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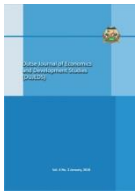

APPLICABILITY AND THE WORKING OF PHILLIPS CURVE ON THE NIGERIAN ECONOMY

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Abstract

Unemployment and inflation are two major problems of any economy. The objective of this paper is to investigate whether Phillips Curve holds for Nigeria, and, if it holds, whether short-run and long-rung relationship exist between the variables. Time series data covering 36 years, a period from 1980 to 2016 were used to estimate a VAR-Vector Autoregression model and Impulse Response Function after time series properties was ascertained using Augmented Dickey Fuller (ADF) test for stationarity, Johansen Juselius cointegration tests as well as Lag Order Selection Criteria. Diagnostic tests were further estimated in order to assess the results obtained and see if they hold under the assumptions. The study established that there exists an inverse relationship between unemployment and inflation in Nigeria, and that there is a short-run relationship between unemployment and inflation. This study provides evidence of the applicability of Phillips Curve in the Nigerian context. Based on the findings of this study, policy makers and government have to implement policies that create jobs and reduce inflation both in the short-run and long-run. Capital projects should be implemented, dependence on importation be discouraged. Policy makers could forecast the future for the purpose of policy-making using the findings of this study. Real Interest Rate does influence the behavior of the variables in the model.

Keywords: Impulse Response Function (IRF), Vector Autoregression (VAR), Inflation, Unemployment, Phillips Curve.
JEL Classification:

Introduction

Unemployment and inflation are the complex twin problems of any economy. In spite of any economic system a country may adopts, two major goals of interest are low inflation and low unemployment rate, but quite often, these goals conflict, both in developed and developing countries. In Nigeria, the level of unemployment averaged 12.31% from 2006 up until 2018, reaching an all-time high of 23.10% in the third quarter of 2018 and a record low of 5.10% in the fourth quarter of 2010 (Nigerian Bureau of Statistics, 2018). It follows therefore that about 16.8 million Nigerian are unemployed. Inflation rate for Nigeria has fluctuated over time and substantially increasing between 1998 to 2017 period ending at 16.5% (Knoema.com, 2017). In fact, the performance of an economy can be seen by looking at the inflation and unemployment rates. Both rates when added give a nation's "Misery Index" a measure of National discomfort (it measures how happy or miserable people are). This tradeoff between inflation and unemployment is described and analyzed in the Philips curve. This empirical discovery by Philips in 1958 shows an inverse relationship between nominal interest rate and unemployment rate Kunst, R. (2012). The traditional Phillips curve postulates that there is a trade-off, or negative relationship, between unemployment and inflation, Chuku, C. *et al.* (2013).

This paper employed the variant of Philips curve with interest rate as an additional variable of interest; this is due to the multilateral influence of interest rate on all the input variables of both the original Phillips curve and Augmented Phillips curve. The nominal interest rate has a multilateral influence on many macroeconomic variables. This could be analyzed by the means of a vector auto regression model which is based on the variables of the Phillips curve – inflation and the

unemployment rate but enlarged with nominal interest rate as exogenous variable (see, Gentle, *et al.* 2005). Phillips curve is a graph depicting the inverse relationship that subsists between the rate of unemployment and the rate of inflation in an economy.

From the above graph it could be observed that if we draw all the possible Philips curves that could be drawn we see that all points would be consistent with long run equilibrium which must lie on a vertical curve and this curve is called the long-run Phillips curve. In the long run, the economy must return to this curve. Meaning that, in the long run, there is no relation between inflation and unemployment. In the long term, the economy returns to the natural unemployment rate as in the classical model (Jochumzen, 2010).

The main objective of this paper is to research the applicability and the working of Phillips curve on the Nigerian Economy during the period from 1980 to 2016. The study has an Introductory section at the beginning, while review of literature is covered in the second section; data and methodology shall be discussed in the third section. The results obtained shall be presented and discussed in the fourth section with conclusion and recommendation at the end of the paper.

Literature Review

The first to convincingly support the Phillips Curve were Samuelson and Solow (1960) in a paper using the US data to support the negative relationship between inflation and unemployment. Phelps (1967) and Friedman (1968) were the researchers who criticized the Phillips curve mentioning that there is no trade-off relationship between unemployment and inflation. Friedman's non-agreement with the Phillips on the Phillips curve is the possibility of simultaneous increase of both unemployment and inflation which Friedman observed at the time. Stagflation is "the simultaneous occurrence of high rates of inflation and unemployment" (Arnold, 2005-2008). "Meanwhile, Lucas (1976) strongly opposed the proposition of the existence of the Phillips curve, supporting that there could be a trade-off relationship between unemployment and inflation, providing that policy makers have not create a situation where high inflation is paired with low unemployment. In a different case, employees would predict inflation and an increase in wages would be possible.

In such a case there would be high unemployment and high inflation rate known as the 'Lucas critique'" (Dritsaki and Dritsaki, 2012). A transient variation in inflation and a soaring unemployment figure are the worst economic statistics any economy has to grapple with. Unfortunately for Nigeria, it falls among countries of the world who are still struggling to stabilize in economic growth with those indices under control and within desirable neighborhood (single digit inflation rate and a low unemployment rate). Unemployment is regarded as one of the most complex and challenging economic problems facing the Nigerian government Fatukasi (2011). With high inflation rate households or individual economic agents experience a drop in the value of the money they have. It is common to hear people complain about their income not being enough to get them what ordinarily they would afford without inflation. It is even worse when uncertainty follows price increases Nwaobi (2009).

Empirical Literature

Ademola and Badiru (2013), examined the effects of unemployment and inflation on economic performance in Nigeria. Ordinary Least Square (OLS) technique was adopted with various diagnostic tests to determine how fit are the data for the analysis. The study indicated that there exist long-run relationship between RGDP, Unemployment and inflation.

Orji, A., *et al.* (2015), tested the original Phillips curve by examining the inflation and unemployment nexus in Nigeria. The study which adopted a distributed lag model with data covering the period 1970-2011 reveals that unemployment is a significant determinant of inflation and that there is a positive relationship between inflation and unemployment rate in Nigeria. This finding invalidates the original proposition on the Phillips curve hypothesis in Nigeria.

Kunst, R. (2012) Estimated The US Phillips Curve using time series data for Unemployment, inflation and interest rate. The findings reveal that interest rate seems determined by unemployment rate and confirmed the argument that there is inverse relationship between unemployment and inflation.

Iyeli, I., & Ekpung, E. G., (2017). In their work titled, "Price Expectation and the Philips curve hypothesis: The Nigerian case" utilizes the availability of time series data using the variables; price, inflation rate and unemployment rate. Their findings revealed that Instead of unemployment Reducing inflation as postulated in Philips Curve, unemployment rather contributed significantly to increase inflation in Nigeria.

Nelson Barbosa (2011), formulated a Structuralist Philips Curve model using time series data of inflation rate, wages, price index and exchange rate. Findings reveal that inflation depends on the relative price of the non-labor input and the relative price of capital.

Samanhyia, S., (2014), examine the expectations-augmented Philips curve using data from Ghana. Ordinary Least Squares (OLS) regression was employed on Inflation, unemployment, interest rates, real income and exchange rate. The research revealed growth rates of real interest rate, real income, real exchange rate and past inflation as significant determinants of inflation in Ghana.

Methodology

For this model, we consider three time-series as follows: real interest rate, unemployment rate, and inflation rate. All of the three series were obtained from the World Bank development indicators (WB) for the period of thirty-six (36) years from 1980 to 2016. To achieve the objective of this study, VAR (Vector Autoregression) and Impulse Response Function shall be implemented along with all the necessary pre-estimation tests and diagnostic tests as specified in the estimation model.

Model of Estimation

Since macroeconomic time series data often shows a unit root process (Nelson and Plosser, 1982) unit root tests were conducted with all the data series of all the variables of interest. An augmented Dickey–Fuller test was conducted. This involves estimating the following regression and carrying out unit root tests:

$$X_t = c + \Phi_1 X_{t-1} + \Phi_2 X_{t-2} + \ldots + \Phi_p X_{t-p} + \varepsilon_t \quad \ldots\ldots (1)$$

Vector Auto-Regression

Vector Auto-Regression (VAR) is an econometric model used to capture the evolution and the interdependencies between multiple time series, generalizing the univariate AR models. All the variables in a VAR are treated symmetrically by including for each variable an equation explaining its evolution based on its own lags and the lags of all the other variables in the model. Based on this feature, Christopher Sims advocates the use of VAR models as a theory-free method to estimate economic relationships, thus being an alternative to the "incredible identification restrictions" in structural models. The most important property of this approach is that we do not need to specify ex-ante which of our variables are endogenous and which are exogenous determined. A three variable VAR model investigates all possible combinations such that each variable is once modeled endogenously (i.e. determined by the other variables) and exogenously (i.e. it is used to model the other ones) in the remaining two specifications.

The first step in order to carry out this approach is to test for stationarity in all the series used. For us to be able to execute a VAR model all variables need to be stationary either at levels (I (0)) or at first difference (I (1)). To examine these properties, we implemented the popular augmented Dickey-Fuller (ADF) tests on all variables but individually. The ADF tests indicate that inflation and the nominal interest rate and unemployment rate are all integrated of order 1 or stationary at first difference. Inflation rate is difference stationary at first difference while nominal interest rate is integrated of order one at first difference without trend but with intercept and unemployment rate attained first difference with trend but without intercept. Since a VAR model requires the included variables to be either I(1) or I(0) we can proceed with this approach.

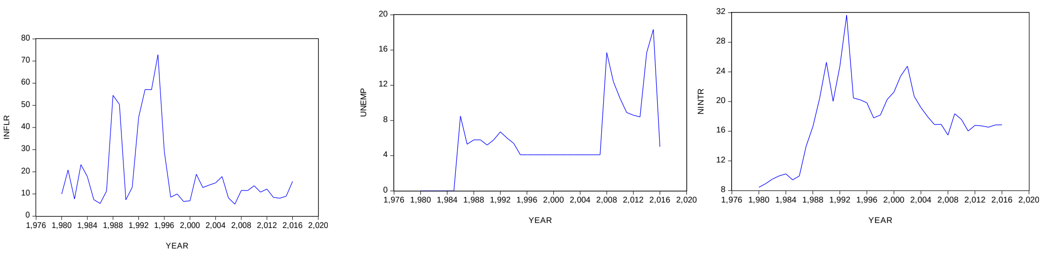


Fig. 1: Trend Analysis

Inflation rate has consistently exhibited spikes at some point in time but not at regular interval. Around 1980 inflation rate increased but decreased almost immediately. This trend was exhibited almost nine times within the study period with 1994 having the peak. Unemployment rate was about 8% around 1984 but declined and remain stable for about 20 years before increasing to one of highest rate in Nigerian history around year 2008 with the highest unemployment rate happening around 2016. Interest rate exhibited spikes too but with constant increase in the rate till the last date we are considering.

Table 1: Test for Stationarity

Variables	ADF test statistic	5% Critical value	P-value	Order of Integration
INFLR				I(1)
	-5.580626	-2.948404	0.0000	
NINTR				I(1)
	-5.214897	-2.951125	0.0001	
UNEMP				I(1)
	-5.505573	-2.951125	0.0001	

Source: Authors' computation using E-views 9.

Since the lag-length p is not derived from theory we need to determine it by comparing different specifications. As a benchmark we use various information criteria. The sequential modified LR test statistic (LR), Final Prediction error (FPE), Akaike information criteria (AIC) as well as Schwarz information criteria (SC) all indicate a lag structure of p=1 at 5% level. We chose our lag structure based on the consistency of the outcome.
VAR Lag Order Selection Criteria was computed to select the lag order of an unresrestricted VAR. the table displays various information criteria for all lags up to the specified maximum. The lag starts at 0 because exogenous variables were specified in the model; otherwise the lag starts at 1. From the table, it could be observed that the selected lag from each column criterion is indicated by an asterisk (*). These are the lags with the smallest value of the criterion which gives us the best estimation possible in our VAR estimation.

Table 2: Lag Order Selection Criteria

VAR Lag Order Selection Criteria
Endogenous variables: INFLR NINTR UNEMP
Exogenous variables: C
Date: 09/10/18 Time: 16:43
Sample: 1 37
Included observations: 34

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-339.5174	NA	112927.9	20.14808	20.28276	20.19401
1	-308.8399	54.13679*	31653.05*	18.87294*	19.41165*	19.05665*
2	-302.7036	9.746010	38012.32	19.04139	19.98414	19.36289
3	-292.8050	13.97438	37369.18	18.98853	20.33532	19.44782

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Source: Authors' computation using E-views 9.

Before the interpretation of the VAR results, there is need to establish whether there is co-integration i.e. long-run relationship among the variables of interest. To do this exercise, a Johansen Joselius co-integration test was implemented but there was no co-integration among our variables both under Trace test and Maximum Eigen values.

VAR Estimation Results

The significant coefficients in the inflation equation on the first column of our VAR estimates table indicates, that the lagged variable of inflation and also the lagged variable of unemployment rate influence the inflation rate. Our model suggests that the interest rate has no statistically significant influence on inflation. A priori, the expectation is that past inflation would have a positive impact while, past unemployment was expected to have a negative impact. The positive coefficient on INFLR (-1) of 0.450427 and the negative coefficient on INFLR (-2) of -0.374697 seem to be in line with these expectations. The interpretation of the coefficient on INFLR (-2) is that past high inflation rates lead to high inflation rates in the next period but the effect is weakened in the following period due to INFLR (-2). So the effect of past inflation is highest in the beginning but becomes weaker with more lags. Also, the coefficients on UNEMP (-1) of -0.613168 and on UNEMP (-2) of 0.680009 supports the hypothesis inherent in the assumption of the Phillips curve that there is a negative influence of unemployment on the inflation rate even though it seems to be very limited due to the nearly total balancing or mirror effect of the second

coefficient. As in the case of inflation the coefficient on UNEMP (-2) ensures that an unemployment shock weakens from the system over time. In the case of unemployment, the results from the VAR estimation suggest that past unemployment rates are the only significant determinants of current unemployment. So it seems that there is a reverse causality between unemployment and interest compared to our a priori expectations.

Table 3: Vector Autoregression Estimation Result

Vector Autoregression Estimates
Date: 09/10/18 Time: 16:40
Sample (adjusted): 3 37
Included observations: 35 after adjustments
Standard errors in ( ) & t-statistics in [ ]

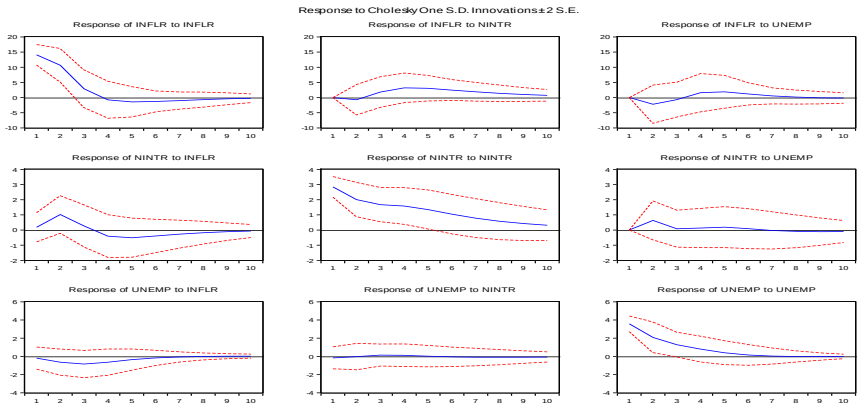
	INFLR	NINTR	UNEMP
INFLR(-1)	0.750427	0.065632	-0.037397
	(0.17353)	(0.03510)	(0.04420)
	[4.32457]	[1.87008]	[-0.84599]
INFLR(-2)	-0.374697	-0.078045	-0.007357
	(0.17968)	(0.03634)	(0.04577)
	[-2.08540]	[-2.14764]	[-0.16073]
NINTR(-1)	-0.285845	0.713859	0.026233
	(0.87657)	(0.17729)	(0.22330)
	[-0.32610]	[4.02656]	[0.11748]
NINTR(-2)	1.065241	0.092540	0.027009
	(0.80478)	(0.16277)	(0.20501)
	[1.32365]	[0.56854]	[0.13175]
UNEMP(-1)	-0.613168	0.175676	0.582758
	(0.87911)	(0.17780)	(0.22395)
	[-0.69748]	[0.98804]	[2.60222]
UNEMP(-2)	0.680009	-0.163885	-0.007604
	(1.00236)	(0.20273)	(0.25534)
	[0.67841]	[-0.80840]	[-0.02978]
C	-1.487442	3.787948	2.584672
	(9.34591)	(1.89023)	(2.38080)
	[-0.15915]	[2.00397]	[1.08563]
R-squared	0.492242	0.709601	0.420591
Adj. R-squared	0.383437	0.647373	0.296432
Sum sq. resids	5560.858	227.4711	360.8639
S.E. equation	14.09262	2.850258	3.589985
F-statistic	4.524063	11.40320	3.387520
Log likelihood	-138.3556	-82.41716	-90.49302
Akaike AIC	8.306037	5.109552	5.571030
Schwarz SC	8.617106	5.420622	5.882099
Mean dependent	19.56848	18.03226	6.038429
S.D. dependent	17.94746	4.799836	4.279960
Determinant resid covariance (dof adj.)		20609.26	
Determinant resid covariance		10551.94	
Log likelihood		-311.1097	
Akaike information criterion		18.97770	
Schwarz criterion		19.91091	

Source: Authors' computation using E-views 9.

Coefficients of the VAR models are difficult to interpret since they totally lack any theoretical background. In order to overcome this criticism, the advocates of VAR models estimate so-called impulse response functions. The impulse response function examines the response of the dependent variable in the VAR to shocks in the error terms (Dimitrois, 2007). If we take a look at the response of the inflation rate to a one-unit shock in the unemployment rate, we notice that the graph increases from the very first period up until period four where the graph begin to decrease or fall and consistently decrease until period ten. Also, if we take a look at the response of the inflation rate to a one-unit shock in the unemployment rate, we notice that the graph is explosive for the first five periods but begin to converge in the sixth period. From then on, it continues to converge until period 10.

Impulse Response Analysis

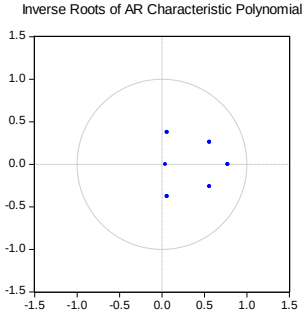
Since VAR estimates which could be interpreted both in terms of short run (causality) or long-run cointegration doesn't make so much meaning in theory, we conducted an Impulse Response Analysis on our estimated VAR – model. According to Kunst (2012), An Impulse Response Function traces the effect of a one-time shock to current and future values of the endogenous variables. Finally, we conducted an Impulse Response Analysis on our estimated VAR – model. The first line in the figure below shows the "one-unit impulse" response of the inflation rate for shocks occurring in one of our three variables. The second row which is the three middle graphs from top to bottom shows the response of the interest rate we chose and the third row shows the impact of shocks to the unemployment rate.



Source: Authors' computation using E-views 9.

Fig. 2: Impulse Response Function

If we for example take a look at the response of the unemployment rate to a one-unit shock in the inflation rate, we notice that the graph is decreasing for the first three periods. From then on, increases until the seventh period when it stabilizes around the zero axis. When the impulse is unemployment rate, every response of inflation is all positive at each responsive period from the first period to period three, growing marginally before dropping a little and then hovering around the zero axes from period four until period ten. When the impulse is inflation rate, the response of unemployment is negative in the second period and continues at negative value until the seventh period.



Source: Authors' computation using E-views 9

Fig. 3: Stability Test

AR Roots Graph: Test for stability.

AR Roots reports the inverse roots of the characteristic AR polynomial (Lutkepohl, 1991). The estimated VAR is stable (stationarity) as could be seen from the stability test result obtained in graphical form above, all roots have modulus less than one and lie inside the unit circle. If the VAR is not stable, then results such as the impulse response standard errors are not valid.

Test for Normality

Table 4: Residual Test

VAR Residual Normality Tests
Orthogonalization: Cholesky (Lutkepohl)
Null Hypothesis: residuals are multivariate normal
Date: 12/17/18 Time: 16:30
Sample: 1 37
Included observations: 35

Component	Skewness	Chi-sq	df	Prob.
1	1.097810	7.030258	1	0.0080
2	-0.191990	0.215018	1	0.6429
3	0.973192	5.524760	1	0.0187
Joint		12.77004	3	0.0052

Component	Kurtosis	Chi-sq	df	Prob.
1	4.415947	2.923822	1	0.0873
2	6.111535	14.11907	1	0.0002
3	5.936818	12.57798	1	0.0004
Joint		29.62087	3	0.0000

Component	Jarque-Bera	df	Prob.
1	9.954080	2	0.0069
2	14.33409	2	0.0008
3	18.10274	2	0.0001
Joint	42.39090	6	0.0000

Source: Authors' computation using Eviews 9.

From the VAR Residual Normality Tests, shows that Cholesky (Lutkepohl) are multivariate normal. Meaning that the distribution when orthogonalized is normally distributed hence, results obtained from estimations are robust.

Conclusion and Recommendations

This paper argued that interest rate if included as an input variable in the analysis of Phillips curve with unemployment and real interest rate can impact the modeling and the result since interest rate affects loads of macroeconomic variables. It is in the light of the foregoing that a Phillips curve model including real interest rate, unemployment and inflation rate with each variable assuming the role of an exogenous variable with the remaining variables being endogenous variables was developed. To conduct our estimation with the view to achieving our objectives, a set of Nigerian annual time series data from 1980 to 2016 was employed. Before carrying out the estimation of the model, time series properties were tested in order to ascertain what modelling best fits the data. All the variables attained stationarity at first difference which gives us the leverage to implement a VAR-Vector autoregression. As a result, we implemented the VAR lag order selection criterion, Impulse response function, and VAR. we carried out diagnostics including test for normality and stability tests. We cannot infer long-run

relationship from our Johansen test for cointegration, but long run relationship does exist from our VAR long-run estimates, similar conclusion was reached by Dritsaki, C. and Dritsaki, M. (2013). Also, trade off exist between unemployment and inflation, the findings of this study is in tandem with the findings by Auwal *et al* (2013). We conducted a test to identify whether our model performs better in comparison to the traditional Phillips curve model. The test results suggest that the model that included real interest along with the traditional variables performed better.

Based on the findings above, it would be recommended that policy makers shift towards discretionary policy in targeting inflation, especially in the short-run. While, government should increase its expenditure which will have a direct positive impact on aggregate expenditure (aggregate demand and supply) by creating jobs and increasing total output. The rising inflation in Nigeria would have impacted positively on the economy by reducing unemployment as a result of job creation something we did not see happening in Nigeria. A situation that can be attributed to faulty policy implementations motivated by political agenda, corruption that erodes capital projects, poor internal revenue generation capacity and high dependence on importation of both goods and services, as well as, medical trips abroad and payment of fees in foreign educational institutions.

References

CBN Journal of Applied Statistics (June, 2017) Vol. 8 No. 1.

Central Bank of Nigeria (2017). Statistical Bulletin, 2, December.

Chuku, C., Atan, J., & Obioesio, F. (2017). Testing for the Stability and Persistence of the Phillips Curve for Nigeria. *CBN Journal of Applied Statistics* Vol. 8(1):123-147.

Dritsaki, C. & Dritsaki, M. (2013). Phillips curve inflation and unemployment: an empirical research for Greece. *Int. J. Computational Economics and Econometrics,* Vol. 3, Nos. 1/2, pp.27–42.

Esu, G. E., & Atang, J. A. (2017). The Philips Curve in Sub-Saharan Africa: Evidence from Panel Data Analysis. *Journal of World Economic Research.* Vol. 6, No. 5, pp. 59-66.

Furuoka, F. (2007). "Does the "Phillips Curve" Really Exist? New Empirical Evidence from Malaysia." *Economics Bulletin*, Vol. 5, No. 16 pp. 1-14.

Gentle, P. F., Paudel, K. P., & Upadhyaya, K. P. (2005). Real wages, real interest rates, and the Phillips curve. *Applied Economics*. 37, 397–402.

Gordon R. J. (1997). The Time-Varying NAIRU and its implication for Economic Policy. *Journal of Economic Perspectives.* 11 (1) 11-32.

Gordon R. J. (2008). 'The History of the Phillips Curve: An American Perspective ', Paper presented at NU Macro Workshop Revised version of paper given at Australasian Meetings of Econometric Society Evanston, IL September 29th.

Gordon, R. J. (2011), The History of the Phillips Curve: Consensus and Bifurcation. Northwestern University, NBER, and CEPR.

Idenyi, O. S., Favour, O. E., Johnson, O. N., & Thomas, O. O. (2017). Understanding the Relationship between Unemployment and Inflation in Nigeria. *Advances in Research.* 9(2): 1-12, no.AIR.32218 ISSN: 2348-0394, NLM ID: 101666096.

Jochumzen, P. (2010). Essentials of Macroeconomics. *Bookboon*. ISBN 978-87-7681-558-5.

Kilian, L. (1990). Impulse Response Analysis in Vector Autoregressions with Unknown Lag Order. *Journal of Forecasting*. 20:161-171.

Kunst, R. (2012). Estimating The US Phillips Curve. Applied Times Series Analysis. WS. Universitat Wien.

Lu, C., & Xin, Z. (2010), Impulse-Response Function Analysis: An application to macroeconomic data of China. School of Economics and Social Sciences, Hoskolan Dalarna, D-Level Essay in Statistics for M.S. Degree.

Lucas, R.E. and Sargent, T. (1978) 'After Keynesian econometrics', After the Phillips Curve: Persistence of High Inflation and High Unemployment, *Conference Series* 19, Federal Reserve Bank of Boston, Boston.

Mankiw, N. G. (2000). Macroeconomics, *Worth Publishers*, USA, 4th Edition.

Mankiw, N. G. (2010). Principles of Economics– *South-Western Cengage Learning*.

Muhammad, A. B., Sa'idu, B. M., Nwokobia, O. J., & Yakubu, K. M. (2013). Effect of Unemployment and Inflation on Wages in Nigeria. *Journal of Emerging Trends in Economics and Management Sciences (JETEMS)*. 4(2): 181-188. (ISSN: 2141-7024). Retrieved from jetems.scholarlinkresearch.org.

Orji, A., Orji, O., & Okafor, J. (2015). Inflation and unemployment nexus in Nigeria: Another test of the Phillips curve. *Asian Economic and Financial Review*, 5(5) 766-778.

Patrick, N., & Karlsson, K., (2013), An empirical analysis of the Phillips Curve - A time series exploration of Germany. Bachelor's Thesis.