The Determinants of Inflation in Sierra Leone: A Cointegration Analysis

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Abstract

The Sierra Leone economy has been plagued over the years with inflationary trends, monetary instability and economic vulnerability largely due to persistent resources mismanagement, pre and post war corruption, weak coordination in policies (monetary and fiscal) and the disruption of economic activities caused by social disorder. This study is therefore aimed at investigating the determinants of inflation in Sierra Leone between the period 1990 and 2013 despite immense data limitation. The Augmented Dickey-Fuller test result showed that the variables were integrated in the same order. The Johansen Cointegration result suggested that there are at most four cointegrating vectors among the estimated variables. The estimated coefficient of the ECM revealed that the speed of adjustment for errors in the long run is 74.82 percent and that in the short run, the explanatory variables money supply and GDP significantly and positively contributed to the inflation rate in Sierra Leone while interest rate is having a negative but significant relationship. There is no significant relationship among exchange rate; import of goods and services to that of inflation rate in the short run. The explanatory variables accounted for 75.40 percent of the variations in inflation during the period of study with the error term accounting for the remaining 24.6 percent. All the independent variables have significant effect on inflation in the long run with money supply and GDP contributing positively while exchange rate; interest rate and import contribute negatively. Money supply should be controlled in the short run and better channeled in the long run.

Keywords: Cointegration, Exchange Rate, Gross Domestic Production, Inflation; Interest Rate; Money Supply.

1.0 Introduction

Inflation is a complex macroeconomic phenomenon that has the potential to negatively impact economies around the world. Dealing with this macroeconomic phenomenon is getting to know its roots cause. The concept of Inflation is widely known and can be characterized by "a state in which the general price level is rising persistently and the market value of money falling over a period of time". Inflation can be attributed to the phenomenon in which too much money chases too few goods. It can be mild; creeping; runaway or galloping. Extreme cases of inflation are not desirable in any economy. Inflation rate above 50% can be classified as hyperinflation and above that point, the currency of the said economy would loses its value as the case reported of Germany in 1923 when it inflation rate exceeded 1 million percent; the same as the present day Zimbabwe. Inflation below zero percent is categorized as deflation; which the Japanese economy suffered the 90s. The effects of inflation can affect the production pattern in an economy; the level of income distribution; consumption and welfare of the citizenry; foreign trade; the socio-political atmosphere could also be heated and manufacturers also are of no exception.

Measuring inflation is a major challenge for government statisticians. To achieve this, a number of goods which serve as representative of the economy are put together into a market basket. The cost of the basket is then compared over time. Sierra Leone is believed to be using the consumer's price index (CPI) in its calculation for the rate of inflation. Many a times, inflation is been overstated by government statisticians due to problems of "quality adjustment bias and substitution bias". This was brought to bear by a government commission in the United States of America in 1995-1996 headed by Michael Boskin of Stanford University. His commission concluded that inflation is normally overstated by 1-2 percentage point annually due to the fact that quality improvement that is sometimes accompanied by an increase in the price of a good or service is normally not considered when measuring price changes; this give rise to the problem of quality adjustment bias. On the other hand, an increase in the prices of goods and services that have close substitutes might lead consumers to switch to the consumption of the cheaper substitute product (all things being equal), but CPI is based on the notion that consumers purchase a fixed basket of goods and services over a period of time ignoring the fact that the consumer has substituted his consumption to the cheaper product. This inflates the CPI because of the problem of substitution effect that was ignored.

Unanticipated inflation can lead to: creditors losing out to debtors; people with fixed income faces a decline in their purchasing power and subsequently their standard of living; and domestic products would be less competitive if the inflation rate is greater than that of other countries.

When there is an increase in the cost of production normally occasioned by trade union pressure on wage rate; business monopoly power; increasing prices of raw materials that results in the fall of aggregate supply give rise to cost push inflation. Demand pull inflation on the other hand arises when aggregate demand

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surpasses aggregate supply. Whilst structural inflation arises due to unstable and slower growth rate in the production, marketing and distributive systems of the economy.

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 a 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 includes: the temporal removal of import duties on rice and a reduced excise duties on petroleum. These measures were backed up by a stable exchange rate and domestic food 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 1990 to 2013.
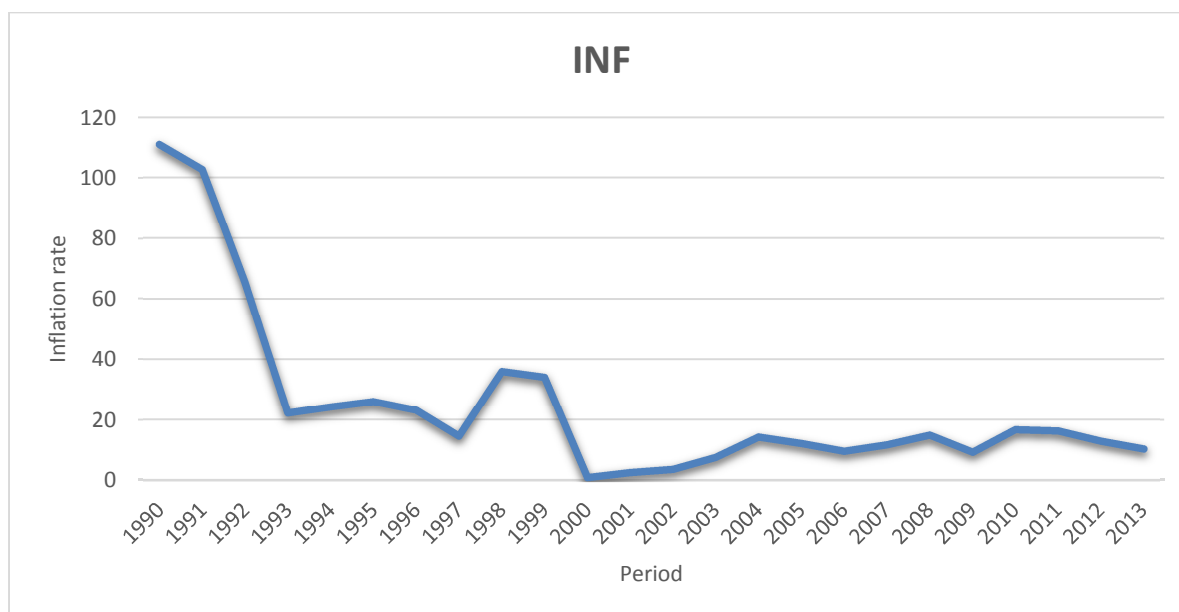

Figure 1: The inflationary trends in Sierra Leone for the period 1990 to 2013
Source: Author's estimate from Microsoft excel.

Figure 1 shows the inflationary trend for Sierra Leone from 1990 to 2013. It depicts a very high inflation rate of over 100 percent from 1990 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'etat 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.

The aim of this paper therefore, is to contribute to the existing literature on the aspect of the determinants of inflation in Sierra Leone using annual data and cointegration analysis that account for the long-run equilibrium relationship among the variables. The result of this study will be useful to policy makers in enhancing economic growth in the Sierra Leone economy.

The rest of the paper is organized as follows; section 2 Literature Review, section 3 Methodology, section 4 Estimation of result and discussion, section 5 Conclusion and Recommendations.

2. Literature Review
2.1 Theoretical Literature
Inflation as a macroeconomic phenomenon is looked upon differently by different schools of thought and different ideological view point. The quantity theory of money was the key to the classical view of inflation. The theory was primarily based on the Fisher's Equation of Exchange: MV = PT; where M is the amount of money in circulation, V is the velocity at which money circulate, P is the average price level and T is the number of transactions taking place. This theory argues that, all things being equal, there is a direct proportion between money supply and price level.

The Keynesians on the other hand did not agree that money supply and price level are at equal proportion instead they believe that an increase in money supply would reduce the velocity at which money circulate but would increase the transaction rate. They believe that inflation occurs when the aggregate demand for final goods and services are in excess of the aggregate supply at full or near full employment. This is as a result of an excessive increase in investment which create more jobs and hence the supply of goods and services are inadequate to catch up with the growing demand hence an increase in the price level.

Inflation in the Fed's view is when the prices of goods and services increase overtime. Pigou's view on inflation is "when money income is expanding relatively to the output of work done by the productive agents for which it is the payment". In a general perspective, inflation is viewed as a sustained increase in the general price level for goods and services which sees a fall in the value of the national currency.

Some empirical literatures were reviewed on various works by different scholars on inflation and it determinants and the report of my findings is recorded below:

2.2 Empirical Literature
Yen Chee Lim and Siok Kun Sek (2014) in their publication which focused on two categories of countries – (High inflation group and Low inflation group) the use of the error correction model based on the auto regressive distributed lag (ARDL) to explain the short run and the long run relationship between inflation and other variables revealed that in low inflation countries, GDP growth and imports of goods and services in the long run have significant impact on inflation. Whilst none of the variables were found to be significant determinants in the short run in high inflation countries. In low inflation countries according to their study, money supply, imports of goods and services and GDP growth were found to have a significant relationship with inflation with the exception of national expenditure. In Low inflation countries import of goods and services and GDP growth were found to have negative effect on inflation in the short run and long run respectively whilst money supply was negatively related to inflation in the long run in high inflation countries. Their study recommended that exogenous variables that are significantly and negatively impacting inflation should be controlled in order to stabilize the economy.

Another study on the determinants of inflation in Pakistan for the period 1981 to 2010 by Aurangzeb and Anwar Ul Haq (2012) using variables gross domestic production, exchange rate, interest rate, fiscal deficit and unemployment used multiple regression analysis techniques and it revealed that GDP is negatively related to inflation but there exist a positive relationship between inflation and the remaining variables. Their study recommended amongst other things that the government should reduce its rate of borrowing and increase taxes.

Hossain and Islam (2013) on their economic analysis of the determinants of inflation in Bangladesh analyzed the relationship between inflation, money supply, interest rate, nominal exchange rate and fiscal deficit for the period 1990 to 2010 using the ordinary least square (OLS) method. Their findings showed that inflation is positively and significantly affected by money supply and a year lagged of interest rate. But when the same money supply was lagged by a year together with fiscal deficit, they significantly and negatively influenced inflation. Their study revealed that interest rate, fiscal deficit and nominal exchange rate have no significant relationship with inflation. They cautioned in their recommendation that wages and import of goods and services from abroad to be controlled, as well as the supply of money.

Sahadudheen I. (2012) studied the relationship among inflation, GDP, broad money, interest rate and exchange rate from the first quarter of 1996 to the second quarter of 2009 in India. The study employed the Johansen-Juselius Cointegration method and it was revealed that GDP and broad money affects inflation in the long run positively. On the other hand, there was a negative relationship among inflation, interest rate and exchange rate or interest rate and exchange rate affected inflation negatively.

D. Mohanty and John J. (2014) analyzed the relationship between inflation, crude oil prices, output gap, fiscal policy and monetary policy in India for the period 1996-1997 (Q1) to 2013-2014 (Q3). Structural vector auto regressive (SVAR) model was used. Their result showed that various determinants influenced inflation in the given time periods in India. The global price shocks had trickle effect on the domestic price of crude oil predominantly during the period 2009 to 2011. In 2011 – 2012, inflation was highly determined by fiscal deficit and a negative output gap was registered during 2012-2013.

Abidemi and Malik (2010) in their study of inflation and its major determinants for the period 1970 to 2007 in Nigeria examined the inter relationship among the variables, they used the Johansen cointegration analysis and the error correction model (ECM). Their study concluded that, growth rate of GDP, money supply, imports, 1st lag of interest rate and inflation are positively related to inflation rate, while exchange rate and fiscal deficit are associated to inflation indirectly.

Ashwani, (2014) used a cointegration approach to identify the key determinants of inflation in India for the period 1981 to 2011. The study found the existence of a long run relationship among inflation, money supply, private and social spending and exchange rate. It was concluded that money supply, exchange rate and private final consumption expenditure contributed significantly to Indian's inflation at that time. It was recommended that there should be a balance between fiscal spending, money supply and exchange rate management for the maintenance of economic growth.

Haile KebretTaye, (2013) in an attempt to underscore the determinants of inflation in Botswana with the use of Autoregressive Distributed Lag (ARDL) estimation technique and quarterly time series data ranging from the first quarter of 1990 to the fourth quarter of 2010. The authors' findings revealed that, real GDP, broad money supply, exchange rate, interest rate and other external factors like South African prices significantly influence domestic inflation in Botswana.

Odusanya and Atanda, (2010) critically analyzed inflation and its determinants in Nigeria for the period between 1970 and 2007 using annual time series data. The augmented Engle-Granger cointegration test and Error Correction Mechanism (ECM) model were employed as analytical tools to establish the long run and short run relationship among the variables. Growth rate of GDP, money supply growth rate, real share of import, first lagged of inflation rate and interest rate were found to exert a positive influence on inflation rate with GDP growth and lagged inflation showing significant effect on inflation. Fiscal deficit and exchange rate exert negative influence in the long run. They recommended that money supply expansion techniques should moderately be devised in ensuring a stable and non-accelerating price level in the economy. Also, a policy that would help reduce interest rate on lending should be instituted to avert the resultant effect of investment crowding-out. A well-coordinated government expenditure with strict supervision to other key sectors of the economy in order to forestall the problem of over-spending and over estimation of projects execution.

Patnaik, A. (2010) studied inflation in India using a Cointegrated Vector Autoregression (VAR) approach. The study concluded that inflation in India was largely demand pulled and that the supply side only influenced inflation in the short run. As recommendation, the researcher suggested that stabilization policies be implemented proactively in both the short run and the long run.

Awe, A. A. and Shina, O. S. (2012) analyzed the nexus between budget deficit and inflation in the Nigerian economy for the period 1980 to 2009 using the Vector Error Correction Mechanism. The study revealed that there is a significant causal relationship from budget deficit to inflation and the other way round was found to be insignificant. It was suggested as recommendation that adequate monetary policy be introduced to mitigate the role played by money supply to both budget deficit and inflation.

A study conducted by by Kesavarajah M., (2011) on "A Multivariate Cointegration analysis of inflation in Sri Lanka by the use of inflation rate, money supply, budget deficit and exchange rate as their estimation variables for the period 1978 to 2010. Tested empirical results indicated that money supply growth, budget deficit and exchange rate (depreciation) had a positive and significant effect on inflation rate in Sri Lanka during that period. The Granger causality test further suggested the existence of a one-way causality from money supply to inflation; exchange rate to inflation; and budget deficit to inflation. It was recommended that stable macroeconomic policies relating to these variables be strengthen in order to maintain price stability in as much as low inflation rate enhances economic growth.

Bashir et al., (2011) shed light on the determinant of inflation in Pakistan by the use of the Johansen cointegration, vector error correction approaches and the Granger Causality test. Annual time series data was used for the period from 1972 to 2010. The authors' empirical findings revealed that consumer price index proxy of inflation was found to be positively and significantly influenced by money supply, gross domestic product, imports and government expenditures while government revenue is pulling negative strings on the overall price level in Pakistan. The Granger causality result outlined that inflation is significantly affected by money supply, GDP, government expenditure and revenue as suggested by the Johansen and VECM approaches. A bidirectional relationship was also found to run from government expenditure to CPI, government revenue to CPI; from CPI to both imports and exports. They concluded by suggesting that, there should be an optimal

improvement in all the variables to maintain price stability in Pakistan.

Iya, I. B. and Aminu, U. (2014) investigated the determinants of inflation in Nigeria during the period 1980 to 2012 by using empirical analysis. Their result revealed that money supply and interest rate positively influenced inflation with government expenditure and exchange rate haven exacted negative influence. Monetary and fiscal policies regulations formed part of the recommendations of this study in a view to see a reduction in the supply of money and an increment in government expenditure, increasing exchange rate and reduced interest rate.

3. Methodology

3.1 Data Source

This study uses secondary data to analyze the long run relationship between the estimated variables. The determinants of inflation are almost the same in most countries, but its magnitude differs from one country to another due to country's specifics. Data limitation in Sierra Leone is acute thus the data of this study were primarily sourced from The International Financial Statistics and data files; World Bank database on world development indicator; and The Central Bank of Sierra Leone. A multiple regression analysis formed the empirical recourse of this study. In this study, we have used the data of Inflation; money supply; exchange rate, interest rate; import of goods and service and gross domestic product for the period of 1990 to 2013.

3.2 Methodology

From the above selected variables, we can deduced a function for inflation in the form of:

$$INF = f(MS, EXR, IR, IMP, GDP) \qquad (1)$$

The econometric form of the model is stated as:

$$INF = \beta_0 + \beta_1 MS + \beta_2 EXR + \beta_3 IR + \beta_4 IMP + \beta_5 GDP + \mu \qquad (2)$$

Thus the logarithmic form of the above econometric model can be written as:

$$LogINF = \beta_0 + \beta1 LogMS + \beta2 LogEXR + \beta3 LogIR + \beta4 LogIMP + \beta5 LogGDP + \mu \qquad (3)$$

Where INF is the inflation per consumer prices, f represents the function of and MS, EXR, IR, IMP, GDP and μ represent respectively, broad money growth (annual%), exchange rate (Local currency/US$ annual average), interest rate (prime lending rate), import of goods and services, gross domestic product per capita (current US$), Log indicates natural logarithm and the error term. β_0 is the intercept and the impact of the explanatory variables on the explained variable is given by the coefficients: β_1; β_2; β_3; β_4; β_5 respectively.

The a priori for the coefficients in the model is expected as:

$\beta_1>0$ $\qquad \beta_2>0$ $\qquad \beta_3<0$ $\qquad \beta_4>0$ $\qquad \beta_5<0$

It is expected based on economic theory that an increase in MS, EXR depreciation, import of goods and services and a decrease in both interest rate and GDP would generate inflationary pressure. Therefore, the coefficients of the explanatory variables MS, EXR and IMP are expected to be positive while those of IR and GDP negative from the empirical result.

4. Estimation of Results and Discussion

Several statistical methods and econometric tests were used to pinpoint the determinants of inflation in Sierra Leone. These include, the Augmented Dickey-Fuller test for unit root testing and to ascertain the stationarity of the estimated variables at first difference, the Johansen's Cointegration test to ascertain whether or not there is a long run relationship between the endogenous and the exogenous variables and Error Correction Mechanism test for the short run relationship.

4.1 Empirical Results

To avoid the problem 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) unit root test is used to determine the order of integration of the variables. The general form for ADF is given below and results for the estimate are shown in table 1 below:

$$\Delta X_t = \alpha + \alpha_1 + \gamma X_{t-1} + \sum_{i=1}^{k} \Delta X_{t-1} + e_t$$

$$(4)$$

Where:

$\Delta Xmb_t = the\ first\ difference\ of\ the\ series\ X_t$

$X_t - is\ the\ individual\ time\ series$

$e_t = white\ noise\ error\ term$

$k = the\ lag\ order, t = linear\ trend, \alpha = constant$

Table 1: Stationary Test Results at level and first difference

Variables	Integrating	ADF test stats	Test Critical value	Probability Value	Included in the equation	Inference
Log INF	Level	-2.640041	-3.622033**	0.2677	Intercept & trend	Non-Stationary
	First difference	-5.319127	-3.632896**	0.0016	Intercept & trend	Stationary
Log MS	Level	-0.227369	-1.961409**	0.5903	None	Non-Stationary
	First difference	-5.814206	-1.961409**	0.0000	None	Stationary
Log IR	Level	-3.345800	-3.622033**	0.0839	Intercept & trend	Non-Stationary
	First difference	-3.939038	-3.644963**	0.0285	Intercept & trend	Stationary
Log EXR	Level	-4.173355	-4.416345*	0.0166	Intercept & trend	Non-Stationary
	First difference	-4.323082	-3.632896**	0.0127	Intercept & trend	Stationary
Log GDP	Level	-1.246315	-3.622033	0.8758	Intercept & trend	Non-Stationary
	First difference	-4.402912	-3.632896	0.0108	Intercept & trend	Stationary
Log IMP	Level	-3.455760	-3.622033	0.0685	Intercept & trend	Non-Stationary
	First difference	-7.258705	-3.632896	0.0000	Intercept & trend	Stationary

* denotes 1%; ** denotes 5% and *** denotes 10% significant level, Source: Estimate result from Eviews.

Table 1 shows the result from the ADF unit root test using an automatic lag length selection of five (5) and at 5 percent significant level. The result reveals that all the variables in the model except exchange rate were found to be non-stationary at levels and became stationary after first differencing. It could therefore be said that exchange rate is stationary at level while other variables at first difference. A co-integration test should therefore be performed for the series that were integrated at first difference of the same order.

4.2 Johansen's Cointegration Method.
Since the variables 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 requires the error term to be stationary in the long run.
This study employs the Johansen and Juselius's (1990) method of cointegration which suggest that the variables entering the cointegration relationship must be integrated by the same order.

$$\lambda_{trace(r)} = -T \sum_{i=r+1}^{n} \ln(1 - \lambda_i)$$

(5)

$$\lambda_{max(r, r+1)} = -Tln(1 - \lambda_{r+1})$$

(6)

Where T = number of observations
$\lambda_i = Eigen\ value$
$\lambda_{trace} = test\ the\ null\ hypothesis$
r=0 against the alternative of r>0
$\lambda_{max} = test\ the\ null\ hypothesis$
r=0 against the alternative of r=1
The cointegrating series is: LogINF LogMS Log EXR logIR logIMP logGDP
Lag interval of 1 to 1 was used for the Johansen's cointegration rank test for both Trace and Maximum Eigenvalue and the results are presented in the table below:

Table 2: Cointegration Test result (Trace)

Unrestricted cointegration rank test (Trace)				
Null hypothesis	Eigenvalue	Trace Statistic	5% Critical Value	Prob.**
None*	0.955825	181.2731	95.75366	0.0000
At most 1*	0.869027	112.6418	69.81889	0.0000
At most 2*	0.711319	67.92096	47.85613	0.0002
At most 3*	0.692395	40.58740	29.79707	0.0020
At most 4	0.462296	14.65074	15.49471	0.0667
At most 5	0.044476	1.000896	3.841466	0.3171

* denotes rejection of the hypothesis at the 0.05 level and **MacKinnon-Haug-Michelis (1999) p-values
Source: Author's estimation from E-views 7.2

Table 3: Cointegration Test result (Maximum Eigenvalue)

Unrestricted cointegration rank test (Maximum Eigenvalue)				
Null hypothesis	Eigenvalue	Max-Eigen Statistic	5% Critical Value	Prob.**
None*	0.955825	68.63136	40.07757	0.0000
At most 1*	0.869027	44.72080	33.87687	0.0018
At most 2*	0.711319	27.33356	27.58434	0.0538
At most 3*	0.692395	25.93666	21.13162	0.0097
At most 4	0.462296	13.64985	14.26460	0.0624
At most 5	0.044476	1.000896	3.841466	0.3171

* denotes rejection of the hypothesis at the 0.05 level and **MacKinnon-Haug-Michelis (1999) p-values
Source: Author's estimation from E-views 7.2

Tables 2 and 3 show the results of an unrestricted cointegration rank tests Trace and Maximum Eigenvalue respectively. The results from the above tables reveal that the null hypotheses for none and at most 3 cointegrating relationship among the variables were rejected at 5 percent significant level, indicating the existence of at most 4 cointegrating relationships among the variables.

Table 4: Long run relationship between inflation and its determinants

LOGINF	LOGMS	LOGEXR	LOGIR	LOGIMP	LOGGGDP
1.000000	-1.090360	0.918210	0.486563	3.121355	-2.176156
	(0.15803)	(0.08049)	(0.05850)	(0.20787)	(0.12247)

Figures in parenthesis are the standard errors; Source: Author's estimation from E-views

Table 4 above shows the normalized coefficients and standard errors of the cointegrating equation in the long run.

4.2.1 Long Run Relationship

The result from the table 4 depicts that money supply and GDP are having a negative effect on inflation with coefficients 1.09 and 2.17 respectively; contravening the monetarist view for the case of money supply and in conformity to the Keynesian view. The negative relationship between money supply and inflation is in line with a study conducted by Yen Chee Lim and Siok Kun Sek (2014); which was empirically proven that there was a negative relationship between the two variables in high inflation countries. The same study further support our findings that GDP influenced inflation negatively this was also supported by Aurangzeb and Anwar Ul Haq (2012); Haile KebretTaye (2013). On the other hand, exchange rate (depreciation); interest rate (prime lending) and import of goods and services are positively related to inflation with interest rate also falling short of economic theory's expectation. This result is in line with studies conducted by Aurangzeb and Anwar Ul Haq (2012), Abidemi and Malik (2010), Bashir et al., (2011) in line with imports of goods and services; Ashwani, (2014), Kesavarajah (2011) supporting exchange rate's relationship to inflation and Iya, I. B. and Aminu, U. (2014), and Odusanya and Atanda (2010) are in line with interest rate. The coefficients measured the long run degree of responsiveness of inflation to money supply; exchange rate; interest rate; import of goods and services and GDP. A percentage increase in money supply would reduce inflation by 1.09 percent at 5 percent significant level in the long run. Also, one percent increase in the GDP will have a corresponding 2.17 percent point decrease in inflation at 5 percent significant level. Conversely, one percent increase in exchange rate; interest rate and import will increase inflation rate by 0.91 percent; 0.48 percent and 3.12 percent respectively at 5 percent significant level.

It is viewed that money supply which was considered as the main driver to positively affect inflation has proved otherwise in the long run. Implying that with robust and sound economic policies in place and a

thriving economy (low level of corruption, high level of infrastructural development, effective and efficient energy supply, a high level of foreign direct investment, …); an increase in money supply would have downward effect on the rate of inflation as the newly injected money into the system would further strength economic activities to increase on the output level in the long run. Thus, creating a downwards pressure in the prices of goods and services. As Crown Thomas also reported that "the velocity of money does not create inflation rather it is a symptom of inflation".

4.3 The Dynamic Short Run Relationship (Error Correction Model)
This error correction mechanism has been used to examine both the short run and the long run behaviour of the endogenous variable inflation in relation to its explanatory variables. This dynamic relationship includes the cointegrating regression residual value been lagged in addition to the variables of the first difference. The variables included from the long run relationship would capture short run dynamics. There may be disequilibrium in the short run, thus the error correction model may be utilized to eliminate deviations from the long run equilibrium.
The ECM is simply defined as:

$$\Delta LogINF_t = \alpha_0 + \sum_{i=1}^{q} \alpha_{1i} \Delta LogINF_{t-1} + \sum_{i=1}^{q} \alpha_{2i} \Delta LogMS_{t-1} + \sum_{i=1}^{q} \alpha_{3i} \Delta LogIR_{t-1} + \sum_{i=1}^{q} \alpha_{4i} \Delta LogEXR_{t-1}$$
$$+ \sum_{i=1}^{q} \alpha_{5i} \Delta LogIMP_{t-1} + \sum_{i=1}^{q} \alpha_{6i} \Delta LogGDP_{t-1} + \lambda ECM_{t-1} + \varepsilon_t$$

(7)

Where λ is the speed of adjustment, ε_t is the white noise error parameter and αs are parameters for the short run. The ECM has no problem of spurious regression because all the variables in the ECM are stationary. If λ is significant, it means there is a short run relationship among the variables. The value of λ indicates the speed of adjustment towards equilibrium after a short run shock.

Table 5: Results of the error correction model for the dependent variable inflation

Variable	Coefficient	Std. Error	t – Statistic	Probability	Inference
C	-0.258787	0.155320	-1.666151	0.1151	Insignificant
D(LOGMS)	0.464944	0.163068	2.851236	0.0116	Significant
D(LOGIR)	-0.668922	0.095418	-7.010446	0.0000	Significant
D(LOGEXR)	0.640958	0.621478	1.031344	0.3177	Insignificant
D(LOGIMP)	-0.302615	0.383722	-0.788632	0.4419	Insignificant
D(LOGGDP)	1.385182	0.761315	1.819461	0.0876	Significant
ECM(-1)	-0.748213	0.181485	-4.122716	0.0008	Significant
R-squared	0.821147		Mean dependent var.	-0.103470	
Adjusted R-squared	0.754078		S.D. dependent var.	0.910167	
S.E. of regression	0.451357		Akaike info criterion	1.492673	
Sum squares resid	3.259569		Schwarz criterion	1.838259	
Log likelihood	-10.16575		Hannan-Quinn criterion	1.579587	
F-statistic	12.24320		Durbin-Watson statistic	1.628997	
Probability (F-statistic)	0.000033				

Source: Eviews 7.2 output

Table 5 shows the annual speed of adjustment of the previous disequilibrium in inflation as 74.82 percent, which is relatively high. The result further indicates that money supply is significant in influencing inflation rate in Sierra Leone in the short run. A 1 percent increase in money supply will cause inflation in the short run to increase by 46.49 percent at 5 percent significant levels. The interest rate and the residual term of the model are also significant and they have negative sign as it should be. A drop in the interest rate (lending rate) by 1 percent would lead to a 66.89 percent increase in inflation in the short run for the period under the study. GDP is also significant at 10 percent and has a positive sign. The adjusting coefficients for exchange rate and imports are showing some level of insignificance with imports having a negative sign while exchange rate is positive. The negative sign and the significance of the residual simply validates that both the dependent and the independent variables have a long run equilibrium relationship.

The adjusted R-squared is 0.754078, depicting that 75.40 percentage point variation in inflation during the period 1990 to 2013 in Sierra Leone is explained by the independent variables. The estimated error correction model enjoys a high goodness fit (R- squared = 0.821147 and adjusted R-squared = 0.754078).

On a whole, the equation is statistically significant for forecasting inflation as shown by the probability value of the F-statistic (0.000033).

The regression equation for the model above is therefore:

LogINF = -0.258787 + 0.464944LogMS - 0.668922LogIR + 0.640958LogEXR - 0.302615LogIMP + 1.385182LogGDP   (8)

5.0 Diagnostic Test

For any research work to be meaningful, its analytical tool must be exemplified and its model free from been a spurious one. The diagnostic test result reported in table 6 helps to give a clearer picture on how we came about selecting the model used in this study. It is observed from the various test conducted for both the best regression model and the error correction model that we fail to reject the null hypotheses but rather accepted them, implying that the residuals of the model are not suffering from serial correlation; they are normally distributed and they are homoscedastic as reported by both Breusch-Pagan-Godfrey and ARCH tests respectively. The model is also enjoying relative stability as recorded by a 3.74 percent from the Ramsey Reset test which is below 5 percent.

Table 6. Diagnostic test for residuals of the best estimated regression model and the ECM

Null hypothesis	Test	Prob. value	Inference
Residual test for best regression model			
No serial correlation	Breusch Godfrey LM Test	0.2487	Fail to reject null hypothesis
Normally distributed	Jarque-Bera Statistics	0.912175	Fail to reject null hypothesis
Not heteroskedastic	Breusch-Pagan-Godfrey	0.1213	Fail to reject null hypothesis
Not heteroskedastic	ARCH	0.2294	Fail to reject null hypothesis
Model is stable	Ramsey Reset	0.0374	Fail to reject null hypothesis
Residual test for ECM			
No serial correlation	Breusch Godfrey LM Test	0.3295	Fail to reject null hypothesis
Normally distributed	Jarque-Bera Statistics	0.641924	Fail to reject null hypothesis
Not heteroskedastic	Breusch-Pagan-Godfrey	0.3213	Fail to reject null hypothesis

Source: Eviews estimate output

It is also evident from the above table that the probability values for the residual test for ECM are greater than 5 percent, thus we cannot reject the null hypotheses for the various tests but rather accept them. Therefore, the residuals of the ECM are not serially correlated; they are normally distributed and homoscedastic which is desirable. Hence the model is well fitted to correct any variation in the long run.

In summary, it has been empirically proven that we can rely on this model to forecast the trend of inflation in Sierra Leone.

6.0 Conclusion and Recommendations

This study employed six (6) variables and 24 annual observations from 1990 to 2013. Inflation is major macroeconomic challenge in the Sierra Leone economy. Its determinants are multi-faceted and curbing inflation would bolster the economic growth and development. The knowledge of the determinants of inflation in Sierra Leone is the baseline to forging a long term solution.

In this study, the macroeconomic uncertainties that are associated with inflation in Sierra Leone are but not limited to broad money growth (annual %) as proxy to Money supply; interest rate (prime lending rate); exchange rate; imports of goods and services and Gross Domestic Product. These independent variables jointly and significantly influenced the rate of inflation in Sierra Leone as much as 75.40 percent while the error term captured the remaining 24.6 percent at 5 percent level of significance.

With the existence of unit root at levels for all the variables, the study then employs the Johansen's cointegration analysis to test among the variables for the existence of a long run relationship, all the explanatory variables were found to be statistically significant at the conventional 5 percent level. The error correction model was used to estimate the short run relationship between inflation and its determinants and it reveals that both the trace and Eigen value tests indicate that there are at most four cointegrating vectors. It is concluded that money supply and GDP have a negative effect on inflation in the long run while interest rate, exchange rate and imports of goods and services have a positive effect. The coefficient of money supply is -1.09 implying that a one percent increase in money supply in Sierra Leone ceteris paribus would lead to a 1.09 percent decrease in inflation contrary to economic theory. Similarly, the coefficient for interest rate is 0.48, meaning a one percent increase in the interest rate leads to a 0.48 percent increase in inflation.

Money supply should be controlled in the short run and better channeled in the long run since the study reveals that it is one of the major variable that is influencing instability in the rate of inflation in Sierra Leone.

Thus, the velocity at which money circulate must be closely monitored. Interest rate has also proven otherwise based on this study and do not follow economy theory in its long run relationship with inflation in Sierra Leone.

The achievement of a single digit inflation rate is highly dependent on external drivers, thus the need to boost the export sector in the world market. This was evident by the upsurge of export of iron ore in 2012 which brought significant export income, revenue to the state and the GDP also grew thus reducing inflationary pressures. Also, exports should be diversified and should not be limited only to minerals.

Government borrowing at both national and international levels should also be minimized in order to fit in the gap between domestic revenue and expenditure. Also, too much borrowed monies will lead to mismanagement of resources and high levels of corruption which has been witnessed for several years. Corruption should also be brought to its knees and resources thereof could be used to boost the economic performance of the economy.

The study was able to underscore the point that money supply and interest rate do not always follow economic principles when it comes to their relationship with inflation. Though the study was envisaging the normal principle but empirical analysis have proved otherwise through tested results. With firm government commitments in upholding economic policies (fiscal and monetary) and sound governance in place, some of these economic theories can be proved on the contrary as in the case of the above study.

Scope for Further Research

Since inflation is a complex macroeconomic phenomenon that has diverse faces, finding its determinants is therefore imperative if we want to bring it to a tolerable and acceptable level. Determining the determinants of inflation is nowhere to end soon, thus, there is still room for further research in this area. A possible area of research could be "The economic relationship between Inflation as a dependent variable and fiscal deficit; government expenditure, unemployment and export as independent variables towards economic growth of Sierra Leone". This would better highlight the associated relationship existing between inflation and its independent variables and better policies could be proffered for growth and development.

Possibly, another research area could be "Examining solely the causal relationship between Inflation and money supply" in an economy that is deemed to be a donor driven one in a bid to better advice policy makers on sound macroeconomic policies which would revamp the economy and bolster growth.

Acknowledgment

Conflict of Interest.

This piece of work has got no conflict of interest in any shape or form. The authors have decided to work on this article in order to contribute to the body of knowledge and hence give the readership a broader view on issues bordering growth and development in emerging economies especially the Sub-Saharan Africa. Thus, the article is purely a scholarly work for academic advancement.

References

Abidemi and Maliq (2010). Analysis of Inflation and its Determinants in Nigeria. Pakistan Journal of Social Sciences, Vol.7, No.2, 97-100. DOI: 10.3923/pjssci.2010.97.100

Adu and Marbuah (2011). Determinants of Inflation in Ghana: An Empirical Investigation, South African Journal of Economics, Vol.79, No.3, 251-269. http//DOI:10.1111/j.1813-6982.2011.01273.x

Agayev, S. (2011). Exchange Rate, Wages, and Money; What explains Inflation in CIS Countries, "EuroJournals Publishing", Vol.1,6-13.

Ashwani, (2014). Determinants of Inflation in India: A Co-Integration Approach. International Journal of Multidisciplinary Consortium, Vol. 1, Issue 1, 1-11 ISSN2349-073X

Aurangzeb and Anwar Ul Haq (2012). Determinants of Inflation in Pakistan; Universal Journal of Management and Social Sciences, Vol.2,No.4;89-96.

Awe, A. A. and Shina, O. S. (2012). The Nexus between Budget Deficit and Inflation in the Nigerian Economy (1980 – 2009), Research Journal of Finance and Accounting, Vol.3, No.10, 78-92 ISSN-1697(paper) ISSN 2222-2847(online)

Bakare, I. A. O. et al. (2014), Empirical Investigation between Budget Deficit Inflation and Money Supply in

Nigeria, European Journal of Business and Social Sciences, Vol.2, No.12, 120-134 ISSN:2235-767X

Basher S. A. and Elsamadisy E. M. (2012). Country Heterogeneity and Long-Run Determinants of Inflation in the Gulf Arab States, OPEC Energy Review, Vol. 36, No.2, 170-203 DOI: 10.1111/j.1753-0237.2011.00208.x

Bashir, F. et. al. (2011), Determinants of Inflation in Pakistan: An Econometric Analysis using Johansen Cointegration Approach, Australian Journal of Business and Management Research Vol. 1, No. 5 71-82.

Chimobi, O.P., and Igwe, O.I. (2010). Budget Deficit, Money Supply and Inflation in Nigeria. European Journal of Economics, Finance and Administrative Sciences. Vol.1,52-60. http://www.eurojournals.com

D. Mohanty and John J. (2014). Determinants of Inflation in India; Journal of Asian Economics.

Iya, I. B. and Aminu, U. (2014). An Empirical Analysis of the Determinants of Inflation in Nigeria. Journal of Economics and Sustainable Development, Vol.5, No. 1, ISSN 2222-2855

Johansen, S. and Juselius, K. (1990). Maximum Likelihood Estimation and Inference on Cointegration. With applications on the Demand for money. Oxford Bulletin of Economics and Statistics, 52(2), 169-210.

Odusanya and Atanda, (2010). Analysis of Inflation and its determinants in Nigeria. Pakistan Journal of Social Sciences, Vol. 7, No. 2, 97-100

Sahadudheen I. (2012). A Cointegration and Error Correction Approach to the Determinants of Inflation in India, International Journal of Economic Resources; Vol.3i1,105-112

T. Hossain and N. Islam (2013). An Economic Analysis of the Determinants of Inflation in Bangladesh, The International Journal of Social Sciences, Vol.11, No.1; 29-36

Patnaik, A. (2010), Study of Inflation in India: A Cointegration Vector Autoregression Approach, Journal of Quantitative Economics, Vol. 8, No. 1, 118-129.

Yen Chee Lim and Siok Kun Sek (2014). An Examination on the Determinants of Inflation; Journal of Economics, Business and Management, Vol. 3, No.7, 678-682.

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