Inflation, output and unemployment trade-offs in Sub-Saharan Africa countries

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Abstract

This paper studies the behaviour of inflation, output and unemployment in Sub-Saharan Africa (SSA) countries. In a heterogenous panel data analysis, the short run estimates show significant inflation - unemployment and output - unemployment relationships, consistent with the predictions of the Phillips curve and Okun's law. In the long run however, the Okun's law coefficient declines greatly and turns positive while the Phillips curve phenomenon gravitates towards the New Keynesian Phillips Curve (NKPC) but with a negative relationship. The short-term behaviour of inflation, output and unemployment can be attributed to economic slackness reflecting subdued demand while the long run outturns may be explained by supply shocks reflecting shifts in productivity. In the country specific analysis, I find that the coefficients on both past and expected inflation are positive and significant in all countries. However, the coefficients on expected inflation dominate the coefficients on past inflation, suggesting that inflation dynamics in the sub region are more forward looking in line with the theoretical predictions of the NKPC.

Key words: Phillips curve, Okun's law, Panel ARDL

JEL classification: E24, E31

1. Introduction

In the conduct of its monetary policy, the objectives of the Federal Reserve of the US as mandated by the Congress in the Federal Reserve Act include promoting maximum employment and stabilising prices. Even when not explicitly specified, central banks across the globe pursue output and unemployment objectives aside the usually explicitly specified inflation objectives. Discussions and debates about output, unemployment and inflation have a long-standing history. Ever since the 1950s, the exact relationship between these concepts has attracted the attention of economists. Output, unemployment and inflation have welfare implications and rightfully so are of key considerations in policy formulations. In Sub-Saharan Africa (SSA), disinflationary policies have relatively been successful in stabilising prices and jettisoning the eras of high rates of inflation. However, concerns may arise over the real output and employment costs of disinflation as recent data (Figure 1) depicts declining real output growth in the sub region while unemployment rate remains largely unchanged and increased slightly between 2016 and 2018. The persistency of relatively high unemployment rates in most SSA countries requires revisiting the relationships between inflation, unemployment and output and apply them to economic policy. This study is concerned with the inflation, unemployment ad output trade-offs in SSA.

This study relates to the never-ending debate on the Phillips curve scenario. Phillips (1958) espouses a stable and negative statistical relationship between the unemployment rate and the rate of change of money wage. Subsequent studies show a similar negative relationship between unemployment levels and inflation. Recent surveys have found a temporal trade-off between the inflation rate and the rate of change of unemployment for the US after the recession (Stock and Watson, 2010), the existence but declining Phillips curve for the US (Blanchard, 2016), and empirically significant Phillips curve phenomena for a number of OECD economies (Bhattarai, 2016). Friedman (1968) argues for the influence of expectations on inflation and intimates that any trade-off between inflation and unemployment — negative sloping Phillips Curve — may exist in the short run at least, but not in the long run. Prior to Phelps (1968) and Friedman (1968), the basic Phillips curve had been the favoured model of the relationship between unemployment and inflation (Hall and Sargent, 2018). The standard Phillips Curve rests in the submission that improved demand and economic activities would increase output and employment but as the

labour market approaches full employment, significant wage growth arises[1] to ignite inflation. However, Friedman (1968) contends that the inflation and unemployment trade-off could only be temporal as the economy would return to its natural rate of unemployment with a stable rate of inflation. Expectation formations framed in the rational expectation hypothesis form the centrepiece of the formulation by Phelps (1968), Friedman (1968) and Lucas (1973) and led to the inclusion of expected inflation to the right-hand sides of what has become known as the augmented Phillips curves. Blanchard (2016) concludes that the Phillips curve is prevalent and has implications for the conduct of monetary policy. This paper focuses on the Phillips curve phenomenon in SSA where disinflation policies are prime in the presence of macroeconomic instabilities.

This paper connects also with other strands of literature. First, it relates to the papers that examine the trade-off between inflation and output stabilisation (Hutchison and Walsh, 1998; Justiniano, Primiceri and Tambalotti, 2013). These papers focus on the output cost of stabilising inflation. Inflation variations would lead to movements in real output if not fully anticipated. Monetary easing may generate economic expansions but would also lead to increases in inflation; conversely, economic slowdowns are usually associated with reductions in the rate of inflation (Hutchison and Walsh, 1998). Thus, monetary policy may lose its countercyclical influences if inflation expectations become entrenched. Blanchard and Galí (2007) allude to the "divine coincidence" property of the New Keynesian frameworks that implies that there is no trade-off between stabilizing inflation and stabilizing the welfare relevant output gap. However, the "divine coincidence" ceases on the emergence of real imperfections (real wage rigidities) and the trade-off between stabilization of inflation and stabilization of the output gap arises. In their study of New Zealand, Hutchison and Walsh (1998) find that short-run output and inflation trade-off rose in the early 1990s and both low-expected and average inflation were associated with high short-run trade-off. In an estimated DSGE model for the US, Justiniano, Primiceri and Tambalotti (2013) show that conflicting stabilisation objectives has negligible effects on optimal policy.

Second, this paper is linked to those investigating the relationship between GDP growth and unemployment rates. The Okun (1963) relationship underpins an enduring macroeconomic

[1] Wage increases result from labour union pressures and employers' desire to induce further hours in response to the improved demand

parameter that underscores the nexus between fluctuations in economic activity and the variations in unemployment. Perman and Tavera (2007) indicate that the absolute value of the Okun's Law Coefficient (OLC) varies from country to country and is unstable over time. The growth – unemployment relationship is of significant interest to macroeconomic policy since the size of the OLC is perceived as a benchmark measure of higher unemployment cost and serves as a significant measure of the extent of interdependence of labour movements and output growth around their long-run paths. Also, the desirability of disinflation policies hinges on the sacrifice ratio - the sensitivity of unemployment rates to the rate of output growth (Perman and Tavera, 2007). Empirical surveys (Harris and Silverstone, 2001; Villaverde and Maza, 2009; Ball, Leigh and Loungani, 2013) test for validity of the Okun's law, structural changes and asymmetry of the OLC. Lee (2000) tests for structural changes and asymmetry of the OLC and find that the Okun's law is statistically valid for most OECD countries. For a sample of ten industrial countries, Freeman (2001) finds that the OLC averaged under two points of real GDP growth for a unit change in the unemployment rate. Perman and Tavera (2007) test for the presence of convergence and find that there is no convergence of the OLC among several groupings of European economies.

This study also relates to the strand of literature that focusses on the moderating effect of monetary policy frameworks (inflation targeting) on the output-inflation and unemployment-inflation trade-offs (Bernanke et al., 1999; Wong, Clifton and Leon, 2001; Carbo, Landerretche and Schmidt-Hebbel, 2002). Using data from mostly OECD countries, this strand of literature investigates the effect of the adoption of Inflation Targeting monetary policy frameworks or/and central bank independence on the output and unemployment cost of price stabilisation. The current study concentrates on SSA countries where inflationary policies have been adopted to steer the economies from the inflation spirals that were typical of the fiscal-dominance economic structures prior to economic and central bank reforms in the late 1980s.

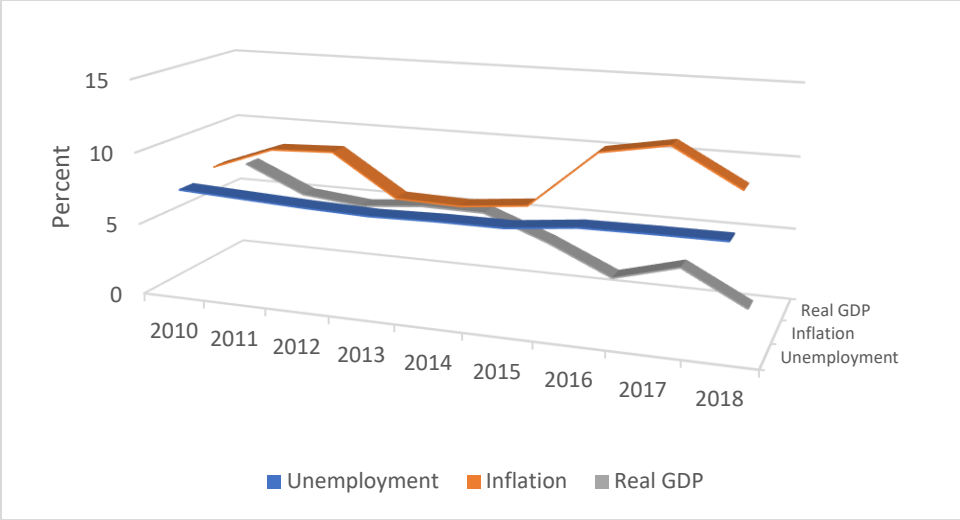
In several of the jurisdictions studied, inflation rates are significantly low and within target while unemployment rates have reduced to very low levels. In most SSA countries however, inflation though declined from the hyper levels, remains relatively high and persistent as cost push factors, trade shocks and exchange rate volatilities continue to generate significant inflationary pressures. Unemployment rates are relatively high while concerns remain over the institutional quality, policy credibility and transmission channels of monetary policy. Disinflationary policies are of immense

importance in SSA but not at a great expense of real output growth and employment as the twin developmental challenge of poverty and inequality continue to scourge the sub region. Evaluation of the relationship between inflation, real output and unemployment is critical to economic and monetary policy in SSA. This paper examines the inflation dynamics both from the accelerationist Phillips curve and the New Keynesian Phillips Curve (NKPC) perspectives. The paper provides evidence that both NKPC and the accelerationist Phillips curve explain inflation dynamics in SSA. I find that the coefficients on both past and expected inflation are positive and significant in all countries. However, the coefficients on expected inflation dominate the coefficients on past inflation. This may suggest that inflation dynamics are more forward looking, which is consistent with the theoretical predictions of the NKPC.

I also confirm the validity of the Okun's law and the Phillips curve in the short run. The short run inflation – unemployment and output – unemployment trade-offs are consistent with theoretical predictions of the Okun's law and the Phillips curve. The Okun relationship holds for some countries and for the SSA region. This may suggest that it could be considered as pointed out by Bajo-Rubio, Díaz-Roldán, and Esteve, (2007), a "near-rationale rule of thumb" with some caveats, to offer predictions about unemployment/income. The long run behaviour of inflation, output and unemployment shows significant negative inflation – output gap relationship while the output – unemployment nexus is positive. This may be attributed to supply shocks reflecting variations in productivity. The findings of this paper also show that in the long-term equilibrium, unemployment declines with changes in real output. This paper confirms the validity of the Okun relationship and the Phillips curve in SSA countries and their shape offers critical implications for economic policy. In the short term, there exists significant output cost of unemployment and a trade-off between inflation and unemployment objectives. However, in the long term, there are significant output gains from stabilised prices. This may suggest that economic policy should prioritise price stability as the long-term output gains are also translated into decreases in unemployment with potential welfare improving implications.

The remainder of this paper is organized as follows. Section II describes the data and the empirical methods. Section III discusses the empirical results and Section VI concludes.

Figure 1: Inflation, real GDP and unemployment in SSA, 2010-2018



Date Source: International Financial Statistics and World Development Indicators

2. Data and Methods

Data: The data for this paper consists of inflation rates and real GDP growth rates from the IMF's International Financial Statistics and unemployment rates from the World Development Indicators (World Bank). The analysis is implemented for 28 Sub-Saharan Africa countries for which data is available and covers the period 1990 – 2018. The data (Table 1) shows that the sampled countries recorded an average unemployment rate of 7.86 percent over the period 1990 – 2018 with South Africa posting the highest rate of unemployment while Niger posted the lowest rate of unemployed labour force. The mean inflation rate stands at 9.23 percent with Zambia's inflation rate of 183.31 percent in 1993 representing the highest rate of price changes over the sample period. The data indicates that real GDP growth averaged 4.03 percent over the period 1990 – 2018 with Rwanda's real output growth rate of -41.89 percent recorded during the 1994 genocide, representing the worst performance.

Table 1: Descriptive statistics

	Inflation	Real GDP Growth	Unemployment
Mean	9.23	4.03	7.86
Maximum	183.31	24.54	33.47
Minimum	-8.48	-41.89	0.27
Std. Dev.	14.14	4.53	7.17

The strategy of this paper is to estimate country specific trade-offs as well as the relationship between unemployment, inflation and output within panel setting. While the time series for inflation rate is available on quarterly and annual frequency, only annual series of real GDP growth and unemployment rates are available. The panel analysis utilises the annual series. However, the country specific estimations are shrouded with the concern of relatively short samples within the time series literature. Unemployment rates and real GDP growth are interpolated to quarterly series to deal with the issue of longer estimation period. It is assumed that the annual observations represent the observations for the fourth quarter and utilising the backward prediction capacity of the Kalman filter's smoothing algorithm in a state-space representation, the observations for the first, second and third quarters are predicted to complete the interpolation from the annual series to quarterly observations.

Empirical methods

Country specific trade-offs: The analysis starts with the estimation of inflation – unemployment, inflation – output, and unemployment – growth relationships for each country.

Inflation – unemployment trade-off – the Phillips curve: Friedman (1968) submits that the inflation rate is a function of expected inflation and the deviation of unemployment from its natural rate. The expectations-augmented Phillips curve is usually represented as follows:

$$\pi_t = \pi_t^e + \alpha(u_t - u_t^*) + \varepsilon_t \quad (1)$$

where π is inflation, π^e is expected inflation, u is unemployment, u^* is the natural rate of unemployment and ε is a stochastic error term. Friedman (1968) explains that when inflation is not fully anticipated, expected inflation is well proxied by past inflation. Thus, equation (1) is represented as follows:

$$\pi_t = \pi_{t-1} + \alpha(u_t - u_t^*) + \varepsilon_t \quad (2)$$

where π_{t-1} is past inflation. Equation (2) is referred to as the accelerationist Phillips curve and has guided the empirical research on inflation. The unemployment gap is proxied by the deviation of the Hodrick–Prescott (HP) trend from the actual rate and the accelerationist Phillips curve is estimated for each country using the GMM instrumental variable regression technique.

Inflation – output relationship: The inflation – output relationship is analysed using the New Keynesian Phillips Curve (NKPC). One of the pillars that anchor the microeconomic foundations to the Keynesian macroeconomics is the NKPC. The formulation of the NKPC to explain the inflation process is guided by the assumptions of nominal rigidities and is underscored by the theoretical contributions of Taylor (1980), Rotemberg (1982) and Calvo (1983). With the price stickiness postulation, the NKPC assumes rational expectations of inflation where future price expectations play a key role in the price setting process. These theoretical establishments culminate into a relationship christened the New Keynesian Phillips Curve. The NKPC relates the inflation process to the expected future inflation and a measure of the output gap[2] (Abbas, Bhattacharya and Sgro, 2016). The NKPC implemented for this analysis is specified as follows:

$$\pi_t = \beta E_t \pi_{t+1} + \gamma y_t + \varepsilon_t \quad (3)$$

where $E_t\pi_{t+1}$ is next period's expected inflation rate and y_t is the output gap. The rest of the terms are as hitherto defined. The expected inflation is proxied by the inflation forecast of the IMF's World Economic Outlook[3] and the output gap is proxied by the deviation of the Hodrick–Prescott

[2] For empirical implementation of the NKPC, the real marginal cost has been proxied using a measure of the output gap (the deviation of output from its potential level).
[3] The data is available on annual basis and was interpolated to quarterly series.

(HP) trend from the actual growth rate. Equation (3) is estimated for each country using the least squares regression approach.

Unemployment – GDP growth relationship – the Okun's law: Third, the unemployment and out trade-off is examined for each country. The basic Okun's Law involves the deviation of real output and unemployment rates from their long-run or full employment levels. The 'gap' equation represents a simple formulation of the empirical relationship between output and unemployment suggested by Okun and is a of the type:

$$u_t^c = \alpha y_t^c + \varepsilon_t \tag{4}$$

where $u_t^c = u_t - u_t^*$ is the cyclical unemployment rate and $y_t^c = y_t - y_t^*$ is the cyclical output growth. The cyclical output and unemployment rates are obtained from the HP filter. Equation (3) is estimated for each country using the least squares regression approach to obtain the Okun's law coefficient.

Panel analysis: The country specific models assume contemporaneous relationship between inflation, unemployment and output. The panel analysis involves a dynamic model based on the Polled Mean Group / Dynamic Fixed Effects (PMG/DFE) estimator by Pesaran et al. (1999) which allows the short-term coefficients to vary between country groups while providing for the similarity of long-term parameters. The analysis starts with the investigation of the cross-sectional dependency and the integration levels of the variables. The cross-sectional independency of the series is investigated with Pesaran's (2004) CD test and the integration levels of the variables is examined via the Im, Pesaran, and Shin (IPS) and ADF-Fisher (ADF) panel unit root tests. A dynamic heterogeneous panel regression can be specified using ARDL (*p, q*) model where *p* is the lag order on the response variable and *q* is the lag order on the explanatory variables. The model is formulated as follows:

$$y_{it} = \sum_{j=1}^{p} \lambda_{ij} y_{i,t-j} + \sum_{j=0}^{q} \gamma_{ij}' x_{i,t-j} + \varphi_i + \varepsilon_{it} \tag{5}$$

where y is the response variable, x is a $k \times 1$ vector of explanatory variables, the $k \times 1$ vector, γ contains the coefficients of the independent variables, λ is the coefficient of the lagged dependent variable (referred to as scalers), φ is the country-specific fixed effects and ε represents the error terms. Equation (5) in the form of error correction model can be reparametrized as:

$$\Delta y_{it} = \phi_i\left(y_{i,t-1} - \theta_i' x_{it}\right) + \sum_{j=1}^{p-1} \lambda_{ij}^{*} \Delta y_{i,t-j} + \sum_{j=0}^{q-1} \gamma_{ij}'^{*} \Delta x_{i,t-j} + \varphi_i + \varepsilon_{it} \qquad (6)$$

where the group-specific speed of adjustment parameter is defined as:

$$\phi_i = -(1 - \sum_{j=1}^{p} \lambda_{ij}); \theta_i$$

and θ is a vector of long run relationships, $\left(y_{i,t-1} - \theta_i' x_{it}\right)$ is the error correction term (ECT) and λ and γ are the short run dynamic coefficients.

3. Empirical results

The accelerationist Phillips curve: The estimates for the accelerationist Phillips curve (Table 2) show that the evolution of inflations is significantly explained by past inflation in all the countries. This may indicate the highly persistence nature of inflation in SSA countries. However, the textbook Phillips curve hypothesis is not so profound in majority of the countries. The textbook accelerationist Phillips curve expects that a high level of unemployment causes inflation to fall over time. Significant negative feedback from unemployment to inflation is found only in Cape Verde, Malawi, Namibia, Uganda and Zambia representing 17.85 percent of the countries sampled. Côte d'Ivoire, Ghana, Mauritius and Togo on the other hand display a positive significant relationship. The waning accelerationist Phillips curve has been observed in the empirical literature and some interpretations has been professed. First, inflation expectations have been significantly anchored which has considerably prevented actual inflation from falling very far below the levels anticipated. Second, inflation depends on the short-term unemployment rate rather than the

aggregate unemployment rate espoused in textbook Phillips curves. Substantial downward pressure on wages emanates from the short-term unemployed and not from the long-term unemployed whose attachment to the labour force is rather weak. The findings of this paper support these interpretations.

Table 2: Estimates of the accelerationist Phillips curve

Country	Past Inflation	z-statistic	P-value	Unemployment gap	z-statistic	P-value
Burundi	0.908	28.76	0.000	-13.506	-1.47	0.143
Benin	0.817	15.30	0.000	1.267	0.53	0.594
Burkina Faso	0.798	9.07	0.000	-1.236	-0.89	0.371
Botswana	0.978	82.67	0.000	-0.063	-0.64	0.519
Central A. Republic	0.914	25.26	0.000	3.583	1.07	0.283
Côte d'Ivoire	0.840	15.62	0.000	0.879	2.33	0.020
Cameroon	0.682	6.43	0.000	-0.780	-0.87	0.385
Cape Verde	0.825	15.42	0.000	-1.700	-1.75	0.081
Ethiopia	0.836	20.93	0.000	-12.396	-1.25	0.212
Ghana	0.946	36.00	0.000	2.780	2.22	0.026
Gambia	0.916	28.82	0.000	1.421	0.94	0.347
Guinea-Bissau	0.952	18.76	0.000	3.394	0.65	0.513
Kenya	0.940	19.85	0.000	-4.124	-1.20	0.232
Madagascar	0.905	21.35	0.000	0.665	1.44	0.151
Mali	0.765	11.37	0.000	-0.076	-0.19	0.847
Mauritius	0.939	36.11	0.000	0.934	1.75	0.080
Malawi	0.939	26.70	0.000	-7.383	-1.80	0.059
Namibia	0.994	107.79	0.000	-0.183	-2.32	0.020
Niger	0.797	8.07	0.000	0.715	0.46	0.644
Nigeria	0.985	33.26	0.000	-0.329	-0.26	0.791
Rwanda	0.912	27.08	0.000	3.016	0.38	0.706
Senegal	0.889	8.28	0.000	0.291	0.91	0.362
Swaziland	0.947	36.72	0.000	-0.484	-0.78	0.436
Togo	0.832	17.84	0.000	9.064	1.76	0.079
Tanzania	0.954	20.25	0.000	0.330	0.27	0.786
Uganda	0.901	24.76	0.000	-1.337	-1.69	0.090
South Africa	0.974	54.35	0.000	0.105	0.46	0.647
Zambia	1.005	35.58	0.000	-0.474	-2.17	0.030

The weak inflation – unemployment trade-offs in these countries may indicate that the contribution of wage mark-up shocks to macroeconomic fluctuations is rather small in SSA countries. The structure of the labour markets with considerable rigidities and increasing presence of labour unions and the downward wage rigidity may also account for the fading trade-offs between inflation and unemployment rates. Rising unemployment rates are not significantly associated with declining wages and thus any implication for inflation is less magnified. Besides, slackness in the economy may not be significantly captured by the long-term unemployment rates; thus, reducing the role of unemployment in the development of inflation. Rising unemployment may therefore not moderate largely the inflationary pressures. This may imply significant room for countercyclical policy measures in most SSA countries at least in the short run as policies to stabilise unemployment around its natural rate may not translate into higher rates of inflation.

The New Keynesian Phillips curve: The accelerationist is somehow "backward-looking" but the NKPC is forward-looking. However, both are intrinsically linked by the general equilibrium outcome of demand declines / market slackness – lower output in the goods market and a higher unemployment in the labour market. Market slackness predicts lower inflation as declining output from persistent low demand would cause prices to decline.

The estimates of the NKPC (Tale 3) show significant positive output-inflation trade-off in Botswana, Central Africa Republic, Ghana, Mauritius, Rwanda, Togo and Zambia. Ghana shows the lowest output cost of disinflation while the sacrifice ratio is highest in Zambia. The inflationary environment in Zambia may account for the relatively high output cost of disinflation as the country suffered hyper inflations in the early 1990s. In these countries, policymakers are faced with the challenge of trading-off the stabilization of output around potential with that of price inflation. Nonetheless, central banks can ride on the relation and achieve immediate stabilisation of inflation by committing to eliminating positive output gaps in the future.

Table 3: Estimates of the New Keynesian Phillips Curve

Country	Expected inflation	t-statistic	P-value	Output gap	t-statistic	P-value
Burundi	1.025	35.84	0.000	-0.540	-2.65	0.009
Benin	1.082	30.61	0.000	-0.081	-0.36	0.722
Burkina Faso	1.159	34.45	0.000	-0.111	-1.06	0.293
Botswana	0.996	96.03	0.000	0.069	2.07	0.041
Central A. Republic	1.586	11.34	0.000	0.567	3.31	0.001
Côte d'Ivoire	1.076	35.66	0.000	-0.139	-1.49	0.138
Cameroon	0.920	10.58	0.000	-3.018	-5.63	0.000
Cape Verde	0.864	20.11	0.000	0.157	1.01	0.314
Ethiopia	1.049	25.82	0.000	-0.057	-0.35	0.726
Ghana	1.105	33.53	0.000	0.0001	2.31	0.023
Gambia	1.017	42.07	0.000	0.013	0.19	0.849
Guinea-Bissau	1.043	44.96	0.000	-0.120	-0.65	0.517
Kenya	1.092	31.93	0.000	-0.425	-1.17	0.243
Madagascar	1.060	45.88	0.000	-0.177	-1.44	0.152
Mali	1.148	39.79	0.000	-0.153	-2.04	0.044
Mauritius	0.945	36.14	0.000	0.364	2.62	0.010
Malawi	1.077	48.85	0.000	-0.810	-4.77	0.000
Namibia	0.764	30.44	0.000	-0.475	-2.78	0.006
Niger	1.123	26.55	0.000	0.138	1.33	0.187
Nigeria	1.283	19.40	0.000	-1.335	-1.95	0.053
Rwanda	0.554	13.03	0.000	0.164	2.07	0.041
Senegal	1.130	33.31	0.000	-0.108	-0.61	0.546
Swaziland	1.011	48.67	0.000	-0.085	-0.55	0.581
Togo	1.304	30.77	0.000	0.115	1.69	0.094
Tanzania	0.973	29.94	0.000	-3.230	-5.04	0.000
Uganda	0.218	5.08	0.000	0.490	0.84	0.405
South Africa	0.989	54.40	0.000	0.152	1.09	0.279
Zambia	1.021	84.05	0.000	1.327	4.22	0.000

Some countries including Burundi, Cameroon, Mali, Malawi, Namibia, Nigeria, and Tanzania have negative output effects. The results may suggest that stabilization policy in these countries appears to face a "desirable" trade-off among its inflation and output objectives and much of the inefficient variation in output could be eliminated while concurrently reducing volatilities in inflation; thus, potentially increasing welfare at the same time. However, the negative output effects may be an indication of the stagflation phenomenon – high inflation rates in the presence of slowing economic growth rates, which may pose a different policy dilemma. One interpretation offered in the literature for the negative output effects rests on the rigidities in prices and wages which ensure that variations in aggregated demand yield changes in output but are not translated into moves in prices and wages in the short run. Also, the negative relation may be explained by supply shocks which increase inflationary pressures and elicit restrictive measures with attendant declining implications for output. Finally, Table 3 indicates that inflation expectation significantly explains inflation realisation in all the countries.

The Okun's law coefficient: Within the Real Business Cycle literature, a shortfall in GDP relative to normal growth is hypothesised to increase unemployment rates. The relationship between output and the unemployment rate is known as the Okun's law. The supply side economic predictions imply that enhanced supply and real activity should improve employment outturns in the labour market. Table 4 confirms the Okun's law for four countries: Côte d'Ivoire, Cameroon, Cape Verde, and Madagascar. Six other countries including Guinea-Bissau, Kenya, Malawi, Swaziland, Tanzanian and South Africa exhibit significant positive output – unemployment relationship. Positive output and unemployment relationship – the job-less growth hypothesis, has been reported in other jurisdictions as well – for Central and East European countries (Gabrisch and Buscher, 2006) and OECD countries (Bhattarai, 2016). This may be an indication that employment inducing component of aggregate demand is low as GDP growth is largely driven by productivity progress. Thus, the varying results in the country specific estimates may be partially explained by disparities in productivity growth. The stark variation of output effects on unemployment among SSA countries could also be linked to the idiosyncratic characteristics and structures of the respective countries' labour markets. The absolute values of the coefficients are also substantially lower than Okun's estimates of 0.3. South Africa's Okun's Law coefficient of 0.17 is the highest with Ethiopia recording as low as 0.0001.

Table 4: Estimates of the Okun's law coefficient

Country	Output gap	t-statistic	P-value
Burundi	-0.0011	-0.47	0.641
Benin	0.0148	1.11	0.270
Burkina Faso	0.0072	0.74	0.463
Botswana	0.0475	1.32	0.190
Central A. Republic	-0.0004	-0.22	0.828
Côte d'Ivoire	-0.0780	-4.14	0.000
Cameroon	-0.0519	-2.83	0.006
Cape Verde	-0.0245	-2.46	0.016
Ethiopia	0.0001	0.09	0.929
Ghana	-0.0069	-0.39	0.698
Gambia	0.0027	0.57	0.569
Guinea-Bissau	0.0055	2.05	0.043
Kenya	0.0348	4.25	0.000
Madagascar	-0.0423	-3.11	0.002
Mali	-0.0142	-0.80	0.427
Mauritius	0.0041	0.20	0.841
Malawi	0.0112	3.03	0.003
Namibia	0.0457	0.78	0.436
Niger	0.0001	0.02	0.981
Nigeria	-0.0075	-0.82	0.414
Rwanda	-0.0006	-1.00	0.318
Senegal	-0.0087	-0.34	0.736
Swaziland	0.0727	5.11	0.000
Togo	0.0007	0.57	0.569
Tanzania	0.0420	19.91	0.058
Uganda	-0.0147	-0.59	0.558
South Africa	0.1739	2.93	0.004
Zambia	0.0329	0.80	0.427

Panel analysis: I incorporate also pooled estimation procedures to the analysis of the inflation, output and unemployment trade-offs. Freeman (2001) contends that pooled estimation provides potential edge over multiple-units cross section estimates and time series estimates of a single unit - pooled estimation may alleviate the challenge of changing parameter estimates by controlling for time-varying omitted factors; collinearity problems often associated with macroeconomic data can be lessened by the additional variability in the regressors and more efficient estimates may be occasioned by the added degrees of freedom in pooled data. I start the analysis by investigating the cross-section interdependence of the variables. I utilise Pesaran's (2004) CD test to check for cross sectional dependence. The CD test results reported in Table 5 reject the null hypothesis of no cross-section dependence. This indicate the presence of significant cross-sectional dependency among the variables across all countries and imply potential common influences even if experienced differently. This cross-sectional correlation may allow for comparative static analysis and enable policy makers to evaluate external potential influences by inferences from other countries within the sub region.

Table 5: Pesaran Cross-section dependency tests

Variable	Statistic	Prob
Inflation	28.70	0.00
Real GDP	10.35	0.00
Unemployment	15.48	0.00

After confirming cross sectional dependence, panel unit root tests are performed to investigate the time series properties of the variables. The stationary properties of the variables are examined via the Im, Pesaran, and Shin (IPS) and ADF-Fisher (ADF) panel unit root tests. Table 6 shows that the variables follow *I (0)* and *I (1)* order of integration.

Table 6: Panel unit root tests

Variables	IPS		ADF-Fisher		Level of integration
	Level	First Difference	Level	First Difference	
Inflation	-8.37*	-22.97*	174.11*	504.43*	*I (0)*
Real GDP	-10.03*	-24.03*	211.84*	528.16*	*I (0)*
Unemployment	-1.04	-9.35*	65.16	194.54*	*I (1)*

Note: * indicates statistical significance at 1% level.

Panel ARDL: I estimate the heterogenous dynamic panel model using the pooled mean group (PMG) and dynamic fixed effects (DFE) regressions. However, the Hausman test has been applied to assess the efficiency and consistency among the estimators (PMG and DFE). The validity of long-run homogeneity restrictions across SSA countries, and hence efficiency of PMG estimator over the DFE estimator is confirmed if the Hausman test fail to reject the null hypothesis. Otherwise, heterogeneity in long term equilibrium is assumed and the PMG is less efficient than the FDE. The results of the pooled mean group (PMG) and dynamic fixed effects (DFE) regressions are reported in Table 7.

Table 7A: Panel ARDL model results (PMG and DFE estimates)

Variable / Dependent Var.	Pooled Mean Group			Fixed Dynamic Effects		
	Real GDP	Inflation	Unempl	Real GDP	Inflation	Unempl
Long-run coefficients						
Real GDP		-0.322*	-0.007***		0.027	-0.018
		(-1.72)	(-2.83)		(0.06)	(-1.55)
Inflation	-0.005		-0.0005	0.005		0.003
	(-0.99)		(-0.69)	(0.59)		(1.42)
Unempl	0.346 ***	0.100		0.143	-0.822	
	(2.79)	(0.12)		(0.56)	(-0.31)	
ECT	-1.276***	-0.533***	-0.691***	-1.298***	-0.346 ***	-0.655***
	(-34.29)	(-11.37)	(-22.95)	(-37.37)	(-13.06)	(-19.15)
Short-run coefficients						
Δ Real GDP		0.152	0.011*		0.163	0.010**
		(1.16)	(1.90)		(1.64)	(2.14)
Δ Inflation	0.0295		-0.007	0.017		-0.001
	(1.10)		(-1.05)	(1.28)		(-0.48)
Δ Unempl	-2.552 ***	-2.757**		-0.296	0.817	
	(-2.57)	(-2.41)		(-1.02)	(1.04)	
Constant	0.032	3.784***	0.001	-0.094	2.967***	-0.019
	(1.34)	(7.39)	(0.49)	(-0.61)	(7.24)	(-0.98)
Hausman	1.04	0.01	86.98			
p-value	0.308	0.993	0.000			

Note: Estimates are based on cyclical components of real GDP and unemployment time series:
Unempl - unemployment
***, ** and * indicate statistical significance at 1%, 5% and 10% level respectively.
Z-statistics in parenthesis

The PMG estimates show significant short run trade-offs between output and unemployment on one hand and inflation and unemployment on the other hand, consistent with the predictions of Okun's law and the Phillips curve respectively. The Okun's law coefficient of 2.55 compares favourably to the Okun's estimate of three-to-one ratio. Relative to other jurisdictions, estimates of the increase in output growth associated with unemployment reduction of one percent, range from around two percent in the US and Canada to three to five percent in Europe, to more than 10 percent in Japan (Freeman, 2001). The results confirm the validity of the Okun's law and the Philips curve in the SSA region. The short run cost of one percentage point increase in unemployment rate is about 2.55 percentage points decrease in real GDP growth and 2.76 percentage points downturn in inflation rate. The results signify significant output cost of unemployment in the sub region. The short-run estimates suggest that the accelerationist doctrine may not be thriving but the relationship between unemployment rate and the level of inflation is valid at least on the average in SSA. This finding is consistent with the observations reported by Blanchard (2016).

The short run estimates point to significant tension between unemployment gap and inflation stabilisations. The short-term trade-offs between output, inflation and unemployment objectives may be explained by economic slackness as reflected in higher unemployment rates which accounts for slowdown in economic growth and restrained inflationary pressures as aggregate demand is subdued.

The PMG long run estimates show significant relationships between the output gap and unemployment gap and between inflation and the output gap. The Okun's law coefficient declines significantly in the long run and turns positive. The inflation - unemployment link is not significant in the long run as the Phillips curve phenomenon gravitates towards the NKPC. The inflation – output gap relationship is however negative. The long run behaviour of output, inflation and unemployment may be attributed to supply shocks reflecting changes in productivity. Productivity driven growth may not reduce unemployment substantially as the employment generating component of aggregate demand may be low. On the other hand, inflationary pressures from supply shocks may elicit disinflationary policies with associated declining implications for output. Finally, the PMG and FDE estimates (Tables 7A and 7B) show that inflation and unemployment in SSA countries are structural as well as cyclical. Table 9B shows that inflation increases with

real GDP in the short run and decreases with real GDP in the long run while unemployment increases in the short run but declines in the long run with changes in real GDP growth.

Table 7B: Panel ARDL model results (PMG and DFE estimates)

Variable / Dependent Var.	Pooled Mean Group		Fixed Dynamic Effects		
	Real GDP	Inflation	Real GDP	Inflation	Unempl
Long-run coefficients					
Real GDP		-0.303***		-0.510*	-0.182***
		(-2.83)		(-1.86)	(-2.60)
Inflation	-0.059***		-0.037 **		0.054***
	(-5.94)		(-2.34)		(2.79)
Unempl	0.125**	-0.106	-0.092	1.279**	
	(2.11)	(-0.67)	(-0.80)	(2.22)	
ECT	-0.829***	-0.556***	-0.911***	-0.371 ***	-0.109***
	(-14.50)	(-10.90)	(-25.18)	(-13.51)	(-7.18)
Short-run coefficients					
Δ Real GDP		0.148		0.244***	0.013**
		(1.23)		(3.25)	(2.37)
Δ Inflation	0.054		0.047 ***		-0.001
	(1.62)		(2.73)		(-0.44)
Δ Unempl	-1.651**	0.261	-0.234	0.465	
	(-2.28)	(0.26)	(-0.97)	(0.93)	
Constant	3.032***	5.164***	4.671***	0.210	0.885***
	(8.38)	(7.39)	(5.51)	(0.12)	(7.08)
Hausman	0.39	0.00			
p-value	0.824	0.993			

Note: Estimates are based on real GDP growth and unemployment rate time series:
Unempl – unemployment. The PMG estimation for unemployment as the dependent variable failed as convergence was not achieved
***, ** and * indicate statistical significance at 1%, 5% and 10% level respectively.
Z-statistics in parenthesis

4. Conclusion

The "missing deflation" has spurred recent empirical study of the evolution of inflation. This paper examines the behaviour of inflation, unemployment and output in SSA. I find that on the average, the output – unemployment and the inflation – unemployment relationships in the short run are

consistent with the predictions of the Okun's law and the Phillips curve. In the long run, the Okun relationship is positive while the Phillips curve phenomenon suggests the new Keynesian Phillips curve. The results indicate that economic policy faces the trade-off of stabilising unemployment and stabilising inflation while unemployment incurs significant output cost.

The country specific analysis shows that the coefficients on past inflation and expected inflation are positive in all countries. The coefficients on expected inflation average 1.022 while the coefficients on past inflation average 0.896. But for Namibia, Rwanda and Uganda, the coefficients on expected inflation dominate the coefficients on past inflation in all countries. This may suggest that inflation dynamics are forward-looking in SSA countries. The accelerationist Phillips curve significantly explains inflation evolution in nine countries (four countries are incorrectly signed) while the NKPC significantly explains inflation development in 14 countries (seven countries are incorrectly signed).

Conclusion drawn from this study is that policymakers must endure unemployment to minimize price distortions in the short run, however in the long run there are significant real output gains from price stability. Thus, economic policy should prioritize the stabilization of price inflation, even if this choice entails destabilizing output in the short run. The estimates show that in the long-term unemployment declines with changes in real GDP growth. This suggests that the long run gains in output are also translated into reduced unemployment.

In the country specific analysis, both the NKPC and the accelerationist Phillips curve fail to significantly explain the inflation dynamics in a good number of the countries studied. This may suggest that exogenous shifts in domestic real activities may not be the ultimate source of variations in price inflations. This should be considered in policies targeted at addressing price distortions to avoid misguided policies. This motivates the research agenda to examine the influence of globalisation on the inflation dynamics in SSA countries. Recent literature suggests that the process of globalization limits the effects of domestic economic activity on inflation. Thus, the estimation of open economy Phillips curves is highly recommended.

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