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The Asymmetric Impact of Exchange Rate on the Inflation Rate in Sierra Leone

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Abstract

The paper is aimed at investigating empirically, the impact of exchange rate on inflation and the extent of its asymmetry. The econometrics tool of analysis utilized by this study is Autoregressive Distributed Lag Model (ARDL) and Non-linear ARDL (NARDL) using time series data of Sierra Leone for a period 1970 - 2016. The results of the ARDL indicated that the exchange rate is inflationary but only in the short-run. There is no evidence of the long-run influence of exchange rate on inflation in the country. Meanwhile, the results of the NARDL not only confirms the short-run inflationary of the positive shocks of the exchange rate, but it also signifies the disinflationary effect of the negative shocks during the long-run. The findings of the research are limited to Sierra Leone whose data were used, based on ARDL and NARDL as the econometrics techniques applied, on the country's data from 1970 to 2016 as well as the variables that are chosen. This implies that devaluation of local currencies in Sierra Leone can immediately raise the level of prices of imported commodities, in particular, and immediately raise the level of inflation in the country in general, but such effects are limited to the short-run, while revaluation has a disinflationary effect in the long-run.

Keywords:

ARDL, Exchange Rate, Inflation, NARDL, Sierra Leone.

JEL Codes:

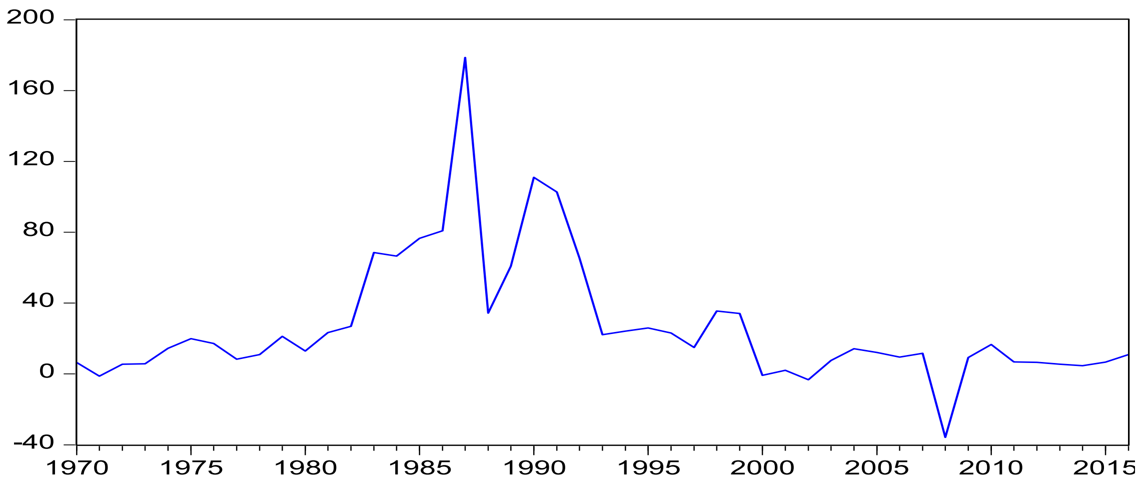
E30, E31

Introduction

The sustainability of prices stability is none negotiable to be possessed and maintained, in the process of achieving countries' aim of attaining long-term economic growth. Stability of prices not only hinders exploitation of the many by the few, but it also narrows the rich-poor economic gap. The primary concern of every developing country is to have sustainable price stability for the purpose of moving their economies forward. High inflation rate has been considered harmful to the performance of any economy (Sek, Teo & Wong, 2015). Therefore, having sustainable price stability has become one of the perpetual macroeconomic aims of many countries (Nguyen, 2014; Bawa & Abdullahi, 2012).

Sierra Leone is a country situated in the West African region, and it is one of -the four- West African Commonwealth Countries (WACCs). It is among the less progressive (most rural) in term of economic activities compared with the rest of WACCs, and the country has been suffering from high level of the inflation rate. Most developing economies are unable to tackle the problem of the double-digit inflation rate. It is considered necessary for developing economies to make and maintain their inflation rate single digit for the desired economic growth and development attainment (Phiri, 2002; Anwar & Islam, 2011; Risso & Sanchez-Carrera, 2009; Danlami, Hidthiir & Hassan, 2018). The inflation rate in Sierra Leone for a period of 1970 – 2016 is observed and presented in Figure 1. Out of 47 years, only ten years of single-digit inflation rate was recorded (1970, 1972, 1977, 2001, 2003, 2006, 2009, 2014 and 2015) four years of deflation (1971, 2000, 2002 and 2008), the rest of years are for the high inflation rate.

Figure 1: Sierra Leone Inflation Rate 1970 – 2016

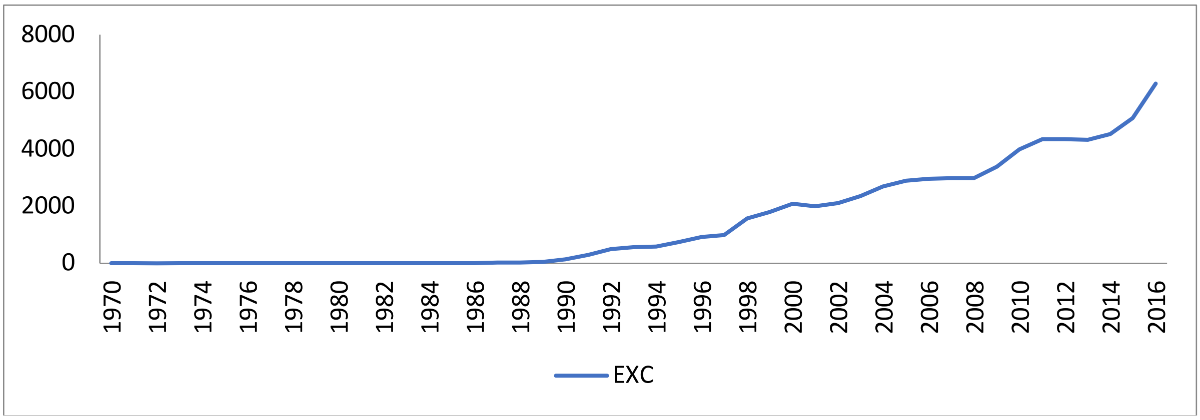


Source: Danlami, Hiththiir and Hassan (2018)

The theoretical exposition of the cause of the high inflation rate depends on the theoretical accounts of inflation. Money supply is, considered to be, the sole source of inflation by Monetarist theorists. While to Keynes and a Neo-Keynesian strand of thought, inflation is caused mainly by the existence of excess demand over supply. To Structural rigidity theory, the existence of constraints or rigidities in developing economies can trigger any variable or activity to prompt and trigger inflation (Kennedy, 2011; Mordi *et al*. 2007).

The exchange rate in Sierra Leone has been trending upward after the abolishing of fixed exchange regime in 1986. Figure 2 shows its trend for a period of 1970 – 2016. The figure shows that the exchange rate started rising immediately after abolishing the regime of the fixed exchange rate in 1986. The period of floating exchange rate regime started from 1986 onward, and from the figure, it can be seen that inflation rate immediate shoot up to its highest rate which is 179 percent just one year (1987) after starting floating exchange rate regime.

Figure 2: Sierra Leone Exchange Rate 1970 – 2016



This research is aimed at investigating how the exchange rate affects inflation in Sierra Leone, and also to assess the extent of asymmetry on the effect of exchange rate fluctuations on inflation, using Autoregressive Distributed Lag Model (ARDL) and non-linear ARDL (NARDL). The extent of asymmetric effects of a variable on another variable reflects the existence of differences between positive and negative shocks effects or relationships among the variables. The positive shocks may have a greater or a lesser effect compare to the negative shocks. It could also be a one-way effect when only either the positive effect is significant while the negative effect insignificant and vice versa. For example, the effect of the increase in exchange rate (currency devaluation) on inflation may be higher than the effect of a decrease in exchange rate (currency revaluation) on inflation in the same country. The paper consists of the following remaining sections; Section two presents a literature review and theoretical framework while Section three highlights the detail of the methodology used in the research. Results and findings are presented in Section four while the conclusion is highlighted in Section five of the paper.

Literature review

There exist a number of researches conducted to investigate the nature of relationships between the exchange rate and inflation in other countries using various econometric techniques. Though, their findings are inconclusive and inconsistent which makes generalizations, using their findings, impossible. In their study in Uganda, Mawajje and Lwanga (2016) using Vector Autoregression (VAR) and Vector Error Correction Model (VECM) reported a significant positive impact of exchange rate on inflation, and this is in accord with the findings of Karagoz, Demirel and Bozdag (2015) applied the same techniques in Asia, Turkey and Latin America. In South Africa, Akinboade, Siebrits and Niedermeier (2004) affirmed the same findings with the same methodology.

On the other hand, a significant inverse effect of exchange rate on inflation has been reported by Khai (2011) using VECM on Malaysian data in both the short-run and the long-run. Also, Adu and Marbuah (2011) used ARDL, Dynamic Ordinary Least Squares (DOLS) and Fully Modified OLS (FMOLS) to report a significant inverse effect of exchange rate on inflation. Akinbobola (2012) used VECM on Nigeria data and reported a significant inverse effect of exchange rate on inflation in the country during the long-run period.

An insignificant influence of exchange rate on inflation has been reported in Ghana by Adu and Marbuah (2011) during the short run period using ARDL, DOLS, and FMOLS. In his study, Nguyen (2014) using Pool Mean Group (PMG) and Generalized Method of Moment (GMM) on Asian economies reported that exchange rate changes happened to be insignificant in providing an explanation on inflation rate fluctuations in during the two separate periods of short-run and long-run. Moser (1995) used VECM, and DOLS stressed the insignificant impact on inflation exist by the current or immediate exchange rate in Ghana.

A number of studies reported a significant positive influence of money supply on inflation; among them include Asongu (2013) using VECM in some countries in Africa during the long run. Mawajje and Lwanga (2016) used VECM in the short run of Uganda and Adu and Marbuah (2011) using ARDL, DOLS, and FMOLS of Ghana. Also, a significant inverse influence of money supply on inflation has been reported by Olubusoye and Oyaromade (2008) used VECM observed that lagged value of money supply significantly and inversely influences inflation in Nigeria during the short-run. Hossain and Islam (2013) reported a similar finding in Bangladesh. Nguyen (2014) using GMM reported a significant inverse influence of money supply on inflation in Asian economies. However, an insignificant influence of money supply on inflation was reported by many studies, including Lim and Papi (1997) on the Turkish economy using DOLS and VECM in the long run, Lim and Sek (2015) using ARDL in the short-run of high inflation countries and the long-run of low inflation countries, and Durevall and Sjo (2012) using VECM in the long run of Kenya.

The review of the empirical studies on the influence of GDP on inflation reveals that inconsistent findings and unsettled results exist as both positive significant, negative significant and insignificant findings were reported by different studies. Aliyu and Englama (2009) using VAR and Impulse Response Function (IRF) on Nigerian data revealed that the response of inflation to GDP changes is positive. Also, Bashir *et al*. (2011) reaffirmed the positive influence of GDP on inflation using VECM on data from Pakistan. The positive influence of GDP on inflation in the long run of low inflation countries was reported by Lim and Sek (2015). Using ARDL and PMG, although, they reported an inverse influence of GDP on inflation in their long run. In Ghana, both in short run and long run, GDP has been influencing inflation rate inversely as reported by Adu and Marbuah (2011) that applied ARDL, FMOLS and DOLS. Also, ARDL was applied to Nigerian data, and the result shows that GDP influences inflation inversely (Imimole & Enoma, 2011). In Mexico, VAR was applied to their data, and the result was insignificant (Risso & Sanchez-Carrera, 2009). Nguyen (2014) reported an insignificant effect of GDP on inflation using PMG and GMM in both short run and long run for Sub Saharan Africa (SSA). Nevertheless, Lim and Sek (2015) reported that in high inflation countries, GDP is insignificant in explaining the rate of inflation fluctuations.

The review revealed that inconsistent and findings results exist and therefore, generalization using the findings of one study or some studies is not feasible. Variables need to be empirically tested to confirm the nature of their effects in the concerned country.

Theoretical Framework

The nature of how the exchange rate affects inflation in this study can best be explained by the arguments and the explanations of the structural rigidity theory of inflation. The theorists explained that the existence of constraints or rigidities in developing economies as the sources of inflation in the country concern (Kennedy, 2011). Having constraints in producing enough agricultural output due to lack of sufficient modern equipment for agriculture will lead to a country to have shortage supply of food and needs to source it from the rest of the world through international trade to balance the excess demand. In this situation, devaluation of the country's currency will not discourage the import but rather the increase in an exchange rate will be injected into the price of the imported food and hence induces inflation.

Methodology of research

As mentioned in the introduction, ARDL and NARDL are used to analyze the impact of exchange on inflation and its asymmetry in Sierra Leone. ARDL measures the simple linear dynamic influence of the exchange rate on inflation whereas, NARDL measures the asymmetric dynamic relationship between exchange rate and inflation.

Model specification

Following the arguments of Kennedy (2011), Hagger (1977) and Seers (1962), the model of inflation using structural rigidity theory is presented as follows:

$$INF = f(M_2, EXC, GDP) \quad [1]$$

where: INF is inflation rate, money supply is represented by M_2, EXC is Exchange rate, and Gross Domestic Product being the measure of economic growth is termed as GDP. Presenting equation (1) in econometric function as follows:

$$LINF_t = \alpha_0 + \alpha_1 LEXC_t + \alpha_2 LBRAG_t + \alpha_3 LGDP_t + U_t \quad [2]$$

where: LINF is a log of inflation rate, LEXC is a log of exchange rate, LBRAG is a log of money supply, and LGDP is a log of Gross Domestic Product, α is a parameter, U is the error term, and *t* is time showing the data is time series. Applying Pesaran, Shin and Smith (1999, 2001) procedures in Equation (2) to get ARDL function and is presented in Equation (3).

$$\Delta LINF_t = \alpha_0 + \sum_{k=1}^{p} \alpha_1 \Delta LINF_{t-k} + \sum_{k=0}^{q} \alpha_2 \Delta LEXC_{t-k} + \sum_{k=0}^{q} \alpha_3 \Delta LBRAG_{t-k} + \sum_{k=0}^{q} \alpha_4 \Delta LGDP_{t-k} + \beta_1 LINF_{t-1} + \beta_2 LEXC_{t-1} + \beta_3 LBRAG_{t-1} + \beta_4 LGDP_{t-1} + U_t \quad [3]$$

where: Δ is difference operator, α & β are parameters, p and q are the lag values of the dependent variable and independent variables, respectively, the rest as defined in the previous equations. The variable of concern is the exchange rate.

Log of Consumer Price Index (CPI) is used as a proxy for inflation rate whereas log of Broad Money annual growth rate is used in place of the money supply, a log of GDP is a measure of economic growth. All variables are in logarithm form for the purpose of data smoothing and uniform interpretation during analysis. The coefficients (α and β) are expected to have positive signs excluding the GDP which is expected to have an inverse influence on inflation.

The short-run and the long-run equations are presented in Equation [4] and Equation [5], respectively.

The short-run Equation:

$$\Delta LINF_t = \alpha_0 + \sum_{k=1}^{p} \alpha_1 \Delta LINF_{t-k} + \sum_{k=0}^{q} \alpha_2 \Delta LEXC_{t-k} + \sum_{k=0}^{q} \alpha_3 \Delta LBRAG_{t-k} + \sum_{k=0}^{q} \alpha_4 \Delta LGDP_{t-k} + \vartheta_0 ECT_{t-1} + U_t \quad [4]$$

where: ϑ_0 is the speed of adjustment of the symmetric model, ECT is the error correction term, the rest are as defined in the previous equations.

The long-run Equation:

$$LINF_t = \beta_0 + \sum_{k=1}^{p} \beta_1 LINF_{t-k} + \sum_{k=0}^{q} \beta_2 LEXC_{t-k} + \sum_{k=0}^{q} \beta_3 LBRAG_{t-k} + \sum_{k=0}^{q} \beta_4 LGDP_{t-k} + U_t \quad [5]$$

All variables and their respective coefficients are as defined in the previous equations.

The asymmetric ARDL or NARDL normally estimates two different coefficients for the shocks (positive and negative) of the concerned variable separately, especially, when the effects of the positive shocks differ with that of the negative shocks on the dependent variable (Shin, Yu & Greenwood-Nimmo, 2011; Ali, Shan, Wang & Amin, 2018).

The NARDL specification is as follows:

$$\Delta LINF_t = \phi_0 + \sum_{k=1}^{p} \phi_1 \Delta LINF_{t-k} + \sum_{k=0}^{q} (\phi_2^{+'} \Delta LEXC_{t-k} + \phi_2^{-'} \Delta LEXC_{t-k}) + \sum_{k=0}^{q} \phi_3 \Delta LBRAG_{t-k} + \sum_{k=0}^{q} \phi_4 \Delta LGDP_{t-k} + \mathfrak{s}_1 LINF_{t-1} + (\mathfrak{s}_2^{+'} LEXC_{t-1} + \mathfrak{s}_2^{-'} LEXC_{t-1}) + \mathfrak{s}_3 LBRAG_{t-1} + \mathfrak{s}_4 LGDP_{t-1} + U_t \quad [6]$$

where: ϕ and $\mathfrak{s}$ are short-run and long-run coefficients, $\phi_2^{+'}$ and $\mathfrak{s}_2^{+'}$ are coefficient of the positive shocks of the exchanges rate for short run and long run, respectively, while $\phi_2^{-'}$ and $\mathfrak{s}_2^{-'}$ are coefficients of the negative shocks of the exchange rate, the rest are as defined in the previous equations.

The short-run Equation of the NARDL:

$$\Delta LINF_t = \phi_0 + \sum_{k=1}^{p} \phi_1 \Delta LINF_{t-k} + \sum_{k=0}^{q} (\phi_2^{+'} \Delta LEXC_{t-k} + \phi_2^{-'} \Delta LEXC_{t-k}) + \sum_{k=0}^{q} \phi_3 \Delta LBRAG_{t-k} + \sum_{k=0}^{q} \phi_4 \Delta LGDP_{t-k} + \vartheta_1 ECT_{t-1} + U_t \quad [7]$$

where: ϑ_1 is the speed of adjustment for the asymmetric model and the rest as defined in the previous equations.

The long-run Equation of the NARDL:

$$LINF_t = \mathfrak{s}_0 + \sum_{k=1}^{p} \mathfrak{s}_1 LINF_{t-k} + \sum_{k=0}^{q} (\mathfrak{s}_2^{+'} LEXC_{t-k} + \mathfrak{s}_2^{-'} LEXC_{t-k}) + \sum_{k=0}^{q} \mathfrak{s}_3 LBRAG_{t-k} + \sum_{k=0}^{q} \mathfrak{s}_4 LGDP_{t-k} + U_t \quad [8]$$

All as defined in the previous Equations.

Source of Data: World Development Indicators (WDI) of World Bank is used as the data source for this research. Also, annual data for a period 1970 – 2016 is used. All variables are in logarithm.

Results and Finding

In this section, data analysis and findings on the basis of the analysis are presented. Table 1 present the summary statistics of the variables.

Table 1: Descriptive Statistics of the variables

	LINF	LEXC	LBRAG	LGDP
Mean	2.92	4.56	23.66	20.86
Median	2.81	6.21	24.46	20.68
Maximum	5.19	8.75	29.44	22.34
Minimum	0.74	-0.22	17.58	19.89
Std. Dev.	1.00	3.52	3.94	0.66
Skewness	0.30	-0.29	-0.09	0.83
Kurtosis	2.48	1.35	1.57	2.74
Jarque-Bera	1.14	5.46	3.70	5.12
Probability	0.56	0.07	0.16	0.08
Sum	125.35	196.25	1017.22	896.91
Sum Sq. Dev.	42.38	519.99	652.25	18.25
Observations	43	43	43	43

Source: Authors' 2019

The table shows that the mean for LINF is 2.92, LEXC is 4.56 LBRAG is 23.66, and LGDP is 20.86. LINF has the lowest of the maximum value of 5.19 and LBRAG has the highest maximum value 24.46. On the other hand, LEXC has the highest standard deviation of 3.52 the lowest goes to LGDP with 0.66 as its standard deviation. All the variables are normally distributed, as they have probability values of more than five percent on Jarques-Bera statistics.

The unit root result demonstrates that all variables are stationary at first difference in both the Augmented Dickey-Fuller test (ADF) and Philip Peron test (PP) conducted. The result is presented in Table 2.

Table 2: Results of Unit Root test

	TEST TYPES			
	Augmented Dickey-Fuller – ADF test		Phillips Peron – PP Test	
Variables	Level	First Difference	Level	First Difference
LINF	-2.25	-7.23*	-2.16	-7.37*
	(0.19)	(0.00)	(0.22)	(0.00)
LEXC	-0.99	-3.23*	-0.76	-3.10
	(0.75)	(0.02)	(0.82)	(0.03)
LBRAG	-1.03	-3.51*	-0.63	-3.44*
	(0.73)	(0.01)	(0.85)	(0.01)
LGDP	-1.69	-5.54*	-1.76	-5.74*
	(0.74)	(0.00)	(0.71)	(0.00)

*Source: Authors' 2019; Notes: * represents statistically significant at 5 percent level.*

The Bound Test for Cointegration for the ARDL Model

The results of the ARDL estimation are presented in Table 3. The estimation is subsequently used for Bound test for cointegration, as well as short-run and long-run estimations.

Table 3: ARDL (1, 1, 1, 1) Estimation Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LINF(-1)	0.46*	0.11	4.30	0.00
LEXC	1.83*	0.63	2.89	0.01
LEXC(-1)	-2.14*	0.44	-4.83	0.00
LBRAG	-0.87	0.70	-1.25	0.22
LBRAG(-1)	1.17	0.75	1.55	0.13
LGDP	0.27	0.61	0.44	0.67
LGDP(-1)	-0.82	0.57	-1.43	0.16
C	7.51	6.85	1.10	0.28
R-Squared	0.8674			
Adjusted R-Squared	0.8365			

Source: Authors' 2019; Note: '' indicate significant at five percent.*

The estimated ARDL result is presented in Table 3 with lag (1, 1, 1, 1) using AIC criteria. It was selected after e-views evaluated about 24 estimations. This estimation is used for the bound test to check the existence of long-run relationships.

The existence of long-run relationship has been confirmed using the bound testing approach having the result of *F*-statistics 7.73 over and above bound test critical value at I(1) at one percent 5.61 and I(0) 4.29, using Pesara, Shin and Smith (2001) statistics.

Presentations of ARDL results

Table 4 presents the results of both short-run and long-run estimation.

Table 4: Short-Run and Long-Run Results of the ARDL

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
		Short Run Results		
D(LEXC)	1.83*	0.63	2.89	0.01
D(LBRAG)	-0.87	0.70	-1.25	0.22
D(LGDP)	0.27	0.61	0.44	0.67
CointEq(-1)	-0.54*	0.11	-5.03	0.00
		Long Run Results		
LEXC	-0.56	0.87	-0.65	0.52
LBRAG	0.55	0.93	0.59	0.56
LGDP	-1.03	1.39	-0.74	0.46
C	13.94	11.93	1.17	0.25

*Source: Authors' 2019; Notes: * represents statistically significant at 5 percent level.*

Table 4, reveals that during the short-run, the exchange rate is inflationary and have a positive effect on inflation. Specifically, an increase in exchange rate by one percent in the short run will increase the rate of inflation by 1.83 percent and vice versa, holding other variables constant. The speed of adjustment towards long-run equilibrium is around 54 percent. The rest of the variables are insignificant during the short run.

Meanwhile, there is no significant variable during the long-run.

The Symmetric Estimation Diagnostic Checks

It is a vital task, after model estimation to conduct post-estimation diagnostics check to ensure that the analyses conducted are in the right direction, the following tests conducted for that purpose and the results are presented in Table 5:

Table 5: Postestimation Diagnostic Checks Results of the ARDL Model

Test Type	Jarque-Bera/*F*-Statistics
Normality	3.30 (0.19)
Serial Correlation	0.21 (0.81)
Heteroskedasticity	1.23 (0.32)
Ramsey Reset Test	3.13 (0.06)

Normality Test

Given the value of 3.30 of Jarque-Bera statistics and a probability value of 0.19 percent indicates that: the errors term of the model have no normality distribution problems as they are white noise.

Serial Correlation Test

Based on the Breusch Godfrey Serial Correlation LM test conducted, there is no serial correlation in the estimated model, having an F-statistic value of 0.21 and a probability value of 0.81 percent.

Heteroskedasticity Test

Based on the Breusch Pagan-Godfrey test of heteroskedasticity conducted, the test vindicates the estimated model and exempts it from heteroskedasticity as the F-statistic is 1.23 with a probability of 0.32 percent. This indicated that the variance of the errors is constant.

Specification Test

The result of Ramsey Reset for specification shows that the model is correctly specified, having *F*-Statistics value of 3.13 and a corresponding probability value of 0.06.

Stability of the Estimated ARDL Model

The estimated model is very stable; this can be seen from Figure 3, and Figure 4 for *CUSUM* and *CUSUM* of squares, respectively, with a line of the estimated model, lays within the ridgeline, i.e., it lays below the upper ridge line and above the lower ridge line.

Figure 3: CUSUM Stability

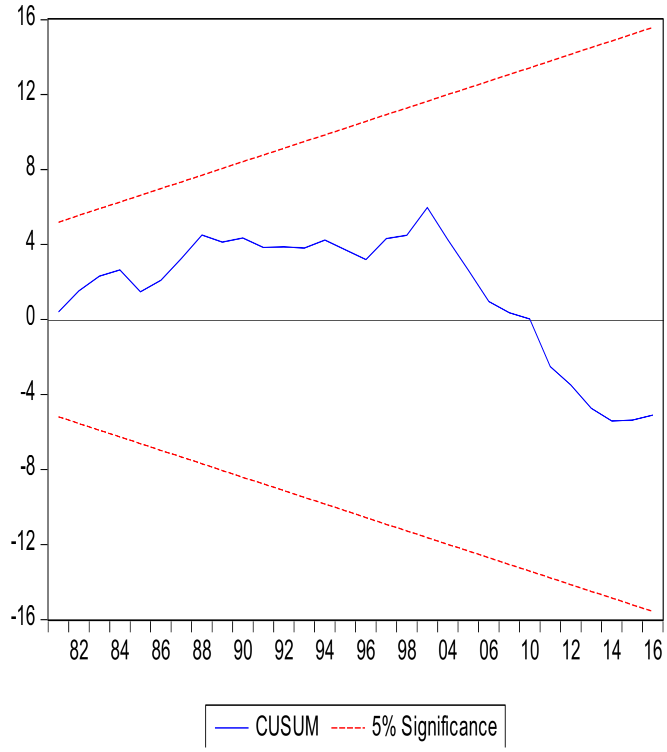
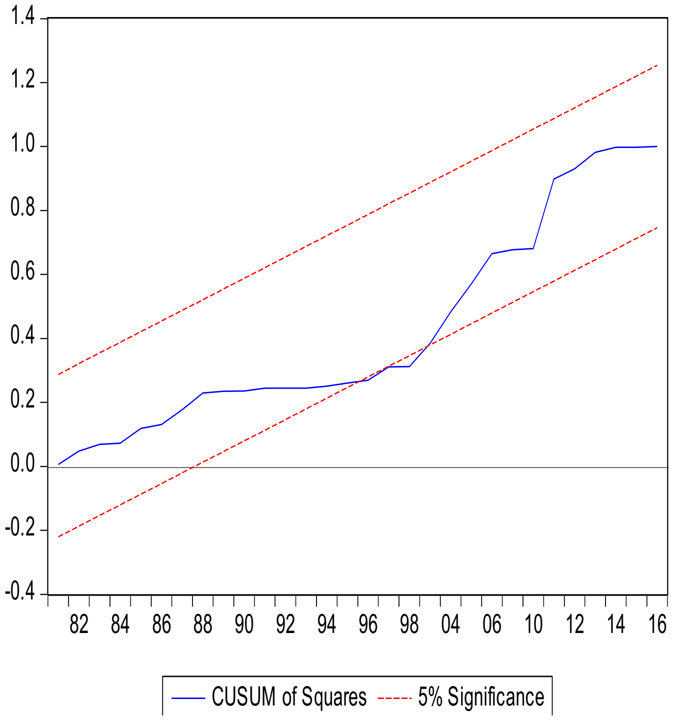


Figure 4: CUSUM of Squares Stability



The Bound Test for Cointegration for the NARDL Model

The results of NARDL estimation are presented in Table 6. The estimation is subsequently used for Bound test for cointegration, as well as the short-run and the long-run estimations.

Table 6: NARDL (1, 1, 1, 1) Estimation Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LINF(-1)	0.32*	0.10	3.09	0.004
LEXC_POS	1.76*	0.57	3.10	0.004
LEXC_POS(-1)	-2.15*	0.40	-5.38	0.000
LEXC_NEG	-2.66	4.10	-0.65	0.521
LEXC_NEG(-1)	-7.09	4.12	-1.72	0.096
LBRAG	-1.02	0.64	-1.60	0.120
LBRAG(-1)	1.28	0.68	1.87	0.071
LGDP	0.13	0.54	0.25	0.807
LGDP(-1)	-1.07*	0.52	-2.06	0.049
C	15.59*	6.58	2.37	0.025
R-squared	0.9040			
Adjusted R-squared	0.8731			

Source: Authors' 2019; Note: '' indicate significant at five percent.*

The estimated NARDL result is presented in Table 6 with lag (1, 1, 1, 1) using AIC criteria. It was selected after e-views evaluated about 48 estimations. This estimation is used for the bound test to check the existence of long-run relationships and it is also used for the asymmetry test to check the existence of non-linear relationships.

The existence of long-run relationship has been confirmed using the bound testing approach having the result of *F*-statistics 10.07 over and above bound test critical value at I(1) at one percent 5.06 and I(0) 3.74, using Pesara, Shin and Smith (2001) statistics.

The existence of asymmetry or non-linear relationship has been established through Wald restriction test. The test restricts the positive and negative coefficients of the exchange rate, from Table 6, to be equal, as the null hypothesis which implies symmetry or absence of asymmetry. The null hypothesis is rejected, and the existence of asymmetry is confirmed from the Wald test, with *F*-Statistics value of 10.51 and its corresponding probability value of 0.00 at one percent level.

Presentations of NARDL Results

The results of the short-run and the long-run of the NARDL model are presented in Table 7.

Table 7: Short Run and Long Run Results of the NARDL

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
		Short Run Results		
D(LEXC_POS)	1.76*	0.57	3.10	0.00
D(LEXC_NEG)	-2.66	4.10	-0.65	0.52
D(LBRAG)	-1.02	0.64	-1.60	0.12
D(LGDP)	0.13	0.54	0.25	0.81
CointEq(-1)	-0.68*	0.10	-6.54	0.00
		Long Run Results		
LEXC_POS	-0.57	0.61	-0.94	0.36
LEXC_NEG	-14.37*	3.91	-3.68	0.00
LBRAG	0.38	0.65	0.58	0.57
LGDP	-1.37	0.97	-1.41	0.17
C	22.96*	8.59	2.67	0.01

*Source: Authors' 2019; Notes: * represents statistically significant at 5 percent level.*

The table reveals that during the short-run, positive shocks in the exchanges rate is significant and positively affecting the inflation rate; specifically, one percent increase in the exchange is associated with a 1.76 percent increase in the rate of inflation during the short run. The negative shocks in the exchange rate and the rest of the variables are insignificant in explaining the changes in the inflation rate. The speed of adjustment towards long-run equilibrium is significant and fast as it moves around 68 percent.

The table also reveals that; during the long-run, the coefficient of the positive shocks of the exchange rate is insignificant. The coefficient of the negative shocks of the exchange rate is significant in influencing the inflation rate. Specifically, an increase in the negative shocks of the exchange rate of Leone; which is the local currency in relation to USD by one percent is associated with a decrease in the rate of inflation by 14.37 percent. The rest of the variables are insignificant during the long run except constant.

Diagnostic Checking of the Asymmetric Estimation

It is necessary after model estimation to conduct postestimation diagnostics check to ensure that the analyses conducted are in the right direction, the following tests conducted for that purpose and the results are presented in Table 8:

Table 8: Postestimation Diagnostic Checks Results of the NARDL Model

Test Type	Jarque-Bera/F-Statistics
Normality	2.56
	(0.28)
Serial Correlation	0.85
	(0.44)
Heteroskedasticity	1.84
	(0.09)
Ramsey Reset Test	1.65
	(0.11)

Normality Test

The value of 2.56 for Jarque-Bera statistics, with a probability value of 0.28 percent, indicates that the errors term are white noise.

Serial Correlation Test

Similarly, based on the Breusch Godfrey Serial Correlation LM conducted, it indicates that there is no serial correlation in the estimated model, having an F-statistic value of 0.85 and a probability value of 0.44 percent.

Heteroskedasticity Test

Based on the Breusch Pagan-Godfrey test of heteroskedasticity conducted, the test vindicated the estimated model and exempted it from heteroskedasticity as the F-statistic is 1.84 with a probability of 0.09 percent. This indicated that the variance of the errors is constant.

Specification Test

The result of Ramsey Reset for specification shows that the model is correctly specified, having *F*-Statistics value of 1.65 and a corresponding probability value of 0.11.

Stability of the Estimated NARDL Model

The estimated model is very stable; this can be seen from Figure 5, and Figure 6 for *CUSUM* and *CUSUM* of squares, respectively, with a line of the estimated model, lays within the ridgeline, i.e., it lays below the upper ridge line and above the lower ridge line.

Figure 5: CUSUM Stability

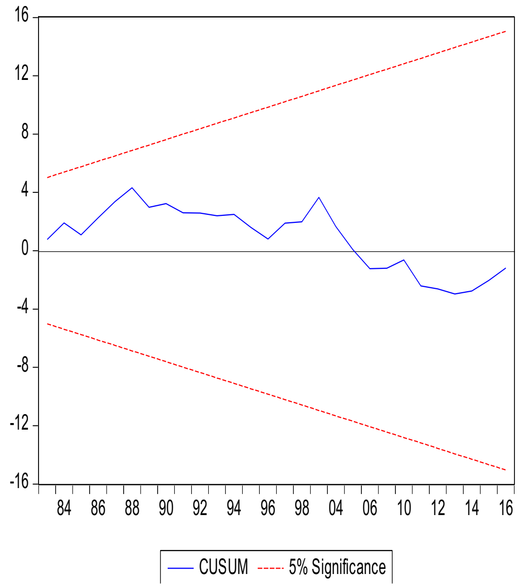
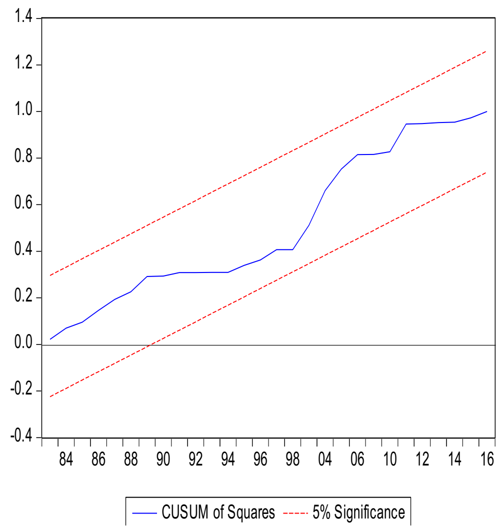


Figure 6: CUSUM of Squares Stability



Conclusions

From the results of the diagnostic checks, it can be concluded that the estimated models have no issues as they passed all the tests conducted. During the short-run period of the ARDL model, only the exchange rate is inflationary in the country. The speed of adjustment towards long-run equilibrium is significant at one percent level, and it is speedy being about 54 percent. The R^2 and adjusted R^2 are 86.74 percent and 83.65 percent respectively. The rest of the variables are insignificant in the short-run period. The result of the ARDL model shows that there is no significant variable during the long-run period. The short-run result of the NARDL model reveals that the positive shocks of the exchange rate are inflationary and significant whereas, the negative shock and the rest of the variables are insignificant. The implication of the findings is that when local currencies are devalued, it leads to inflation immediately but reversing such devaluations (revaluations of currencies) does not cure the inflation caused by currency devaluation immediately, it takes time as it must reach long-run. It is pertinent for policymakers to take note and cognizance of this implication before embarking on currency devaluation in Sierra Leone as inflation caused by currency devaluation has no immediate reversible powers by currency revaluations when used as a policy of stabilization. The speed of adjustment toward long-run equilibrium is significant and very fast being about 68 percent. Meanwhile, the long-run period result of the NARDL model reveals that only the negative shocks are significant, and it is disinflationary. Therefore, from the results, it can be concluded that the inflationary effect of exchange rate devaluation in Sierra Leone is only in the short-run, and there is no evidence of the long-run effect of exchange rate on inflation in the country for the symmetry result. The asymmetry results confirm the inflation effect of exchange rate devaluation during the short-run and also shows that the revaluation of the local currency is disinflationary during the long-run.

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