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VALIDITY OF AUGMENTED PHILIPS CURVE HYPOTHESIS IN SUB SAHARAN AFRICAN COUNTRIES: EVIDENCE FROM RATIONAL EXPECTATIONS OF INFLATION RATE

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ABSTRACT

The purpose of this study are of twofold: first to examine the validity of augmented Philips curve hypothesis. The second to examine how rational expectations of inflation rate with unemployment rate influences augmented Philips curve hypothesis in Sub-Saharan African countries. To achieve these two objectives, the study uses dynamic sys- Generalized Method of Moments (GMM) technique for the analysis. The study draws a panel data for twenty-six countries in the region for the period 2009-2016. The importance of this study cannot be under estimated. The study helps to show the tradeoff between inflation rate and unemployment. The estimation results show that the validity of augmented Philips curve with support of rational expectations of inflation rate and unemployment rate is positive. But when the output gap is used as proxy for unemployment rate, the validity of augmented Philips curve hypothesis is negative. The result also shows that the rational expectations of inflation rate with unemployment rate has positive and significant influence on augmented Philips curve hypothesis in Sub-Saharan African countries. This lead to the recommendation that proper policy for the provision of enabling environment for ease of doing business to enhance productivity should be given an adequate attention to ensure a robust employment creation and reduction in inflation rate.

Keywords: Inflation; Unemployment; Philips curve; System GMM; Africa

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1. INTRODUCTION

The deflation and employment creation are the most desired for every developing region like Africa to achieve robust growth and development. Most developing countries have not substantially achieved inflation rate reduction and employment creation that guaranteed a sustainable and improved condition of living and adequate investment to their citizens (Niskanen, 2012). Indeed, developing countries like Sub-Saharan African countries have been found characterized by high rate of inflation and unemployment (Hossain and Mitra, 2013; Ojonta and Ogbuabor, 2021; Nwosu et al., 2018). Such high rate of inflation and unemployment rate were believed to have not only led to unprecedented setback on economic growth, but also reignited the concerns of economic researchers and policymakers about the influence of inflation and unemployment rate in achieving augmented Philips curves hypothesis. This setback on economic growth has brought in to African countries a serious impediment especially on the part of general consumption for both food and non-food. Often, this consumption impediment that has been traced to setback on economic growth would have gone a long way encouraging more investment. The investment will create job that might reduce widespread of inflation rate in developing countries. This implies that if consumption is not affected, it will go a long way to boost investment. However, Sub-Saharan African countries still exhibits several characteristics of developing countries such as low employment rate, high inequality and high poverty.

The concept of this hypothesis is that increased employment increases inflation rate which implies that inflation rate is inversely proportional to unemployment rate. The major challenge facing most developing countries like Sub-Saharan African countries include high inflation rate and unemployment. The evidence is confirmed in a report domiciled in the World Development Indicator (WDI, 2018). The report revealed that the relationship between inflation and unemployment rate among African countries have not shown reliable result in terms of its significant positive impact to economic growth.

According to the report, some African countries for instance, Nigeria, Niger, Benin, Ghana, Cameroon and Togo show that the relationship between inflation and unemployment rate is negative. This implies that the inflation and unemployment rates support the hypothesis of augmented Philips curves. Surprisingly, it has been found that many countries in Sub-Saharan African countries have not overtime experienced employment growth and inflation rate reduction. Generally, somehow economy of Sub-Saharan African countries appear to have been affected by high unemployment and inflation rate. The increased unemployment and inflation rate were found to have caused unbalanced exchange rate, high dependency ratio and extreme poverty in the region (Ojapinwa and Esan, 2013). For instance, Urama and Iheonu (2019) explained that Nigeria, which is Africa's largest economy, is presently regarded as the world's poverty headquarters with over 93 million people living in poverty. According to the study Hossain and Mitra (2013) show that the inflation and unemployment rate are still persisting in most countries in Sub-Saharan Africa. The study revealed that the augmented Philips curve hypothesis has not efficiently drive the economic and development growth for most countries in the region. Evidence from literature has shown that high rate of inflation and

unemployment contributed to the major issues threatening the general growth in terms of job creation, consumption enhancement and improved living standard in the developing countries like Africa (Ojonta and Ogbuabor, 2021).

However, the significant of this study in Sub-Saharan African countries cannot be overemphasized. It is obvious that policies can be drafted due to the functionality of augmented Philips curve hypothesis. This study would be resourceful for policy formulations towards employment creation and reduction on inflation rate in the developing countries like Africa (Atkeson and Ohani 2001). Apart from this study being useful to policy formulations, the study can serve as the basis for conducting further research on augmented Philips curve hypothesis in other regions outside African region. Also the managers of business would see the outcome of this study useful in executing an important social responsibility. Despite this importance of this study, evidences from literature shows that the job creation, poverty reduction and reduction in inflation rate have not been achieved in Sub-Saharan African countries (Ojonta and Ogbuabor, 2021). However, the region is still facing a serious problem of adverse selection or moral hazard arising from socioeconomic factors such as poor education, poor health service delivery, poor output production and low level of productivity (Leijonhufvud, 1968). The problem of adverse selection or moral hazard could be avoided if the region is able to understand the important role of rational expectations of inflation with unemployment rate on influencing the augmented Philips curve hypothesis. Unfortunately, many African countries are still under a siege to understand the important role of augmented Philips curve hypothesis.

Numerous studies from extant literature for instance, (e.g. Lipsey 1960; Samuelson and Solow 1960; Phelps, 1967; Leijonhufvud, 1968; Gordon et al., 1970; Lucas, 1972; 1973; 1976; Okun et al. 1975; Turner 1997; Atkeson and Ohani 2001; Reichel 2004; Niskanen 2012) have all conducted a study on the validity of augmented Philips curve hypothesis. These studies focused on individual country using cross sectional data with ordinary least square (OLS) estimation model technique for the analysis. Other studies like Ojapinwa and Esan (2013) and Orji et al. (2015) studied how adaptive expectations of inflation with unemployment rates influence augmented Philips curve hypothesis. All the studies in the literature have not considered how important the rational expectations of inflation rate with unemployment rate influence augmented Philips curve hypothesis. Thus, how rational expectations of inflation with unemployment rate influences augmented Philips curve hypothesis in Sub-Saharan African countries is yet to be investigated. It is the goal of this study to fill this gap in the literature by ascertaining how rational expectations of inflation rate with unemployment rate influences augmented Philips curve hypothesis in Sub-Saharan African countries. The research hypothesis for the study: Rational expectations of inflation rate with unemployment rate do not significantly influence the augmented Philips curve hypothesis in Sub-Saharan African countries. Consequently, the key questions asked in this study: How does rational expectations of inflation rate with unemployment rate influences augmented Philips curve hypothesis in Sub-Saharan African countries?

The purpose of this study:

1. To examine how rational expectations of inflation rate with unemployment rate influences augmented Philips curve hypothesis in Sub-Saharan African countries.
2. To examine whether augmented Philips curve hypothesis is valid or exist in Sub-Saharan African countries.

The different sections of this paper would be determined as follows. The next Section provides review of empirical related literatures. Another section which is 3 showcases the method approach such as data descriptions and detailing the model specification. The empirical results are in Section 4, while Section 5 concludes the paper.

2. LITERATURE REVIEW

Some studies in the literature have shown how adaptive expectations of inflation influences augmented Philips curve hypothesis from different perspectives, both in developed and underdeveloped economies. In developed economies, for instance, Lipsey (1960), Samuelson and Solow (1960), Soskice and Iversen (2000), Atkeson and Ohani (2001), Hansen and Pans (2001), Holden (2005), Coricelli et al. (2006), Paul (2009), Del Boca et al. (2010), André et al. (2012), Niskanen (2012), Sánchez (2012), Grammy (2013) and Hossain and Mitra (2013) found that adaptive expectations of inflation is significant and has a positive influence on augmented Philip curve hypothesis. However, some studies in the developed countries like Phelps (1967), Friedman (1968), Lucas (1976), Turner (1997), Furuoka (2007), Tang & Lean (2007), Schreiber and Wolters (2007), Russell and Banerjee (2008) Paul (2009) and Gerlach et al. (2015) including the current studies like Binder (2015), Sovbetov and Kaplan (2019) and Ball and Mazumder (2019) examined in aggregation the two components of inflation forecast, rational and adaptive expectations to examine their influence on the augmented Philips curve hypothesis. The result of these components shows that inflation is significant and has a negative influence on the augmented Philips curve hypothesis.

Some studies that focused on developing countries also abound in the literature. For instance, Alnaa and Ahiakpor (2011) and Solomon (2014) employed aggregate data to forecast the influence of adaptive expectations on augmented Philips curve hypothesis in Ghana. Orji et al. (2015), Ojapinwa and Esan (2013) employed Autoregressive Distributed Lag (ARDL), Autoregressive Integrated Moving Average (ARIMA), and a multivariate time series Vector Autoregressive (VAR) models respectively for the study. The result shows that adaptive forecast is significant and has negative influence on the augmented Philips curve hypothesis.

3. METHODOLOGY

3.1 Empirical Model and Data

This study examined how augmented Philips curve hypothesis is influenced by rational expectations of inflation with unemployment rate in Sub-Saharan African countries for the

period 2009-2016 using dynamic sys-GMM panel estimation approach. A representation of the expectations augmented Philips curve is generally specified in a dynamic panel form as:

$$\pi_{it} = \alpha_i + \pi_{it}^e + \beta_{i1} \text{unem}_{it} + \varepsilon_{it} \quad (1)$$

From equation 1 above, I represents country and t represents time period. π stands for inflation rate measured by consumer price index. π^e stands for expected rate of inflation. β_{i1} is coefficients to be estimated with vector of core explanatory variable unemployment (unem) measured as total unemployment as a percentage of total labour force with a priori expectation sign to be negative, α_i is country specific effects, and ε is the error term assumed to independently and identically distributed with zero mean and constant variance. Our major interest is on the rational expectation of future inflation rate π^e by economic agent which entered the equation with a coefficient of unity in accordance with “natural rate” hypothesis of Lucas (1972) which signalled that agents put into consideration the anticipated real purchasing power of the prices they pay and receive. However, the way in which people form expectations changes as a result of changes in inflation behaviour. This situation changes the way expectations about inflation rate are formed. People could not expect the rate of inflation in the present year to be the same as the previous year. This change in expectations changes the nature of the relation between unemployment and inflation. Hence, the rational expectations of economic agents about future prices are assumed to be based on factors that cause price changes which include the experience of past inflation, external debt, broad money supply, real income level, and interest rate. Therefore, the functional form for π^e is expressed thus:

$$\pi^e = f(\pi_{t-1}, \text{extd}, \text{ms}, \text{ri}, \text{int}) \quad (2)$$

Subsuming equation (2) into (1) will yield

$$\pi_{it} = \alpha_i + \phi_{i1} \pi_{t-1} + \beta_{i1} \text{extd}_{it} + \beta_{i2} \text{ms}_{it} + \beta_{i3} \text{ri}_{it} + \beta_{i4} \text{int}_{it} + \beta_{i5} \text{unem}_{it} + \varepsilon_{it} \quad (3)$$

From equation (3), π_{t-1} denotes past inflation rate with a priori expectation sign to be positive; extd denotes external debt with a priori expectation sign to be positive; ms denotes money supply proxied by broad money supply (M2) with a priori expectation sign to be positive; ri denotes real income proxied by real gross domestic product with a priori expectation sign to be negative as increase in real income rises real money demand thereby declining the growth of money; and int denotes interest rate with a priori expectation sign to be positive.

Even though this study estimated the aforementioned model, we re-estimated the model with output gap as a proxy for unemployment in order to check for robustness of our result to alternative model specifications. The output gap is measured in this study as $(Y - \bar{Y})$ which is the difference between the log of actual real gross domestic product and the potential real gross domestic product. Potential GDP is estimated using Hodrick Prescott filter. We employed

annual time series data for twenty-six Sub-Saharan African countries which include: Angola, Benin, Botswana, BurkinaFaso, Burundi, CaboVerde, Cote d'Ivoire, Guinea-Bissau, Kenya, Lesotho, Liberia, Malawi, Mali, Mauritius, Mozambique, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Sierra Leone, South Africa, Tanzania, Togo, Uganda and Zambia. We excluded other African countries due to lack of data for some of the variables. The countries include: Djibouti, Equatorial Guinea, Eritrea, Ethiopia, Gabon, The Gambia, Ghana, Guinea, Cameroon, Central African Republic, Chad, Comoros, Congo (Brazzaville), Congo (Democratic Republic), Madagascar, Mauritania, Namibia, Réunion, Seychelles, Somalia, Sudan, Swaziland, Western Sahara and Zimbabwe. The data for study was sourced from World Development Indicators which was conducted in 2018. The choice of this dataset followed the study by Gali and Gertler (1999) and Gali et al. (2005). However, their study used Robust Instrumental Variables System Generalized Method of Moments (GMM) estimation approach to estimate the model in equation (3). The dynamic panel data estimator has been found very suitable in a situation where unobservable indicators influence the dependent and independent variables to ensure that some of the independent variables are correlated with dependent variable. This is likely to be the case in regressions of variables on financial sector development and economic growth. So, in dealing with this potential endogeneity bias introduced by the lagged endogenous regressor, the Difference GMM estimator and the System GMM estimator have been proposed, among other estimators in literature.

The reasons for adopting dynamic sys-GMM panel model cannot be overstressed. One of the reasons is that the model helps in addressing the estimation omission problem of Static panel (Baum & Christopher, 2006). The general view is that static panels are most often misspecified because it has been found that sys-GMM panel estimator considers the lagged dependent variables in the model analysis (Bond, 2002). Also, the dynamic sys-GMM panel model supports in addressing the endogeneity problem because in most cases correlation could occur between the independent variables and the error term in model. The dynamic sys-GMM panel model is suitable to address problem of spurious result by lagging the dependent variable in the model (Roodman, 2009). Another reason is that dynamic sys-GMM panel model has a better performance than differenced-GMM (DIF-GMM) in multivariable dynamic sys-GMM panel models (Arellano and Bond, 1991). The reason for such performance is that dynamic sys-GMM panel model is suitable especially if the variables are “random walk” (Bond, 2002) while the DIF-GMM estimator have weak instrumentation problem in such case (Sarafidis and Roberson, 2009). More also, Blundell & Bond (1998) argued that dynamic sys-GMM panel model does not show change in variation in a random walk variables even when the series does changes. The dynamic sys-GMM panel model is suitable in the midst of reduction existing in finite sample bias estimators caused by the manipulations of additional moment conditions (Blundell and Bond, 2000). Finally, dynamic sys-GMM panel model is suitable when a panel data series is unbalanced in order to avoid problems from the weakness of magnifying gaps since dynamic sys-GMM panel model considers the cross-sectional independence of the error terms. Therefore, this study followed the robustness test for the system GMM as proposed by Arellano & Bover (1995) and Blundell & Bond (1998).

3.2 Descriptive analysis

Table 1 shows the percentage share of unemployment of labour force and inflation rate by quintiles in sub-Saharan Africa. The table shows that 1992-1996, unemployment rate of labour force and inflation rate in sub-Saharan Africa is 7.9 and 13.33 percent respectively. In the second quintile of 1997-2001, unemployment rate of labour force increased to 8.4 percent by 0.5 percent while the inflation rate decreased to 5.91 percent from 13.33 percent. The table also shows that for a decade from 2002-2011 there was a consistent decrease in unemployment rate of labour force but increase in inflation rate during the period. This implies that augmented Philips curve hypothesis holds in sub-Saharan Africa for two decades from 1997 to 2011. The table as well revealed that after the period, there was decrease in unemployment rate of labour force from 2011 to 2016 showing also decrease in inflation. This of cause implies that there is a mismatch in the line of taught by augmented Philips curve hypothesis which says increase in unemployment rate decreases inflation rate. This is shown clearly in quantitative terms in Table 1.

Table:1 Percentage share of employment and inflation rate by quintile in sub-Saharan Africa

Indicators	1992-1996	1997-2001	2002-2006	2007-2011	2012-2016
Unemployment rate	7.9	8.4	7.92	7.25	6.88
Inflation rate	13.33	5.91	6.03	6.93	5

Source: Author's computations from WDI 2018 using SPS

4. FINDINGS

The study adopted dynamic sys-GMM panel estimation for the study. The purpose was to avoid the traps of serial correlation, reverse causality, heteroscedasticity and potential endogeneity of the regressors. If avoided the issue of unobserved heterogeneity including the omitted bias variables that are associated with dynamic sys-GMM model would be taken care of. These conditions were confirmed in a study conducted by (Bond 2002; Blundell & Bond 1998; Arellano and Bover 1995; Arellano and Bond 1991). The study also considers to estimate three important specification tests which include: the Sargan/Hansen tests, Arellano-Bond test and Difference-in-Hansen test. Those tests are important to take care of exogenous instruments, error serial correlation at the second order (AR2), and exogeneity of instrument subsets respectively.

The estimation results of the variables included in the study are reported in Table 2.

Table 2: Two step Sys-GMM panel estimation regression results

VARIABLES	(1)	(2)	(3)
	SGMM1	SGMM2-END-CL-a	SGMM2-END-CL-a
π_{t-1}	0.648*** (0.170)	0.423*** (0.148)	0.569*** (0.172)
lnrgdp	-1.581 (3.216)	-7.353** (3.500)	-12.87*** (3.787)

lnm2gdp	-3.239 (2.604)	-21.49*** (8.336)	-33.69*** (8.458)
intr	-0.0999 (0.102)	-0.181*** (0.0698)	-0.240*** (0.0766)
lnextd	0.428 (2.657)	8.996** (4.222)	16.13*** (4.726)
unem	0.193 (0.269)	0.407** (0.188)	
opg			-11.28 (8.255)
Constant	42.95 (46.83)	49.65** (21.09)	67.49*** (22.71)
Observations	182	182	182
Number of crossid	26	26	26
country effect	YES	YES	YES
year effect	NO	NO	NO
Hansen_test	23.72	6.354	3.272
Hansen Prob	1	0.385	0.774
Diff-in-Hansen	-0.71	0.91	0.52
Diff-Hansen Prob	1	0.636	0.771
AR(1)_test	-1.765	-1.653	-1.794
AR(1)_P-value	0.0775	0.0983	0.0729
AR(2)_test	-1.785	-1.159	-0.739
AR(2)_P-value	0.0743	0.246	0.460
No. of Instruments	99	13	13

Standard errors in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$, SGMM2 denote Two-Step GMM. Also regressions with suffix “END” treat lagged inflation rate & lnm2gdp as endogenous. Regressions with suffix “CL” follow Roodman (2009) and collapse the instrument matrix while “a” denote lag (1’3).

The empirical result from the panel of 26 African countries is presented in Table 1. The result in column 1 indicates that the relationship between inflation and unemployment is negatively and statistically insignificant. However, a closer look at the result in column 1 showed that the numbers of instruments exceed the number of groups in the model and thus, the outcome of the analysis may be weak, and the exogenous variables in the model may not be strictly exogenous.

Therefore, when system GMM follows Roodman (2009) and collapse the instrument matrix with lag interval specification in column 2 and 3 to account for too many instruments, the number of instruments becomes lesser than the number of groups in the model in line with the basic assumption of the system GMM. The outcome in column 2 and 3 validated the choice of using collapse instrument matrix as a better approach for the estimation of the panel data employed in this study. Therefore, in column 2, we observed that the relationship between inflation rate and unemployment rate is positively and statistically significant. This suggests that on the average, one percent increase in unemployment rate results to a 0.4 percent rise in inflation rate. This finding does not support the postulation of the Phillips curve hypothesis that inflation rate has an inverse relationship with unemployment. The positive relationship between inflation and unemployment in sub-Saharan African countries is not surprising, owing to the present stagflation being witnessed in most of sub-Saharan African countries Solomon (2014)

and Orji et al. (2015) suggesting that the Phillips curve relation does not exist in sub-Saharan African countries.

However, for robust and more reliable conclusion, output gap was used as a proxy for unemployment rate to estimate the augmented expectation of Philips curve hypothesis in column 3. The findings reveal that the relationship between inflation and unemployment rates are negative but systematically insignificant. This insignificant relationship is in line with the finding of Esu and Atan (2017).

The study found that inflation rate own past realizations has positive and significant impact, justifying the use of sys-GMM methodology as well as taking backward looking model of inflation into consideration. Therefore, rational expectations of inflation rate is an important determinant of current and future inflation. Adu and Marbuah (2011) and Esu and Atan (2017) substantiate the argument that inflation inertia is fundamental in the rational expectations framework. The study also found out that an increase in real income has a negative and statistically significant effect on inflation rate which is consistent with theoretical prediction. This study followed the findings obtained by Solomon (2014) who found out that rise in income level leads to decline in inflation in Ghana.

External debt is also an important determinant of current and future inflation with regard to expectation of Philips curve analysis. The result shows that the growth of external debt impacts positively and significantly on inflation rate with a coefficient of 0.0698. This indicates that a percentage rise in external debt explains inflation surges to about 7 percent. The finding is consistent with Neo-classical theory which argues that relationship between inflation and external debt is positive in that external debt presents disequilibrium temporally in the money market by increasing the supply money vis-à-vis aggregate spending and thus the general price level. Surprisingly, money supply appears to be driven by a negative inflation in the short-run. Money supply rather had a diminishing impact on inflation which sounds counter intuitive and contrary to theoretical prediction, but with unique feature within Sub-Saharan African perspective. The negative relationship between inflation and money supply could be attributed to the fact that inflation is not seen as a monetary phenomenon in the short-run. A number of studies empirically found similar result such as Solomon (2014) and Orji et al. (2015).

5. DISCUSSION AND CONCLUSION

This study examines the dynamic relationship between inflation and unemployment rates of augmented rational expectations framework in the African region. A panel of twenty-six countries in region was employed based on annual data from 2009 to 2016 using Two Step System-GMM model. Overall, there was no evidence of Philips curve hypothesis in Africa. An alternative model specification where output gap was used as a proxy for unemployment to estimate the augmented expectation Philips curve. The purpose of this study are of twofold: first to examine the validity of augmented Philips curve hypothesis. The second to examine how rational expectations of inflation with unemployment rates influences augmented Philips curve hypothesis in Sub-Saharan African countries. The theoretical contribution helps the study

to show the trade-off between inflation rate and unemployment rate in Sub-Saharan African countries. However, evidence of Philips curve remains doubtful, mostly operational through factors closely related with rational expectations of economic agent in African countries. Furthermore, inflation inertia, external debt, broad money supply, real income level, and interest rate are significant determinant of current and future inflation.

The policy implication of this result is that policy makers in Africa should understand that rational expectation is an important ingredient for Philips curve hypothesis. Perhaps the positive relationship between inflation and unemployment could explain why Sub-Saharan Africa is still struggling to leverage the twin devil identified as the coexistence of high inflation and high unemployment. Therefore, a good knowledge of inflation and unemployment relationship and anchoring inflation expectations in the region is important for suitable policy formulation. Given the positive influence of external debt on inflation, the study therefore, recommends that external debt should be evaluated to checkmate wasteful public expenditure which ultimately would help meet future inflation targets and afterward, monetary authority should also improve revenue generation through efficient tax system instead of embarking on external finance. Since real income has significant impact on reducing inflation, proper policies for the provision of conducive environment for ease of doing business and boosting productivity, should be vigorously pursued. Another area that can support validity of augmented Philips curve and rational expectation efficiently in developing countries like Africa is through reduction of high demand and increase in employment. This will go a long way to improve living conditions of people particularly the class of individuals found mostly at lower end income distribution. There is a need to create more industries in Africa. This will help in reducing poverty and engage more people working and reduction of high inflation through adequate policy making. Reduction of inflation and increase in employment can be easily achieved by government through various intervention such as monetary policy and establishment of industries. These policies will go a long way in repositioning the issues of inflation, inequalities and unemployment that are mostly rampant in developing countries like Africa.

This study has established that augmented Philips curve hypothesis is being positively influenced by rational expectations of inflation rate and unemployment in SSA countries. It is the position of this study that rational expectations of inflation rate with unemployment rate provides a better understanding of Philips curve hypothesis. Further studies would be required to investigate other aspect of inflation rate with unemployment where available data would be used to estimate the relationship.

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