Re-examining the Phillips Curve Theory in Nigeria: An Empirical Analysis

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Abstract: This article re-examines the Phillips Curve Theory for Nigeria; time-series data for the period from 1980 to 2022 have been analyzed. The study employed the ARDL model to examine the linkage between inflation and unemployment in Nigeria. The study revealed that there was a negative relationship between unemployment and inflation, thus enhancing the fact that the Phillips Curve Theory exists in Nigeria. A relatively weak negative association is unveiled to exist between unemployment and the nominal GDP. Stability tests (Cusum Sum of Squares) confirmed that the model is robust. Diagnostic tests actually justify its reliability (heteroskedasticity, multicollinearity, and autocorrelation). These results (findings) suggest that the monetary authorities must exercise caution while implementing inflation-targeting policies or adjusting money supply because these policies may be influencing unemployment rates.

Key words: Phillips curve, ARDL, Inflation rate, nominal GDP, Unemployment rate, exchange rate.

1.0 INTRODUCTION

Lower unemployment and price stability are significant macroeconomic goals that every country strives to achieve, regardless of her ideology (Solow & Taylor, 1998; Stiglitz et al., 2006). Nigeria is no exception as she adopts output and monetary targeting as a policy tool to realize these goals (Amassoma & Nwosa, 2011). While some countries have maintained low unemployment rates and low rates of inflation-as in the U.S., Canada, Germany, or China, for example-Nigeria's unemployment rates are high with corresponding high rates of inflation (Nurudden Abu, 2019; Goryunov et al., 2023; Goodwin et al., 2022; Larrain, 2020). For example, inflation fluctuated between highs of 9.97% in 1980 and more than 50% at the end of the 1980s; at lower levels below 20% since 1997, challenges persist (IMF, 2023). The new Nigeria Labour Force Survey (NLFS) methodology reports unemployment at around 6% for the period 2020-2022; other methods report significantly higher rates, with over 30% reported in 2020 and above 20% reported for both 2021 and 2022 (IMF, 2023).

2.0 LITERATURE REVIEW

A lot of research had been conducted using different methodologies, both in Nigeria and outside Nigeria to test the validity of Phillips curve theory. Some researchers showed that the Phillips curve theory exists, some showed its existence only in a short-run, some showed that the Phillips curve does not exist, some showed its existence only in a long-run. Abu, (2019) conducted a research in Nigeria using 1980 to 2016 data and applied ARDL, FMOLS, DOLS and SOLS. Collected data for unemployment and inflation, found out that trade-off exist (Phillips curve theory hold in Nigeria), Sasongko, et al (2022) also conducted research in Indonesia, using data spanning from 1977 to 2019 for inflation and unemployment, the researchers applied SVAR and found out that trade-off exist (Phillips curve theory hold in Indonesia). Udede et al. (2021) conducted a research in Nigeria using data spanning from 1981 to 2018, the research applied ARDL and collected data on unemployment rate, GDP, inflation and total government expenditure, the research found out that a negative relationship exist between inflation and unemployment (Phillips curve theory hold in Nigeria). Ahmed, (2020) conducted a research in Pakistan using data on inflation and unemployment spanning from 1991 to 2015, the research applied Granger Causality and graphical analysis and found out that negative relationship between inflation and unemployment exist (Phillips curve theory holds in Pakistan). Kartika, M., & Kurniasih, (2020) also conducted a research using data on inflation and unemployment spanning from 2008 to 2017 for ASEAN countries; (Indonesia, Philippines, Malaysia, Singapore, Brunei, Darussalam, Thailand, Vietnam, Laos, Cambodia and Myanmar) the research applied dynamic panel data methods and found out that there is negative relationship between unemployment and inflation both in a short-run and in a long-run. Some researches that found an existence of a positive relationship between inflation and unemployment are: Sylvester et al. (2023)

conducted a research in Nigeria, using data on inflation, unemployment rate, GDP, and exchange rate spanning from 1991 to 2021. The research applied ARDL and Bound test analysis and found out that a positive relationship exists between inflation and unemployment (Phillips curve theory does not hold in Nigeria). Lawal, (2023) conducted research in Nigeria using data on inflation rate, unemployment rate, monetary policy rate, exchange rate and poverty rate spanning from 1986 to 2021. The research applied ARDL and Granger Causality test and found out that Phillips curve theory does not hold in Nigeria. Innocent, & Irmiya, (2019) also conducted a research in Nigeria using data on inflation and unemployment spanning from 1980 to 2018, the research applied ARDL and found out that there is a positive relationship between inflation and unemployment. Tule, & Adeleke, (2019) conducted a research in Nigeria using data on inflation rate, unemployment rate, previous inflation rate, GDP and supply shocks spanning from 1990 Q1 to 2018 Q3, the research applied OLS with HAC (heteroskedasticity auto-regression robust) and found out that there is a positive relationship between inflation and unemployment in Nigeria. Others include: Buthelezi, (2022) uses inflation and unemployment for South Africa from 2008 – 2022, using Markov-Switching dynamic regression, the research found out that there is a time when Phillips curve theory holds, and there are times when it didn't. Azam, M.et al (2021) uses inflation rate and unemployment rate from middle east and north African countries for data collected from 1991- 2019, using Panel ARDL/Pooled mean group (PMG), the research found out the existence of positive relationship in a long-run but negative and insignificant relationship in short-run. Seth, A.et al. (2018) uses GDP and unemployment in Nigeria from 1980 – 2015, using ARDL and ECM, the research found out that there is no long-run relationship between unemployment and economic growth in Nigeria. Al-zeaud, & Al-hosban, (2020) uses inflation and unemployment in Jordan using VECM after various unit root tests, the research found out that there is negative and non-linear relationship between unemployment and inflation. Sisay, (2020) uses inflation, unemployment and expected inflation in Ethiopia using data from 1985 – 2020, the research applied ARDL, Granger Causality test and ECM, found out that there is no short-run relationship between unemployment and inflation, but there exist a negative relationship in a long-run only. Gobhoza,

(2020) uses inflation, GDP, Money Supply, Real Exchange Rate, Interest rate, and import price using data from 1980 - 2017 in Botswana found out that unemployment has no significant impact of inflation. Daniel, et al (2021) uses inflation, GDP and unemployment in Nigeria, using data spanning from 1980 – 2020, the research applied VAR and ECM, and found out that there is no significant relationship between unemployment and inflation. Emmanuel, (2019) uses inflation rate, GDP growth rate and unemployment rate from 1981 to 2017 in Nigeria and applied Fully Modified Least Square (FMOLS), the research found out that Phillips curve theory hold, and that for Nigeria to achieve a 1% decrease in unemployment, she must be ready to tolerate 49% increase in inflation.

The mixed results from previous researches and the trend from the data that showed at some point in time both inflation and unemployment moves in the same direction, while in some point in time they moves in opposite direction, these triggered the need to re-examine whether or not the Phillips curve theory actually exists in the context of Nigeria, using data from 1980 to 2022 on variables; nominal GDP, Inflation rate, unemployment rate and nominal exchange rate, this research seeks to examine whether it holds or not.

3.0 METHODOLOGY

3.1 Sources of data

This study uses secondary data obtained from the International Monetary Fund (IMF), World Bank, National Bureau of statistics (NBS) and the Central Bank of Nigeria statistical bulletin. Data on consumer price index as a proxy for inflation, and nominal exchange rate, nominal GDP, and unemployment rate from the year 1980 to 2022 were collected.

3.2 Unit root tests

As the prerequisite in time series data the first thing is to test the stationary of the data to avoid spurious regression. The Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) were conducted to avoid misspecification of the model.

3.3 Bound Co-integration test

After conducting the unit root tests, the results showed a combination of I(0) and I(1), for these reasons, a bound co-integration test was further

conducted to ascertain whether or not there is a long-run relationship between the variables.

3.4 Autoregressive Distributed Lag (ARDL) Model Specification

The Autoregressive Distributed Lag (ARDL) model is a widely used econometric model for analyzing the long-run relationship between variables. It is particularly useful when dealing with non-stationary time series data. Here's how an ARDL model can be specified:

Let Yt represent the dependent variable (economic growth), $X1t$ represent the first independent variable (unemployment rate), X2t represent second independent variable (Inflation rate), X3t represent the third independent variable (exchange rate).

The ARDL model is specified as follows:

$$Yt= \beta0+\beta1Yt\text{-}1+\beta2X1t\text{-}1+\beta3X2t\text{-}1+ \beta4X3t\text{-}1+\epsilon t$$

Where:

Yt is the dependent variable at time t, which is unemployment rate

X1t is the first independent variable at time t, which is economic growth (GDP)

X2t is the second independent variable at time t, which is inflation rate.

X3t is the third independent variable at time t, which is exchange rate

$\beta0$ is the intercept.

$\beta1,2$, $\beta3$, and β4 are the slopes

ϵt is the error term.

4.0 RESULT AND DISCUSSION

4.1 Unit Root Test Results

Lninf = natural log of inflation rate, d(lnngdp) = first differenced of natural log of nominal GDP, lnun = natural log of unemployment rate, d(lnexc) = first differenced of natural log of exchange rate.

Table 2: Unit Root Test Results

Variable	ADF Prob	PP Prob
lninf	0.0091	0.0134
D(lngdp)	0.0000	0.0000
lnun	0.0341	
D(lnexc)	0.0000	0.0000

Result from E views

The results showed that lninf and lnun are both stationary at level while D(lngdp) D(lnexc) are stationary at first difference.

4.2 Bound Co-Integration Test Results

Table 3: Bound Co-integration test result

F- bound test	Null Hypothesis: No levels relationship

Test Statistics	Value	Signif		I(0)	I(1)
F-Statistics K		Asymptotic: n=10000			
		10%		2.72	3.77
	1.202339	5%		3.23	4.35
	3	2.5%		3.69	4.89
		1%		4.29	5.61
	39	Finite sample: n = 40			
		10%	2.93		4.02
Actual		5%	3.548		4.803
Sample size		1%	5.018		6.61
		Finite	sample:		
		n=35			
		10%	2.958		4.1
		5%	361.5		4.913
		1%	5.198		6.845

Result from E views

The results showed that there is no co-integration because the calculated F-statistics which is 1.202339 is lower than the critical value of the lower bound I(0).

### 4.3 Autoregressive Distributed Lag Model Results

Table 4: ARDL results

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LNUN(-1)	0.363051	0.164491	2.207111	0.0367
LNUN(-2)	0.402168	0.162678	2.472170	0.0206
LNNGDP	-0.244930	0.071727	-3.414766	0.0022
LNNGDP(-1)	-0.170240	0.061188	-2.782252	0.0101
LNNGDP(-2)	0.070256	0.056203	1.250038	0.2229
LNNGDP(-3)	0.036542	0.031128	1.173924	0.2515
LNNGDP(-4)	-0.088743	0.034741	-2.554386	0.0171
LNINF	0.009043	0.028218	0.320467	0.7513
LNINF(-1)	-0.054418	0.030375	-1.791540	0.0853
LNINF(-2)	-0.045157	0.025319	-1.783541	0.0866
D(LNEXC)	-0.110178	0.051549	-2.137339	0.0425
D(LNEXC(-1))	-0.081225	0.040539	-2.003609	0.0561
D(LNEXC(-2))	-0.061646	0.048999	-1.258103	0.2200
C	1.759206	0.321255	5.476042	0.0000
R-squared	0.921909	Mean dependent var		1.462345
Adjusted R-squared	0.881301	S.D. dependent var		0.184351
S.E. of regression	0.063514	Akaike info criterion		-2.401859
Sum squared resid	0.100850	Schwarz criterion		-1.804683
Log likelihood	60.83625	Hannan-Quinn criter.		-2.187597
F-statistic	22.70295	Durbin-Watson stat		1.715200
Prob(F-statistic)	0.000000			
Result from Eviews				

It can be seen that the ARDL result indicates that there is a negative relationship between the unemployment which is the dependent variable and the inflation rate as the independent variable in its normal form not it lags.

4.4 Stability Test

The Cusum Sum of square test was also conducted and the test showed that the model is dynamically stable.
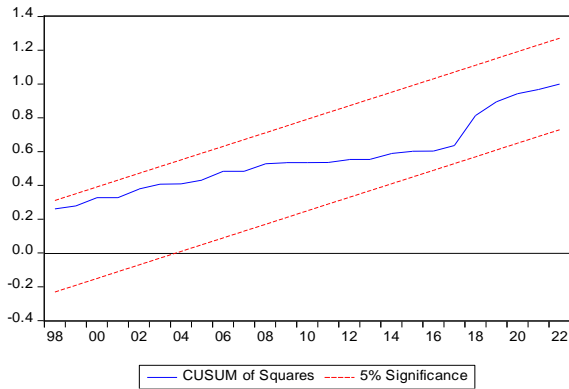
Result from Eviews

The graph indicates that the model is dynamically stable as the green line remained withing the 5% significance

4.5 Correlation Test

Correlation coefficients between unemployment and GDP showed that there is a negative relationship between unemployment and GDP.

Table 5: Correlation Result

	LNNGDP	LNUN
LNNGDP	1	-0.03501354
LNUN	-0.03501354	1

Result from Eviews

It can be seen that the correlation coefficient is negative and week (-0.035013354) indicating that as unemployment decreases, GDP will increase.

4.6 Heteroskedasticity test

Table 6: Heteroskedasticity test result

F-statistic	1.262846	Prob. F(13,25)	0.2971
Obs*R-squared	15.45894	Prob. Chi-Square(13)	0.2796
Scaled explained SS	4.670958	Prob. Chi-Square(13)	0.9817

Result from Eviews

The result showed that we cannot reject the null hypothesis, meaning there is homoscedasticity (absent of heteroskedasticity)

4.7 Serial Correlation

Serial correlation test also showed that there is no serial correlation indicated by Breusch-Godfrey serial correlation LM test.

Table 7: Serial Correlation Test Result

F-Statistic	3.100984	Prob. F(2,17) 0.0711
Obs R-Squared	10.42484	Prob. Chi-Square (2) 0.0054

Result from Eviews
The result indicates the absent of serial correlation because we cannot reject the null that there is no serial correlation.

4.8 Multicollinearity

Multicollinearity test showed that there is no multicollinearity in the model, below is the variance inflation factor result.

Table 8: Multicollinearity test result

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
LNUN(-1)	0.027057	570.6034	9.142565
LNUN(-2)	0.026464	551.2231	8.266968
LNNGDP	0.005145	412.3741	2.214587
LNNGDP(-1)	0.003744	293.7371	4.386019
LNNGDP(-2)	0.003159	244.4262	4.255604
LNNGDP(-3)	0.000969	73.48031	3.343347
LNNGDP(-4)	0.001207	91.72649	4.171858
LNINF	0.000796	58.86368	3.471132
LNINF(-1)	0.000923	68.49669	4.055960
LNINF(-2)	0.000641	46.98044	2.878815
D(LNEXC)	0.002657	2.757949	2.071128
D(LNEXC(-1))	0.001643	1.706390	1.279899
D(LNEXC(-2))	0.002401	2.489911	1.871739
C	0.103205	997.7671	NA

Result from Eviews

From the centered VIF, it can be seen that all the VIF values are less than 10, indicating there is no perfect multicollinearity among the variables

5. FINDINGS

Based on the results obtained from this research, which found a negative relationship between unemployment and inflation in Nigeria using the ARDL model, the findings align with several studies reviewed in the literature that support the existence of the Phillips curve trade-off. These include:
Abu, N. (2019), Babatunde Emmanuel Oladapo (2022), Udede et al. (2021), Ahmed, B. (2020), Kartika, M., & Kurniasih, E. P. (2020),
Furthermore, the findings of a negative correlation between unemployment and nominal GDP, although not strong, align with the implications of the Phillips curve theory, which suggests that low unemployment is associated with higher inflation and, consequently, higher nominal GDP.
Additionally, the findings contrast with other studies reviewed in the literature that found a positive

relationship between inflation and unemployment, contradicting the Phillips curve theory, such as Sylvester et al. (2023), Lawal, J. O. (2023), Innocent and Irmiya (2019), and Tule and Adeleke (2019).

6. CONCLUSION

This study, using the ARDL model, found a negative relationship between unemployment and inflation in Nigeria, consistent with the Phillips curve theory, which suggests a trade-off between the two variables. Similar results were observed in studies by Abu (2019), Okoro et al. (2018), and others.

Although the negative correlation between unemployment and nominal GDP was weak, it aligns with the Phillips curve's implication that low unemployment can lead to higher inflation and nominal GDP. However, no long-term relationship between the variables was found, in contrast to studies by Udede et al. (2021) and Kartika & Kurniasih (2020).

Notably, some studies, such as Sylvester et al. (2023) and Lawal (2023), found a positive relationship between inflation and unemployment, challenging the Phillips curve.

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