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Inflation Dynamics in Developing Economies: A Study of Key Economic Determinants

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Abstract: *The study sought to establish the determinants of inflation in developing economies using Sierra Leone economy as case study and covers a period from 1994-2018. The study used ordinary least squares for estimation of time series data covering the period 1994-2018. One equation was regressed and the following variables were regressed on the annual inflation rate that is the money supply, exchange rates, gross domestic product and central bank rate. The study revealed that, there was a negative relationship between GDP and inflation level, Central bank rates was found to be statistically significant at 5% level of significance in causing the variation in inflation rate. Money supply (M2) and exchange rate had a positive relationship with the inflation rate while GDP growth rate and the real interest rate had a negative relationship with inflation. Therefore, policy makers should adopt policies that cushion an increase in central bank rates. Interest rate is the major tool used by the central bank to achieve inflation target. Changes in this interest rate affect various kinds of economic activity and thereby, over time, inflation.*

Keywords: *Inflation, Developing economies, Money supply, Exchange rate*

JEL Classification: *G21, G28, E58, K23, O16*

I. Introduction

Inflation measures a rise in the overall price level of goods and services in a given economy. It is a decline of purchasing power of a given currency (The Sierra Leonean Leone in this case). A quantitative estimate of the rate at which the decline in purchasing power occurs can be revealed in the increment of an average price level of a basket of selected goods and services in the country during the study period. The study explored the various factors that cause continuous increment in the general price level in the economy. The majority of the developed countries have low rate of inflation and stable economies over the years. Sweden, UK and USA have registered 2.04%, 2.48%, 2.44% as inflation rate in 2018, respectively. On the other hand, developing countries have unstable economies and high inflation rate. Sierra Leone, Sudan and Angola have registered 19.83%, 63.2% and 19.63% inflation rates in 2018, respectively. Double digit inflation which is caused by several factors has become worrying for the policy makers. The determinants of inflation are different from one country to another. From an economic perspective, these determinants have been classified as supply side and demand side factors. Supply side factors are those economic factors which cause inflation by increasing cost of production. Some important supply side factors are output growth, capital formation, import prices, exchange rate, tax and wage. On the other hand, demand side factors lead to inflation by decreasing the purchasing power of money .

The study sought to establish the various determinants of inflation in Sierra Leone in the recent past and aims to draw lessons to inform policy on how to manage inflation in future.

Sierra Leone has experienced inflation swings since 1970 and the study sought to explain the causes of these swings and how they were later controlled to attain lower rates of inflation in subsequent years.

There are many definitions of inflation, World Bank (2007) defines inflation rate as "*an annual increase in the price of a basket of goods and services that are purchased by consumers in an economy*" while the London oxford economic dictionary

(2009) defines inflation as "*the consistent tendency for nominal prices to increase which leads to a decline in the purchasing power in a country's currency*". Inflation rate therefore measures the changes over time of the consumer prices or the Gross Domestic Product (GDP) deflator which takes into account prices of goods and services produced in the country. This percentage cost of living is calculated using the consumer price index in Sierra Leone.

Basu (2011) in his study 'understanding inflation and controlling it' defines inflation as a sustained rise in prices across the board as opposed to relative changes in price of goods and services. It refers to a phenomenon where the average price of goods is on rising trajectory for a period of time. In economics, there are peculiarities that are specific to different regions and nations depending on their stages of development. Inflation can be ascribed to a general increase in money supply, excess demand, rises in public expenditure, change s in labour market, changes in costs and oil price increases among others. There are mainly three methods of measuring inflation; the GDP deflator, the Consumer Price Index (CPI) and the Wholesale Price Index (WPI). According to (Mburu, 2002) inflation is easy to spot but tricky to measure and the choice of the method of measurement is influenced by information available.

Sierra Leone adopted the use of CPI in 1961 and it has continued to be accepted as the most practical measure. The CPI method has weaknesses and biases such as not taking into account the change in the quality of goods and new products entering the market as well as the failure to capture the fact that relative prices change at different rates (Mburu, 2002).

1.1 Objectives of the Study

The aim of the study is to analyze the determinants of inflation in developing economies using Sierra Leone as a case study.

The specific objectives were:

i. To identify the major determinants of inflation in Sierra Leone; and
ii. To proffer policy recommendations on the cure to inflation.

II. Literature Review

2.1 Theoretical Review

2.1.1 Monetarism theory

This theory was put forward by Cagan (1956) who viewed inflation as being caused by monetary growth and focused on the demand for money during hyperinflation and asserted that expectations of future inflation rates depended on past inflation rates.

The theory on monetarism was brought forward by Friedman (1982) and in his theory he looks at the quantity theory of money and linked spending to the total amount of money in the economy. His theory asserts that inflation was as a result of an increase in the supply of money in the economy. He concludes that inflation occurs if the growth of money supply in the economy supersedes the economic growth.

The monetarist theory explains demand pull inflation as being caused by excess demand for goods and services which causes a positive output gap, whereby businesses respond by raising prices to increase their profit margin. This is attributed to increases in the money supply in the economy, depreciation of the exchange rate and reduction in the tax rates in an economy.

Monetarism maintains the view that inflation is as a result of higher rate of growth of money supply from the rate of growth in the economy, aimed at regulating the quantity, cost and allocation of money and credit in the whole economy. Moreover, it aims at achieving a set of objectives to maintain growth and stability in the economy. Therefore, any monetary policy seeks to stabilize both the exchange rates and prices, raise the level of employment, stable economic growth and interest rate smoothing.

2.1.2 Structural Perception of Inflation

This holds the view that inflation is brought about by structural rigidities in the economy as a natural consequence. According to Ndebbio (1993) these rigidities results mainly from imbalances in public finance where the government is unable to raise enough revenue to match with the expenditures increasing. An increase in food demand with a low growth of agricultural production and rigidity in foreign trade where exports do not raise revenues to match the increasing import demand also contributes to these rigidities. They insist that as long as these rigidities remain in place, inflation will be hard to reduce as these rigidities affect the relative price structure and hence the absolute or general price level.

2.1.3 Cost Push View

This came into being mainly in the 1950"s and 1960"s and asserts that pressure in wages and monopoly pricing policies cause inflation. They argue that with strong trade unions nominal wages keep going up once the price level goes up. The adjustment in wages should match up the price index so as to check inflation levels; however, the commodity shortages and crop failures coupled with high oil prices also cause inflation.

Cost push inflation is brought about by factors that make costs to go up, which include wages, exchange rates and costs of inputs that activate inflation through the supply side by causing costs of production and hence lower output. These costs are hence passed on to the consumers through higher prices. This is also referred to as wage push inflation since wages take the largest part of the total production cost (Zahoo & Shama, 2010) Supply shocks lead to a sudden change in the price of a commodity and this may be due to the shortage of a particular good. A good example of this would be oil prices and when used as an input the price further goes up due to the high exchange rate in the international market.

2.1.4 Phillips Curve Model

It shows the short-run relationship between inflation and unemployment. Phillips showed that the nominal wage growth was negatively correlated with unemployment and later in 1960 Samuelson and Solow found a negative correlation between inflation and unemployment and further referred it to the Phillips Curve. (Romer and Chow, 1996)

The model asserts that the rate of money wages has an inverse relationship with the rate of unemployment. This means that as wages go up the rate of unemployment goes down, the model suggests that the policy makers could choose between different unemployment and inflation rates. (Friedman, 1968)

Phillips observed that in the short run there was no trade-off between inflation and unemployment but in the long run inflationary policies would not increase or decrease unemployment. In the long run the Phillips curve is vertical at the natural rate of unemployment where the rate of inflation has no effect on unemployment. A similar pattern was found in other countries and therefore this means that fiscal and monetary policies could be used to stimulate the economy, raise the gap and lower unemployment. However, this view was disputed since in the 1970's countries experienced both high inflation and unemployment (stagflation) and Friedman was of the view that it was a short run phenomenon.

There is usually a trade-off between unemployment and inflation and monetary policy together with fiscal policy could be used as a variable to bring down the unemployment at certain inflation levels. The relationship was found to be unstable, however as people would anticipate inflation then policies were not able to lower unemployment and therefore leading to an outward shift on the Phillips curve due to high levels of unemployment and high inflation (Friedman, 1976).

Friedman together with Phelps argued that the Phillips curve would shift up when inflationary expectations rise and came up with the expectations augmented Phillips curve. However, in the long run, monetary policy cannot affect unemployment and therefore adjusts back to its natural rate called the non-accelerating inflation rate of unemployment also known as the long run Philips curve.

Friedman therefore provided an explanation for the shift and concluded that in the long run unemployment rate could not be affected by monetary policy because there was no trade-off between the wage rate and unemployment. This gave rise to the natural rate of unemployment and concluded that inflation had no impact on unemployment rate once individuals had expectations on the level of inflation. The authorities can influence unemployment through the supply side by providing information to the labour market. (Friedman, 1968) With expectations the faster the prices are expected to rise , the faster money wages demand will rise for a given level of unemployment. It asserts that in the long run the wage earners will anticipate inflation and this leads to the Phillips curve being a straight line this gave rise to the augmented Phillips curve (Friedman, 1976).

The rational expectations on the other hand, imply that the short run Phillips curve is vertical and that systematic, fiscal and monetary policies have no impact on unemployment. Only unanticipated policies affect the real side of the economy and agent can forecast then there is no impact. It assumes that people make expectations on inflation depending on all information economically available about the given variable. This led to the long run Phillips curve collapsing in the short run and in this case any inflation brought about by a government policy are anticipated and therefore influence unemployment when they first appear. Under adaptive expectations, people form expectations about the future and are adaptive since they look at the previous behaviour of inflation and the expected inflation is a weighted average of current and past inflation rates. (Friedman, 1976)

2.2 Empirical Literature

According to Hume (1980) an increase in the money supply in the economy increases the general price level through a different transmission mechanism. This may occur because when the money supply increases, the volume of goods and services demanded also increases. The increase in nominal cash balances of economic units initially results in higher

expenditures for goods, and therefore in higher production. Then, under the assumption of underemployment, prices start to adjust to a rise in money supply.

Killick & Mwega (1990) in their paper monetary policy in Kenya notes that inflation in Kenya has never gone above 25% with moderate price increases after independence. They assert that monetary policy plays a crucial role to the performance of the Kenyan Economy.

Chhibber (1991) after analyzing economies of some African countries concludes that inflation is caused by four main factors; cost push factors emanating from currency devaluations, demand pull forces created by excessive credit expansion in the economy, balance of payment problems and controlled prices that deviate from the prevailing market prices and the readjustment of these prices cause inflationary shocks.

Easterly & Schimdt-Hebbel (1991) assert that inflation has mainly been caused by seigniorage revenue especially during economic and political crisis, whereby the government prints more money to be in circulation.

Cardoso (1992), Powers (1995), Ravallion (1998), and Braumann (2004) find that there is a positive correlation between inflation and poverty. Chaudhry & Chaudhry (2008) found that food price inflation increases poverty in Pakistan.

Sowa & Kwakye (1993) explained that inflation in Ghana could be explained more by the monetary factors and formulated a model showing the sources of inflation as monetary factors, real factors and expectations i.e. P=f (M, Y, E, Pe). Inflation is seen as dependent on both the growth of money and output and rate of exchange that is the domestic price of foreign currency and price expectations. They found out that monetary pressure was a strong force in Ghana's inflation and exchange rate devaluations have an effect on inflation but supply factors constituted a much stronger inflationary force than monetary factors but exchange rate adjustments did not show a strong influence on inflation therefore a multifaceted issue with many causes.

Kallon (1994) uses a structural equation for inflation and estimates using the two-stage least squares with variables including growth of narrow money growth, growth of real government expenditure, real Gross National Product (GNP) growth, import price inflation, percentage in the treasury bill rate, change in interest rate differential and inflation expectations. In his analysis, he found out that money growth raise inflation and that a one per cent increase in money growth leads to a 0.5 per cent in the increase in inflation over four quarters and 1.3 per cent in the long run. Real GDP growth was found to lead to a higher inflation and expectations. Inflation was found to be insensitive to import price inflation or increases in gernment expenditure and concludes that authorities should use monetary restraint and aggregate demand policies to counter inflation.

Bowa (1994) in his paper the determinants of the inflationary process in Zambia observes that the inflationary process in Zambia was attributed to monetarists and structuralist's schools of thought and changes in money supply and exchange rate adjustments were found to be significant determinants of inflation. Tightening of monetary and fiscal policies was essential to reduce money supply changes. His findings revealed that an increase in money supply led to a 1 per cent rise in the rate of inflation within two years.

Ndungu (1996) in his paper on inflation in Kenya asserts that inflation emanates from cost push factors, due to currency devaluation, demand pull forces where excessive credit expansion causes excess demand, balance of payments crisis and controlled prices which deviate from market prices causing shocks. He observes that the monetary base, exchange rate, real income growth and interest rate have an effect on the rate of inflation in a country and concludes that exchange rate is more important than monetary factors in explaining the inflationary process in Kenya and that inflation and money supply leads to the depreciation of the nominal exchange rates.

Bernanke & Mishkin (1997) in their paper inflation targeting, ''A new framework for monetary policy" observes that inflation targeting involves the announcement of an official target ranges for the inflation rate and therefore conclude that monetary policy aims at having a low and stable inflation. They observe that it involves the announcement by the government's central bank that in the future it will strive to hold inflation at some numerically specified level. They are often in ranges rather than single numbers and cover a period of years and their view on inflation targeting offers transparency of policy by making their intentions known to the public and moreover increasing central banks accountability and coherent policy making.

Romer & Chow (1996) found out that a prudent monetary policy which aims at low inflation and steady growth, may lead to an improved life for the poor in the long run and reduce the value of the cash holdings and therefore making the poor poorer. While analysing the effect of political stability on inflation, Aisen & Veiga (1999) asserts that inflation leads to the reduction of the welfare of people in the society and economic growth and found out that political instability can lead to higher inflation levels especially in developing nations. Moreover, political instability has an effect on the efficiency of the tax system and hence government revenues used due to tax evasion and people holding the government responsible for economic outcomes and a rising demand for public expenditure which may end up being financed by inflation tax. (Edward, Tabbellini & Cukierman 1992)

Mburu (2002) argues that the inflationary pressure in Kenya in the decade of 1970's was mainly supply side due to changes in external prices, he also observes that in the 1980's there was excessive deficit financing which resulted to seigniorage and in the 90's there was excess liquidity leading to rise in prices due to monetary expansion in the economy. He explains the inflation trend and concludes that inflation targeting has succeeded in bringing inflation rates down in Kenya; however; he adds that inflation control measures should be undertaken together with other policies.

Bernanke & Reinhart (2004) is of the view that the consumer price index portrays the increase in price for poor households and is mostly confined on food, fuel, medicine, and some essential commodities. This would therefore mean inflation for the poor is the increase in price of the most essential commodities.

It is observed that with higher levels of inflation, the perception of corruption levels increased in a developing nation and as the level of prices increased corruption went high (Belasen & Peyton, 2006).

Gottschalk et al (2008) in their paper on analysing determinants of inflation when there are data limitations in the case of Sierra Leone, they use the structural vector auto regression approach to help forecast inflation and find out that domestic inflation increases with higher oil prices, higher money supply and leads to nominal wage depreciation.

The purchasing power of the poor may shrink if commodities rise and makes it harder for the poor who may be surviving on a limited budget. This would be due to the fact that their incomes do not increase in the same rate as prices increase. (Wilson, 2011).

In analysing inflation in Uganda, Kabundi (2012) uses the error correction model to analyses the dynamics of inflation and found out that in the short run and long run external and domestic factors contribute to inflation causation with the agricultural sector being affected by the demand and supply of it commodities.

Hachicha et al (2013) on inflation uncertainty and output in Tunisia, concludes that recession in an economy may be brought about by inflation uncertainty in an economy. Inflation rate being a monetary and a fiscal phenomenon and coupled with other internal and external factors is influenced by deficit financing depending on whether government decides to borrow internally or externally or resulting to seigniorage to finance its budget especially in developing countries and expectations on how the price level may change in the future may make residents to speculate (Kallon, 1994)

Devarajan & Fengler (2013) observes that inflation hurt the poor especially in the developing countries who have to cut on their spending when faced by inflation. This would lead down to cutting on the expense of vital items like education and healthcare, in his opinion this makes inflation the worst tax to the poor. Inflation is a serious concern for the common people, Cambell & Shiller (2001) found that there may be a difference bet ween how common people and economists perceive inflation and non-economist s see that inflation may lower the people's standard of living. Easterly & Fischer (2001) found out that inflation affects the poor more than the rich.

According to Kiptui (2013) Kenya's inflation rate is driven by domestic developments in the medium to long-term but in the short-term other factors come into play and contribute to the inflationary pressure. He asserts that movements in inflation are as a result of price developments abroad and real exchange rate changes. He uses the p-star model to explain the effect of policy change in a timely manner making it possible to achieve price stability and consistency between monetary policy decisions and the macro environment.

III. METHODOLOGY

The study makes use of the Ordinary Least Squares (OLS) for estimation. It is preferred because of its ability to explain the effects of one variable resulting from changes of other several variables. The regression was done using Stata version 12.

3.1 Data Type and Source

The research made use of secondary data, time series data extracted from the Bank of Sierra Leone and the World Bank World Development Indicators.

3.2 Model Specification, Estimation Techniques and Basic results.

The study adopted a model used to analyse inflation in Tanzania in 2001 by Laryea and Sumalia where they observe that in the short run output and monetary factors influence inflation while in the long run exchange rate, output and monetary factors do.

Pt = f (Mt,Yt, Et, Pt-1, Ptf) …….. Equation 1

Where:

INF - Inflation rate

Mt – Money supply
Y – Nominal output
RER– real exchange rate
CBR – real interest rate
However, to analyse the Sierra Leone case, the study sought to add the following variables to the equation.
Central Bank Rates - (real interest rate)
Money supply
Real exchange rate
Cross domestic product
Error term- ε
The model therefore takes the following functional form.

$INF_t = f(GDP, RER, MS, RIR)$ ……. Equation 2

$INF_t = \beta_0 + \beta_1 GDP_t + \beta_2 RER_t + \beta_3 MS_t + \beta_4 CBRt + \varepsilon$ ……Equation 3

Assuming that the price of non-tradable depend on the money market equilibrium while prices of tradable depends on foreign prices and are therefore determined in the world market.
Political instability was a dummy variable that took the value 0 or 1 and corruption perception was an index.

3.2 Analysis And Data Exploration Techniques

3.2.1 Pre-Estimation Tests

Stationarity tests

For data to be valid, the data sets must be stationary, that is the mean and the variance of the data set is time independent and they are constant over time, to test for stationarity the study made use of the order of integration. If a series is integrated of order (0) i.e. I (0) then it is stationary but if otherwise it is non-stationary and to test for stationarity, the research made use of the Dickey Fuller Unit Root Test. (Gujarati, 1995).

Augmented Dickey Fuller Unit Root Test

This test is derived from the Dickey Fuller test and it is an appropriate method of checking whether a variable is integrated of orders one which was proposed by Dickey & Fuller (1979). However, due to the fact that the dickey fuller test may suffer autocorrelation in the residual process if OLS is applied, we made use of the augmented dickey fuller test. This is because the errors may not be normally and identically distributed and the residual variance may be biased. The test can be used to test the order of integration for a variable generated with a drift from and a deterministic trend. The null hypothesis may be taken to mean prices follow a random walk and future prices cannot be predicted while the alternative may mean economic agents may predict future prices and the do not follow a random walk (Gujarati, 1995).

Multicollineality

When Multicollineality exists among explanatory variables, it is impossible to get unique estimate of all parameters. The explanatory variables should not be correlated, this is because if they are correlated the determinant will be zero and the variance cannot be found.
This therefore makes it difficult to draw statistical inference about them from a given sample. The Ordinary least squares remain the best linear unbiased estimator as long as there is no multicollinearity.
The problem of multicollineality may lead to large variances and standard errors of the OLS estimators, wider confidence intervals, insignificant t ratios, high values of t ratios and high values of R2. It also makes the OLS estimators and their standard errors to be sensitive to small changes in the data.
When multicollineality exists, there could be wrong signs of the regression coefficients and in the presence of serious multicollineality problem. This could be solved by having prior information on the parameters, transformation of variables acquisition of new data, dropping one of the variables in the model or rethinking the model all together. (Gujarati, 1995).

Heteroscedasticity

This problem occurs when the variances of the population are not constant or unequal. The problem of heteroscedasticity is tested using the Breusch-Pagan test.
If the chi-square value obtained exceeds the critical chi-square value, the null hypothesis of no heteroscedasticity is rejected. (Gujarati, 1995).

Autocorrelation
For the ordinary least squares to work there must be no autocorrelation that is the current error term must not be correlated with the previous error term. There should not be correlation between observations ordered in time. When there is no autocorrelation, it simply means;
E (Ui, Uj) = 0 where ij
The expected value of the two error terms Ui and Uj is zero. This means that the disturbance term relating to any observation is not influenced or related by the disturbance term relating to another observation.
Autocorrelation may occur due to various reasons and one such cause is due to inertia or sluggishness. Time series such as price indices and GNP may experience business cycles where there are fluctuations in the economic activities causing interdependence.
This phenomenon autocorrelation may also occur due to error in the model specification either by being stated in the wrong functional form or some important variables being omitted in the model. Data manipulation may also cause autocorrelation and here the Durbin Watson test is used to check for autocorrelation. (Gujarati, 1995).

Normality Tests
This test seeks to prove that the error term is normally distributed and is based on the assumption that Ui is normally distributed. The research will make use of the Shapiro-wilk test for testing for normality (Gujarati, 1995).

Testing for structural stability of regression models.
This test is used when dealing with time series data and there may be a structural change between the dependent variable Y and the explanatory variables the X's. This will be achieved by dividing the data into two sets, and for the purpose of this research investigate whether shocks in the economy had an impact on the inflation rate.

IV. Discussions

4.1 Descriptive Statistics
This section briefly discusses the basic statistical properties of the relevant variables of the study. Table 4.1 presents the descriptive statistics of the variables. From Table 4.1, it is evident that all the variables have positive average value (mean). It can also be seen that export (INF), GDP are positively skewed, implying that majority of the values are less than their means. On the other hand, foreign direct investment (LNRER), log of money supply and (RIR) are negatively skewed implying that majority of the values are greater than their means.

Table 4.1 Descriptive Statistics Result

Variables	Inflation	GDP	LNRER	LNMONEY_SUPPLY	RIR
Mean	30.60430	1.82302	6.176300	25.53019	0.424853
Median	17.18548	1.114009	7.545913	26.04895	3.718932
Maximum	165.6766	5.026509	9.106115	29.77496	27.14598
Minimum	-6.00873	4.907808	0.048597	19.37923	-51.61725
Std. Dev.	36.44274	1.34809	2.834832	3.204831	17.78324
Skewness	1.946375	1.065376	-1.087674	-0.503538	-1.027926
Kurtosis	6.806119	2.771228	2.792628	2.104442	3.548961
Observation	40	40	40	40	40

Source: World Bank, World Development Indicators 2023

4.2 Correlation Matrix

In order to address the problem of multicollinearity in the model, the research estimates a correlation matrix to determine the extent of correlation among the variables. Correlation explains the magnitude to which a change in one variable alters the other. If there is correlation among two variables that is above 70%, then there is a multicollinearity in the model. However, Table 4.2 shows that the model is free from multicollinearity because the highest value of correlation is 89.7% between real interest rate (RIR) and money supply (LNMS). Thus, the result shows a negative relationship between inflation and Real interest rate and money supply, whilst a positive relationship is found to exist between inflation and the other independent variables.

Table 4.2 Correlation Matrix

Variables						
INFLATION	1.0000					
GDP	0.101127	1.0000				
LNRER	0.225996	0.476119	1.0000			
LNMS	-0.29163	-0.27192	0.375566	1.0000		
RIR	-0.89764	-0.04847	-0.27597	-0.27802	1.0000	

Source: World Bank, World Development Indicators 2023

4.3 Stationarity Test

Although the bound test Autoregressive Distributed Lag (ARDL) approach to cointegration does not require the pretesting of the variables for unit roots. It is important to conduct this test to confirm the order of integration of the variables. Hence, in order to ensure that some variables are not integrated at higher order, there is a need to complement the estimated process with unit root tests. In view of this, prior to applying the (ARDL) approach to cointegration, unit root tests were conducted in order to investigate the stationarity properties of the data. Therefore, the Augmented Dickey-Fuller (ADF) and Phillips Perron (PP) tests were applied to all variables in levels and in first difference in order to determine their order of integration and confirms stationarity. The maximum lags length used were determined based on the lag selection by Schwartz-Bayesian Criterion (SBC) and Akaike Information Criterion (AIC). The results of both Augmented Dickey-Fuller and Philips Perron for unit root with intercep t only in the model for all variables are presented in Table 4.3

Table 4.3 Stationarity Test Results

Variables	**Augmented Dickey-Fuller**		**Phillips Perron**		**Order of integration**
	Level	**1st difference**	**Level**	**1st difference**	
INFLATION	-4.058308	-5.166383	-3.960908	-13.15331	I (1)
GDP	-0.220257	-4.963463	-0.250070	-3.511695	I (1)
LNRER	-2.638488	-1.660394	-4.412058	-1.817507	I (1)
LNMS	-0.440295	-5.189516	-0.693993	-5.185889	I (1)
RIR	-4.775951	-3.457415	-4.779569	-10.80026	I (0)

Source: World Bank, World Development Indicators 2023

Note: 5 percent level of significance, with critical value = -2.9411

From the unit root test results in Table 4.3, it found that all of the variables are integrated of order one I (1), that is non-stationary, except RIR that are I (0), that is stationary at levels. The decision rule states that we accept the null hypothesis if the absolute critical value at 5% level significance is greater than the absolute t-statistic value.

From Table 4.3, it is clear that the corresponding critical values at level for each of the I (0) variables is greater than the t-statistic values, hence we accept the null hypothesis at level and conclude that the variables are non-stationary. But at first difference, the corresponding critical value at 5% is less than the t-statistic values of these variables, and we therefore reject the null hypothesis and accept the alternative hypothesis, and conclude that INF, GDP, LNMS and RER are stationary at first differencing for both ADF and PP tests, which shows that these variables are integrated order one I (1)

Similarly, the corresponding critical value for RIR is less than the t-statistic value. Hence, we reject the null hypothesis and conclude that these variables stationary in levels, i.e. they are integrated of order zero I (0). Since the unit root test results above confirmed the absence of I (2) variables, the ARDL framework is used for estimation.

4.4 Lag Selection

In order to estimate the ARDL model, there is a need to determine the optimal number of lag length based on the lag length criteria such as sequential modified LR test statistic (LR), Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SC), and Hanna-Quinn information criterion (HQ) were employed to determine the appropriate lag length.

Table 4.4 Lag Length Selection Result

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1506.055	NA	2.045629	81.67864	81.89633	8175539
1	-1261.449	409.8795	1.453424	69.80807	71.11422*	70.26855*
2	-1232.271	41.00782*	1.2567234*	69.58220*	71.97681	70.38701

Source: World Bank, World Development Indicators 2023

From the result in Table 4.4, lag length of 2 was chosen as the maximum lag length based on the Akaike Information Criterion (AIC) and Final Prediction Error (FPE). Therefore, this study uses two lags for each of the variables. This is also consistent with Pesaran and Shin (1999) who recommended choosing a maximum lag length of 2 for small sample annual data.

4.5 Bound Test for Cointegration Analysis

Fundamentally, the primary objective of this study is to assess the main determinants of export performance in Sierra Leone. In view of this, it is essential to test the existence of long-run relationship among variables within the framework of the bounds testing approach to cointegration. The decision rule states that the null hypothesis, of no co-integration, must be accepted if the f-statistic is less than the lower bound. However, if the computed F-statistic is less than the lower critical bound, then the test fails to reject the null hypothesis, suggesting that a long-run relationship does not exit. Thus, the results of the ARDL F-bounds test are computed below in Table 4.5.

Table 4.5 Bounds Test Cointigration Result

Test statistic	Value	Signif.	I (0)	I (1)
Asymptotic: n=1000				
f-statistic				5.927731
				10%
2.2				3.09
k	4	5%		
2.56	3.49			
2.5%	2.88			3.87
1%	3.29	4.37		

Source: World Bank, World Development Indicators 2023

Based on the results in Table 4.5, we conclude that the calculated F-statistic 5.927731 is higher than the upper bound critical value at the 5 percent level of significance (3.49). This simply shows that the null hypothesis of no cointegration is rejected at the 5 percent level and that there is indeed a cointegration relationship among the inflation and its determinants. Therefore, the study proceeds to estimate both the long-run and short-run models within the ARDL framework. The long-run result is presented in Table 4.6.

4.6 Long-Run Estimation

Table 4.6: Ardl Long-Run Result

Variables	Coefficient	Std. Error	t-Statistic	Probability
GDP	-2.615309	2.947609	-0.889667	0.3797
LNRER	-0.001342	0.001696	-0.791374	0.4341
LNMONEY_SUPPLY	1.533390	0.156902	9.772903	0.0000
RIR	-1.889296	0.129298	-14.61199	0.0000

Source: World Bank, World Development Indicators 2023

The result from the long-run estimates in Table 4.6 reveals that gross domestic product (GDP), real interest rate (RIR), and real exchange rate (LNRER) and money supply are the main long-run determinants of inflation in Sierra Leone. Specifically, the result reveals a negative relationship between real exchange rate and inflation in the long-run with statistically significant coefficient at the 5 percent significance level. A decrease in real exchange rate (depreciation of the Leones) by 1 percent will cause inflation to improve by approximately 0.5 percent during the study period. The implication of this result is that a stable and depreciating exchange rate makes local products cheaper in the foreign market thereby making encouraging producers to undertake investment, innovation and trade. This may also create a tention in the market that leads to higher inflation. The above result is in line with most studies, including Apkan (2008) and Kin Sibanda (2012) on exchange rate and economic growth relationship.

However, Tarawallie (2010) found a positive relationship between real exchange rate and inflation in Sierra Leone.

Similarly, the real interest rate is statistically significant at the conventional level, with a negative effect on inflation during the study period. This result is not astonishing, as the interest rate decrease by 1% it will lead to an increase in the inflation by (1.889296). The result further shows that money supply was found to be positive determinants of inflation in Sierra Leone. A 1 percent increase in money supply (MS) will in increase in inflation by 1.5 percent in the long-rum.

4.7 Short-Run Estimation

The estimation of short-run model with the Autoregressive Distributed Lag Model (ARDL) is based on the Akaike Information Criterion (AIC) employed. From Table 4.7, the results of the short-run estimates reveal that gross domestic product (GDP) and the real exchange rare are significant in explaining the dependent variable in the short-run although they are not significant in the long-run. However, cross domestic product exhibit positive relationship in both the short-run and long-run. The short-run result as reported in Table 4.7 reveal that real interest rate has negative impact on inflation in the short-run. Specifically, a 1 percent increase in the interest rate will reduce inflation by 1.4 percent. The result indicates that the decrease in the interest rate will cause an increase in the outflow of money supply which will leads to an increase in the inflation rate. However, the short-run result is consistent with the long-run findings on the impact of money supply (MS) on inflation.

Table 4.7: Error Correction Model Representation For Selected ARDL Model- ARDL (1, 0, 1, 0, 2, 0, 1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	297.6355	120.4525	2.470978	0.0198
D(GDP)	8.7160209	4.493409	1.941342	0.0623

D(LNRER	12.28775	10.74664	1.143404	0.0022
D(LNMS(-1))	9.201285	23.77182	0.387067	0.7016
D(RIR)	-1.388759	0.147888	-9.390639	0.0000
ECT(-1)*	-0.822657	0.114687	-7.173054	0.0000

R-squared	0.951612	Mean dependent var	32.14427
Adjusted R-squared	0.936059	S.D. dependent var	36.71819
S.E. of regression	9.284753	Akaike info criterion	7.515558
Sum squared resid	2413.786	Schwarz criterion	7.946502
Log likelihood	-132.7956	Hannan-Quinn criterion	7.668885
F-statistic	61.18446	Durbin-Watson stat	2.402940
Prob(F-Statistic)	0.000000		

Source: World Bank, World Development Indicators 2023

From the short-run result, the coefficient of the error correction term ECT (-1) has a negative sign with a statistically significant coefficient at the one percent level. With a coefficient of 0.82, the result indicates that approximately 82 percent of the disequilibrium caused by previous year's shocks converges back to the long run equilibrium in the current year. The result indicates a high speed of adjustment to long-run equilibrium.

It further reveal that the value of the R- squared is 0.951612, indicating that approximately 95 percent of the variation in the dependent variable (inflation) is well explained by the exogenous variables, which is an indication of a very good fit. The overall model is highly statistically significant as shown by the probability value of the F-statistic (0.000000). Moreover, the Durbin-Watson statistic of 2.402940 confirms the existence of no autocorrelation in the residuals and therefore ensures that the estimated results are not spurious.

4.8 Diagnostic Test

Inflation performance models were subjected to various diagnostics tests. The model was tested for serial correlation, heteroscedasticity, normality, and stability. These diagnostic checks are based on the null hypothesis that: EZ there is no serial correlation for the LM test; there is normality for the Jarque-Bera test, there is no heteroscedasticity for the White heteroscedasticity test and all coefficients are stable.

4.8.1 Serial Correlation

The null hypothesis cannot be rejected as the probability value is greater than the normal 5 percent requirement of no serial correlation in the model. Therefore, the model is free from serial correlation as shown in Table 4.8.1

Table 4.8.1: Serial Correlation Result

F-statistic	2.560270	prob. F (2, 26)	0.0966
Obs*R-squared	6.252479	prob. Chi-square (2)	0.0439

Source: World Bank, World Development Indicators 2023

4.8.2 Heteroscedasticity Test: BREUSCH-PAGAN-GODFREY

The estimated model passes the test for heteroscedasticity test based on the regression of squared residuals on squared fitted values. The White Heteroscedasticity test below clearly shows that the p-value of about 0.0080 which is approximately 48 percent is more than the critical value of 5 percent.

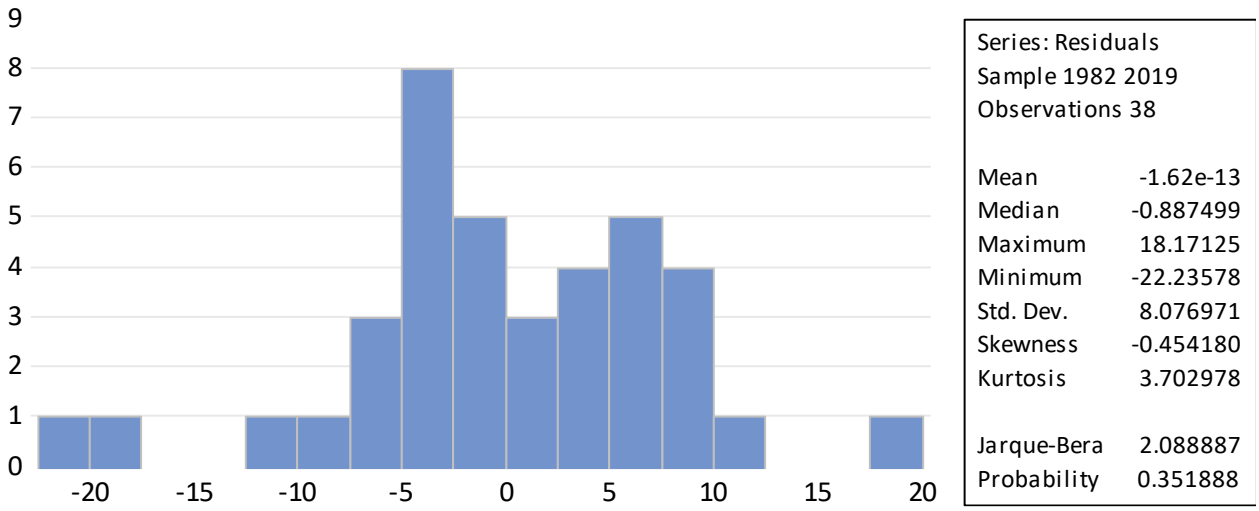
Table 4.8.2: Result of Heteroskedasticity

F-statistic	3.243485	prob. F (9, 28)	0.0080
Obs*R-squared	19.39579	prob. Chi-Square (9)	0.0220
Scaled explained SS			14.23210
prob. Chi-Square (9)	0.1143		

Source: World Bank, World Development Indicators 2023

4.8.3 Normality Test

The model also passed the Normality test based on the Jarquer-Bera value of 2.08887 and the probability of 0.351888 which is above the required normal 5 percent level. Hence, the residuals are normally distributed across observations as shown in Figure 1. **Figure 1: Normality Test**

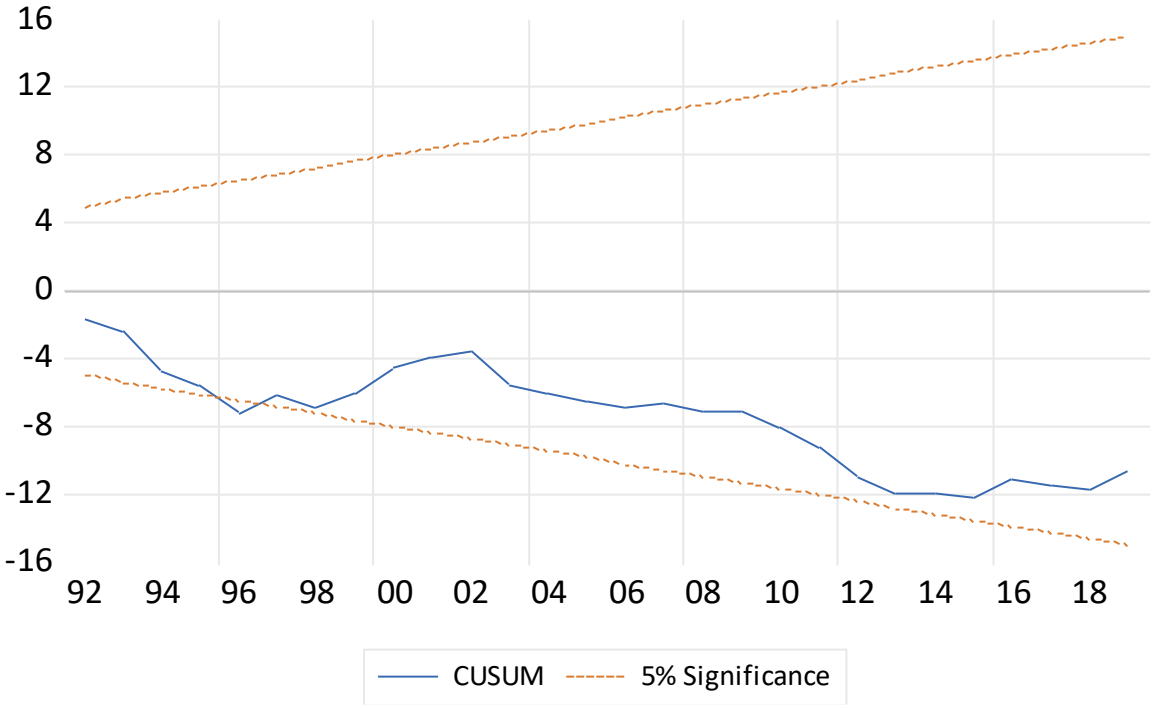


Source: World Bank, World Development Indicators 2023

4.8.4 Stability Test

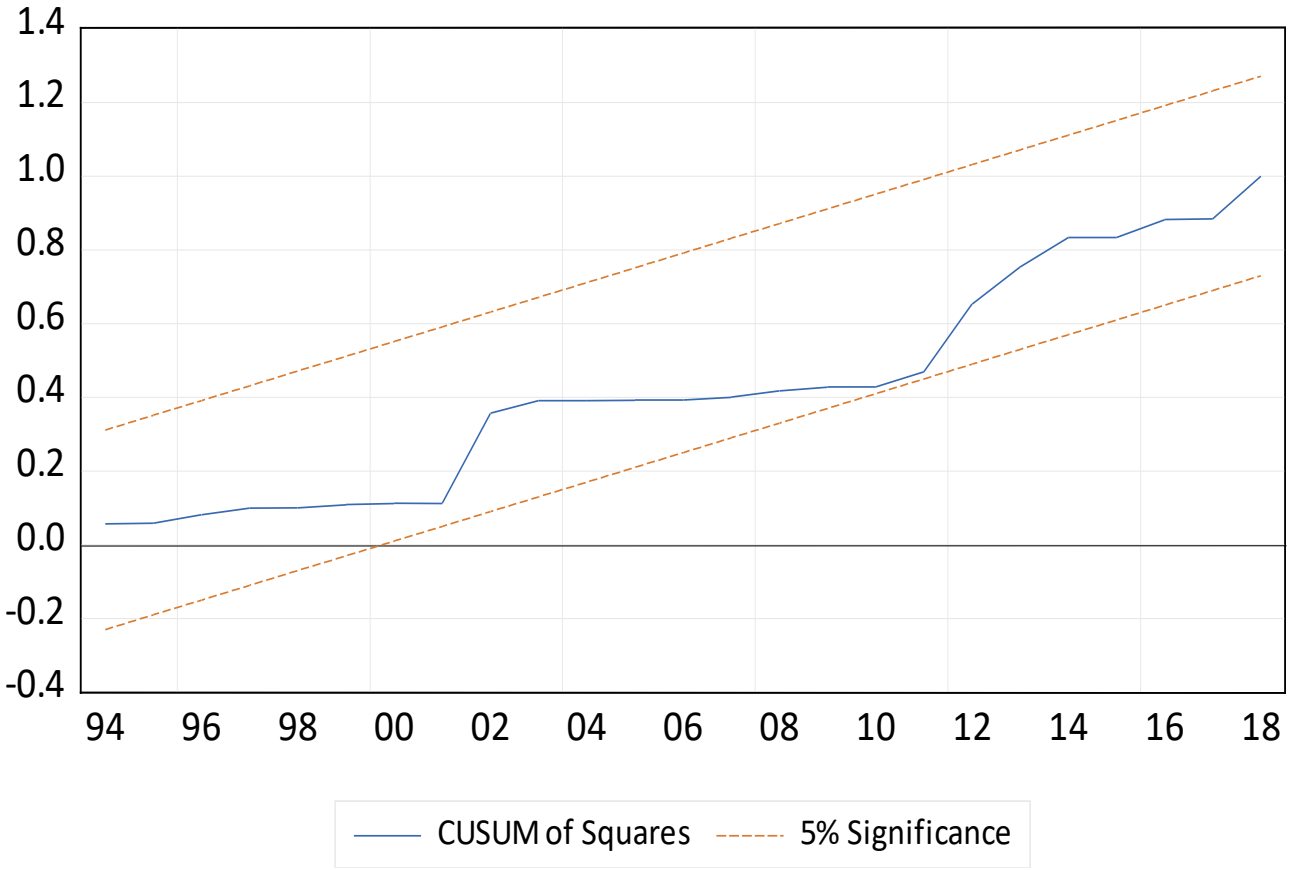
Pesaran and Pesaran (1997) suggests that the test for the stability for parameters using cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares of recursive residuals (CUSUMSQ) plots be conducted after the model is estimated. This is done to get rid of any bias in the results of the estimated model due to unstable parameters. The results for CUSUM and the results depict that the plots of CUSUM and CUSUMSQ for the estimated ARDL model shows CUSUMSQ are depicted in Figure 2 and Figure 3 respectively.

Figure 2:



Source: World Bank, World Development Indicators 2023

Figure 3: Result of CUSUMSQ Test for Stability



Source: World Bank, World Development Indicators 2023

V. Conclusions

The primary objective of the study was to investigate the determinants of inflation in developing economies using Sierra Leone as case study for the period of 1994 – 2018. The In order to achieve the objectives, the study employed the autoregressive Distributed Lag (ARDL) approach to cointegration to examine the long-run and short-run dynamics among the variables used in the estimation. Inflation was used as the dependent variable and the explanatory variables used were gross domestic product, money supply, real exchange rate, and real interest rate. All tests and estimations were conducted with the help of EViews 12 package.

Before estimating the model, time series characteristics of data were tested using the Augmented Dickey-Fuller (ADF) and Phillips-Perron test statistics. The unit root results suggested that whilst some variables were stationary at levels, others became stationary at their first difference. The study then proceeded to examine the long-run and short-run determinants of inflation in Sierra Leone. The bounds test results confirmed the existence of cointegration which established the existence of long run relationship between inflation and its determinants. The long-run result revealed that gross domestic product, money supply, real exchange rate and real interest rate are the main determinants of inflation during the study period. In the short run analysis, the result revealed that money supply and interest rate are the statistically significant variables in explaining inflation during the study period.

With a coefficient of 0.82, the result showed that approximately 82 percent of the disequilibrium caused by pr

evious year's shocks converges back to the long run equilibrium in the current year.

The diagnostic test further revealed that approximately 95 percent of the variation in the dependent variable (export performance) is well explained by the exogenous variables, Overall model is highly statistically significant as shown by the probability value of the F-statistic (0.000000).

The plots of the cumulative sum of recursive residuals and the cumulative sum of squares of recursive residuals stability test for the model indicated that all the parameters estimated were stable over the study period.
Central Bank Rate (CBR) and economic growth are the main instruments policy makers should aim at in controlling the inflation rate. According to the result, central bank rates and GDP growth rate are significant determinants of inflation rate during the study period. According to the result, an increase in CBR will lead to an increase in inflation.

Therefore, policy makers should adopt policies that cushion an increase in central bank rates. Interest rate is the major tool used by the central bank to achieve inflation target. Changes in this interest rate affect various kinds of economic activity and thereby, over time, inflation. Interest policy is effective in reducing the supply of money thereby reducing the rate of inflation. Economic growth has a negative impact on the rate of inflation. This implies that an increase in economic growth reduces the level of inflation. Therefore, policy makers should embrace fiscal policies that spur economic growth in order to contain an increase in inflation.

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