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AN EMPIRICAL ANALYSIS OF UNEMPLOYMENT AND INFLATION RATE IN NIGERIA

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ABSTRACT: *Inflation distorts the working of the price system, creates arbitrary redistribution from debtors to creditors, disrupt productive investment activity, and it is usually costly to eliminate. Also, the inability of job seekers to secure gainful employment tends to create disaffection among people and causes the youth, to resort to social vices (such as robbery, suicide, prostitution, drug addiction, terrorism and political unrest etc. in Nigeria. Thus, this research used the Annual data on Unemployment and Inflation rate which were extracted from Central Bank of Nigeria (CBN) 2019 statistical bulletin to investigate the relationship between unemployment rate and inflation rate in Nigeria. Jarque-Bera normality test was first conducted on the variables which reveal that the variables are normally distributed. Unit root test was also carried out on the macroeconomic variables which the results revealed that all the variables are stationary at first difference. The existence of long run relationship was also investigated using Johansen and Juselius Cointegration Test. The trace test and the maximum eigenvalue test showed there exist long run relationship between unemployment rate and inflation rate in Nigeria. Also, VECM model was implemented; the results revealed that inflation rate and unemployment rate are significantly negatively related in the long run in Nigeria. Error Correction Model (ECM) was developed to study the short run dynamics of our variables, the pairwise Ganger causality test revealed that both variables do not Granger caused each other i.e. there is evidence of short run relationship between unemployment rate and inflation rate in Nigeria. For the short run models, a normality test was conducted using histogram on the residuals and evidence from the Jarque-Bera test revealed that the residuals are normally distributed (p-values>0.05). The CUSUM stability test shows that the parameters of the short run unemployment rate model are not stable over time while for inflation rate model, the parameters of the model are stable over time i.e. an increase in inflation rate leads to decrease in unemployment rate and on the other hand increase in unemployment rate leads to decrease in inflation rate in Nigeria. Thus, inflation rate does not granger cause unemployment rate in Nigeria and also unemployment rate does not granger cause inflation rate in Nigeria.*

KEYWORDS: Cointegration, Unemployment, Inflation Error Correction Model, Vector Error Correction Mode

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INTRODUCTION

Inflation is bad, especially when unexpected, because it distorts the working of the price system, creates arbitrary redistribution from debtors to creditors, creates incentives for speculative as opposed to productive investment activity, and it is usually costly to eliminate. Inflation can be defined as a positive rate of growth of the general price level.

Chowdhury and Tanjil (2014) defined unemployment as a state in which people who can work are without jobs and are seeking for pay or profit. Some studies have provided the following as determinants of unemployment. These include: inflation rate, population growth, graduate outputs, Openness of Trade, and Private Domestic Investment and many more (Oniore et al., 2015).

The inability of job seekers to secure gainful employment tends to create disaffection among these people and causes some of them, especially the youth, to resort to social vices such as robbery, suicide, prostitution, drug addiction, terrorism and political unrest.

Indeed, unemployment constitutes underutilization of human resources and the failure to prevent these resources going to waste does not only make them vulnerable to poverty but is also a loss of potential income tax revenue to the nation.

According to economic theory, inflation and unemployment rate are inversely related which can be explained by Phillips Curve, which is the study of the interrelationship between unemployment and inflation. For instance, Umoru & Anyiwe (2013) examined the dynamics of inflation and unemployment rates in Nigeria using the Vector Error Correction Model over a period of twenty- seven (27) years. Their findings revealed evidence of stagflation in the Nigerian economy over the period they studied.

Mohammed et al. (2015) studied the relationship between unemployment, inflation and economic growth in Nigeria. Their findings confirmed that in the long run, interest rate and total public expenditure have significant impact on economic growth in Nigeria, while inflation and unemployment have inverse effects on growth in Nigeria; Orji et al (2015) examined the inflation and unemployment nexus in Nigeria by testing if the original Phillips curve proposition holds for Nigeria. They adopted a distributed lag model on data covering a period from 1970 to 2011. They found out that unemployment is a significant determinant of inflation and there is a positive relationship between inflation and unemployment rate in Nigeria; Ojapinwa & Esan (2013) also examined the existence and the stability of Phillips curve for Nigeria using time series data from 1970 to 2010. They reported that the estimates from the relation between the change in inflation rate and the unemployment rate was theoretically negative in the short run; and that the relationship became non-existence in the long run with positive relationship between inflation and unemployment signifying stagflation.

Aminu & Anono (2013) investigated the relationship between unemployment and inflation in the Nigerian economy between 1977 and 2009. They reported that inflation impacted negatively on unemployment, the causality test reveals that there was no causality between unemployment and inflation in Nigeria and there exist a long run relationship between unemployment and inflation rates in Nigeria; Bula (2014) reported that inflation is negatively correlated with unemployment rates in Nigeria as stipulated by the Phillips curve; Torruam & Abur (2014) investigated the relationship between unemployment, inflation and crime in Nigeria using Vector Error Correction Model (VECM). Their result revealed that there is

unidirectional causality running from unemployment and inflation to crime in Nigeria. The study concluded that unemployment in Nigeria Granger causes crime.

Mohaddes & Raissi (2014) examined the long-run relationship between consumer price index industrial workers (CPI-IW) inflation and GDP growth in India using cross-sectionally augmented distributed lag (CS-DL) as well as the standard Panel ARDL method. Their findings suggested that on average, there is a negative long-run relationship between inflation and economic growth in India while Al-Zeaud & Al-Hosban (2015) examined the relationship between inflation rate and unemployment rate in order to predict and estimate the existence of Phillips curve trade-off relation within Jordanian economy over the period of 1976 to 2013. Their findings revealed that there was a negative and non-linear relationship between unemployment and inflation rates. Their study further proved a strong empirical existence of Phillips curve on Jordanian economy.

This paper tends to explore the dynamic interrelationship between unemployment and inflation rates in Nigeria, to see if unemployment rate causes inflation rate in Nigeria or whether inflation rate causes unemployment in Nigeria and also to study the dynamic interrelation between unemployment rate and inflation rate in Nigeria using Vector Error Correction Model (VECM) and Granger Causality Test.

METHOD OF ANALYSIS

Annual data on Unemployment and Inflation rate were extracted from Central Bank of Nigeria (CBN) 2019 statistical bulletin. The data was transformed using Natural logarithm; this was done to achieve normality for the macroeconomic variables.

Most macroeconomic time series data are not stationary at level thereby having unit root problem that can led to spurious regression. To avoid spurious regression, one need to test for unit root. If unit root is present first differencing makes such variable stationary. Cointegration means long rung relationship, which is also common among related variables and lastly, the use of Vector Error Correction Models (VECM) allows one to describe the long run relationships and short run relationships of non-stationary variables.

Unit Root Testing

Engle and Granger, (1987) considered seven test statistics in a simulation study to test cointegration. They concluded that the Augmented Dickey Fuller test was recommended and can be used as a rough guide in applied work. The essence of the unit root test is to avoid spurious regression.

To distinguish a unit root, we can run the regression

$$\Delta Y_t = b_o + \sum_{j=1}^{k} b_j \Delta Y_{t-j} + \beta t + \gamma Y_{t-1} + u_t \qquad (1)$$

The model in (1) may be run without t if a time trend is not necessary. This technique was applied in Ajayi and Mougoue (1996). If there is unit root, differencing Y should result in a white-noise series (no correlation with Y_{t-1}). The Augmented Dickey-Fuller (ADF) test of the

null hypothesis of no unit root test is of the form H_o: $\beta = \gamma = 0$ (if there is trend we use F-test) and H_o: $\gamma = 0$ (if there is no trend we use t-test). If the null hypothesis is accepted, we assume that there is a unit root and differencing the data before running a regression. If the null hypothesis is rejected, the data are stationary and can be used without differencing (Salvatore & Reagle, 2002).

Johansen and Juselius Cointegration Test

The most popular test for cointegration testing is the Johansen and Juselius cointegration test i.e. Maximum Eigenvalue test and the trace test (Johansen & Juselius, 1990). The maximum eigenvalue test and the trace test are used as procedures to determine the number of co-integration vectors.

The maximum eigenvalue statistic test the null hypothesis of r cointegrating relations against the alternative of r+1 cointegrating relations for r= 0, 1, 2 ,…, n-1. This test statistic is computed as

$$\lambda_{\max}(r, r+1) = -T \ln(1 - \hat{\lambda}_{r+1})$$

where $\hat{\lambda}$ is the computed maximum eigenvalues and T stands for the sample size.

The main difference between the maximum eigenvalue test and the trace test is that the trace test is a joint test, whereas the maximum eigen value test conducts separate test on the individual eigenvalues.

Trace statistic examines the null hypothesis of r cointegrating relations against the alternative of n cointegrating relations, where n is the number of variables in the system for

r = 0,1,2, . . ., n-1.

It is computed according to the following formula

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{n} \ln(1 - \hat{\lambda}_i)$$

The results of trace test should be chosen where trace and maximum eigenvalue statistic may yield different results in some case (Habte, 2014).

Vector Error Correction Model (VECM)

The main feature of the VECM is its capability to correct for any disequilibrium that may shock the system from time to time. The error correction term picks up such disequilibrium and guides the variables of the system back to equilibrium (Hossain, 2009).

The following VECM specifications usually exist:

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$$\Delta y_t = \alpha\beta^T y_{t-p} + \Gamma_1 \Delta y_{t-1} + ... + \Gamma_{p-1} y_{t-p+1} + u_t \quad (1)$$

with

$$\Gamma_i = -(I - A_1 - ... - A_i) \quad (2)$$

and

$$\Pi = \alpha\beta^{\mathrm{T}} = -(I - A_1 - ... - A_p) \quad (3)$$

The Γ_i matrices contain the cumulative long run impacts, hence this VECM specification is signified by long run form. The other specification is given as follows and is commonly used:

$$\Delta y_t = \alpha\beta^T y_{t-1} + \Gamma_1 \Delta y_{t-1} + ... + \Gamma_{p-1} y_{t-p+1} + u_t \quad (4)$$

with

$$\Gamma_i = -(A_{i+1} + ... + A_p) \quad (5)$$

and

$$\Pi = \alpha\beta^{\mathrm{T}} = -(I - A_1 - ... - A_p) \quad (3)$$

Hence, the Π matrix is the same as in the first specification. However, the Γ_i matrices now differ, in the sense that they measure transitory effects. Therefore, this specification is signified as transitory form. In case of cointegration the matrix $\Pi = \alpha\beta^{\mathrm{T}}$ is of reduced rank. The dimension of α and β is $K \times r$ is the cointegration rank, that is, how many long run relationships between the variables y_t do exist. The matrix α is the loading matrix and the coefficients of the long-run relationships are contained in β (Pffaf, 2008).

Short Run Error Correction Model

The cointegrating regression considers only the long-run property of a given model, and does not deal with the short-run dynamics explicitly. Clearly, a good time series modelling should describe both short-run dynamics and the long-run equilibrium simultaneously. For this purpose, Error Correction Model (ECM) was developed. Although ECM has been popularized after Engle and Granger, it has a long tradition in time series econometrics.

To start, we define the error correction term by

$$\varepsilon_t = y_t - \beta x_t$$

Where β is a cointegration. In fact, ε_t is the error from a regression of y_t on x_t. Then an ECM is simply defined as

$$\Delta y_t = \alpha\varepsilon_{t-1} + \gamma\Delta x_t + u_t$$

where u_t is independently and identically distributed. the ECM equation simply says that Δy_t can be explained by the ε_{t-1} and Δx_t. We can notice that ε_{t-1} can be thought of as an equilibrium error (or disequilibrium term) occurred in the previous period.

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Granger Causality Test

This is a technique for determining whether one-time series is useful in forecasting another (Granger, 1969), this test can be carried out either by Wald or F-test (Hacker and Hatemi, 2006). In more formal terms the Granger causality test is based on the following regression

$$X_t = \sum_{i=1}^{n} \alpha_i Y_{t-i} + \sum_{j=1}^{n} \beta_j X_{t-j} + u_{1t} \quad \ldots(6)$$

$$Y_t = \sum_{i=1}^{n} \lambda_i Y_{t-i} + \sum_{j=1}^{n} \delta_j X_{t-j} + u_{2t} \quad \ldots(7)$$

where it is assumed that the disturbance u_{1t} and u_{2t} are uncorrelated. Since we have two variables, we are dealing with bilateral causality.

PRESENTATION OF DATA

The data used in this study are presented in table and in graph. To ensure normality of the data, the macroeconomic variables were transformed using the natural log transformation. The transformed data is presented in Fig. 1 below.

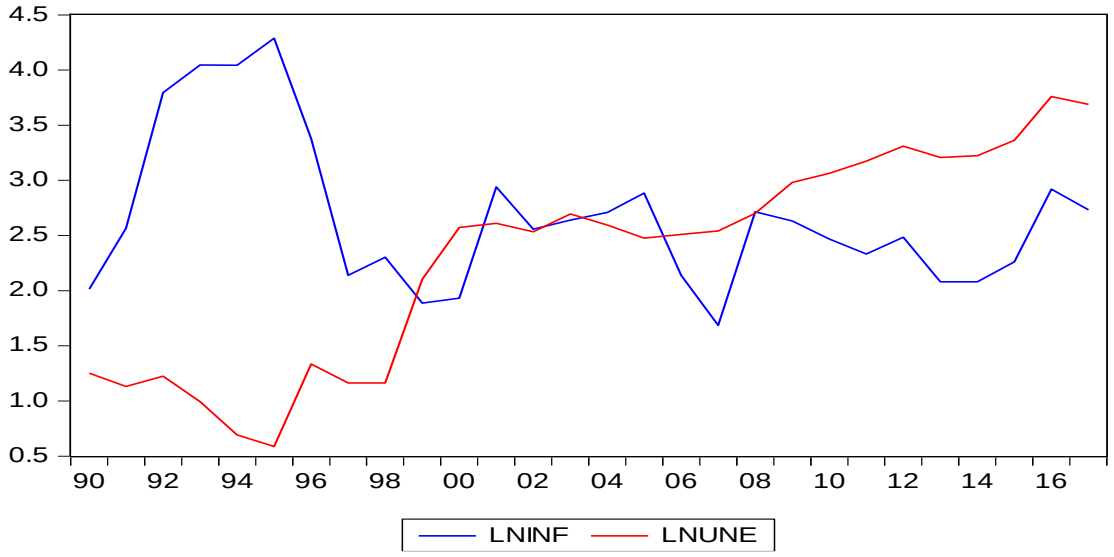

Fig. 1: Graph showing the Log transformation of inflation rate (LNINF) and Unemployment rate (LNUNE).

The above fig 1 shows interaction between unemployment and inflation rates at the mid periods under consideration, while in the later years the graph exhibited similar behaviour between inflation rate and unemployment rate in Nigeria over the period of 1990 to 2017.

Table 2: ADF Test

Variables	t-statistic	p-value	Remark
LNINF	-2.344156	0.1663	Not Stationary
D(LNINF)	-4.483350	0.0016	Stationary
LNUNE	-0.449922	0.8864	Not Stationary
D(LNUNE)	-4.220434	0.0031	Stationary

The table 2 above presents the unit root test results from the macroeconomic variables. The above results revealed that all the variables are stationary at first difference. The next thing is to examine the existence of long run relationship (that is, Cointegration test).

Table 3: Johansen Cointegration Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.538800	21.10502	(20.12202)	15.49471 (14.26460)	0.0064(0.0053)
At most 1	0.037102	0.982998	(0.982998)	3.841466 (3.841466)	0.3215 (0.3215)

The Table 3 above presented the results of the Johansen cointegration test. Evidence from trace test and the maximum eigenvalue test indicated 1 cointegration equation. This implies that there exists long run relationship among Unemployment rate and inflation rate in Nigeria.

Since the variables are stationary at first difference and are also cointegrated, then the Vector Error Correction Model will be appropriate to study these macroeconomic variables.

Table 4: VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-53.68945	NA	0.295079	4.455156	4.552666	4.482201
1	-16.87364	64.79582*	0.021418	1.829891	2.122421*	1.911027*
2	-12.96089	6.260403	0.021754	1.836871	2.324421	1.972097
3	-8.433032	6.520114	0.021272*	1.794643*	2.477213	1.983959

Table 4 presents VAR selection lag to be used to build the VECM model. VAR selection lag using the AIC criterion select lag 3. But since VECM is difference model, lag 2 was used for the VECM model.

Table 5: Long run Relationship between Unemployment rate and Inflation rate

Variables	Coefficients	Std error	t-statistic	Remarks
LNINF(-1)	-2.504683	0.48955	-5.11630	Significant
Constant	9.089723			

Table 5 above presents the Long Relationship between Unemployment rate and Inflation Rate in Nigeria. The results revealed that inflation rate is significantly negatively related to unemployment rate in Nigeria. This implies that an increase in inflation rate will leads to corresponding decrease in unemployment rate in Nigeria.

Table 6: Long run Relationship between Inflation rate and Unemployment rate

Variables	Coefficients	Std error	t-statistic	Remarks
LNUNE(-1)	-0.399252	0.11515	-3.46738	Significant
Constant	3.629091			

Table 6 above presents the Long Relationship between inflation Rate and unemployment rate in Nigeria. The results revealed that unemployment rate is significantly negatively related to inflation rate in Nigeria. This implies that an increase in unemployment rate will leads to corresponding decrease in inflation rate in Nigeria.

Table 7: Granger Casualty Test

Null Hypothesis:	Obs	F-Statistic	Prob.
LNUNE does not Granger Cause LNINF	26	2.34121	0.1208
LNINF does not Granger Cause LNUNE		1.97464	0.1638

The table 7 above presented the Pairwise granger causality test for inflation and unemployment rates in Nigeria. Since the p-values>0.05 we do not reject the null hypotheses and conclude that in Nigeria the interrelationship between inflation and unemployment rates are independent that is none of the variable Granger cause the other variable.

Table 8: Short run Analysis of the Relationship between Unemployment rate and Inflation Rate in Nigeria

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.040781	0.070730	0.576575	0.5710
D(LNINF(-1))	-0.114129	0.110928	-1.028856	0.3165
D(LNINF(-2))	-0.256255	0.089942	-2.849125	0.0103
D(LNUNE(-1))	0.991407	0.527543	1.879292	0.0756
D(LNUNE(-2))	-0.504207	0.196345	-2.567969	0.0188
ECM(-1)	-1.053322	0.604177	-1.743401	0.0974

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The table 8 revealed a short run relationship between unemployment rate and inflation rate in Nigeria. The results revealed a significant negative short run relationship between unemployment rate and unemployment rates at lag 2 and inflation rate at lag 2 (p-values<0.05), while unemployment rate relationship with unemployment rate at lag 1 and inflation rate at lag 1 are not significant (p-values>0.05). The speed up adjustment is very high at the rate of 105% by the previous year but only significant at 10% (p-value = 0.0974 > 0.05).

Table 9: Multicollinearity test for the short run Unemployment Rate Model

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	0.005003	2.071338	NA
D(LNINF(-1))	0.012305	1.615388	1.614357
D(LNINF(-2))	0.008089	1.044385	1.044058
D(LNUNE(-1))	0.278302	10.33833	9.065556
D(LNUNE(-2))	0.038551	1.341872	1.228055
ECM(-1)	0.365029	9.859239	9.859222

Table 9 above conducted multicollinearity test for the short run unemployment rate Model. The test revealed absence of multicollinearity since each VIF values are all less than 10 (VIF<10) except high multicollinearity cause by unemployment rate at lag 1 (VIF>10).

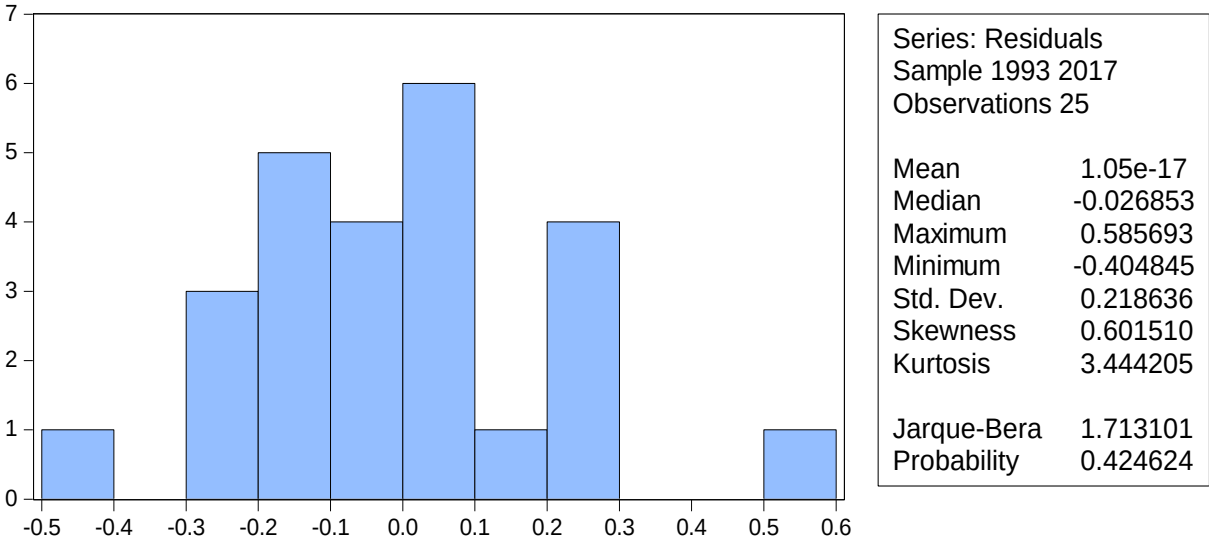

Fig 2: Normality Test for the Residuals of the Short run Unemployment rate Model

Fig 2 above presented the histogram of the residuals and evidence from the Jarque-Bera test revealed that the residuals are normally distributed (p-values=0.4246>0.05).

Table 10: Breusch-Godfrey Serial Correlation LM Test for Unemployment Rate Model

F-statistic	0.585956	Prob. F(2,17)	0.5674
Obs*R-squared	1.612257	Prob. Chi-Square(2)	0.4466

Table 10 above tested for serial correlation in the short run unemployment rate model. The test revealed absence of serial correlation in the model (p-value=0.5674>0.05)

Table 11: Heteroskedasticity Test: Breusch-Pagan-Godfrey for Unemployment Rate Model

F-statistic	1.065116	Prob. F(5,19)	0.4102
Obs*R-squared	5.473229	Prob. Chi-Square(5)	0.3609
Scaled explained SS	3.863478	Prob. Chi-Square(5)	0.5692

Table 11 above tested for heterocedasticity in the short run unemployment rate model. The test revealed absence of heteroscedasticity in the model (p-value=0.4102>0.05).

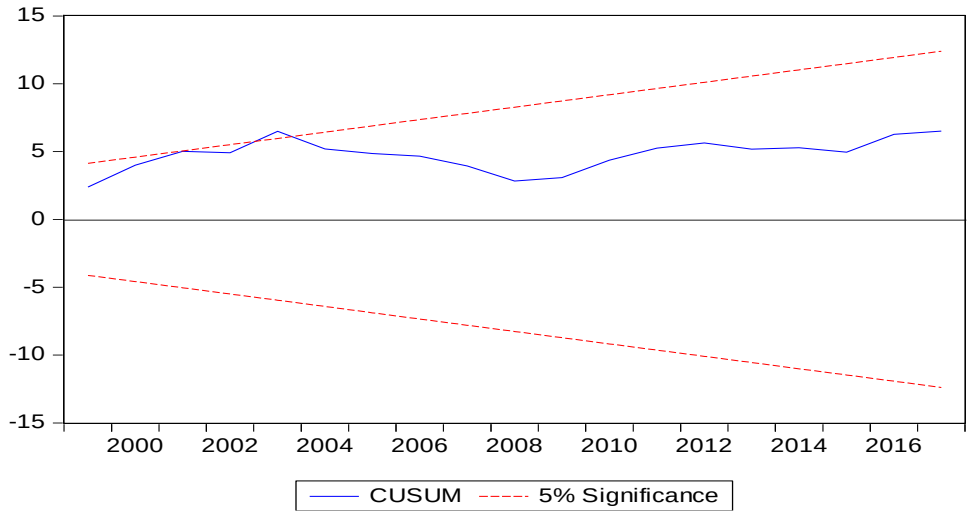

Fig 3: Stability Test for the Short Run Unemployment Rate Model

The Fig 3 above revealed that the parameters of the short run unemployment rate model are not stable over time. This implies that the model is not good for forecasting purpose.

Table 12: Short run Analysis of the Relationship between Inflation Rate and Unemployment rate in Nigeria

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.064043	0.099793	-0.641763	0.5287
D(LNINF(-1))	0.693627	0.293834	2.360607	0.0291
D(LNINF(-2))	-0.170476	0.167392	-1.018427	0.3213
D(LNUNE(-1))	-0.664251	0.369548	-1.797469	0.0882
D(LNUNE(-2))	0.910291	0.339419	2.681913	0.0148
ECM(-1)	-0.994953	0.392488	-2.534991	0.0202

The table 12 revealed a short run relationship between inflation rate and unemployment rate in Nigeria. The results revealed a significant positive short run relationship between inflation rate and inflation rate at lag 1 and unemployment rates at lag 2 (p-values<0.05), while inflation rate relationship with unemployment rate at lag 1 and inflation rate at lag 2 are not significant (p-values>0.05). The speed up adjustment is very high at the rate of 99.5% by the previous year is significant at 5% (p-value=0.0202<0.05).

Table 13: Multicollinearity test for the short run Inflation Rate Model

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	0.009959	1.229331	NA
D(LNINF(-1))	0.086339	3.379333	3.377177
D(LNINF(-2))	0.028020	1.078544	1.078207
D(LNUNE(-1))	0.136566	1.512541	1.326329
D(LNUNE(-2))	0.115205	1.195568	1.094160
ECM(-1)	0.154047	3.722077	3.721318

Table 13 above conducted Multicollinearity test for the short run inflation rate Model. The test revealed absence of multicollinearity since each VIF values are all less than 10 (VIF<10).

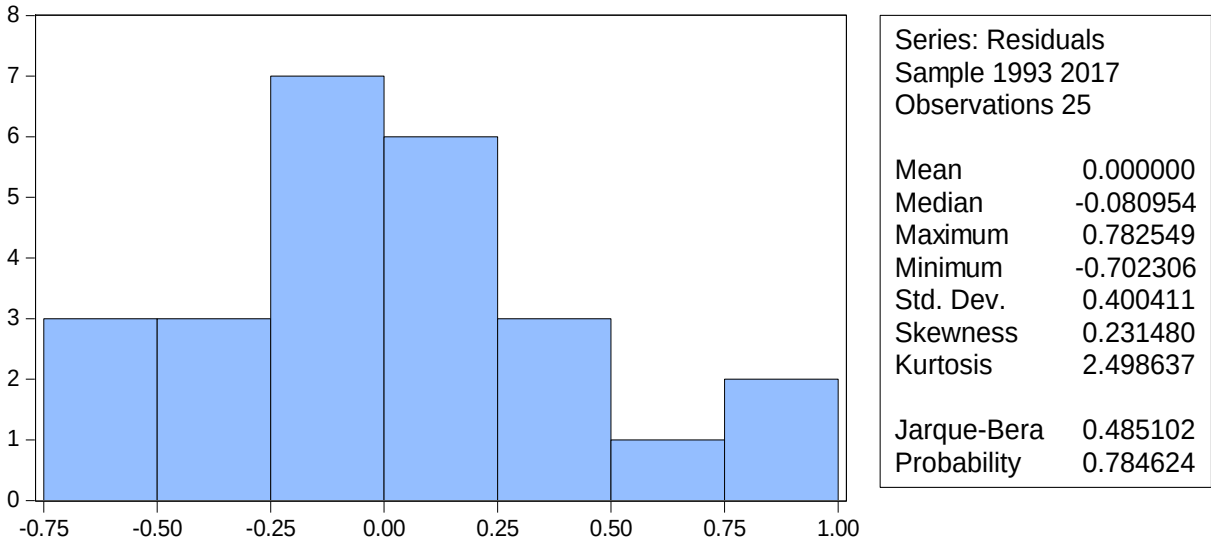

Fig 4: Normality Test for the Residuals of the Short run Inflation rate Model

Fig 4 above presented the histogram of the residuals and evidence from the Jarque-Bera test revealed that the residuals are normally distributed (p-values=0.7846>0.05).

Table 14: Breusch-Godfrey Serial Correlation LM Test for Inflation Rate Model

F-statistic	4.897269	Prob. F(2,17)	0.0209
Obs*R-squared	9.138558	Prob. Chi-Square(2)	0.0104

Table 14 above tested for serial correlation in the short run inflation rate model. The test revealed the presence of serial correlation in the model (p-value=0.0209<0.05)

Table 15: Heteroskedasticity Test: Breusch-Pagan-Godfrey for Inflation Rate Model

F-statistic	0.767462	Prob. F(5,19)	0.5846
Obs*R-squared	4.200704	Prob. Chi-Square(5)	0.5209
Scaled explained SS	1.818091	Prob. Chi-Square(5)	0.8737

Table 15 above tested for heteroscedasticity in the short run inflation rate model. The test revealed absence of heteroscedasticity in the model (p-value=0.5846>0.05).

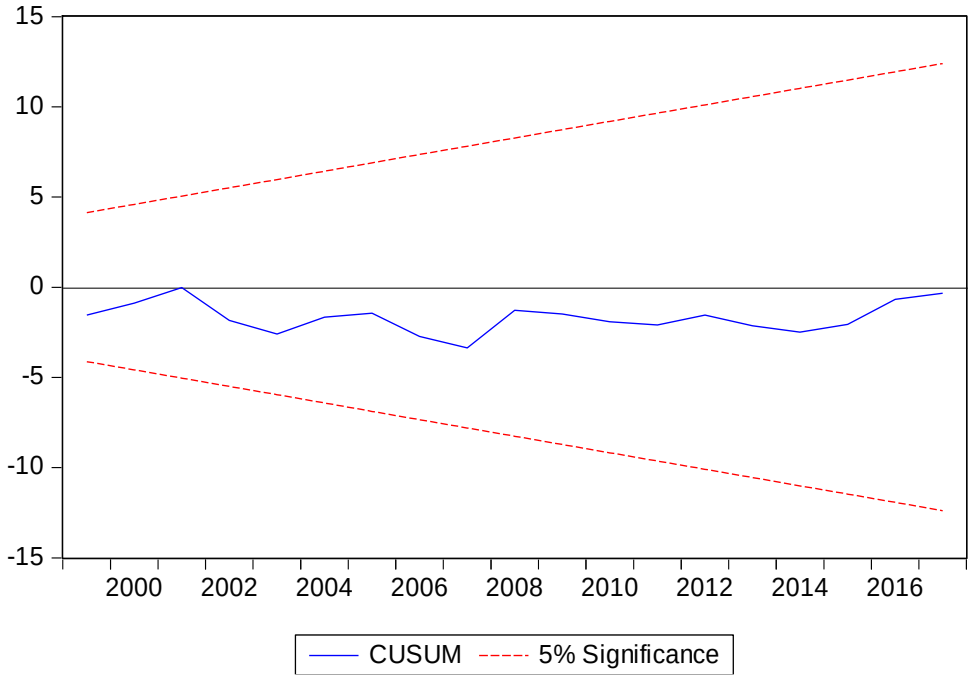

Fig 5: Stability Test for the Short Run Inflation Rate Model

The Fig 5 above revealed that the parameters of the short run inflation rate model are stable over time. This implies that the model is good for forecasting purpose

CONCLUSION

Results from the Jarque-Bera normality test revealed that the variables are normally distributed (p-values>0.05). Furthermore, the unit root test results from the macroeconomic variables revealed that all the variables are stationary at first difference. Also, the existence of long run relationship was investigated and the results of the Johansen cointegration test from trace test and the maximum eigenvalue test indicated 1 cointegration equation. This implies that there exists long run relationship between unemployment rate and inflation rate in Nigeria.

VAR selection lag using the AIC criterion selected lag 3, but since VECM is difference model, lag 2 was used for the VECM model. The full VECM model was implemented, the results revealed that inflation rate and unemployment rate are significantly negatively related in the long run in Nigeria. Result from the pairwise Ganger causality test revealed that both variables do not Granger caused each other. The results also revealed evidences of short run relationship between unemployment rate and inflation rate in Nigeria. In the unemployment rate model, the speed up adjustment is very high at the rate of 105% by the previous year but only significant at 10% (p-value = 0.0974 > 0.05) while in the inflation rate model, the speed up adjustment is very high at the rate of 99.5% by the previous year is significant at 5% (p-value=0.0202<0.05).

For both short run models, the histogram of the residuals and evidence from the Jarque-Bera test revealed that the residuals are normally distributed (p-values>0.05). The CUSUM stability

test revealed that the parameters of the short run unemployment rate model are not stable over time. While for inflation rate model, the parameters of the model are stable over time. It was seen that unemployment rate and inflation rate are negatively significantly related in Nigeria in the long run. This implies that an increase in inflation rate leads to decrease in unemployment rate and on the other hand increase in unemployment rate leads to decrease in inflation rate in Nigeria.

Lastly, inflation rate does not granger cause unemployment rate in Nigeria and also unemployment rate does not granger cause inflation rate in Nigeria.

Based on these findings, we therefore recommend that government policy should be implemented to reduce inflation rate to a single digit in Nigeria and there is also need for government to support the Small and Medium enterprises that will help to great more employment opportunities in Nigeria.

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