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Estimating the Impact of Official and Parallel Exchange Rates on Inflation in Sierra Leone.

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Abstract:

This study examines the duality of the exchange rate market in Sierra Leone, delving into the distinct impacts of the official and parallel exchange rates (between the Leone and the United States Dollar) on inflation. Employing the Autoregressive Distributed Lag (ARDL) approach and utilizing annual time series data from 1980 to 2020, the research reveals that the depreciation of the Leone significantly influences inflation. This effect is more pronounced in the case of the parallel exchange rate, where a 1% depreciation results in a 1.26 percentage point increase in inflation, gradually decreasing to 0.92 percentage point over two years. Conversely, the depreciation of the official rate leads to a 0.43 percentage point increase inflation and subsequently to 0.52 percentage point increase in inflation for every 1% depreciation of the official exchange rate in the second year. The findings confirm the significance of both official and parallel exchange rates in influencing inflation, highlighting a substantial difference in their effects on the economy. Nevertheless, the results indicate no statistically significant long-term relationship between inflation and both the official and parallel exchange rates in Sierra Leone. Exchange rate depreciation, particularly in the parallel market, is shown to have a pronounced impact on inflation, necessitating careful oversight and regulation of the parallel market to ensure price stability. The study also uncovers the presence of foreign exchange market fragmentation, posing challenges to effective monetary policy and exchange rate management. Policy implications drawn from the research underscore the importance of regulating the parallel market to enhance transparency and stability. Integrating fragmented foreign exchange markets is deemed crucial for minimizing exchange rate pass through to inflation. Acknowledging the data limitations, the research suggests enriching future investigations by incorporating recent data, global economic factors, and investor sentiments, all of which have the tendency to affect exchange rate movements.

Keywords: Official Exchange Rate, Parallel Exchange Rate, Inflation, exchange-rate-market- duality, Sierra Leone.

JEL Classification Codes: F31, G15, O24, G15, E31, E42, O42 O11

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1.1 Background of the Study

Exchange rates serve as a critical component of any nation's economic framework, influencing trade, investment, and overall economic performance. In Sierra Leone, the exchange rate regime comprises both official and parallel rates, reflecting the dual nature of the country's foreign exchange market. The official exchange rate, typically set by the Bank of Sierra Leone, coexists with a parallel or market-determined rate that emerges from the foreign exchange transactions within the informal sector. The presence of both official and parallel exchange rates introduces a layer of complexity to Sierra Leone's economic landscape. This complexity is rooted in the divergent determinants and mechanisms that shape these rates. The official rate is often influenced by government policies, international trade agreements, and foreign reserves, while the parallel rate is subject to market forces, informal transactions, and other factors that may not align with official policies. Given the dual exchange rate system in Sierra Leone, understanding the impact of these rates on inflation is paramount. Inflation, as a measure of the general rise in prices of goods and services, directly affects the purchasing power of the population. Therefore, a comprehensive analysis of the relationship between exchange rates and inflation is crucial for formulating effective economic policies, enhancing economic stability, and fostering sustainable development.

To appreciate the current economic scenario, it is essential to consider recent historical perspectives that have shaped Sierra Leone's exchange rate dynamics. For example between 2016 and 2023, Sierra Leone experienced significant depreciation in its exchange rate, with rates dropping by 23.67% in 2016, and 55.27% in 2023. These periods coincided with high inflation rates of 10.83%, and 52.16% respectively, suggesting a clear connection between exchange rate depreciation and inflationary pressures in the country. However, the years 2013 and 2014 saw a different trend, where the Leones appreciated against the Dollar. During this time, inflation remained relatively moderate at 5.52% and 4.65% respectively. This indicates that exchange rate movements may partly explain inflationary trends in Sierra Leone. The existence of a parallel market for foreign exchange indicates significant discrepancies between the official and parallel rates, which can have far-reaching implications for the overall economy.

High and unpredictable inflation erodes the purchasing power of individuals, destabilizes the economy, and creates an uncertain business environment (Bangura, Caulker, and Pessima, 2012). The twin problems of high exchange rate depreciation and inflation call for a deeper understanding of their relationship and their combined impact on the country's economic stability.

While some studies have explored aspects of exchange rates and inflation in developing countries, there remains a gap in the literature concerning Sierra Leone's specific context. This research seeks to address this gap by providing a focused and in-depth analysis of the impact of both official and parallel exchange rates on inflation within the unique economic environment of Sierra Leone. The coexistence of official

and parallel exchange rates in Sierra Leone raises questions about their individual and collective influence on inflation. Understanding these dynamics is essential for policymakers, economists, and market participants to formulate effective strategies for economic management and growth.

The main objectives of this research are: To assess and compare the impact and magnitude of the official and parallel exchange rates on inflation in Sierra Leone, and ultimately, to provide recommendations for policymakers based on the findings. To guide the study, the following research questions will be addressed: How does the official exchange rate influence inflation in Sierra Leone? What is the impact of the parallel exchange rate on inflation in Sierra Leone? How do the effects of the official and parallel exchange rates on inflation compare? The *a priori* expectation is that both the official and parallel exchange rates will have a significant impact on inflation in Sierra Leone. Moreover, there is an anticipation of observing a substantial difference in the effects of the official and parallel exchange rates on inflation in the country.

This research is significant as it provides valuable insights into the relationship between exchange rates and inflation in Sierra Leone. The findings can inform economic policies, helping to mitigate inflationary pressures and enhance overall economic stability.

The rest of the paper is organized as follows: Section Two provides details of the Literature Review, which is divided into Theoretical and Empirical literature. Section Three addresses the Methodology, with attention focused on the Theoretical Framework, Model Specification, and description of the Data. Section Four provides details of the Empirical Results, which incorporate Summary Statistics, Unit Root analysis, and Model Results. Finally, Section Five concludes with some pointers for policy formulation.

2. Literature Review

The relationship between exchange rate and inflation has been a topic of debate for many years. Some studies have found that a depreciation of the exchange rate leads to an increase in inflation, while others have found no significant relationship. The impact of exchange rate on inflation may depend on a number of factors, including the exchange rate regime, the structure of the economy, and the monetary policy framework. The general consensus is that there is a positive relationship between the two variables. This means that a depreciation in the exchange rate is likely to lead to higher inflation. When the exchange rate depreciates, imports become more expensive, which can lead to higher inflation. This is because consumers have to pay more for imported goods and services, which pushes up the prices of domestic goods and services. In addition to the official exchange rate, which is set by the government, there is often a parallel exchange rate that is determined by the informal market. The parallel exchange rate is often higher than the official exchange rate, and it can be used to circumvent government controls on foreign

exchange. This can lead to inflation, if businesses and individuals use the parallel exchange rate to import goods and services at a higher price.

One of the most influential studies on the exchange rate-inflation relationship was conducted by Bruno and Sachs (1985). They found that a 10% depreciation in the exchange rate was associated with a 1% increase in inflation. This study has been replicated by many other researchers, and the results have been consistent. In a study of 11 African countries, Duodu et al. (2022) found that exchange rate depreciation has a positive impact on inflation. The authors argue that this is because depreciation makes imported goods more expensive, which in turn pushes up prices of domestic goods. They also found that the impact of exchange rate depreciation on inflation is stronger in countries with fixed exchange rate regimes. A study by Okhiria and Saliu (2008) found that exchange rate has a significant positive impact on inflation in Nigeria. The authors argue that this is because depreciation makes imported goods more expensive, which in turn increases the cost of production for domestic firms. They also found that the impact of exchange rate on inflation is stronger in countries with high import dependency.

De Grauwe & Gunther (2008) analysed the impact of the exchange rate regime on inflation and output in Southeastern and Central Europe using panel estimations with annual data ranging from 1994 to 2004. The purpose of the study is to show that de facto measures of exchange rate stability possess better explanatory power than the de jure measures in the inflation and growth equations. The estimations revealed a significant impact of exchange rate stability on low inflation as well as a highly significant positive impact on real growth. To robustly address the study outcome, the estimation outcomes were further subdivided into "high inflation" (1994-1997) and "low inflation" periods (1998-2004). With the removal of outliers from the sample period, the evidence uncovered a positive association between exchange rate stability and the disappearance of inflation. The evidence also attests to the fact that stability in the exchange rate resulted in a higher real growth rate. The findings suggest that countries' membership in the (South) Eastern and Central European countries (part of the European Monetary Union) would yield a positive impact on growth rates overall, both within the union and for member countries.

Bui (2018) also tried to explore causality in Vietnam's Parallel Exchange Rate system using annual data from 2005 to 2011. Vietnam, as a category of a transition economy, experienced multiple exchange rate systems with three exchange rates in coexistence. The paper explored the use of the Vector Error Correction (VECM) model, and the Granger causality tests to investigate the relationship between the official and black-market exchange rates during the period January 2005 to April 2011. Results from the empirical output confirm that a long-run relationship exists between the official and parallel market rates of the Vietnam Dong against the United States Dollar. The short-run dynamics outcome suggests that the official exchange rate impacts the black-market exchange rate, but not the other way around. The conclusion from the study is also valid for both the sub-period of stability and the sub-period of vibrant fluctuations,

with February 2008 serving as the cut-off period. The findings of the study rejected the black-market efficiency hypothesis for foreign exchange but supported the policy choice of the State Bank of Vietnam not to work in the direction of the black-market signals in its effort to manage official exchange rates and stabilise the macroeconomic environment.

Schiumerini & Steinberg (2020) demonstrate the links between countries with high inflation and stringent currency regulations, which normally produce thriving black markets for dollars. Despite the prevalence of this phenomenon, little is known about the political consequences of foreign-currency black markets. This paper argues that the black market for dollars hurts the pocketbooks of many citizens, thereby reducing support for the government. Data from Argentina, where the black market for dollars grew between 2011 and 2015, provides support for the argument. Using aggregate time-series data, we estimate that a ten-percentage-point increase in the black-market price of the dollar relative to the official price reduces Presidential approval by 5 percentage points in the long run. To test the pocketbook mechanism more directly, we use individual-level data from a list experiment. We find that people who bought dollars on the black market were 10 percentage points less likely to vote for the incumbent party in the 2015 Presidential election. Individuals who bought dollars illegally also expressed stronger opposition to the current regulations that contributed to the black market and were more knowledgeable about those regulations. These findings suggest that the black market for dollars can have important political consequences.

However, not all studies have found a positive relationship between exchange rate and inflation. For example, a study by Illeditsch (2011) found no significant relationship between exchange rate and inflation in a sample of 10 developed countries. The author argues that this is because the impact of exchange rate on inflation is mediated by other factors, such as monetary policy and the level of economic activity. The impact of exchange rate on inflation may also depend on the exchange rate regime. In a study of 10 emerging market economies, Eichengreen et al. (1995) found that exchange rate depreciation has a larger impact on inflation in countries with fixed exchange rate regimes. The authors argue that this is because depreciation in a fixed exchange rate regime leads to a loss of foreign exchange reserves, which can put pressure on the central bank to increase interest rates. Higher interest rates, in turn, can lead to a slowdown in economic activity and a decline in demand, which can help to moderate inflation.

In summary, the connection between exchange rates and inflation is intricate and influenced by various factors. The influence of the exchange rate on inflation can manifest as positive, negative, or even insignificant. Crucial determinants include the exchange rate regime, economic structure, and the framework of monetary policy. Currently, there's a notable lack of research directly comparing the impact of official and parallel exchange rates on inflation. This gap in the literature is significant, given the crucial role of exchange rates in effective monetary policy management. There is a need for further exploration of

this comparative impact to better understand the dynamics between exchange rates and inflation, aiding more effective policymaking.

3.0 Methodology

3.1 Estimated Model Specification

To examine the relationship between inflation and its determinants in our research paper, we specified an inflation model of the form:

$$Inf = f(Exr, GDP, M2, LR) \quad \text{Eq. 1}$$

Where *Exr* is the official Exchange rate and the Parallel Exchange rate (*Specified in two separate equations*), *GDP* is the Real Gross Domestic Product Growth, *M2* is the Money Supply Growth, *LR* is the Commercial Bank Lending Rates. Therefore our two estimated models are:

$$Inf_t = \delta + \beta_1 Inf_{(t-1)} + \beta_2 Inf_{(t-2)} + \beta_3 PEXR_t + \beta_4 PEXR_{(t-1)} + \beta_5 PEXR_{(t-2)} + \beta_6 M2_t + \beta_7 M2_{(t-1)} + \beta_8 M2_{(t-2)} + \beta_9 LR_t + \beta_{10} LR_{(t-1)} + \beta_{11} RGDP_t + \beta_{12} RGDP_{(t-1)} + \beta_{13} RGDP_{(t-2)} + \varepsilon_t \quad \text{Eq. 2}$$

$$Inf_t = \delta + \beta_1 Inf_{(t-1)} + \beta_2 Inf_{(t-2)} + \beta_3 OEXR_t + \beta_4 OEXR_{(t-1)} + \beta_5 OEXR_{(t-2)} + \beta_6 M2_t + \beta_7 M2_{(t-1)} + \beta_8 M2_{(t-2)} + \beta_9 LR_t + \beta_{10} LR_{(t-1)} + \beta_{11} RGDP_t + \beta_{12} RGDP_{(t-1)} + \beta_{13} RGDP_{(t-2)} + \varepsilon_t \quad \text{Eq. 3}$$

These models aim to capture the multifaceted interactions and dependencies between inflation and the specified determinants, offering a comprehensive framework for empirical analysis and insightful interpretations. The inclusion of both official and parallel exchange rates recognizes the dual nature of the exchange rate system, providing a nuanced understanding of their impact on inflation. The Real Gross Domestic Product Growth, Money Supply Growth, and Commercial Bank Lending Rates are incorporated as crucial economic indicators that can potentially influence inflation dynamics.

3.2 The Estimation Method

We employed the Generalized ARDL approach because it is particularly useful when dealing with mixed-order integration of variables. It allows for the inclusion of both I(0) and I(1) variables in the same model, making it flexible for various economic time series data. The estimation of the model involves determining the appropriate lag lengths, testing for cointegration, and interpreting the short-run and long-run effects of the variables. By including lagged values of the dependent variable (inflation) and other relevant variables, the ARDL approach accounts for the persistence of inflation and the lagged impact of its determinant overtime. Since it combines the features of Autoregressive Integrated Moving Average (ARIMA) and

Distributed Lag (DL) models, making it suitable for cases where both integrated and non-integrated variables coexist. One key advantage is its ability to address endogeneity, which is crucial when studying the relationship between inflation and its determinants. The ARDL model also proves advantageous when working with small sample sizes, which are common in many empirical studies. This flexibility allows for meaningful analysis even with shorter time series or data constraints.

Furthermore, the ARDL model facilitates both short-run and long-run analysis. By distinguishing between short-term and long-term effects, it helps examine the immediate impact of changes in variables such as the exchange rate, GDP, money supply, and lending rates on inflation (short run), as well as the persistent or equilibrium relationship between these variables and inflation (long run).

Finally, the ARDL model incorporates an error correction mechanism, which captures the speed at which the system adjusts back to the long-term equilibrium following short-term shocks. This mechanism is crucial for understanding the short- and long-term dynamics of inflation. By analyzing how deviations from the long-term equilibrium are corrected and how inflation converges back to its long-run path, the ARDL model provides valuable insights into the adjustment process.

The generalized ARDL (P, Q) model is specified as:

$$Y_t = \alpha_{0i} + \sum_{i=1}^p \alpha_{1i} Y_{t-1} + \sum_{i=1}^q \alpha_{2i} X_{t-1} + \varepsilon_t \quad \text{Eq.4}$$

Where Y_t is a vector and the variable X_t are allowed to enter the model purely if they are I(0), I(1) or cointegrated; α_{1i} and α_{2i} are coefficients; β_{0i} is the constant or intercept of the regression equation; $i=1, 2, \dots, k$ and p and q are the optimal lag orders. ε_t is a vector of the error terms/ random walk/white noise-unobservable zero mean vector process (serially uncorrelated and independent). The ECM is used to estimate system equations as is specified below. Where q_1 and q_2 represents the lags that the regressors would take whilst P represent the lag orders for the dependent variables. The generalized ARDL (P, Q_1 , Q_2) model:

$$Y_t = \alpha_{0i} + \sum_{i=1}^p \alpha_{1i} Y_{t-1} + \sum_{i=1}^q \alpha_{2i} X_{t-1} + \sum_{i=1}^q \alpha_{3i} Z_{t-1} + \varepsilon_t \quad \text{Eq. 5}$$

If there is no Cointegration the ARDL (p q1 q2) model is specified as;

$$\Delta Y_t = \alpha_{0i} + \sum_{i=1}^p \alpha_{1i} \Delta Y_{t-1} + \sum_{i=1}^q \alpha_{2i} \Delta X_{t-1} + \sum_{i=1}^q \alpha_{3i} \Delta Z_{t-1} + \varepsilon_t \quad \text{Eq. 6}$$

If there is Cointegration the Error Correction Model (ECM) representation in Equation (7) is specified as:

$$\Delta Y_t = \alpha_{0i} + \sum_{i=1}^p \alpha_{1i} \Delta Y_{t-1} + \sum_{i=1}^q \alpha_{2i} \Delta X_{t-1} + \sum_{i=1}^q \alpha_{3i} \Delta Z_{t-1} + \lambda \text{ECT}_{t-1} + \varepsilon_t \quad \text{Eq. 7}$$

Where

$\lambda = (1 - \sum_{i=1}^p \alpha_i)$, speed of adjustment parameter with a negative sign

$\text{ECT} = (Y_{t-1} - \varphi V_t)$, the error correction term

$\varphi = \sum_{i=1}^p \beta_i$, is the long run parameter

$\alpha_{1i}, \alpha_{2i}, \alpha_{3i}$ are the short run dynamic coefficients of the model's adjustment long run/ equilibrium.

The Error Correction Model in ARDL approach has some econometric advantages over Engle and Granger (1987) and the maximum likelihood-based approach as proposed by Johansen and Juselius (1990) and Johansen's (1991) cointegration techniques. To highlight a few of these: (i) the bounds test does not require pre-testing of the series to determine their order of integration since the test can be conducted regardless of whether they are purely I(1), purely I(0), or mutually integrated. (ii) the ARDL model incorporates enough lags to capture the data generating process, that is, from a general to specific modelling framework (Laurenceson et al., 2008). To establish whether a long-run relationship exists, the bounds test procedure will need to be specified as expressed by Pesaran et al. (2001).

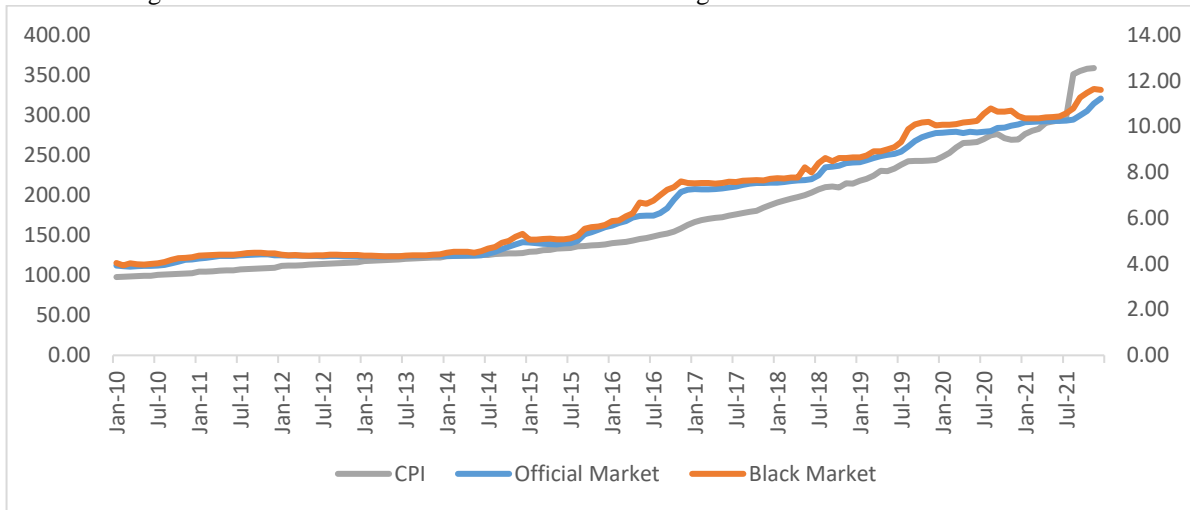
3.3 Data Description

This research draws insights from an annual time series dataset spanning from 1980 to 2020 obtained from the World Bank World Development Indicators. The key variables under scrutiny include the nominal exchange rate between the Leone and the US dollar, encompassing both official and parallel markets. Additionally, the analysis incorporates money supply, representing the total broad money (M2) circulating in the economy on a yearly basis. The lending rates taken into account are reflective of the average commercial bank lending rate, providing an indication of borrowing costs. Furthermore, the study incorporates GDP growth, wherein the growth rate of real GDP is calculated to capture the economic expansion or contraction over the specified period. Finally, the inflation is calculated as the percentage year on year change of the monthly consumer price index.

1. Exchange Rate Movements and Inflation

Historically, fluctuations in both the official and parallel exchange rates have exhibited a discernible correlation with changes in inflation see figures 1 and 2. An appreciation in the official exchange rate or a widening gap between the official and parallel rates tends to be associated with lower inflation, while depreciations or convergences lead to upward pressure on inflation. The historical correlation between exchange rate movements and inflation in Sierra Leone reveals a compelling narrative of interdependence. The intricate dance between official and parallel rates provides valuable insights into the factors influencing inflation, offering a foundation for informed economic decision-making and policy formulation.

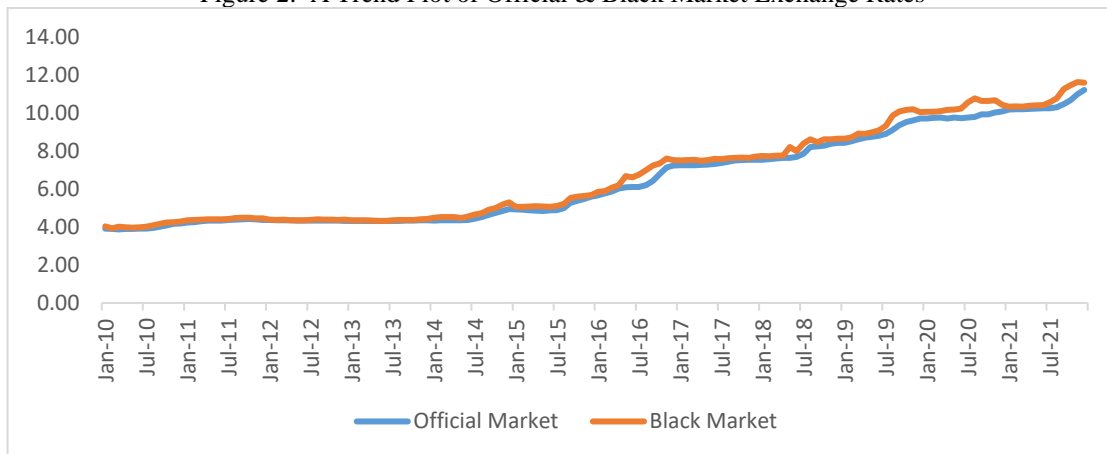
Figure 1: A Trend Plot of Official & Parallel Exchange Rates and Consumer Price Index



2. Differential Effects of Official and Parallel Exchange Rates:

The official exchange rate may have a more direct and immediate impact on inflation due to its association with government policies and international trade agreements. Conversely, the parallel exchange rate, being influenced by market forces and the Sierra Leone’s large informal sector, may exhibit more short-term volatility and could have a relatively quicker impact on inflation.

Figure 2: A Trend Plot of Official & Black Market Exchange Rates



The differential timing of the impact further distinguishes these two exchange rates. The official rate, with its close ties to government actions, can trigger a larger consequences on inflation. Changes in government policies or shifts in international trade dynamics may swiftly reverberate through the official exchange rate channel and could have larger influence. On the other hand, the parallel exchange rate, influenced by market sentiment and short-term fluctuations, may exhibit a quicker response to immediate market conditions, creating a more instantaneous effect on inflation.

4.0 Empirical Results

In Table 1, the Summary Statistics reveal that there are 41 observations for all the variables. The mean serves as a measure of central tendency, representing an average value in the dataset. Meanwhile, the standard deviation gauges the spread of values around the mean. A higher standard deviation implies greater variability, whereas a lower standard deviation indicates values closer to the mean. The minimum value signifies the smallest observed value, providing insight into the lower boundary of the data distribution. On the other hand, the maximum value represents the largest observed value, offering a glimpse into the upper boundary of the data distribution.

4.1 Summary Statistics

Table 1: Summary Statistics

Variable	Obs	Mean	Std. dev.	Min	Max
Inflation Rate	41	30.93	36.99	-3.29	178.7
Lending Rate	41	24.93	11.29	11	62.83
Exchange Rate Depreciation	41	31.51	47.02	-5.07	215.89
Black Market Exchange Rate Depreciation	41	25.95	33.46	-6.08	112.27
Money Growth	41	32.33	21.74	2.62	88.40
Real GDP Growth	41	2.42	8.43	-20.60	26.41

4.2 The Unit Root Test Results

The results of the unit root tests presented in table two confirm the collective findings derived from three distinct assessments: the Dickey-Fuller GLS, Perron-Vogelsang, and Clemente-Montanes-Reyes tests. The rationale behind conducting these three separate tests lies in addressing potential single and double structural breaks as well as outliers in the data. The decision to utilize multiple unit root tests for time series data is crucial to prevent the misidentification of stationarity in the time series variables. Employing a combination of these tests helps safeguard against the risk of using an incorrect estimation method (misspecification error), thereby ensuring a more robust and accurate analysis of the data. When dealing with non-stationary variables, estimating models using the Autoregressive Distributed Lag (ARDL) approach can yield misleading results. This is because non-stationary variables may exhibit a common trend, leading to high t-ratios that are not reflective of a true relationship between the variables. To address this issue, it is crucial to apply appropriate transformations to the non-stationary variables to avoid erroneous conclusions (see Table 2).

Variable	Order of Integration from DF-GLS	Order of Integration from PV	Order of Integration from CMR	Conclusion from all the three results
Inflation Rate	I(0)	I(0)	I(1)	I(0)
Exchange Rate Depreciation	I(0)	I(0)	I(0)	I(0)
Black Market Exchange Rate Depreciation	I(1)	I(k)	I(k)	I(1)
Money Growth	I(1)	I(0)	I(0)	I(0)
Lending Rate	I(2)	I(1)	I(1)	I(1)
Real GDP Growth	I(0)	I(0)	I(0)	I(0)

Note that all the I(1) variables were used in the models in their differenced form.

Although our stationarity test results, as displayed in Table 2, indicated a mixture of I(0) and I(1) variables, we proceeded to test for cointegration for both models, using the Pesaran Shin Smith method. However, the results revealed no long-run relationship among our specified variables of interest as is shown in tables 3 and 4. Consequently, we transformed the I(1) variables into I(0) variables and applied the general ARDL in first differences for further analysis. As shown in table 4.

4.3 Cointegration Analysis

With a sample size of 41 and annual observations we chose a lag length of 2 in the bounds test for cointegration, in line with Pesaran and Shin's (1999) recommendation of a maximum of 2 lags for annual data—also supported by Narayan (2004) and Narayan and Siyabi (2005).

Table 3: Pasaran-Shin-Smith Cointegration Test Results (Model 1).

Test- Statistics	Value(s)	Lags	Significance Level(s)	Bound Critical values (restricted intercept and no trend)*	
				I(0)	I(1)
F- Statistics	1.85 M1	2	1%	2.05	2.89
			5%	2.49	3.01
			10%	1.34	2.01

* Base on Narayan (2004)

Note: Model 1 is the parallel exchange rate model.

Table 4: Pasaran-Shin-Smith Cointegration Test Results (Model 2).

Test- Statistics	Value(s)	Lags		Bound Critical values (restricted intercept and no trend)*	
F- Statistics	1.93 M2	2	Significance Level(s)	I(0)	I(1)
			1%	2.40	3.03
			5%	2.55	3.46
			10%	1.82	1.90

* Base on Narayan (2004)

Note: Model 2 is the official exchange rate model.

As is shown in tables 3 and 4 the F-statistics for both model 1, and model 2 are 1.851357 and 1.930768, respectively. These values are below the upper critical bound values of 3.01 and 3.46 at the 5 percent significance level respectively. This implies that, at the 5 percent level of significance, there is no statistically significant long-run relationship between inflation and the official and parallel exchange rates.

4.4 Model Results

The analysis presented in Table 5 sheds light on the outcomes derived from two distinct models that were examined in the context of Sierra Leone. These models, namely Model 1 and Model 2, were carefully considered to unravel the complex relationship between inflation and exchange rates within the country. A noteworthy revelation from the estimated models is the pivotal role played by a surge in money supply (M2) in driving inflation. This phenomenon was observed in the estimated models for both Model 1, which focused on the parallel exchange rate, and Model 2, which centered on the official exchange rate. The consistency of this finding across both models underscores its significance and reliability, providing valuable insights into the economic dynamics of Sierra Leone. The observed correlation between an increase in money supply and rising inflation aligns seamlessly with the expected outcomes.

Table 5: Model Estimation Output

Variables	Model 1 (Parallel)		Model 2 (Official)	
	Coefficients	P-Value	Coefficients	P-Value
$\Delta INFLATION(t - 2)$	-0.265599	0.0070		
$\Delta LnM2$			151.5537	0.0000
$\Delta LnM2(t - 1)$	81.18975	0.0046	137.7980	0.0000
$\Delta LnM2(t - 2)$	80.67433	0.0015		

ΔGDP_GROWTH	-0.189383	0.3655		
$\Delta GDP_GROWTH(t - 2)$	-0.195474	0.3445		
ΔLR	1.252638	0.0072		
$\Delta LR(t - 1)$			-1.876478	0.0020
$\Delta EDEP_PARALLEL$	1.262981	0.0213		
$\Delta EDEP_PARALLEL(t - 2)$	0.920776	0.0637		
$\Delta EDEP_OFFICIAL$			0.425533	0.0238
$\Delta EDEP_OFFICIAL(t - 1)$			0.418845	0.0634
$\Delta EDEP_OFFICIAL(t - 2)$			0.516037	0.0013
C	-17.76790	0.0047	-45.83217	0.0000
R-squared	0.805328			0.816047
Adjusted R-Squared	0.740438			0.779256
Normality Test (Jacque Bera)	0.606466			0.748015
Serial Correlation (LM Test)	Prob. F(2,18) (0.0951)			Prob. F(2,28) (0.0614)
Heteroscedasticity (Breusch .P. Godfrey)	Prob. Chi-Square(8)(0.8183)			Prob. Chi-Square(6) (0.9796)
Prob(F-statistic	0.000001 (12.41056)			0.000000 (22.18085)

The results reveal that whether in the parallel market or the official market, the depreciation of the exchange rate plays a crucial and statistically significant role in shaping inflationary trends within the country. The findings validate the expectation that a decline in the exchange rate corresponds to an increase in inflation. The study reveals a 1.26 percentage point increase in inflation for every 1% depreciation in the parallel market. This emphasizes the acute sensitivity of the economy to fluctuations in the parallel exchange rate, indicating that changes in this market have an almost instantaneous effect on inflation. However, the temporal dimension adds a layer of complexity to this relationship. Over a two-year period, the effect gradually diminishes to 0.92 percentage points. This nuanced temporal aspect suggests that while exchange rate depreciation contributes significantly to inflation in the short term, its influence tends to weaken over time. This observation may be indicative of the economy adjusting and adapting to the new exchange rate levels, potentially mitigating the inflationary impact.

Similarly, the official exchange rate exhibits a comparable pattern of influence on inflation, albeit with some interesting variations. The study indicates a contemporaneous positive impact on inflation, with a coefficient of 0.43 percentage points for every 1% depreciation in the official rate. This signifies an immediate inflationary response to changes in the official exchange rate. Intriguingly, the effect intensifies over time, reaching 0.52 percentage points for every 1% depreciation. This implies that the official exchange rate not only has an immediate impact on inflation but continues to exert a growing influence over an extended period. This pattern may be attributed to various factors such as policy responses, market dynamics, and the broader economic environment.

We observe from the result that the impact of depreciation of the parallel rate on inflation is almost three times the impact of the official rate. A crucial aspect contributing to the observed distinctions is the differential impact on economic actors. The depreciation of the parallel exchange rate influences a larger group of economic participants, particularly those operating outside the formal financial sector who rely on the parallel market for foreign exchange needs. Given the relatively larger size of the informal sector in the economy, it is not entirely surprising that depreciations in the parallel market exchange rates exert a more pronounced pass-through effect on inflation.

The research findings reveal a statistically significant relationship between the lending rate and inflation in two distinct models. Model 2, centered on the official exchange rate, indicates a negative association, suggesting that an increase in the commercial bank lending rate corresponds to a decrease in inflation, aligning with conventional economic theories. Conversely, Model 1, focusing on the parallel exchange rate, presents an unexpected scenario where an increase in the lending rate is associated with an inflationary impact. This discrepancy suggests that economic agents, particularly within Sierra Leone's substantial informal economy, may exhibit limited responsiveness and indifference to lending rates in the formal banking system. Additionally, the analysis between GDP growth and inflation, revealed delayed and complex relationships in both models. Model 1 shows that GDP growth influences inflation after a two-period lag, while in Model 2, considering the official exchange rate, the unexpected sign of the GDP growth coefficient underscores the intricate interactions in the Sierra Leonean economic landscape.

5.0 Conclusions

The dual nature of the exchange rate system in the country introduces complexities rooted in divergent determinants, policy influences, and market forces. The primary aim of this study is to compare the impacts of the official and parallel exchange rates on inflation. By addressing this research gap within the context of Sierra Leone, the findings sought to contribute significantly to the broader literature on exchange rates

and inflation, particularly in the unique economic environment of the country. The coexistence of official and parallel exchange rates prompts essential questions about their individual and collective influences on inflation, demanding a nuanced understanding for effective economic management. The research objectives, encompassing the assessment of impacts, evaluation of magnitudes, and comparison of effects, are driven by the overarching goal of providing reasonable recommendations for policymakers. The hypotheses tested affirm the significance of both official and parallel exchange rates in influencing inflation, moreover, it also confirms that there is a significant difference in the effects of the official and parallel exchange rates on inflation in Sierra Leone. This research holds substantial significance as it not only addresses a knowledge gap specific to Sierra Leone but also provides valuable insights that can inform evidence-based economic policies.

The research employed the generalized Autoregressive Distributed Lag (ARDL) approach with dataset spanning from 1980 to 2020. The study shows that exchange rate depreciation of the Leones significantly influences inflation in Sierra Leone in the short run. The effect is more pronounced in the case of the parallel exchange rate, where a 1% depreciation results in a 1.26 percentage point increase in inflation increase, gradually decreasing to 0.92 percentage point over two periods. This is an indication of foreign exchange market fragmentation, indicating that a significant portion of foreign currency transactions occurs outside the official channels. This fragmentation introduces inefficiencies and imbalances in foreign currency resource allocation, posing challenges to the efficacy of monetary policies and exchange rate management. Similarly, the depreciation of the official rate exhibits a contemporaneous positive impact on inflation of 0.43 percentage point increase. This increases further to 0.52 percentage point increase in inflation for every 1% depreciation of the Leones in the second year. Furthermore, the research uncovers that there exist no statistically significant long-run relationship between inflation and exchange rates.

5.1 Policy Implications

Foreign Exchange Market Integration: Address the fragmentation in the foreign exchange market to enhance efficiency and reduce imbalances. Encourage measures that bring a larger share of foreign currency transactions within official channels to minimize the impact of parallel exchange rates on inflation. Given the significant impact of the parallel exchange rate on inflation, authorities should closely monitor activities in the parallel market. Consider implementing measures to discourage excessive reliance on the parallel market, such as measures to reduce the spread between official and parallel rates.

Policy Communication and Transparency: Providing forward guidance on potential future policy changes allows market participants to anticipate adjustments, contributing to overall market stability. Accessible information channels, including press releases and official statements, should be utilized to disseminate

information widely, fostering trust and minimizing misinformation. Actively engaging with stakeholders through briefings and consultations ensures a collaborative approach to exchange rate management. Consistency in messaging is paramount to avoid confusion and maintain confidence. Develop and communicate crisis communication plans to address unforeseen events or economic downturns. Having a well-prepared plan enables authorities to respond promptly during crises, reassuring markets and minimizing disruptions.

Periodic Review of Exchange Rate Management: Regularly review and adjust exchange rate management strategies in response to changing economic conditions. Flexibility and adaptability in policy responses are essential to address evolving challenges in the foreign exchange market. Continue investing in research and data collection to monitor the relationship between exchange rates and inflation. Periodic assessments will enable policymakers to make informed decisions and adjust strategies based on evolving economic conditions.

Diversification of Foreign Exchange Sources: To enhance remittance practices, it is advisable to implement policies that promote the utilization of official channels, such as formal banking systems. This can be achieved through measures like providing favorable exchange rates, minimizing transaction costs, and ensuring the accessibility and efficiency of the formal financial sector for remittance recipients. Simultaneously, efforts should be directed towards advancing financial inclusion, particularly in rural areas, to broaden access to banking services. By establishing a more inclusive banking infrastructure, there is a higher likelihood of individuals and businesses opting for formal financial channels for various transactions, including foreign exchange activities. This strategic shift can contribute to diminishing reliance on informal or parallel markets, fostering a more regulated and efficient remittance landscape.

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APPENDICES

Appendix 1: Dickey-Generalized Least Squares (DF-GLS) Unit Root Test Results

Variable		Deterministic Component	Lag	Test Statistics	Conclusion
Inflation Rate	L	Constant	2	-3.697	I(0)
	1D				
	2D				
Exchange Rate Depreciation	L	Constant	1	-5.447	I(0)
	1D				
	2D				
Black Market Exchange Rate	L	Constant	9	-0.497	I(1)
	1D	Constant	1	-5.530	
	2D				
Money Growth	L	Constant	2	-4.322	I(0)
	1D				
	2D				
Lending Rate	L	Constant	1	-1.834	I(1)
	1D	Constant	1	-4.306	
	2D				
Real GDP growth	L	Constant	1	-3.389	I(0)
	1D				
	2D				
Critical Values					
Constant					
1%: -2.634					
5%: -2.345					
Note: 1. L = level, 1D = 1st Difference and 2D = 2nd difference					
2. I(K) means series is not stationary after second differencing					
3. "a" stationary at 1 %					

Appendix 2: Perron-Vogelsang Single Break Unit Root Test Result								
Variable		Additive Outlier (Immediate Break)			Innovative Outlier (Gradual Break)			Conclusion
		Breakpoint	P-Value for Break	Test Statistics	Breakpoint	P-Value for Break	Test statistics	
Inflation Rate	L	1993	0.000	-3.217	1990	---	-2.803	I(0)
	1D							
	2D							
Exchange Rate depreciation	L	1992	0.000	-2.493	1991	0.000	-8.200	I(0)
	1D							
	2D							
Black Market Exchange Rate	L	1989	0.007	-1.732	1991	----	-0.565	I(k)
	1D	1991	0.977	1.259	1992	----	-1.593	
	2D	1989	0.139	0.128	1991	-----	-3.860	
Money Growth	L	1989	0.001	-5.577	1990	0.000	-6.992	I(0)
	1D							
	2D							
Lending Rate	L	1988	0.065	0.892	1994	0.108	-2.712	I(2)
	1D	1992	0.010	-1.411	1991	----	-3.977	
	2D	1991	0.973	-4.874	1992	-----	-5.551	
Real GDP growth	L	1999	0.012	-4.113	2001	0.043	-2.826	I(0)
	1D							
	2D							
5% Critical Values:								
Additive Outlier: -3.560				Innovative Outlier: -4.270				

Appendix 3: Clemente-Montanes-Reyes (double break) Unit Root Test Results								
Panel A: Additive Outlier (Immediate Break) Results								
Variable		First Break			Second Break			Conclusion
		Breakpoint	P-Value for Break	Test Statistics	Breakpoint	P-Value for Break	Test statistics	
Inflation Rate	L	1985	0.004	-0.744	1992	0.000	-0.744	I(1)
	1D	1985	0.311	-6.391	2000	0.609	-6.391	
	2D							
Exchange Rate Depreciation	L	1992	0.011	-3.821	1998	0.445	-3.821	I(k)
	1D	1984	0.967	-0.098	1991	0.535	-0.098	
	2D	1988	0.417	-0.913	1991	0.661	-0.913	

Black Market Exchange Rate	L	1992	0.000	-0.203	1999	0.055	-0.203	I(k)
	1D	1989	0.407	-0.585	1992	0.372	-0.585	
	2D	1990	0.979	-0.327	1993	0.906	-0.327	
Money Growth	L	1991	0.000	-6.189	2012	0.225	-6.189	I(0)
	1D							
	2D							
Lending Rates	L	1988	0.000	-3.242	1995	0.000	-3.242	I(2)
	1D	1986	0.062	0.035	1992	0.003	0.035	
	2D	1990	0.014	-4.462	1993	0.017	-4.462	
Real GDP growth	L	1999	0.014	-3.668	2011	0.471	-3.668	I(1)
	1D	1990	0.881	-9.290	2013	0.439	-9.290	
	2D							
Additive Outlier 5% Critical Values : -5.490								

Panel B: Innovative Outlier (Gradual Break) Results

Variable	Variable			First Break			Conclusion	
	Breakpoint	P- Value for Break	Test Statistics	Breakpoint	P- Value for Break	Test statistics		
Inflation Rate	L	1986	----	-2.803	1991	-----	-2.803	I(2)
	1D	1986	----	-2.014	1992	-----	-2.014	
	2D	1985	-----	-7.652	1987	-----	-7.652	
Exchange Rate Depreciation	L	1983	-----	-6.281	1992	-----	-6.281	I(0)
	1D							
	2D							
Black Market Depreciation	L	1991	-----	-2.829	1998	-----	-2.829	I(k)
	1D	1991	-----	-1.593	1993	-----	-1.593	
	2D	1991	-----	-3.860	1994	-----	-3.860	
Money Growth	L	1983	0.004	-9.408	1990	0.000	-9.408	I(0)
	1D							
	2D							
Lending Rate	L	1988	-----	-1.728	1992	-----	-1.728	I(2)
	1D	1991	----	-5.256	1996	-----	-5.256	
	2D	1991	-----	-5.551	1993	----	-5.551	
	L	2000	0.000	-10.649	2013	0.000	-10.649	

Real GDP growth	1D							I(0)
	2D							
Innovative Outlier 5% Critical Values : -5.490								

Appendix 5: Post Estimation Diagnostics

Figure 9: CUSUM Test

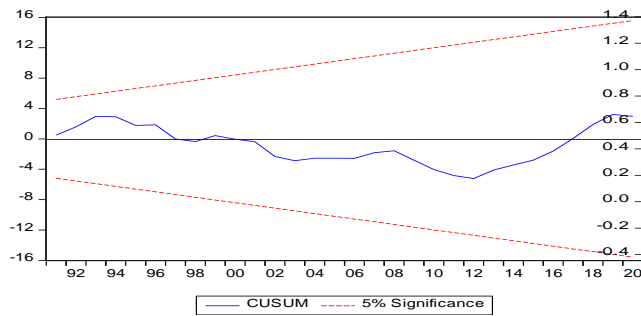


Figure 10: CUSUUM Square Test

