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The Impact of Inflation on Economic Growth: Empirical Evidence from Sierra Leone

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Abstract

Like several other countries both industrialized and non-industrialized, one of the central objectives of macroeconomic policies in Sierra Leone is to promote economic growth and to keep inflation at a low level. However, there has been substantial debate on whether inflation promotes or harms economic growth. Motivated by this controversial, this study examined the impact of inflation on economic growth and established the existence of inflation growth relationship. Time-series data for the period 1980-2017 were used to examine the impact of inflation on economic growth. The study employed an econometric approach where Correlation coefficient, co-integration technique and error correction models established the relationship between inflation and GDP and Coefficient of elasticity were applied to measure the degree of responsiveness of change in GDP to changes in general price levels. Results suggest that inflation has a negative impact on economic growth. The study also revealed that there was a unique co-integration between inflation and economic growth during the period of study. Consequently, there is evidence of long-run relationship between inflation and economic growth in Sierra Leone. Several policy recommendations were made so as to keep inflation at an acceptable level in the country.

Keywords: Economic growth, Inflation, Co-integration, Dickey-Fuller, Phillip-Prron, Sierra Leone

1. Introduction

The aim to achieve sustainable economic growth is the objective of most countries across the globe. However, it has been a problem to achieve such objective due to many factors that affects economic growth. Economic growth and the rate of inflation are central to macroeconomic policy. Among many variables that can be stated as the determinant of economic growth is inflation (Barro, 1995).

However, the question on whether or not inflation is harmful to economic growth has recently been a subject of intense debate to policy makers and macro economists. Several studies have estimated a negative relationship between inflation and economic growth. Specifically the bone of contention is that whether inflation is necessary for economic growth or it is detrimental to growth. Basically the rate of economic growth depends primarily on the rate of capital formation and the rate of capital formation depends on the rate of savings and investment (Datta and Kumar,

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2011). World economic growth and inflation rates have been fluctuating. Likewise, inflation rates have been dominating to compare with growth rates in virtually many years (Madhukar and Nagarjuna, 2011) and relationship between inflation and the economic growth continued to be one of the most macroeconomic problems. Similarly, Ahmed (2010) maintains that this relationship has been argued in various economic literatures and these arguments shown differences in relation with the condition of world economy order. In accordance with these policies, increases in the total demand caused increases in production and inflation too. However, inflation was not regarded as a problem in that period rather considered as a positive impact on the economic growth which was widely accepted. Amid these views, Phillips first hypothesizes that high inflation positively affects the economic growth by lowering unemployment rates. Nowadays the opinion has changed and today there is a consensus that economic growth and inflation variable are associated. Consequently, in periods with low inflation rate, it will certainly have economic growth, and when the inflation rate passes double-digits or in periods when there is a higher inflation rate, this would also hurt the economic growth trends. In this study, time series data is used with data for Sierra Leone covering a relatively long period of time and sufficient and accepted standards which attempt to produce professional and accepted results. Our hypothesis is that Inflation rate has a negative impact on economic growth. In order to assess it for the purpose of this study for the results to from the study to be more real, along with inflation rate and economic growth there are other data (variables) used too, labour capital, human capital development etc.

Following the introduction, the rest of the paper is structured as follows: section two provides a stylized fact on inflation and economic growth in Sierra Leone. Section three presents the methodology. Section four provides analysis of empirical results and discussion and section five offers conclusions and policy recommendation.

2. Inflation and Economic Growth in Sierra Leone

Sierra Leone in the 70s, inflation has been a foremost macroeconomic problem. Generally, Sierra Leone is characterized as a "donor driven country" largely dependent on the exports of unprocessed goods in their raw state, especially agricultural products and minerals. The economy grew at nearly 4% yearly during the first decade after the country's independence in April 1961. Inflation at that time was low and the foreign exchange rate and fiscal position of the country was healthy. Since the first oil-price shock of the 1970s, one of the major macroeconomic problems of the country has been persistent high inflation.

The country witnessed positive growth in the early 1980s as real GDP growth rate increased from 2.9 percent in 1980 to 4.4 percent in 1984, and further increased from 1.5 percent in 1986 to 3.6 percent in 1990. However, real GDP growth remained negative in the 1990s, but economic activities picked up in 2000 resulting to an increase in real GDP growth from 3.8 percent to 18.2 percent in 2002. However, despite remaining positive, real GDP growth decline from 10.9 percent in 2003 to 4.9 percent in 2010.

Sierra Leone's economy is small and undiversified. GDP growth in Sierra Leone has been conspicuously inconsistent. This instability could be associated with the uneven economic growth across sectors, and largely driven by the export-led mining sector. The post-war economic recovery was first driven by agriculture, and from 2010 onwards propelled by the mining industry. Without steady growth, it is hard to attract investments that can strengthen the economic sectors to foster job creation. Gross capital formation, which reflects the prospect of future stability in Sierra Leone,

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rose from 1 percent of GDP in 2000, fluctuated between 9.8 and 11.8 percent throughout the rest of the decade, and attained its highest point at 42 percent in 2011. However, this investment bump was short-lived, as capital investment declined by 15 percent of aggregate output by 2012.

The 2017 GDP growth rate (3.7 percent) was dismal in comparison with the 2016 rate (6.1 percent) after a recovery from an abysmal performance in 2015 (-20.6 percent), with agriculture contributing 55.1 percent of GDP, services 36.6 percent, and manufacturing 9.3 percent. The sharp drop in GDP growth between 2014 and 2015 is attributed largely to the outbreak of the Ebola that halt many economic activities (Figure 1).

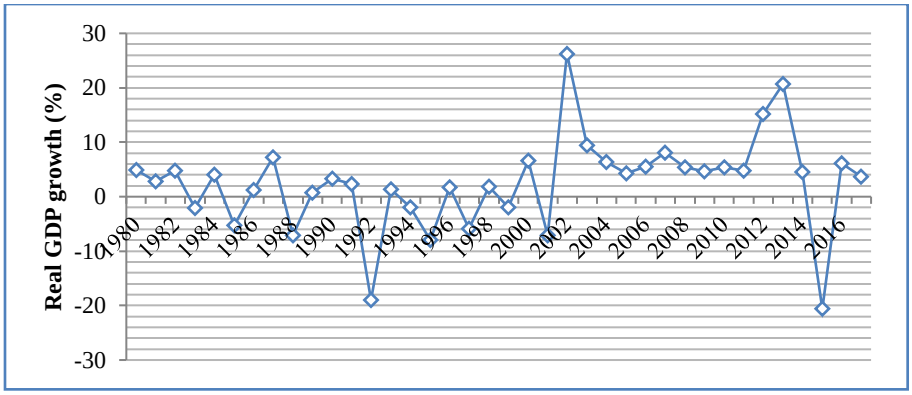

Figure 1Trend in GDP growth in Sierra Leone (1980-2017)

Inflation has a crippling effect on the economy of Sierra Leone which is generally characterized as a "donor driven economy" that is largely dependent on the export of unprocessed goods in their raw state especially minerals and agricultural products. It saw unprecedented disruptions caused by the eleven years civil disturbance and with tremendous government efforts trying to institutes policies to maintain inflation to a low but relatively stable level; thereby increasing the standard of living of the average Sierra Leonean. There was a dramatic reduction in the rate of inflation during the early post war period to a single digit year-on-year. The Sierra Leonean economy was not able to maintain this achievement largely due to the nature of its economy. The global financial crisis of 2008 further exacerbated the inflationary pressures because of its effects on international prices of mostly food and oil. Because a hike in the prices of petroleum products in Sierra Leone, will influenced an increase in the prices of other basic commodities. Though there are other ways to measure inflation; inflation is measured in Sierra Leone as the percentage change in the annual level of prices as measured by the consumer price index. Sierra Leone had instituted sound and robust monetary and fiscal policies with the sole aim of bringing inflation to a single digit by maintaining price stability and restraint excess liquidity consistent with the macroeconomic fundamentals of the country but it has still remain a problem in the post war period. In 2010, inflation reached the peak of 16.64 percent (AfDB Statistics Department) largely due to hikes in food and fuel prices during the global financial crisis of 2008 which has pass-through effects on domestic prices. A targeted inflation rate of 11.6 percent year-on-year for 2012 was not achieved. An improvement in the inflationary pressure was occasioned by proactive monetary and fiscal policies in keeping prices of basic commodities at affordable levels; these measures include: the temporal removal of import duties on rice and reduced excise duties on petroleum. These measures were backed up by a stable exchange rate and domestic food

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supplies availability. Administrations both past and present had instituted various measures to keep inflation at a moderate level in the country but so far, the desired result for the long term has not yet been achieved. The figure below shows the inflationary trends in Sierra Leone from 1980 to 2017.

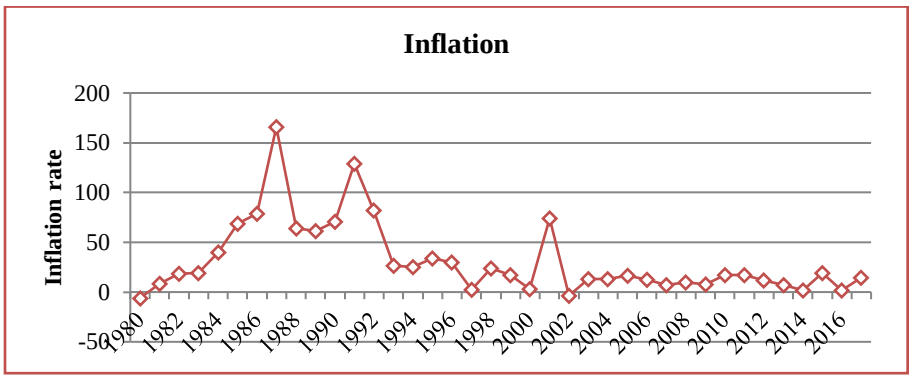

Figure 2 Inflation trend in Sierra Leone (1980-2017)

Figure 2 shows the inflationary trend for Sierra Leone from 1980 to 2017. Inflation mounted to 178.5% in 1987, Kallon (1993), which was the highest inflation in Sierra Leone history, this point can be confirmed in figure 1.2. It depicts a very high inflation rate of over 100 percent from 1980 to 1991. These were the early stages of the civil war because of poor governance and mismanagement of state resources which largely fuelled the rebel war. Inflation rate saw a sharp decrease from 65.5 percent in 1992 to 22.20 percent in 1993. This was as a result of the military takeover from the then government which brought some sanity into the economy. Inflation rate was better controlled until 1997 which saw another military coup d'état that ousted the democratically elected government of that time. The economic was in shambles as the international community imposed economic sanctions and trade blockade in an already impoverish nation. The general prices for goods and services were increased which led inflation to rise up to 35.97 percent in 1998 from 14.56 percent in 1997. Democratic order was restored which saw a decrease in the rate of inflation to a percentage point in 2000. The increase from then was with fluctuating trends to date.

Maintenance of price stability continues to be overriding objective of monetary policy for most countries across the globe. The emphasis given to price stability in conduct of monetary policy is with a view to promoting sustainable growth and development as well as strengthening the purchasing power of the domestic currency amongst others. The Central Bank of Sierra Leone (BSL) employs the monetary targeting framework in the conduct of its monetary policy. This is based on the assumption of a stable and predictable relationship between money supply and inflation. Consequently, the need to understand the relationship between inflation and economic growth of the Sierra Leone economy become imperative and the dynamics of inflation became central to the success of monetary policy to ensure the achievement of price stability. The effect of inflation (price instability) in the growth and development of the Sierra Leone economy cannot be over-emphasized.

Given the Inflation-growth situation in Sierra Leone and due to the controversial issues about economic growth and inflation, the researcher is highly interested to examine the

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relationship between inflation and economic growth in Sierra Leone a small open economy that has been witnessing high and fluctuating inflation rate for decades. In addition, this paper will test the causality relationship between inflation and economic growth, as such, whether the causal relation is bidirectional, unidirectional or no causal relation in Sierra Leone.

3. Methodology

This study considers annual time series data for Sierra Leone spanning from 1980 to 2017. In order to increase the sample size, the annual data set was transformed to quarterly data from 1980Q1 to 2017Q4. The quarterly data was obtained through interpolation of the annual time series data using E-views version 10. This was done using the low frequency to high frequency method and the quadratic match average and quadratic match sum for each observation of the low frequency series. The variables and their sources are presented in table 1.

Table 1 Variables Used in the Study

Variable	Symbol	Source
Economic Growth	*GDP*	Penn World Table (2018)
Inflation	*INF*	Penn World Table (2018)
Education	*EDU*	Penn World Table (2018)
Trade Liberalization	*TL*	Penn World Table (2018)
Labour	*L*	Penn World Table (2018)
Human Capital	*HK*	Penn World Table (2018)
Total Factor Productivity	*TFP*	Penn World Table (2018)
Real Exchange Rate	*EXRV*	Penn World Table (2018)

3.1 Empirical Model Specification

Following the endogenous growth model, the study specifies a model that best captures the effect of inflation on economic growth. Given the growing empirical evidences supporting the negative effect of inflation on economic growth (Quartey, 2010 and Shitundu and Luvanda, 2000) we control for other factors considered as control variables that influence long run growth and generalize the specification of a growth equation that accounts for the effects of inflation on economic growth. This is due to the fact that the main objective of the linear regressions was to uncover the general shape of the growth function relating the inflation rate and economic growth. Thus, in deriving our empirical model for estimating this relationship for Sierra Leone, we state that:

$$growth_t = \beta_0 + \beta_1 * Inflation_t + \theta' * X_t + \varepsilon_t \quad (1)$$

Where the dependent variable, $growth_t$, is the the real GDP, measured by constant US currency, and the explanatory variables include the constant (β_0), the inflation rate ($Inflation_t$) and a vector of the control variables (X_t), which depend on the specification of the growth equation. If the accounting growth equation is used, then X_t includes the growth rate of the total factor Productivity *(TFP)*, the human capital stock *(HK)*, which can be measured by the secondary school enrollment rate, the average years of secondary schooling of the total population etc., is an important explanatory variable in the growth accounting equation. We also made use of trade

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liberalization *(TL)*, labour *(L)*, real exchange rate *(EXRV)*, ε_t is the error term and "*t*" is the time series index. Equation (1) is the basis of estimating the relationship between economic growth and inflation. Substituting the set of conditioning variables will give:

$$GDP_t = \beta_0 + \beta_1 INF_t + \beta_2 \log L_t + \beta_3 EDU_t + \beta_4 TL_t + \beta_5 HK_t + \beta_6 TFP_t + \beta_7 EXRV_t \quad (2)$$

3.2 Estimation Procedure

Estimation of the above model was through four steps. In step one, we determine the orders of integration for each variable under consideration, i.e., differencing each series successively until stationarity is achieved. In step two, we estimated cointegration regressions with Ordinary Least Squares (OLS) method using variables with the same order of integration. Test for stationary residuals of the cointegration regression was performed in step three. Finally, we estimated the error-correction model and diagnostics and stability test to validate the robustness of the model adopted.

4. Results and Discussion

Before computing the specified growth equation, the summary statistics are presented in the first instance to give a fair description of the link between economic growth and inflation for the data set collected for Sierra Leone over the period 1980Q1-2017Q4. The summary statistics for the entire sample is presented in table 2 from the summary statistics reported in the table, GDP for the entire sample averaged around 5.72 %. It can be seen that inflation averaged around 3.04% and labour denoted as L averaged around 14.40%. For the overall sample, even though the level of trade liberalization denoted as TL as one of the indicators that influences growth average around 3.88%, but the extent of human capital development stood at 0.29% which is considered weak in the country compared to developed economies and other African countries in particular. When it comes to total factor productivity, it averaged around 8.83% whereas exchange rate volatility averaged around 6.04%.

Table 2 Summary Statistics

Variables	Mean	Std. Dev
GDP	5.724857	0.456145
INF	3.045675	1.050443
L	14.40845	0.185866
TL	3.885878	0.322608
HK	0.297156	0.103938
TFP	8.829951	0.372579
EXRV	6.047504	2.716965
Obs.	149	149

In an attempt to detect the problem of multicollinearity in the model, a correlation matrix was done to determine the degree of correlation among the variables under investigation.

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Correlation explains the changes that occur in one variable due to change in other variable. If a high correlation is found between variables especially the set of explanatory variables, it can lead to multicollinearity. The table below shows the result from the pair wise correlation matrix.

The rule of thumb is that if multicollinearity among two independent variables is 70% and above, then it is a cause of concern. However, the current study does not show any severe case of multicollinearity between the set of independent variables as the highest value of correlation is – 64.0% between total factor productivity (TFP) and labour (L). This confirms the absence of multicollinearity among the variables in the model.

Table 3 Pair-wise correlation matrix

	GDP	INF	L	TL	HK	TFP	EXRV
GDP	1.0000						
INF	-0.4870	1.0000					
L	0.5303	-0.5790	1.0000				
TL	0.5673	-0.2422	0.5069	1.0000			
HK	0.4186	-0.6401	0.2343	0.4892	1.0000		
TFP	0.5678	-0.0277	0.5636	0.6401	0.4974	1.0000	
EXRV	-0.4964	-0.5832	-0.5912	-0.3742	-0.5901	-0.1835	1.0000

4.1 Unit Root Test Results

To avoid the problem of trended data in time series data computation, it is but fitting to first and foremost perform the unit root test. The Augmented Dickey-Fuller (ADF) test and the Phillips-Perron (PP) tests are used to determine the order of integration of data compiled for each series under consideration. The results of the unit root tests on the variables in levels are presented in the table 4 below.

Table 4: Stationary Test Results at level using ADF and PP test

Augmented Dickey-Fuller (ADF) test			
Variables	**ADF Statistic**	**ADF Critical (5%)**	**P-Value**
GDP	-2.577025	-3.440681	0.2915
INF	-2.114880	-2.881123	0.2392
L	-2.464762	-3.440681	0.3452
TL	-3.181252	-3.441552	0.0924
HK	0.159736	-2.881123	0.9691
TFP	-1.442709	-3.440681	0.8443
EXRV	-1.185795	-3.440681	0.9092
Phillips-Perron (PP) test			
Variables	**PP Statistic**	**PP Critical (5%)**	**P-Value**
GDP	-1.999283	-3.440471	0.5966

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INF	-2.978722	-3.440471	0.1418
L	-1.699085	-3.440471	0.7470
TL	-2.452216	-3.440471	0.3514
HK	-1.801305	-3.440681	0.6993
TFP	-0.195301	-3.440471	0.9926
EXRV	-0.679427	-3.440471	0.9722

The variables are tested for significance at 5% level of significance for stationarity. The results of the both the ADF and PP tests clearly indicate that the null hypothesis of a unit root cannot be rejected. Hence, we make the conclusion that the variables are well characterized as non–stationary and integrated of first order. Differencing the variables leads to rejection of the null hypothesis of unit root for all the variables. So, all the variables at their levels are non–stationary but are stationary after taking their first–order differences. Therefore, we say that all variables in our cointegration regression are I(1) variables. The first–order differences of the variables are presented in the table 5 below.

Table 5: Stationary Test Results at first difference using ADF and PP test

Augmented Dickey-Fuller (ADF) test			
Variables	**ADF Statistic**	**ADF Critical (5%)**	**P-Value**
GDP	-4.682731	-3.440681	0.0011
INF	-8.433439	-3.440681	0.0000
L	-11.99741	-3.440894	0.0000
TL	-3.811734	-3.441552	0.0186
HK	-3.468589	-3.440681	0.0466
TFP	-2.357207	-1.943012	0.0183
EXRV	-4.894552	-3.440681	0.0005
Phillips-Perron (PP) test			
Variables	**PP Statistic**	**PP Critical (5%)**	**P-Value**
GDP	-4.682401	-3.440681	0.0011
INF	-8.456404	-3.440681	0.0000
L	-12.00195	-3.440894	0.0000
TL	-4.025455	-3.440681	0.0099
HK	-4.832045	-3.440471	0.0006
TFP	-12.15751	-3.440894	0.0000
EXRV	-4.903845	-3.440681	0.0005

4.2 Co-integration Analysis

Given that the variables used in the model are integrated in the same order I(1) at first difference, a test for cointegration would be the next step to follow in this empirical analysis to ascertain the long run relationship among the variables. This study employs the Johansen and Juselius's (1990) method of cointegration which suggest that the variables entering the

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cointegration relationship must be integrated by the same order. Johansen and Juselius (1988, 1990) suggested the use of two statistical tests which are the trace test (λ_{trace}) and the maximum eigen value test (λ_{max}). These two tests are reported in table 6 and 7 respectively.

Table 6. Unrestricted Co-integration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.529643	319.0897	159.5297	0.0000
At most 1 *	0.439392	210.4758	125.6154	0.0000
At most 2 *	0.272742	127.1382	95.75366	0.0001
At most 3 *	0.215536	81.27786	69.81889	0.0046
At most 4	0.143141	46.32114	47.85613	0.0692
At most 5	0.104678	24.07569	29.79707	0.1973
At most 6	0.054260	8.153354	15.49471	0.4492
At most 7	0.000832	0.119923	3.841466	0.7291

Source: E-views output

Table 7 Unrestricted Co-integration Rank Test Result (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.529643	108.6138	52.36261	0.0000
At most 1 *	0.439392	83.33765	46.23142	0.0000
At most 2 *	0.272742	45.86033	40.07757	0.0100
At most 3 *	0.215536	34.95672	33.87687	0.0371
At most 4	0.143141	22.24545	27.58434	0.2081
At most 5	0.104678	15.92234	21.13162	0.2294
At most 6	0.054260	8.033431	14.26460	0.3753
At most 7	0.000832	0.119923	3.841466	0.7291

Source: E-views output

The values of both the trace statistics (319.0897) and the Max-Eigen statistic (108.6138) are greater than their critical values at 5% significant level of (159.5297) and (52.36261) respectively and their corresponding probability values are less than 5%, which implies that we fail to reject the null hypothesis of no cointegrating relationship at the 5% significant level. The same interpretation holds for at most 1, 2 and 3 given that their statistical values are greater than their critical values at the 5% significant level. Moreover, whiles we fail to reject the null hypothesis of no cointegrating relationship at the 5% significant level for none, at most 1, at most 2, and at most 3, we reject the null hypothesis of at most 4 cointegrating relationship at the 5% significant level; since the trace and Max-Eigen test statistic (46.32114) and (22.24545) are less than their critical

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values at 5% significant levels of (47.85613) and (27.58434) respectively. The same explanation holds for at most 5, at most 6 and at most 7. Consequently, both the trace and Max-Eigen test statistic shows four cointegrating relationships. This result confirms that there is a long run relationship among economic growth, inflation, labour, education, trade liberalization, human capital development, total factor productivity and exchange rate volatility. Since variables can either have long run or short run effects, then an error correction model (ECM) is used to disaggregate this effect. The long run cointegrating relationship is thus specified in the table 4.7 below.

Table 8 Result of the long run Growth model

GDP	INF	L	TL	HK	TFP	EXRV
	-0.778241	3.048305	0.954024	3.69405	0.808297	-0.5126
	(0.11595)	(1.10932)	(0.25619)	(0.73936)	(0.38447)	(0.26224)

Values in Parenthesis are standard errors

Source: E-views output

The result in table 8 above shows that labour, trade liberalization, human capital development, and total factor productivity have positive effect on GDP growth. These variables are statistically significant in influencing growth, while inflation (INF) and exchange rate (EXRV) are found to have a negative relationship on GDP growth with statistically significant values. This indicates that high inflation raises the cost of production and reduces returns from investment and thus impact negatively on GDP growth.

4.3 Preliminary Relationships Verification

In the preliminaries, we try to ascertain whether economic growth increases or decrease as inflation increases using scatter plots. The evidence for this is shown in the figures below. The figures tend to portray a negative relationship between inflation and exchange rate volatility and growth in Sierra Leone, it can also be seen that the fitted line is somewhat steep suggesting a strong relationship. Equally, we also preview, through scatter plots, the response of growth to the other growth determining variables. The figures present these trends. The entire results support the view that economic growth is positively related to labour, education, trade liberalization, human capital development and total factor productivity. The fitted values are also strong with a positive trend.

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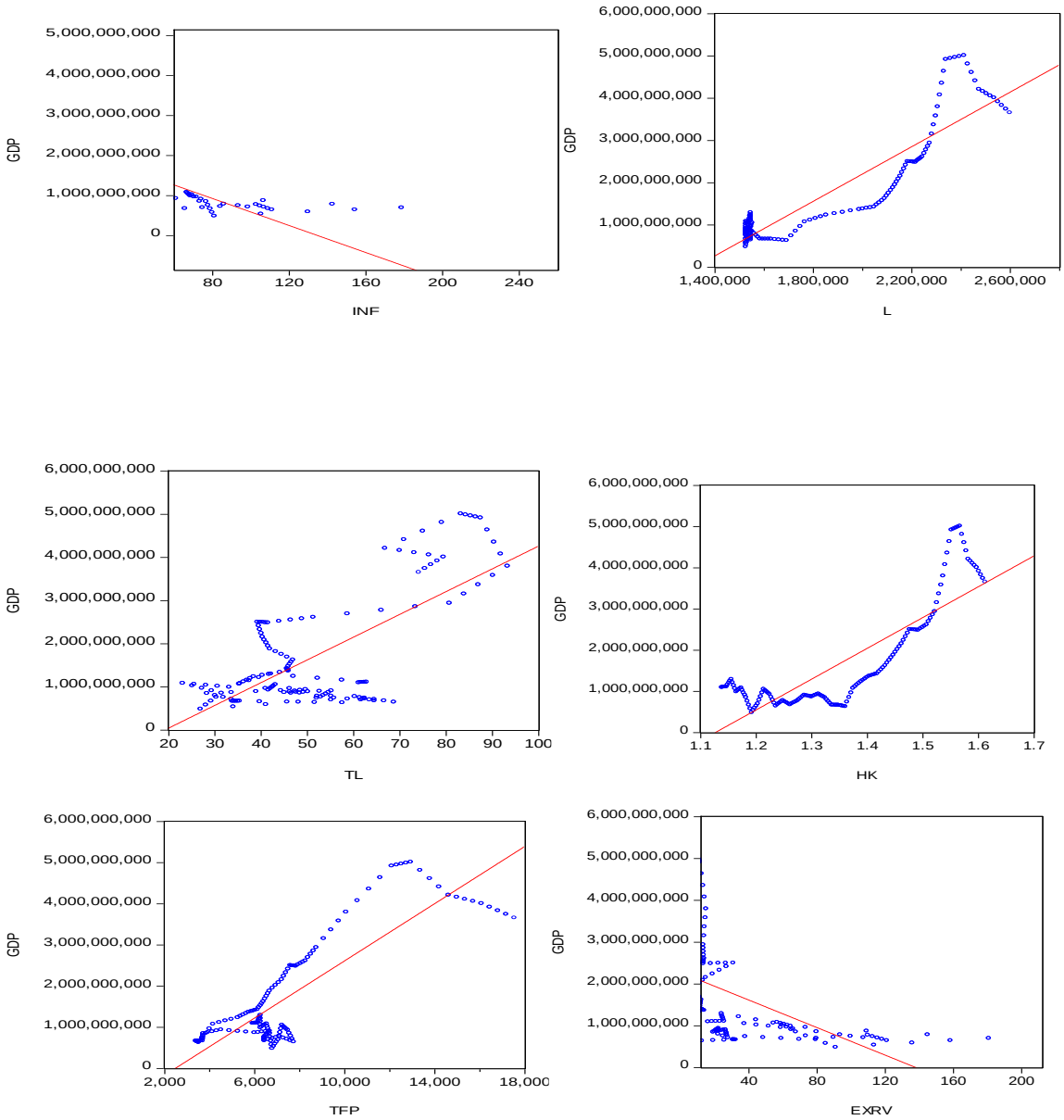

Figure 3 Scatter plots of Model variables

It can be seen from the scatter plots in figure 3 that when it comes to labour, education, trade liberalization, human capital development and total factor productivity and their relationship with growth, there is a significant positive relationship as opposed to inflation and exchange rate volatility relationship with growth. However, using the scatter plots, we can only get a fair understanding on the nature of the relationships among the variables. In order to measure the extent of the relationship quantitatively, we estimated the general OLS regression to measure how much each of the set of independent variables influences the dependent variable. These results are presented in table 9 below.

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Table 9 General OLS Regression Output

Variables	Coefficient	Std. Error	t-Statistic	Prob.
c	10.99007	5.394909	2.037119	0.0435
INF	-0.230617	0.021666	-10.64415	0.0000
L	0.071872	0.031451	2.285223	0.0238
TL	0.162931	0.057850	2.816428	0.0056
HK	8.700365	1.188886	7.318083	0.0000
TFP	0.253454	0.096968	2.613798	0.0099
EXRV	-0.206016	0.021983	-9.371514	0.0000
R-squared		0.947519		
Adjusted R-squared		0.944914		
F-statistic		363.6710		

In interpreting the above model, the coefficient of inflation rate is found to be statistically significant for the study with a negative impact on economic growth in the country. Holding everything constant, a 1 percentage increase in inflation will lead to approximately 23.06% fall in economic growth. This result is in line with the A priori expectation of the variable and also in conformity with previous findings by Nkechi, E. R. (2013). It is believed that high inflation rate signals a sign of weak macroeconomic performance and investors both foreign and domestic may not be willing to invest in an environment of high inflation rate and thus a negative consequence on growth.

The coefficient of labour 0.071872 has a positive and statistically significant impact on economic growth. There is a direct relationship between labour and economic growth. This implies that a 1% increase in the labour force participation leads to approximately 7.18% increase in economic growth in Sierra Leone. This outcome is in line with theories and previous studies that labour can serve as a lubricant to speed up growth in an economy.

Furthermore With regards to trade liberalization is found to be statistically significant for the study with a positive impact on economic growth in the country. A 1 percentage increase in trade liberalization will lead to approximately 16.29% increase in economic growth. This result is in line with the A priori expectation of the variable and also in conformity with previous findings in the literature.

Also the coefficient of total factor productivity (0.253454) has a positive and statistically significant impact on the economic growth of Sierra Leone. There is a direct relationship between TFP and economic growth. This implies that a 1% increase in TFP can lead to approximately 25.3% increase in economic growth.

Similarly, exchange rate volatility (EXR) has an inverse relationship with economic growth. The coefficient was also found to be negative and significant from the value of the t-statistics greater than two and the probability value less than 1. This suggests a 1 percent increase in exchange rate volatility will reduce economic growth by approximately 20.6 percent on average. The degree of responsiveness of economic growth with respect to exchange rate volatility is -0.206016 this finding is also in line with the A priori expected sign that an increase in the volatility in exchange rate will give incentive to investors not to invest which will in turn reduce the level of investment and doing businesses and consequently affect growth.

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4.4 Result of the Error Correction Model

The existence of long run relationship among the I(1) variables suggests the estimation of the short run dynamic model. The short-run error-correction model (ECM) is an autoregressive model for the stationary forms of GDP growth, inflation, labour, education, trade liberalization, human capital development, total factor productivity and exchange rate volatility. It is estimated using OLS. The error correction mechanism is employed to examine the short-and long-run behavior of GDP growth in relation to inflation and the rest of the explanatory variables. This equation incorporates the short run adjustment mechanism into the model. In the previous section, it was evident that there exists a unique cointegrating relationship between GDP growth, and the set of explanatory variables. Nevertheless, in the short run, there may be disequilibria and the error correction model is therefore employed to eliminate deviation from the long run equilibrium.

The results of the short run dynamic model are reported in table 4.9. The coefficient of the error correction term indicates the speed of adjustment in eliminating deviation from the long run equilibrium. The coefficient has the expected negative sign (-0.202825) and it is statistically significant at the 5% level. The significance of the coefficient further confirms the existence of the long run relationship between GDP growth and the I(1) variables under consideration. The magnitude of the coefficient implies that nearly 20.28% of the disequilibrium in the previous year's shock adjusts back to long run equilibrium in the current year.

Table 10 Short Run Dynamics (ECM), Dependent Variable: ΔlnGDP

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.119166	0.043631	-2.731234	0.0071***
ΔlnINF	-0.018654	0.008494	-2.196124	0.0297**
ΔlnL	0.181054	0.017185	10.53579	0.0000***
ΔlnTL	0.018936	0.005307	3.568045	0.0005***
ΔlnHK	59.92135	18.14529	3.302309	0.0012***
ΔlnTFP	0.102089	0.027453	3.718676	0.0003***
ΔlnEXRV	-0.270813	0.063331	-4.276129	0.0000***
ΔlnGDP(-1)	0.650727	0.404303	1.609504	0.1097
ΔlnINF (-1)	-0.848972	0.195838	-4.335079	0.0000***
ΔlnL(-1)	0.012910	0.003853	3.350767	0.0010***
ΔlnTL(-1)	2.073219	2.854769	0.726230	0.4689
dlnHK(-1)	2.004631	0.164996	12.14957	0.0000***
ΔlnTFP(-1)	0.058054	0.012592	4.610379	0.0000***
ΔlnEXRV(-1)	-0.023842	0.004089	-5.830455	0.0000***
ECM(-1)	-0.202825	0.088107	-2.302047	0.0228**

Note: (***) and (**) denote 1 %; and 5% significance level respectively. R-squared= 0.901536; Adjusted R-squared= 0.896648; DW: 2.011666; Prob. (F-statistic) = 0.000000

The adjusted R- squared is 0.896648, implying that approximately 89.66% of the variation in the determinant of economic growth is explained by the independent variables, which is an indication of a very good fit. In comparison to the R square, the adjusted R square is better and more precise good fit measure because it allows degree of freedom to sum of squares therefore even after addition of new independent variable(s) the residual variance does not change. The

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Durbin Watson statistic indicates the absence of autocorrelation among the variables which means the model has an economic meaning. The overall equation is highly statistically significant as shown by the probability value of the F-statistic (0.000000).

4.4 Diagnostics and Stability Test

Diagnostic tests were performed in order to validate the parameter evaluation of the outcomes achieved by the model adopted in this research. The goodness of fit of the model was tested in five main ways, i.e. the langrage multiplier (LM) test for serial correlation, the Breusch-Godfrey and ARCH tests for heteroscedasticity, and the Jarque-Bera for normality test. These tests results are presented in table 11

Table 4.10 Diagnostic test results

Test	Null Hypothesis	Statistics	Probability
Langrage Multiplier (LM)	No serially correlated errors	Obs*R-squared = 0.499090	0.7792
Breusch-Godfrey	No heteroscedasticity	Obs*R-squared = 7.067719	0.4219
ARCH	No heteroscedasticity	Obs*R-squared = 0.189305	0.6635
Jarque-Bera (JB)	There is a normal distribution	Jarque-Bera = 2.3186	0.3137

Source: Author's computation using E-views 10

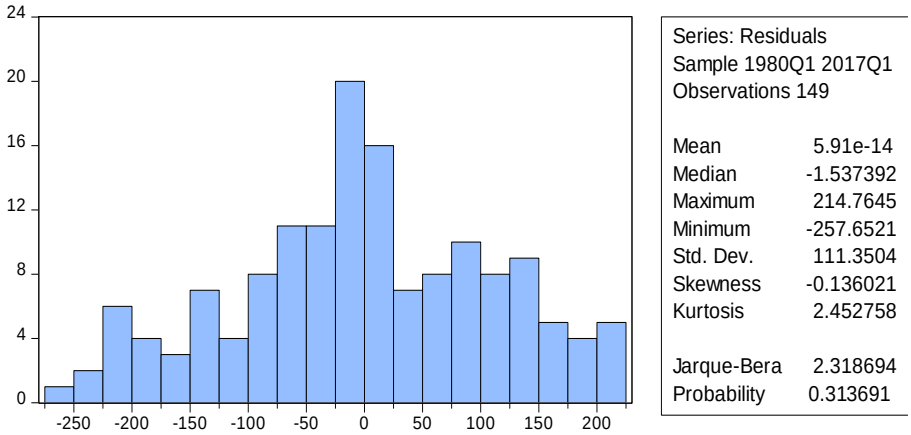

Figure 4 Histogram of Model Normality

The results presented in table 4 suggest that there is no serial correlation, there is no ARCH effect on the model's error, there is no presence of heteroscedasticity, the model error is normally distributed and the model is correctly specified. We therefore fail to reject the null hypothesis and conclude that the model has a very good fit and thus we can rely on its analysis.

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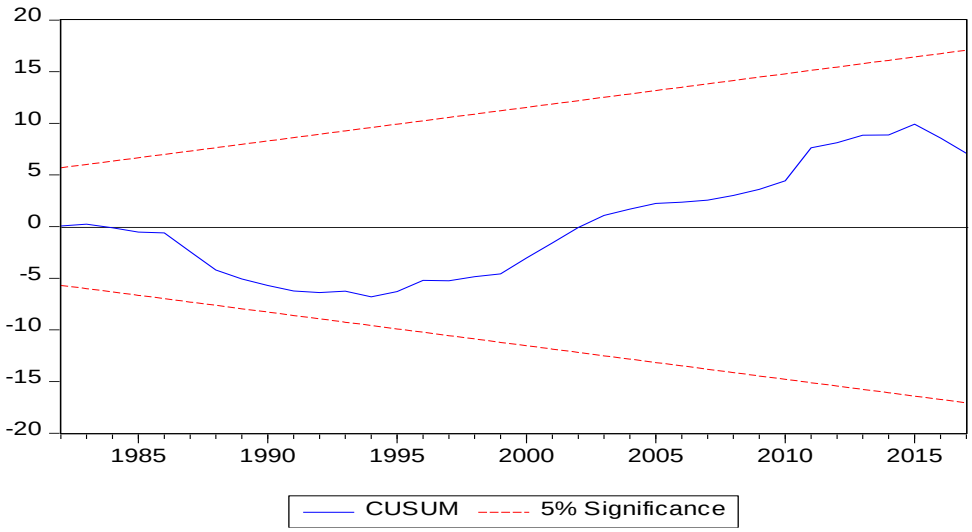

Figure 5: Plot of Cumulative Sum (CUSUM)

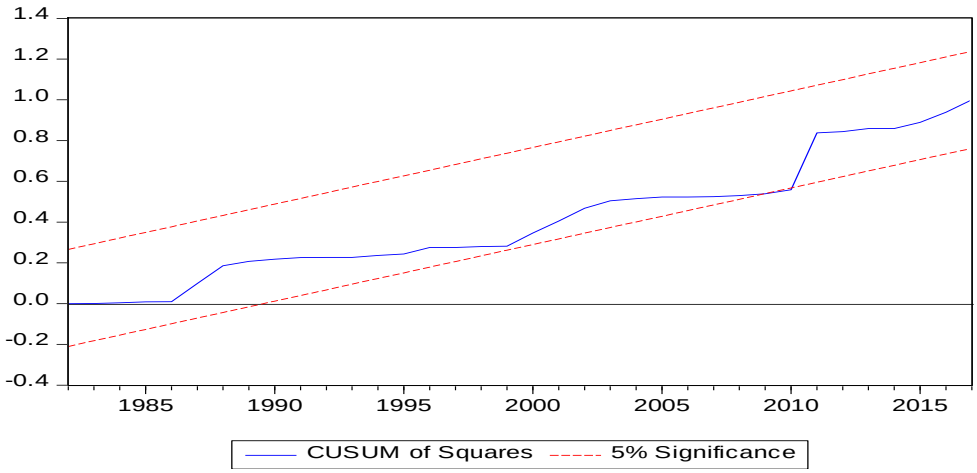

Figure 6: Plot of Cumulative Sum of Squares (CUSUMQ)

With regards stability test, the results of both the CUSUM (5) and CUSUMQ (figure 6) plots lie within the 5% critical band width which confirm the stability of the coefficients over the study period and the correct specification of the model.

5. Conclusion and Recommendation

5.1 Conclusion

The main objective of this study was to examine the impact of inflation on economic growth in Sierra Leone. Annual time-series data for the period of 1980-2017 were employed and consequently transformed to quarterly data so as to increase the sample size. The diagnostic tests carried out for all variables were all satisfied, that is, the residual error of the model was normally distributed, no serial correlation and heteroskedasticity were observed, implying that the estimates are reliable and therefore can be relied upon.

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To examine the relationship between inflation and economic growth, growth model was formulated by including other explanatory variables (i.e. labour, education, trade liberalization, human capital, total factor productivity and exchange rate volatility) in addition to inflation. Since time effect is necessary for the model, the discussion is relied on the general OLS model. A theoretical framework was established and extensive literatures were reviewed in establishing the research model.

The methodology employed in this study included the regression analysis to examine the impact; stationary test was carried out using the Augmented Dickey-Fuller technique and Phillips-Perron (PP) test. The results of unit root suggested that all variables in the model were stationary after first difference. The results from regression analysis revealed that inflation has the negative impact on economic growth of Sierra Leone. This indicated that inflation is harmful to economic growth of Sierra Leone. The same results were found by (Quartey, 2010) in Ghana. Correlation coefficient and co-integration technique were employed to establish the relationship between inflation and GDP. The results of co-integration test using Johansen co-integration test showed that over the period of 1980Q1-2017Q4 there was a unique co-integrating relationship between inflation and economic growth. That is, there is statistically significant long-run relationship between inflation and economic growth in Sierra Leone. Consequently a negative and statistically significant long and short term relationship was found. These results are consistent with other previous studies such as (Ahmed, 2010; Mallik, and Chowdhury, 2001; Carneiro and Faria, 2001). Moreover, the study found that the degree of responsiveness of GDP to changes in the general price levels is large. The study concluded that the degree of responsiveness of change in GDP as a result of change in the general price levels is to the tune of -0.230617.

5.2 Policy Recommendation

This study found out that an increase in the general price level (inflation) has been detrimental to sustainable economic growth in Sierra Leone. These results have important policy implications for both domestic policy makers and development partners, implying that controlling inflation is a necessary condition for promoting economic growth. Thus, policy makers should focus on maintaining inflation at a low rate (single digit). Stability in inflation rate is an important factor as the results from the findings indicated that when inflation increase by one percent it will result to approximately 23 percent fall in GDP and about 94 percent of the variations in GDP have been explained by inflation and the other set of explanatory variables. This could imply any fluctuation in country's general price level has a significant impact on economic growth. In this regard the study concluded that all factors which cause an increase in the general price levels such as energy crisis, exchange rates volatility, and increase in money supply, poor agricultural production and so forth should be addressed with the appropriate policies so as to foster economic growth.

Since the double-digit inflation rate in Sierra Leone was mainly due to the heavy reliance on the import of commodity products, energy crisis and poor agricultural produce, the government should use other sources of power such as gas as an alternative to hydro-electricity. Constant availability of power is of great important for production since the more the country produces the less the prices of goods and services hence higher economic growth. Similarly agricultural produce may be increased by improving infrastructure, provision of labour force, training to farmers as well as strategies like loan provision schemes with affordable interest rates and establishment of

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permanent markets for their products should be undertaken. The elasticity coefficient of GDP to inflation rate is inelastic due to the fact that inflation rate is a very important macroeconomic variable to the changes of GDP. To policy makers this could implies that even if there are other factors which influence economic growth such as labour, human capital, trade liberalization, education, exchange rate etc. and geographical position of the country as well as government policies like better maintenance of rule of law, less non-productive government consumption and better public investment in high-return avenues (see Hussain, 2011; Kasidi, 2010). Thus to attain and sustain high economic growth (GDP) policy makers in Sierra Leone should strive to keep inflation rate at a possible minimum rate.

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