



# The Role of Forecasting Exchange Rate Volatility and Its Impact on Inflation in Sierra Leone: Evidence from a GARCH-MIDAS approach

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## Abstract

This research investigates the relationship between exchange rate volatility forecasting and its impact on inflation in Sierra Leone, utilizing a GARCH-MIDAS approach with mixed data. The analysis spans from January 2020 to August 2023 for monthly inflation and daily nominal exchange rates, employing the GARCH-MIDAS model and the Prophet machine learning model for forecasting exchange rates. Our findings highlight a robust link between monthly inflation and daily exchange rate volatility, emphasizing the critical connection between exchange rate depreciation and heightened inflation in Sierra Leone's import-reliant economy. Exchange rate patterns reveal a consistent depreciation trend of the Leone against the US dollar, with a projected peak rate of 1 US dollar equal to 25.64 Leones by March 12, 2024. Distinctive patterns of strengthening on Sundays and Mondays, followed by sharp depreciation from Tuesdays onward, are observed due to dynamics in foreign exchange market demand. Notably, the study identifies increased depreciation during April and May, associated with the Hajj pilgrimage, and a resurgence of exchange rate pressure in mid-October due to importer demand for essential commodities. Policy implications point to the need for the Bank of Sierra Leone to adopt unconventional measures, emphasizing effective inflation-targeting policies, exchange rate stabilization, diversification of imports, and prudent foreign exchange reserve accumulation. Investments in resilient sectors like agriculture and manufacturing are crucial to reduce import dependency. In conclusion, this research reveals the relationship between exchange rate volatility and inflation in Sierra Leone while identifying a knowledge gap that warrants further investigation into the impact of geopolitical events and supply chain disruptions on exchange rates and inflation, offering valuable insights for more

effective policy formulation.

## Subject Areas

Economics

## Keywords

Exchange Rate Volatility, Inflation, GARCH-MIDAS-X, Machine Learning and Forecast Methods

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## 1. Introduction

Inflation is defined as the sustained and generalized increase in the average price level of goods and services in an economy over a specified period, resulting in a reduction in the purchasing power of a currency (Mankiw, 2016) [1]. It signifies a scenario where prices, on average, are rising, consequently diminishing the currency's buying power. Typically expressed as an annual percentage, inflation is a multifaceted economic phenomenon with far-reaching implications. Sierra Leone's economy, characterized by heavy reliance on imports for essential commodities, renders it particularly susceptible to fluctuations in the exchange rate market. For instance, the ongoing conflict between Russia and Ukraine and the COVID-19 pandemic have exerted significant pressure on Sierra Leone's exchange rate, leading to a depreciation of the Leone currency.

Sierra Leone has experienced a substantial trade deficit over the past two decades, exacerbated by a relatively unproductive real sector. This has fostered a significant consumer appetite for imported goods and services, leading to a direct impact on exchange rate depreciation. Consequently, there is a high passthrough effect on prices, as substantial foreign exchange is required to settle import bills. This observation aligns with recent empirical research findings on inflation dynamics and exchange rate pass-through, as explored by researchers such as Jackson, Tamuke, and Jabbie (2020) [2] and Bangura (2012) [3].

The ongoing global economic upheaval triggered by the COVID-19 pandemic has further exacerbated inflationary pressures in Sierra Leone. This situation poses a continued risk to the economy, primarily due to the limited operational capacity of the real sector (Warburton and Jackson, 2020) [4]. As underscored in a recent study conducted by Santacreu (2022) [5], disruptions in global supply chains for goods and services are expected to result in price hikes, particularly for inelastic items like rice, a staple diet in the country.

Sierra Leone remains susceptible to exchange rate and inflationary crises due to its persistent reliance on imports to meet domestic consumption needs and its vulnerability to both internal and external shocks. This depreciation can be further attributed to a global trend where central banks, particularly in developed economies such as the USA, are raising interest rates to combat rising inflation.

Consequently, foreign direct investment (FDI) inflow into Sierra Leone and receipts from exports have dwindled, resulting in a shortage of US dollars. The heightened demand for the dollar has outstripped its supply, amplifying pressure on the Leone. Within a year, the Leone has lost more than half of its value against the dollar, resulting in increased exchange rate volatility.

This study delves into the critical role of forecasting exchange rate volatility and its ramifications on inflation in Sierra Leone, employing a GARCH-MIDAS approach. The primary objective is to dissect the intricate relationship between inflation and exchange rate volatility in Sierra Leone, leveraging the GARCH-MIDAS approach to assess the vulnerability of the Leone currency to inflationary pressures. Additionally, the study assesses the in-sample and out-of-sample predictability of exchange rate volatility using a machine learning model called Prophet.

This research constitutes a significant contribution as it pioneers the utilization of the GARCH-MIDAS technique to scrutinize the impact of exchange rate volatility on inflation in Sierra Leone. Furthermore, it introduces the application of the machine learning model Prophet to predict daily exchange rates for the Leone currency.

The remainder of this paper is structured as follows: Section 2 presents the Theoretical and Empirical Literature Review, Section 3 outlines the Methodology, Section 4 provides the Empirical Results, and Section 5 concludes the study.

## 2. Literature Review

### 2.1. Theoretical Literature Review

The relationship between exchange rates and inflation is both complex and multifaceted, drawing considerable attention from economists and policymakers. This literature review seeks to provide a comprehensive overview of the key theories and empirical findings that explore this intricate connection.

One of the foundational theories in this context is the Purchasing Power Parity (PPP) theory, which posits that, over the long run, exchange rates should adjust to equalize the purchasing power of different currencies. According to this theory, there is a direct link between inflation differentials and exchange rate movements. Specifically, higher inflation in a country should lead to a depreciation of its currency, as the purchasing power of that currency diminishes (Froot, Ken and Rogoff, 1995) [6].

Another important framework is the Interest Rate Parity (IRP) theory. This theory suggests that differences in nominal interest rates between two countries should be offset by changes in exchange rates. Higher inflation in one country often leads to higher nominal interest rates, which, according to the IRP theory, could cause its currency to appreciate as investors seek higher returns (Adler and Dumas, 1983) [7] (Evans and Lyons, 2002) [8].

The J-Curve effect offers a different perspective by describing the dynamic response of a country's trade balance following a change in its exchange rate. In the

short term, currency depreciation driven by inflation may initially worsen the trade balance because the immediate price effects dominate. However, over time, as price elasticities adjust, the trade balance may improve, potentially leading to a reduction in inflation (Marquez, 2002 [9]; Bahmani-Oskooee & Hegerty, 2009 [10]; Jackson, Tamuke & Sillah, 2021) [11].

Empirical studies on the relationship between exchange rates and inflation have yielded mixed results. While some research supports the theoretical links between exchange rates and inflation differentials, other studies find inconsistencies, suggesting that various factors—including interest rates, monetary policy, and market expectations—also play significant roles in this relationship (Frankel, 1986 [12]; Sarno & Taylor, 2002 [13]; Engel, 2016) [14].

The relationship between exchange rates and inflation is a critical aspect of international economics. Although theoretical models like PPP and IRP provide a foundation for understanding this relationship, empirical evidence indicates that it is far more complex than these models alone can explain. This complexity underscores the necessity for ongoing research and vigilance from policymakers in monitoring and managing these interrelated economic variables, as will be further explored in this study.

## 2.2. Empirical Literature Review

A study conducted by Afees, Juncal, and Rangan in 2021 [15], examines the predictability of exchange rate volatility in BRICS nations concerning geopolitical risks (GPR). This research amalgamates historical and contemporary GPR data, employing the GARCH-MIDAS-X model at varying data frequencies. The results reveal that recent GPR data exerts a more significant influence on BRICS exchange rates than historical data. Furthermore, the analysis elucidates distinctions between global GPR data and GPR data specific to individual BRICS countries, suggesting that global GPR wields a more pronounced influence than domestic GPR on exchange rates in BRICS nations. Lastly, the study underscores the potential economic advantages of incorporating GPR considerations in the evaluation of foreign exchange portfolios in out-of-sample scenarios.

Barunik, in his 2016 [16] paper titled “Modelling and Forecasting Exchange Rate Volatility in Time-Frequency Domain”, introduces an enhanced approach to forecasting exchange rate volatility by employing time-frequency decomposition of realised volatility, leading to more precise results. His research accentuates the persisting aspects of high-frequency volatility components and furnishes invaluable insights for risk management and investment decision-making. This methodology has received sustained endorsement in subsequent studies, underscoring its relevance in contemporary financial practices.

Obstfeld in their 2000 [17] paper contends that integrating international trade costs—such as transport expenses, tariffs, and non-tariff barriers—can illuminate key empirical puzzles that have challenged international macroeconomists for over twenty-five years. The study demonstrates that modifying the conventional

international macroeconomic model to include trade costs significantly enhances its explanatory power, addressing these once intractable anomalies. Additionally, the paper explores international pricing puzzles, including the purchasing power parity puzzle and the exchange-rate disconnect puzzle, encompassing the Meese-Rogoff exchange rate forecasting puzzle.

Furthermore, Benavides and Capistrán, in their 2012 [18] comprehensive study titled “Forecasting Exchange Rate Volatility: The Superior Performance of Conditional Combinations of Time Series and Option Implied Forecasts,” investigate the effectiveness of combined forecasts. They specifically focus on the amalgamation of time series and option implied forecasts in predicting exchange rate volatility. Their noteworthy findings highlight the consistent outperformance of these conditional combinations compared to individual forecasts and unconditional combinations. The sustained superior performance remains evident even when considering varying volatility regimes. This successful synergy between time series and option implied forecasts is attributed to the unique abilities of each: time series data encapsulates historical volatility persistence, while option implied forecasts reflect market expectations.

Lastly, Hansen, in his 2005 [19] research titled “A Forecast Comparison of Volatility Models,” underscores the exceptional performance of the GARCH(1,1) model in forecasting accuracy, a conclusion that subsequent research has consistently corroborated across diverse domains. This reaffirms the GARCH(1,1) model’s status as a fundamental and effective tool for forecasting volatility while emphasizing the imperative need for a customized model selection. These insights retain their relevance in contemporary financial practices.

While the body of literature addressing exchange rate volatility and its implications for inflation has witnessed substantial growth, with prominent methodologies such as GARCH-MIDAS and the integration of machine learning tools being widely applied, it is noteworthy that, to date, no prior work has explored this subject within the specific context of Sierra Leone. Consequently, this paper makes a significant contribution to the existing knowledge base by investigating the predictive capabilities of exchange rate volatility on inflation in Sierra Leone.

This study employs the GARCH-MIDAS approach and introduces an innovative machine learning tool, “Prophet”, for forecasting daily nominal exchange rate volatility in Sierra Leone.

However, when we compare Sierra Leone’s economic situation with other Sub-Saharan African countries that share similar economic characteristics, such as Nigeria, Liberia, Guinea, The Gambia and Ghana, their comparative analysis highlights similarities in exchange rate volatility, inflationary pressures, and import dependency, thus broadening the paper’s relevance to a wider audience. By examining the policies and outcomes in these countries, this study’s findings are positioned within a broader regional context, making the implications of the research more applicable across similar economies.

### 3. Methodology

To investigate our research hypothesis, we employ the GARCH-MIDAS framework. This choice is determined by data availability for the variables of interest. As previously mentioned, the predicted series related to exchange rates is available at a daily (higher) frequency, while the predictor series, inflation, is recorded at a monthly (lower) frequency. Utilising data at their inherent frequencies helps mitigate the challenge of information loss that can occur when data is aggregated or disaggregated to achieve a uniform frequency.

Our choice of the GARCH-MIDAS and Prophet models is strongly justified by their distinct strengths in capturing both high-frequency volatility and long-term trends in exchange rates, which are essential for understanding inflation dynamics in an import-dependent economy like Sierra Leone. Comparative analyses with alternative models, such as ARIMA, VAR, and traditional GARCH models, reveal that the GARCH-MIDAS model outperforms these alternatives, particularly due to its ability to incorporate mixed data frequencies, which is a critical advantage in volatility modelling. Additionally, traditional VAR and ARIMA models fall short when compared to the Prophet model. The Prophet model, being a machine learning tool, not only conducts all necessary statistical tests but also effectively handles missing data, such as weekends and public holidays, before generating forecasts. This capability enhances the accuracy of predictions, particularly in contexts with irregular data availability. These considerations underscore why the GARCH-MIDAS and Prophet models were selected, as they provide superior performance in capturing the unique economic characteristics of Sierra Leone.

However, on the flipside, the applicability and limitations of the GARCH-MIDAS and Prophet models particularly in the context of other developing countries. The GARCH-MIDAS approach, while effective in capturing mixed-frequency data and long-term volatility trends, may be limited by its complexity and the availability of high-frequency data in less-developed financial markets. The Prophet model, though powerful in handling time series data with strong seasonal effects, may require significant adjustments when applied to economies with less regular economic cycles or where data is scarce and unreliable.

#### 3.1. The GARCH-MIDAS Model

The GARCH-MIDAS model consists of four equations, including the constant conditional mean equation and the conditional variance equation, which is further decomposed multiplicatively into high and low-frequency components. For comprehensive technical details, please refer to Engle (2013) [20].

$$r_{i,t} = \mu + \sqrt{\tau_t} \times h_{i,t} \times \varepsilon_{i,t}, \quad \forall i = 1, \dots, N_t \quad (1)$$

$$h_{it} = (1 - \alpha - \beta) + \alpha (r_{i-1,t} - \mu)^2 / \tau_i + \beta h_{i-1,t} \quad (2)$$

$$\tau_i^{(rw)} = m_i^{(rw)} + \theta_i^{(rw)} \sum_{k=1}^k \varphi_k (\omega_1, \omega_2) X_{i-k}^{(rw)} \quad (3)$$

$$\varphi_k^{(w_1, w_2)} = \frac{k / (k+1)^{w_1-1} \times (1 - k / (k+1))^{w_2-1}}{\sum_{j=1}^k (\tau / (k+1))^{(w_1-1)} \times (1 - j / (k+1))^{w_2-1}} \quad (4)$$

$$\varepsilon_{i,t} / \phi_{i-1} \sim N(0,1)$$

Defining the variables and components within the framework,  $r_{i,t}$  is the return series for daily nominal exchange rates, calculated as the natural logarithm of  $S_{i,t}$  (the cost of the Leone currency to 1 US dollar) minus the natural logarithm of  $S_{i-1,t}$  (the previous month's cost) on the  $t^{\text{th}}$  day of month  $t$ .  $N_t$  is the number of days in month  $t$ .  $\mu$  is the unconditional mean of the exchange rate returns.  $h_{i,t}$  and  $\tau_i$  are the short- and long-run components of the conditional variance in Equation (1). They are further elaborated in Equations (2) and (3). For the short-run component  $h_{i,t}$  (Equation (2)), it follows a GARCH(1,1) process. Here,  $\alpha$  and  $\beta$  are the ARCH and GARCH terms, respectively, with the expectations that  $\alpha > 0$ ,  $\beta \geq 0$ , and  $\alpha + \beta < 1$ .

The long-term component  $\tau_i$ , initially varying on a monthly basis, is converted to daily frequency as described in Equation (3). In this Equation (3),  $m$  represents the long-run constant,  $\theta$  is the slope coefficient (the sum of the weighted rolling window exogenous variable), indicating the impact of inflation on the long-run return volatility of the daily nominal exchange rates.  $\varphi_k^{(\omega_1, \omega_2)}$  is the beta polynomial weighing scheme, with  $\varphi_k^{(\omega_1, \omega_2)} \geq 0$  for  $k = 1, \dots, K$ , and the sum of these weights equals unity for model identification.  $X_{i-k}$  represents the predictor variable (Inflation), while the superscripted "rw" indicates the utilization of the rolling window framework. Lastly, the random shock  $\varepsilon_{i,t}$ , conditioned on  $\mathcal{F}_{i-1,t}$ , signifies the information set available at the  $t^{\text{th}}$  day of month  $t$  and follows a normal distribution.

### 3.2. Data Type and Sources

The dataset comprises both daily and monthly observations spanning from 2020 to 2023, and it was sourced from the Bank of Sierra Leone's Data Warehouse. In the context of the GARCH-MIDAS model, a daily nominal exchange rate was utilized for the period ranging from January 2, 2020, to August 31, 2023. As for the inflation variable, which was converted to a percentage using the Consumer Price Index (CPI) variable, monthly data was employed, covering the timeframe from January 2020 to August 2023.

For the Prophet model<sup>1</sup>, a daily exchange rate data was used for the duration commencing from January 2, 2020, through September 14, 2023, with daily observations

### 4. Empirical Results

**Table 1** presents the outcomes of a GARCH-MIDAS (Generalised Autoregressive Conditional Heteroskedasticity—Mixed Data Sampling) model, with the daily

<sup>1</sup>Prophet Model is a machine learning tool and it is a time series forecasting model developed by Facebook's Core Data Science team, and it is widely used for forecasting various time-dependent data, including financial metrics, exchange rates, stock prices other economic indicators.

exchange rate as the dependent variable and monthly inflation as the independent variable. The dataset comprises a total of 892 observations.

**Table 1.** Predictability of inflation for daily exchange rate volatility.

	<b>Coeff</b>	<b>StdErr</b>	<b>tStat</b>	<b>Prob</b>
mu	0.21	(0.08)	2.73	0.01***
alpha	0.03	(0.04)	0.70	0.48
beta	0.49	(0.67)	0.74	0.46
theta	0.25	(0.04)	5.65	0.00***
w	1.00	(0.19)	5.25	0.00***
m	-3.11	(0.59)	-5.26	0.00***

Standard errors in parentheses \*\*\*P < 0.01, \*\*P < 0.05, \*P < 0.1. Source Authors estimation using MATLAB software.

The “mu” coefficient, measuring 0.21, represents the model’s constant term, signifying a significant observation. It suggests that daily exchange rates exhibit an average return of approximately 0.21 percent, with high statistical significance at the one percent level.

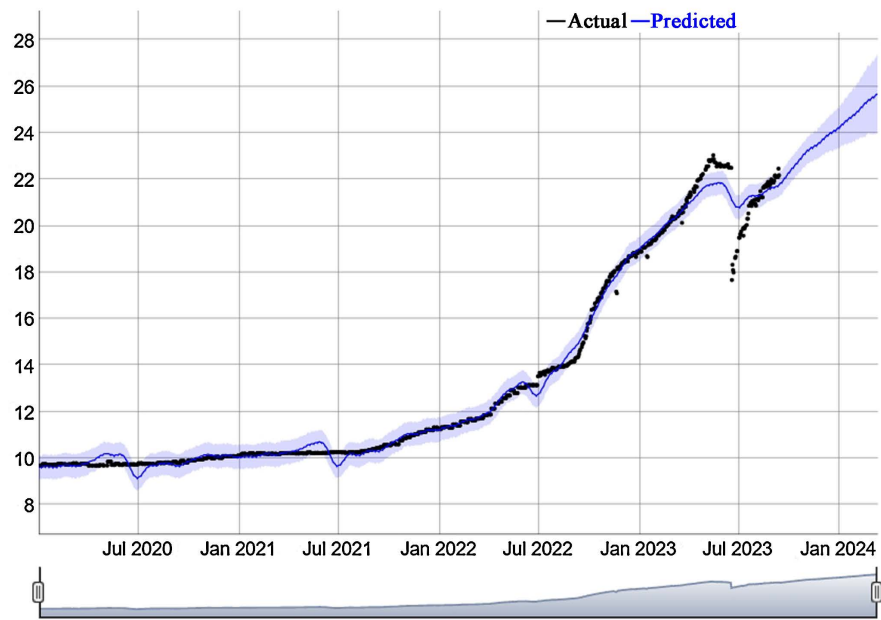
In contrast, the “alpha” coefficient, set at 0.03, aligns with the GARCH (1, 1) component of the model, governing short-term volatility dynamics. Although this coefficient is relatively modest in magnitude, it indicates a certain level of short-term volatility persistence in the daily exchange rate returns, yet it does not attain statistical significance.

Similarly, the “beta” coefficient, registering at 0.49, also falls within the GARCH (1, 1) component, measuring long-term volatility dynamics. Like the alpha coefficient, it exhibits a relatively small value, failing to achieve statistical significance. This implies a weak long-term dependence on past returns in the volatility of exchange rates.

The “theta” coefficient, evaluated at 0.25, is closely associated with the MIDAS component of the model, providing insights into the relationship between monthly inflation and daily exchange rate volatility. The positive value indicates a direct and highly statistically significant correlation between monthly inflation and exchange rate volatility. This suggests that higher depreciation tends to be associated with increased inflation. This phenomenon is particularly evident in Sierra Leone, given its status as an import-dependent nation, where exchange rate fluctuations are transmitted to economic agents in the form of increased prices.

Conversely, the “w” coefficient, set at 1.00, plays an essential role within the MIDAS component as a weight or scaling factor for lagged monthly inflation. Notably, this coefficient underscores the robust connection between historical monthly inflation and exchange rate volatility while maintaining statistical significance.

Lastly, the “m” coefficient, marked at -3.11, is also a vital part of the MIDAS component. Its negative value highlights an inverse relationship between monthly



**Figure 1.** IN and OUT of sample prediction of daily exchange rate.

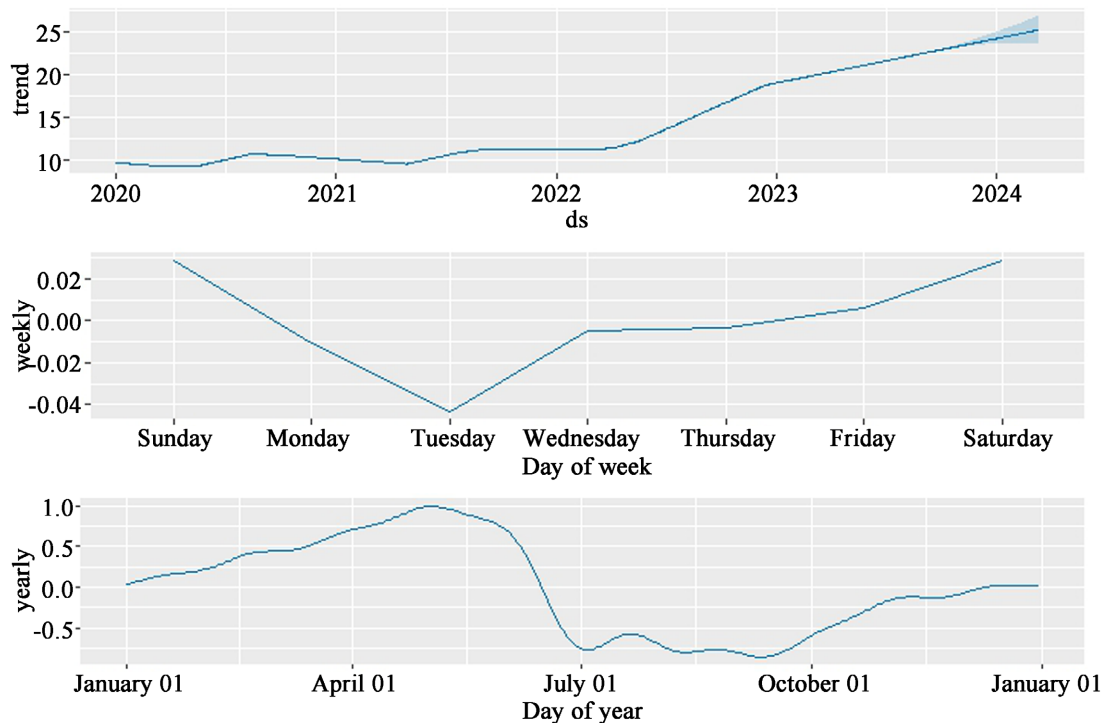
inflation and exchange rate volatility, and it is statistically significant.

**Figure 1** above illustrates a sample forecast of the nominal exchange rate, covering the period from September 15, 2023 to March 12, 2024. This forecast is based on daily data, comprising approximately 180 observations. The out-of-sample data suggests that the Leone will continue to exhibit a weakening trend against the US dollar, with an expected peak rate of 1 US dollar to 25.64 Leones as of March 12, 2024.

It is crucial to acknowledge the inherent uncertainty surrounding this forecast, as indicated by the fan chart. Within this framework, the exchange rate is anticipated to fluctuate, with a lower bound of approximately 23.78 Leones to a US dollar and an upper bound of about 26.58 Leones to a US dollar over the forecast horizon. These variations underscore the importance of the monetary authority considering strategies to mitigate the potential exacerbation of depreciation.

**Figure 2**, depicted above, comprises three distinct panels. The first panel provides insights into the trajectory of Sierra Leonean Leone depreciation over the course of the investigation. It reveals that, since 2020, exchange rate depreciation remained relatively moderate, with stability at 10 Leones to a US dollar. However, depreciation began to escalate around February 2022, coinciding with the commencement of the Ukraine-Russia conflict, a pivotal global event that triggered uncertainty and supply chain disruptions.

This upheaval in the global landscape led to surging inflation rates, particularly in developed nations, compounded by oil supply shortages and sanctions imposed on Russia. In response to mounting inflation, the developed world tightened interest rates, diminishing the availability of investment funds that traditionally flowed to developing countries. Consequently, Sierra Leone's exports have struggled, resulting in significantly reduced export receipts. Moreover, the real sector's



**Figure 2.** Seasonal pattern of the daily exchange rate pattern over the period (2020 to 2023).

productivity has weakened, intensifying the pressure on importers to secure funding for the acquisition of goods for consumption. As a result, depreciation has continued to worsen and is projected to deteriorate further in 2024.

The second panel of **Figure 2** reveals a consistent pattern of Leone depreciation, predominantly occurring from Tuesdays onward. Notably, there is a noticeable strengthening of the Leone's value on Sundays, Mondays, and early Tuesdays, followed by a sharp depreciation trend commencing on Tuesdays.

This observed pattern can be attributed to the dynamics of the foreign exchange market. During the weekend, the demand for foreign currency is relatively subdued, resulting in an oversupply of Leone compared to the demand for the US dollar. Consequently, the price of the dollar tends to decline during the weekend due to this surplus. As the new business week unfolds, with Mondays and Tuesdays still witnessing a relatively weak appetite for the US dollar by businessmen and economic agents, the situation begins to shift. However, from Tuesday onwards, a surge in demand for the US dollar surpasses its supply, exerting upward pressure on the dollar's price, contributing to inflationary pressures.

Moving to Panel 3 within **Figure 2**, a distinct pattern emerges. Specifically, it becomes evident that we experience more pronounced depreciation during the months of April and May. This period coincides with the annual Hajj pilgrimage to Mecca, a significant event in the Islamic calendar that necessitates substantial demand for foreign exchange, observed during this time.

Conversely, from June to early October, the exchange rate appears to appreciate and remains relatively stable. This period signifies a phase of relative currency

strength and stability. However, this trend encounters a turning point around mid-October, indicating a resurgence in exchange rate pressure, attributed to the forthcoming festive season. This prompts heightened demand from importers requiring substantial volumes of foreign exchange to facilitate the importation of vital commodities, particularly fuel and essential goods.

## Findings

The study employed a GARCH-MIDAS model to examine the relationship between daily exchange rate volatility and monthly inflation in Sierra Leone, using a dataset of 892 observations. The findings provide significant insights into the dynamics between these two critical economic variables.

Firstly, the analysis reveals a robust correlation between exchange rate volatility and inflation, as indicated by the “theta” coefficient of 0.25. This positive and significant relationship suggests that as the Leone depreciates, inflationary pressures intensify. This is particularly pronounced in an import-dependent economy like Sierra Leone, where the cost of imported goods rises sharply with currency depreciation, leading to higher overall price levels. This finding underscores the vulnerability of such economies to external shocks and exchange rate fluctuations, which can quickly translate into domestic inflation.

The study also delves into the volatility dynamics captured by the GARCH(1,1) model components. The “alpha” (0.03) and “beta” (0.49) coefficients indicate the presence of short-term volatility dynamics; however, these are not statistically significant. This suggests that while there is some level of short-term volatility in the exchange rate, the long-term persistence of these fluctuations is relatively weak. The implication is that exchange rate movements in Sierra Leone may be influenced more by external factors or shocks rather than by a sustained, inherent volatility pattern over time.

Furthermore, the “w” coefficient, set at 1.00, highlights the significant role of historical inflation in shaping current exchange rate volatility. This strong connection suggests that past inflationary trends have a lasting impact on the economy’s exchange rate behaviour, reflecting how deeply ingrained inflation expectations and past experiences are in the economic psyche of the nation. This persistence can exacerbate the effects of volatility, making it more challenging to stabilize the currency without addressing underlying inflationary pressures.

Interestingly, the study also identifies a statistically significant inverse relationship between monthly inflation and exchange rate volatility, as indicated by the “m” coefficient of  $-3.11$ . This inverse relationship highlights the complex interplay between inflation and exchange rate movements, where periods of lower inflation may coincide with higher exchange rate volatility, and vice versa. This finding suggests that in Sierra Leone, efforts to control inflation could potentially reduce exchange rate volatility, or conversely, that stabilizing the exchange rate could help mitigate inflationary pressures.

Lastly, the study uncovers distinct patterns in the Leone’s exchange rate

behavior. Notably, the currency tends to strengthen on Sundays and Mondays, followed by depreciation from Tuesdays onward. This pattern may be driven by the dynamics of the foreign exchange market, where lower demand for foreign currency over the weekend leads to a temporary strengthening of the Leone, which then reverses as demand picks up during the week. Additionally, the study identifies specific periods, such as April and May (coinciding with the Hajj pilgrimage), and mid-October (pre-festive season), where the Leone experiences more pronounced depreciation. These patterns are critical for understanding the timing and drivers of exchange rate movements in Sierra Leone, providing valuable insights for policymakers aiming to stabilize the currency and manage inflation effectively.

## 5. Policy Recommendations

The findings of this study carry important implications for economic policy in Sierra Leone, particularly concerning the management of exchange rate volatility and inflation. The strong correlation between exchange rate depreciation and inflation underscores the need for targeted and strategic policy interventions to maintain economic stability.

First, the study highlights the critical importance of exchange rate stabilization as a central policy goal for the Bank of Sierra Leone. To achieve this, the central bank should consider active interventions in the foreign exchange market during periods of heightened demand, such as the pre-festive season or the Hajj pilgrimage. These interventions could help prevent sharp depreciations that tend to amplify inflationary pressures, thereby protecting the purchasing power of the Leone.

Additionally, the findings emphasize the necessity of effective inflation-targeting policies to manage the inflationary impacts of exchange rate volatility. The central bank should strengthen its monitoring of price levels and be prepared to adjust interest rates or deploy other monetary tools as needed to keep inflation in check. By doing so, the Bank of Sierra Leone can better contain the inflationary spirals that often accompany exchange rate fluctuations.

Moreover, the study suggests that diversifying imports is a crucial strategy to mitigate the adverse effects of exchange rate fluctuations on essential commodities. The Bank of Sierra Leone should encourage the local production of staples like rice and reduce the economy's dependence on specific imports that are particularly vulnerable to price increases during periods of currency depreciation. This approach would help stabilize prices and reduce the inflationary impact of exchange rate movements.

Building and maintaining robust foreign exchange reserves is another key recommendation. By accumulating sufficient reserves, the Bank of Sierra Leone can create a buffer against external economic shocks, enabling it to stabilize the exchange rate during periods of uncertainty and ensuring a steady supply of foreign currency for critical needs.

Lastly, the study underscores the importance of investing in resilient sectors

such as agriculture, manufacturing, and other productive industries. These investments are vital for reducing the economy's reliance on imports and enhancing domestic production capacity. By bolstering these sectors, Sierra Leone can achieve greater economic stability and resilience, better shielding itself from the disruptive effects of exchange rate volatility.

## 6. Conclusion

In conclusion, this research underscores the significant link between exchange rate volatility and inflation in Sierra Leone, particularly in the context of its import-dependent economy. The application of the GARCH-MIDAS model reveals a robust and statistically significant relationship, highlighting the critical impact of exchange rate depreciation on inflationary pressures. The study also identifies key seasonal patterns in exchange rate movements, which have direct implications for policy formulation. To address these challenges, the Bank of Sierra Leone should prioritize effective inflation-targeting policies, enhance exchange rate stabilization efforts, and promote economic diversification. These measures are essential for mitigating the adverse effects of exchange rate fluctuations and ensuring greater economic stability. Further research is needed to explore the impact of geopolitical events and supply chain disruptions on these dynamics, providing additional insights for more effective policy interventions.

## Conflicts of Interest

The authors declare no conflicts of interest.

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