Influence of Supply-Side Variables on Economic Growth: An Empirical Analysis of Kenya from 1990 To 2019

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Abstract
Economic growth is a major concern for all countries and it can be achieved through increased supply of goods and services in the economy according to supply-side economics. The levels of unemployment and inflation rates can be lowered through reduced taxation, loser business regulation and lower capital borrowing to boost supply in the economy. This would consequently result to higher economic growth. This study assumed that unemployment and inflation rates are key supply-side macroeconomic variables and it examined the influence of the two variables on economic growth in Kenya for the time period between 1990 and 2019. The theoretical literature reviewed in the study included Okun's law and Phillip's curve alongside empirical literature from more recent studies on the subject area. The data in the study was sourced from World Development Indicators (WDI) and the Central Bank of Kenya (CBK). The study used Eviews 11 to perform unit root tests, cointegration analysis and pair-wise Granger causality test. ARDL bounds test approach was employed in the study because the variables under study were integrated of orders I(0) and I(1) and that none of them was integrated of order I(2). The ARDL bounds test results showed that inflation rate has a short-run effect on GDP growth while cointegration analysis pointed to the existence of a long-run relationship between the variables when the GDP growth and inflation rate are treated as dependent variables. Granger causality test results implied that GDP growth granger causes unemployment rate. The findings from the study suggest that proper policies on capital borrowing rates should be formulated to ensure that inflation rate is maintained low and predictable so as to boost the confidence of potential investors in the Kenyan economy. This will consequently stimulate supply through increased production meanwhile leading to higher GDP growth rate. Increased economic growth will result to lower unemployment rates in Kenya. The study further suggests that more research should be done examine the influence of other supply-side macroeconomic variables on Kenyan economic growth.
Key words: Supply-side economics, ARDL bounds test, GDP Growth, Unemployment Rate, Inflation Rate.

I.   Introduction

Supply-side economics argues that higher production of goods and services is a major driver of economic growth. It is the background upon which certain variables, which influence the country's ability to increase supply of goods and services, are targeted. Such variables are influenced through lower taxation, loser business regulation and lower borrowing rates. Conversely, demand-side economics, which is associated with John Keynes, argue that economic growth is achieved through stimulating demand. Demand-side economics targets to spur demand through increasing government spending and unemployment benefits. Levels of inflation and unemployment rates influence economic growth through their effect on supply in an economy. The two variables can be manipulated through taxation, business regulatory and capital borrowing policies. The relationship between economic growth, inflation and unemployment rates is a popular discussion in economics as well as a major concern for any economy.

Economic growth is the increase in productive capacity of goods and services over a time period (Amadeo 2018). It is closely related to economic development which has to do with the societal impact of economic growth in raising the people's living standards (Haller 2012). Economic growth leads to economic and social qualitative and quantitative changes consequently leading to cumulative and durable increase in real national product and an increase in per capita (Haller, 2012). Unemployment rate is the proportion of the labour force that has no work, despite being available for and seeking to work (World Bank Indicators 2020). The labour force is the sum total of both employed and unemployed persons. Unemployment rate is therefore a measure of the underutilization of the labor force in an economy and it includes persons who have lost their jobs voluntarily or otherwise (World Bank Indicators 2020). World Bank Indicators (2020) further state that low unemployment rate can occur in low income countries whilst high income countries can observe high unemployment rate. This is because people from low income countries lack unemployment benefits which exposes them to subsist from vulnerable employment options. Citizens of high income countries enjoy

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unemployment benefits and therefore they can wait longer for suitable employment opportunities. The World Bank measures unemployment rate as the percentage of unemployed persons to the total labour force.

Inflation is the percentage increase in living cost and is measured by Consumer Price Index. Higher inflation rates are seen when there is an increase in money supply that is proportionally lower than the production of goods and services in the economy (Gylych et al, 2016). This is normally a sign of macroeconomic imbalance in an economy whilst low inflation rate implies favourable investment climate, consequently contributing to economic growth. The United Nations (2007) argues that high inflation rate indicates unsustainable public finances. Classical economics, in their view of inflation and unemployment rates, argue that they constitute a short-run phenomena which eventually end on its own. This is anchored on the assumption of flexible prices and wages.

The Kenyan economic growth has not been steady since independence. It was highest in 2010 at 8.41% and lowest in 1992 at a negative growth of 0.8%. This negative growth rate in 1992 was attributed to the prevailing political climate that was experienced in the country that year. The International Labour Organization avails Kenyan unemployment rate data from 1991 showing that unemployment was lowest in 2008 at 2.6% and highest in 2003 at 2.904%. In 2010 when the country recorded highest economic growth, unemployment was still high at 2.84%. Inflation rate in 1993 was highest at 45.98% and lowest at 1.55% in 1995. Inflation has largely been steady except for the spikes in 1993 and 2008 where it rose to 26.24%.

Proper management of unemployment and inflation rates can potentially spur economic growth through inducing supply in the economy. The current COVID-19 pandemic has confirmed this assumption. Globally, economic activities have been adversely affected as governments impose restriction measures to combat the pandemic leading to increased unemployment rates and volatile inflation rate. Additionally, the governmental economic stimulus packages aimed at salvaging the economies have influenced liquidity flow directly affecting the respective country's inflation rate. Higher unemployment and inflation rates have adversely affected the supply of goods and services in leading to dismal performance on the Kenyan Economic growth. The Kenyan government tried to salvage the economy by a downward revision of income tax, substantive reduction in mobile money transfer and by employing other stimulus packages. The World Bank predicted global economic contraction of 5.2% in 2020 constituting a major economic recession. The institution further predicts 1.5% growth of the Kenyan economy which could potentially fall to as low as 1%. This is significantly different from 6.3% and 5.4% growth rates that Kenya recorded in 2018 and 2019 respectively.

This study assessed the influence of unemployment and inflation rates on the Kenyan economic growth and it used annual data for the three variables. It was limited to three variables only: economic growth as the dependent variable which was measured by GDP Growth and inflation rate, which was measured by Consumer Price Index and unemployment rate which was measured by the percentage of unemployed persons. The data about the three variables was for the time period 1990 to 2019 which was also the study period. The study used percentage growth of both unemployment rate and economic growth, thereby avoiding big figures and obtaining a sensible regression model. The general objective of the study was to assess the influence of supply-side variables on economic growth in Kenya. The findings of this study add vital information to the existing literature regarding the relationship between macroeconomic variables in the Kenyan economy.

This study was organised in to five sections, which include introduction, literature review, methodology, data analysis and interpretation and conclusion and policy implication. Introduction details the background and rationale for the study. The literature review details the existing scholarly findings from other studies on the subject area and it consists of both theoretical and empirical literature. The methodology draws the road map of the study while the data analysis and interpretation explains various tests that were relevant. Conclusion and policy implication summarizes the findings of the study and their practical application to the management of the Kenyan economy.

II.   Literature Review
This section reviews literature related to the influence of unemployment and inflation rates on economic growth. It consists of review of related theoretical and empirical literature.

2.1 Theoretical Literature
Okun's law and Phillip's curve are the two major theories that model the relationship between economic growth, unemployment and inflation rate. They are discussed on this section of theoretical literature. Okun's law relates a country's unemployment with its economic growth. It was proposed by Arthur Okun in the 1960s in which he asserted that a 1% decrease in unemployment results to 2% increase in real GDP. Recent studies however estimate a 3% decrease in output when unemployment increases by 1%. In his study, which was based on the American economy, Okun observed that unemployment reduced in the times that real economic growth increased. The law implies that output depends on amount of labour used in production. He argued that to reduce a country's unemployment it is imperative to ensure an economic growth that is above the

country's potential. Niranjala (2019) added that the negative relationship between unemployment and economic growth is a stable macroeconomic model while Makaringe (2018) in his study on unemployment and economic growth in South Africa observed that Okun's law famously outlines an empirical relationship between output and economic growth and that it holds true mainly in the developed world. However, the law did not prove practical during the 2008 economic crisis (Owyang & Sekhposyan 2012). Tasci & Meyer (2012) adds that 0.5 decrease in GDP and 3% increase in unemployment were recorded in 2009 in the USA. This adds to the opposition against Okun's law as a rule of thumb. Additionally, the law has a weakness in that its coefficients range from -3.22 to 0.17 (Diakhoumpa 2020). This presents a weakness in its application to predict economic growth given a country's unemployment rate.

A.W Phillip published Phillip's curve in 1958 as he examined the relationship between employment and wage inflation. He observed an inverse relationship between inflation and unemployment and that an increase in economic growth results to higher inflation rate. He used the data of the United Kingdom over the period from 1861 to 1957. His study showed that a 5.5% increase in unemployment had no effect on wage inflation whilst unemployment rate below 5.5% led to high wage inflation (Jonahan & Nitzan, 1990). The study seemed to hold true in other developed economies. However, a formidable challenge to the relationship is the fact that increase in economic growth leads to higher inflation rate, popularly known as stagflation. Such a scenario was observed in the 1970s when the developed world recorded high inflation and unemployment rates simultaneously. The applicability of the model was therefore challenged, as it could not always be used for policy formulation.

2.2 Empirical Literature

Recent empirical studies have divergent propositions on the influence of unemployment rate and inflation rate on economic growth. These can be attributed to country-specific factors or the difference in methodological approaches of different studies. This section reviews existing literature that relate unemployment, inflation rate and economic growth. The first subsection includes two clusters of studies that present a case for or against Okun's law. This is followed by studies that second Phillip's curve and those that oppose.

Unemployment and Economic Growth

Several studies second the assertion of Okun's law. For instance, Avdiu and Ziber (2020) assessed the relationship and impact of macroeconomic variables on unemployment in Kosovo for the time period between 2005 and 2017. They used multiple regression least squares method in the study. They observed that a 1% increase in GDP resulted to 1.7% decrease in unemployment rate which confirmed Okun's law. In the study, they treated the GDP as the independent variable. Niranjala (2019) assessed the estimates for Okun's coefficients in his study on the effect of unemployment on economic growth in Sri Lanka. He employed an ARDL approach to study the possible long-term relationships and short-term dynamics between unemployment and economic growth for the time period 1991 to 2007. In his study, no short-run relationship was observed while there was evidence of long-run relationship between growth and unemployment. The study indicated that unemployment has significant and negative effect on economic growth since a 1% increase in unemployment caused 1.17% decrease in output in the long run. This finding closely resonates Okuns' law as does the study by Avdiu and Ziber.

Moreover, Dogan, Erdal & Karakas (2014) assessed the relationship between unemployment and GDP in Turkey in which they compared their findings to Okun's Law. They observed seasonal negative relationship between unemployment and GDP in Turkey for the time period 1988-2012. This was foreseen by Okun's law (Dogan, Erdal & Karakas 2014). They asserted that the varying relationship was due to seasonal changes in the Turkish economic growth. This was because changes in economic growth can be too swift to lead to decreased unemployment rate, consequently fast economic growth may not be sufficient in dealing with unemployment. Makaringe & Khobai (2018) in their study on unemployment and economic growth in South Africa using the ARDL model observed a long run relationship between unemployment and economic growth in South Africa. They noted that a unit increase in unemployment rate decreases economic growth by 0.011% in the long run and in the short run a unit increase in economic growth decreases unemployment rate by 0.004%. This finding satisfied the assumption by Okun of a negative relationship between economic growth and unemployment rate.

Other studies do not clearly refute Okun's law. To begin with, Garidzirai & Pasara (2020) studied the relationship between unemployment and economic growth in South Africa between 1980 and 2018 using a VAR model. They observed no influence of unemployment on economic growth in one of the models whilst in another model, they observed an inverse relationship between GDP and economic growth. They observed unidirectional causality from GDP to unemployment rate. The study did not explicitly tally with Okun's rule of thumb. Dritsakis and Stamatiou (2016) studied the effect of unemployment on economic growth from 1995 to 2015 in Greece. In the study they used ARDL model to test for long-run and causal relationship between the

variables. They observed both short-run and long-run unidirectional causal relationship running from unemployment to economic growth. The study did not explicitly specify whether inverse relationship between unemployment and economic growth exists.

Evidently, other studies contrast with Okun's law. To begin with, Gylych et al, (2016) examined the influence of unemployment and inflation rates on economic growth in selected member states of Economic Community of Western Africa States (ECOWAS). They used ordinary least squares approach in their analysis in which they observed a positive relationship between the two macroeconomic variables on economic growth. They thus proposed introduction of labour intensive methods of production. This observation presented a sharp contrast in comparison with Okun's law. Similarly, AKenju and Olanipekun (2014) tested the validity of Okun's Law in Nigeria by studying the relationship between unemployment and economic growth in the oil-rich country. They used Error Correction Model and Johansen Cointegration test in determining both short and long run relationships between the variables. The study found that Okun's law does not apply in the Nigerian economy since both high economic growth and unemployment rates were observed from the findings. This phenomenon implied that a high dependence on oil, which employed a small proportion of the country's labour force, resulted to high unemployment alongside economic growth. Moreover, Diakhoumpa (2020) examined the effect of economic growth and inflation on unemployment using an empirical analysis of Senegal from 1991 to 2018. He employed an ARDL modelling approach and Granger causality test to study the direction of relationship between the variables. In the study he observed no causality between unemployment and economic growth.

Inflation Rate and Economic Growth

Available studies differ on the influence of inflation rate on economic growth. Some of them argue that there exists a significant relationship between the variables. To begin with, Dritsakis & Stamatiou (2016) observed a unidirectional relationship between inflation rate and economic growth. In their study they investigated the effect of unemployment on economic growth from 1995 to 2015 in Greece. The macroeconomic variables unemployment, inflation rate and economic growth are interdependent and there exists unidirectional causality running from inflation rate to economic growth Dritsakis & Stamatiou (2016). In the study by Diakhoumpa (2020) on the effect of economic growth and inflation on unemployment using an empirical analysis of Senegal from 1991 to 2018, he found a positive relationship between unemployment and inflation rates. This finding contradicted Philip curve's finding of an inverse relationship between unemployment and inflation rates.

Similarly, Palesa & Precious (2014) assessed the impact of monetary policy on economic growth using a case study of South Africa. Their study used Johansen maximum likelihood approach to conduct co-integration test. They observed significant influence of inflation on economic growth in the South African economy. Gylych et al (2016) conducted a study on the influence of unemployment and inflation rate on economic growth in which they observed that inflation rate has a positive influence on economic growth. In the study, they used ordinary Least Squares (OLS) regression to assess the impact of inflation and unemployment in 10 selected countries of the Economic Community of west Africa States (ECOWAS).

Barro (2013) assessed the effect of inflation on economic performance for 100 countries for the time period between 1960 and 1990. He observed that high long term inflation led to reduced economic growth. Increase of inflation by 10% decreased GDP growth by 0.2- 0.3% and the real GDP decreased by 4-7% after 40 years. This resonated with the negative relationship assertion of Phillip's curve. Chimobi (2010) conducted a study determining the relationship between inflation rate and economic growth in Nigeria for the time period between 1970 to 2005. By use of Johansen co-intergration model, he observed no long-run relationship between the two variables for the study time period. He further observed a unidirectional causality from inflation rate to economic growth. The study did not however determine whether the relationship between the variables in positive or negative.

Evidently, other scholars assert that there is no significant relationship between inflation rate and economic growth. For instance, Avdiu and Ziber (2020), in their study as they assessed the relationship and impact of macroeconomic variables on unemployment in Kosovo for the time period between 2005 and 2017, observed an insignificant relationship between unemployment and inflation rate. They study however predicted Phillip's curve. Similarly, Semuel & Nurina (2015) analysed the effect of inflation, interest and exchange rates on the Indonesian GDP. They used the Partial Least Squares (PLS) approach the study possible structural relationship between several independent variables and a single dependent variable. For the study period between June 2005 and December 2013, they observed no significant influence of inflation rate on the GDP. The path coefficient of inflation rate on the GDP was 0.04 with a t-statistic of 0.848 which fell below the threshold of 1.96 for accepting the hypothesis. The average inflation rate for the whole study period was 7.45% which, being mild, would have no effect on the economy (Semuel & Nurina 2015). Finally, Omankhanlen (2011) assessed the influence of inflation rate on Foreign Direct Investment (FDI) and its subsequent effect on

economic growth in Nigeria for the time period 1980 to 2009. In his study in which he used ordinary least squares estimation procedure, he observed that inflation has little effect on FDI and subsequently it has insignificant effect on the economy.

Studies on the influence of unemployment rate and inflation rate on economic growth are inconclusive. For instance, the studies by Avdiu and Ziber (2020), Niranjala (2019), Dogan, Erdal & Karakas (2014) and Makaringe & Khobai (2018) confirmed the assumption of Okun's law that there exists a negative relationship between economic growth and unemployment rate. Dritsakis and Stamatiou (2016) and Garidzirai & Pasara (2020) did not explicitly confirm the assumptions of Okun's law. Conversely, the studies done by Gylych et al, (2016)**,** AKenju and Olanipekun (2014), and Diakhoumpa (2020) contrasted with Okun's law. Evidently, the contradictions of various scholars vary from mild to sharp contrast to the propositions of Okun's law.

Additionally, the studies that assess the influence of inflation on economic growth are at odds in varying degrees. For instance Dritsakis & Stamatiou (2016), Diakhoumpa (2020), Palesa & Precious (2014), Gylych et al (2016), Barro (2013) and Chimobi (2010) observed significant influence of inflation rate on economic growth. The findings observed by these scholars range from unidirectional relationship running from inflation to economic growth and vice versa. Some studies observed positive relationship between the variables while others observed a negative relationship. This was contrary to the studies by Avdiu and Ziber (2020), Semuel & Nurina (2015) and Omankhanlen (2011) which argued that no significant relationship exists between inflation and economic growth. The variations on the findings from recent studies form the rationale for conducting this study.

III.   Methodology
This section outlines the methodology employed in the study. It has the two subsections of data and data sources and the methodological approach.

3.1 Data and Data Sources
This study used secondary data exclusively for all the three variables under study. The variables used were Economic growth, unemployment rate and inflation rate. Economic growth was measured by GDP growth rate while unemployment rate was measured by the percentage of the total employed persons to the actual labour force. Inflation was measured using Consumer Price Index (CPI). The study used annual data of the three variables for the time-period 1990 to 2019, which was the study time-period. However, the unemployment rate value for 1990 was not available from the data sources. It was estimated to have been 2.69. This was informed by the upward trend of unemployment rates of 1991 and 1992 which were 2.71 and 2.75 respectively. The data was obtained from the World Development Indicators (WDI) and the Central Bank of Kenya (CBK) as outlined in the table 3.1 below.

Table 3.1 Data Sources

Data	Description	Source
Gross domestic Product growth rate.	This is a measure of economic growth	World Development Indicators
Percentage of total employed persons to the labour force	This is a measure of unemployment rate	World Development Indicators
Consumer Price Index (CPI)	This is a measure of inflation rate	World Development Indicators Central Bank of Kenya

3.2 Methodological Approach
The approach employed in the study had four major steps. The first one constituted Unit Root Test using Augmented Dickey Fuller Test (ADF) and Phillips-Peon (PP) tests. The KPSS (Kwaitkowski et al., 1992) test was also used to confirm the results. This was followed by cointegration analysis, residual diagnostic tests and pairwise Granger causality test respectively. All the tests in the study used Eviews 11 Student lite version. Cointegration analysis assessed both the short-run and long-run relationship between the variables using ARDL bounds approach. This decision was arrived at based on the fact that the variables were either integrated of order $I(1)$ or $I(2)$. Residual diagnostic tests were performed to ascertain the reliability of the ARDL model employed in the study. Pairwise Granger causality test examined the causal relationship as well as the direction of the relationship between the three variables. The model for the study was outline by the equation below.

$$\textit{Economic Growth} = f(\textit{unemployment rate, inflation rate})$$

Economic growth was measured by GDP growth whilst unemployment and inflation rates were measured by the ratio of total employed persons to the labour force and Consumer Price Index (CPI) respectively.

IV. Analysis and Discussion

4.1 Unit Root Tests

Unit root was tested using ADF test by Dickey and Fuller (1979) and PP test by Phillips and Perron (1988). GDP growth was stationary at level whilst the unemployment and inflation rates were stationary at the first difference. The results were consistent for both ADF and PP tests. The differences in the integration order on the variables necessitated the need for ARDL bounds test model for the study. This is because GDP growth is stationary at level while Unemployment and inflation rates are integrated of order $I(1)$ and none of the variables is of order $I(2)$. The unit root test results at 0.05% significance level are summarized in table 4.1 below.

Table 4.1 Unit Root Test

Variable (i)	ADF		PP		Decision
	t- statistic	CV	t-statistic	CV	
GDP Growth(0)	-3.103105	-2.967767	-3.054640	-2.967767	Reject H_0
Unemployment (1)	-3.377121	-2.971853	-3.143255	-2.971853	Reject H_0
Inflation Rate (1)	-5.984227	-2.981038	-12.31097	-2.976263	Reject H_0

4.2 Cointegration Analysis

The cointegration analysis is a sequel to the Unit Root test accomplished in the previous section. The test makes use of ARDL approach to assess the likelihood, or otherwise, of both short-run and long-run relationships between economic growth, unemployment rate and inflation rate. This test is applied when the variables under study are integrated of order $I(0)$ or $I(1)$. It is effective and consistent when there is a small sample under study (Dritsakis & Stamatiou 2016). In order to employ the ARDL approach, the optimal lag length was established by running an unrestricted Vector Auto Regression (VAR) and choosing the criterion that yielded the smallest number. The table 4.2 summarised the optimal lag length selection criteria results.

Table 4.2 Optimal Lag Selection Criteria (Max=2)

Lag	Log L	LR	FPE	AIC	SC	HQ
0	-114.45	NA	1.20	8.70	8.84*	8.74*
1	-104.43	17.06*	1.12*	8.62*	9.20	8.80
2	-97.93	9.63	1.39	8.81	9.82	9.11

The optimal lag length selected for the model was 1. This was also the optimal lag length that was selected by three out of the five selection criteria. However, the optimal lag length for the individual variables was 2 for inflation rate and 1 for both unemployment rate and GDP growth. The ARDL bounds model that was employed for the study is specified in equations (1), (2) and (3) below.

$$GDP_t = \beta_{01} + \sum_{i=1}^{p} \alpha_{1i} GDP_{t-i} + \sum_{i=0}^{q} \alpha_{2i} UNE_{t-i} + \sum_{i=0}^{c} \alpha_{3i} INF_{t-i} + \varepsilon_{1t} \qquad (1)$$

$$UNE_t = \beta_{02} + \sum_{i=1}^{p} \alpha_{1i} UNE_{t-i} + \sum_{i=0}^{q} \alpha_{2i} GDP_{t-i} + \sum_{i=0}^{c} \alpha_{3i} INF_{t-i} + \varepsilon_{2t} \qquad (2)$$

$$INF_t = \beta_{03} + \sum_{i=1}^{p} \alpha_{1i} INF_{t-i} + \sum_{i=0}^{q} \alpha_{2i} GDP_{t-i} + \sum_{i=0}^{c} \alpha_{3i} UNE_{t-i} + \varepsilon_{3t} \qquad (3)$$

Where the GDP_t, UNE_t and INF_t are the dependent variables and the p, q and c are optimal lag for the ARDL model. An independent variable is considered to be insignificant to a given dependent variable when its p-value is above the critical 0.05. Wald test was used to confirm the t-statistics results. The findings for both the t-statistics and the Wald test results for equations (1), (2) and (3) are summarized in table 4.3 below.

Table 4.3 ARDL Short-Run Test Results

Dependent Variable	Independent Variables				
GDP	UNE	t-statistic: insignificant	INF	t-statistic: significant	
		Wald test: insignificant		Wald test: significant	
UNE	GDP	t-statistic: insignificant	INF	t-statistic: insignificant	
		Wald test: insignificant		Wald test: insignificant	
INF	GDP	t-statistic: insignificant	UNE	t-statistic: insignificant	
		Wald test: insignificant		Wald test: insignificant	

From the ARDL bounds test, only inflation rate had a short-run causal effect on GDP growth. This was confirmed by both the t-statistic and Wald test findings.

Bounds Cointegration Test

This test is used to examine the possibility of a long-run relationship between the variables under study. The variables should be of integration order $I(0)$ and $I(1)$. The null hypothesis for the study for the study states that there is no cointegration equation in the model whilst the alternative hypothesis states that there is at least a cointegration equation in the model. When the *F- statistic* value is greater that the critical value at 10%, 5% or 1% for the upper bound $I(0)$ then cointegration exists. This necessitates the need to employ an Error Correction Model. If the *F- statistic* value is less than the critical values, then there is no cointegration and only an ARDL model is necessary. The results of bounds cointegration test are summarised in the table 4.4 below.

Table 4.4 Bounds Cointegration Test Results

Dependent Variable	F- Statistic	Critical Values		
		Significance Level	$I(0)$	$I(1)$
GDP Growth	5.34	10%	2.63	3.35
		5%	3.1	3.87
		1%	4.13	5
Unemployment Rate	2.97	10%	2.63	3.35
		5%	3.1	3.87
		1%	4.13	5
Inflation Rate	10.97	10%	2.63	3.35
		5%	3.1	3.87
		1%	4.13	5

The results obtained in the study pointed to the existence of cointegration at 5% when GDP growth and inflation rate were the dependent variables. This was not the case when unemployment was the dependent variable. This necessitated the performance of a long run relationship using the ECM approach.

**Estimation of Long-Run Relationship**

The long-run relationship is derived from the ARDL bounds test and is composed of a short-run equation as well as a long-run representation (Dritsakis & Stamatiou 2016). The equations (4) and (5) for the ECM mechanism for the GDP growth and inflation rate are specified below.

$$\Delta GDP_t = \beta_{01} + \sum_{i=1}^{p} \alpha_{1i}\Delta GDP_{t-i} + \sum_{i=0}^{q} \alpha_{2i}\Delta UNE_{t-i} + \sum_{i=0}^{c} \alpha_{3i}\Delta INF_{t-i} + \lambda_1 ECM_{t-1} + \varepsilon_{1t} \qquad (4)$$

$$\Delta INF_t = \beta_{03} + \sum_{i=1}^{p} \alpha_{1i}\Delta INF_{t-i} + \sum_{i=0}^{q} \alpha_{2i}\Delta GDP_{t-i} + \sum_{i=0}^{c} \alpha_{3i}\Delta UNE_{t-i} + \lambda_3 ECM_{t-1} + \varepsilon_{3t} \qquad (5)$$

The coefficient for the ECM_{t-1} should be negative and significant for the long-run relationship to exist in the model. In the case of GDP growth as a dependent variable, the error correction term was significant at 1% with a negative coefficient of 0.9676. The model was found stable once subjected to stability test. It also never suffered from serial correlation neither was it heteroscedastic. Additionally, when the inflation rate was the dependent variable, the error correction term was significant at 5% with a negative coefficient of 2.9343. This model was also stable. The cumulative Sum for both the GDP growth and inflation rate as the dependent variables are availed below in figures 4.1 and 4.2 respectively.

Figure 4.1 Plot of Cumulative Sum: GDP Growth is the Dependent Variable
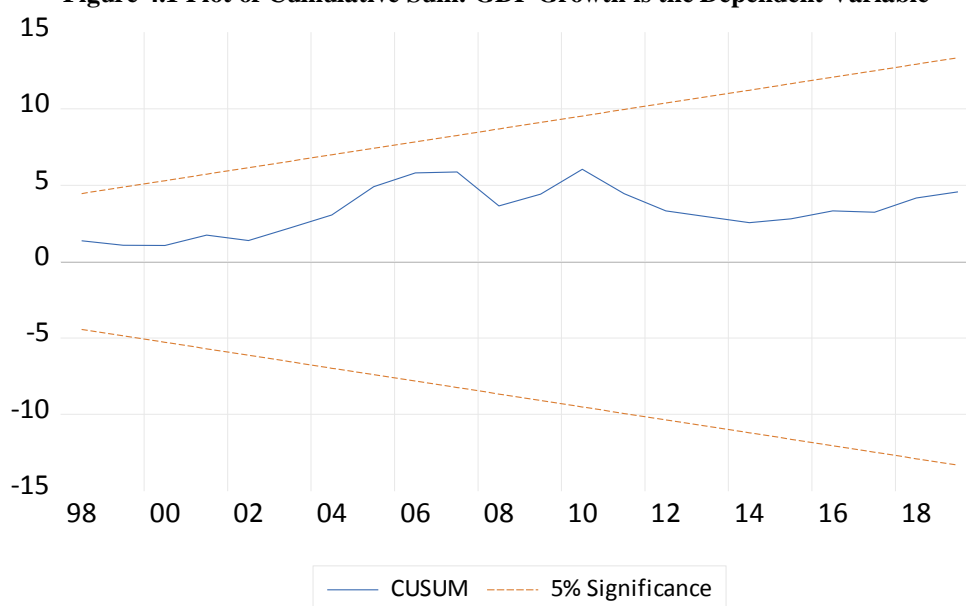
Figure 4.2 Plot of Cumulative Sum: Inflation Rate is the Dependent Variable
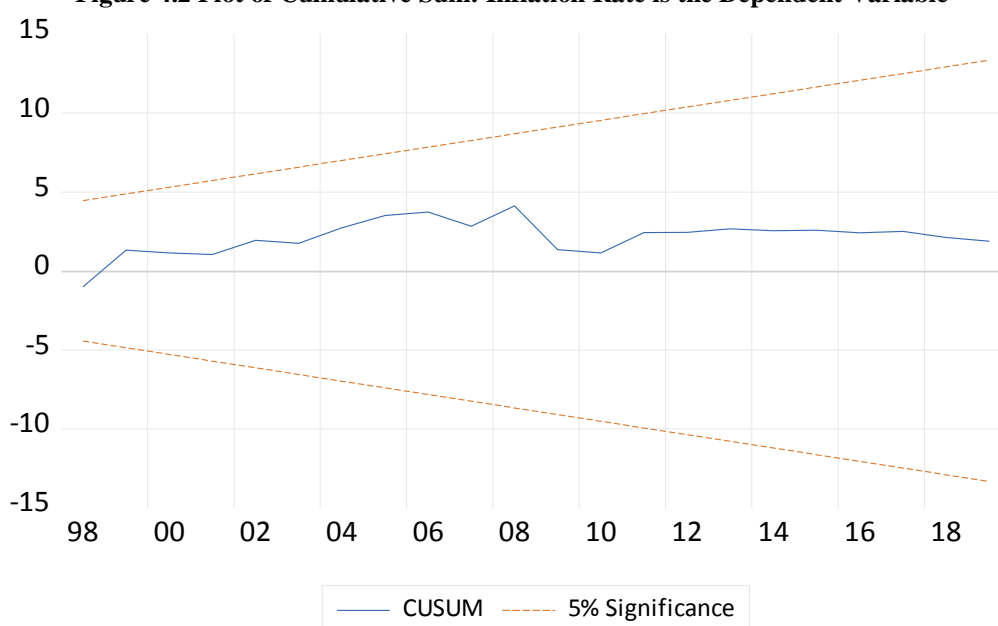
4.3 Residual Diagnostic Test

The residual diagnostic tests for the ARDL model were conducted at 5% level of significance. The tests were performed to unsure that the model employed is reliable. The null hypotheses in all the three diagnostic tests were accepted. The residual diagnostic test results are summarized in table 4.5 below.

Table 4.5 Residual Diagnostic Test

Residual diagnostic test	P-Value	Null hypothesis (H_0)	Decision
Breusch- Godfrey Serial Correlation	34.83	Residuals are not serially correlated	Do not reject H_0
Breusch- Pagan- Godfrey Heteroscedasticity	71.46	Residuals are not heteroscedastic	Do not reject H_0
Jarque-Bera Normality Test	20.3290	Residuals are normally distributed	Do not reject H_0

4.4 Pairwise Granger Causality Test

Granger casualty test is conducted to test the direction of causality between two variables in a pair. The decision criteria in this test is to reject null hypothesis when the P value is less than 0.05, otherwise we fail to reject it. The pairwise Granger causality test results for the three variables are presented in the table 4.6 below.

Table 4.6 Pairwise Granger Causality Test Results

Null Hypothesis	F-test	Prob	Decision
DUNE does not Granger cause GDP	0.71367	0.5008	Do not reject H_0
GDP does not Granger cause DUNE	3.61961	0.0438	Reject H_0
DINF does not Granger cause GDP	1.77563	0.1928	Do not reject H_0
GDP does not Granger cause DINF	0.17699	0.8390	Do not reject H_0
DINF does not Granger cause DUNE	0.71349	0.5009	Do not reject H_0
DUNE does not Granger cause DINF	0.35017	0.7084	Do not reject H_0

Form the causality test results, it was observed that GDP growth Granger causes unemployment rate. This is evidently a unidirectional relationship since the causality of unemployment rate on GDP growth was not observed at 5% significance level.

V. Conclusion and Policy Implication

5.1 Conclusion

The Kenyan economy is characterized by high unemployment rates and worrying fluctuation of inflation rate which went as high as 45% in 1993. Unemployment and inflation rates constitute a major concern for any economy as they influence supply consequently affecting GDP growth as it is argued by supply-sides economics. This study sought to examine the influence of unemployment rate and inflation rate on economic growth in Kenya for the study time period of 1990 to 2019. The study found that the independent variables have an influence on economic growth in Kenya. For instance, the ARDL bounds test showed that inflation rate has a short-run effect on GDP growth. The bounds cointegration test showed the existence of a long-run relationship when GDP growth and inflation rate were dependent variables. Granger causality test showed that GDP growth Granger causes unemployment.

5.2 Policy Implications

The study recommends the formulation of economic policies that will maintain low inflation rate as well as keep it within a predictable level. This will boost the confidence of potential investors to Kenya. this will eventually boost supply within the Kenyan economy, consequently spurring economic growth. Higher economic growth attained will reduce high unemployment rates in the country. Additionally, from available literature, there is scarcity of studies on the influence of supply-side macroeconomic variables on economic growth in Kenya. More studies in this subject should therefore be conducted on the subject area.

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