has R^2 of 0.588990 with AIC and SC values of 332.5366 and 335.8637 respectively.

The Log model of rate of inflation on the rate of unemployment and money supply gave the best fit of the variables. Cause unemployment p-value (0.00000478***) and money supply pvalue (0.0410**) showed significant with R^2 of 0.964484 with AIC and SC values 63.69961 and 67.02673 respectively. This implies that log transformation of the variables gave the best fit of the model since it has highest R^2 values and the two variables in view (unemployment rate and money supply) were found significant simultaneously.

The differenced and Log difference models are not best model specification for the rate of inflation on the rate of unemployment and money supply relationship variables. The cointegration regression models differenced and log differenced of inflation rate on unemployment rate and money supply are not significant. Also, there R^2 values 0.021378 and 0.007999 respectively are not high enough. The differenced model of inflation rate on unemployment money supply are 331.5869 and 334.8620 while the AIC and SC of Log differenced model of inflation rate on unemployment and money supply are 66.78364 and 70.05881.

Table 4: Cointegrating Regression Models of Inflation Rate against the independent variables (Unemp and MS) with constant

Model	Parameters	Estimates (With Constant)	R^2	AIC	SC
Actual	B0	18.1022 (0.1595)	0.113898	332.3624	337.3531
	Unemployment (B1)	-0.412681 (0.8185)			
	Money Supply (B2)	0.000931213 (0.3094)			
Log	B0	2.95062 (0.0003)***	0.599927	51.54856	56.53925
	Unemployment (B1)	-1.16384 (0.0371)**			
	Money Supply (B2)	0.345475 (0.0000402)***			
Difference (▼)	B0	2.43125 (0.5287)	0.032478	333.1498	338.0626
	Unemployment (B1)	-2.60631 (0.5655)			
	Money Supply (B_2)	-0.00150521 (0.7245)			
	B0	0.238888 (0.2824)	0.039255	67.51090	72.42366
Logarithm Difference (Log▼)	Unemployment (B1)	-1.87885 (0.3166)			
	Money Supply (B2)	-0.726251 (0.3990)			

***10% level (-2.609066), **5% level (-2.941145), ***1% level (-3.615588)**

The above table 4 showed co independent variables (unemployment rate and money supply) with constant. From the table, it can be seen that the actual model of unemployment rate (p-value=0.8185) and money supply (p-value=0.3094) were not statistically significant. The model fit has R^2 of 0.113898 with AIC and SC values of 332.3624 and 337.3531 respectively.

The Log model of rate of inflation on the rate of unemployment and money supply gave the best fit of the variables. Because unemployment p-value (0.0371**) and money supply pvalue (0.0000402***) were significant with R^2 of 0.599927 with AIC and SC values 51.54856 and 56.53925 respectively. This implies that log transformation of the variables gave the best fit of the model since it has highest R^2 values and the two variables were found statistically significant simultaneously.

The differenced and Log differenced models are not best model specification for the rate of inflation on the rate of unemployment and money supply relationship. The co-integration regression models of inflation rate on differenced and log differenced of unemployment rate and money supply are not significant. Also, there R^2 values 0.032478 and 0.039255 respectively are not high enough. The differenced model of unemployment money supply are 333.1498 and 338.0626 while the AIC and SC of Log differenced model of inflation rate on unemployment and money supply are 67.51090 and 72.42366.

Table 5: Cointegrating Regression Models of Inflation Rate against the independent variables (Unemp and MS) with constant and linear trend

Model	Parameters	Estimates (Linear Trend)	R^2	AIC	SC
Actual	B0	15.0232 (0.1782)	0.355125	321.9691	328.6234
	Unemployment (B1)	-2.86769 (0.0980)*			
	Money Supply (B2)	0.000314153 (0.6969)			

	Time (B3)	1.44667 (0.0009)***			
Log	B0	6.45814 (0.0006)***	0.651210	48.19865	54.85290
	Unemployment (B1)	-2.55340 (0.0029)***			
	Money Supply (B2)	-0.364701 (0.2633)			
	Time (B3)	0.203578 (0.0296)**			
Difference (▼)	B0	-2.89847 (0.7139)	0.049481	334.4761	341.0264
	Unemployment (B1)	-2.44134 (0.5928)			
	Money Supply (B2)	-0.00556131 (0.4139)			
	Time (B3)	0.394661 (0.4409)			
Logarithm Difference (Log▼)	B0	0.270456 (0.3142)	0.040601	69.45760	76.00795
	Unemployment (B1)	-1.69842 (0.4129)			
	Money Supply (B2)	-0.711460 (0.4166)			
	Time (B3)	-0.00202843 (0.8284)			

***=10% level, **=5% level ***=1% level**

The above table 5 showed co independent variables (unemployment rate and money supply) with constant and linear trend. From the table, it can be seen that the actual model of unemployment rate (p-value=0.0980) was not significant at 5% but found significant at 1% while money supply (p-value=0.6969) was not statistically significant at all level. The model fit has R^2 of 0.355125 with AIC and SC values of 321.9691 and 328.6234 respectively.

The Log model of rate of inflation on the rate of unemployment and money supply gave the best fit of the variables. Because the constant value (p-value, 0.0006***), unemployment p-value (0.0009***), and trend value (0.0296)** were found statistically significant at 1% and 5% alpha level but money supply p-value (0.2633). The model has a R^2 fit model of 0.651210 with AIC and SC values 48.19865 and 54.85290 respectively. This implies that log transformation of the variables gave the best fit of the model since it has highest R^2 values and the two variables were found statistically significant simultaneously.

The differenced and Log differenced models are not best model specification for rate of inflation on the rate of unemployment and money supply relationship. The co-integration regression models of differenced and log differenced of inflation rate on unemployment rate and money supply are not found statistically significant. Also, the R^2 values 0.049481 and 0.040601 respectively were not high enough. The AIC and SC of differenced model of unemployment money supply are 334.4761 and 341.0264 while the AIC and SC of Log differenced model of inflation rate on unemployment and money supply are 69.45760 and 76.00795.

Table 6: Cointegrating Regression Models of Inflation Rate against the independent variables (Unemp and MS) with quadratic trend

Model	Parameters	Estimates (With Quadratic Trend)	R^2	AIC	SC
Actual	B0	21.5132 (0.0861)*	0.380740	322.3884	330.7062
	Unemployment (B1)	-2.43608 (0.1648)			
	Money Supply (B2)	-0.00172205 (0.3692)			

	Time (B3)	-0.529591 (0.7591)			
	Timesq (B4)	0.0750618 (0.2439)			
Log	B0	6.56512 (0.0028)***	0.651309	50.18760	58.50540
	Unemployment (B1)	-2.60246 (0.0097)***			
	Money Supply (B2)	-0.370263 (0.2702)			
	Time (B3)	0.203396 (0.0322)**			
	Timesq (B4)	7.26827e-05 (0.9224)			
Difference (▼)	B0	2.11418 (0.8549)	0.059854	336.0591	344.2470
	Unemployment (B1)	-3.58212 (0.4736)			
	Money Supply (B2)	-0.00817920 (0.3173)			
	Time (B3)	-0.377283 (0.7859)			
	Timesq (B4)	0.0243647 (0.5504)			
Logarithm Difference (Log▼)	B0 Unemployment (B1)	0.0176923 (0.9609) - 0.646390 (0.7786)	0.071353	70.21966	78.40759
	Money Supply (B2)	-1.39762 (0.2066)			
	Time (B3)	0.0492497 (0.3311)			
	Timesq (B4)	-0.00130239 (0.3035)			

***10% level (-2.609066), **5% level (-2.941145), ***1% level (-3.615588)**

The above table 6 showed co independent variables (unemployment rate and money supply) with constant and quadratic trend. From the table, it can be seen that the actual model of unemployment rate and money supply were not statistically significant but the constant was found significant at 10% level of significance. The model fit has R^2 of 0.380740 with AIC and SC values of 322.3884 and 330.7062 respectively.

The Log model rate of inflation on the rate of unemployment and money supply gave the best fit of the variables. Because constant value (0.0028***) at 1%, unemployment rate value (0.0009***) at 1%, and linear trend (0.0322**) at 5% were significant but money supply (0.2702) and timesq (0.9224) and were not found statistically significant. Also, the log model have highest R^2 (0.651210) with AIC and SC values of 50.18760 and 58.50540 respectively. This implies that log transformation of the variables gave the best fit of the model since it has highest R^2 values and the two variables were found statistically significant simultaneously with at least with three significant variables.

The differenced and Log differenced models are not best model specification for rate of inflation on the rate of unemployment and money supply relationship. The co-integration regression models of differenced and log differenced of inflation rate on unemployment rate and money supply are not found statistically significant. Also, the R^2 values 0.059854 and 0.071353 respectively were not high enough. The AIC and SC of differenced model of unemployment and money supply are 336.0591 and 344.2470 while the AIC and SC of Log differenced model of inflation rate on unemployment and money supply are 70.21966 and 78.40759.

Autoregressive Regression Analysis of inflation rate on unemployment rate and money supply

VAR system, lag order 1

OLS estimates, observations 1983-2023 (T = 38)

Log-likelihood = -21.200965

Determinant of covariance matrix = 0.1787018
AIC = 1.3264
BIC = 1.4987
HQC = 1.3877
Portmanteau test: LB (9) = 17.3918, df = 8 [0.0263]

Table 7: Autoregressive Regression Analysis of Log (INF) on Log (INF (-1)), Log (UNEMP (-1)) and Log (MS (-1))

	Coefficient	Std. Error	T-ratio	P-value
const	3.19076	1.01783	3.135	0.0035 ***
Log (INF (-1))	0.207662	0.167334	1.241	0.2231
Log (UNEMP (-1))	-1.45684	0.6813	-2.138	0.0398 **
Log (MS (-1))	0.323143	0.098748	3.272	0.0025 ***

Mean dependent var	2.699740	dependent var	0.684649
Sum squared resid	6.790668	S.E. of regression	0.446907
R-squared	0.608461	Adjusted R-squared	0.573913
F(3, 34)	17.61225	P-value(F)	4.51e-07
Rho	0.003850	Durbin-Watson	1.978550

F-tests of zero restrictions: All lags of Log(INF) F(1, 34) = 1.5401 [0.2231]

The table 7 above showed R^2-value is (0.608461) meaning that the overall model explains up to 60.8% of the entire model fitness. However, the F(1, 34) = 1.5401 (0.2231) showed that the general model is not significant. Individually, the table further showed that, there is significant positive relationship between constant term (0.0035***) at 1% level of significance. There is positive but insignificant relationships with log of inflation at lag one (0.2231). Then, there is negative and significant relationship between log of inflation and log of unemployment at lag one (0.0398**) at 5% level of significance of one point four unit. Lastly, the log of inflation showed positive and significant relationship between log of money supply at lag one (0.0025 ***) at 1% level of significance.

Forecasting Model

Hence, the final model built for rate of inflation on the rate of unemployment and money supply in the Nigeria economic system is given as thus below:

Log (INF) = β_0 + β_1 Log (UNEMP (-1)) + β_2 Log (MS (-))

Log (INF) = 3.19076 + 0.207662 (UNEMP (-1)) - 1.45684 Log (MS (-)) + 0.323143 (Time) Log (INF (-1)) is excluded from the final since it is not significant with the Log transformation of inflation rate model.

Conclusion

The study examined inflation and unemployment rates in Nigeria in order to investigate whether Phillips Curve theory holds. From the Philips Curve, an inverse (trade off) relationship exists between unemployment and inflation in any given economic system. Following the results of the study using the original Phillips curve model, it was discovered a unit increase in the dependent variable (inflation) is caused by decrease in unemployment and there is a considerable correlation between the two macroeconomic variables. The autoregressive regression of log transformation of inflation rate data and log transformation of unemployment and money supply at lag one indicated that each of the variables is significantly related to inflation rate. The Engle co-integration also showed significant long-run relationship between the log transformations of the variables. This implies that unemployment reduction dependence on both inflation rate and monetary and fiscal policies. The control of money supply also enhances economic growth and on the long-run help in reducing unemployment rate in Nigeria. Conclusively, from the result of the study, it is concluded that Phillips curve theory holds in Nigeria since a trade-off relationship exist between unemployment and inflation within the period of observation, 1980-2018.

Hence, the study has be able to uncover that Phillips curve model holds in Nigeria economic system suggesting influence of several factors such as money circulation control policy, uncontrollable inflation rate with ever increasing unemployment in the nation. Based on the above, the study becomes a panacea for reviewing some of the policies relating macroeconomic phenomenon especially inflation and unemployment whose impact directly affect the nation's economy.

Recommendations

From the result of the findings, the study recommends as follows.

1. Government should create efficient platform for business opportunities wish subsequently can be translated into unemployment reduction hence meeting up with the inflation trend in the nation.
2. Since unemployment and inflation are the key variables in macroeconomics, Nigerian government should ensure the variables are maximally controlled for optimal stability using Philips curve postulation within the Keynesian framework.
3. Although inflation rate may need to be high to guarantee full employment, howbeit, it should be within a reasonable extent to avert dire consequences on the low and middle class citizens.
4. Monetary and fiscal policies should be keenly observed to enhance economic growth as well as to reduce unemployment growth rate. This will help the government to control insecurity challenges that are thought to be caused primarily by high rate of unemployment in the nation.

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