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Investigating the Evidence of the Philips Curve in Ghana, Nigeria and the US: Does the empirical evidence support the Philips Curve in Ghana, Nigeria and the US?

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Abstract: **The main purpose of this study is to quantitatively explore the empirical evidence either in support of or against the existence of the Phillips curve in Ghana using a modified version of the New Keynesian Phillips curve (NKPC) model with Nigeria and US as benchmarks. With time-series data from 1971-2020, the study uses the Ordinary Least Squares (OLS) regression framework to analyse the statistical significance of the parameters of the model. Using different measures of market tightness, informed by Chow's structural break test, and drawing on variants of the NKPC, the study interestingly finds that the standard positive association between the output gap and inflation for the US and other advanced economies is not present for Ghana and Nigeria. This new discovery has important relevance for the conduct of economic policy in Ghana, Nigeria and other developing countries and warrants a careful evaluation of the application of the NKPC for developing and emerging economies.**

Keywords: **Inflation, Money, Monetary Policy, New Keynesian Model, New Keynesian Phillips curve, Phillips curve, Phillips curve evidence, flattening of the Phillips Curve, Phillips curve evidence in developed and developing countries.**

1. INTRODUCTION

Is the Phillips curve supported by the empirical evidence in Ghana? The main aim of this dissertation is to provide an answer to this key research question which is of interest to policymakers, financial institutions, academia and many other institutions, industries and groups of people seeking to know the evidence on the relationship between macroeconomic variables such as inflation and unemployment over time in an economy. Stable Inflation is a key macroeconomic indicator or target of monetary policy so evidence of the relationship between inflation and any macroeconomic variable is of particular interest to central banks. Phillips (1958) identified an inverse relationship between inflation and unemployment in the UK and the evidence supported a stable relationship up to the early 1960s (Eliasson, 2001).

However, the relationship has been found to be invalid by most of the recent findings in many countries. For example, Romer (2019) and Eliasson (2001) observe that the once stable relationship between inflation and unemployment has broken down in the face of evidence in the late 1960s and 1970s. Since then, there has been conflicting evidence in different countries for the existence of the Phillips curve. For instance, Mukoka (2019) found an inverse relationship between inflation and unemployment and support for the Phillips curve in the Zimbabwe economy, while Orji et al. (2015) found a positive relationship between inflation and unemployment, the opposite relationship to Phillips' proposition in Nigeria. It

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is this ambiguous context that has aroused the author's interest to use the available data to investigate the empirical evidence either in support of or against the existence of the Philips Curve in Ghana.

This report is broken down into four sections. Section one is a brief overview of the existing literature on the Phillips curve. Section two provides a description of the data used, and this is followed by the methodology or the econometrics approach in section three. Section four contains a discussion of the findings – the analysis of the empirical results, leading to a conclusion.

2. OVERVIEW OF THE LITERATURE

This section reviews the literature on the Phillips curve to find the most suitable theoretical framework to carry out the empirical analysis of the data on Ghana. The investigation into the possibility of a trade-off between inflation and strong economic growth was initiated by a New Zealand economist, Alban William Phillips, who was a professor of economics at the London School of Economics. The idea got him to study British data on unemployment and nominal wage growth (wage inflation as a measure for inflation) and found an inverse relationship between them and this landmark trade-off was published with the title "The Relationship Between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom, 1861-1957" (Phillips, 1958) and became known as the Phillips curve. A couple of rough sketches of the relationship by Pettinger (2019) are shown in figure 1 below.

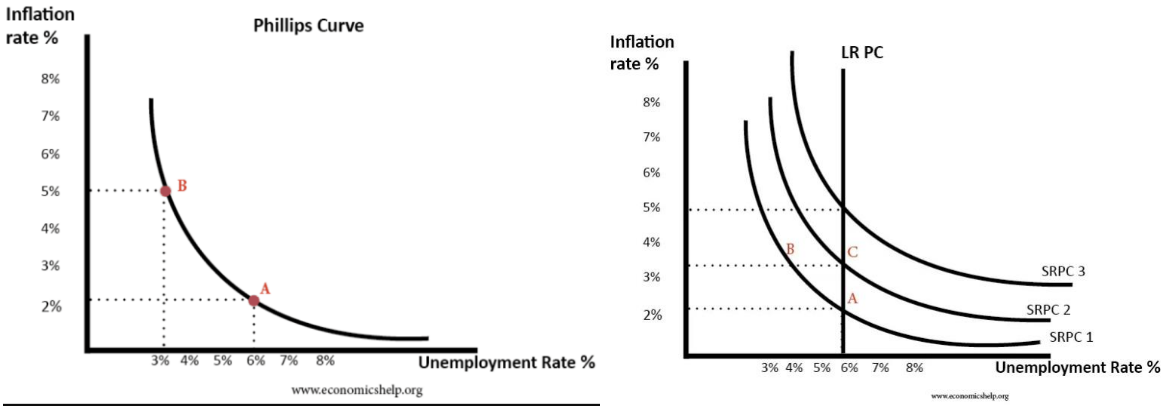

Figure 1: Phillips curve Illustrations

The main policy implication was that unemployment could be reduced by demand-side expansionary fiscal and monetary policies to point B on the Phillips curve in figure 1 as long as one is willing to accommodate an increase in inflation. This discovery was very timely as a policy solution to the aftermath of the Great Depression and the Second World War. As a result, policymakers exploited this trade-off relationship to reduce unemployment, and the Phillips curve nexus gained traction and became popular as subsequent researchers confirmed the theoretical and empirical support for the stable inverse relationship between inflation and unemployment (Romer, 2019).

However, in the 1970s, the trade-off relationship between inflation and unemployment appeared to have broken down as many economies experienced stagflation from the oil price shock. The occurrence of stagflation made policy application of the Phillips curve invalid as more expansionary policies only made the inflationary situation worse. In the words of Romer (2019, p.257), the stable tradeoff relationship was shattered in the late 1960s and early 1970s, and he cited Friedman (1968) and Phelps (1968) as the main economists that provided the theoretical attack in the form of the natural rate hypothesis, which states that "there is some 'normal' or 'natural' rate of unemployment, and that monetary policy cannot keep unemployment below this level indefinitely" (Friedman, 1968; Phelps, 1968, cited in Romer, 2019, p.257). To Friedman and Phelps, it was unreasonable to think money supply as a nominal variable could permanently affect output and unemployment which are real variables. The summary of the argument was that in the long-run real forces (not nominal forces) determine real variables such as unemployment. The natural rate of unemployment, in the long run, could be thought of as the 6% on the above Phillips curve on the right-hand side of figure 1. Figure 1b below also indicates the failure of the Phillips curve relationship after the 1960s in the United States (US) from 1961-1995. From the later 1960s, the US Phillips curve appears to show a combination of no relationship, positive/negative relationships to a shift in the relationship.

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Figure 1b: Unemployment and inflation in the United States, 1961-1995.

Source: Romer, 2019, p.258.

This has led to further investigations and the evidence is in stark contrast to the validity and the stability of the Phillips curve relationship in many studies. For example, using smooth transition regression methodology with the US data, Stimel (2009) finds the Phillips curve relationship to be unstable in the sense that the Phillips curve varies asymmetrically and shifts over the US business cycle. This means the relationship between inflation and unemployment may be neither stable nor linear over time.

However, despite the conflicting views and arguments about the Phillips curve relationship, it sheds light on important issues in macroeconomics, particularly in the area of monetary policy and inflation-targeting by central banks. According to Elliot (2015), regardless of the conflicting opinions on the Phillips curve, it cannot be overlooked when it comes to the conduct of monetary policies. The insights from the Phillips curve provide a benchmark for policymakers to build on in their macroeconomic management. The consensus now is that in the short term, where there are imperfections in markets, there may be a trade-off relationship between inflation and unemployment but, in the long-run, there is no such relationship as the long-run Phillips curve on the right-hand side of figure 1 depicts a perfectly inelastic (vertical) Phillips curve at the natural rate of unemployment.

Apart from the different views on the Phillips curve, there are also different formulations of the Phillips curve in the literature. The simplest form is given by Clark et al. (1996) in equation A1 below, and the rest are found in Romer (2019).

$$\pi_t = \pi_{t+1} + \beta gap_t + \varepsilon_t \qquad \text{(A1)}$$

$$\pi_t = \pi_t^* + \lambda(lnY_t - ln\bar{Y}_t) + \varepsilon_t, \;\; \lambda > 0 \qquad \text{(A2)}$$

$$\pi_t = \pi_{t-1} + \lambda(y_t - \bar{y}_t) + \varepsilon_t \qquad \text{(A3)}$$

$$\pi_t = E_{t-1}\pi + \lambda(y_t - \bar{y}_t) + \varepsilon_t \qquad \text{(A4)}$$

$$\pi_t = \beta_1\pi_{t-1} + \beta_2 E_t\pi_{t+1} + K(y_t - \bar{y}_t) + \mu_t \qquad \text{(A5)}$$

$$\pi_t = \beta_1 y_t + \beta_2 E_t\pi_{t+1} + \mu_t \qquad \text{(A6)}$$

$$E_t[\pi_{t-1}] - \pi_t = \left(\frac{1-\beta}{\beta}\right)\pi_t - \frac{K}{\beta}(y_t - \bar{y}_t) + \mu_t \qquad \text{(A7)}$$

In equation A1, π_t is inflation, π_{t+1} is expected inflation, "gap_t" is the unemployment gap or the output gap, the ε_t (or μ_t in A5) is the error stochastic term and subscript "t" is the time period.

Equation A2 is the expectations-augmented Phillips curve, where π^* is core inflation at the potential or natural rate of output ($\bar{Y}$), Y is output and the error term (ε) captures supply shocks (Romer, 2019, p.259).

Equation A3 is the accelerationist Phillips curve which implies inflation inertia; inflation is influenced by the previous period's inflation (π_{t-1}), that is, where high inflation (and the cost of reducing it) is likely to persistently continue unless output falls (Romer, 2019, p.338). Lower cases y and $\bar{y}$ are the natural logarithms of output (Y) and the full-employment or flexible prices or natural rate of output ($\bar{Y}$).

Equation A4 is a version of the Phillips curve known as the Lucas Supply curve where $E_{t-1}\pi$ is expected current inflation (Romer, 2019, p.338).

Equation A5 is a hybrid Phillips curve with backward-looking and forward-looking elements (Romer, 2019, p.339).

Equation A6 is the new Keynesian Phillips curve originally derived by Roberts (1995) which says higher output (y) and higher expected inflation ($E_t\pi_{t+1}$) cause the inflation rate to also rise (Romer, 2019, p.329).

Equation 7 is a rewritten version of equation A6 by Romer (2019), and the intuition is that anticipated disinflation, that is $when\ E_t[\pi_{t-1}] - \pi_t\ is\ negative$, "is associated with an output boom" Romer (2019, p.338).

All the above equations are closed economy models. This study uses an open economy model by including the exchange rate. Further, the above equations are different forms of the New Keynesian Phillips curve (NKPC). "The NKPC is a forward-looking model of inflation, according to which current inflation is determined by expected future inflation and marginal costs" (Mavroeidis et al., 2014, p.127). This makes the NKPC radically different from the traditional Phillips curve in that the new one limits the tendency to excessively exploit the Phillips unemployment-inflation trade-off and has important implications for central banks to use both conventional and unconventional monetary policy tools to control inflation by managing inflation expectations in the economy. In their major scholarly analysis, Kuttner and Robinson (2010) and Mavroeidis et al. (2014) also highlight that the NKPC is a key price determination equation in a three-equation system in the New Keynesian Model (NKM), which is a dynamic stochastic general equilibrium (DSGE) model, widely used by central banks around the world in the conduct of monetary policy. Below are the three equations in the NKM found in Gali (2015).

$$\pi_t = \beta E_t(\pi_{t+1}) + \kappa x_t \qquad \text{(NKPC = AS)} \qquad \text{(A8)}$$

$$y_t = E_t(y_{t+1}) - \frac{1}{\sigma}[i_t - E_t(\pi_{t+1}) - r_t^n] \qquad \text{(Dynamic IS Curve = AD)} \qquad \text{(A9)}$$

$$i_t = \rho + \phi_\pi \pi_t + \phi_y \hat{y}_t + v_t \qquad \text{(Monetary Policy/Taylor Rule)} \qquad \text{(A10)}$$

Equation A8 is the NKPC, also known as the aggregate supply (AS) expression which conveys the same message that inflation is determined by expected future inflation $[E_t(\pi_{t+1})]$ and real marginal cost (x_t). This purely forward-looking equation is appealing to researchers and policymakers mainly because of its strong grounding in microfoundations (Mavroeidis et al., 2014). It is derived from the optimisation behaviour of firms in a monopolistic competitive environment in a Calvo-pricing setting (Gali, 2015).

Equation A9 is the dynamic investment-savings (IS) or aggregate demand (AD) expression, where y_t is the output gap, and r_t^n is the real interest rate equivalent to the nominal interest rate minus the expected inflation $[i_t - E_t(\pi_{t+1})]$.

Equation A10 is the Taylor rule or monetary policy rule in which the nominal interest rate (i_t) is driven directly by the real interest rate in the steady state (ρ), inflation (π_t), the deviation of output from its steady state ($\hat{y}_t$), and monetary policy shock (v_t). In other words, central banks tend to increase the policy interest rate when inflation rises above the target level (around 2% for the US, UK, and the EU) as we are currently (2022) witnessing around the world so as to bring it down to the target level. As a result of the appeal and importance of the NKPC, it has been propelled to the forefront of empirical work in macroeconomics.

The model specification is in the methodology (statistical model) section and the hypothesis to be tested is that there is a negative relationship between inflation and unemployment in Ghana. Alternatively, there is a positive relationship between inflation and economic growth or the output gap. In other words, the Phillips curve is evident in Ghana.

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3. DATA DESCRIPTION

This paper uses the sample 1971-2020 time series annual data from the World Bank's World Development Indicators (WDI)[1] online database.

The Gross Domestic Product (GDP) is a measure of the national income or output of the Ghanaian economy per year. The GDP data are measured in current United States of America (US) dollars, converted from domestic Ghana cedis using single official exchange rates by the Bank of Ghana for each year.

The Consumer Price Index (CPI) is the price level that measures the cost of living or changes in the prices paid by the average Ghanaian consumer for a basket of representative goods and services. The CPI data are yearly averages and the base year (where the CPI is 100) is 2010.

The exchange rate (ER) is expressed directly in local currency terms as the number of units of the Ghana cedi (GH₵) per the US dollar, and it is calculated as an annual average based on monthly averages. So an increase in the Ghana ER signifies a depreciation of the local Ghana cedi currency, and a decrease in the ER shows an appreciation of the Ghana cedi against the US dollar.

It must be noted that in 2007, the Ghana cedi was redenominated by the Bank of Ghana to become GH₵0.93- GH₵1 to 1US dollar ($1) from the prevailing ER at the time which was about ¢9,300-¢10,000 to $1 (Amoah and Aziakpono, 2017, p. 263).

The descriptive or summary statistics of GDP, CPI, ER, inflation, unemployment and GDP growth rate (GDPG) are shown in table 1 below.

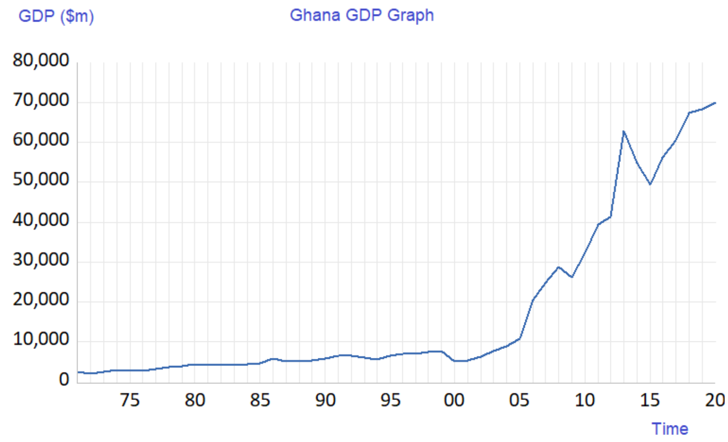
Table 1: Summary Statistics of 50 observations from 1971-2020

	GDP	CPI	ER	INFLATION	UNEMPLOYMENT(U)	GDPG
Mean	17,700,000,000	53.5536	0.9480	29.5745	6.2023	3.7842
Median	6,290,000,000	7.4948	0.1417	18.0887	5.7410	4.6514
Maximum	70,000,000,000	305.9831	5.5957	122.8745	10.4600	14.0471
Minimum	2,110,000,000	0.0020	0.0001	4.8654	3.4900	-12.432
Std. Dev.	21,500,000,000	83.5787	1.5083	27.6161	1.7780	4.4699
Skewness	1.3804	1.6737	1.8066	2.0907	0.8686	-1.2669
Kurtosis	3.3703	4.6999	5.1495	7.1005	3.0423	5.7998
Jarque-Bera	16.1654	29.3648	36.8249	71.4550	3.7744	29.7063
Probability	0.0003	0.0000	0.0000	0.0000	0.1515	0.0000
Observations	50	50	50	50	30 (1991-2020)	50

Source: Author's computations

From table 1, the lowest GDP of $2.1bn in the data series from 1971-2020 occurred in 1972 while the highest of $70.0bn occurred in 2020 with an average GDP of about $17.7bn. The GDP plot in figure 2 below indicates a general upwards trend. There was a gradual but steady increase from 1971 to about 2000 when the economy experienced a slight dip in GDP. Thereafter, the Ghanaian economy experienced rapid expansion in the GDP until around 2013 when it was about $62.8bn but fell significantly to about $49.4bn by the end of 2015. The marked fall in the GDP in 2015 depicted in figure 2 can be explained by a significant depreciation of the local currency in terms of the US dollars to the tune of about 29%. The GDP measured in the local Ghanaian cedi currency actually increased by 3.9% from 2014 to 2015 in table 1.2 below which uses 2006 as the base year. Even though both Covid-19 pandemic and the Russia-Ukraine war are currently impacting the Ghanaian economy, the full and lagging effects remain to be seen and assessed.

[1] https://databank.worldbank.org/source/world-development-indicators



Source: Author's computation

Figure 2: GDP Graph from 1971-2020

Table 1.2: Revised GDP statistics from 2010-2015

Memorandum Items						
Economic Aggregate	2010	2011	2012	2013	2014	2015*
Population estimate (million)	24.66	25.24	25.82	26.43	27.04	27.67
Exchange rate (₵/$)	1.43	1.51	1.81	1.92	2.94	3.78
GDP current (million Gh₵)	46,042	59,816	75,315	93,416	113,343	138,748
Non-Oil GDP current (million Gh₵)	45,865	56,070	69,666	85,974	105,550	133,596
GDP current (million US$)	32,186	39,517	41,656	48,654	38,552	36,739
Per capita GDP (Gh₵)	1,867	2,370	2,916	3,535	4,192	5,014
Per capita GDP (US$)	1,305	1,566	1,613	1,841	1,426	1,328
GDP at constant 2006 prices (million Gh₵)	24,101	27,486	30,040	32,237	33,522	34,835
Non-Oil GDP at constant 2006 prices (million Gh₵)	24,031	26,012	28,248	30,121	31,310	32,603
GDP at constant 2006 prices (million US$)	16,848	18,158	16,615	16,790	11,402	9,224
Growth Rates			%			
GDP at current market prices	25.8	29.9	25.9	24.0	21.3	22.4
GDP at constant 2006 prices	7.9	14.0	9.3	7.3	4.0	3.9
Non-Oil GDP at constant 2006 prices	7.6	8.2	8.6	6.6	3.9	4.1
Change in GDP deflator	16.6	13.9	15.2	15.6	16.7	17.8

*Revised

Source: Ghana Statistical service (2016)[2]

From table 1, it can be seen that the average CPI was about 53.55 from 1971-2020, the lowest was 0.0020 in 1971, and the highest was 305.98 in 2020 with 2010 as the base year. The price level has been rising continuously since 2000 when it was about 19 through the base year, 2010 when it was designated 100 to about 306 in 2020. This upwards trend translates to an increase in the cost of living in the Ghanaian economy.

A closer inspection of table 1 further reveals that the average ER for the period 1971-2020 was GH₵0.9480 to the US dollar ($1). Over the same period, the Ghana cedi was most valuable to the dollar (minimum ER of GH₵0.0001 to US dollar ($1)) in 1971 and least valuable to the dollar (maximum ER of GH₵5.5957 to the US dollar ($1)) in 2020.

Graphical representation depicts a general upward trend of the ER (a consistent depreciation of the Ghana cedi against the US dollar) since 1983 when the Ghana cedi was no longer fixed to the US dollar (Bank of Ghana, cited in Amoah and Aziakpono, 2017, p. 263). There is no single year since 1983 that the Ghana cedi appreciated against the US dollar, that is,

[2] https://www2.statsghana.gov.gh/docfiles/GDP/GDP2016/Revised_Annual_2015_GDP_September%202016%20Edition.pdf

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showed a decrease in the ER. The ER has been consistently indicating a depreciation of the Ghana cedi, and the depreciation has been more rapid in recent years. This may be an indication that the Ghana cedi is either overvalued and/or the macroeconomic fundamentals of the economy are weak.

Inflation, indicating the rate of increase in the average price, measured by the annual percentage changes in the CPI, ranged from 4.9% in 1999 to 122.9% in 1983 with an average of 29.6% over the 1971-2020 period in Ghana.

Data on unemployment, the share of the labour force looking for jobs but cannot find one, was available only over the period 1991-2020 and ranged from 3.5% in 1991 to 10.5% in 2000 with an average of 6.2% over the 30-year period.

Table 1 also reveals that the GDP growth rate averaged 3.8% over the 1971-2020 period in Ghana. The lowest GDPG was a 12.4% decline in 1975, and the highest GDPG was 14% in 2011.

In terms of the spread of the data series in table 1, the GDP has the highest standard deviation while the ER has the lowest standard deviation from their respective averages. With regards to the normality of the data series in table 1, the skewness (a measure of asymmetry) is expected to be zero to indicate that the data series is symmetric and normally distributed, and the kurtosis (a measure of peakness or flatness) is expected to be three to reflect a normal distribution of the data series. Inflation has the highest skewness of 2.09. This is above zero and indicates that the distribution is positively skewed or skewed to the right and has a long right tail with more higher values. Conversely, GDPG has a negative skewness, implying a long left tail with more lower values to the mean in the distribution.

Again, inflation has the highest kurtosis of 7.10. This is above three and indicates that the distribution of the inflation series has a positive kurtosis, a peaked curve with more higher values. Unemployment has the lowest skewness of 0.87 (closest to zero), and also the lowest kurtosis of 3.04 (closest to three) among all the data series in table 1, and its approximate normal distribution is confirmed by the Jargue-Bera test which fails to reject the null hypothesis that the distribution is normal with a p-value of 0.15.

Scatter plots similar to figure 1b are displayed below in figure 3 along with that of Nigeria and the US as benchmarks. The rationale for choosing these two countries is that Nigeria and the US are, respectively, the biggest economies in Africa and the world by GDP . All of the graphs and scatter plots by the author appear congruent with the literature and do evidence the breakdown of the Phillips curve relationship in Ghana, Nigeria and the US over the sample period.

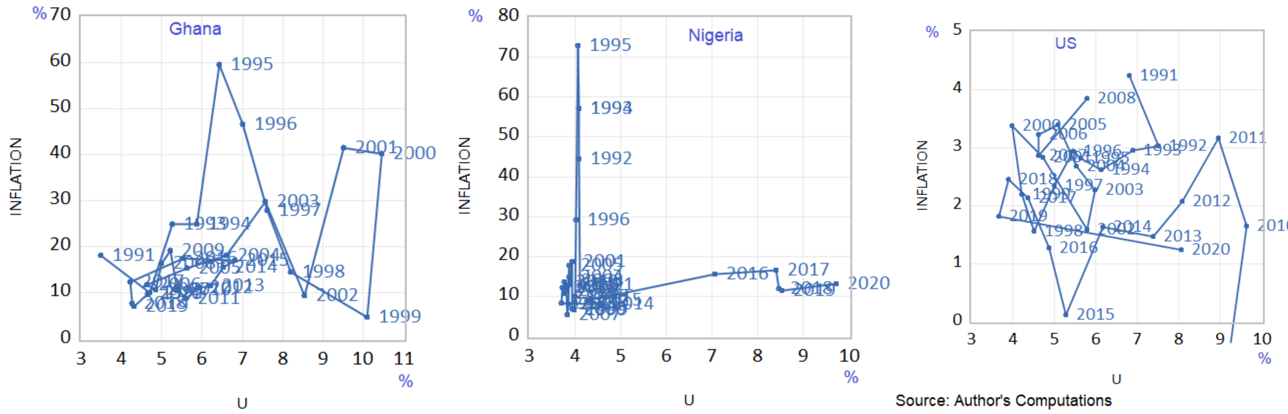

Figure 3: Scatter Plot of Unemployment and Inflation in Ghana, Nigeria and the US, 1991-2020

Unit Root Tests and Order of Integration

It is advisable to first test for unit roots of all the variables in time series analysis to ensure the data series are stationary so as to give more meaningful econometric estimates and to avoid spurious regression results. The ADF unit root tests results depict that GDP, GDP growth rate (GDPG), inflation and unemployment are stationary at their levels, that is, these series are integrated of order zero, I(0). However, the price level (CPI), real GDP (RGDP) and the exchange rate (ER) are not stationary. RGDP and ER are stationary at their first difference, that is, integrated of order one, I(1) while the CPI is stationary at the second difference, that is, I(2). The change in the log of CPI (DLCPI), and the change in the log of RGDP (DLRGDP) are stationary. As a result, all the variables used in the model specifications in this study are stationary.

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4. METHODOLOGY (STATISTICAL MODEL)

The main objective of this study is to use quantitative analysis to answer the central question – is the Phillips curve evident in Ghana? The econometrics approach or the statistical methodology deployed to answer the research question in this study is the Ordinary Least Squares (OLS). The OLS is the best linear unbiased estimator of the parameters if the assumptions about the error term such as normal distribution with zero mean and constant variance, no autocorrelation and the others hold (Greene, 2008).

In keeping with the literature on the NKPC, equation A3 ($\pi_t = \pi_{t-1} + \lambda(y_t - \bar{y}_t) + \varepsilon_t$, rewritten with a constant below as equation 1, is chosen as the baseline model for this study.

$$\pi_t = \beta_0 + \beta_1\pi_{t-1} + \beta_2(y_t - y_t^*) + \mu_t \qquad (1)$$

where π_t and π_{t-1} are inflation at time t and its lag as stated before, $(y_t - y_t^*)$ is the output gap which is a proxy for real marginal cost in the NKPC (Kuttner and Robinson, 2010; Mavroeidis et al., 2014), y_t is the natural log of real GDP, and y_t^* is trend (log) real GDP reproduced as a new series by the Hodrick-Prescott Filter in EViews. The lagged inflation term (π_{t-1}) as an explanatory variable in equation 1 is preferred because the purely forward-looking model $(\pi_t = \beta_0 + \beta_1\pi_{t+1} + \beta_2(y_t - y_t^*) + \mu_t)$ is rejected on statistical grounds (Fuhrer, 2005), and does not fit inflation dynamics well, so the specification with the lagged inflation is used in this study and it is popularly known as "intrinsic inflation persistence" (Mavroeidis et al., 2014, p.130). The coefficient of the lagged inflation illustrates inflation persistence and could also be taken as some firms adjusting their prices by a backward-looking rule of thumb. The sign of the coefficient of the output gap is expected to be positive and statistically significant to validate the existence of the Philips curve.

To check the strength of the methodology and the robustness of the parameters of the model, the US and Nigeria are used as benchmarks. Furthermore, a comparison is made between Ghana, Nigeria and the US by replacing the output gap $(y_t - y_t^*)$ in equation 1 with a similar but different measure of market tightness such as the unemployment gap. The model is written as equation 2 below.

$$\pi_t = \beta_0 + \beta_1\pi_{t-1} + \beta_2(U_t - U_t^*) + \mu_t \qquad (2)$$

where π_t and π_{t-1} represent inflation and its lag as before, $(U_t - U_t^*)$ is the unemployment gap (Ugap), U_t is the unemployment rate and U_t^* is the unemployment trend generated by the Hodrick-Prescott Filter in EViews. The sign of the coefficient of the unemployment gap is expected to be negative to validate the existence of the Philips curve.

For robustness of the estimated parameters of the above models, and also in view of Cornia's (2020) discovery that developing countries are structurally different from developed countries, and that one model may not fit the data equally well for both Ghana and Nigeria on the one hand, and the US on the other, an alternative model is required. Therefore, a slightly different approach for another model is deployed. Real GDP growth substitutes the output gap as a proxy and the real GDP measured as the current GDP at constant 2015 prices for model 1 is also replaced with nominal GDP deflated by the inflation GDP deflator, that is real GDP equals current GDP divided by the deflator.

In light of the range of different specifications of the Phillips curve in the literature and given that the NKPC has inflation as the dependent (endogenous) variable, the strategy in pursuit of an alternative model is to start from a general model of inflation and test and refine until a parsimonious version that reflects the NKPC is reached. Based on the available data collected, a general model of inflation, starting from the price level in a log-linear form, can be written as follows:

$$logCPI_t = \beta_0 + \beta_1 logRGDP_t + \beta_2 logER_t + \mu_t \qquad (3)$$

where log is the logarithm, CPI_t is the price level at time t, $RGDP_t$ is the real GDP at time t using the deflator, ER is the exchange rate at time t and μ_t is the error term having the stochastic assumptions. The parameters β_{0-2} are the constant and coefficients to be estimated, and the error term (μ_t) captures the rest of the variations in the endogenous variable (log of CPI in this case) that are not explained by the explanatory (exogenous) variables RGDP and ER.

Taking a logarithmic (log) transformation of the data does not only help to linearise nonlinear models but also has many advantages, such as helping to reduce variability in the data to enable better estimation of the parameters of a model (Mukoka, 2019).

Taking a change in the logarithms of the variables in equation (3) gives

$$\log CPI_t - logCPI_{t-1} = \beta_0 + \beta_1(logRGDP_t - logRGDP_{t-1}) + \beta_2(logER_t - logER_{t-1}) + \mu_t$$

Or

$$\Delta LCPI_t = \beta_0 + \beta_2 \Delta LRGDP_t + \beta_3 \Delta LER_t + \mu_t \quad (4)$$

The change in the log of the CPI gives the inflation rate, the change in the log of the real GDP gives the growth rate and the change in the log of ER is the rate of depreciation of the Ghana cedi.

So on the basis of the standard economic theory, equation (4) can be written with dynamics as:

$$\Delta LCPI_t = \beta_0 + \beta_1 \Delta LCPI_{t-1} + \beta_2 \Delta LCPI_{t-2} + \beta_3 \Delta LRGDP_t + \beta_4 \Delta LRGDP_{t-1} + \beta_5 \Delta LER_t + \mu_t$$

or

$$\pi_t = \beta_0 + \beta_1 \pi_{t-1} + \beta_2 \pi_{t-2} + \beta_3 \Delta y_t + \beta_4 \Delta y_{t-1} + \beta_5 \Delta er_t + \mu_t \quad (5)$$

where π_{t-1} is the last year's inflation (lag inflation), π_{t-2} is the previous two years' inflation, Δy_t is the output growth, Δy_{t-1} is the previous year's output growth and Δer_t is the exchange rate growth.

Equation 5 says inflation at time t is determined by the previous two inflation rates, output growth and its lag, the exchange rate growth and the error term as already explained.

Equation 5 can be refined by dropping some of the variables that may not be statistically significant to arrive at a model that mirrors the Phillips curve precisely as follows.

$$\Delta LCPI_t = \beta_0 + \beta_1 \Delta LCPI_{t-1} + \beta_2 \Delta LRGDP_t + \mu_t$$

Or

$$\pi_t = \beta_0 + \beta_1 \pi_{t-1} + \beta_2 \Delta y_t + \mu_t \quad (6)$$

Equation 6 is a version of the NKPC which says inflation is explained by its expectation where the expected inflation (π_{t+1}) equals the last period's inflation (π_{t-1}) with backward-looking expectations, the output gap which is the output growth (Δy_t) if we assume log output is a random walk, and that the natural rate is last period's rate and the error term (μ_t).

Parameter β_1 is expected to have a positive sign as expected inflation tends to be self-fulfilling. The output gap coefficient β_2 is expected to be positive to reflect evidence of the Phillips Curve as higher growth raises employment (decreases unemployment) and demand that can be inflationary or cause higher inflation (equations A1-A6). This is consistent with Okun's Law, which establishes an inverse relationship between output growth and unemployment. However, Romer (2019) gives the possibility of a negative coefficient of the output gap to an anticipated disinflation in equation A7.

5. DISCUSSION OF FINDINGS

Table 2 below presents the summary of the OLS results for the model in equation 1. The officially reported measure of consumer price inflation series was used as an alternative to the change in the logs of the CPI ($\Delta LCPI_t$) and both results are very similar with the exception that the size of the coefficient of the output gap appeared implausible in the case of the former. The full regression results and the associated diagnostic tests and residual plots for both specifications are available on request.

Table 2: OLS Estimated Regression Results of Equation 1 for Ghana, Nigeria and the US

OLS Model: $\pi_t = \beta_0 + \beta_1 \pi_{t-1} + \beta_2(y_t - y_t^*) + \mu_t$ (equation 1), using observations 1971-2020 Independent variable = Inflation = $\Delta LCPI_t = \pi_t$									
Country	**Variables**	**Coefficient**	**Std.error**	**P-value**	**P-value(F)**	**R²**	**SE**	**DW**	**AIC**
Ghana	Constant	0.14	0.04	0.001***	0.002***	0.23	0.16	2.19	-0.72
	π_{t-1}	0.45	0.13	0.001***					
	$(y_t - y_t^*)$	-0.79	0.64	0.223					

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Nigeria	Constant π_{t-1} $(y_t - y_t^*)$	0.07 0.59 -0.06	0.02 0.12 0.26	0.016** 0.000*** 0.812	0.000***	0.34	0.10	1.65	-1.73
US	Constant π_{t-1} $(y_t - y_t^*)$	0.004 0.88 0.41	0.0.004 0.08 0.11	0.290 0.000*** 0.000***	0.000***	0.74	0.01	1.82	-5.60
	P-values: *, **, and *** indicate significance at the 10%, 5%, and 1% respectively.								

Source : Author's computations

It can be seen from table 2 that the coefficients of the output gap for Ghana and Nigeria are, unexpectedly, negative and statistically insignificant. This implies that there is no evidence in support of the existence of the Phillips curve in these two developing countries. However, the US has the expected positive sign of the coefficient of the output gap implying that a 1% increase in the output gap results in about a 0.41% rise in inflation, all the other relevant factors remaining unchanged. Although this positive sign is consistent with the existing literature, the statistical significance at the 1% level is not entirely in harmony with the available evidence in the literature such as Kuttner and Robinson (2010) and Mavroeidis et al. (2014). In other words, even though the positive sign and the statistical significance of the coefficient of the output gap lend support to the existence of the Phillips curve in the US over the sample period, the evidence runs counter to the existing literature. For example, Mavroeidis et al. (2014) used both linear and nonlinear Generalised Instrumental Variables (GIV) approach and found a correct sign and statistical significance only when labour share of income was used as a proxy for the real marginal cost in the NKPC rather than when the output gap is used. Using a hybrid NKPC and Generalised Methods of Moment (GMM) methodology, Kuttner and Robinson (2010, p.116) also found a positive sign but an insignificant coefficient of the output gap for the US with sample data from 1960:Q1 to 2007:Q2. The coefficient of lagged inflation confirms inflation persistence as the main statistically significant driver of inflation in all the three countries, driving up current inflation by 0.88% for 1% increase in lagged inflation in the US. The impact of lagged inflation, indicating inflation persistence, is even more pronounced in the results for equation 6 in table 5.

The diagnostic tests reveal that model 1 fits the US data very well but not Ghana and Nigeria. For example, all the diagnostic tests for this model specification for Ghana fail except serial correlation. Following this misspecification problem, the multiple breakpoint test (under stability test in EViews) was run and the results for Ghana indicated two breakpoints at 1982 and 2002. Surprisingly, the results for the subsequent three subsamples (1971-1982, 1983-2002, and 2003-2020) presented discouraging outcomes. In some cases, all the coefficients or the entire model was statistically insignificant.

In an attempt to resolve the puzzling negative sign of the coefficient of the output gap in the case of Ghana and Nigeria, model 1 was extended to include one lag of the output gap and commodity prices index. The available data from the WDI was oil rent, which is the difference between the value of crude oil production at regional prices and total costs of production , but the results did not exhibit any improvement on the outcome in table 2. Even though the coefficient of the lagged output gap was positive, it was statistically insignificant on its own just like the coefficient of the oil rent.

To examine the robustness of the parameters of the estimated NKPC, the regressions for equation 2 are run and summarized in table 3 below.

Table 3: OLS Regression Results of inflation on its lag and the unemployment gap

OLS Model: $\pi_t = \beta_0 + \beta_1\pi_{t-1} + \beta_2(U_t - U_t^*) + \mu_t$ (Equation 2) , using observations 1991-2020 Independent variable = Inflation = π_t									
Country	**Variables**	**Coefficient**	**Std.error**	**P-value**	**P-value(F)**	**R^2**	**SE**	**DW**	**AIC**
Ghana	Constant π_{t-1} $(U_t - U_t^*)$	10.59 0.43 2.62	3.97 0.17 2.34	0.013** 0.016** 0.273	0.035**	0.22	11.84	1.9	7.88
Nigeria	Constant π_{t-1} $(U_t - U_t^*)$	4.97 0.74 1.11	3.15 0.13 4.34	0.126 0.000*** 0.800	0.000***	0.56	11.60	1.5	7.84

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US	Constant	1.47	0.40	0.001***	0.024**	0.24	0.91	2.0	2.75
	π_{t-1}	0.34	0.15	0.029**					
	$(U_t - U_t^*)$	-0.22	0.14	0.111					
	P-values: *, **, and *** indicate significance at the 10%, 5%, and 1% respectively.								

Source: Author's computations

Again, the summary results in table 3 illustrate that the Phillips curve is not evident in all these three countries as the estimated coefficient of the unemployment gap for each country is statistically insignificant at the 5% level. The summary results also indicate that only the coefficient of the unemployment gap for the US has the expected negative sign. However, it is statistically insignificant. These results give credence to the outcome from model 1 which has evidence against the existence of the Philips curve in Ghana.

Table 4 presents the OLS results for the model in equation 5 which is rewritten below with standard errors in parentheses.

$$\pi_t = 0.09 + 0.39\pi_{t-1} + 0.32\pi_{t-2} - 0.19\Delta y_t - 0.08y_{t-1} + 0.02er_t \quad (5)$$

SE =(0.04) (0.15) (0.15) (0.03) (0.04) (0.07)

$R^2 = 0.61 \quad SE = 0.12 \quad DW = 2.09 \quad F - Statistic = 12.89 \quad AIC = -1.24$

All the coefficients (except that of growth) have the expected signs. The coefficients of lagged inflation and growth rate are statistically significant at the standard 5%. However, the coefficients of lagged growth rate and the growth of the exchange rate are insignificant at 5% as their P-values are more than the standard 0.05.

The coefficients on each of the independent or exogenous variables indicate their marginal or partial effect on the dependent or endogenous variable (inflation). For example, a 1% increase in lagged one inflation causes the inflation rate (π_t) to also increase by about 0.39% holding all other things unchanged. Similarly, if growth or the output gap (Δy_t) increases by 10%, the corresponding partial effect on inflation is a reduction of about 1.9%. Unexpectedly, this significantly suggests evidence against the Phillips curve. An increase in the output gap implies a decrease in unemployment, and this causes inflation to fall. A 10% increase (depreciation) of the exchange rate increases inflation by about 0.02%, but this was statistically insignificant at 5%. One period lag in the change of ER was added to equation 3, but it was insignificant and uninformative with a negative coefficient.

Table 4: OLS Estimation of Equation 5

Dependent Variable: DLCPI
Method: Least Squares
Sample (adjusted): 1974 2020
Included observations: 47 after adjustments

Variables	Coefficient	Std. Error	t-Statistic	Prob.
C	0.087448	0.035091	2.492015	0.0168**
DLCPI(-1)	0.394995	0.148622	2.657721	0.0112**
DLCPI(-2)	0.325433	0.147147	2.211621	0.0326**
DLRGDP	-0.188017	0.032988	-5.699615	0.0000***
DLRGDP(-1)	-0.0826	0.043762	-1.887469	0.0662*
DLER	0.020443	0.070726	0.289041	0.7740
R-squared	0.611261	Mean dependent var		0.248991
Adjusted R-squared	0.563853	S.D. dependent var		0.185333
S.E. of regression	0.122396	Akaike info criterion		-1.244362
Sum squared resid	0.614215	Schwarz criterion		-1.008173
Log likelihood	35.24251	Hannan-Quinn criter.		-1.155483
F-statistic	12.89383	Durbin-Watson stat		2.092769
Prob(F-statistic)	0.0000***			

P-values: *, **, and *** indicate significance at the 10%, 5%, and 1% respectively.

Source: Author's computations

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The diagnostic tests and the associated residual plots for equation 5 were quite revealing. The DW and the Breusch-Godfrey serial correlation LM test confirm that there is no autocorrelation in the residuals over the period. However, the Ramsey Reset test for functional form reveals that the model is not stable, and the Breusch-Pagan-Godfrey test rejects the homoskedasticity assumption about the error term. Although model/equation 5 appears to have a reasonably good fit, the failure in the other diagnostic tests (functional form and homoskedasticity) reveals that the model is not well specified.

In pursuit of a better model, a variable deletion test was conducted in order to confidently drop the variables that are insignificant in equation 5. The test confirms that lagged output growth (Δy_{t-1}), the second period lagged inflation (π_{t-2}) and growth in the exchange rate (Δer_t) should be removed.

Having confirmed the above with the variable deletion test, a more parsimonious model (equation 6) is estimated and the full regression result is summarised below. Further, the log changes of the CPI and RGDP are multiplied by 100 and the corresponding regression results are stated below as equation 6.1.

$$\pi_t = 0.10 + 0.66\pi_{t-1} - 0.19\Delta y_t \quad (6)$$

SE =(0.03) (0.11) (0.03)

$R^2 = 0.55 \quad SE = 0.13 \quad DW = 2.5 \quad F-Statistic = 27.83 \quad AIC = -1.25$

$$\pi_t = 10 + 0.66\pi_{t-1} - 0.19\Delta y_t \quad (6.1)$$

SE =(3.17) (0.11) (0.03)

$R^2 = 0.55 \quad SE = 13 \quad DW = 2.5 \quad F-Statistic = 27.83 \quad AIC = 7.96$

Model 6 illustrates a modified version of the NKPC. Again, the coefficient of lagged inflation has the anticipated sign and is statistically significant while that of growth, although it is statically significant at 5%, the negative sign appears unexpected and counterintuitive. The intercept implies that inflation will be around 0.10% even if expected or lagged inflation and output growth are zero. The marginal effect of lagged inflation is bigger (0.66) in model 6 than in model 5 (0.39). This suggests a strong inflation persistence and that inflation is determined by the previous period's inflation or expected inflation by backward-looking, and this inflation inertia is statistically significant. The partial effect of growth (output gap), on the other hand, is approximately the same (-0.19) in both models 5 and 6, indicating there is no evidence in support of the existence of the Phillips curve. Models 6 and 6.1 are obviously identical. Almost everything is the same except in the case of 6.1, the constant and its standard error, and the standard error of the entire equation are also proportionately multiplied by 100.

For purposes of comparison, model/equation 6 is also run for Nigeria and the US as benchmarks and the results are summarised in table 5 below.

Table 5: Comparing OLS Estimated Regression Results of Equation 6 for Ghana, Nigeria and the US

OLS Model: $\pi_t = \beta_0 + \beta_1\pi_{t-1} + \beta_2\Delta y_t + u_t$, (Equation 6), using observations 1971-2020
Independent variable = Inflation = π_t

Country	Variables	Coefficient	Std.error	P-value	P-value(F)	R^2	SE	DW	AIC
Ghana	Constant	0.10	0.03	0.003***	0.000***	0.55	0.13	2.5	-1.25
	π_{t-1}	0.66	0.11	0.000***					
	Δy_t	-0.19	0.03	0.000***					
Nigeria	Constant	0.06	0.02	0.014**	0.000***	0.45	0.09	1.9	-1.89
	π_{t-1}	0.67	0.11	0.000***					
	Δy_t	-0.04	0.01	0.007**					
US	Constant	0.01	0.00	0.046**	0.000***	0.84	0.01	1.5	-6.04
	π_{t-1}	0.92	0.06	0.000***					
	Δy_t	-0.04	0.01	0.000***					
	P-values: *, **, and *** indicate significance at the 10%, 5%, and 1% respectively.								

Source: Author's computations

The evidence in all these three countries over the sample period unanimously rejects the existence of the Philips curve as the coefficient of growth as a proxy for the output gap has a negative sign and it is statistically significant across the board. The lagged inflation coefficient in Ghana and Nigeria are very similar at 0.66 and 0.67 respectively whereas the growth coefficient between Nigeria and the US are the same (-0.04) and larger than Ghana's at -0.19.

However, almost all the diagnostic tests (apart from normality) for model 6 reject the null hypothesis that the model is well specified. This suggests that model 6 has specification problems.

As a result, the multiple breakpoint test was conducted, and the test revealed one structural break at 1992 which was confirmed by the Chow test. This breakpoint is consistent with the inflation graphs. The economic explanation is that prior to 1992, Ghana had experienced periods of persistent hyperinflation. The unsustainable levels of high inflation compelled the country to embark on structural economic reforms called the Economic Recovery Programme under the guidance of the IMF and the World Bank from 1983. The programme involved instilling fiscal discipline, removal of inefficient government subsidies, market liberalisation, public sector and institutional reforms, privatisation and adoption of a market-oriented approach to provide the enabling economic environment to promote economic growth. Among other things, the reforms resulted in reducing inflation from 142% in 1983 to only about 10% by the end of 1991 (IMF, n.d).

Informed by the structural breakpoint test and the economic rationale above, the data was split into two subsamples from 1971-1992, and 1993-2020. The regression results and the corresponding diagnostic tests outcomes are summarised in table 6 below.

Table 6: OLS Estimated results of a version of the New Keynesian Phillips curve with backward-looking expectations (Full and subsamples)

OLS Model: $\pi_t = \beta_0 + \beta_1\pi_{t-1} + \beta_2\Delta y_t + u_t$, (equation 6), using observations 1971-2020 with subsamples. Independent variable = Inflation = π_t									
Period	**Variables**	**Coefficient**	**Std.error**	**P-value**	**P-value(F)**	**R^2**	**SE**	**DW**	**AIC**
1971-1992	Constant	0.11	0.05	0.040**	0.000***	0.79	0.11	2.9	-1.48
	π_{t-1}	0.75	0.13	0.000***					
	Δy_t	-0.35	0.05	0.000***					
1993-2020	Constant	0.09	0.03	0.015**	0.004***	0.35	0.09	2.07	-1.94
	π_{t-1}	0.54	0.17	0.003***					
	Δy_t	-0.07	0.03	0.020**					
1971-2020	Constant	0.10	0.03	0.003***	0.000***	0.55	0.13	2.5	-1.25
	π_{t-1}	0.66	0.11	0.000***					
	Δy_t	-0.19	0.03	0.000***					
	P-values: *, **, and *** indicate significance at the 10%, 5%, and 1% respectively.								

Source: Author's computations

The coefficient of determination (R^2), which is a measure of the predictive power of the model and tells us about the proportion of the variation in inflation explained by the exogenous variables (lagged inflation and output growth) in this model, is highest (79%) in the 1971-1992 subsample and lowest (35%) in the 1993-2020 subsample, but this can be misleading as the other criteria suggest otherwise.

Using the Akaike Information Criterion (AIC) which recommends a smaller value to reflect a better fit model to the data (in EViews), the subsample 1993-2020 has the best fit model. The AIC of minus 1.94 is the smallest among the three. Moreover, it has the least regression standard error (SE of just 0.09), which is roughly about 9%. The Durbin-Watson statistic (DW of 2.07) is almost at the standard level of 2, which implies that there is no autocorrelation in the error term in the subsample. All the diagnostic tests indicate that the two subsample models are well specified.

5.1 The Flattening of the Phillips Curve

Between the two subsamples in table 6, it can be observed that all the estimated coefficients, as well as the constants, decreased in absolute values from the 1971-1992 estimate to the 1993-2020 estimates. For example, the absolute value of the estimated coefficient of the output growth (β_2) has decreased over time from 0.35 in 1997-1993 to 0.07 in 1993-2020. This indicates that the Phillips curve has flattened, particularly the partial effects of the output gap on inflation has fallen. In other words, the sensitivity of inflation to the output gap (a measure of market tightness) has decreased over time. The flatter Phillips curve means there is a smaller impact of the changes in the output growth (gap) on inflation, other factors remaining unchanged.

The flatness of the Phillips curve evidence in this study is in line with the exploration by Kuttner and Robinson (2010) who observe that, recently, policymakers have seen an apparent flattening of the Phillips curve. This is echoed by Blanchard (2016, 2022) and Kiefer (2016) who all argue that the flattening of the Phillips curve has implications for the conduct of monetary policy and that a flattened Phillips curve implies that inflation has become less sensitive to fluctuations in employment and output such that even overheating of the economy driven by an increase in the output gap (a decrease in the unemployment gap) will have a limited effect on inflation. From the evidence in this study, we can observe and infer that the output-inflation trade-off has markedly declined from 0.35 to 0.07 in the estimates shown in table 6. Using the Generalised Method of Moment (GMM) approach, Kuttner and Robinson (2010) found clear evidence of the flattening of the Phillips curve for the US and Australia which began gradually from 1975. However, the flattening of the Phillips curve poses a challenge for central banks in that once inflation is established, it would be more difficult to reduce it. With some degree of skepticism, they also attempted to provide some plausible reasons for the flattening of the Phillips curve, which range from stronger anchoring inflation expectations by firms to the impact of globalisation.

Besides, a decrease in the coefficient of lagged inflation from 0.75 to 0.54 indicates a reduction in the intrinsic persistence of inflation, accentuating the flattening of the Phillips curve idea. This means the lagged inflation has relatively less substantial pressure on current inflation and that inflation expectations have fallen over the two subsample periods and become less anchored.

5.2 Criticism

A major criticism of the main literature used in this study is their inability to provide general empirical evidence for both high-income and low-income countries. As well noted by Cornia (2020), a model that works for developed countries may not necessarily work for developing countries due to the structural economic differences. This argument appears to be evident in the empirical findings in this study. Although model 1 fits the data reasonably well for the US (a developed country), it does not work for Ghana and Nigeria (developing countries) as seen in the negative coefficient of the output gap. Conversely, for Ghana and Nigeria, model 6 reasonably fits the data but it does not appear to do so for the US. However, with the exception of the US in model 1, the evidence in all cases (models) shows no support for the existence of the Phillips curve.

The issue with model 1 is the puzzling negative sign of the coefficient for the output gap for Ghana and Nigeria and the statistical significance of the coefficient for the US. In the case of Ghana, the problem with model 2 having a relatively higher standard error (11.84) and other issues with the diagnostic test justify opting for model 6. As a result, the preferred parsimonious model specification for Ghana is equation 6 with the two subsamples from 1971-1992 and from 1993-2020 in table 6. Both subsample models clearly indicate statistically significant evidence against the existence of the Phillips curve in Ghana over the entire period. This means there is no inverse relationship between inflation and unemployment. This finding may be due to several factors, one of which is the idea that the Ghanaian economy is structurally different as Cornia (2020) observes. With weak institutions and reliance on the primary sector, the consumption, investment and production functions may be different as well as the availability of spare capacity in the labour market with high unreported unemployment not captured by the official International Labour Organisation's measure which was 4.5% in 2020[3] . The unemployed may be family reliant and not be actively looking for work, such that spare capacity may allow an increase in growth without overheating the economy.

[3] https://tradingeconomics.com/ghana/unemployment-rate

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Another plausible explanation for the finding is external and supply shocks to the Ghanaian economy. This view is supported by Florentini and Hassan (1994) who employed VAR and OLS techniques to reveal that inflation in countries in sub-Saharan Africa, particularly Ghana, is mainly determined by supply shocks and money supply, and that Ghana is vulnerable to exogenous and supply shocks such as those from the weather affecting agricultural supplies, changes in the international price of crude oil, cocoa, gold, and other major exports and imports. More recent evidence from the Bank of Ghana working paper employing the Bayesian Vector Autoregression (BVAR) methodology lends credence by revealing that external shocks account for about 30% of inflation in Ghana (Abradu-Otoo and Walley, 2019, p.2). This means Ghana is not immune from the global macroeconomic environment.

Even though an earlier study of the Phillips curve in Ghana by Elliot (2015) revealed a negative coefficient of the output gap, the statistically significant evidence in this study is not in total agreement. Elliot (2015) found the negative coefficient of the output gap insignificant, and concluded that changes in the output gap do not cause statistically significant changes in inflation, and thus, rejected the evidence of the Phillips curve in Ghana using data from 1970-2013.

It must be noted that certainty in the confidence in the findings in this study can be assured only as far as the data reported by the World Bank are an accurate reflection of the economy of Ghana for the period 1971-2020. Cornia (2020) rightly points out that most of the economic activities in developing countries are in the informal sector and are not captured by the GDP statistics. Furthermore, although the coefficients of both of the explanatory variables in the preferred specification subsample models are statistically significant, the model's predictive power is relatively small (35% in table 6 for the second subsample). This makes the model less reliable for policymakers.

6. CONCLUSION

Overall, this study has convincingly answered the central research question - does the empirical evidence support the existence of the Phillips curve in Ghana? - with an emphatic no! The empirical analysis has provided further evidence of the Phillips curve from the perspective of a small, open developing country (Ghana) with Nigeria and the US as useful benchmarks to provide further supporting evidence. The study sheds more light on the counter-arguments and evidence of Ghana's Phillips curve negative relationship between inflation and unemployment.

The findings are relevant for policies aimed at managing inflation and increasing (decreasing) employment (unemployment) in Ghana. The key message is that such employment-generating policies are more likely to succeed without causing inflationary pressures in Ghana, at least in the short term. It is especially important for policymakers to note that growth-targeted policies may not be inflationary. Additionally, a tightening monetary policy to control inflation is unlikely to result in a trade-off between inflation and unemployment in the short run.

Finally, the study recommends employing more advanced econometrics tools such as impulse response functions, VARs and simulations to capture supply and demand shocks on inflation. The study sides with the recommendation put forth by Mavroeidis et al. (2014, p.125) to move away from the "limited information" one equation model to a new approach involving "full-information" methods in which the NKPC is one of the multiple structural equations in a system of dynamic stochastic general equilibrium (DSGE) model. These recommendations would enable researchers to estimate the parameters of the Phillips curve relationship with more precision and reliability, and hopefully with more predictive power.

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