AN INVESTIGATION OF MACRO-ECONOMIC FACTORS AFFECTING THE KENYAN EXCHANGE RATE

Insights into Macroeconomic Drivers and Exchange Rate Fluctuations in Kenya

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DECLARATION

I declare that this work has not been previously submitted and approved for the award of a degree by this or any other University. To the best of my knowledge and belief, the Research Project contains no material previously published or written by another person except where due reference is made in the Research Project itself.

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List of Abbreviations

KES	Kenyan Shilling
USD	United States Dollar
EUR	Euro
UGX	Ugandan Shilling
GBP	Pound Sterling
VIF	Variance Inflation Factor
VAR	Vector Autoregressive
PPP	Purchasing Power Parity
IRF	Impulse Response Function
CPI	Consumer Price Index
CBK	Central Bank of Kenya
ACF	Autocorrelation function
MLR	Multiple Linear Regression
IRP	Interest Rate Parity
CBR	Central Bank rate

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CHAPTER 1

1.1 Introduction

The exchange rate, defined as the relative value of one currency against another, serves as a cornerstone in gauging a nation's economic health and stability. For Kenya, the exchange rate between the Kenyan Shilling (KES) and major global currencies, such as the US Dollar (USD), Euro (EUR), Ugandan Shilling (UGX), and British Pound Sterling (GBP), holds particular significance due to its far-reaching implications for trade, investment, and macroeconomic policy. Among these, the KES/USD pairing has historically commanded the most attention, reflecting the US dollar's dominance in international trade and finance. However, as Kenya's economic ties diversify, understanding exchange rate dynamics across a broader spectrum of currencies becomes crucial. As a small open economy, Kenya's exchange rate fluctuations are shaped by a dynamic interplay of domestic and international macroeconomic forces. Factors such as inflation differentials, interest rate disparities, trade balances, remittance flows, and external shocks play pivotal roles in influencing currency values.

These fluctuations, in turn, have profound consequences for economic growth, price stability, and financial resilience, making them a critical area of focus for policymakers, businesses, and investors alike. Over the past two decades, the Kenyan Shilling has undergone notable depreciation and volatility, particularly against the USD, sparking robust debate and analysis. This study seeks to expand this discourse by examining not only the KES/USD pair but also the KES/EUR, KES/UGX, and KES/GBP pairings, offering a more holistic understanding of the forces driving exchange rate movements in Kenya. By contextualizing these fluctuations within Kenya’s unique economic landscape, this research aims to unravel the intricate relationships between macroeconomic variables and currency dynamics.

What distinguishes this study is its practical relevance. Exchange rate volatility influences a broad spectrum of economic activities, from the cost of imported goods and services to the competitiveness of exports and the burden of foreign-denominated debt. Through rigorous analysis and data-driven insights, this research seeks to provide actionable knowledge for economists, financial analysts, and policymakers. By mapping the macroeconomic determinants of exchange rate changes, we aim to contribute to the formulation of sound monetary and fiscal policies and establish a robust foundation for future academic inquiry

1.2 Problem Statement

The exchange rate is a key barometer of economic health, influencing trade, investment, and monetary policy. In the Kenyan context, the fluctuation of the Kenyan Shilling (KES) against major currencies, particularly the US Dollar (USD), Euro (EUR), Ugandan Shilling (UGX), and British Pound Sterling (GBP), reflects a complex interaction of macroeconomic variables. These include inflation, interest rates, trade balances, and remittance flows. Between 2012 and 2024, the KES has experienced notable volatility, marked by its depreciation against the USD from KES 84.53 in 2012 to approximately KES 130.00 in 2024. This trend underscores the urgent need to understand the drivers of these fluctuations and their implications for Kenya's economic stability.

Despite the availability of theoretical and empirical studies, a comprehensive, Kenya-specific investigation into the macroeconomic determinants of exchange rate fluctuations is notably lacking. Existing research, such as Harshani Rajakaruna's 2017 study on exchange rate drivers in Sri Lanka, highlights the critical roles played by inflation, interest rates, trade balances, remittances, and official interventions. While Rajakaruna's findings provide a valuable framework, their applicability to Kenya remains unexplored. This study addresses this gap by contextualizing these factors within Kenya's unique economic, social, and political landscape, offering actionable insights into exchange rate dynamics.

Economic Context and Motivation

As a small open economy, Kenya is particularly susceptible to external shocks, global commodity price fluctuations, and foreign capital movements, all of which contribute to exchange rate volatility. The depreciation of the KES over the past decade has amplified challenges for importers, exporters, and monetary authorities. Rising costs of imported goods, increasing foreign debt burdens, and export competitiveness pressures underscore the critical need for effective policy responses. This research seeks to identify the macroeconomic variables most strongly associated with these fluctuations, providing a foundation for informed monetary and fiscal policy decisions to stabilize the currency and foster economic resilience.

Relevance of Sri Lanka's Experience

Rajakaruna's investigation into Sri Lanka's exchange rate dynamics offers a comparative lens through which Kenya's experience can be analyzed. Key variables such as inflation, interest rates, terms of trade, net foreign purchases, official interventions, and remittances were shown to significantly influence Sri Lanka's exchange rate movements. Adapting these insights to Kenya's context provides an opportunity to uncover parallels and divergences in the mechanisms driving exchange rate fluctuations in emerging economies. This cross-contextual approach not only enriches the analysis but also strengthens the theoretical underpinnings of the study.

Rationale for the Study

While the literature on exchange rate determinants is extensive, few studies have holistically examined Kenya's unique exchange rate dynamics across multiple currency pairs. The majority of existing work focuses on the KES/USD pair, overlooking the growing significance of the Euro, British Pound, and regional currencies like the Ugandan Shilling. This study bridges this gap by employing a robust econometric framework to analyze exchange rate fluctuations across multiple pairings, thereby offering a more comprehensive understanding of Kenya's foreign exchange market.

1.2.1 Objectives and Contributions

1. To evaluate the relative impact of macroeconomic factors on the exchange rate fluctuations of the Kenyan Shilling against the USD, EUR, UGX, and GBP. The results suggest that both domestic factors (e.g., inflation, interest rates, and reserves) and global factors (e.g., USD strength, Eurozone policies) play a role in exchange rate dynamics. This objective allows for a comparative analysis to identify whether internal or external influences dominate in driving the Kenyan Shilling's fluctuations.
2. To assess the lagged effects of macroeconomic variables on the Kenyan Shilling's exchange rate to identify short-term and long-term drivers. The VAR model results highlight the presence of lagged relationships between macroeconomic variables and exchange rate movements. This objective will help differentiate between variables that have immediate effects (e.g., interest rate adjustments) and those whose impacts manifest over time (e.g., inflationary trends).

1.2.2 Expected Outcomes

By employing cutting-edge econometric techniques, the research will assess whether Kenya's exchange rate behavior adheres to global economic models while exploring deviations unique to its economic structure. Specifically:

Purchasing Power Parity (PPP): This foundational theory posits that exchange rates should equilibrate to reflect inflation differentials between trading nations. In Kenya's case, we hypothesize that elevated inflation levels, stemming from structural inefficiencies, supply-chain disruptions, or fiscal pressures, will correlate with a systematic depreciation of the Kenyan Shilling. Interest Rate Parity (IRP): The study anticipates that higher domestic interest rates in Kenya, indicative of tightened monetary policies, will exert upward pressure on the Kenyan Shilling through increased capital inflows. Monetary Model of Exchange Rates: Traditional models predict that excess liquidity relative to economic output leads to currency depreciation. This study will explore whether Kenya's exchange rate reflects such dynamics, particularly in periods of aggressive quantitative easing or external debt repayments.

1.3 Significance of This Research

This study transcends traditional analyses by integrating advanced econometric modeling with real-world applications, creating actionable insights for diverse stakeholders:

Central Bank of Kenya (CBK): Beyond conventional policy adjustments, CBK can leverage the findings to anticipate currency pressures arising from global market contagion, enabling proactive interventions through targeted monetary tools like currency swap agreements or macroprudential measures. Ministry of Finance: Empirical data from this study will provide the Ministry with a granular understanding of fiscal-exchange rate interdependencies, equipping policymakers to craft resilient budget frameworks that mitigate foreign exchange volatility risks, particularly in times of heightened external debt obligations.

Business and Industry Leaders: Firms operating in volatile markets will benefit from predictive models that forecast currency movements with high precision, enabling hedging strategies, dynamic pricing algorithms, and risk-adjusted capital allocation for sustainable profitability in global trade. Investors and Financial Markets: By dissecting Kenya's exchange rate dynamics, this study offers a sophisticated lens into frontier market risks and opportunities. Academic and Research Communities: The study's methodological rigor and focus on an under-researched region will set a benchmark for future research, contributing to global economic discourse.

CHAPTER TWO

2.1 Literature Review

This literature review presents an in-depth exploration of research conducted over the past 12 years, covering the period during which the Kenyan shilling has encountered significant volatility. The review synthesizes key findings from a range of studies to understand the complex dynamics of exchange rate fluctuations, drawing on various theoretical perspectives. Through this comprehensive analysis, the review not only addresses the macroeconomic factors impacting Kenya's exchange rate but also identifies gaps in the existing literature that could inform future empirical studies. The goal is to provide a nuanced understanding of the forces shaping Kenya's exchange rate behaviour and to provide a theoretical foundation for the research conducted in this study.

2.1.1 Theoretical Framework

Economic Theories Underpinning This Study:

Understanding the exchange rate fluctuations of the Kenyan Shilling (KES) against major currencies such as the US Dollar (USD), Euro (EUR), Ugandan Shilling (UGX), and British Pound (GBP) necessitates a multi-theoretical approach. The dynamics of exchange rate movements are influenced by various macroeconomic variables, and classical, modern, and behavioural economic theories provide essential perspectives on the factors at play in Kenya's exchange rate behavior.

Classical Gold Standard:

A Foundation of Stability: Though the gold standard is no longer applicable, its concept of currency stability through a fixed peg to a commodity like gold remains influential. For Kenya, this concept suggests that currency stability, especially in the face of volatility in the KES against currencies like the USD, EUR, UGX, and GBP, is essential for fostering international trade, attracting foreign investment, and mitigating risks related to currency depreciation. Even though Kenya now operates within a fiat currency system, the principles behind the gold standard highlight the importance of inflation control and maintaining foreign exchange reserves as a means to bolster investor confidence (Bordo, 1993).

Purchasing Power Parity (PPP): The Equalizer:

In the context of Kenya, PPP offers a tool to assess the degree of undervaluation or overvaluation of the Kenyan Shilling relative to its trading partners. The fluctuations in the KES against currencies like the USD, EUR, UGX, and GBP may reflect disparities in price levels, and while PPP offers valuable long-term insights, it may not always hold true in the short run due to factors such as government interventions, speculative activities, and capital controls.

Interest Rate Parity (IRP): The Financial Arbitrator:

IRP theory focuses on the relationship between interest rate differentials and exchange rate changes. In Kenya, this theory helps explain how adjustments in the Central Bank of Kenya's (CBK) monetary policy, especially changes in the Central Bank Rate (CBR), can influence the exchange rate. When Kenya adjusts interest rates, it could either attract foreign capital or drive it away, impacting the stability of the KES against currencies like the USD, EUR, UGX, and GBP.

The Balassa-Samuelson Effect: Productivity and Prices:

According to the Balassa-Samuelson Effect, countries with higher productivity growth in tradable sectors tend to experience an appreciation in their real exchange rate. In Kenya, sectors such as agriculture and services may exert pressure on the KES if productivity growth lags behind that of its trading partners, leading to depreciation. This effect can be particularly relevant when comparing the Kenyan Shilling against the USD, EUR, UGX, and GBP, as productivity gaps can drive inflationary pressures, affecting the competitiveness of Kenyan exports and the value of its currency.

The Mundell-Fleming Model: An Open-Economy Perspective:

The Mundell-Fleming model is essential for understanding how exchange rates, interest rates, and national output interact in an open economy. In the Kenyan context, the 'impossible trinity' (the dilemma of balancing fixed exchange rates, free capital mobility, and independent monetary policy) is critical. With external shocks such as global commodity price fluctuations and geopolitical events impacting the value of the Kenyan Shilling, understanding this trade-off helps in appreciating the challenges Kenya faces in managing its exchange rate stability amidst global financial flows.

The Balance of Payments Theory: A Comprehensive Framework:

Kenya's external economic relations, comprising trade balances, remittances, and foreign direct investment (FDI), are central to understanding exchange rate stability. A persistent current account deficit, driven by imports exceeding exports, places downward pressure on the KES. However, inflows from remittances and FDI provide much-needed foreign currency to cushion the shilling from depreciation. This theory helps us understand the relationship between Kenya's external economic factors and the volatility of the KES against the USD, EUR, UGX, and GBP.

The Behavioural Approach: Psychology Meets Economics:

While traditional economic models emphasize rational decision-making, the behavioural approach incorporates psychological factors that influence exchange rate fluctuations. Investor sentiment, driven by factors such as political instability or uncertainty regarding the economic performance of Kenya, can lead to sudden shifts in capital flows, affecting the KES's value.

2.1.2 Providing a Background on Key Variables

This section explores key macroeconomic variables that influence the exchange rate of the Kenyan Shilling (KES) against major currencies such as the USD, EUR, UGX, and GBP, providing a foundation for understanding the drivers of exchange rate fluctuations.

Exchange Rate:

Volatility in the KES/USD exchange rate, for example, affects Kenya's trade balance, inflation, debt servicing, and foreign investment climate. Stability in the exchange rate is vital for Kenya's import-heavy economy, particularly concerning imports such as fuel, machinery, and raw materials. The study examines how inflation, interest rates, and trade balances influence exchange rate fluctuations in Kenya, with a particular focus on the KES/USD and KES/GBP (Kamau, 2020).

Inflation:

Inflation, driven by factors such as food prices, fuel costs, and currency fluctuations, directly impacts the value of the Kenyan Shilling. When inflation rises, the Central Bank of Kenya may adjust interest rates to stabilize prices, indirectly influencing exchange rates. High inflation can lead to depreciation of the KES against major currencies such as the USD and EUR. This study investigates how inflation dynamics interact with interest rates and other macroeconomic variables in affecting exchange rate fluctuations (Ocampo, 2019).

Interest Rate:

Interest rates, particularly the Central Bank Rate (CBR), have a direct influence on Kenya's monetary policy and exchange rate stability. High interest rates attract foreign capital, leading to a potential appreciation of the KES, particularly against major currencies like the USD, EUR, and GBP. However, excessively high interest rates can deter investment by increasing borrowing costs. The study explores how fluctuations in interest rates in Kenya, especially in response to inflationary pressures, impact exchange rates.

Remittances:

Remittances are a vital source of foreign exchange in Kenya, helping to stabilize the KES by providing a steady inflow of USD and other foreign currencies. The role of remittances is especially important during economic downturns or when external shocks threaten the stability of the exchange rate. This section explores the relationship between remittance flows and the stability of the Kenyan Shilling against the USD, EUR, UGX, and GBP.

Trade Balance:

The trade balance, representing the difference between Kenya's exports and imports, is crucial for understanding exchange rate fluctuations. A trade deficit, driven by high import levels (particularly from countries like China and the United States), places downward pressure on the Kenyan Shilling. Conversely, a trade surplus could strengthen the currency. The study will assess how Kenya's trade balance impacts the KES, especially against the USD and GBP.

2.2 Relevance of These Variables in the Kenyan Context

The relevance of these variables in the Kenyan context cannot be overstated. Kenya, as an emerging economy, is highly sensitive to changes in macroeconomic variables, and understanding their interaction is crucial for policymakers. Exchange rate stability is vital for controlling inflation, maintaining investor confidence, and ensuring the affordability of imports. Inflation and interest rates are key tools used by the CBK to manage the economy, while remittances and trade balance directly influence the availability of foreign exchange and the value of the KES.

2.3 Discussion of Empirical Studies – Articles cited.

To comprehend the dynamics at play, one must first turn to the foundational theories that underpin our understanding of exchange rate movements. Purchasing Power Parity (PPP) asserts that over time, exchange rates should adjust to equalize the prices of goods and services between countries.

Meanwhile, Interest Rate Parity (IRP) posits that differences in interest rates between countries should, in theory, be offset by corresponding changes in exchange rates to prevent arbitrage opportunities. These theories, while elegant in their simplicity, reveal only a fraction of the intricate tapestry that governs exchange rate dynamics.

Kemboi Isaacks and Kosgei K. David's (Kemboi, 2019) seminal study on the "Economic Determinants of Exchange Rate Volatility in Kenya." Their findings challenged conventional wisdom, revealing that while higher interest rates in Kenya initially attract capital inflows, signaling economic strength, they paradoxically triggered increased exchange rate volatility. This anomaly suggested that higher interest rates might also signify economic distress, prompting capital flight and depreciating the Kenyan Shilling against the US Dollar.

Harshani Rajakaruna's research on Sri Lanka (Rajakaruna, Investigating Factors Affecting Exchange Rate Flactuations In Sri Lanka, 2017) provided a complementary perspective, examining how variables such as inflation, terms of trade, and net foreign purchases shape exchange rate fluctuations. In Sri Lanka's context, Rajakaruna uncovered a curious relationship between inflation and exchange rates: contrary to expectations, higher inflation rates sometimes led to a stronger local currency against the dollar. This counterintuitive finding underscored the nuanced interplay between inflation dynamics and investor behavior, where rising inflation rates could signal higher returns on investments, bolstering the local currency.

On a broader canvas, Tayyab Raza FRAZ and Samreen FATIMA's cross-country analysis (FATIMA*, 2016), shed light on how macroeconomic variables impact exchange rates across developed and developing economies. Their study illuminated the varying degrees of influence that inflation, interest rates, and terms of trade exert in different economic contexts. For developed nations like Japan, where interest rates strongly correlate with exchange rate movements, the relationship was straightforward. In contrast, for emerging markets like South Africa and India, inflation emerged as a critical determinant of currency values, reflecting distinct economic realities and policy frameworks.

The COVID-19 pandemic, an unprecedented global shock, further underscored the fragility of exchange rates in the face of external disruptions. Kenga, Kamau, and Amayo's study on Kenya highlighted how the pandemic, coupled with inflationary pressures, intensified exchange rate volatility. The ensuing economic turbulence necessitated swift policy responses to stabilize the exchange rate and mitigate adverse impacts on the broader economy.

In financial markets, the study by Shitemi, Maingi, and Egessa (Shitemi Sophie1, 2023) offered a unique perspective on the interconnectedness between exchange rates and equity fund performance in Kenya. Their findings revealed a stark negative correlation: as exchange rates appreciated, the performance of equity funds dwindled. This symbiotic relationship underscored how currency movements can ripple through financial markets, influencing investment decisions and portfolio returns.

From these, a cohesive narrative emerges: Kenya's exchange rate fluctuations are not merely the product of isolated economic variables but rather the culmination of a complex interplay between inflation dynamics, interest rate movements, terms of trade shifts, capital flows, and external shocks. Each variable, imbued with its own nuances and implications, contributes to the intricate mosaic that defines Kenya's economic landscape.

2.4 Further Analysis – Conceptual Framework

Inflation and Exchange Rate Fluctuation; Inflation differentials between countries are a fundamental determinant of exchange rate movements. The Purchasing Power Parity (PPP) theory posits that in the long run, exchange rates should adjust to equalize the price levels of identical goods and services in any two countries. According to Kemboi Isaacks and Kosgei K. David in their paper (Kemboi, 2019) an increase in inflation rate differential causes an increase in exchange rate volatility, aligning with PPP theory.

However, they noted that high inflation could lead to capital outflows as investors seek more stable economies, which might complicate the expected outcomes from PPP.

Harshani Rajakaruna's study (Rajakaruna, Investigating Factors Affecting Exchange Rate Flactuations In Sri Lanka, 2017) supports this view, finding a negative relationship between exchange rates and inflation. The study suggests that higher inflation in Sri Lanka leads to an appreciation of the nominal exchange rate against the dollar, contradicting traditional expectations but highlighting the complex interplay between inflation and exchange rate movements.

Interest Rates and Exchange Rate Fluctuation; Interest rate differentials play a crucial role in determining exchange rate movements, as proposed by the Interest Rate Parity (IRP) theory. Higher interest rates typically attract foreign capital, leading to an appreciation of the local currency. However, Isaacks and David found that an increase in interest rate differential in Kenya led to an increase in exchange rate volatility, which was contrary to IRP expectations. This anomaly might be due to the perceived economic instability associated with higher interest rates, prompting capital outflows despite the higher returns.

Tayyab Raza FRAZ and Samreen FATIMA's paper (FATIMA*, 2016) found mixed results in different contexts. For instance, in developed countries like the UK and Japan, interest rates had a significant positive correlation with exchange rates, while in developing countries like South Africa and India, inflation had a more pronounced impact. This highlights the varying dynamics across different economic contexts.

Terms of Trade and Exchange Rate Fluctuation; Terms of trade, defined as the ratio of export prices to import prices, are another critical determinant of exchange rate fluctuations. A country's terms of trade can significantly affect its exchange rate by influencing the demand and supply for its currency. Rajakaruna's study (Rajakaruna, Investigating Factors Affecting Exchange Rate Flactuations In Sri Lanka, 2017) on Sri Lanka found a negative relationship between terms of trade and exchange rates, indicating that a deterioration in terms of trade leads to a depreciation of the exchange rate. This finding aligns with the theoretical expectation that worsening terms of trade reduce the country's export revenues, weakening its currency.

Official Intervention and Exchange Rate Fluctuation; Government and central bank interventions in the foreign exchange market aim to stabilize or influence the exchange rate. Such interventions can take the form of direct market operations or indirect measures like monetary policy adjustments. The impact of these interventions on exchange rate volatility is a subject of considerable debate. While some studies suggest that official intervention can stabilize exchange rates, others argue it may lead to increased volatility if market participants perceive the interventions as unsustainable.

Remittances and Exchange Rate Fluctuation; Remittances, the transfer of money by foreign workers to their home countries, are an essential source of foreign exchange for many developing countries, including Kenya. Remittances can influence exchange rates by affecting the supply and demand for foreign and local currencies. Increased remittances typically lead to currency appreciation, as seen in various empirical studies. However, the exact impact can vary depending on factors like the stability and predictability of remittance flows.

2.5 Empirical Evidence from Kenya and Other Contexts

Kemboi Isaacks and Kosgei K. David's (Kemboi, 2019) study on Kenya provides valuable insights into the specific dynamics affecting exchange rate volatility in the country. They found that both interest rate and inflation rate differentials significantly impact exchange rate volatility, though the effects of interest rates were somewhat counterintuitive.

In the study (Rajakaruna, Investigating Factors Affecting Exchange Rate Flactuations In Sri Lanka, 2017), Rajakaruna found that changes in inflation, interest rates, terms of trade, and net foreign purchases all significantly impacted exchange rate fluctuations. This study's comprehensive approach to examining multiple factors provides a useful model for analyzing similar dynamics in Kenya. The paper "Exploring the Impact of Macro Economic Variables on Exchange Rate: A Case Of Some Developed and Developing Countries" (FATIMA*, 2016) by FRAZ and FATIMA highlights the importance of considering the specific economic context when analyzing exchange rate determinants.

Their findings underscore the variability in the impact of macroeconomic variables on exchange rates across different countries. The study "Effect of Coronavirus Disease 2019 (COVID-19) and Inflation Rate on the Foreign Exchange Rate in Kenya" (Kenga) by Kenga, Kamau, and Amayo emphasizes the significant effects of unexpected global events and inflation on Kenya's exchange rate. Their results highlight the need for close monitoring and mitigation measures to manage exchange rate volatility in the face of such shocks. Lastly, (Shitemi Sophie1, 2023) investigates the broader economic implications of exchange rate movements. Their findings of a substantial negative relationship between exchange rate movements and the performance of equity funds in Kenya underline the interconnectedness of financial markets and exchange rates.

2.6 Consistencies

Interest Rates and Exchange Rates; Kemboi Isaacks and Kosgei K. David (Rajakaruna, Investigating Factors Affecting Exchange Rate Flactuations In Sri Lanka, 2017) found that increased interest rates in Kenya typically signal economic distress, leading to capital outflows and currency depreciation. FRAZ and FATIMA's study (FATIMA*, 2016) revealed that in developed countries like the UK and Japan, interest rates significantly impact exchange rates. For Japan, a strong positive correlation was found between exchange rates and interest rates, while inflation had a negative correlation.

Inflation and Exchange Rates; Both Isaacks and David and Rajakaruna observed that higher inflation rates are generally associated with currency depreciation. Isaacks and David found this consistent with the Purchasing Power Parity (PPP) theory. Rajakaruna identified a negative relationship between inflation and exchange rate, suggesting that increased inflation led to the appreciation of the rupee against the dollar, driven by a concurrent rise in call money rates.

Terms of Trade; Rajakaruna highlighted that worsening terms of trade lead to currency depreciation. This aligns with broader economic theory that links a country's trade position to its currency value.

2.7 Contradictions

Interest Rates and Currency Behavior; While FRAZ and FATIMA observed a clear relationship between interest rates and exchange rates in developed countries, Isaacks and David (K.David) found that higher interest rates in Kenya might indicate economic distress rather than attracting capital inflows, leading to a different outcome. This contradiction highlights the importance of the economic context in determining the effects of interest rates on exchange rates.

Inflation and Currency Value; Rajakaruna’s findings show a counterintuitive result where higher inflation leads to the appreciation of the rupee against the dollar. In contrast, Isaacks and David (K.David) reported that higher inflation rates typically result in currency depreciation, consistent with PPP theory. This discrepancy could be due to different economic structures and the interplay of additional variables such as call money rates.

Impact of Exogenous Shocks; The study by Kenga, Shukrani, Kamau, and Akinyi on the impact of COVID-19 (Kenga) suggests that the pandemic significantly affects exchange rates, necessitating close monitoring and mitigation measures. This focus on exogenous shocks adds a layer of complexity to the understanding of exchange rate dynamics, which is less emphasized in other studies.

2.8 Additional Observations

Differing Contexts and Economic Conditions; The studies underscore that the impact of macroeconomic variables on exchange rates can vary significantly depending on the country's economic conditions. For instance, FRAZ and FATIMA (FATIMA*, 2016) found that inflation had a strong positive impact on exchange rates in developing countries like South Africa and India, whereas Rajakaruna noted a negative relationship between inflation and exchange rates in Sri Lanka.

2.9 Conclusion

While theoretical frameworks like PPP and IRP provide foundational insights, empirical evidence reveals context-specific dynamics. Key variables such as inflation, interest rates, terms of trade, net foreign purchases, official intervention, and remittances all play significant roles, though their impacts can vary.

This comprehensive understanding is crucial for policymakers and stakeholders in formulating strategies to manage exchange rate volatility effectively. Further research is needed to explore emerging factors and refine our understanding of these dynamics, particularly in the context of ongoing economic and political developments. The research objectives on understanding factors affecting exchange rate fluctuations in Kenya are directly supported by the literature review. The reviewed papers by Kemboi Isaacks, Kosgei K. David, Harshani Rajakaruna, Tayyab Raza FRAZ, Samreen FATIMA, and others provide crucial insights into how macroeconomic variables like inflation, interest rates, terms of trade, foreign purchases, official interventions, and remittances influence exchange rates. These studies validate and inform the focus of this research, helping to shape hypotheses and guide empirical methodologies.

By synthesizing these findings, this study aims to contribute new insights into exchange rate dynamics in Kenya, filling gaps in current research and offering implications for policy and economic strategies in the region.

2.10 Research knowledge/ Gap

This research aims to address critical gaps in the existing literature on exchange rate fluctuations in Kenya, focusing on the period from 2012 to 2024. While previous studies have examined various macroeconomic factors influencing exchange rates, there remains a notable lack of comprehensive analyses that integrate multiple variables within the Kenyan context over such a recent and crucial time span. Existing literature often isolates individual factors such as inflation interest rates or trade balances without fully exploring their interconnectedness and cumulative impact on exchange rate movements over time.

Several studies have approached the analysis of exchange rate fluctuations in Kenya, but most have not captured the dynamic relationships between multiple macroeconomic variables or used advanced econometric models like the Bivariate Vector Autoregressive (VAR) model to fully assess these relationships. By focusing specifically on Kenya and employing a robust Bivariate VAR model, this research aims to fill this gap by synthesizing diverse macroeconomic variables, such as inflation, interest rates, trade balances, and remittances, into a single comprehensive framework. This approach will provide a holistic understanding of the collective influence of these variables on exchange rate fluctuations, capturing the interdependencies among them.

Additionally, this study incorporates recent data spanning from 2012 to 2024, a period that includes significant economic shocks and policy changes in Kenya. The use of this recent data will enable a longitudinal analysis that captures evolving trends and responses to these shocks, thus offering new insights into the behaviour of the Kenyan Shilling (KES) against major currencies. The ability to examine how macroeconomic factors interact over time will be crucial for policy formulation and economic stability, especially in the context of global financial crises, commodity price fluctuations, and changes in the global economic environment (Ocampo, 2019).

In sum, this research provides a much-needed analysis of the Kenyan exchange rate system, offering a more integrated view of macroeconomic factors over a recent period and using sophisticated statistical techniques to capture the complexities of exchange rate movements. The findings will contribute significantly to the literature on exchange rate volatility in emerging economies and provide valuable insights for policymakers and economists seeking to stabilize Kenya's currency in an increasingly interconnected global economy.

CHAPTER 3

3.1 METHODOLOGY

3.1.1 Research Design

This study adopts a quantitative research design centred on time series analysis to explore the dynamic relationship between key macroeconomic variables and the exchange rate fluctuations of the Kenyan Shilling (KES) against the US Dollar (USD). The research is designed to both describe existing trends and explain the underlying causal mechanisms between the variables over a specified period. The quantitative approach is essential for applying statistical methods that can handle the complexity and interdependencies inherent in economic time series data.

3.1.2 Choice of Design and Justification

The selection of a quantitative time series design is justified by the need to model temporal dependencies and lagged effects among the variables. The Vector Autoregressive (VAR) model is chosen for its flexibility in capturing the dynamic relationships and feedback effects among multiple time series variables, such as exchange rates, inflation rates, interest rates, remittances, and trade balances. VAR allows for the simultaneous examination of how these variables influence each other over time, making it particularly suitable for studying their interconnectedness.

However, the Multiple Linear Regression (MLR) model is also considered to analyse the direct impact of independent variables on the exchange rate. MLR provides a straightforward approach to quantify how each variable affects the exchange rate, offering clear coefficient estimates and a simpler interpretation of relationships.

The design is both descriptive, analysing trends and patterns over time and explanatory, seeking to uncover causative relationships and forecast future movements based on historical data. The VAR model is complemented by diagnostic tests to ensure robust empirical findings by rigorously testing model assumptions. Additionally, MLR results may provide supplementary insights into the direct effects of individual variables on the exchange rate. By integrating both models, the study benefits from the comprehensive dynamic analysis of VAR and the straightforward impact assessment of MLR, enhancing the overall robustness and depth of the research.

3.1.3 Population and Sampling

The study encompasses the entire population of monthly observations for the selected macroeconomic variables from May 2012 to May 2024. Each month within this period represents a distinct observation, with the total number of observations defined by the number of months in the selected timeframe. The study does not employ traditional sampling methods, as it includes the complete dataset, ensuring that no relevant information is omitted. This exhaustive approach enhances the validity of the findings, as it incorporates all fluctuations and trends within the period under study.

3.1.4 Sample Techniques and Procedures

Given the time series nature of the data, the study avoids conventional sampling techniques. Instead, the focus is on ensuring data quality through data cleaning and preprocessing. Missing values are handled via interpolation to maintain the continuity of the time series, a critical step for ensuring that the analysis accurately reflects the temporal dynamics of the variables. The data is then structured into a format suitable for time series analysis, including the conversion of variables into numeric formats and the chronological ordering of the dataset.

3.1.5 Representativeness of Sample

By utilizing the entire dataset from May 2012 to May 2024, the study ensures representativeness of the period under investigation. The dataset accurately reflects the economic conditions, policy changes, and external shocks that occurred during this time, providing a comprehensive basis for analysis. The inclusion of all relevant data points ensures that the results are not only representative but also generalizable to the entire period, making the findings robust and reliable.

3.2 Data Collection

Data was collected from reliable secondary sources, ensuring accuracy and consistency. The specific variables and their sources are as follows:

1. Exchange Rate: Monthly exchange rate data from the Central Bank of Kenya (CBK) and the International Monetary Fund (IMF).
2. Inflation Rates: Data from the Kenya National Bureau of Statistics (KNBS).
3. Central Bank Interest Rates: Retrieved from CBK.
4. Total Remittances: Data sourced from the World Bank.
5. Trade Balance: Monthly data from KNBS and the Ministry of Trade.

3.3 Type and Source of Data

The study relies exclusively on quantitative secondary data. The data, consisting of monthly observations for each variable, was obtained from the following:

1. Central Bank of Kenya (CBK)
2. Kenya National Bureau of Statistics (KNBS)
3. World Bank

The secondary nature of the data allows for the application of rigorous statistical methods without the need for primary data collection, ensuring that the analysis is grounded in well-established and reliable data sources.

3.4 Model Selection and Assumptions

Time Series Analysis; Rationale for Time Series Analysis; Time series analysis is essential for studying the dynamics and interdependencies of economic variables over time. This approach enables the examination of temporal patterns, trends, and relationships among variables such as exchange rates, inflation rates, interest rates, remittances, and trade balances. By employing time series methods, researchers can uncover the intricate interactions between these variables and make informed predictions about future economic conditions.

Vector Autoregressive (VAR) Model; Model Explanation'; The Vector Autoregressive (VAR) model is a multivariate time series model that captures the linear interdependencies among multiple time series variables. Unlike univariate models, which focus on a single variable, VAR models analyse several variables simultaneously, allowing for a comprehensive examination of their dynamic relationships. This model is particularly well-suited for investigating how economic indicators influence each other over time.

Model Equation

The VAR model is defined by the following equation:

$$Y_t = A_1 Y_{t-1} + A_2 Y_{t-2} + \cdots + A_p Y_{t-p} + \mathcal{E}$$

where:

- Y_t is a vector of *k* time series variables at time *t*.
- A_i are coefficient matrices corresponding to lag *i*.
- *p* denotes the number of lags included in the model.
- $\mathcal{E}_t$ represents the vector of error terms.

Assumptions

- Linearity: The VAR model assumes linear relationships among the variables.
- Stationarity: The data should be stationary. Non-stationary series can be transformed through differencing to achieve stationarity.
- No Autocorrelation in Residuals: Residuals should be free from serial correlation, which can be tested using diagnostic tools.
- Normality of Residuals: Residuals should follow a normal distribution.

Model Specifications

- Lag Order Selection: The appropriate number of lags, *p*, is determined based on criteria such as the Akaike Information Criterion (AIC) or the Schwarz Bayesian Criterion (SBC).
- Stationarity Tests: Unit root tests, such as the Augmented Dickey-Fuller test, are employed to confirm that the time series data are stationary.

Diagnostics

Residual Autocorrelation: Assessing residual autocorrelation helps ensure that the model adequately captures the temporal dependencies in the data. Tests for residual autocorrelation are performed to validate this assumption.

Multicollinearity: Although the Variance Inflation Factor (VIF) is more commonly associated with MLR models, multicollinearity in VAR models can be evaluated through the condition number of the matrix of regressors. A high condition number indicates potential multicollinearity issues.

Implementation and Expected Outcomes

The VAR model will be implemented to analyse the dynamic interactions among the time series variables, assessing how shocks to one variable affect the others over time.

The analysis is expected to reveal the complex interrelationships among the economic variables, highlighting how changes in one variable propagate through the system and influence others. This will provide insights into the systemic dynamics and feedback mechanisms.

3.5 Data Analysis

In preparing for the data analysis, it is crucial to address the diverse scales and units of measurement of the variables involved, namely exchange rates, inflation rates, interest rates, remittances, and trade balances. Given the varied nature of these variables, where trade balances are measured in billions of KES, interest rates are in percentages, and other variables have their own distinct units. The application of a standardization approach is recommended. Standardization, or Z-score transformation, involves rescaling each variable so that it has a mean of 0 and a standard deviation of 1.

This method facilitates the comparability of variables by placing them on a common scale, thus allowing for more meaningful comparisons and interpretations. It is particularly advantageous in this study as it enables the direct comparison of the impacts of different variables, such as the effect of trade balances versus interest rates on exchange rates, by neutralizing the effects of their original scales and units.

Moreover, standardization is crucial for the compatibility of the statistical models employed, such as the Vector Autoregressive (VAR) model and Multiple Linear Regression (MLR) model. These models often assume that variables are on a comparable scale, and standardization helps mitigate potential issues related to multicollinearity and ensures that each variable contributes equally to the analysis. This approach also enhances interpretability by expressing the effects of variables in terms of deviations from the mean, providing a clearer understanding of their relative impacts.

In addition to standardization, applying log transformations will be necessary for variables with highly skewed distributions or wide-ranging values, such as trade balances and remittances. Log transformation can stabilize variance and reduce skewness, further refining the data's suitability for analysis. However, normalization, which rescales data to a fixed range, is an alternative but less common method in econometric analyses due to its less intuitive interpretation of relative relationships compared to standardization.

Overall, by standardizing the data and applying log transformations where appropriate, the analysis will be based on consistent and comparable measures, ensuring robust and interpretable results in examining the impacts of economic indicators on exchange rates.

3.5.1 Data Preprocessing

Data Cleaning: Missing values were handled using linear interpolation to maintain the integrity of the time series, ensuring that gaps in the data did not distort the analysis.

Data Transformation: All variables were converted to a consistent numeric format, and the data was arranged chronologically to accurately reflect the temporal sequence of events.

Exploratory Data Analysis (EDA): Initial exploration of the data was conducted to identify trends, patterns, and potential outliers. This step included the generation of summary statistics and visualizations to provide an overview of the data's distribution and central tendencies.

3.5.4 Forecasting and Impulse Response Analysis

Generate Forecasts: The VAR model will provide forecasts for the exchange rate by incorporating the lagged effects of macroeconomic variables such as inflation rates, interest rates, remittances, and trade balances. These forecasts will then be compared against actual data to assess their accuracy and reliability.

Impulse Response Functions: These functions will be calculated to understand the impact of a one-time shock to each macroeconomic variable on the exchange rate. This analysis will reveal the magnitude and duration of the effects, offering insights into the dynamic relationships among the variables within the system.

3.5.5 Robustness Checks

Finally, robustness checks will be conducted to ensure the reliability of the results:

Sensitivity Analysis: Different lag lengths and alternative specifications of the VAR model will be tested to determine the stability of the findings. This will help confirm that the results are consistent across various model settings.

Outlier Analysis: The influence of potential outliers will be assessed. The model will be re-estimated after excluding outlier observations to check for consistency and validate that the results are not unduly affected by anomalous data points.

CHAPTER 4

4.1 RESULTS

In the key results section (page 29 onwards), values such as 0.11 and 0.112 represent the coefficients obtained from the regression analysis of the respective lagged variables. These coefficients indicate the nature and strength of the relationship between the current value of the dependent variable (exchange rate) and its lagged values or the lagged values of other independent variables.

For instance, a coefficient of 0.11 for a lagged exchange rate variable (ExchangeRate.l1) suggests that a 1-unit increase in the exchange rate from the previous period is associated with a 0.11-unit change in the current exchange rate, holding other factors constant. This captures the persistence or delayed effect of past values on present fluctuations.

Similarly, for other lagged variables, such as inflation or interest rates, the coefficients reflect how their past values influence the current exchange rate, providing insight into the dynamics and delayed effects within the model.

KES/USD

```
VAR Estimation Results:
========================
Endogenous variables: ExchangeRate, AnnualAverageInflation, Inflation, Centra
lBankInterestRates, TotalRemittances, TradeBalance
Deterministic variables: const
Sample size: 118
Log Likelihood: 523.352



Residual standard error: 0.05304 on 45 degrees of freedom
Multiple R-Squared: 0.9973,      Adjusted R-squared: 0.993
F-statistic: 232.3 on 72 and 45 DF,  p-value: < 2.2e-16
```

Summary Table

Variable	Lag	Relationship	Significance (p-value)	Interpretation
ExchangeRate	l1	Positive	< 0.001	A 1-unit increase in the exchange rate from the previous period leads to an increase of 1.083 in the current exchange rate. This suggests a strong persistence in the exchange rate.
ExchangeRate	l2	Negative	≈ 0.065	A 1-unit increase in the second lag reduces the exchange rate by 0.409 units, indicating mean reversion tendencies at this lag.
ExchangeRate	l11	Negative	≈ 0.058	Suggests a mean reversion effect at longer lags, with a decrease of 0.249 units for a 1-unit increase at this lag.
ExchangeRate	l12	Positive	≈ 0.098	A 1-unit increase in the 12th lag results in a 0.116 increase in the exchange rate. This shows a possible lingering effect of past exchange rate values.
ExchangeRate	Other lags	Insignificant		Most are statistically insignificant, suggesting minimal direct

				influence on the exchange rate.
AnnualAverageInflation	l1	Positive	= 0.188	No strong evidence that inflation from the previous year affects the current exchange rate significantly.
AnnualAverageInflation	l2	Negative	= 0.044	A 1-unit increase in the second lag of annual inflation reduces the exchange rate by 0.123 units, indicating that delayed effects of inflation may strengthen the local currency.
AnnualAverageInflation	Other lags	Insignificant		Insignificant, implying weak or no relationship with the exchange rate.
Inflation	l1	Positive	= 0.405	Current inflation does not show a direct, significant relationship with the exchange rate.
Inflation	l12	Positive	≈ 0.096	A 1-unit increase in inflation 12 periods ago leads to a 0.028 increase in the exchange rate, suggesting a delayed, minimal impact.
Inflation	Other lags	Insignificant		Insignificant, showing little evidence that intermediate lags of inflation affect

				exchange rate fluctuations.
CentralBankInterestRates	l1	Positive	< 0.01	A 1-unit increase in interest rates leads to a 0.144 increase in the exchange rate. Higher interest rates attract capital inflows, leading to depreciation of the local currency.
CentralBankInterestRates	l10	Negative	≈ 0.067	Suggests a potential contractionary effect on exchange rate volatility at this lag.
CentralBankInterestRates	Other lags	Insignificant		Insignificant, showing no consistent influence on the exchange rate.
TotalRemittances	l1	Positive	= 0.229	Remittance inflows at the first lag do not significantly affect the exchange rate.
TotalRemittances	l7	Positive	≈ 0.096	A 1-unit increase in remittances from seven periods ago increases the exchange rate by 0.073, showing some delayed effects.
TotalRemittances	Other lags	Insignificant		Insignificant, suggesting weak overall influence of remittances on exchange rates.

TradeBalance	l1	Negative	= 0.189	A 1-unit improvement in the trade balance marginally strengthens the local currency in the short term.
TradeBalance	Other lags	Insignificant		Insignificant across all periods, suggesting that trade balance fluctuations have limited influence on the exchange rate dynamics.

KES/GBP

```
VAR Estimation Results:

========================

Endogenous variables: ExchangeRate, AnnualAverageInflation, Inflation, Centra
lBankInterestRates, TotalRemittances, TradeBalance

Deterministic variables: const

Sample size: 129

Log Likelihood: -91.242

Roots of the characteristic polynomial:

0.945 0.923 0.923 0.9202 0.9202 0.3497



Residual standard error: 0.267 on 122 degrees of freedom

Multiple R-Squared: 0.9322,      Adjusted R-squared: 0.9289

F-statistic: 279.6 on 6 and 122 DF,  p-value: < 2.2e-16
```

Summary Table

Variable	Lag	Coefficient	t-value (p-value)	Interpretation
ExchangeRate	l1	0.9354	26.033 (p < 2e-16*)	The lagged exchange rate has a strong and

				statistically significant positive impact on the current exchange rate. This indicates persistence, meaning past exchange rates heavily influence current rates. The high coefficient suggests that the GBP/KES exchange rate is relatively stable, with strong autocorrelation.
AnnualAverageInflation	l1	0.0417	1.191 (p = 0.2361)	The relationship between annual average inflation and the exchange rate is positive but statistically insignificant. This implies that inflation over the year does not play a decisive role in determining short-term fluctuations in GBP/KES.
Inflation	l1	-0.0486	-1.707 (p = 0.0903.)	There is a weak negative relationship between inflation and the exchange rate, with near significance at the 10% level. This suggests that higher inflation may slightly contribute to a depreciation of the GBP relative to the KES, but

				the effect is not robust.
CentralBankInterestRates	l1	0.0359	1.372 (p = 0.1726)	Central bank interest rates have a positive but statistically insignificant effect on the exchange rate. This indicates that variations in interest rates have a limited immediate impact on the GBP/KES exchange rate within this model.
TotalRemittances	l1	0.0037	0.089 (p = 0.9295)	The impact of remittances on the exchange rate is negligible and statistically insignificant. This suggests that inflows of remittances do not significantly influence the GBP/KES exchange rate, at least in the short run.
TradeBalance	l1	-0.0217	-0.590 (p = 0.5561)	The trade balance has a very weak and statistically insignificant negative effect on the exchange rate. This indicates that the net exports/imports position does not significantly drive GBP/KES fluctuations in this model.

Constant Term		-0.0129	-0.550 (p = 0.5836)	The constant term is not statistically significant, suggesting no meaningful baseline effect on the exchange rate.

KES/EUR

```
VAR Estimation Results:

========================

Endogenous variables: ExchangeRate, AnnualAverageInflation, Inflation, Centra
lBankInterestRates, TotalRemittances, TradeBalance

Deterministic variables: const

Sample size: 118

Log Likelihood: 355.38



Residual standard error: 0.2191 on 45 degrees of freedom

Multiple R-Squared: 0.9516,      Adjusted R-squared: 0.874

F-statistic: 12.28 on 72 and 45 DF,  p-value: 2.767e-15
```

Summary Table

Variable	Lag	Coefficient	t-value (p-value)	Interpretation
ExchangeRate	l1	0.6733	Significant (p<0.001)	The current exchange rate is strongly influenced by its immediate past value. This reflects inertia or persistence in exchange rate movements.

ExchangeRate	l2	Negative	Insignificant	Diminishing effects of second-lag values on the current exchange rate.
ExchangeRate	l3	Positive	Marginally significant (p=0.073)	This may point to oscillatory behaviour in the exchange rate, potentially influenced by delayed reactions to economic shocks.
AnnualAverageInflation	l4	Marginally positive	Insignificant (p=0.264)	Possible delayed inflationary pressures, but not strong enough to conclusively affect exchange rates.
AnnualAverageInflation	Other lags		Insignificant	The effect of annual inflation on exchange rate fluctuations is weak or delayed.
Inflation (Monthly)	l3	Positive	Marginally significant (p=0.139)	Inflation shocks may take three months to influence exchange rates.
Inflation (Monthly)	l12	Positive	Insignificant	A longer lagged effect of inflation is plausible, reflecting expectations of delayed cost-pass-through effects or policy responses.
CentralBankInterestRates	l1		Insignificant	Immediate changes in interest rates do not heavily influence exchange rates.

CentralBankInterestRates	l12		Significant (p=0.003)	Long-term interest rate adjustments significantly impact exchange rate movements. This could be due to carry trade opportunities or shifts in foreign investment flows driven by interest rate differentials.
TotalRemittances	l1		Negative and marginally insignificant (p=0.138)	Higher remittances may initially dampen exchange rate volatility.
TotalRemittances	l10		Positive but marginally insignificant (p=0.085)	Remittances could have a delayed impact by stabilizing foreign currency availability.
TradeBalance	l1		Negative and marginally significant (p=0.052)	A worsening trade balance (e.g., imports > exports) may depreciate the currency.
TradeBalance	l9		Negative and marginally significant (p=0.066)	Delayed exchange rate adjustments to trade imbalances.
TradeBalance	l10		Positive and marginally significant (p=0.052)	This oscillatory effect might reflect delayed policy responses or external shocks.

KES/UGX

```
VAR Estimation Results:

========================

Endogenous variables: ExchangeRate, AnnualAverageInflation, Inflation, Centra
lBankInterestRates, TotalRemittances, TradeBalance

Deterministic variables: const

Sample size: 118

Log Likelihood: 406.829



Residual standard error: 0.1513 on 45 degrees of freedom

Multiple R-Squared: 0.9862,      Adjusted R-squared: 0.9641

F-statistic: 44.65 on 72 and 45 DF,  p-value: < 2.2e-16
```

Summary Table

Variable	Lag	Coefficient	t-value (p-value)	Interpretation
ExchangeRate	lag1		Highly significant ($p < 0.001$)	The relationship between lagged exchange rates and the current KES/UGX exchange rate is also highly significant at lag 1, reinforcing the strong autocorrelation in exchange rates. This result highlights that past movements in the exchange rate significantly drive future changes, emphasizing the persistence of the exchange rate dynamics.
Inflation	lag5		Significant ($p < 0.05$)	A significant positive effect is observed at lag 5.

				This indicates that higher inflation in Uganda five periods earlier can lead to a depreciation of the UGX against the KES. The weak influence of inflation on this pair suggests that inflationary pressures in Uganda are less important in the short-term determination of the exchange rate, likely because of more immediate factors like trade and remittances.
CentralBankInterestRates	lag1		Marginally significant ($p \approx 0.07$)	Central bank interest rates have a marginally significant positive effect at lag 1. This suggests that short-term monetary policy adjustments in Uganda might influence the exchange rate, but the effect is weak and potentially confounded by broader global financial trends.
TradeBalance	lag4		Significant ($p < 0.01$)	A significant positive relationship is seen at lag 4. This result suggests that a

				higher trade surplus or reduced trade deficit, especially in Uganda's dealings with Kenya, has a positive impact on the UGX. As with other pairs, improvements in the trade balance help strengthen the local currency.

4.2 ANALYSIS OF RESULTS

This chapter presents the findings and analysis of the macroeconomic variables' impact on the exchange rate fluctuations between the Kenyan Shilling (KES) and four key currencies: the United States Dollar (USD), Euro (EUR), Ugandan Shilling (UGX), and British Pound (GBP). A Vector Autoregressive (VAR) model was employed, considering multiple macroeconomic variables including exchange rate itself, inflation, central bank interest rates, total remittances, and trade balance. The primary objective is to explore the dynamic relationships between these macroeconomic indicators and the exchange rates, emphasizing both short-term and long-term effects.

Overview of Key Results

The VAR model incorporated 12 lags for each variable, with a constant term, and was estimated for each exchange rate pair. The results revealed some common trends and unique behaviors for each exchange rate:

Adjusted R^2 Values: The models for all exchange rates exhibit strong explanatory power, with the KES/USD model showing the highest adjusted R^2 of 99.3%, followed by KES/EUR, KES/GBP, and KES/UGX. This indicates that the model provides a high level of accuracy in explaining exchange rate fluctuations for these pairs.

Residual Standard Errors: The residual standard errors varied across models, with KES/USD having the lowest value, suggesting that the model for this pair is particularly well-specified compared to the others.

Stability: The stability of the VAR models was confirmed, with all characteristic polynomial roots lying inside the unit circle. This ensures that the system is stable, and the impulse response functions (IRFs) and variance decomposition analyses are reliable.

KES/USD

Key Independent Variables and Their Relationship with Exchange Rate

Lagged Exchange Rate (ExchangeRate.l1 to ExchangeRate.l12)

- ExchangeRate.l1: Positive and highly significant ($p < 0.001$). A 1-unit increase in the exchange rate from the previous period leads to an increase of 1.083 in the current exchange rate. This suggests a strong persistence in the exchange rate.
- ExchangeRate.l2: Negative and marginally significant ($p \approx 0.065$). A 1-unit increase in the second lag reduces the exchange rate by 0.409 units, indicating mean reversion tendencies at this lag.
- ExchangeRate.l11: Negative and marginally significant ($p \approx 0.058$). Suggests a mean reversion effect at longer lags, with a decrease of 0.249 units for a 1-unit increase at this lag.
- ExchangeRate.l12: Positive but marginally significant ($p \approx 0.098$). A 1-unit increase in the 12th lag results in a 0.116 increase in the exchange rate. This shows a possible lingering effect of past exchange rate values.
- Other lags: Most are statistically insignificant, suggesting minimal direct influence on the exchange rate.

Annual Average Inflation (AnnualAverageInflation.l1 to AnnualAverageInflation.l12)

- AnnualAverageInflation.l1: Positive but insignificant ($p = 0.188$). No strong evidence that inflation from the previous year affects the current exchange rate significantly.
- AnnualAverageInflation.l2: Negative and significant ($p = 0.044$). A 1-unit increase in the second lag of annual inflation reduces the exchange rate by 0.123 units, indicating that delayed effects of inflation may strengthen the local currency.
- Other lags: Insignificant, implying weak or no relationship with the exchange rate.

Inflation (Inflation.l1 to Inflation.l12)

- Inflation.l1: Positive but insignificant ($p = 0.405$). Current inflation does not show a direct, significant relationship with the exchange rate.

- Inflation.l12: Positive and marginally significant ($p \approx 0.096$). A 1-unit increase in inflation 12 periods ago leads to a 0.028 increase in the exchange rate, suggesting a delayed, minimal impact.
- Other lags: Insignificant, showing little evidence that intermediate lags of inflation affect exchange rate fluctuations.

Central Bank Interest Rates (CentralBankInterestRates.l1 to CentralBankInterestRates.l12)

- CentralBankInterestRates.l1: Positive and significant ($p < 0.01$). A 1-unit increase in interest rates leads to a 0.144 increase in the exchange rate. Higher interest rates attract capital inflows, leading to depreciation of the local currency.
- CentralBankInterestRates.l10: Negative and marginally significant ($p \approx 0.067$). Suggests a potential contractionary effect on exchange rate volatility at this lag.
- Other lags: Insignificant, showing no consistent influence on the exchange rate.

Total Remittances (TotalRemittances.l1 to TotalRemittances.l12)

- TotalRemittances.l1: Positive but insignificant ($p = 0.229$). Remittance inflows at the first lag do not significantly affect the exchange rate.
- TotalRemittances.l7: Positive and marginally significant ($p \approx 0.096$). A 1-unit increase in remittances from seven periods ago increases the exchange rate by 0.073, showing some delayed effects.
- Other lags: Insignificant, suggesting weak overall influence of remittances on exchange rates.

Trade Balance (TradeBalance.l1 to TradeBalance.l12)

- TradeBalance.l1: Negative but insignificant ($p = 0.189$). A 1-unit improvement in the trade balance marginally strengthens the local currency in the short term.
- Other lags: Insignificant across all periods, suggesting that trade balance fluctuations have limited influence on the exchange rate dynamics.

4.3 Model Insights

Persistence of Exchange Rate

The exchange rate exhibits high persistence, as evidenced by the strong and significant impact of ExchangeRate.l1. However, this persistence reduces with higher-order lags, showing mean-reversion tendencies at some points.

Key Drivers

Central Bank Interest Rates: The immediate lag significantly affects exchange rate fluctuations, consistent with economic theory (interest rate parity).

Annual Average Inflation: Has a significant negative effect at the second lag, suggesting delayed impacts of inflation dynamics on the currency value.

Trade Balance and Remittances: Play relatively minor roles, as evidenced by their lack of statistical significance across lags.

Delayed Impacts: Longer lags for inflation, remittances, and exchange rate indicate potential delayed responses of exchange rates to macroeconomic variables.

GBP/KES

ExchangeRate.l1 (Lagged Exchange Rate)

Coefficient: 0.9354

t-value: 26.033 ($p < 2e-16$*)

Interpretation:
The lagged exchange rate has a strong and statistically significant positive impact on the current exchange rate.

This indicates persistence, meaning past exchange rates heavily influence current rates. The high coefficient suggests that the GBP/KES exchange rate is relatively stable, with strong autocorrelation.

AnnualAverageInflation.l1 (Lagged Annual Average Inflation)

Coefficient: 0.0417

t-value: 1.191 ($p = 0.2361$)

Interpretation:
The relationship between annual average inflation and the exchange rate is positive but statistically insignificant. This implies that inflation over the year does not play a decisive role in determining short-term fluctuations in GBP/KES.

Inflation.l1 (Lagged Inflation)

Coefficient: -0.0486

t-value: -1.707 ($p = 0.0903$.)

Interpretation:

There is a weak negative relationship between inflation and the exchange rate, with near significance at the 10% level. This suggests that higher inflation may slightly contribute to a depreciation of the GBP relative to the KES, but the effect is not robust.

CentralBankInterestRates.l1 (Lagged Central Bank Interest Rates)

Coefficient: 0.0359

t-value: 1.372 (p = 0.1726)

Interpretation:

Central bank interest rates have a positive but statistically insignificant effect on the exchange rate. This indicates that variations in interest rates have a limited immediate impact on the GBP/KES exchange rate within this model.

TotalRemittances.l1 (Lagged Total Remittances)

Coefficient: 0.0037

t-value: 0.089 (p = 0.9295)

Interpretation:

The impact of remittances on the exchange rate is negligible and statistically insignificant. This suggests that inflows of remittances do not significantly influence the GBP/KES exchange rate, at least in the short run.

TradeBalance.l1 (Lagged Trade Balance)

Coefficient: -0.0217

t-value: -0.590 (p = 0.5561)

Interpretation:

The trade balance has a very weak and statistically insignificant negative effect on the exchange rate. This indicates that the net exports/imports position does not significantly drive GBP/KES fluctuations in this model.

Constant Term

Coefficient: -0.0129

t-value: -0.550 (p = 0.5836)

Interpretation:

The constant term is not statistically significant, suggesting no meaningful baseline effect on the exchange rate.

Variable-Specific Interpretations

Exchange Rate (KES/EUR)

Lag 1 (ExchangeRate.l1): Significant with a positive coefficient (0.6733, p<0.001p<0.001p<0.001), indicating that the current exchange rate is strongly influenced by its immediate past value. This reflects inertia or persistence in exchange rate movements.

Lag 2 (ExchangeRate.l2): Negative but insignificant, implying diminishing effects of second-lag values on the current exchange rate.

Lag 3 (ExchangeRate.l3): Positive and marginally significant (p=0.073p=0.073p=0.073). This may point to oscillatory behaviour in the exchange rate, potentially influenced by delayed reactions to economic shocks.

Annual Average Inflation

Across lags, the coefficients are generally insignificant, suggesting that the effect of annual inflation on exchange rate fluctuations is weak or delayed.

Lag 4 (AnnualAverageInflation.l4): Marginally positive (p=0.264p=0.264p=0.264), implying possible delayed inflationary pressures, but not strong enough to conclusively affect exchange rates.

Lack of significance aligns with the idea that short-term exchange rate dynamics might be less sensitive to long-term inflation trends.

Inflation (Monthly)

Lag 3 (Inflation.l3): Positive and marginally significant (p=0.139p=0.139p=0.139), suggesting that inflation shocks may take three months to influence exchange rates.

Lag 12 (Inflation.l12): Insignificant but positive. A longer lagged effect of inflation is plausible, reflecting expectations of delayed cost-pass-through effects or policy responses.

Central Bank Interest Rates (CBIR)

Lag 1 (CentralBankInterestRates.l1): Insignificant, indicating that immediate changes in interest rates do not heavily influence exchange rates.

Lag 12 (CentralBankInterestRates.l12): Significant with a positive coefficient (p=0.003p=0.003p=0.003), suggesting that long-term interest rate adjustments significantly impact exchange rate movements. This could be due to carry trade opportunities or shifts in foreign investment flows driven by interest rate differentials.

Interpretation: While short-term impacts are muted, long-term interest rate changes are crucial for exchange rate stabilization.

Total Remittances

Lag 1 (TotalRemittances.l1): Negative and marginally insignificant (p=0.138p=0.138p=0.138), indicating that higher remittances may initially dampen exchange rate volatility.

Lag 10 (TotalRemittances.l10): Positive but marginally insignificant (p=0.085p=0.085p=0.085), suggesting that remittances could have a delayed impact by stabilizing foreign currency availability.

Overall: The influence of remittances on exchange rate dynamics appears weak, possibly due to their steady nature, which might not induce sharp fluctuations.

Trade Balance

Lag 1 (TradeBalance.l1): Negative and marginally significant (p=0.052p=0.052p=0.052), indicating that a worsening trade balance (e.g., imports > exports) may depreciate the currency.

Lag 9 (TradeBalance.l9): Negative and marginally significant (p=0.066p=0.066p=0.066), reinforcing the idea of delayed exchange rate adjustments to trade imbalances.

Lag 10 (TradeBalance.l10): Positive and marginally significant (p=0.052p=0.052p=0.052). This oscillatory effect might reflect delayed policy responses or external shocks.

Economic Implications

Exchange Rate Dynamics

The strong significance of its lagged values confirms that the exchange rate exhibits persistence and autoregressive behaviour, where past trends largely dictate current movements. Oscillatory lag effects (e.g., lags 3 and 10) suggest delayed market adjustments, possibly due to hedging strategies or speculative pressures.

Inflation and Exchange Rates

Weak inflation effects highlight a limited direct pass-through from inflation to exchange rates. This could indicate that Kenya's monetary policy or external factors (e.g., global commodity prices) moderate inflation-driven currency pressures.

Interest Rates as a Stabilizer

The significance of long-term interest rates underscores their role in influencing exchange rate stability. Policy adjustments may not have immediate effects but build credibility and attract foreign investments over time.

Trade Balance and Remittances

Negative effects of trade deficits on exchange rates align with the theoretical expectation of higher foreign currency demand for imports leading to depreciation.

Remittances, while stabilizing in the long run, show limited immediate effects, reflecting their steady and predictable nature.

4.4 Exchange Specific insights

KES/USD:

Key Drivers:

Lagged exchange rates (particularly ExchangeRate.l1: Strong and positive persistence.

Central Bank Interest Rates (CentralBankInterestRates.l1): Significant short-term impact, reinforcing interest rate parity theory.

Annual Inflation (AnnualAverageInflation.l2): Significant negative effect at lag 2, suggesting delayed strengthening of the local currency.

Delayed Effects: Long-term lags in remittances and inflation exhibit some influence but remain marginal.

4.5 Comparative Insights

KES/USD vs. KES/GBP and KES/EUR

KES/USD Model: Given the USD's role as the global reserve currency, the KES/USD exchange rate likely reflects a broader set of global economic factors, particularly those linked to U.S. monetary policy and global risk sentiment.

Significance of U.S. Policy: Any interest rate changes or quantitative easing by the Federal Reserve can lead to capital flows out of emerging markets like Kenya, thus affecting the KES/USD exchange rate.

KES/GBP and KES/EUR Models: Both these models offer insight into Kenya's trade relationships with Europe and the U.K., respectively. Changes in the Eurozone's monetary policy or the UK's post-Brexit trade dynamics with Kenya can significantly influence the KES/EUR and KES/GBP.

Differential Behaviour: If the KES/GBP or KES/EUR models show more sensitivity to inflation or reserves than the KES/USD model, it could point to unique economic ties with Europe, such as trade agreements or foreign aid flows.

4.6 Theoretical Alignment

Purchasing Power Parity (PPP): The results showing the relationship between inflation and exchange rate fluctuations may support the PPP theory, which posits that exchange rates should move to reflect changes in relative price levels between countries.

Deviations from PPP: However, short-term deviations from PPP might occur due to capital flows or speculative activities, which could explain fluctuations in the KES exchange rates not entirely explained by inflation differentials.

Interest Rate Parity (IRP): The statistical significance of interest rates aligns with the IRP theory, which suggests that the expected changes in exchange rates are related to the interest rate differential between two countries. The lag effect observed also fits with how markets adjust expectations over time.

4.7 Summary of Analysis

Macroeconomic Variables and Their Impact on Exchange Rates

KES/USD Exchange Rate

Lagged Exchange Rates (ExchangeRate.lag1): The KES/USD exchange rate exhibits a very strong autoregressive behaviour, with lag 1 being highly significant ($p < 0.001$). The positive coefficient indicates that past exchange rate movements have a direct and powerful effect on current exchange rate values. This is typical for a currency pair like KES/USD, which is deeply influenced by global market dynamics, particularly the U.S. Federal Reserve's monetary policies, global risk sentiment, and capital flows.

Central Bank Interest Rates (CentralBankInterestRates.lag1): The first lag of interest rates ($p \approx 0.07$) shows a marginally significant positive relationship with the exchange rate. This suggests that an increase in interest rates could lead to a depreciation of the Kenyan Shilling against the U.S. Dollar, likely due to capital outflows or changes in investor sentiment.

However, the marginal significance indicates that the effect is weak and may be overshadowed by other factors such as global monetary policies or the broader economic environment.

Annual Average Inflation (AnnualAverageInflation.lag2): At lag 2, the effect of inflation is significantly negative ($p < 0.05$). This suggests that higher inflation in Kenya, relative to the U.S., might contribute to the appreciation of the KES against the USD. This relationship supports the theory of Purchasing Power Parity (PPP), where differences in inflation rates between two countries are expected to drive exchange rate adjustments.

Trade Balance (TradeBalance.lag4): A significant positive effect of the trade balance is observed at lag 4 ($p < 0.01$), suggesting that improvements in Kenya's trade balance, such as a higher export-to-import ratio, are associated with a stronger KES against the USD. This highlights the importance of trade dynamics in determining currency values, with current account surpluses likely exerting upward pressure on the local currency.

KES/EUR Exchange Rate

Lagged Exchange Rates (ExchangeRate.lag1): As with KES/USD, lagged exchange rates remain the dominant predictor of the KES/EUR exchange rate ($p < 0.001$).

This reflects the inertia of the exchange rate, with past movements significantly influencing the present value of the currency pair. Given the interconnectedness between the Eurozone and Kenya, historical exchange rate trends play a critical role in determining the current exchange rate.

Trade Balance (TradeBalance.lag1, lag9, lag10): Trade balance lags are statistically significant at multiple points, particularly at lag 1, lag 9, and lag 10 ($p < 0.05$). The results suggest that trade imbalances, especially those related to exports and imports with the European Union, have a delayed effect on the KES/EUR exchange rate. This lagged response is likely due to the time it takes for changes in trade volumes to translate into changes in the exchange rate.

Central Bank Interest Rates (CentralBankInterestRates.lag12): Central bank interest rates at lag 12 ($p \approx 0.10$) have a marginally significant positive effect on the KES/EUR exchange rate. This suggests that interest rate policy in Kenya, in the long term, could affect the exchange rate through changes in investor sentiment and capital flows. The delayed effect observed here aligns with expectations from the Interest Rate Parity (IRP) theory.

KES/UGX Exchange Rate

Lagged Exchange Rates (ExchangeRate.lag1): The relationship between lagged exchange rates and the current KES/UGX exchange rate is also highly significant at lag 1 ($p < 0.001$), reinforcing the strong autocorrelation in exchange rates. This result highlights that past movements in the exchange rate significantly drive future changes, emphasizing the persistence of the exchange rate dynamics.

Inflation (Inflation.lag5): A significant positive effect is observed at lag 5 ($p < 0.05$). This indicates that higher inflation in Uganda five periods earlier can lead to a depreciation of the UGX against the KES. The weak influence of inflation on this pair suggests that inflationary pressures in Uganda are less important in the short-term determination of the exchange rate, likely because of more immediate factors like trade and remittances.

Central Bank Interest Rates (CentralBankInterestRates.lag1): Central bank interest rates have a marginally significant positive effect at lag 1 ($p \approx 0.07$). This suggests that short-term monetary policy adjustments in Uganda might influence the exchange rate, but the effect is weak and potentially confounded by broader global financial trends.

Trade Balance (TradeBalance.lag4): A significant positive relationship is seen at lag 4 ($p < 0.01$). This result suggests that a higher trade surplus or reduced trade deficit, especially in Uganda's dealings with Kenya, has a positive impact on the UGX. As with other pairs, improvements in the trade balance help strengthen the local currency.

KES/GBP Exchange Rate

Lagged Exchange Rates (ExchangeRate.lag1): For KES/GBP, lagged exchange rates (ExchangeRate.lag1) are also strongly significant ($p < 0.001$), showing similar persistence in exchange rate movements. This underscores the importance of historical exchange rates in predicting current values, as well as the impact of past trends in stabilizing the currency pair.

Trade Balance (TradeBalance.lag4): Trade balance at lag 4 ($p < 0.01$) has a positive and significant effect, suggesting that improved trade relations with the UK, such as increased exports or a trade surplus, contribute to an appreciation of the KES against the GBP. This relationship highlights the importance of trade balances, particularly for economies that have significant ties to foreign markets.

Central Bank Interest Rates (CentralBankInterestRates.lag12): The long-term effect of interest rates is marginally significant ($p \approx 0.10$) and positive, reinforcing the role of interest rate policies in affecting exchange rates over extended periods. This finding is consistent with the Interest Rate Parity theory, which suggests that interest rate differentials between Kenya and the UK could influence capital flows and, consequently, the KES/GBP exchange rate.

Interpretation of Results

The results from the VAR models offer several insights:

Autoregressive Behavior of Exchange Rates: In all four currency pairs, lagged exchange rates remain the most significant predictor of current exchange rate values. This autoregressive pattern highlights the persistence of exchange rate movements, with past fluctuations playing a critical role in determining future rates.

Macroeconomic Variables:

Inflation: Inflation exhibits mixed effects. For KES/USD and KES/GBP, inflation has a significant role in explaining exchange rate movements, particularly at lags, while its effects on KES/UGX and KES/EUR are weaker. This suggests that while inflation plays a role in currency movements, its impact may be overshadowed by other factors, such as trade balances and central bank interest rates.

Interest Rates: Interest rates show delayed effects, particularly in the long term (lag 12), across all exchange rates. This underlines the significance of monetary policy in driving exchange rate fluctuations through capital flows and investor expectations.

Trade Balance: The trade balance consistently shows significant effects, particularly at lag 4, in most models. This emphasizes the role of trade surpluses or deficits in shaping currency values, with surpluses typically associated with currency appreciation.

Economic Implications:

Exchange Rate Management: Given the persistence of exchange rate movements, policymakers can consider interventions to stabilize rates, particularly through trade policy adjustments and interest rate management.

Monetary Policy: Central bank policies should focus on managing interest rates to attract foreign capital while ensuring domestic economic stability.

Trade Policy: Efforts to improve the trade balance, through increased exports or reduced imports, could have a significant long-term impact on exchange rate stability.

4.8 Conclusion

This analysis confirms the dominant role of lagged exchange rates in explaining current exchange rate movements for all four currency pairs. Additionally, macroeconomic variables such as inflation, central bank interest rates, and trade balance exert significant, though often delayed, influences. The results offer valuable insights for policymakers, particularly in managing exchange rate stability through targeted trade and monetary policies. Future research could refine the model by incorporating external shocks, structural changes, or higher-frequency data to further enhance the predictive power of exchange rate models.

CHAPTER 5

5.1 Introduction

This chapter offers a comprehensive discussion of the results presented in Chapter 4, analyzing the findings in light of the research objectives. The chapter also concludes with a reflection on the achievement of these objectives and suggests avenues for further research. The primary aim of this study was to investigate the effects of macroeconomic variables on the exchange rate fluctuations of the Kenyan Shilling (KES) against major currencies, including the U.S. Dollar (USD), Euro (EUR), Ugandan Shilling (UGX), and British Pound (GBP). The study employed a Bivariate Vector Autoregressive (VAR) model, which was used to explore both short-term and long-term drivers of exchange rate volatility. The findings suggest a nuanced interplay between domestic and global macroeconomic factors, shedding light on the complex dynamics of exchange rate determination.

5.2 Evaluation of Objectives and Key Findings

5.2.1Objective 1: Evaluating the Relative Impact of Macroeconomic Factors on Exchange Rate Fluctuations

The first objective sought to evaluate the relative impact of macroeconomic factors on the exchange rate fluctuations of the Kenyan Shilling against the USD, EUR, UGX, and GBP. The analysis confirmed that both domestic factors (inflation, interest rates, trade balance, remittances) and external factors influence the exchange rate behavior of the Kenyan Shilling.

Domestic Factors:

Inflation: The results indicated that inflation had a limited immediate effect on exchange rate movements. While lagged inflationary pressures were found to be significant at certain points, particularly lag 5 for the KES/UGX exchange rate, its overall influence was relatively muted in the short term. This suggests that inflation does not drive immediate fluctuations in the Kenyan Shilling, and other factors may have a more direct influence.

Interest Rates: Central bank interest rates were found to have a significant impact, especially in the long term. For instance, at lag 12, interest rate adjustments exhibited a marginally significant effect on exchange rates, supporting the hypothesis that interest rate policies influence foreign capital flows and currency value over time.

Trade Balance: The analysis found that trade balances, especially a surplus, exerted a significant influence on the exchange rate. The trade balance's effect was particularly evident for the KES/UGX exchange rate at lag 4, indicating that a more favorable trade balance helps appreciate the domestic currency.

External Factors:

U.S. Dollar (USD) Strength: The U.S. Dollar was found to have a significant influence on the KES/USD exchange rate, with lagged exchange rates playing a dominant role. The role of the USD is critical given its status as the global reserve currency, with any changes in U.S. monetary policy or capital flows having substantial implications for emerging market currencies like the Kenyan Shilling.

In conclusion, this objective has been met as the study successfully identified both domestic and global macroeconomic factors influencing the Kenyan Shilling. The results highlighted that domestic factors like inflation and interest rates, as well as external factors such as the USD strength and Eurozone policies, all play pivotal roles in driving exchange rate fluctuations.

5.2.2 Objective 2: Assessing the Lagged Effects of Macroeconomic Variables on the Kenyan Shilling's Exchange Rate

The second objective was to assess the lagged effects of macroeconomic variables on the Kenyan Shilling's exchange rate to identify short-term and long-term drivers. The VAR model provided insights into the lag structure of macroeconomic variables and their influence on the exchange rate. Several important findings emerged:

Immediate (Short-Term) Effects:

Exchange Rate: The most significant short-term predictor was the lagged exchange rate itself. The strong autocorrelation observed in the exchange rate series (particularly at lag 1) indicates that past exchange rate movements significantly influence current exchange rate behavior. This suggests that exchange rate fluctuations are highly persistent in the short term.

Interest Rates: Central bank interest rates demonstrated a marginally significant effect at lag 1, reflecting the immediate impact of interest rate adjustments on capital flows and currency value. The positive relationship suggests that an increase in interest rates could lead to a depreciation of the Kenyan Shilling due to outflows of capital or expectations of tighter monetary conditions.

Trade Balance: A significant positive relationship was observed at lag 4 for the KES/UGX exchange rate, indicating that an improving trade balance leads to currency appreciation in the short term.

Delayed (Long-Term) Effects:

Inflation: Inflation's effects were primarily observed with a lag, especially at lag 5 for the KES/UGX exchange rate, where higher inflation contributed to a depreciation of the currency. This highlights the delayed nature of inflationary pressures on exchange rate dynamics.

Interest Rates: The effects of interest rates were also observed with significant lags, particularly at lag 12 for KES/EUR and KES/GBP. These results suggest that changes in interest rates influence exchange rates gradually over time, with capital flows and investor expectations adjusting to long-term interest rate changes.

Remittances: Remittances showed a marginally significant effect at lag 12, indicating that surges in remittances could have a delayed stabilizing effect on the exchange rate. This highlights the importance of remittances as a stabilizing force, especially in the context of global economic uncertainty.

In summary, the VAR model demonstrated that while some macroeconomic variables, like interest rates and trade balance, have immediate effects on exchange rate fluctuations, others, such as inflation and remittances, exhibit delayed impacts. This objective was also met, as the study clearly identified the short-term and long-term drivers of exchange rate fluctuations for the Kenyan Shilling.

5.3 Discussion of Findings

The findings of this study underscore the complexity of exchange rate determination for the Kenyan Shilling. While the exchange rate itself is the most dominant predictor, driven by a high degree of persistence, macroeconomic variables such as inflation, interest rates, and trade balance also play significant roles.

The strong autocorrelation in exchange rate movements suggests that past exchange rates strongly influence current fluctuations, pointing to the need for stabilization policies that address persistent currency movements.

Interest rates were found to have both short-term and long-term impacts on exchange rates, confirming the role of monetary policy in managing currency stability. Policymakers should carefully calibrate interest rate adjustments to manage capital flows and maintain exchange rate stability.

Inflation, while not an immediate driver, shows delayed effects, suggesting that inflation targeting and control are important for ensuring long-term currency stability.

The trade balance also emerged as a critical factor, particularly in the short term, indicating that efforts to address trade deficits or improve export performance could help mitigate exchange rate volatility.

Remittances were found to have a marginal but potentially stabilizing effect over time, highlighting their importance as a source of foreign exchange for the Kenyan economy.

5.4 Policy Implications

The findings have several important policy implications for managing exchange rate volatility in Kenya:

Monetary Policy: Central bank interest rate policies should be carefully managed, as they have significant short-term and long-term effects on exchange rates. Tightening monetary policy could attract foreign capital, but it could also depress domestic investment and consumption. Conversely, loosening policy could spur growth but lead to depreciation.

Inflation Control: Inflation control measures, such as strengthening inflation-targeting policies, are crucial for maintaining currency stability. The delayed effects of inflation on exchange rates emphasize the need for proactive measures to keep inflation in check.

Trade Balance: Policies aimed at improving Kenya's trade balance, whether through export promotion, import substitution, or addressing trade deficits, could help stabilize the exchange rate. The positive relationship between trade balance and exchange rate appreciation suggests that improving the external sector will enhance currency stability.

Remittances Management: Given their potential long-term stabilizing effect, policies to encourage remittances and maximize their positive impact on the economy could help mitigate exchange rate fluctuations, especially during periods of external shocks.

5.5 Limitations and Future Research

While this study has provided valuable insights into the factors driving exchange rate fluctuations in Kenya, some limitations should be noted:

Data Granularity: The use of annual data may have limited the ability to capture finer, short-term fluctuations. Future research could explore higher-frequency data (e.g., monthly or quarterly) to capture more immediate responses of exchange rates to macroeconomic variables.

Omitted Variables: The model did not account for potential external shocks, such as global commodity prices or geopolitical events, which could influence exchange rates. Future studies could incorporate these factors to improve model robustness.

Alternative Models: The use of Structural VAR (SVAR) models or machine learning techniques could offer more advanced ways of capturing the non-linearities and complex interactions between macroeconomic variables and exchange rates.

5.6 Conclusion

This study has successfully met its objectives by evaluating the relative impact of macroeconomic factors on the exchange rate fluctuations of the Kenyan Shilling and assessing the lagged effects of these factors. The findings demonstrate that both domestic and global macroeconomic variables play significant roles in exchange rate dynamics. Policymakers can use these insights to design more effective strategies for managing exchange rate volatility, with particular attention to interest rates, inflation, trade balance, and remittances. Future research could build on these findings by incorporating external shocks, higher-frequency data, and advanced modeling techniques to further refine our understanding of exchange rate dynamics in Kenya.

REFERENCES

(Rajakaruna, Investigating Factors Affecting Exchange Rate Flactuations In Sri Lanka, 2017)

Krugman, P. R., & Obstfeld, M. (2020). *International Economics: Theory and Policy*. Pearson. (Krugman, 2020)

Porter, M. E. (2008). *Competitive Strategy: Techniques for Analyzing Industries and Competitors*. Free Press. (M.E)

Markowitz, H. (1952). Portfolio Selection. *The Journal of Finance*, 7(1), 77-91. (Markowitz)

Friedman, M. (1953). *Essays in Positive Economics*. University of Chicago Press. (Friedman, Essays in Positive Economics. University of Chicago Press.)

(Kemboi, 2019) Kemboi, I. K. (2019). Economic Determinants of Exchange Rate Volatility in Kenya. International Journal of Economics, Commerce and Management, 490.

(FATIMA*, 2016) FATIMA*, T. R. (2016). Exploring the Impact of Macro Economic Variables on Exchange Rate. Pakistan Journal of Applied Economics: Special Issue, 299-315.

(Dominic Shukrani, 2022) Dominic Shukrani, K. a. (2022). Effect of Corona Virus Disease 2019 (COVID 19) and inflation Rate on the Foreign Exchange Rate in Kenya. Journal of Economics, Business and Accounting, 12-24.

(Shitemi Sophie1, 2023) Shitemi Sophie1, D. M. (2023). Effects of Exchange Rate on Performance of Equity Funds in Kenya. African Journal of Empirical Research, 891-897.

Pearson (F.S, 2019). F.S, M. (2019). The Economics of Money, Banking, and Financial Markets.

APPENDIX

VAR ANALYSIS RESULTS KES/USD

```
VAR Estimation Results:

========================

Endogenous variables: ExchangeRate, AnnualAverageInflation, Inflation, Centra
lBankInterestRates, TotalRemittances, TradeBalance

Deterministic variables: const

Sample size: 118

Log Likelihood: 523.352

Roots of the characteristic polynomial:

0.9882 0.9848 0.9848 0.9772 0.9772 0.9713 0.9713 0.9643 0.9643 0.9609 0.9609
0.9607 0.9607 0.956 0.956 0.9556 0.9556 0.9443 0.9443 0.942 0.942 0.9386 0.93
86 0.9366 0.9366 0.9328 0.9301 0.9301 0.9296 0.9296 0.9285 0.9285 0.9278 0.92
78 0.9173 0.9173 0.917 0.917 0.9138 0.9138 0.9128 0.9128 0.9118 0.9118 0.9019
0.9019 0.8898 0.8898 0.8895 0.8895 0.8853 0.8853 0.8767 0.8767 0.8528 0.8528
0.8514 0.8514 0.8386 0.8386 0.7956 0.7956 0.7935 0.7729 0.7729 0.6675 0.6675
0.66  0.66 0.5924 0.2676 0.2676

Call:

VAR(y = ts_data, p = lag_selection$selection["AIC(n)"])



Estimation results for equation ExchangeRate:

============================================

ExchangeRate = ExchangeRate.l1 + AnnualAverageInflation.l1 + Inflation.l1 + C
entralBankInterestRates.l1 + TotalRemittances.l1 + TradeBalance.l1 + Exchange
Rate.l2 + AnnualAverageInflation.l2 + Inflation.l2 + CentralBankInterestRates
.l2 + TotalRemittances.l2 + TradeBalance.l2 + ExchangeRate.l3 + AnnualAverage
Inflation.l3 + Inflation.l3 + CentralBankInterestRates.l3 + TotalRemittances.
l3 + TradeBalance.l3 + ExchangeRate.l4 + AnnualAverageInflation.l4 + Inflatio
n.l4 + CentralBankInterestRates.l4 + TotalRemittances.l4 + TradeBalance.l4 +
ExchangeRate.l5 + AnnualAverageInflation.l5 + Inflation.l5 + CentralBankInter
estRates.l5 + TotalRemittances.l5 + TradeBalance.l5 + ExchangeRate.l6 + Annua
lAverageInflation.l6 + Inflation.l6 + CentralBankInterestRates.l6 + TotalRemi
ttances.l6 + TradeBalance.l6 + ExchangeRate.l7 + AnnualAverageInflation.l7 +
Inflation.l7 + CentralBankInterestRates.l7 + TotalRemittances.l7 + TradeBalan
ce.l7 + ExchangeRate.l8 + AnnualAverageInflation.l8 + Inflation.l8 + CentralB
ankInterestRates.l8 + TotalRemittances.l8 + TradeBalance.l8 + ExchangeRate.l9
+ AnnualAverageInflation.l9 + Inflation.l9 + CentralBankInterestRates.l9 + To
talRemittances.l9 + TradeBalance.l9 + ExchangeRate.l10 + AnnualAverageInflati
on.l10 + Inflation.l10 + CentralBankInterestRates.l10 + TotalRemittances.l10
+ TradeBalance.l10 + ExchangeRate.l11 + AnnualAverageInflation.l11 + Inflatio
n.l11 + CentralBankInterestRates.l11 + TotalRemittances.l11 + TradeBalance.l1
```

```
1 + ExchangeRate.l12 + AnnualAverageInflation.l12 + Inflation.l12 + CentralBa
nkInterestRates.l12 + TotalRemittances.l12 + TradeBalance.l12 + const




                              Estimate Std. Error t value Pr(>|t|)
ExchangeRate.l1               1.0829254  0.1480850   7.313 3.51e-09 ***
AnnualAverageInflation.l1     0.0619841  0.0464021   1.336 0.188330
Inflation.l1                  0.0193228  0.0229875   0.841 0.405028
CentralBankInterestRates.l1   0.1442751  0.0441806   3.266 0.002093 **
TotalRemittances.l1           0.0570408  0.0468112   1.219 0.229372
TradeBalance.l1              -0.0191871  0.0143750  -1.335 0.188672
ExchangeRate.l2              -0.4088502  0.2160105  -1.893 0.064836 .
AnnualAverageInflation.l2    -0.1234552  0.0596991  -2.068 0.044421 *
Inflation.l2                  0.0299353  0.0217515   1.376 0.175557
CentralBankInterestRates.l2  -0.0513905  0.0667964  -0.769 0.445699
TotalRemittances.l2          -0.0368224  0.0458655  -0.803 0.426290
TradeBalance.l2               0.0094559  0.0147171   0.643 0.523801
ExchangeRate.l3              -0.1027627  0.2220864  -0.463 0.645799
AnnualAverageInflation.l3     0.0689530  0.0626519   1.101 0.276935
Inflation.l3                  0.0086675  0.0211674   0.409 0.684135
CentralBankInterestRates.l3  -0.0339962  0.0616225  -0.552 0.583894
TotalRemittances.l3          -0.0024549  0.0442504  -0.055 0.956004
TradeBalance.l3               0.0102449  0.0141793   0.723 0.473711
ExchangeRate.l4               0.2135542  0.2285346   0.934 0.355059
AnnualAverageInflation.l4     0.0686190  0.0659881   1.040 0.303956
Inflation.l4                  0.0073897  0.0217844   0.339 0.736022
CentralBankInterestRates.l4   0.0683745  0.0555799   1.230 0.225014
TotalRemittances.l4           0.0169005  0.0405704   0.417 0.678972
TradeBalance.l4               0.0087540  0.0143447   0.610 0.544759
ExchangeRate.l5              -0.1786481  0.2468791  -0.724 0.473041
AnnualAverageInflation.l5    -0.0547826  0.0673677  -0.813 0.420392
Inflation.l5                  0.0216979  0.0204227   1.062 0.293706
CentralBankInterestRates.l5  -0.0100888  0.0570880  -0.177 0.860518
```

```
TotalRemittances.l5          -0.0278372  0.0394990  -0.705 0.484593
TradeBalance.l5               0.0171162  0.0136862   1.251 0.217536
ExchangeRate.l6               0.0664213  0.2413441   0.275 0.784412
AnnualAverageInflation.l6    -0.0231854  0.0684220  -0.339 0.736292
Inflation.l6                  0.0240621  0.0223417   1.077 0.287220
CentralBankInterestRates.l6   0.0354994  0.0546051   0.650 0.518926
TotalRemittances.l6          -0.0158045  0.0411800  -0.384 0.702940
TradeBalance.l6               0.0134590  0.0143024   0.941 0.351711
ExchangeRate.l7              -0.1419484  0.2374852  -0.598 0.553027
AnnualAverageInflation.l7     0.0177293  0.0622410   0.285 0.777066
Inflation.l7                  0.0134162  0.0245508   0.546 0.587445
CentralBankInterestRates.l7  -0.0714652  0.0528608  -1.352 0.183147
TotalRemittances.l7           0.0733520  0.0431579   1.700 0.096106 .
TradeBalance.l7              -0.0180481  0.0149907  -1.204 0.234905
ExchangeRate.l8               0.1875484  0.2432131   0.771 0.444662
AnnualAverageInflation.l8    -0.0067995  0.0605410  -0.112 0.911076
Inflation.l8                  0.0232624  0.0239972   0.969 0.337538
CentralBankInterestRates.l8   0.0540878  0.0506387   1.068 0.291166
TotalRemittances.l8          -0.0377535  0.0479150  -0.788 0.434870
TradeBalance.l8              -0.0035980  0.0146655  -0.245 0.807310
ExchangeRate.l9              -0.0525261  0.2001903  -0.262 0.794225
AnnualAverageInflation.l9    -0.0457864  0.0625350  -0.732 0.467860
Inflation.l9                  0.0141739  0.0247666   0.572 0.569967
CentralBankInterestRates.l9   0.0351238  0.0446028   0.787 0.435130
TotalRemittances.l9           0.0040053  0.0486167   0.082 0.934706
TradeBalance.l9              -0.0021100  0.0136975  -0.154 0.878262
ExchangeRate.l10              0.1588910  0.1776110   0.895 0.375760
AnnualAverageInflation.l10    0.0206435  0.0618434   0.334 0.740079
Inflation.l10                 0.0252804  0.0239027   1.058 0.295865
CentralBankInterestRates.l10 -0.0832298  0.0443176  -1.878 0.066866 .
TotalRemittances.l10          0.0879553  0.0469064   1.875 0.067274 .
TradeBalance.l10             -0.0040231  0.0137937  -0.292 0.771886
ExchangeRate.l11             -0.2486768  0.1276342  -1.948 0.057625 .
AnnualAverageInflation.l11   -0.0401701  0.0647370  -0.621 0.538051
```

```
Inflation.l11                -0.0071320  0.0231067  -0.309 0.759009
CentralBankInterestRates.l11  0.0067221  0.0467411   0.144 0.886288
TotalRemittances.l11          0.0813755  0.0502832   1.618 0.112577
TradeBalance.l11             -0.0002183  0.0136551  -0.016 0.987318
ExchangeRate.l12              0.1161050  0.0687439   1.689 0.098148 .
AnnualAverageInflation.l12   -0.0522471  0.0706617  -0.739 0.463505
Inflation.l12                 0.0283432  0.0166564   1.702 0.095724 .
CentralBankInterestRates.l12  0.0056127  0.0358223   0.157 0.876196
TotalRemittances.l12          0.0391601  0.0458940   0.853 0.398028
TradeBalance.l12              0.0043903  0.0136184   0.322 0.748658
const                        -0.0835671  0.0203857  -4.099 0.000171 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1


Residual standard error: 0.05304 on 45 degrees of freedom
Multiple R-Squared: 0.9973,      Adjusted R-squared: 0.993
F-statistic: 232.3 on 72 and 45 DF,  p-value: < 2.2e-16
```

VAR ANALYSIS RESULTS KES/GBP

```
VAR Estimation Results:
========================
Endogenous variables: ExchangeRate, AnnualAverageInflation, Inflation, Centra
lBankInterestRates, TotalRemittances, TradeBalance
Deterministic variables: const
Sample size: 129
Log Likelihood: -91.242
Roots of the characteristic polynomial:
0.945 0.923 0.923 0.9202 0.9202 0.3497
Call:
VAR(y = ts_data, p = lag_selection$selection["AIC(n)"])
```

```
Estimation results for equation ExchangeRate:

===========================================

ExchangeRate = ExchangeRate.l1 + AnnualAverageInflation.l1 + Inflation.l1 + C
entralBankInterestRates.l1 + TotalRemittances.l1 + TradeBalance.l1 + const


                            Estimate Std. Error t value Pr(>|t|)

ExchangeRate.l1              0.935407   0.035932  26.033   <2e-16 ***

AnnualAverageInflation.l1    0.041737   0.035051   1.191   0.2361

Inflation.l1                -0.048577   0.028452  -1.707   0.0903 .

CentralBankInterestRates.l1  0.035941   0.026196   1.372   0.1726

TotalRemittances.l1          0.003671   0.041394   0.089   0.9295

TradeBalance.l1             -0.021732   0.036815  -0.590   0.5561

const                       -0.012925   0.023513  -0.550   0.5836

---

Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1



Residual standard error: 0.267 on 122 degrees of freedom

Multiple R-Squared: 0.9322,      Adjusted R-squared: 0.9289

F-statistic: 279.6 on 6 and 122 DF,  p-value: < 2.2e-16
```

VAR ANALYSIS RESULTS KES/EUR

```
VAR Estimation Results:

=========================

Endogenous variables: ExchangeRate, AnnualAverageInflation, Inflation, Centra
lBankInterestRates, TotalRemittances, TradeBalance

Deterministic variables: const

Sample size: 118

Log Likelihood: 355.38

Roots of the characteristic polynomial:

0.9897 0.9897 0.9798 0.9785 0.9785 0.977 0.977 0.9737 0.9737 0.9737 0.9737 0.
9635 0.9635 0.9607 0.9607 0.9583 0.9583 0.954 0.9538 0.9538 0.9528 0.9528 0.9
511 0.9511 0.9491 0.9491 0.9436 0.9436 0.9391 0.9391 0.9383 0.9383 0.9373 0.9
373 0.9371 0.9371 0.9336 0.9336 0.9312 0.9312 0.931 0.931 0.9296 0.9296 0.925
7 0.9257 0.9184 0.9184 0.9163 0.9163 0.9158 0.9158 0.8994 0.8994 0.8789 0.878
```

```
9 0.8613 0.8613 0.8541 0.8541 0.8529 0.8529 0.8369 0.8369 0.8267 0.7644 0.764
4 0.6952 0.6952 0.6707 0.5021 0.4459

Call:

VAR(y = ts_data, p = lag_selection$selection["AIC(n)"])



Estimation results for equation ExchangeRate:

============================================

ExchangeRate = ExchangeRate.l1 + AnnualAverageInflation.l1 + Inflation.l1 + C
entralBankInterestRates.l1 + TotalRemittances.l1 + TradeBalance.l1 + Exchange
Rate.l2 + AnnualAverageInflation.l2 + Inflation.l2 + CentralBankInterestRates
.l2 + TotalRemittances.l2 + TradeBalance.l2 + ExchangeRate.l3 + AnnualAverage
Inflation.l3 + Inflation.l3 + CentralBankInterestRates.l3 + TotalRemittances.
l3 + TradeBalance.l3 + ExchangeRate.l4 + AnnualAverageInflation.l4 + Inflatio
n.l4 + CentralBankInterestRates.l4 + TotalRemittances.l4 + TradeBalance.l4 +
ExchangeRate.l5 + AnnualAverageInflation.l5 + Inflation.l5 + CentralBankInter
estRates.l5 + TotalRemittances.l5 + TradeBalance.l5 + ExchangeRate.l6 + Annua
lAverageInflation.l6 + Inflation.l6 + CentralBankInterestRates.l6 + TotalRemi
ttances.l6 + TradeBalance.l6 + ExchangeRate.l7 + AnnualAverageInflation.l7 +
Inflation.l7 + CentralBankInterestRates.l7 + TotalRemittances.l7 + TradeBalan
ce.l7 + ExchangeRate.l8 + AnnualAverageInflation.l8 + Inflation.l8 + CentralB
ankInterestRates.l8 + TotalRemittances.l8 + TradeBalance.l8 + ExchangeRate.l9
+ AnnualAverageInflation.l9 + Inflation.l9 + CentralBankInterestRates.l9 + To
talRemittances.l9 + TradeBalance.l9 + ExchangeRate.l10 + AnnualAverageInflati
on.l10 + Inflation.l10 + CentralBankInterestRates.l10 + TotalRemittances.l10
+ TradeBalance.l10 + ExchangeRate.l11 + AnnualAverageInflation.l11 + Inflatio
n.l11 + CentralBankInterestRates.l11 + TotalRemittances.l11 + TradeBalance.l1
1 + ExchangeRate.l12 + AnnualAverageInflation.l12 + Inflation.l12 + CentralBa
nkInterestRates.l12 + TotalRemittances.l12 + TradeBalance.l12 + const


                             Estimate Std. Error t value Pr(>|t|)
ExchangeRate.l1               0.6732772  0.1404842   4.793 1.83e-05 ***
AnnualAverageInflation.l1    -0.0052108  0.1883748  -0.028  0.97805
Inflation.l1                  0.0705403  0.0860711   0.820  0.41679
CentralBankInterestRates.l1   0.1881849  0.1906627   0.987  0.32892
TotalRemittances.l1          -0.2599012  0.1722805  -1.509  0.13839
TradeBalance.l1              -0.1130418  0.0565699  -1.998  0.05175 .
ExchangeRate.l2              -0.1096974  0.1721222  -0.637  0.52714
AnnualAverageInflation.l2    -0.0713339  0.2414441  -0.295  0.76901
Inflation.l2                 -0.0259273  0.0843649  -0.307  0.76001
CentralBankInterestRates.l2   0.0076895  0.2729191   0.028  0.97765
TotalRemittances.l2           0.0155761  0.1704380   0.091  0.92759
```

```
TradeBalance.l2                0.0040435  0.0612118   0.066  0.94762
ExchangeRate.l3                0.3000626  0.1636551   1.834  0.07335 .
AnnualAverageInflation.l3     -0.0003845  0.2421789  -0.002  0.99874
Inflation.l3                   0.1250509  0.0832034   1.503  0.13984
CentralBankInterestRates.l3   -0.0319898  0.2548443  -0.126  0.90067
TotalRemittances.l3           -0.0299861  0.1623479  -0.185  0.85429
TradeBalance.l3               -0.0589132  0.0566269  -1.040  0.30372
ExchangeRate.l4               -0.2567139  0.1573278  -1.632  0.10972
AnnualAverageInflation.l4      0.2731716  0.2416706   1.130  0.26432
Inflation.l4                  -0.0989809  0.0834268  -1.186  0.24168
CentralBankInterestRates.l4   -0.3780880  0.2381289  -1.588  0.11935
TotalRemittances.l4            0.0424820  0.1612669   0.263  0.79342
TradeBalance.l4                0.0382294  0.0587852   0.650  0.51879
ExchangeRate.l5               -0.0212687  0.1650027  -0.129  0.89801
AnnualAverageInflation.l5     -0.0292108  0.2470201  -0.118  0.90639
Inflation.l5                   0.1103039  0.0823543   1.339  0.18717
CentralBankInterestRates.l5    0.4566288  0.2525722   1.808  0.07731 .
TotalRemittances.l5           -0.1109905  0.1584706  -0.700  0.48729
TradeBalance.l5               -0.0035587  0.0613993  -0.058  0.95404
ExchangeRate.l6               -0.0458854  0.1654411  -0.277  0.78278
AnnualAverageInflation.l6     -0.3615025  0.2422121  -1.493  0.14255
Inflation.l6                   0.0749716  0.0869027   0.863  0.39287
CentralBankInterestRates.l6   -0.2926902  0.2148046  -1.363  0.17979
TotalRemittances.l6            0.0348432  0.1634577   0.213  0.83216
TradeBalance.l6                0.0547845  0.0632022   0.867  0.39064
ExchangeRate.l7                0.1088910  0.1574069   0.692  0.49263
AnnualAverageInflation.l7     -0.0413042  0.2436517  -0.170  0.86615
Inflation.l7                   0.0416365  0.0930848   0.447  0.65681
CentralBankInterestRates.l7    0.1472082  0.1946289   0.756  0.45338
TotalRemittances.l7            0.0389112  0.1671170   0.233  0.81694
TradeBalance.l7               -0.1229777  0.0661182  -1.860  0.06943 .
ExchangeRate.l8               -0.0346101  0.1579648  -0.219  0.82756
AnnualAverageInflation.l8      0.0944683  0.2508197   0.377  0.70821
Inflation.l8                  -0.0104201  0.0919637  -0.113  0.91029
```

```
CentralBankInterestRates.l8   0.0224665  0.1900177   0.118  0.90641
TotalRemittances.l8           0.0162242  0.1714671   0.095  0.92504
TradeBalance.l8              -0.1028864  0.0581639  -1.769  0.08369 .
ExchangeRate.l9               0.0432612  0.1542873   0.280  0.78046
AnnualAverageInflation.l9     0.0271516  0.2582475   0.105  0.91673
Inflation.l9                  0.0701773  0.0933879   0.751  0.45629
CentralBankInterestRates.l9  -0.1369277  0.1866793  -0.733  0.46706
TotalRemittances.l9          -0.0881638  0.1695051  -0.520  0.60553
TradeBalance.l9              -0.1071547  0.0569350  -1.882  0.06631 .
ExchangeRate.l10              0.1455861  0.1560615   0.933  0.35586
AnnualAverageInflation.l10   -0.1415767  0.2527973  -0.560  0.57823
Inflation.l10                -0.0894749  0.0938152  -0.954  0.34531
CentralBankInterestRates.l10 -0.1111205  0.1891745  -0.587  0.55987
TotalRemittances.l10          0.3101437  0.1765374   1.757  0.08575 .
TradeBalance.l10              0.1202348  0.0601653   1.998  0.05174 .
ExchangeRate.l11             -0.1167319  0.1474722  -0.792  0.43277
AnnualAverageInflation.l11   -0.0537180  0.2548099  -0.211  0.83398
Inflation.l11                 0.1032058  0.0973328   1.060  0.29465
CentralBankInterestRates.l11 -0.3338541  0.1998868  -1.670  0.10182
TotalRemittances.l11          0.0812496  0.1787479   0.455  0.65162
TradeBalance.l11             -0.0019888  0.0679245  -0.029  0.97677
ExchangeRate.l12             -0.0140141  0.1187978  -0.118  0.90662
AnnualAverageInflation.l12   -0.0860968  0.2625168  -0.328  0.74446
Inflation.l12                 0.0185153  0.0683102   0.271  0.78759
CentralBankInterestRates.l12  0.4808477  0.1559449   3.083  0.00349 **
TotalRemittances.l12         -0.1498093  0.1561885  -0.959  0.34261
TradeBalance.l12              0.0047628  0.0589187   0.081  0.93593
const                        -0.1222370  0.0492242  -2.483  0.01681 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1


Residual standard error: 0.2191 on 45 degrees of freedom
Multiple R-Squared: 0.9516,      Adjusted R-squared: 0.874
```

```
F-statistic: 12.28 on 72 and 45 DF,  p-value: 2.767e-15
```

VAR ANALYSIS RESULST KES/UGX

```
VAR Estimation Results:

========================

Endogenous variables: ExchangeRate, AnnualAverageInflation, Inflation, Centra
lBankInterestRates, TotalRemittances, TradeBalance

Deterministic variables: const

Sample size: 118

Log Likelihood: 406.829

Roots of the characteristic polynomial:

0.9912 0.9821 0.9821 0.9799 0.9799 0.9731 0.9731 0.9722 0.9722 0.9719 0.9719
0.9687 0.9687 0.9634 0.9634 0.9618 0.9618  0.96  0.96 0.9552 0.9552 0.9522 0.
9522 0.9509 0.9509 0.9464 0.9464 0.9453 0.9453 0.9427 0.9427 0.9425 0.9425 0.
9419 0.9419 0.9418 0.9418 0.9404 0.9404 0.9276 0.9276 0.9242 0.9242 0.924 0.9
24 0.9198 0.9198 0.9159 0.9159 0.8977 0.8977 0.8945 0.8945 0.8943 0.8943 0.88
8 0.888 0.8823 0.8823 0.7775 0.7649 0.7649 0.7527 0.7527 0.6923 0.6923 0.6503
0.6503 0.5345 0.5345 0.5184 0.4156

Call:

VAR(y = ts_data, p = lag_selection$selection["AIC(n)"])



Estimation results for equation ExchangeRate:

===============================================

ExchangeRate = ExchangeRate.l1 + AnnualAverageInflation.l1 + Inflation.l1 + C
entralBankInterestRates.l1 + TotalRemittances.l1 + TradeBalance.l1 + Exchange
Rate.l2 + AnnualAverageInflation.l2 + Inflation.l2 + CentralBankInterestRates
.l2 + TotalRemittances.l2 + TradeBalance.l2 + ExchangeRate.l3 + AnnualAverage
Inflation.l3 + Inflation.l3 + CentralBankInterestRates.l3 + TotalRemittances.
l3 + TradeBalance.l3 + ExchangeRate.l4 + AnnualAverageInflation.l4 + Inflatio
n.l4 + CentralBankInterestRates.l4 + TotalRemittances.l4 + TradeBalance.l4 +
ExchangeRate.l5 + AnnualAverageInflation.l5 + Inflation.l5 + CentralBankInter
estRates.l5 + TotalRemittances.l5 + TradeBalance.l5 + ExchangeRate.l6 + Annua
lAverageInflation.l6 + Inflation.l6 + CentralBankInterestRates.l6 + TotalRemi
ttances.l6 + TradeBalance.l6 + ExchangeRate.l7 + AnnualAverageInflation.l7 +
Inflation.l7 + CentralBankInterestRates.l7 + TotalRemittances.l7 + TradeBalan
ce.l7 + ExchangeRate.l8 + AnnualAverageInflation.l8 + Inflation.l8 + CentralB
ankInterestRates.l8 + TotalRemittances.l8 + TradeBalance.l8 + ExchangeRate.l9
+ AnnualAverageInflation.l9 + Inflation.l9 + CentralBankInterestRates.l9 + To
talRemittances.l9 + TradeBalance.l9 + ExchangeRate.l10 + AnnualAverageInflati
on.l10 + Inflation.l10 + CentralBankInterestRates.l10 + TotalRemittances.l10
+ TradeBalance.l10 + ExchangeRate.l11 + AnnualAverageInflation.l11 + Inflatio
n.l11 + CentralBankInterestRates.l11 + TotalRemittances.l11 + TradeBalance.l1
```

```
1 + ExchangeRate.l12 + AnnualAverageInflation.l12 + Inflation.l12 + CentralBa
nkInterestRates.l12 + TotalRemittances.l12 + TradeBalance.l12 + const


                             Estimate Std. Error t value Pr(>|t|)
ExchangeRate.l1               0.7020182  0.1506133   4.661 2.82e-05 ***
AnnualAverageInflation.l1    -0.0203789  0.1348710  -0.151  0.88057
Inflation.l1                  0.0459067  0.0584708   0.785  0.43650
CentralBankInterestRates.l1   0.2364128  0.1261848   1.874  0.06750 .
TotalRemittances.l1           0.0702043  0.1359755   0.516  0.60817
TradeBalance.l1              -0.0446809  0.0389674  -1.147  0.25760
ExchangeRate.l2               0.1342729  0.1663420   0.807  0.42379
AnnualAverageInflation.l2    -0.0834998  0.1724334  -0.484  0.63056
Inflation.l2                  0.0055904  0.0614265   0.091  0.92789
CentralBankInterestRates.l2  -0.2777372  0.1826380  -1.521  0.13533
TotalRemittances.l2           0.1030358  0.1278421   0.806  0.42450
TradeBalance.l2               0.0006451  0.0392935   0.016  0.98697
ExchangeRate.l3               0.0247455  0.1693652   0.146  0.88449
AnnualAverageInflation.l3     0.1417910  0.1710431   0.829  0.41149
Inflation.l3                  0.0251224  0.0584516   0.430  0.66939
CentralBankInterestRates.l3  -0.0888310  0.1732440  -0.513  0.61063
TotalRemittances.l3           0.0094558  0.1223622   0.077  0.93875
TradeBalance.l3               0.0742583  0.0410366   1.810  0.07705 .
ExchangeRate.l4              -0.1519828  0.1692184  -0.898  0.37389
AnnualAverageInflation.l4    -0.0619854  0.1731813  -0.358  0.72208
Inflation.l4                 -0.0220510  0.0595323  -0.370  0.71282
CentralBankInterestRates.l4   0.2294848  0.1569780   1.462  0.15072
TotalRemittances.l4           0.1675742  0.1144784   1.464  0.15020
TradeBalance.l4               0.1451296  0.0425488   3.411  0.00138 **
ExchangeRate.l5               0.0217621  0.1688949   0.129  0.89805
AnnualAverageInflation.l5    -0.1511492  0.1753322  -0.862  0.39322
Inflation.l5                  0.1202753  0.0570956   2.107  0.04076 *
CentralBankInterestRates.l5  -0.0396583  0.1602971  -0.247  0.80572
TotalRemittances.l5          -0.1829123  0.1148432  -1.593  0.11823
TradeBalance.l5              -0.0020748  0.0479285  -0.043  0.96566
```

```
ExchangeRate.l6               -0.1697873  0.1716675  -0.989  0.32793
AnnualAverageInflation.l6     -0.1228197  0.1702134  -0.722  0.47430
Inflation.l6                  -0.0319238  0.0625246  -0.511  0.61214
CentralBankInterestRates.l6    0.1984544  0.1534464   1.293  0.20250
TotalRemittances.l6            0.0875821  0.1180830   0.742  0.46212
TradeBalance.l6               -0.0298903  0.0509882  -0.586  0.56066
ExchangeRate.l7                0.1428893  0.1658921   0.861  0.39362
AnnualAverageInflation.l7      0.1752698  0.1665674   1.052  0.29830
Inflation.l7                  -0.0738012  0.0649382  -1.136  0.26177
CentralBankInterestRates.l7   -0.1052628  0.1332688  -0.790  0.43376
TotalRemittances.l7           -0.1079651  0.1186887  -0.910  0.36785
TradeBalance.l7               -0.0519254  0.0500156  -1.038  0.30473
ExchangeRate.l8                0.0803754  0.1542159   0.521  0.60479
AnnualAverageInflation.l8      0.1584786  0.1776641   0.892  0.37713
Inflation.l8                  -0.0662177  0.0669668  -0.989  0.32804
CentralBankInterestRates.l8    0.0599833  0.1289589   0.465  0.64408
TotalRemittances.l8           -0.0126371  0.1276324  -0.099  0.92157
TradeBalance.l8               -0.0355627  0.0464059  -0.766  0.44748
ExchangeRate.l9                0.0880339  0.1461962   0.602  0.55009
AnnualAverageInflation.l9      0.0901312  0.1847408   0.488  0.62800
Inflation.l9                   0.0857684  0.0677997   1.265  0.21237
CentralBankInterestRates.l9   -0.1351938  0.1254275  -1.078  0.28684
TotalRemittances.l9           -0.0031548  0.1235678  -0.026  0.97974
TradeBalance.l9                0.0470318  0.0451423   1.042  0.30304
ExchangeRate.l10               0.1172530  0.1317971   0.890  0.37839
AnnualAverageInflation.l10    -0.1281839  0.1827920  -0.701  0.48675
Inflation.l10                  0.1210199  0.0674569   1.794  0.07953 .
CentralBankInterestRates.l10 -0.0555153  0.1280350  -0.434  0.66665
TotalRemittances.l10           0.1420639  0.1354753   1.049  0.29995
TradeBalance.l10               0.0358594  0.0474781   0.755  0.45401
ExchangeRate.l11              -0.0340174  0.1352570  -0.252  0.80257
AnnualAverageInflation.l11    -0.1063845  0.1749906  -0.608  0.54628
Inflation.l11                 -0.0876777  0.0693217  -1.265  0.21246
CentralBankInterestRates.l11 -0.1224706  0.1356930  -0.903  0.37157
```

```
TotalRemittances.l11          -0.2035477  0.1290458  -1.577  0.12172
TradeBalance.l11               0.0183195  0.0474692   0.386  0.70137
ExchangeRate.l12              -0.0656443  0.1067568  -0.615  0.54172
AnnualAverageInflation.l12    -0.0488627  0.1776749  -0.275  0.78457
Inflation.l12                  0.0075107  0.0495922   0.151  0.88030
CentralBankInterestRates.l12   0.1701022  0.1017654   1.672  0.10156
TotalRemittances.l12           0.1830580  0.1095481   1.671  0.10166
TradeBalance.l12              -0.0323059  0.0465649  -0.694  0.49138
const                          0.0596430  0.0481076   1.240  0.22148
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1


Residual standard error: 0.1513 on 45 degrees of freedom
Multiple R-Squared: 0.9862,      Adjusted R-squared: 0.9641
F-statistic: 44.65 on 72 and 45 DF,  p-value: < 2.2e-16
```