EFFECT OF MACROECONOMIC VARIABLES ON EXCHANGE RATE VOLATILITY IN KENYA

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A THESIS SUBMITTED TO THE SCHOOL OF BUSINESS, ECONOMICS AND MANAGEMENT SCIENCES IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE CONFERMENT OF THE DEGREE OF MASTER OF ARTS IN ECONOMICS,UNIVERSITY OF ELDORET, KENYA

2025

DECLARATION

Declaration by the Candidate:

This thesis is my original work and has never been presented for the award of an academic degree in any other university and should not be copied, or reproduced in any format without written authority from the author and/or University of Eldoret.

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DEDICATION

This thesis is dedicated to my beloved mother Elizabeth Wanjiku, my brothers Martin Murigi and Peter Mungai, my uncles James Mburu, Amos Kamau, Gibson Mungai, and Antony Muiruri, as well as my grandparents Jacob Murigi and Ann Nyambura, whose unwavering love, support, understanding, and perseverance have been my constant source of strength. Their kindness, guidance, unity, and generosity have inspired my hard work and hope, giving me both the moral and financial strength to complete my studies.

ABSTRACT

Foreign direct investment, government expenditure, public debt, inflation rate, interest rates, and money supply are essential macroeconomic variables that can alter currency volatility and its impact on the Kenyan economy. The exchange rate of the Kenyan shilling has exhibited significant volatility against major currencies such as the US dollar. In 2022, the KES depreciated by an average of 0.6% monthly. This trend intensified in early 2023, with average monthly depreciation rates reaching 4%, and some months witnessing increases of up to 6%. By October 2023, the exchange rate reached KES 148.4 per US dollar, up from KES 120.8 in early 2022, marking a 13% depreciation in 2023. In January and February 2024, the KES continued to weaken, exceeding KES 160 and 163.98 per US dollar, respectively. This sharp fluctuation in the Kenyan shilling highlights concerns about currency stability. The objective of this study was to examine the effect of foreign direct investment, government expenditure, public debt, inflation rates, interest rates, and money supply on exchange rate volatility in Kenya. The study was informed by the Purchasing Power Parity Theory, the General Equilibrium Theory of Exchange Rate Determination, the International Fisher Effect theory, and the Interest Rate Parity theory. The study used an explanatory research design, analysing annual secondary data from 1971 to 2024. Data was collected using a structured review matrix and tested for stationarity and cointegration before analysis using descriptive statistics and the ARDL model. Descriptive statistics results showed that the average FDI, government expenditure, and public debt were 0.71, 15.68% and 47.60% respectively. Interest rates, inflation rate, and money supply growth averaged 6.20%, 11.31% and 34.77%, respectively. Inferential results revealed that in the long run, a unit increase in foreign direct investment and government expenditure reduced exchange rate volatility by 36.4% and 341.5%, respectively, while inflation and money supply increased it by 55.2% and 239.7%, respectively. Short-run results showed that a 1% increase in FDI, money supply, and inflation rate increased volatility by 18.31%, 19.26%, and 111.83%, respectively, while government spending and public debt reduced volatility by 90.65% and 42.18%, respectively. To reduce or stabilise exchange rate volatility, the study recommended a combination of monetary policy interventions to policymakers. These included foreign exchange operations, interest rate adjustments, hedging strategies, and export diversification. Additionally, the central bank is advised to regulate the growth of the money supply to prevent excessive inflation and currency depreciation, which could exacerbate exchange rate fluctuations.

ACKNOWLEDGMENT

Honour and glory to God for granting me strength, wisdom, and good health of body and mind. Through His love and inspiration, He has consistently guided me in fulfilling my duties and responsibilities. My deepest appreciation goes to my supervisors, Dr. Winrose Chepng'eno and Dr. Elijah Ng'eno, for their invaluable guidance and tremendous support throughout my thesis.

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OPERATIONAL DEFINITION OF TERMS

Exchange Rate: In the context of this study, exchange rate represented the value of one currency in terms of another currency, determining the price at which currencies could be exchanged (Waweru, 2014). This study considered exchange rates between the Kenyan shilling (KES) and the United States dollar (USD).

Exchange Rates volatility: As used in this study, exchange rate volatility referred to the degree of fluctuation in the value of a country's currency relative to other currencies over time (Katusiime *et al.,* 2016). It reflected the unpredictability and instability of exchange rates, which could be influenced by macroeconomic factors.

Foreign Direct Investment: As used in this study, foreign direct investment refer to investment made by a company or individual in one country in business interests in another country, in the form of either establishing business operations or acquiring business assets (Amondi, 2016). For this study, FDI was measured as the net inflow of foreign investment into Kenya, including equity investments, reinvested earnings, and other capital transfers, as reported by the Central Bank of Kenya.

Government expenditure: For this study, government expenditure refer to the total spending by the government on goods, services, and public investments, including recurrent and development expenditures (Miyamoto *et al*., 2019). It was measured as a percentage of GDP to assess its relative impact on the economy.

Inflation Rate: As applied in this study, the inflation rate measures the percentage change in the general price level of goods and services over a specific period, typically annually or monthly (Jattani, 2013). Inflation rates were calculated using the Consumer Price Index (CPI) for Kenya, which tracked changes in the prices of a basket of goods and services commonly purchased by households.

Interest Rate: For this study, interest rate refer to the cost of borrowing money or the return on investment, typically expressed as a percentage. Interest rates were measured as the central bank's policy rate, such as the Central Bank Rate or the Monetary Policy Rate, set by the Central Bank of Kenya to influence borrowing and lending rates in the economy (Kiptoo, 2007).

Money supply: within the scope of this study, money supply referred to the total amount of liquid assets available in the economy, including currency in circulation and demand deposits (Kibiy & Nasieku, 2016). It was measured using broad money, which included both physical currency and easily accessible deposits in banks.

Public debt: Within the scope of this research, public debt refers to the total amount of money that a government owes to domestic and foreign creditors, including both external and internal borrowing (Odera, 2015). Public debt was measured as the ratio of total government debt as a percentage of GDP.

LIST OF ABBREVIATIONS AND ACRONYMS

ADF	Augmented Dickey Fuller
AIC	Akaike Information criterion
AFD	African Development Bank
ARCH-LM	Autoregressive Conditional Heteroskedasticity Lagrange Multiplier test
ARDL	Autoregressive Distributed Lag Model
BWP	Botswana Pula
CBK	Central Bank of Kenya
COVID-19	Coronavirus Disease 2019
CPI	Consumer Price Index
CUSUM	Cumulative Sum
CUSUMSQ	Cumulative Sum of Squares
DCC	Dynamic Conditional Correlation Model
EGP	Egyptian Pound
EUR	Euro
FDI	Foreign Direct Investment
GARCH	Generalized Autoregressive Conditional Heteroskedasticity
GBP	British Pound
GBS	Ghanaian Cedi
GDP	Gross Domestic Product
GLS	Generalized Least Squares
ICT	Information and Communication Technology
IFE	International Fisher Effect
IMF	International Monetary Fund
IRP	Interest Rates Parity
JPY	Japanese Yen

KES	Kenya Shilling
KNBS	Kenya National Bureau of Statistics
LCU	Local Currency Unit
NACOSTI	National Commission for Science, Technology and Innovation
NGN	Nigerian Naira
PP	Phillip Perron
PPP	Purchasing Power Parity
SAR	Saudi Riyal
SSA	Sub-Saharan Africa
STATA	Software for Statistics and Data Science
UNCTAD	United Nations Conference on Trade and Development
US	United States
USD	United States Dollar
VIF	Variance Inflation Factor
WBG	World Bank Group
ZAR	Zuid Afrikaanse Rand

CHAPTER ONE

INTRODUCTION

1.1 Overview

This chapter presents the study's background information, statement of the problem, objectives, research hypothesis, scope, significance, limitations, and assumptions.

1.2 Background Information of the Study

Mishkin and Eakins (2019) defined exchange rates as the price of a currency in terms of another. The exchange rate is the amount of local currency required to acquire foreign currencies such as the dollar, and the pound. It shows the ratio of local currency in relation to foreign currencies. The exchange is carried out in foreign exchange markets. The foreign exchange market refers to the intercontinental market, where currencies are merchandised virtually around the globe (Abdalla, 2021). Exchange rate volatility refers to fluctuations in the value of a currency relative to others over time. Unlike stable exchange rates, which remain relatively constant, volatile exchange rates experience frequent and unpredictable change (Kang & Cabaero, 2025).

Exchange rate volatility affects economies differently depending on their exchange rate regimes, economic structures, and trade linkages. While some level of volatility is normal in foreign exchange markets, excessive volatility can introduce uncertainty, increase transaction costs, and disrupt economic activities. Foreign exchange rate volatility has several effects on the economy, such as the price of imports, exports, profitability level and cost of raw materials (Lagat & Nyandema, 2016). Exchange rate volatility should be closely monitored due to its inherent riskiness and its impact on the

economy. Foreign exchange rates are an economy's growth and development pillar (Ufoeze *et al*, 2018).

The exchange rate is outlined as the number of units of domestic currency required to purchase one unit of foreign currency(Ng & Geetha, 2020). In other words, the rate at which a currency in one country is often changed for alternative currencies. The rate is extremely necessary, because it permits for the conversion of national currency into another, to facilitate international trade and also the transfer of funds between countries. This allows for the comparison of the costs of products in different countries. In general, the value distinction between similar merchandise determines international trade. The demand and supply of foreign currency may stir volatility, and this depends on the economic scenario in the foreign exchange market.

Globally, exchange rate regimes vary significantly. As of 2023, approximately 180 recognized currencies exist worldwide, with the U.S. dollar (USD) being the dominant global reserve currency, accounting for around 59% of global foreign exchange reserves (Crawford, 2023) Other major currencies include the Euro (EUR), Japanese Yen (JPY), and the British Pound (GBP), which all play significant roles in international trade and finance. Many countries, especially those with developing economies, have fixed or pegged exchange rate systems, where their currency is tied to a more stable foreign currency like the U.S. dollar or the Euro. For example, the Saudi Riyal (SAR) has been pegged to the U.S. dollar at a fixed rate of approximately 3.75 SAR per USD since 1986 (Mirza *et al*, 2013).

In contrast, countries with floating exchange rate systems, such as the United States, Japan, and the Eurozone, allow their currency values to fluctuate according to market forces of supply and demand (Obstfeld, 2020). The exchange rates play a central role in the global financial system by determining the relative value of currencies, which directly impacts international trade and economic interactions (Yadgari & Yadgari, 2025). Historically, major financial crises have led to significant exchange rate volatility. For instance, the 2008 Global Financial Crisis triggered sharp volatility in currency markets as investors sought safe-haven assets, causing many emerging market currencies to depreciate. Similarly, the European Sovereign Debt Crisis (2010–2012) resulted in prolonged volatility in the euro, significantly impacting trade within the Eurozone and beyond. As shown in Figure 1.1, during this period, the euro experienced substantial volatility, depreciating from approximately $1.45 in mid-2011 to around $1.21 by July 2012, reflecting heightened investor uncertainty.

Similarly, the EUR/GBP exchange rate declined from 0.90 in 2010 to 0.78 in mid-2012, further demonstrating the instability in currency markets. The JPMorgan Global FX Volatility Index peaked at 13% in 2011, compared to a pre-crisis average of 9%, highlighting increased exchange rate unpredictability. Additionally, rising sovereign bond yields indicated investor concerns, with Greek 10-year bond yields surpassing 35% in 2012, up from approximately 6% in 2010, while Spanish and Italian 10-year bond yields exceeded 7%. This volatility has significant economic repercussions, as uncertainty in exchange rates led to a decline in intra-Eurozone trade, with exports from crisis-affected economies such as Greece, Portugal, and Spain falling by over 10%. Moreover, foreign direct investment (FDI) inflows into the Eurozone dropped by more than 30% between 2010 and 2012, as businesses hesitated due to exchange rate risks.

These volatilities underscore the impact of the crisis on currency stability, trade, and investment, reinforcing the link between sovereign debt instability and exchange rate volatility.

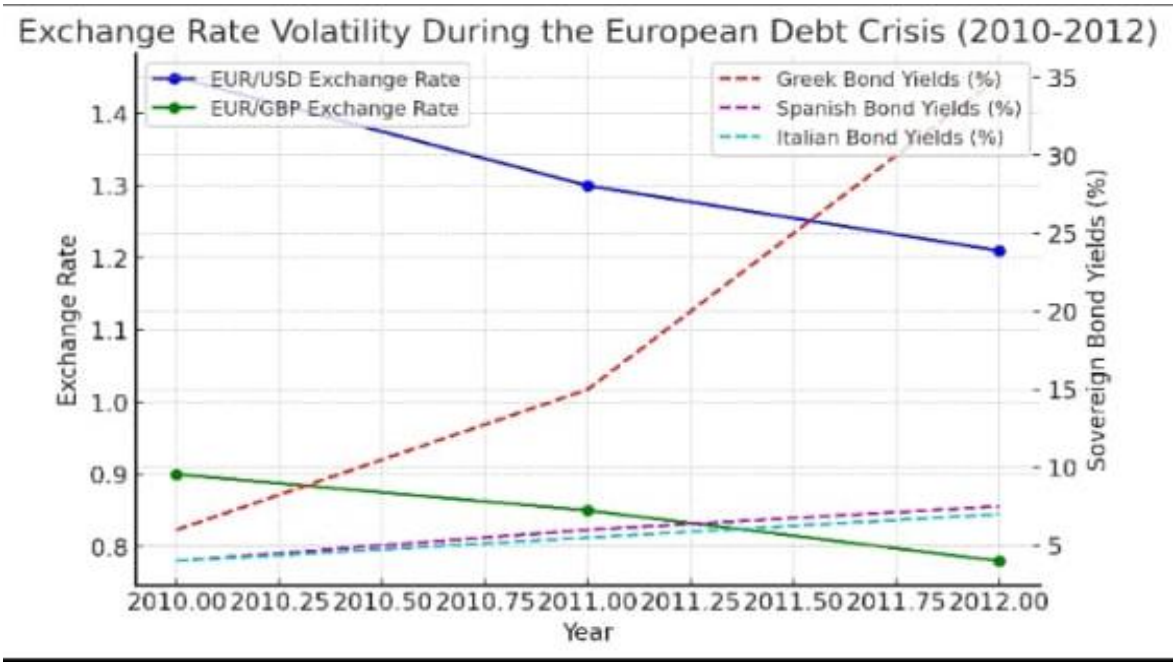

Figure 1.1:Exchange Rate Volatility during European Sovereign Debt Crisis (2010–2012)

The value of the U.S. dollar (USD) against other major currencies has seen significant volatility over the years, with the exchange rate reaching a peak of around 1.60 USD to the British Pound (GBP) in 2007, and falling to approximately 1.20 USD to GBP in 2020, before stabilizing (Mota, 2023). The US dollar strengthened against most global currencies during this period, leading to sharp exchange rate swings that disrupted international trade and investment. Over the past decade, the U.S. dollar has experienced significant volatility, which in turn affected many emerging market currencies (Lysandrou, 2025). From 2014 to 2023, the U.S. dollar appreciated by over 20% against many currencies due to changing global economic factors as shown in

Figure 1.2 below on the exchange rate trends of the U.S. dollar during this period (IMF, 2023).

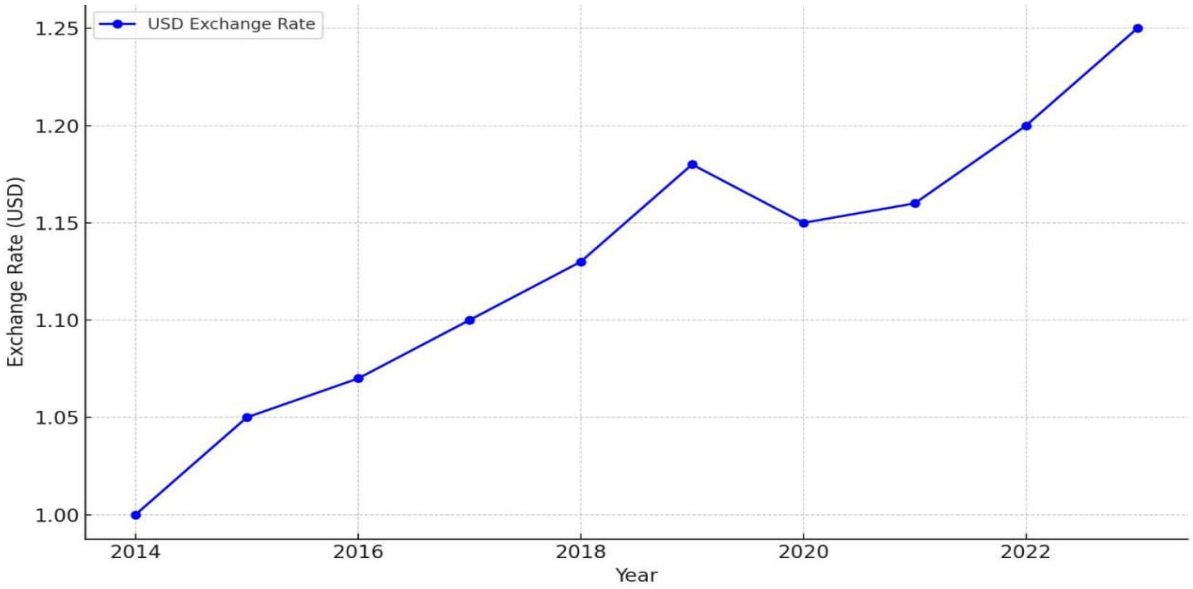

Figure 1.2: U.S. Dollar Exchange Rate Trends (2014–2023)

The COVID-19 pandemic also had a significant impact on exchange rates, causing increased volatility in global currency markets (Duarte *et al,* 2025). Many currencies in emerging markets experienced steep declines due to capital outflows, economic uncertainty, and shifts in investor sentiment, as shown in Figure 1.3 below (UNCTAD, 2021). For example, the Brazilian Real depreciated by more than 37% against the U.S. dollar in 2020, as the country faced significant challenges related to the pandemic (de Paula *et al*, 2025).

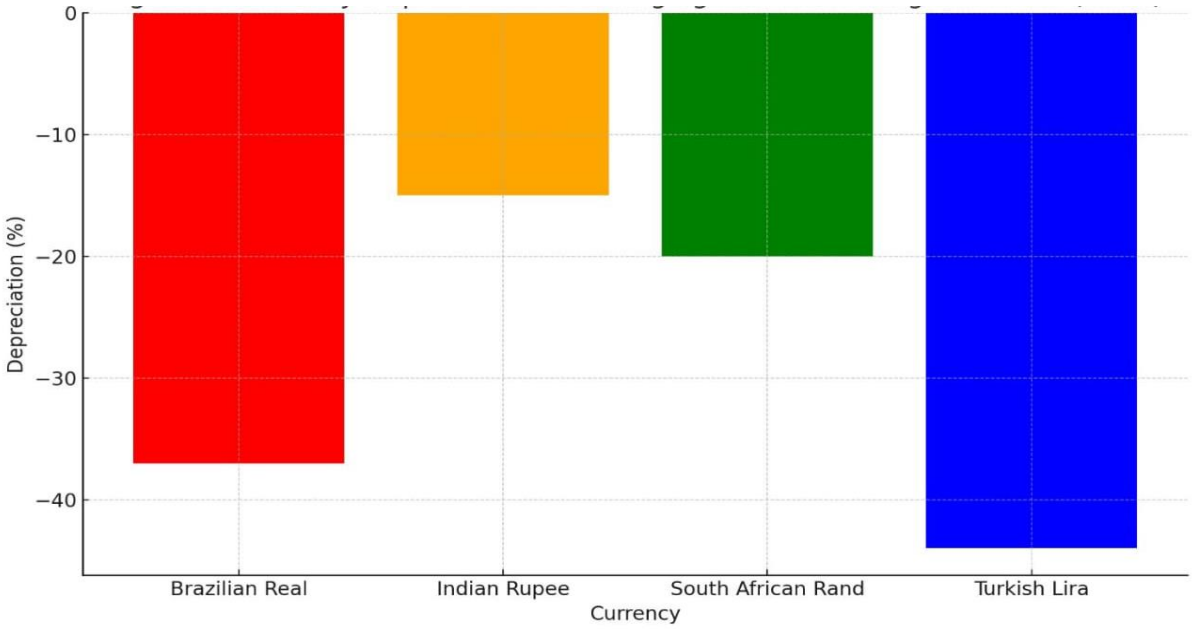

Figure 1.3: Currency Depreciation in Emerging Markets during COVID-19 (2020)

In recent years, volatility in major currencies has remained significant, the Japanese Yen weakened from ¥115 per USD in early 2022 to ¥151 per USD by late 2023, marking one of the largest depreciations in recent history. The British pound saw substantial volatility, reaching $1.03 per GBP in late 2022 before recovering to around $1.25 per GBP in 2024 due to shifting economic conditions. The Euro fluctuated between $1.05 and $1.20 per EUR in 2023, reflecting ongoing market uncertainty.

Currency depreciation continues to be a significant issue for many economies, particularly when market conditions are unstable. A primary factor contributing to the continued depreciation is changes in investor confidence, often driven by political instability, economic downturns, or market speculation (Kumar & Kumar, 2025). In 2022, for instance, the Argentine Peso depreciated by 10% against the U.S. dollar within just the first half of the year, driven by ongoing economic uncertainty and a high inflation rate (Fisunoğlu & Akyüz, 2025). Similarly, the Turkish Lira lost nearly 44%

of its value in 2021, primarily due to high inflation and political uncertainty, which led to a loss of investor confidence in the currency (TOLA, 2025).

The persistent depreciation of currencies in such cases highlights the sensitivity of exchange rates to global and domestic economic conditions. The prolonged depreciation of a currency has widespread implications for an economy. One of the most immediate effects is the increase in import prices, which can fuel inflation and erode the purchasing power of consumers (Ozoji & Ekperechukwu, 2025). Additionally, as the value of the domestic currency declines, foreign investors may become reluctant to invest in local assets, fearing further devaluation or potential losses. This decline in investment can lead to a vicious cycle, where weaker currency values discourage economic growth, which in turn leads to further depreciation (Amico, 2025).

Exchange rate volatility remains a persistent challenge in Africa, affecting trade, inflation, and overall economic stability. Many African economies operate under different exchange rate regimes, ranging from floating to fixed and managed systems. However, irrespective of the regime, fluctuations in currency values are common, impacting economic performance.

In Africa, exchange rate systems and policies are of particular importance due to the continent's diverse economic structures, external economic shocks, and varying dependence on global commodities (Dafe *et al*, 2023). Exchange rates in Africa have shown considerable volatility over the past decade, influenced by both domestic and global factors. The exchange rates of African currencies are often shaped by the type of exchange rate regime adopted by individual countries, whether fixed, pegged, or

floating, and the economic conditions within those countries (Mimouni, 2016). Countries like Lesotho and Eritrea maintain fixed exchange rate regimes, where the value of their currencies is closely aligned with that of other stronger currencies (Abban, 2020).

The fixed exchange rate approach offers a level of stability by reducing fluctuations in currency values, but it can lead to challenges when the country experiences external shocks, such as drops in commodity prices or changes in foreign capital inflows. Other African countries, especially those with more diversified economies, have opted for floating exchange rate systems (Mtenga, 2015). Under a floating exchange rate system, the value of the currency is determined by market forces, primarily through the interaction of supply and demand in the foreign exchange markets. South Africa, Kenya, and Egypt are examples of countries that have embraced floating exchange rate systems, where their currencies adjust based on global market conditions (Gedi, 2019). The flexibility of this system allows countries to respond to external shocks and changing economic conditions more easily than those relying on fixed systems (Kimolo *et al,* 2024). However, floating exchange rates can result in greater volatility, as currency values may fluctuate more rapidly in response to market speculation or changes in investor confidence.

Many African countries, including Nigeria, South Africa, and Angola, have seen their currencies experience significant depreciation, often due to economic instability, political factors, and shifts in global commodity prices. For instance, the Nigerian Naira (NGN) depreciated sharply from approximately 150 NGN per USD in 2014 to over 400 NGN per USD by 2020, largely driven by fluctuations in oil prices, which are critical

to Nigeria's economy (Chukwu & Chukwuemeka, 2024). Countries, such as Ghana and Egypt, have seen their currencies fluctuate significantly. For example, the Ghanaian Cedi (GHS) depreciated from around 1.9 GHS/USD in 2010 to over 5 GHS/USD by 2020 (Alves Aguilar, 2015), and the Egyptian pound (EGP) lost value from around 9 EGP/USD in 2015 to 19 EGP/USD by 2020(Raouf *et al.*, 2024). Similarly, the South African rand (ZAR) depreciated from around 11 ZAR/USD in 2014 to over 17 ZAR/USD in 2020, reflecting both global market dynamics and domestic economic challenges (Du Toit, 2024).

In contrast, some African countries have managed to maintain more stable exchange rates. Botswana, with its relatively small economy and prudent fiscal policies, has kept its currency, the Botswana Pula (BWP), between 10 and 12 BWP/USD over the past decade. Similarly, the West African Franc, used by 14 countries in the region, has been pegged to the Euro, helping maintain its stability (Ugwu, 2020). Deciding between a fixed or flexible exchange rate system in Africa usually depends on each nation's economic structure, trading partners, and how exposed it is to worldwide market influences. For example, oil-exporting countries in West and Central Africa, such as Nigeria and Angola, may face greater challenges in maintaining a fixed exchange rate due to fluctuations in global oil prices, whereas countries with more diversified economies may benefit from flexible exchange rate system (Casiraghi *et al*, 2022).

During the COVID-19 pandemic, African currencies experienced sharp declines due to capital outflows, economic uncertainty, and disruptions in global trade. In 2020, the South African Rand depreciated by more than 20% against the U.S. dollar as a result of the global economic downturn and investor risk aversion (Mathebula, 2024). Other

countries like Egypt saw their pound lose nearly 15% of its value as the pandemic forced the government to devalue its currency to address mounting fiscal challenges (Mohieldin *et al*, 2024). Exchange rate depreciation in Africa often results from a combination of domestic and external factors. Political instability, such as the economic crises in Zimbabwe or the ongoing conflict in Sudan, has led to severe depreciation in local currencies. For example, Zimbabwe has experienced extreme inflation and currency devaluation, with the Zimbabwean Dollar losing significant value due to government policies, economic mismanagement, and hyperinflation. In 2008, Zimbabwe's currency experienced a collapse, with inflation reaching astronomical rates, which led to the abandonment of its currency in favour of the U.S. dollar (Ellyne, 2015). The regional exchange rate dynamics in Africa are influenced by a combination of external factors, such as global commodity prices and international economic trends, and domestic challenges, including political instability and economic mismanagement.

In Kenya exchange rate is the amount of Kenya shillings (KES) required to acquire one US dollar. Exchange rate plays a vital role in the Kenyan economy since it participates in the stock market, and foreign exchange market and also affects international trade, which includes the export and import of goods and services (Kibiy & Nasieku, 2016). The exchange rate is a major economic growth and development pillar of any economy in the world (Taiwo & Adesola, 2013). Kenya being a third world third-world country is faced with the challenges of designing policies to spur economic growth and mitigate the challenges that arise from the implementation of both microeconomic and macroeconomic policies. The exchange rate stability is fundamental in ensuring a country has sound economic and monetary policy objectives. These policies include fiscal policies, monetary policies, exchange rate policies, trade policies, industrial

policies, labor market policies, investment policies, development policies, and environmental policies. Each of these plays a crucial role in addressing economic challenges and fostering long-term economic stability and growth. Exchange rate policies are considered the determinants of international transactions. The exchange rate policy in Kenya has undergone various regime changes in the past. Up to 1974, the exchange rate was pegged to the US dollar, after discrete devaluations, the peg was changed to the International Monetary Fund's Special Drawing Rights. Since the introduction of a freely floating exchange rate regime, the Kenyan shilling and US Dollar exchange rates have been highly volatile (Waweru, 2014). When the foreign exchange market was liberalized, Kenya gained the right to control inflation but lost the right to lock in domestic prices thereby, transmitting the effects of globalization directly into the country (Katusiime *et al*, 2016).

Kenya has experienced significant exchange rate volatility over the past two decades, impacting business operations, trade, and economic planning. The Kenyan shilling (KES) has undergone periods of both appreciation and sharp depreciation, influencing economic stability. The Kenyan shilling has depreciated against the US Dollar since the implementation of the free-floating exchange rate regime with a gradual decline in value from the year 1995 to 1998 followed by a sharp decline in the year 1999 and 2000 (Kwarah, 2021). A period of stability followed in the year 2001 to 2005. The rise in the value of the Kenyan shilling against the US dollar was recorded in the period 2006 to 2008 before a sharp decline that followed in the year 2009 with a historic high being recorded in the year 2011 of Ksh 88.81 (Magu, 2024). The Kenyan shilling appreciated in the year 2012 to KES 84.52 which was followed by depreciation in the year 2013 to KES 86.12 and further to KES 91.63 in 2014 (CBK, 2023). In the year 2022, the Kenya

shilling depreciated at a rate of 7.2 percent, an average of 0.6% per month, against the United States (US) dollar (Ramalho, 2016). This trend continued in 2023 with the currency losing about 4% of its value in January and February 2023 (CBK, 2023). The trend worsened in March 2023 with a 6% drop (CBK, 2023). Throughout 2023, the Kenyan shilling (KES) depreciated at an annual rate of 13% compared to 9 percent, in 2022. Furthermore, the trend continued in January 2024 as the Kenyan shilling (KES) depreciated further, crossing the 160 mark against the US dollar (CBK, 2024).

Along with the CBKs data, the Kenyan exchange rates against the US Dollar exchange rate, have fluctuated over the past years with an increasing trend. As shown in Figure 1.3 below, the exchange rates were KES 7.14 in the year 1971, 63.3 in 2007, 78.0 in 2008, 75.4 in 2009, 80.6 in 2010, 80.6 in December 2011, KES 106.45 in the year 2020, KES 117.87 in 2022, KES 139.83 in 2023 and KES163.98 in February 2024 (World Bank, 2024 and CBK, 2023).

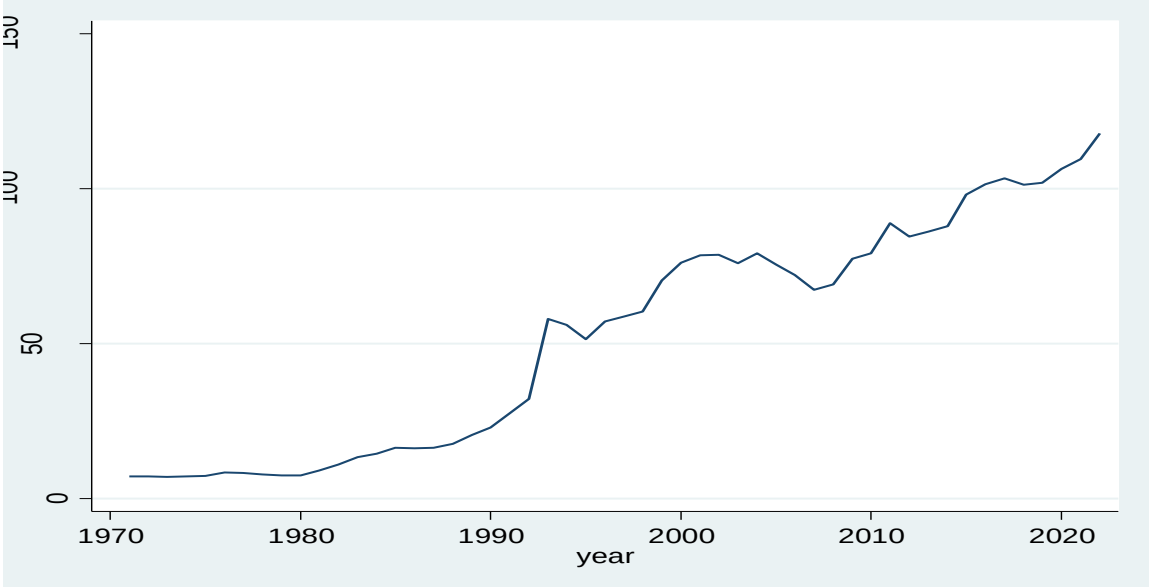

Figure 1.4: The Trend of Kenya Exchange Rates for the Period 1971 to 2024.

Historical trends of exchange rate volatility in Kenya indicates that the Kenyan shilling has experienced significant volatility over the years, influencing economic stability and financial planning. From 1953 to the early 1980s, the exchange rate was relatively stable, with minimal volatility as the Kenyan shilling was pegged to major currencies. However, in the late 1980s and early 1990s, the introduction of market-driven exchange rate policies led to increased volatility. During the 1990s, the exchange rate exhibited significant fluctuations, with the Kenyan shilling depreciating sharply due to economic instability and structural adjustment programs. By the 2000s, the exchange rate showed moderate volatility, with periods of relative stability followed by occasional depreciation.

Between 2010 and 2020, the exchange rate experienced increased volatility, influenced by external shocks such as global financial crises, fluctuating commodity prices, and domestic fiscal policies. The most notable depreciation occurred in 2011 when the exchange rate reached Ksh 107 per USD. Stability was observed between 2015 and 2018, with the exchange rate ranging between Ksh 100–105 per USD. However, in 2023, heightened volatility saw the exchange rate depreciate from Ksh 120 per USD in January to Ksh 160 per USD by December 2023.

Recent data on exchange rate volatility in Kenya shows that as of March 2021, the exchange rate stands at approximately KSH 129.25–129.45 per USD, indicating relative stability compared to previous years. This follows a period of heightened volatility, during which the shilling reached its lowest historical levels. In 2022, the exchange rate moved from KSH 113 per USD in January to KSH 122 per USD in December. The trend continued in 2023, with the shilling depreciating from KSH 120

per USD in January to KSH 160 per USD by December. In 2024, the currency began to recover, strengthening from KSH 160 per USD in January to KSH 140 per USD in December. By March 2025, the exchange rate had further stabilized at approximately KSH 129 per USD. This volatility highlights the dynamic nature of Kenya's exchange rate environment and its implications for economic planning and policy formulation.

As shown in Figure 1.4, exchange rate volatility in Kenya has exhibited significant fluctuations over the years, from 1971 to the early 1980s, the currency value stayed fairly steady, with minimal volatility. However, the late 1970s and early 1980s saw a sharp rise in volatility, reaching a peak of 86.7% around 1980. This period was marked by global economic shocks, structural adjustments, and changes in Kenya's foreign exchange policies.

In the 1990s, the country experienced another wave of volatility, with fluctuations reaching around 81.9% in 2000. The liberalization of the foreign exchange market and economic reforms played a role in these variations. By the mid-2000s, volatility had started to decline, though occasional spikes were observed due to external shocks and inflationary pressures. The 2010s saw a relatively more stable exchange rate environment, with volatility fluctuating between 9.9% and 16.5%. However, more recent years, including the post-pandemic period, have shown moderate fluctuations, with exchange rate volatility remaining around 9.7% in 2020 and slightly reducing by 2023.

Figure 1.5: Exchange Rates Volatility in Kenya for the Period 1971 to 2024.

According to the CBK, inflation has averaged around 9.2 per cent in recent years, significantly above the target range of 2.5 per cent, to 7.5 per cent (Kimolo *et al*, 2023). To combat the high levels of inflation, the CBK has regularly adjusted the Central Bank Rate (CBR), which has reached as high as 9.0% in 2023 in an attempt to curb inflation (CBK, 2023). The CBK also intervened directly in the foreign exchange market by selling foreign currency reserves to stabilize the Kenyan shilling in times of excessive depreciation. For instance, in 2022, the CBK sold approximately $400 million in foreign reserves to defend the currency during periods of extreme volatility (CBK, 2022). Persistent fluctuations in exchange rates affect economic stability and investment attractiveness in an economy (Aidoo, 2017).

1.3 Statement of the Problem

The exchange rate is among the key tools of the economy used to correct numerous economic misalignments a country may be facing. Volatility in exchange rates has pervasive effects on prices, wages, production levels, and employment opportunities

(Obstfeld & Rogoff, 2021). Volatility in the value of currencies across various economies has increased since the collapse of the global economy following the financial crisis (Cooper, 2019). Despite Kenya's growing economy and increasing integration into the global market, the instability of the Kenyan exchange rate remains a concern for economic stability and investment attractiveness. Kenya’s exchange rate volatility has shown significant volatility over the past five decades. From 1971 to the early 1980s, volatility was minimal but sharply rose to a peak of 86.7% around 1980 due to global shocks and policy changes. Another spike occurred in the 1990s, reaching 81.9% by 2000, influenced by market liberalization and reforms. Volatility declined by the mid-2000s with occasional spikes, and during the 2010s it ranged between 9.9% and 16.5%. In recent years, including the post-pandemic period, volatility remained moderate at about 9.7% in 2020.

Recently, the Kenyan shilling has experienced a rapid depreciation due to volatility in foreign exchange rates against major currencies like the United States (US) dollar. The Kenyan shilling depreciated by an average of 0.6 per cent per month against the United States (US) dollar in 2022. This trend continued in early 2023, with average monthly depreciation rates reaching around 4% and, in some months, experiencing an increase of up to 6 per cent. By October 2023, the exchange rates had reached approximately KSH 148.4 per USD, up from KES 124.15 at the start of 2023. Annually, the Kenyan shilling (KES) depreciated at a rate of 13 per cent in 2023 from 9 per cent in 2022 as exchange rates sharply increased from 117.87 in 2022 to 137.240 in 2023. Furthermore, in January 2024, the Kenyan shilling (KES) depreciated further, crossing the 160-shilling mark against the US dollar. In February 2024, the exchange rate increased to KES163.98, indicating an upward trend and thereby causing further depreciation of the

Kenyan shilling. Volatility in exchange rates has caused significant depreciation of the Kenyan shilling, leading to increased concerns about the nation's economic stability and investment attractiveness. This sharp depreciation in the Kenyan shilling raises concerns about the effect of currency volatility and its impact on the Kenyan economy. Therefore, this study investigates the underlying effects of macroeconomic variables on exchange rate volatility in Kenya.

1.4 Objective of the Study

1.4.1 General Objective

The general objective of this study was to examine the effect of macroeconomic variables on exchange rate volatility in Kenya.

1.4.2 Specific Objectives

The following specific objectives guided this study:

(i) To examine the effect of foreign direct investment on exchange rate volatility in Kenya.

(ii) To examine the effect of government expenditure on exchange rate volatility in Kenya.

(iii) To establish the effect of public debt on exchange rate volatility in Kenya.

(iv) To determine the effect of interest rates on exchange rate volatility in Kenya.

(v) To investigate the effect of inflation rate on exchange rate volatility in Kenya.

(vi) To evaluate the effect of money supply on exchange rate volatility in Kenya**.**

1.5 Research Hypotheses

The research was guided by the following hypothesis.

H_{01}: Foreign direct investment has no significant effect on exchange rate volatility in Kenya.

H_{02}: Government expenditure has no significant effect on exchange rate volatility in Kenya.

H_{03}: Public debt has no significant effect on exchange rate volatility in Kenya.

H_{04}: Interest rate has no significant effect on exchange rate volatility in Kenya.

H_{05}: Inflation rate has no significant effect on exchange rate volatility in Kenya.

H_{06}: Money supply has no significant effect on exchange rate volatility in Kenya.

1.6 Significance of the Study

The study was carried out to examine the effect of macroeconomic variables on foreign exchange rate volatility in Kenya. The rationale for conducting the research arose from the persistent volatility observed in Kenya's exchange rate, which posed risks to trade, investment, and overall macroeconomic stability.

The research provides insights intended to assist policymakers by presenting data-driven evidence that could support the development of sound fiscal and monetary strategies for exchange rate stabilization. By identifying the specific macroeconomic factors that significantly impacted exchange rate volatility, decision-makers were better positioned to prioritize interventions that reduced uncertainty in the foreign exchange market and supported sustainable economic growth. In addition, the study contributed to the academic literature by focusing not only on the exchange rate itself but also on its volatility over time. This approach provided a dynamic perspective and enhanced

the understanding of how fluctuations in macroeconomic variables interact with exchange rate behavior in both the short and long run.

The study also holds value for academic understanding and can guide scholars and future researchers who wish to explore similar topics or expand the analysis to other countries or variables. It offered a strong empirical foundation and could guide further research in the fields of international finance, macroeconomics, and development economics. Furthermore, the findings were valuable to private sector actors such as importers, exporters, investors, and financial institutions, who relied on exchange rate stability for planning and decision-making. Understanding the determinants of exchange rate volatility helped these stakeholders mitigate risks and develop more informed strategies.

1.7 Scope of the Study

The study was carried out using annual time series data of the Kenyan economy, focusing on six independent and one dependent variable. These variables are FDI, government expenditure, public debt, money supply, interest rates, and inflation rates on exchange rate volatility. The data that was used was for the period 1971 – 2024. This period was selected because 1971 marks a significant structural shift in the global monetary system with the collapse of the Bretton Woods fixed exchange rate regime and the transition to a flexible exchange rate system. This shift introduced exchange rate volatility as a persistent macroeconomic phenomenon, making 1971 a logical and theoretically sound starting point for this study (Erem, 2022).

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The chapter presents the introduction, review of related literature, theoretical review, conceptual framework, and knowledge/research gap associated with the present study.

2.2 Theoretical Literature Review

This study adopted the theory of purchasing power parity (PPP), the International Fisher Effect (IFE), Interest Rate Parity (IRP), and the Balance of Payments (BOP)theory. However, this study was primarily guided by the Purchasing Power Parity (PPP) theory with additional support from the International Fisher Effect (IFE), Interest Rate Parity (IRP), and the Balance of Payments (BOP)theory.

2.2.1 Theory of Purchasing Power Parity

The theory of purchasing power parity was introduced by the Swedish economist Gustav Cassel in 1918. This theory was a basis for recommending a new set of official exchange rates at the end of World War I. Cassel used this theory to allow for the resumption of normal trade relations (Kirai, 2018). Purchasing power parity is a measure of the price of particular goods in different countries and is utilized to compare the absolute purchasing power of the countries' currencies.

PPP states that exchange rates should adjust so that identical goods have the same price across different countries; that is, a unit of the home currency should have the same purchasing power around the world. The theory bases its prediction of exchange rate movements on the changing patterns of trade due to different inflation rates between

countries. Therefore, when inflation in one nation exceeds that of its trading partner, the exchange rate adjusts by weakening the high-inflation country's currency to maintain equivalent purchasing capacity.

Irungu (2020) argues that exchange rates tend to move to levels at which the cost of goods in any country is the same in the same currency. The absolute form of PPP is based on the notion that, without international trade barriers and transport costs, consumers shift their demand to where prices are low, suggesting that prices of the same basket of products in two different countries should be equal when measured in a common currency (Madura & Fox, 2021). Goods produced in a country with an undervalued currency tend to cost less than similar goods manufactured in another country; therefore, exports will grow and imports will decrease unless trade barriers, transportation costs, or the perishability of products make it feasible for people to buy the same products in various places.

The relative form of this hypothesis is that PPP exists when the difference in aggregate price inflation in two countries matches the rate of depreciation of the domestic currency relative to the foreign currency at a point (Menkhoff, Sarno, Schmeling, & Schrimpf, 2017). The PPP theory suggests that the exchange rate will not remain constant but will instead adjust to maintain parity in purchasing power. The percentage change in the foreign currency should be adjusted to maintain parity between the new price indexes of two countries.

2.2.2 General Equilibrium Theory

The General Equilibrium Theory offers a comprehensive framework for analysing how fiscal and monetary variables interact and influence exchange rate volatility. The theory maintains that economic markets adjust simultaneously to achieve a state of equilibrium, where all markets, including money, goods, and foreign exchange, are interconnected (Acemoglu & Robinson, 2019). Exchange rate fluctuations result from the combined effects of monetary factors, fiscal policy, and external trade conditions (Galí & Monacelli, 2016). It suggests that fiscal and monetary variables jointly affect currency value (Alfaro *et al.*, 2024). Fiscal expansion can cause inflationary pressures and interest rate shifts, which then influence capital flows and exchange rate stability. Monetary policy aimed at controlling inflation or encouraging growth influences exchange rate behaviour through liquidity adjustments and investor expectations (Cecioni *et al.*, 2019). This theoretical perspective provides a structured approach to analysing the effects of macroeconomic policies on exchange rate volatility, making it relevant for examining the interaction between fiscal and monetary variables within an open economy.

2.2.3 International Fisher Effect Theory

Irving Fisher designed the International Fisher Effect Theory in 1930. The International Fisher Effect Theory is an exchange-rate theory that uses nominal interest rates to determine exchange rates. It indicates that the difference between two nominal interest rates in two countries is directly proportional to the change in the exchange rate of their currencies. It suggests that foreign currencies with relatively high interest rates will depreciate in the same way as currencies with high inflation rates.

According to Fisher, the nominal rates are expressed in terms of current dollars, without considering fluctuations in the real value of currency over time. The theory uses interest rates rather than inflation rates to explain why exchange rates change over time. High inflation often coincides with increased interest charges, with the belief that investors in different countries require the same non-inflation return for the same level of risk. The the justification for interest rates to differ for a given risk is the difference in expected inflation (Kirai, 2018).

According to Fisher, a sudden spike in interest rates would draw in foreign investors who might want to put money into the domestic market to benefit from high interest rates. However, if there isn't a rush of inward investment, the market must be anticipating that, if the foreign exchange market is efficient, the value of the domestic currency will decline as it should. The theory essentially provides that arbitrage between financial markets should ensure that the interest differential between any two countries is an unbiased predictor of the future change in the spot rate of exchange. The interest differential is not an accurate predictor rather, the prediction errors tend to cancel out over time (Bile, 2022).

2.2.4 Interest Rate Parity Theory

Interest Rate Parity (IRP) as a theory was first developed by John Maynard Keynes in 1930. It states that if FDI inflows lead to higher investment levels and economic growth, central banks might increase interest rates to keep inflation in check. Higher interest rates can attract foreign investors seeking higher returns, leading to increased demand for the domestic currency and appreciation. An increase in foreign direct investment

increases the demand for local currency, thus leading to an appreciation of the local currency (Njuguna, 2016).

It is based upon the law of one price. such that when securities are quoted in a common currency, identical securities should have the same price in all the markets (Sørensen, 2024). The theory suggests that FDI can influence interest rates on the recipient country. It is defined as an equilibrium state that exits when market forces cause both exchange, and inflation rates to adjust (Munene, 2016).

This arbitrage condition holds when international financial markets are in equilibrium. Capital is easily transferable and foreigners can easily buy assets in Kenya. Indeed each person who is not a resident of one country can still easily buy assets that in this case refer to local and foreign bank deposits, in whichever country they deem to fit. When capital is mobile and when assets are perfect substitutes, if the expected return on a local asset is above that of a foreign asset, both locals and foreigners will want to hold only local assets and will be unwilling to hold foreign assets (Koech, 2018).

According to Njuguna (2016), this theory is important as it describes the situation whereby an investor decides on which country to invest in. IRP does not mean that all currencies must have the same interest rate. A currency experiencing high inflation and high interest rates as a result of an increase in foreign direct investments can neutralize the effects of other currencies by devaluing.

2.3 Empirical Literature Review

2.3.1 Interest Rate and Exchange Rate Volatility

A study by Ndung'u (2000) on the exchange rate and interest rate differential in Kenya discovered that a rise in interest rates lead to strengthening of the Kenyan shilling due to increased foreign investment in government securities. A study by Kiptoo (2007) on real exchange rate volatility in Kenya observed that during periods of high interest rates, Kenyan shilling strengthened as foreign investors sought higher returns on investments, particularly in the bond market. However, this study emphasizing monetary variables and does not incorporate a broader range of economic factors that may influence exchange rate volatility

A study by Alper *et al.,* (2020) established that during the introduction of the interest rate cap in 2016, increased exchange rate volatility occurred as the cap reduced the attractiveness of Kenyan assets to foreign investors, resulting in capital outflows and a fall of the value of the shilling. Research by Desire (2018) found that interest rate differentials between Kenya and its trading partners significantly influenced exchange rate movements, particularly during periods of economic uncertainty.

A study by Patra (2004) investigated the long-run relationship between real exchange rate and real interest rate differentials using the co-integration approach between India and US for the period 1993 – 2003. The study employed both Engle-Granger and Johansen tests for the presence of cointegration. The study findings suggested a potential systematic relationship between the two variables. However, empirical representations supporting this relationship were not identified, and the outcomes remained reliable across different measures of real interest rate differentials. However,

despite suggesting a potential systematic relationship, the study was unable to empirically confirm this link, indicating weak or inconclusive evidence.

Gochoco-Bautista and Bautista (2005) examined the relationship between interest rate differentials and exchange rates in six East Asian countries: Korea, Malaysia, the Philippines, Singapore, Thailand, and Indonesia. From 1986 to 2004, the study observed changes in the nominal exchange rate regime and tracked the relationship between the real exchange rate and the real interest differential. Engle's (2002) dynamic conditional correlation multivariate model was used in the analysis. To determine the relationship between the two variables over time, a Dynamic Conditional Correlation (DCC) model was estimated for each country. The study found that there is a time-varying relationship between interest rate differentials and exchange rates. However, while the dynamic conditional correlation model captures changing correlations, the study does not thoroughly explore how foreign direct investment and other macroeconomic factors interact with interest rate differentials to affect exchange rates.

2.3.2 Inflation Rate and Exchange Rate Volatility

A study by Ndung'u (1997) on price and exchange rate dynamics found that inflationary pressures in the 1990s contributed to fall in value of the Kenyan shilling. The study showed that higher inflation rates lead to an increased demand for foreign currencies as a result of a rise in domestic prices, thus weakening exchange rates. Similarly, a study by Mutuku (2013) on inflation and exchange volatility in Kenya found that inflation had a significant negative impact on the Kenyan exchange rate, particularly during periods of rising global oil prices, which led to higher domestic inflation and subsequent depreciation of the shilling.

A study by Jattani (2013) on the relationship between exchange rates and selected macroeconomic variables in Kenya, discovered that an increase in inflation rates leads to a decrease in exchange rates. The study indicated that inflationary pressures contributed to a depreciation of the Kenyan shilling, as rising domestic prices made local currency less attractive to foreign investors, thereby decreasing its value relative to other currencies. The research emphasized the negative impact of inflation on exchange rate stability, particularly during periods of high inflation.

In contrast, the study by Oranga (2022) on determinants of the Kenyan shilling to United States dollar exchange rate found that increase in inflation rates led to increase in exchange rates, suggesting that higher inflation contributed to the depreciation of the Kenyan shilling against the US dollar. This relationship was attributed to the broader effects of inflation on the economy, including higher import costs and the decreasing purchasing power of the local currency. The study also noted that inflation's impact on the exchange rate was worsened by external factors such as global oil price fluctuations and economic policies.

A study by Ndagara *et.al* (2020) on the effectiveness of monetary policy intervention on exchange rate volatility in Kenya found that inflation affects the effectiveness of monetary policy on exchange rate volatility since monetary actions for controlling volatility negate inflation control. While this finding highlights key trade-offs in macroeconomic policy, the study does not offer practical solutions and focuses mainly on short-term effects, limiting its relevance for understanding long-term challenges in developing economies.

2.3.3 Foreign Direct Investment and Exchange Rate Volatility

Kiyota and Urata (2004) examined the impact of FDI inflows on currency appreciation in emerging economies. The study discovered that FDI inflows contributed to the appreciation of the local currency, as investors purchased the local currency to finance their investments, increasing demand for the currency. However, the study offered limited insight into the long-term effects of FDI on exchange rates and did not differentiate between various types of FDI or sector-specific impacts.

Froot, Perold, and Stein (1991) focused on the US. and found that strong FDI inflows were associated with the appreciation of the US dollar. The study highlighted that the demand for dollar-denominated assets, driven by increased foreign investment, led to a stronger currency. However, the study's concentration on a developed economy limits its applicability to developing countries like Kenya, where financial markets, exchange rate mechanisms, and economic conditions differ significantly.

Additionally, Ochieng and Anyango (2015) explored the role of FDI in exchange rate dynamics in Kenya, particularly in the infrastructure and manufacturing sectors. The study concluded that significant FDI inflows helped strengthen the Kenyan shilling by increasing foreign currency reserves and stabilizing the exchange rate. However, the study did not fully account for the effects of FDI in other critical sectors or consider how macroeconomic variables and policy responses interact with FDI inflows. Moreover, the study lacks an analysis of the long-term sustainability of exchange rate stability driven by FDI, which is crucial for policy formulation.

Amondi, (2016) studied FDI in the real estate and energy sectors in Kenya found that periods of strong FDI inflows contributed Kenyan shilling appreciation. The study emphasized that foreign investments in these sectors led to increased demand for the local currency. However, some studies, such as Mwega and Ngugi (2006), suggest that the effect of FDI on the exchange rate can be temporary, as initial inflows lead to currency appreciation, but repatriation of profits by foreign investors can put downward pressure on the currency. They emphasize that the sustainability of FDI-driven currency appreciation depends on the reinvestment of profits and continuous investment inflows.

2.3.4 Pubic Debt and Exchange Rate Volatility

A study by Bénétrix, Gautam, Juvenal, and Schmitz (2019) on "Public Debt and Exchange Rate Dynamics in Advanced Economies" found that higher public debt cause currency depreciation due to increased risk perception by investors. Similarly, Dell'Ariccia, Rabanal, and Sandri (2018) on their study of "Debt Sustainability and Exchange Rate Volatility," concluded that countries with high debt-to-GDP ratios face increased exchange rate volatility as markets demand higher risk premiums. However, this study overlooks important factors such as debt structure, institutional strength, and exchange rate regimes, which can significantly influence the relationship between debt levels and exchange rate volatility.

Morenike and Chukwuyem (2024) examined the impact of external debt and exchange rate volatility in Sub-Saharan Africa and found that rising public debt burdens contribute to long-term currency depreciation due to persistent fiscal deficits. In the study by Odera (2015) on Analysis of External Public Debt and Exchange Rate Volatility in Kenya established that high levels of external debt cause increased

volatility in the real effective exchange rate. Similarly, a study by Njenga (2022) studied the effect of external debt on exchange rates in Kenya and found that high debt servicing costs increase pressure on the local currency, leading to periodic depreciation.

2.3.5 Government Expenditure and Exchange Rate Volatility

A study by Corsetti and Müller (2015) on Fiscal Expansions and Exchange Rate Responses found that expansionary government spending initially leads to currency appreciation but can result in long-term depreciation if it leads to unsustainable fiscal deficits. A key limitation of this study is that it overgeneralizes the relationship by failing to consider crucial country-specific factors like fiscal policy credibility, monetary policy stance, and investor risk perceptions. In countries with weak institutions or high existing debt, fiscal expansions often cause immediate depreciation due to sustainability concerns, contradicting the study's suggested delayed effect. Similarly, a study by Li and Zhu (2024) on Government spending on consumption and exchange rate adjustment observed that in flexible exchange rate regimes, fiscal expansion results in significant currency appreciation, whereas in fixed regimes, effects are minimal. However, a key limitation of this study is that it assumes a clear-cut difference between flexible and fixed exchange rate regimes without considering hybrid or managed regimes that dominate many economies.

A study by Miyamoto, Nguyen, and Sheremirov (2019) on the effect of government expenditure on real exchange rate found that excessive government spending often leads to exchange rate instability due to inflationary pressures. A study by Bouakez and Eyquem (2015) on government spending, monetary policy and exchange rate, found that government expenditures lead to exchange rate depreciation due to inflationary

pressures and increased money supply. The study observed that higher public spending often resulted in macroeconomic imbalances, influencing exchange rate volatility. Also a study by Popa and Codreanu (2010), on fiscal policy and its role in ensuring economic stability, found that high levels of government expenditure, particularly recurrent spending, contributed to exchange rate depreciation. The study observed that fiscal deficits led to inflationary pressures, which in turn weakened exchange rate.

2.3.6 Money Supply and Exchange Rate Volatility

A study by Chen and Liu (2018), on dissecting the real exchange rate in China concluded that an increase in money supply leads to currency depreciation, especially in economies with high capital mobility. Similarly, a study by Fratzscher and Rieth (2019)on Monetary Policy Shocks and Exchange Rate Fluctuations found that non-sterilised monetary interventions significantly affect exchange rate stability, with expansions in money supply causing currency depreciation. Both studies primarily consider short- to medium-term effects, leaving a gap in understanding the long-term impact of monetary policy on exchange rate stability across diverse economic contexts.

According to a 2016 study by Kibiy and Nasieku on the factors influencing the volatility of the Kenyan shilling relative to major global currencies, the money supply has a significant impact on the three exchange rates' volatility, and when central banks increase their money supply to the economy, exchange rate volatility decreases. However, the study did not account for how other macroeconomic factors like inflation or capital flows might interact with money supply to affect volatility, limiting the comprehensiveness of its conclusions.

A study by Ndung'u (1999) on Monetary and Exchange Rate Volatility in Kenya found that excessive money supply growth leads to currency depreciation, particularly in economies with weak financial markets. However, a study by Muchiri (2017) on the effect of inflation and interest rates on foreign exchange rates found that money supply has a positive effect on foreign exchange rates. However, these studies did not explore how factors like inflation, interest rates, or financial market development mediate this relationship, indicating a gap in understanding the nuanced and potentially context-dependent impact of money supply on exchange rate movements.

2.4 Review of Empirical Models

Empirical models review involves examining various econometric approaches used to analyze the relationship between exchange rate volatility and key fiscal and monetary variables. Common models such as Multivariate Regression Analysis, Autoregressive Distributed Lag (ARDL), and Vector Autoregressive (VAR) models have been widely applied to understand both short-term and long-term influences on exchange rate fluctuations (Pesaran & Shin, 2002).

2.4.1 Multivariate Regression Analysis in Exchange Rate Studies

Multivariate regression models estimate the relationship between multiple independent variables and a dependent variable, making them useful in analyzing the drivers of exchange rate volatility (Wooldridge, 2015). Several empirical studies have utilized multivariate regression analysis to investigate exchange rate dynamics. For example, a study by Saeed (2012) employed this approach to examine the effects of inflation and interest rates on exchange rate fluctuations in Pakistan, revealing significant interactions among these variables. Similarly, Kidwell, Hardesty, Murtha, and Sheng

(2011)explored how changes in interest rates and inflation rates influence currency values, emphasizing the importance of a multifaceted approach to understanding exchange rates.

Regression analysis was used by Kibiy and Nasieku (2016) to investigate the factors that influence the Kenyan Shilling's exchange rate volatility in relation to key global currencies. Although not all of the independent variables were statistically significant in determining each of the currency volatilities, the results of the regression analysis for the volatility of the big three major currencies' exchange rates from January 2006 to December 2015 showed that all of them contributed to the volatility of all three exchange rates.

Bahmani-Oskooee (1996) used multivariate regression to study the relationship between exchange rates and macroeconomic variables such as interest rates, inflation, and trade balances. The study found significant relationships between exchange rates and interest rate differentials, which affect capital flows and, consequently, currency values. Adebayo (2020) applied multivariate regression to study how public debt and monetary policy influenced exchange rate movements in Sub-Saharan Africa.

Similarly, Chinn and Meredith (2004) analyzed the determinants of exchange rate volatility using multivariate regression and found that interest rates and inflation were among the key drivers of exchange rate fluctuations. Their study highlighted that while interest rate differentials had an immediate effect on exchange rates, inflation was a slower-moving variable influencing long-term trends.

In the study by Frenkel and Levich (1975) they applied multivariate regression to model the relationship between exchange rates and factors like economic growth, interest rates, and inflation. They found that interest rates were the most influential factor in the short run, whereas GDP growth had a significant effect in the long run.

Mburu (2015) conducted a multivariate linear regression analysis to investigate the determinants of exchange rate volatility in the Kenyan economy. The study found that both interest rates and inflation had significant short-term effects on the Kenyan exchange rate, while FDI had a weaker, albeit positive, long-term influence. This suggests that exchange rate determination in Kenya is influenced by both domestic macroeconomic policies and external factors such as global interest rates and inflation. On the other hand, Odera (2015) applied multivariate regression to assess how external public debt affects exchange rate fluctuations in Kenya. The findings indicated external public debt had a negative and significant effect on exchange rate volatility and was seen to partly be responsible for aggravating the real effective exchange rate, thus exhibiting a volatility trend.

2.4.2 Autoregressive Distributed Lag (ARDL) Model in Exchange Rate Studies

The ARDL Model is suitable for variables with different levels of integration. ARDL models allow for the simultaneous estimation of both long-term and short-term relationships, making them highly relevant in exchange rate studies. Yabu and Kimolo (2020) applied the ARDL model to examine exchange rate volatility and its implications on macroeconomic variables in East African countries. The study revealed that volatility in the exchange rate is a practical issue in all the sampled countries and is fundamentally driven by export dynamics for the period under consideration. Umoru *et*

al. (2023) applied the ARDL model to examine the causes of exchange rate volatility in Africa. The study found the drivers of exchange rate volatility among African countries vary depending on the specific country.

Abimbola *et al.* (2023) applied panel ARDL to explore the dependence between foreign trade performance and exchange rate volatility. Employing the panel ARDL model with a PMG estimator, the results revealed that in the short-run, exchange rate volatility has an insignificant relationship with both exports and imports (trade performance), whereas it has a very high and significant influence on both exports and imports of goods and services in the long run. Ndung'u & Ngugi (1999) applied the ARDL model to examine the Adjustment and liberalization of financial and foreign exchange markets in Kenya. The result indicated that the Kenyan exchange rate was significantly influenced by difference in interest rate and inflation, with the long-run relationship suggesting that exchange rates tend to revert to equilibrium over time following external shocks.

Ochieng (2018) also utilized the ARDL model to explore the relationship between currency spread determinants and the financial performance of foreign exchange Bureaus in Kenya. FDI had a significant impact on the exchange rate in the long run, while interest rate differentials were a key determinant of short-term fluctuations. Additionally, the findings indicated a weak correlation between exchange rate volatility and FDI inflows, suggesting that other macroeconomic factors played a more significant role in influencing FDI. Investor confidence and economic stability were also highlighted as key determinants of FDI inflows. Similarly, Chege and Kirika (2021) applied the ARDL model to explore the effect of macroeconomic factors on

trading volumes of manufacturing and allied companies listed on the Nairobi Securities Exchange. The study found a stable long-run relationship between FDI and the exchange rate, indicating that inflows of foreign capital led to currency appreciation in the long run. Additionally, the short-term analysis highlighted that interest rates had a more immediate effect on exchange rate fluctuations.

2.4.3 Vector Autoregressive (VAR) Model in Exchange Rate Studies

The VAR model captures the dynamic interactions between multiple macroeconomic variables without imposing strong theoretical restrictions (Leeper & Sims, 1994). It is widely used to understand how shocks to fiscal and monetary variables affect exchange rate fluctuations over time. Nyongesa and Mackton (2018) adopted the VAR model in the econometric assessment of the real effective exchange rate. The findings of the volatile real effective exchange rate imply that regular and persistent real effective exchange rate fluctuation may trigger a financial crisis in the long run.

Maiyo *et al.* (2024) used VAR to estimate the effect of exchange rates on tourism demand; and the forecast tourism demand based on exchange rate fluctuations. The results of the VAR model showed causal effects from the exchange rate, especially the US dollar and the Euro, on regional tourism as represented by the Uganda Shilling. Njenga (2023) used the VAR model to examine the exchange rate pass-through dynamics evidence for Kenya. A VAR (2,0) was the most appropriate for the regression model, as it was statistically significant at the 5% level. The study provides evidence of the existence of Granger causality for 20 NSE share indices, consumer price index, and broad money supply with respect to other endogenous variables.

2.5 Summary of Literature Reviewed

The empirical literature review examined the relationship between exchange rate volatility and key fiscal and monetary variables. Several studies have examined the impact of interest rates, inflation, foreign direct investment (FDI), public debt, government expenditure and money supply on exchange rate volatility in Kenya and other emerging economies. The findings suggest that exchange rates are influenced by multiple factors, with varying results across different countries and time periods.

The relationship between interest rates and exchange rates is well-established in the literature. Studies suggest that higher interest rates generally lead to currency appreciation due to increased foreign investments, as observed by Ndung'u (2000) and Kiptoo (2007). However, restrictive policies such as interest rate caps (CBK, 2015) may increase volatility and deter foreign investors. Global studies, such as Patra (2004) and Gochoco-Bautista & Bautista (2005), emphasize the varying correlations between interest rate differentials and exchange rates over time and across economies.

The impact of inflation on exchange rates is similarly well-documented. Research indicates a negative strong relationship between inflation and exchange rates, with higher inflation leading to currency depreciation (Ndung'u, 1997; Mutuku, 2013; Jattani, 2013). However, Oranga (2022) finds a positive correlation, attributing it to external economic factors. Inflation also weakens monetary policy effectiveness in controlling exchange rate volatility (Ndagara *et al*., 2020).

Research on FDI and exchange rates shows that FDI inflows usually cause currency appreciation by boosting demand for local assets and foreign reserves. Studies find that

FDI inflows often lead to currency appreciation because of higher demand for the local currency (Kiyota & Urata, 2004; Froot *et al.,* 1991; Ochieng & Shilisia, 2016). However, Mwega & Ngugi (2006) warn that profit repatriation can later put downward pressure on exchange rates.

The impact of public debt on exchange rates is largely negative. High public debt is associated with currency depreciation due to increased risk perception (Bénétrix *et al*., 2019; Dell'Ariccia *et al.,* 2018). Studies in Kenya (Odera, 2015; Njenga, 2022) confirm that external debt servicing increases exchange rate volatility.

Similarly, excessive government expenditures have been linked to short-term currency appreciation but long-term depreciation due to fiscal deficits. Expansionary fiscal policies initially cause currency appreciation but may lead to depreciation if they result in unsustainable deficits (Corsetti & Müller, 2015; Bouakez & Eyquem, 2015). Recurrent government spending further contributes to exchange rate depreciation (Popa & Codreanu, 2010).

The impact of Money Supply and Exchange Rate is typically negative. An increase in money supply is generally linked to currency depreciation (Chen & Liu, 2018; Fratzscher & Rieth, 2019). However, Kibiy & Nasieku (2016) suggest it may also reduce exchange rate volatility.

Various econometric models have been used to analyze exchange rate volatility. Multivariate regression (Saeed, 2012; Bahmani-Oskooee, 1996) confirms the influence of fiscal and monetary variables on exchange rates. The ARDL model (Ndung'u &

Ngugi, 1999; Ochieng, 2018) captures both short- and long-run relationships, while the VAR model (Nyongesa & Mackton, 2018; Njenga, 2023) helps track dynamic interactions and policy effects.

2.6 Identification of Knowledge Gap

There were mixed results in the review of empirical literature on the extent to which macroeconomic variables affect exchange rate volatility which brought about the research gap. As shown in Table 2.1.

Table 2.1: Summary of Knowledge Gap

Author and Year	Study	Key Findings	Identified Research Gap	Addressing the gap
Ndung'u (2000)	Exchange rate and interest rate differential in Kenya	Positive relationship; an increase in interest rates resulted in the appreciation of the Kenyan shilling.	Focused only on short-term effects	Incorporate both the short-term and long-term effects.
Kiptoo (2007)	Real Exchange Rate Volatility And Misalignment In Kenya	positive relationship; high interest rates attracted foreign investors, strengthening the currency	The study did focus on monetary variables	incorporate both the fiscal and monetary variables.
Mutuku and Mwalekwa (2019)	Role of interest rate differentials in exchange rate movements	Interest rate differentials influenced exchange rate movements, especially during economic uncertainty	The study lacked a comparative analysis across different economic periods.	This study applied a comparative analysis across different economic periods.
Jattani (2013)	Relationship between Exchange Rates and Selected Macroeconomic Variables in Kenya	positive relationship; higher inflation rates lead to lower currency appreciation.	Contradicting findings on the impact of inflation rates on exchange rates.	The study used ARDL model to establish a clearer causality.
Oranga (2022)	Determinants of the Kenya shilling to USD exchange rate	Inverse relationship: inflation leads to currency depreciation	Contradicting findings on the impact of inflation rates on exchange rates.	The study used the ARDL model to establish a clearer causality.
Kiyota and Urata (2004)	Impact of FDI inflows on currency appreciation	Positive relationship; FDI inflows contributed to the appreciation of the local currency	Limited exploration of the long-term effect of FDI on exchange rates in different emerging economies	This study investigated the long-run effect of FDI on exchange rate volatility,
Bénétrix *et al*. (2019)	Public debt and exchange rate in advanced economies	high public debt leads to currency depreciation due to investor risk perceptions	The study was limited to advanced economies and not developing ones.	This study is conducted in Kenya a developing country.

Kiptoo (2007)	The impact of foreign direct investment on exchange rate volatility in Kenya.	FDI inflows particularly in real estate and energy sectors contributed to the appreciation of the Kenya shilling	Focused mainly on the real estate sector.	This study focused on the whole economy.
Ndagara *et al*. (2020)	Effectiveness of monetary policy on exchange rate volatility	finding that inflation affects monetary policy effectiveness on exchange rate stability	did not differentiate between short-run and long-run effects	This study investigated the short-run and long-run effects
Froot and stein (1991)	The impact of foreign direct investment on exchange rate in the US	Positive relationship; Strong FDI inflows into the US led to appreciation of the dollar.	Focused on a developed country with appreciating currency.	This study focused on a developing country with unstable currency.
Ndung'u (1997)	price and exchange rate dynamics	inflationary pressures in the 1990s contributed to the depreciation of the Kenyan shilling	The study lacks recent data, particularly post-2000s.	The study addressed this gap by incorporating updated data.
Patra (2004)	The long-run relationship between real exchange rate and real interest rate differentials using the co-integration approach between India and the US for the period 1993 – 2003.	Potential systematic relationship between the two variables.	The relationship was not identified as there was no strong empirical evidence supporting the causality.	This study identified the relationship between interest rates and exchange rates.
Gochoco-Bautista and Bautista (2005)	The relationship between exchange rate and interest rate differential in six East Asia countries	The correlation between exchange rates and interest rates differentials varies over time.	Insufficient investigation into the interaction between FDI and other macroeconomic variables.	This study incorporated other macroeconomic variables,
Ndung'u (2000)	Exchange rate and interest rate differential in Kenya	Positive relationship; an increase in interest rates resulted in the appreciation of the Kenyan shilling.	Focused only on short-term effects	Incorporate both the short-term and long-term effects.

2.7 Conceptual Framework

A conceptual framework is a structured approach that organizes and links the study's main concepts, illustrating their relationships to provide a clear focus for the research. It serves as a guide to hypothesis formulation, data analysis, and interpretation, framing the study within existing theory (Miles & Huberman, 1994). The conceptual framework for this study is as shown in Figure 2.1. The figure shows the interactions between the independent variables (FDI, government expenditure, interest rates, inflation rates money supply, and public debt) and the exchange rates as the dependent variable.

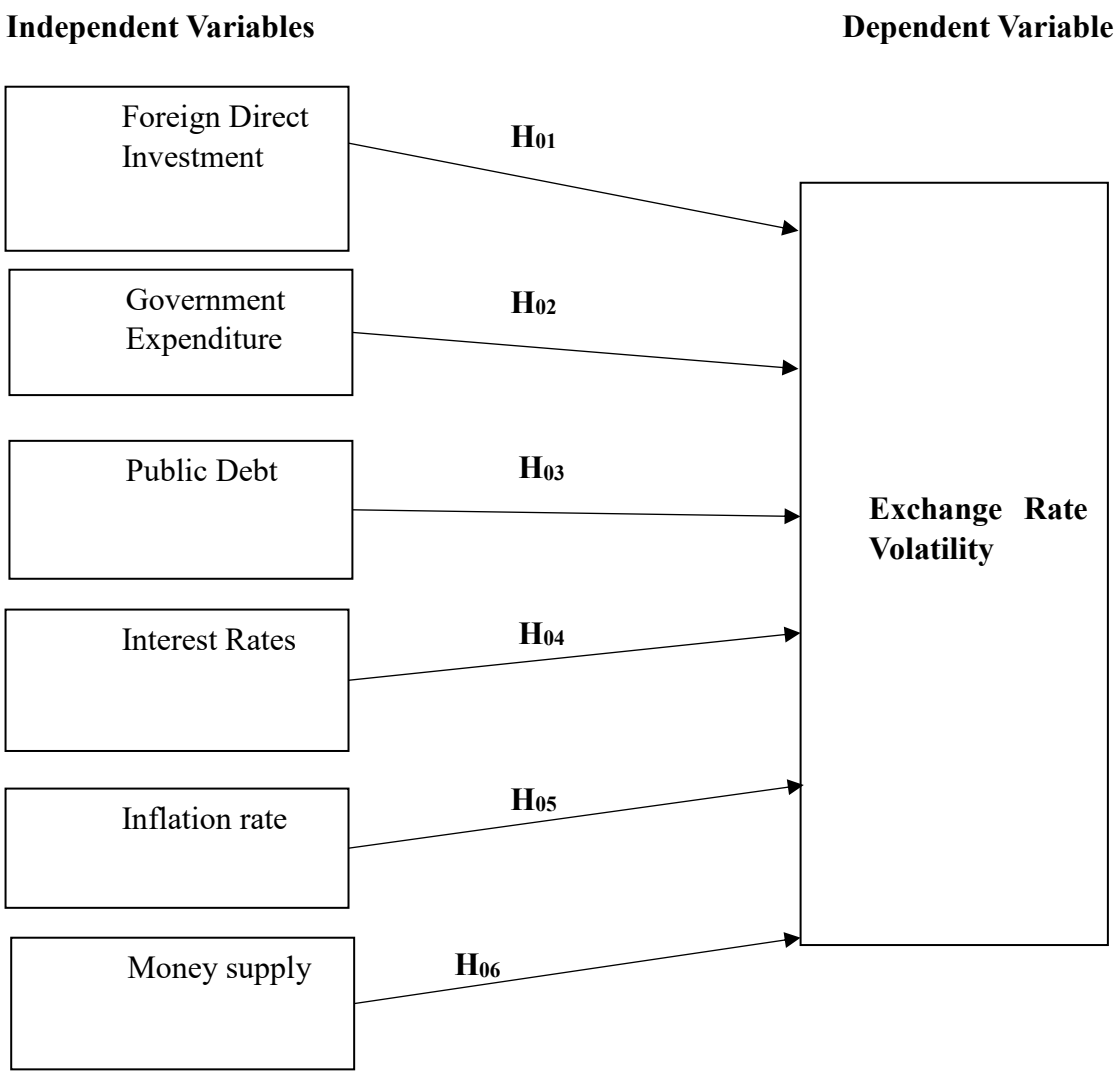

Figure 2.1: Conceptual Framework

Figure 2.1 demonstrates how changes in each independent variable potentially impact the exchange rate, providing a structured overview of the hypothesized relationships that are central to the research objectives. The exchange rate volatility is typically measured as the price of one currency in terms of another, often represented by a currency pair (for example, USD/KES for US dollars to Kenyan shillings), aided by standard deviations. In this framework, the exchange rate volatility between any two currencies is considered to be influenced not only by the main independent variables but also by other significant macroeconomic factors such as FDI, government expenditure, interest rates, inflation rates, money supply, and public debt, all of which may contribute to volatility in exchange rates.

The independent variables selected for this study were chosen based on their consistent use in prior empirical research and their strong theoretical relevance to exchange rate volatility. Macroeconomic variables such as inflation, interest rates, trade balance, and money supply have been widely recognized as key determinants influencing exchange rate dynamics (Heinze, 2018). These variables affect exchange rate volatility through various channels: inflation influences purchasing power parity, interest rates affect capital flows and investment decisions, and trade balance reflects external pressures on currency demand and supply (Ramasamy, 2015).

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the research methodology that was adopted in this study. The chapter highlights the research design, study area, data collection methods, research procedures, data analysis methods and ethical considerations that guided the research process.

3.2 Research Design

Research design refers to the method used to carry out research. It is a framework that assists the researcher in structuring the data collection, analysis, and interpretation (Robinson & Kerr, 2015). The study adopted both descriptive and explanatory research designs. Descriptive research design is a type of quantitative approach that focuses on describing the characteristics of a population or phenomenon. According to Onen (2016), descriptive research design involves examining different kinds of factual findings and then drawing conclusions about a targeted population by describing the data. The descriptive research design was used to systematically describe the characteristics of the population, including measures such as the mean, median, maximum, minimum, standard deviation, skewness, kurtosis, Jarque-Bera statistics, and their corresponding probabilities.

An explanatory research design was also utilised in this study. According to Creswell and Creswell (2017), explanatory research is used to identify the cause-and-effect relationships between variables, which can contribute to theory development and practical applications in various fields. The explanatory design was adopted to bring

out the causal relationship of the variables and this was via a correlation of variables (correlation study). This study ffocused on understanding, explaining, predicting and controlling relationships between variables (MN Saunders, 2012). This design was suitable as it enabled an in-depth analysis of causal relationships and interactions among independent (FDI, government expenditure, public debt, interest rates, inflation rates, and money supply) and dependent (exchange rate volatility) variables.

3.3 Study Area

The study was done in Kenya, as shown in the map in Appendix I. Kenya is located in East Africa. The country lies on the equator, with a coastline along the Indian Ocean to the southeast, bordered by Uganda to the west, Tanzania to the south, Somalia to the east, Ethiopia to the north, and South Sudan to the northwest (Camberlin, 2018). The country has a coastline along the Indian Ocean to the southeast, offering access to maritime trade routes (McCabe, 2019). Kenya covers an area of approximately 580,367 square kilometres, making it the 48th largest country in the world (Abdullahi, 2022). The capital city is Nairobi, and it serves as both the political and economic hub of the country. The other major cities in Kenya include Mombasa, Kisumu, and Nakuru (Njue, 2022). As of 2023, Kenya had a population of over 50 million, with a diverse demographic profile comprising various ethnic groups, including the Kikuyu, Luhya, Luo, Maasai, and others (KNBS, 2023. The population is predominantly young, with a significant proportion under the age of 30 years (KNBS, 2023).

Economically, Kenya is classified as a lower-middle-income country by the World Bank (Jacobsen, Bygvraa, Baygi, & Charalambous, 2023). It's also considered a regional economic hub, particularly in East Africa, with a diversified economy and a

growing entrepreneurial middle class. The country has a market-based economy with a mix of private and state-owned enterprises. Kenya has a long-term development plan, called Vision 2030, which aims to transform the country into a newly industrializing, middle-income nation by 2030 (Jacobsen *et al.,* 2023). Kenya has experienced continued growth in GDP over the last few years, supported by ongoing public infrastructure projects, strong public and private sector investment, and appropriate economic and fiscal policies, reflecting the broad-based and diversified nature of the Kenyan economy (Mugambi, 2016).

According to the National Treasury, 2024/2025 Quarterly Economic & Budgetary Review (QEBR) (2025), macroeconomic stability has been preserved in Kenya over the last few years with inflation, interest rates and exchange rates remaining largely stable, due to the prudent monetary and fiscal policies. Kenya’s economy is primarily driven by agriculture, manufacturing, and services. The key industries include tea, coffee, horticulture, tourism, and financial services. The country has shown consistent economic growth in recent years, although it faces challenges such as poverty, unemployment, and a growing public debt (Erick *et al.* 2023). Kenya's infrastructure has seen improvements, especially in transportation, energy, and communication, facilitating both domestic and international trade (Ogembe, 2017). The country’s central position within East Africa also makes it a regional hub for business and trade (Mwangi, 2021).

3.4 Data Types and Sources

This study used secondary annual time series data covering the period 1971 to 2024, resulting in a total of 54 observations for each variable. Secondary data was suitable for this research as it was readily available, reliable, and cost-effective, providing a practical solution for researchers with limited time and resources (Al Omari, 2021). The study analysed seven key variables: FDI, government expenditure, public debt, interest rates, inflation rates, money supply, and exchange rate volatility.

In this study, macroeconomic factors and exchange rate volatility variables were used for the 1971-2024 period in Kenya. Exchange rate volatility, which serves as the primary dependent variable, was expressed as the price of a currency in respect to another, specifically calculated using the annual average of the Kenyan currency against the US Dollar. Because it was an unobservable variable, the real exchange rate volatility series was measured by the conditional variance values obtained from GARCH model (Bollerslev, 1986; Engel, 1982; Yensu *et al*., 2022). Bollerslev (1987) proposed a useful extension known as the generalized ARCH (GARCH) model. Variance, σ^2, was utilized in this study as a volatility measure. This variable's significance in the model arises from the high sensitivity of the Kenyan economy to exchange rate fluctuations, which critically impact its export markets and the import of goods. Data for exchange rate volatility was collected from the World Bank data base. The independent variables that influence the exchange rate included government expenditure, public debt, inflation rates, interest rates and money supply. Data for government expenditure were obtained from the Kenya National Bureau of Statistics (KNBS). Data on FDI were taken from the World Bank Database. Data on Inflation rates was sourced from the Kenya National Bureau of Statistics (KNBS) and the Central Bank of Kenya (CBK) reports. Public debt

data was extracted from the National Treasury. The money supply was obtained from the Central Bank of Kenya. Interest rate data was obtained from National Treasury reports. Finally, exchange rate data was obtained from the World Bank Database.

The selected study period of 1971 to 2024 was justified by its ability to capture both short-term fluctuations and long-term trends in the macroeconomic variables. Additionally, this period marks the beginning of the transition to a flexible exchange rate regime and the onset of increased market volatility, making it particularly relevant for the study's focus. According to Qabhobho (2017), the breakdown of the Bretton Woods system in the early 1970s led to increased volatility in exchange rates and greater instability in global financial markets. This 54-year span encompasses critical economic events, including structural adjustments, policy reforms, and globalization, which have significantly influenced the dynamics of these variables. Additionally, the availability of consistent and reliable data for this period ensured robust and accurate analysis, making it an ideal timeframe for the study. The data types that were collected for this study included time series data on FDI, government expenditure, public debt, money supply, inflation rates, interest rates, and exchange rates. The data was quantitative, consisting of measurable numerical values.

3.5 Data Collection Instrument

For this study, data were collected using a Secondary Data Review Matrix as shown in Appendix II. A Secondary Data Review Matrix is a structured tool used to gather information in a systematic and organized manner, ensuring that data is collected consistently across all observations. It provides predefined categories or fields that

guide the researcher in collecting specific data, making it easier to organize, analyze, and compare the data later(Saunders *et al.*l, 2009).

3.6 Data Collection Procedure

Data collection refers to the systematic process of gathering and measuring information from various sources to answer research questions and test hypotheses (Creswell & Creswell, 2018). The data collection process for this study followed a structured approach to ensure the reliability and consistency of the secondary data. This study primarily employed secondary data collection, which involves utilizing existing data from credible sources rather than collecting new data directly from subjects (Johnston, 2017). Initially, credible and authoritative sources such as global databases and national publications were identified. Data was accessed primarily through online platforms such as the World Bank Open Data, KNBS, National Treasury, CBK, and the IMF Data Portal, with institutional libraries used as an alternative if necessary. After accessing the data, each dataset went through a verification process to ensure the criteria of the study were met, such as the appropriate time period, units of measurement, and consistency with the variables.

Once verified, the data was organized in a spreadsheet format, categorizing each variable and ensuring proper labelling. Data cleaning was performed to address missing values, outliers, and inconsistencies, ensuring the data was accurate for statistical analysis. The data was consolidated into a unified dataset, ensuring consistency in terms of units and periods across all variables. A final validation process was conducted to cross-check the dataset's accuracy and reliability, ensuring its suitability for analysis.

This systematic procedure guaranteed a rigorous approach for collecting secondary data, and provided a solid foundation for the study's analysis.

3.7 Data Analysis and Presentation

The initial data screening upon completion of the structured collection template was performed by sorting, coding, and cleaning. The data sources were then numbered and coded using a coding frame in readiness for entry and analysis. During preprocessing, missing values were addressed, and data types were verified to ensure consistency before analysis. The collected data were analyzed using both descriptive and inferential statistics. This study employed E-Views version 12.0 software to analyze secondary data.

3.7.1 Descriptive Analysis

Descriptive analysis was employed to summarize and describe the key characteristics of each variable, providing an overview of trends and patterns in the dataset. Descriptive statistics including the mean, median, minimum, maximum, standard deviation, skewness, kurtosis, and the Jarque-Bera statistic, were computed to analyze the distributional properties of each variable. Line graphs were employed to illustrate temporal trends in the variables, such as the exchange rate, its volatility, and other relevant economic indicators. Furthermore, a correlation matrix was constructed to assess the strength and direction of relationships among the variables. The linear association between two variables was measured by a correlation coefficient ranging from -1 to 1. A value of -1 indicated a perfect negative linear relationship, 0 indicated no linear relationship, and 1 indicated a perfect positive linear relationship. This definition provided the basis for interpreting the correlation results presented.

3.7.2 Measuring Volatility of Kenya's Exchange Rate

Before discussing the econometric analysis of the study variables, exchange rate volatility (EXV) was first estimated. In this research, the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model was used in the real effective exchange rate volatility modelling (Bollerslev, 1986; Engel, 1982). Bollerslev (1987) proposed a useful extension known as the Generalized Autoregressive Conditional Heteroskedasticity model. The Autoregressive Conditional Heteroskedasticity Lagrange Multiplier (ARCH-LM) test was conducted to detect the presence of autoregressive conditional heteroskedasticity (ARCH) effects within the exchange rate time series. ARCH effects arise when the variance of the current error term depends on the variances of previous periods, indicating volatility clustering. The ARCH-LM test was conducted by regressing the squared residuals obtained from a previously estimated mean equation on their own lagged values, to determine whether the coefficients of the lagged squared residuals are jointly equal to zero. The null hypothesis states that there are no ARCH effects, implying that the variance of the error term is constant over time. The ARCH-LM test produces two main statistics. The F statistic evaluates the joint significance of the lagged squared residuals based on an F test, while the observed *R*-squared statistic was computed by multiplying the number of observations by the *R*-squared value from the auxiliary regression. This latter statistic follows a chi-square distribution under the null hypothesis. If either of these statistics yields a *p*-value less than the conventional significance level of 0.05, the null hypothesis is rejected, thereby confirming the existence of ARCH effects in the time series. The rationale behind employing this model was its ability to account for historical exchange rate values, in contrast to the ARCH model. The GARCH (1,1) model was formulated by taking the logarithm of the real exchange rate, which was dependent on its preceding value in the

mean equation (Yensu *et al*., 2022). Standard deviation and variance, $\sigma 2$, were utilised in this study as a volatility measure. The GARCH model extends the Autoregressive Conditional Heteroskedasticity (ARCH) framework introduced by Engle (1982) by including lagged conditional variances, allowing for a more flexible and parsimonious representation of volatility persistence. An important feature of the GARCH(p, q) model was that when both the ARCH (lagged squared error) and GARCH (lagged variance) terms are statistically significant, the model behaves similarly to an ARCH (p+q) model. This is because it effectively includes the same number of lagged components for modeling conditional variance, but does so more efficiently by separating short-term shocks (ARCH effects) and long-term volatility persistence (GARCH effects) (Tsay, 2010). The study constructed a moving average (MA) model for the real effective exchange rate and examined whether these variable exhibits autoregressive conditionally heteroskedastic variance (ARCH) (Kiliçarslan, 2018; Yensu *et al*., 2022). The Lagrange multiplier (LM) test, developed by Engle (1982), was employed to determine if the variable displayed ARCH effects, as commonly explored in the empirical literature.

3.7.3 Inferential Data Analysis

To assess the relationship between exchange rate volatility and the selected macroeconomic variables (FDI, government expenditure, public debt, interest rates, inflation rates, money supply), this study employed the Autoregressive Distributed Lag (ARDL) model. The ARDL model was chosen because it was suitable for analyzing relationships between variables irrespective of whether they were stationary at the level or first difference, making it ideal for time-series data with mixed orders of integration (Pesaran *et al.,* 2001). Moreover, the ARDL approach allows for the estimation of both

short-run and long-run dynamics within a single reduced-form equation, providing a comprehensive framework for analyzing the effects of macroeconomic variables on exchange rate volatility.

3.8 Pre-Estimation Tests

Before estimating the ARDL model, it was necessary to conduct pre-estimation tests to ensure the validity and reliability of the results. These tests helped in determining the statistical properties of the data, assessing the suitability of the chosen model, and verifying key assumptions. Specifically, the unit root tests were performed to examine the stationarity of the time series data, while ensuring that no variable was integrated beyond order one (Dickey & Fuller, 1979; Phillips & Perron, 1988). This step was crucial in justifying the use of the ARDL approach, which accommodates both I(0) and I(1) variables.

3.8.1 Unit Root Tests

Stationarity is a crucial assumption in time series analysis, as non-stationary data can lead to spurious results. In this study, the stationarity of the time series variables was assessed using the Augmented Dickey-Fuller (ADF) test and the Phillips-Perron (PP) test. Both tests are widely used to determine whether a time series is stationary or contains a unit root.

Firstly, the Augmented Dickey-Fuller (ADF) Test was used in this study, as shown in Equation 3.1 and adopted from Dickey and Fuller (1981), to test the stationarity of the variables over the period from 1971 to 2024. The ADF (Dickey & Fuller, 1981) test was applied to the annual data on exchange rates, foreign direct investment (FDI),

government expenditure, public debt, interest rates, money supply and inflation rates to determine whether a time series was stationary or had a unit root.

$$\Delta y = \alpha + \gamma y_{t-1} + \delta t + \sum_{j=1}^{k} \alpha_j \, \Delta y_{t-j} \, e_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3.1)$$

Where α is the constant term, δt is the trend term, and k is the number of lags specified, α_j is the coefficient of the parameter in question and e_t is the white noise error term. A significant assumption of the Dicker-Fuller test is that the terms e_t for errors are distributed independently and identically.

Secondly, the Phillips-Perron (PP) Test, as shown in Equation 3.2 (Phillips and Perron, 1988), was applied to the same dataset to check for stationarity by fitting into the regression model;

$$\Delta Y_t = \varphi Y_{t-1} + \sum_{j=1}^{p-1} \alpha_j^* \Delta Y_{t-j} + \upsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.2)$$

Phillips and Perron (1988) proposed two alternative statistics. Phillips and Perron’s test statistics can be viewed as Dickey–Fuller statistics that have been made robust to serial correlation by using the Newey and West (1987) heteroskedasticity and autocorrelation-consistent covariance matrix estimator. The greatest advantage of the Philips test is that it is non-parametric, that is, it does not require selecting the level of serial correlation as in ADF.

3.8.2 Lag Order Selection

Determining the optimal lag length is an important step in time series modeling to ensure that the dynamics of the variables are adequately captured without overfitting. In this study, the optimal lag length for the ARDL model was selected based on several statistical criteria, including the Akaike Information Criterion (AIC), Schwarz Bayesian

Criterion (SBC), Final Prediction Error (FPE), and the Hannan–Quinn Criterion (HQC). These criteria assess model fit while penalizing excessive lag length, helping to strike a balance between model complexity and accuracy. The lag length that minimizes these information criteria is chosen as the optimal lag for the model. This approach ensures reliable parameter estimation and valid inference in both the short-run and long-run analyses within the ARDL framework (Liew, 2004).

3.8.3 Bounds Testing Approach to Cointegration

The ARDL model is capable of testing for the existence of a long-run equilibrium relationship among the variables, even when they have mixed orders of integration (I(0) and I(1)). The Bounds Cointegration Test(Pesaran, Shin, & Smith, 2001) was conducted to check for cointegration between the dependent variable and the independent variables. The bound Cointegration Test involved the estimation of the ARDL model and by performing an *F*-test to check the joint significance of the lagged levels of the variables in the model. If the *F*-statistic was greater than the upper bound critical value, it suggested the presence of a long-run relationship. If the *F*-statistic was below the lower bounds critical value, no cointegration exists.

3.9 Autoregressive Distributed Lag (ARDL) Model

This study utilized the Autoregressive Distributed Lag (ARDL) model, to analyze the dynamic relationship between exchange rate volatility (EXV) and selected macroeconomic variables (Foreign Direct Investment (FDI), public debt (PD), government expenditure (GE), money supply (MS), inflation rates (INFL), and interest rates (INTR)). This analysis was done after conducting the pre-estimation tests. The autoregressive distribution lag (ARDL) developed by Pesaran *et al.* (2001) shows the

direction of causation between variables. The advantage of using the ARDL approach is that it employs only a single reduced equation. The ARDL model is suitable for time-series data, particularly when the variables exhibit different orders of integration (I(0), I(1), or a mixture of both). According to Pesaran *et al*. (2001), the ARDL model eliminates the need for pre-testing the order of integration, allowing the examination of long-run relationships among variables, whether they are I(0), I(1), or a combination of both.

The ARDL model allows for the separation of both short-run and long-run effects, making it highly relevant for analyzing relationships between variables over different time horizons. In its equilibrium correction (EC) representation, the ARDL model provides a means to test for cointegration, which is crucial for determining whether a long-run relationship exists among the variables of interest. This was particularly important for this study, as it helped in the determination of how exchange rate volatility was influenced by the macroeconomic factors under consideration. Therefore, the relationship between exchange rate volatility and macroeconomic variables was expressed in a general functional form of the ARDL model as shown in Equation 3.3.

$$EXV_t = f(FDI_{\{t\}}, GE_{\{t\}}, PD_{\{t\},} INTR_{\{t\}}, INFL_{\{t\}}, MS_{\{t\}}) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.3)$$

Where;

EXV_t represents the exchange rate volatility at time t,

$FDI_{\{t\}}$ represents foreign direct investment at time t,

$GE_{\{t\}}$ represents government expenditure at time t,

$PD_{\{t\}}$represents public debt at time t, and

$INTR_{\{t\}}$ represents the real interest rate at time t.

$INFL_{\{t\}}$ represents the inflation rate at time t,

$MS_{\{t\}}$ represents the money supply at time t,

To facilitate the empirical estimation of the ARDL model, the general functional form presented in Equation 3.3 was re-specified in a linear econometric framework, as shown in Equation 3.4, and adapted from Pesaran, Shin, and Smith (2001) as follows:

$$EXV_t = \alpha_0 + \beta_1 FDI_{\{t\}} + \beta_2 GE_{\{t\}} + \beta_3 PD_{\{t\}} + \beta_4 INTR_{\{t\}} + \beta_5 INFL_{\{t\}} + \beta_6 MS_{\{t\}} + \epsilon_t \quad (3.4)$$

where:

α_0 is the intercept (constant),

EXV_t represents the exchange rate volatility at time *t*,

$FDI_{\{t\}}$ represents foreign direct investment at time *t*,

$GE_{\{t\}}$ represents government expenditure at time t,

$PD_{\{t\}}$represents public debt at time *t*, and

$INTR_{\{t\}}$ represents the real interest rate at time *t*,

$INFL_{\{t\}}$ represents the inflation rate at time *t,*

$MS_{\{t\}}$ represents the money supply at time *t,*

β_1 , β_2 ,β_3 , β_4 are the coefficients measuring

the impact of each of the six independent variables on the dependent variable (exchange rate volatility), and

ϵ_t is the error term, that captures the unobserved factors affecting the exchange rate volatility.

However, exchange rates and macroeconomic variables often exhibit dynamic behaviour, where past values influence present outcomes. To adequately capture this dynamic nature and the presence of volatility clustering in exchange rate movements, this study employed the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model, specifically the GARCH(1,1) specification, due to its effectiveness in modeling time-varying variance through past squared residuals and lagged conditional variances. Before applying the Generalized Autoregressive Conditional Heteroskedasticity model, an Autoregressive Conditional Heteroskedasticity Lagrange Multiplier (ARCH-LM) test was performed to detect heteroskedasticity, thus justifying the use of GARCH-type models. The real effective exchange rate was transformed into its logarithmic form to stabilize the variance, reduce the impact of outliers, and linearize exponential growth patterns commonly found in macroeconomic time series. This transformation further helps in achieving a more normal distribution of the data, thereby improving the reliability of statistical inferences (Chellai, 2025). The real effective exchange rate was transformed into its logarithmic form and analyzed using an ARCH/GARCH model, with the conditional variance obtained from the model serving as a proxy for exchange rate volatility (Epaphra, 2017).

Subsequent to volatility estimation, stationarity tests, including the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests, were conducted on all variables to determine their integration orders and to confirm that none were integrated of order two, which would compromise the validity of the autoregressive distributed lag (ARDL) framework. Following confirmation of integration orders, the optimal lag length for the ARDL model was determined based on the Akaike Information Criterion (AIC), which balanced model fit and ensured simplicity to avoid overfitting. The

bounds testing approach developed by Pesaran *et al*. (2001) was employed to test for the presence of a long-run relationship among the variables. Subsequently, the long-run coefficients were estimated, and the model was reparameterized following Equation 3.5 to formulate the dynamic Error Correction Model (ECM) as described by Hassler and Wolters (2006). This step involved estimating both the Error Correction Term (ECT) and the short-run coefficients. The ECT indicates the speed at which the system returns to equilibrium after experiencing short-term deviations. Finally, to assess the direction of causality between exchange rate volatility and the selected macroeconomic variables, pairwise Granger causality tests were conducted within a Vector Autoregressive (VAR) framework. This procedure enabled the identification of predictive causal relationships among the variables over time. The general ARDL model for this study is as specified in Equation 3.5

$$EXV_t = \alpha_0 + \Sigma_{\{i=1\}}^{\{p\}} \beta_i EXV_{\{t-i\}} + \Sigma_{\{j=0\}}^{\{q_1\}} \delta_{\{1j\}} FDI_{\{t-j\}} + \Sigma_{\{j=0\}}^{\{q_2\}} \delta_{\{2j\}} \mathrm{GE}_{\{t-j\}} + + \Sigma_{\{j=0\}}^{\{q3\}} \delta_{\{3j\}} PD_{\{t-j\}} + \Sigma_{\{j=0\}}^{\{q_4\}} \delta_{\{4j\}} INTR_{\{t-j\}} + \Sigma_{\{j=0\}}^{\{q_5\}} \delta_{\{5j\}} INFL_{\{t-j\}} + \Sigma_{\{j=0\}}^{\{q_6\}} \delta_{\{6j\}} \mathrm{MS}_{\{t-j\}} + \theta_1 FDI_t + \theta_2 \mathrm{GE}_t + \theta_3 \mathrm{PD}_t + \theta_4 INTR_t + \theta_5 INFL_t + \theta_6 \mathrm{MS}_t + \epsilon_t \quad \text{(3.5)}$$

Where;

EXV_t : Exchange rate volatility (dependent variable).

$EXV_{\{t-i\}}$: lagged values of the exchange rate volatility.

FDI_t: annual foreign direct investment.

$FDI_{\{t-j\}}$: lagged values of foreign direct investment.

GE_t ; annual government expenditure.

$\mathrm{GE}_{\{t-j\}}$; lagged values of government expenditure.

PD_t: Annual public debt.

$PD_{\{t-j\}}$: lagged values of public debt.

$INTR_t$: Annual real interest rate.

$INTR_{\{t-j\}}$: lagged values of interest rate.

$INFL_t$: Annual inflation rate.

$INFL_{\{t-j\}}$: lagged values of inflation rates.

MS_t ; annual money supply.

$\mathrm{MS}_{\{t-j\}}$; lagged values of money supply.

α_0: Intercept.

β_i $\delta_{\{ij\}}$: Short-run coefficients.

θ_1 θ_2 θ_3 $\theta_4\theta_5\theta_6$: Long-run coefficients.

ϵ_t: the error term is assumed to be normally distributed with a mean of zero and constant variance of sigma squared, $e \sim N(0, \sigma^2)$, and was included in the model to account for other factors that were not included in the model but affected the exchange rate volatility.

3.10 Diagnostic Tests

To ensure the accuracy, reliability, and validity of the multivariate regression model estimated using the Autoregressive Distributed Lag (ARDL) framework, several essential post-estimation diagnostic tests were conducted. These tests assessed the key assumptions underlying the classical linear regression model and evaluated the overall adequacy and robustness of the estimated model. The diagnostic tests that were conducted included the Breusch-Godfrey LM test and Durbin-Watson Statistic Test for detecting serial correlation, the Breusch-Pagan-Godfrey test and the ARCH-LM test for identifying heteroskedasticity, and the Jarque-Bera test for assessing the normality of

residuals. The Variance Inflation Factor (VIF) was used to detect multicollinearity among the explanatory variables.

Additionally, the CUSUM and CUSUM of Squares tests were utilized to evaluate the structural stability of the model over time. EViews software version 12.0 provided various diagnostic tools that were used to assess assumptions and identify any potential issues with the model. These diagnostic procedures were necessary and sufficient for confirming the reliability of the regression results and ensuring that the model met all required econometric standards. By addressing potential violations and confirming the model's adequacy, the study enhanced the credibility and integrity of its findings (Mutuma, 2023)

3.10.1 Serial Correlation Test

Serial correlation, or autocorrelation, refers to the correlation of residuals across observations, which can lead to underestimated standard errors and inflated test statistics. The Breusch-Godfrey test was applied to detect the presence of serial correlation. The null hypothesis was that there was no autocorrelation, and rejection of the null hypothesis suggested the presence of autocorrelation in the residuals. If the p-value was less than the chosen significance level, the null hypothesis was rejected, indicating statistically significant evidence of autocorrelation. Conversely, a p-value greater than the significance level implied insufficient evidence to reject the null hypothesis, suggesting no significant autocorrelation.

3.10.2 Multicollinearity Test

Multicollinearity, which refers to the correlation between independent variables, was assessed using the Variance Inflation Factor (VIF) as shown in Equation 3.6 below. The VIF measures the extent to which the variance of an estimated regression coefficient is inflated due to multicollinearity. A VIF of one (1) indicates no correlation, while values between 1 and 5 suggest a moderate correlation that does not require corrective measures. VIFs greater than 10 indicate severe multicollinearity, which can lead to unreliable coefficient estimates and questionable p-values (Kyriazos & Poga, 2023).

$$VIF = \frac{1}{1-R^2} \quad \text{.....} \quad (3.6)$$

3.10.3 Heteroscedasticity Test

Heteroscedasticity occurs when the variance of residuals is not constant across observations, which can bias the standard errors and reduce the reliability of the regression results. The Breusch-Pagan LM and ARCH-LM tests were used to test for heteroscedasticity. In the presence of heteroscedasticity, robust standard errors or generalized least squares (GLS) may be used to correct this issue (Orenti *et al*., 2024). The Breusch-Pagan-Godfrey test was used to detect heteroscedasticity by examining whether the variance of the residuals is dependent on the explanatory variables in the model. The null hypothesis for this test is that there is no heteroscedasticity. A significant result, where the p-value is less than the chosen significance level, indicates the presence of heteroscedasticity in the model.

As an alternative to the Breusch-Pagan-Godfrey test, the ARCH-LM test was used. The ARCH-LM test commonly referred to as Engle's ARCH test, is a statistical procedure designed to identify autoregressive conditional heteroskedasticity (ARCH) effects in

time series data (Bollerslev, 1986; Engel, 1982). This test primarily investigates the occurrence of volatility clustering, where significant fluctuations in a time series are often succeeded by additional substantial shifts, resulting in non-constant variance. The null hypothesis of the test states that there are no ARCH effects, meaning the variance of the residuals is constant and does not depend on past squared residuals. If the p-value from the test is less than the chosen significance level the null hypothesis is rejected, providing evidence of time-varying volatility in the residuals. Conversely, if the p-value is greater than the significance level, there is insufficient evidence to conclude the presence of ARCH effects, indicating that the residual variance is constant over time.

3.10.4 Normality Test

The normality of residuals is an assumption for many regression models, particularly for hypothesis testing. A non-normal distribution of residuals may suggest that a transformation of variables is required or that a different model specification could better suit the data (Pigini, 2015). For valid hypothesis testing, the residuals are expected to follow a normal distribution (Barker *et al.,* 2015). The Jarque-Bera test was employed to test the normality of the residuals. The null hypothesis for this test is that the residuals follow a normal distribution. A *p*-value greater than the chosen significance level would indicate that we fail to reject the null hypothesis, suggesting the data was normally distributed. Conversely, a *p*-value less than or equal to the significance level implies rejection of the null hypothesis, indicating that the residuals are likely not normally distributed.

3.11 Model Stability Test

The stability of the regression coefficients over time is essential for reliable predictions. The CUSUM (Cumulative Sum) and CUSUMSQ (CUSUM of Squares) tests were employed to assess the stability of the model. These tests helped determine if any structural breaks existed in the relationship between the variables over time. Stable model parameters indicate that the regression results can be trusted for long-term interpretation (Ahmad *et al,.* 2024).

3.12 Hypothesis Testing

Table 3.1 outlines the study's hypotheses and decision rules that guided hypothesis testing.

Table 3.1: Hypothesis Testing

Hypothesis	p-value	Decision Rule
H_{01}: Foreign direct investment has no significant effect on exchange rate volatility in Kenya.	$p \leq 0.05$	Reject the null hypothesis.
H_{02}: Interest rates have no significant effect on exchange rate volatility in Kenya.	$p \leq 0.05$	Reject the null hypothesis.
H_{03}: Inflation rates have no significant effect on exchange rate volatility in Kenya.	$p \leq 0.05$	Reject the null hypothesis.
H_{04}: Money supply has no significant effect on exchange rate volatility in Kenya.	$p \leq 0.05$	Reject the null hypothesis.
H_{05}: Government expenditure has no significant effect on exchange rate volatility in Kenya.	$p \leq 0.05$	Reject the null hypothesis.
H_{06}: `Public Debt has no significant effect on exchange rate volatility in Kenya.	$p \leq 0.05$	Reject the null hypothesis.

3.13 Description and Measurement of Study Variables

Table 3.1 below represents the six independent variables and one dependent variable that were used in the study. The data presents the operational definition of the variables,

the measurement of the variables and the source.

Table 3.2: Description and Measurement of Study Variables

Name of the variable	Description	Measurement	Source	Expected signs
Exchange Rates	The value of the Kenyan shilling (KES) relative to a foreign currency, typically the US dollar (USD).	Exchange rate of KES to USD. (KES per 1 USD)	World Bank database	N/A
Exchange rate volatility	The degree of fluctuation in a currency value over time due to macroeconomic factors.	Standard deviation of exchange rates.	Calculated from exchange rate data	N/A
Foreign direct investment	The total value of direct investment made by foreign entities into Kenya's economy.	Annual net inflow of FDI (in millions of USD)	World Bank database	+
Government expenditure	The total government spending on goods, services and public investments.	Measured as a percentage of GDP	Kenya National Bureau of Statistics	±
Public debt	The total government borrowing includes domestic and external debt.	Percentage of GDP	National treasury	-
Inflation Rates	The percentage change in the general price level of goods and services over a specified period (usually a year).	Consumer price index (CPI)	Central Bank of Kenya (CBK)	+
Interest rates	The cost of borrowing money or the return on investment is expressed as a percentage of the principal amount.	Annual average interest rate on government bonds (percentage)	National Treasury	±
Money supply	Total liquid assets available in the economy, including currency in circulation and demand deposits.	Broad money supply (M3)	Central Bank of Kenya (CBK)	+

3.14 Ethical Considerations

The research was carried out in strict adherence to ethical guidelines and regulations. To initiate the study, necessary approvals were obtained from the University of Eldoret, the School of Business, Economics and Management Sciences and the National Council of Science and Technology and Innovations (NACOSTI). Through the data collection, analysis, and interpretation phases, care was taken to safeguard the rights of organizations from which data was collected. The researcher also ensured that all data collected in the study remains confidential and is securely protected from unauthorized access or misuse.

CHAPTER FOUR

RESULTS

4.1 Introduction

This chapter presents the findings of the study. It includes the introduction, results on descriptive statistics, correlation analysis, pre-estimation tests, cointegration test, and regression results.

4.2 Descriptive Analysis of Variables

This sub-section presents the findings of the descriptive analysis detailing the mean, standard deviation, median, minimum, maximum, kurtosis and skewness as shown in Table 4.1 of the results. Furthermore, the Jarque-Bera test has been conducted to investigate the normality of the data. The main purpose of descriptive analysis was to establish the trend and pattern of the data and determine the nature of estimation and diagnostic tests to be performed.

Table 4.1: Summary of Descriptive Statistics of Raw Data

Test	Exchange rate	Foreign direct investment	Interest rate	Government expenditure	Public debt	Inflation rate	Money supply
Mean	55.4918	0.7132	6.1982	15.6773	47.6022	11.3057	34.7699
Median	59.5493	0.4838	6.4905	15.8631	43.4550	9.5683	35.7812
Maximum	139.8464	3.0947	21.0963	19.8034	76.0000	45.9789	44.1000
Minimum	7.0012	-0.0053	-10.0960	11.7425	26.4688	1.5543	25.7103
Std. Dev.	39.4147	0.6759	7.1113	2.5203	13.3821	7.8050	4.7906
Skewness	0.1728	1.7470	-0.0979	-0.2162	0.6120	2.0660	-0.1152
Kurtosis	1.8255	5.7794	2.9844	1.6449	2.3029	8.9095	1.9276
Jarque-Bera	3.3723	44.8508	0.0868	4.5522	4.4639	116.9919	2.7072
Probability	0.1852	0.0000	0.9575	0.1027	0.1073	0.0000	0.2583
Sum	2996.554	38.5103	334.7057	846.5755	2570.520	610.5085	1877.579
SumSq. Dev.	82336.36	24.2137	2680.264	336.6508	9491.226	3228.654	1216.367
Observation	54	54	54	54	54	54	54

Results in Table 4.1 show an annual dataset with 54 observations that span from 1971 to 2024, and summing up to for each time series variable that was used. According to the descriptive statistics results, the real effective exchange rate for Kenya averaged KES 55.49 per US dollar during the study period, with a standard deviation of 39.41, indicating substantial volatility. The exchange rate ranged widely from a minimum of 7.00 to a maximum of 139.85, reflecting periods of both strong appreciation and depreciation. The slight positive skewness of 0.17 suggests a mild rightward bias in exchange rate movements. The kurtosis value of 1.83 and the Jarque-Bera probability of 0.1852 indicate that the exchange rate distribution does not significantly deviate from normality.

The table of results also shows that the average Foreign Direct Investment (FDI) inflow was 0.71, with a standard deviation of 0.68, indicating moderate variation over the study period. The FDI values ranged from a negative inflow of -0.005 to a high of 3.09, showing instances of capital withdrawal as well as significant investments. A skewness of 1.75 shows a strong rightward skew, suggesting that large FDI inflows occurred more frequently than outflows. The kurtosis of 5.78 and a Jarque-Bera probability of 0.0000 confirm that the FDI data are not normally distributed, likely due to extreme investment values.

The table of results showed that interest rates averaged 6.20% with considerable variation, as indicated by a standard deviation of 7.11. The minimum observed rate was -10.10%, while the maximum reached 21.10%, demonstrating wide fluctuations, possibly due to monetary policy changes or economic shocks. The near-zero skewness value of -0.10 and kurtosis close to 3.0 suggest the interest rate distribution is

approximately symmetric and normally distributed, which is supported by the Jarque-Bera probability of 0.9575.

Results also show that, on average, government expenditure averaged 15.68% of GDP (or other relevant units), with a relatively low standard deviation of 2.52, implying fairly stable government spending over the period. The expenditure ranged from 11.74 to 19.80, indicating a narrow band of variation. Slight negative skewness of -0.22 and a kurtosis value of 1.64 indicate a modest leftward bias and a somewhat flatter distribution than normal. The Jarque-Bera probability of 0.1027 suggests no significant departure from normality.

Results further show that public debt had a mean value of 47.60, with a standard deviation of 13.38, reflecting notable variability in Kenya's debt levels during the study. Debt values ranged from 26.47 to 76.00, demonstrating substantial changes in borrowing or repayments. The positive skewness of 0.61 shows a moderate rightward bias, while the kurtosis of 2.30 suggests a slightly platykurtic distribution. The Jarque-Bera test probability of 0.1073 indicates the distribution is close to normal.

The table of results showed that inflation averaged 11.31% with a large standard deviation of 7.81, reflecting periods of both low and very high inflation rates in Kenya. Inflation rate ranged between 1.55% and 45.98%, indicating episodes of rapid price increases. The skewness of 2.07 signals a strong rightward skew, meaning inflation spikes are more frequent. The high kurtosis of 8.91 and the Jarque-Bera probability of 0.0000 confirm a non-normal distribution characterized by fat tails and outliers.

The table of results further showed that money supply had a mean growth rate of 34.77% with a standard deviation of 4.79, indicating moderate variability. The minimum and maximum values were 25.71 and 44.10, respectively, showing a steady expansion of the money supply during the period. The near-zero skewness of -0.11 and kurtosis of 1.93 imply a fairly symmetric and slightly platykurtic distribution. The Jarque-Bera probability of 0.2583 suggests the money supply data are consistent with a normal distribution

4.3 Correlation Analysis of Variables

The study conducted a correlation analysis of the variables to establish the strength of the relationship between exchange rate volatility and macroeconomic factors, as shown in Table 4.2 of the results.

Table 4.2: Results of Correlation Matrix of the Variables

	EXV	FDI	GE	PD	INFL	INTR	MS
EXV	1						
FDI	0.1162	1					
GE	-0.8070**	-0.3122**	1				
PD	0.0928	-0.1837	-0.0921	1			
INFL	-0.2007	0.1616	0.2202	-0.2227	1		
INTR	0.3118**	-0.1541	-0.0940	0.0167	-0.3124**	1	
MS	0.8303**	0.1403	-0.7082	0.0296	-0.2131	0.3476**	1

*Legend: ** $p < 0.05$ indicates significance level*
EXV- Exchange rate volatility;
FDI-Foreign direct investment;
PD-Public debt;
GE-Government expenditure;
INFL-inflation rate;
INTR-Interest rate; MS-Money supply

From the correlation matrix in Table 4.2, of results, the pair-wise correlation between exchange rate volatility and money supply is strong and positive ($r = 0.8303$, $p < 0.05$),

indicating that increases in money supply are associated with higher exchange rate volatility. Results from the correlation matrix also showed a statistically significant and strong negative relationship between government expenditure and exchange rate volatility ($r = –0.8070$, $p < 0.05$). This indicates that increases in government expenditure are associated with decreases in exchange rate volatility. The negative coefficient suggests an inverse relationship, whereby higher government spending tends to coincide with more stable exchange rate movements. This may imply that fiscal expansion through increased government expenditure enhances macroeconomic stability, thereby reducing uncertainty in currency markets.

The correlation matrix further revealed a moderate positive correlation between exchange rate volatility and interest rates ($r = 0.3118$, $p < 0.05$). This correlation coefficient of 0.3118 indicates that, although the relationship is not strong, there is a positive linear association between the two variables. As interest rates increase, exchange rate volatility also tends to increase. Since the *p*-value is less than 0.05, this relationship is statistically significant, meaning it is unlikely to have occurred by chance. In practical terms, a correlation of 0.3118 suggests that interest rates explain some but not most of the variation in exchange rate volatility in Kenya, pointing to a moderate influence.

4.4 Measuring Volatility of Kenya's Exchange Rate

The study applied the ARCH-LM test to assess the volatility of Kenya's exchange rate, with results significant at the 5% level, as shown in Table 4.3 below.

Table 4.3: ARCH Lagrange multiplier (LM) Test Results

Heteroskedasticity Test: ARCH			
F-statistic	107.2168	Probability	0.0000
Obs*R-squared	42.32774	Probability	0.0000

Table 4.3 shows the results of the ARCH Lagrange Multiplier (ARCH-LM) test applied to Kenya's exchange rate volatility. The test produced a p-value of 0.00, which is well below the 0.05 significance level. Consequently, the null hypothesis of no ARCH effects is rejected, indicating the presence of ARCH effects in the exchange rate series during the sample period. The F-statistic value of 107.2168 demonstrates that the lagged squared residuals are jointly statistically significant in explaining the current squared residuals, thereby confirming the existence of conditional heteroskedasticity in the data.

Additionally, the Observed *R*-squared statistic, which equals 42.32774, is calculated based on the sample size and the goodness of fit of the auxiliary regression. This test statistic is compared against a chi-square distribution with degrees of freedom corresponding to the number of lags included in the model. Given the *p*-value of 0.00, the test provides strong evidence supporting the presence of ARCH effects. These findings confirm that exchange rate volatility in Kenya exhibits significant volatility clustering, characterized by periods of high volatility being followed by similarly volatile periods, and periods of low volatility being followed by low volatility. This evidence justifies the application of time-varying volatility models, such as ARCH or GARCH, in the analysis of Kenya's exchange rate dynamics.

The calculated coefficients for Kenya's exchange rate volatility were presented in Table 4.4 of the results, showing how well the GARCH variance series, which was obtained from the GARCH (1,1) model, represents real exchange rate volatility.

Table 4.4: GARCH Model Coefficients of Exchange Rate Volatility for Kenya

Test	Coefficient	Standard error	z-value	p-value
GARCH (1,1)	0.890884	0.014810	60.15417	0.0000

Table 4.4 of results presents the estimated coefficient from the GARCH (1,1) model, which was used to model the volatility of Kenya's exchange rate. The GARCH term had a coefficient of 0.890884 with a standard error of 0.014810. The resulting *z*-value was 60.15417, and the *p*-value was 0.0000, indicating that the coefficient was statistically significant at the 1% level. The estimated GARCH coefficient of 0.890884, which was close to one, suggests that volatility shocks tend to persist over time. This implied that a large movement in the exchange rate in one period was likely to be followed by continued high volatility in subsequent periods. Such behaviour was indicative of volatility clustering. The results indicate that past volatility has a strong and statistically significant effect on current exchange rate volatility in Kenya.

4.5 Pre-Estimation Tests Results

4.5.1 Unit Root Test Results

For robust ARDL estimation results, the study first tested for stationarity, aided by the Augmented Dickey-Fuller (ADF) and Philips Peron (PP) unit root tests.

Table 4.5: Results of the Augmented Dickey-Fuller Test

Variable	Level		Variable	First difference		Decision
	t-Statistics	P-Value		t-Statistics	P-Value	
EXV	-1.0557	0.7265	ΔERV	-5.7133	0.0000	Non-stationary
FDI	-6.6499	0.0000	ΔFDI	-	-	Stationarity
GE	-0.8659	0.7914	ΔGE	-7.0681	0.0000	Non-stationary
PD	-2.3903	0.1493	ΔPD	-6.5292	0.0000	Non-stationary
INTR	-1.6976	0.4156	ΔINTR	-6.2236	0.0000	Non-stationary
INFL	-5.2036	0.0001	ΔINFL	-	-	Stationarity
MS	-1.7040	0.4235	ΔMS	-8.3437	0.0000	Non-stationary

Legend:
Null Hypothesis: Variable has a unit root

The Augmented Dickey-Fuller (ADF) test was conducted to examine the stationarity properties of the study variables. The test evaluated the null hypothesis that each variable contains a unit root against the alternative hypothesis of stationarity. The results, as shown in Table 4.5, indicated that at their level form, exchange rate volatility (EXV), government expenditure (GE), public debt (PD), interest rate (INTR), and money supply (MS) contained a unit root. Conversely, foreign direct investment (FDI) and inflation (INFL) were stationary at the level.

The second step in the analysis of this study was to test for the second unit root analysis using the Philips- Perron Test as shown in table 4.6. Upon first differencing, exchange rate volatility (ΔERV), government expenditure (ΔGE), public debt (ΔPD), interest rate (ΔINTR), and money supply (ΔMS) were found to be stationary. These findings suggest that differencing was necessary to achieve stationarity for most variables, confirming their integration order as I(1).

Table 4.6: Philips- Perron Test Results

Variable	Level		Variable	First difference		Decision
	Adj. t-Statistics	P-Value		Adj. t-Statistics	P-Value	
EXV	-1.0249	0.7380	ΔEXV	-5.7133	0.0000	Non-stationary
FDI	-6.8177	0.0000	ΔFDI			Stationarity
GE	-0.8870	0.7848	ΔGE	-7.0816	0.0000	Non-stationary
PD	-2.5646	0.1067	ΔPD	-6.5426	0.0000	Non-stationary
INTR	-1.4518	0.1348	ΔINTR	-7.7845	0.0000	Non-stationary
INFL	-5.2286	0.0001	ΔINFL			Stationarity
MS	-1.5955	0.4778	ΔMS	-8.6889	0.0000	Non-stationary

Legend:
Note: Null Hypothesis: Variable has a unit root

As shown in Table 4.6, at their level form, exchange rate volatility, government expenditure, public debt, interest rate, and money supply failed to reject the null hypothesis, with p-values above 0.05. This indicates that these variables contain a unit root at the level. However, foreign direct investment and inflation rate rejected the null hypothesis at level with *p*-values less than 0.05, implying these variables are stationary.

After first differencing, exchange rate volatility, government expenditure, public debt, interest rate, and money supply rejected the null hypothesis with *p*-values of 0.0000, confirming stationarity. The PP test results align with the Augmented Dickey-Fuller test outcomes, confirming that most variables are integrated of order one, I(1), while FDI and INFL are integrated of order zero, I(0). Although differencing was necessary to achieve stationarity, differencing helps make data stationary but it can hide meaningful trends and it may also weaken model performance if applied too much.

4.5.2 Optimal Lag Selection Results

To conduct the ARDL analysis for the study, the appropriate lag length for the Vector Auto regression (VAR) model was determined as shown in table 4.7 of the results.

Table 4.7: Lag Order Selection Results

Lag	Log L	LR	FPE	AIC	SC	HQ
0	135.7016	NA	1.85e-12	-7.150091	-6.842184	-7.042623
1	315.8643	280.2530	1.34e-15	-14.43690	-11.97365*	-13.57716
2	383.5176	78.92884*	6.56e-16*	-15.47320*	-10.85460	-13.86118*

Legend: indicates lag order selected by the criterion
Log L = Log-Likelihood
LR = Likelihood Ratio
FPE = Final Prediction Error
AIC = Akaike Information Criterion
SC = Schwarz Information Criterion
HQ = Hannan–Quinn Information Criterion

As shown in Table 4.7, the optimal lag length was determined based on multiple selection criteria, including the Akaike Information Criterion (AIC), Final Prediction Error (FPE), Schwarz Information Criterion (SC), Hannan–Quinn (HQ) criterion, and the Likelihood Ratio (LR) test. The lag length of two (2) yielded the lowest AIC value (–15.47), the lowest FPE (6.56e–16), and was also supported by the HQ and LR criteria, confirming it as the most suitable lag for the model. Although the SC suggested lag one (1), the majority of the criteria support lag 2. Based on these results, the optimal model selected for ARDL estimation is ARDL (1, 1, 0, 0, 2, 0, 0), which appeared among the top two models with the lowest AIC values. This ARDL specification indicated that the dependent variable (exchange rate volatility) was lagged once, while the independent variables were lagged in the following order: 1 lag for the first variable (FDI), 0 lags for the second (interest rate) and third (inflation), 2 lags for the fourth variable (money supply), and 0 lags each for the fifth (government expenditure) and sixth (public debt).

Therefore, this ARDL specification was adopted for the subsequent cointegration test analysis.

4.5.3 ARDL F-Bounds Cointegration Test Results

After assessing stationarity and the levels of integration, the autoregressive distributed lag bounds test for integration was performed. The results are captured in Table 4.8.

Table 4.8: The F-Bounds Test Result

Test Statistics	**Value**	**Significance**	**Level**	
F-Statistics	8.72		I(0)	I(1)
K		10%	1.75	2.87
		5%	2.04	3.24
		1%	2.66	4.05
Legend: Null hypothesis: No level relationship.				

As shown in Table 4.8, the calculated *F*-statistic of 8.72 exceeds the 5% upper critical bound of 3.24. This leads to the rejection of the null hypothesis of no long-run relationship among the variables. Therefore, the results provide strong evidence of a co-integrating relationship, indicating that the variables move together in the long run.

4.6 Econometric Results

The study estimated both long-run and short-run relationships among the variables using the ARDL model. The analysis included an examination of the long-run coefficients and short-run dynamics, with particular attention to the adjustment process captured through the error correction mechanism. In addition, Granger causality tests were conducted to assess the direction of causality between the study variables.

4.6.1 Long Run Analysis of ARDL Model

Table 4.9 of the results shows the long-form run results for a long-run relationship between the independent variables (FDI, GE, PD, INF, INTR and MS) and the dependent variable (EXV).

Table 4.9: Estimates of Exchange Rate Volatility in the Long-Run

Variable	Coefficient	Standard Error	t-Statistics	P-Value
FDI	-0.3637	0.14613	-2.4887	0.0196**
INTR	0.2632	0.2309	1.1396	0.2648
INFL	0.5524	0.1517	3.6423	0.0012**
MS	2.3972	0.3913	6.1261	0.0000**
GE	-3.4153	0.4293	-7.9560	0.0000**
PD	-0.1445	0.3208	-0.4504	0.6562
CONS	1.1468	0.2828	4.0542	0.0010**
Diagnostic Test		Test	F-statistics	Probability
Autocorrelation		Breusch-Godfrey LM	2.1973	0.1330
Detects Misspecification		Ramsey RESET	1.3965	0.2659
Heteroscedasticity		ARCH test	107.2168	0.0000
Heteroscedasticity		Breusch Pagan--Godfrey	2.6304	0.0242
Normality test		Jarque-Bera	0.1397	0.9325
Goodness of fit measure		R-Squared= 0.7379	Durbin Watson	2.5261

*Legend: ** $p < 0.05$ indicates significance levels at which the null hypothesis is rejected.*
EXV- Exchange rate volatility; FDI-Foreign direct investment; PD-Public debt; GE-Government expenditure; INFL-inflation rate; INTR-Interest rate; MS-Money supply

The results reveal that foreign direct investment (FDI) had a statistically significant negative effect on exchange rate volatility in the long run. The coefficient of –0.3637 suggested that a 1% increase in net inflows of foreign direct investment as a percentage of GDP would lead to a 36.4% decrease in exchange rate volatility in Kenya, holding other variables constant. From the findings, it was observed that the probability value of 0.0196 was less than 0.0500, leading to the rejection of the null hypothesis (H_0). This implied that FDI had a statistically significant influence on exchange rate volatility at

the 5% significance level. The negative relationship suggested that rising FDI inflows help stabilise the exchange rate by increasing capital availability and productivity, particularly in the traded goods sector. This, in turn, balances the relative prices of traded and non-traded goods, helping to dampen real exchange rate volatility.

Results reveal that the inflation rate (INFL) had a positive and statistically significant effect on exchange rate volatility in the long run. The coefficient of 0.5524 suggests that a 1% increase in the inflation rate leads to a 55.2% increase in exchange rate volatility in Kenya, holding other variables constant. From the findings, it was observed that the probability value of 0.0012 was less than 0.0500, leading to the rejection of the null hypothesis (H_0). This implies that the inflation rate significantly influenced exchange rate volatility at the 5% significance level. Generally, high inflation causes the local currency to depreciate and increases exchange rate volatility, while low inflation tends to strengthen the currency.

Results further reveal that money supply had a positive and statistically significant effect on exchange rate volatility in the long run. The coefficient of 2.3972 suggests that a 1% increase in money supply results in a 239.7% increase in exchange rate volatility in Kenya, holding other variables constant. From the findings, it is observed that the probability value of 0.0000 is less than 0.0500, leading to the rejection of the null hypothesis. This implies that money supply significantly influences exchange rate volatility at the 5% significance level, contributing to the depreciation of the local currency. Increases in money supply beyond economic growth tend to raise the general price level, leading to inflation and increased exchange rate volatility (Muchiri, 2017; Cecioni *et al.,* 2019).

Results reveal that government expenditure (as a % GDP) had a negative and statistically significant effect on exchange rate volatility in the long run. The coefficient of –3.4153 suggests that a 1% increase in government expenditure leads to a 341.5% decrease in exchange rate volatility in Kenya, holding other factors constant. From the findings, it is observed that the probability value of 0.0000 is less than 0.0500, leading to the rejection of the null hypothesis. This implies that government expenditure significantly influences exchange rate volatility at the 5% significance level by helping to appreciate the Kenyan shilling and thus stabilise the exchange rate. Increased government spending can raise interest rates, attracting foreign capital inflows and causing currency appreciation.

Table 4.9 of results also indicated that the coefficient of determination (R^2) was high at 0.7379, implying that approximately 73.79% of the variation in exchange rate volatility in Kenya was explained by the independent variables in the short run. This high R^2 value suggests that the estimation model provided an excellent fit to the data and effectively captured the main factors influencing exchange rate volatility dynamics in Kenya.

4.6.2 Short Run Analysis of ARDL Model

The second step was the estimation of the short-run coefficients. Table 4.10 presents the short-run results generated from the ARDL regression model.

Table 4.10: Estimates of Exchange Rate Volatility in the Short Run

Variable	Coefficient	Standard Error	t-Statistics	P-Value
ΔFDI	0.1831	0.0229	7.9666	0.0041**
ΔINTR	0.0742	0.0291	2.5492	0.0840
ΔINFL	0.1926	0.0245	7.8595	0.0043**
ΔMS	1.1183	0.2066	5.4132	0.0124**
ΔGE	-0.9065	0.2351	-3.8568	0.0308**
ΔPD	-0.4218	0.0538	-7.8282	0.0043**
CONS	1.1468	0.2828	4.0542	0.0010**
ECT	-0.5975	0.0597	-10.0138	0.0021**
Diagnostic Test		Test	F-statistics	Probability
Autocorrelation		Breusch-Godfrey LM	2.1973	0.1330
Detects Misspecification		Ramsey RESET	1.3965	0.2659
Heteroscedasticity		ARCH test	107.2168	0.0000
Heteroscedasticity		Breusch Pagan--Godfrey	2.6304	0.0242
Normality test		Jarque-Bera	0.1397	0.9325
Goodness of fit measure		R-Squared= 0.7379	Durbin Watson	2.5261

*Legend: * $p < 0.05$ indicates significance levels at which the null hypothesis is rejected.*
EXV- Exchange rate volatility; FDI-Foreign direct investment; PD-Public debt; GE-Government expenditure; INFL-inflation rate; INTR-Interest rate; MS-Money supply

Table 4.10 of the results revealed that foreign direct investment had a positive and statistically significant effect on exchange rate volatility in the short run at the 5% significance level. The coefficient of 0.1831 suggests that a 1% increase in net inflows of foreign direct investment as a percentage of GDP would lead to a 18.31% increase in exchange rate volatility in Kenya, holding other variables constant. The p-value of 0.0041 is less than 0.05, leading to the rejection of the null hypothesis (H_0) at this level. This implies that FDI tends to increase short-term exchange rate volatility, likely due to the destabilizing effect of short-term capital inflows.

Results revealed that the inflation rate had a positive and statistically significant effect on exchange rate volatility in the short run at the 5% significance level. The coefficient of 0.1926 indicated that a 1% increase in the inflation rate would lead to a 19.26%

increase in exchange rate volatility in Kenya, holding other factors constant. The corresponding *p*-value of 0.0043 indicated significance at the 5% level, leading to the rejection of the null hypothesis This suggests that rising inflation rate contributes to greater short-term exchange rate fluctuations, likely due to the declining purchasing power of the currency and increased speculative pressures.

The table of results further showed that money supply (MS) had a positive and statistically significant effect on exchange rate volatility in the short run. The estimated coefficient of 1.1183 implied that a 1% increase in the money supply led to a 111.83% increase in exchange rate volatility, holding all other variables constant. The corresponding *p*-value of 0.0124 indicated significance at the 5% level, leading to the rejection of the null hypothesis. This finding suggested that an expansion in the money supply contributed to short-term instability in the exchange rate, likely due to inflationary pressures, speculative currency behavior, or increased liquidity in the market.

Results also revealed that government expenditure had a negative and statistically significant effect on exchange rate volatility in the short run at the 5% significance level. The coefficient of –0.9065 suggested that a 1% increase in government spending resulted in a 90.65% reduction in exchange rate volatility in the short term, holding other factors constant. The corresponding *p*-value of 0.0308 indicated significance at the 5% level, leading to the rejection of the null hypothesis This finding indicated that higher government expenditure contributed to exchange rate stability, potentially by stimulating aggregate demand or enhancing investor confidence.

The table of results further revealed that public debt had a negative and statistically significant effect on exchange rate volatility in the short run. The estimated coefficient of –0.4218 indicated that a 1% increase in public debt led to a 42.18% reduction in exchange rate volatility, holding other factors constant. The associated p-value of 0.0043 confirmed that this relationship was significant at the 5% level. This finding suggested that increased public borrowing may have contributed to macroeconomic stability, potentially through government investment in infrastructure, productive sectors, or social services that stabilized expectations in the foreign exchange market.

Table 4.10 results also indicated that the coefficient of determination (R^2) was high at 0.9610, implying that approximately 96.1% of the variation in exchange rate volatility in Kenya was explained by the independent variables in the short run. This high R^2 value suggests that the estimation model provided an excellent fit to the data and effectively captured the main factors influencing exchange rate volatility dynamics in Kenya.

4.6.3 Granger Causality Tests Results

Table 4.11 of the results shows the pairwise causality results between macroeconomic factors and exchange rate volatility.

Table 4.11: Pairwise Causality Results

Null Hypothesis	F-Statistic	P-Value	Decision
FDI does not cause EXV	4.7713	0.0337	Unidirectional causality
EXV does not cause FDI	0.3905	0.5349	
GE does not cause EXV	0.0851	0.7717	No causality
EXV does not cause GE	2.7061	0.1062	
PD does not cause EXV	0.0076	0.9310	No causality
EXV does not cause PD	0.0125	0.9113	
INTR does not cause EXV	6.7666	0.0133	Bidirectional causality
EXV does not cause INTR	5.9102	0.0200	
INFL does not cause EXV	1.4340	0.2367	Unidirectional causality
EXV does not cause INFL	5.7294	0.0205	
MS does not cause EXV	0.3142	0.5776	Unidirectional causality
EXV does not cause MS	13.5665	0.0006	

Results revealed that there is a one-way causality running from foreign direct investment (FDI) to exchange rate volatility (EXV) in Kenya. The null hypothesis that FDI does not cause exchange rate volatility is rejected at the 5% significance level (*F*-statistic = 4.7713, *p*-value = 0.0337), indicating that FDI significantly influences exchange rate volatility. Conversely, the null hypothesis that exchange rate volatility does not cause FDI failed to be rejected (*F*-statistic = 0.3905, *p*-value = 0.5349), showing no evidence of causality from EXV to FDI.

Further, results showed bidirectional causality between interest rate (INTR) and exchange rate volatility. Both null hypotheses that interest rate does not cause exchange rate volatility and that exchange rate volatility does not cause interest rate are rejected (*F*-statistics = 6.7666 and 5.9102, *p*-values = 0.0133 and 0.0200, respectively, confirming a two-way causal relationship.

Additionally, the results showed there was unidirectional causality running from exchange rate volatility to both money supply (MS) and inflation rate (INFL). The null hypotheses that EXV does not cause MS and EXV does not cause INFL are rejected (*p*-values = 0.0006 and 0.0205), while the null hypotheses that MS and INFL do not cause EXV failed to be rejected (*p*-values = 0.5776 and 0.2367).

On the other hand, no causal relationship was found between government expenditure (GE) or public debt (PD) and exchange rate volatility, as the null hypotheses for causality in both directions failed to be rejected (all *p*-values > 0.05). Thus, these variables do not Granger-cause exchange rate volatility in Kenya.

4.7 ARDL Post-Estimation Analysis

In the analysis, testing for the null hypotheses of non-normality (Jacque–Bera test), no serial correlation (Breusch–Godfrey test), and no heteroscedasticity (ARCH-LM test) was part of the post-estimation study. The Ramsey Reset test was also used to confirm the model's specification, and the CUSUM and CUSUM of squares tests were used to evaluate the model's stability.

4.7.1 Diagnostic Test Results

The Autoregressive Distributed Lag (ARDL) model was subjected to a number of diagnostic tests to evaluate its validity and reliability, as shown in Table 4.12 of the results. These tests included Breusch-Godfrey LM-serial correlation, which supplements the Durbin Watson statistics test to detect the presence of serial correlation, Breusch-Pagan-Godfrey, and the ARCH (Autoregressive Conditional

Heteroscedasticity), which detects the problem of heteroscedasticity. The diagnostic tests utilised the F-statistic distribution. Further, Table 4.12 shows results multicollinearity test using the Variance Inflation Factor (VIF), heteroscedasticity test using the Breusch-Pagan-Godfrey test and White's test, and normality test using the Jarque-Bera test.

Table 4.12: Diagnostic Tests for ARDL Approach

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	2.6304	Probability	0.0242
Obs*R-squared	18.4576	Probability	0.0477
Heteroskedasticity Test: ARCH-LM			
F-statistic	107.2168	Probability	0.0000
Obs*R-squared	42.3277	Probability	0.0000
Serial Correlation Test: Breusch-Godfrey LM			
F-statistic	2.1973	Probability	0.1330
Obs*R-squared	5.5716	Probability	0.0617
Normality test: Jarque-Bera			
F-statistic	0.1397	Probability	0.9325
Multicollinearity test: Variance Inflation Factors	-	Mean VIF	6.63<10

As shown in Table 4.12 of the results, the Breusch Pagan Godfrey test produced an F-statistic of 2.6304 and a *p*-value of 0.0242. Since the *p*-value was less than the 5% level of significance, the null hypothesis of homoskedasticity was rejected. This indicates the presence of heteroskedasticity in the residuals, meaning the variance of the error terms was not constant.

According to the ARCH-LM test results in Table 4.12, the F-statistic was 107.2168 with a p-value of 0.0000. This result led to the rejection of the null hypothesis of no ARCH effect. Thus implied the presence of autoregressive conditional heteroskedasticity in the residuals, which is common in time-series data exhibiting volatility clustering. To correct the presence of heteroskedasticity, the study employed heteroskedasticity-consistent standard errors using the Newey-West estimator within the ARDL

framework. This adjustment ensured that the estimated coefficients remained efficient and the corresponding statistical inferences valid, despite non-constant variance of the residuals.

As shown in Table 4.12, the Breusch–Godfrey LM test for serial correlation produced an F-statistic of 2.1973 with a p-value of 0.1330. Since the p-value exceeded the 5% significance threshold, the null hypothesis of no autocorrelation was not rejected. This suggests that there is no evidence of autocorrelation in the residuals, indicating that the model is correctly specified with respect to serial correlation.

As shown in Table 4.12, the Jarque–Bera normality test results yielded a p-value of 0.9325, which was well above the 5% significance level. This indicated that the null hypothesis of normally distributed residuals was not rejected. Similarly, Appendix VIII presented the Jarque-Bera test results based on the residuals of the main regression model. The accompanying histogram displayed a roughly symmetric distribution, and the Jarque-Bera statistic value of 0.1397, with the same p-value of 0.9325, further confirmed the normality of residuals. Consequently, the assumption of normally distributed residuals was met, supporting the reliability of hypothesis testing within the ARDL modeling framework.

Lastly, the mean Variance Inflation Factor (VIF) was recorded at 6.63, which is below the critical threshold of 10. This indicates that multicollinearity was not a serious concern in the model, and the estimated coefficients were not significantly inflated due to intercorrelations among the independent variables.

4.7.2 Model Stability Test

Figures 4.1 and 4.2 present the findings of the model stability diagnostic tests over time using CUSUM (Cumulative Sum) and CUSUMSQ (CUSUM of Squares) tests respectively.

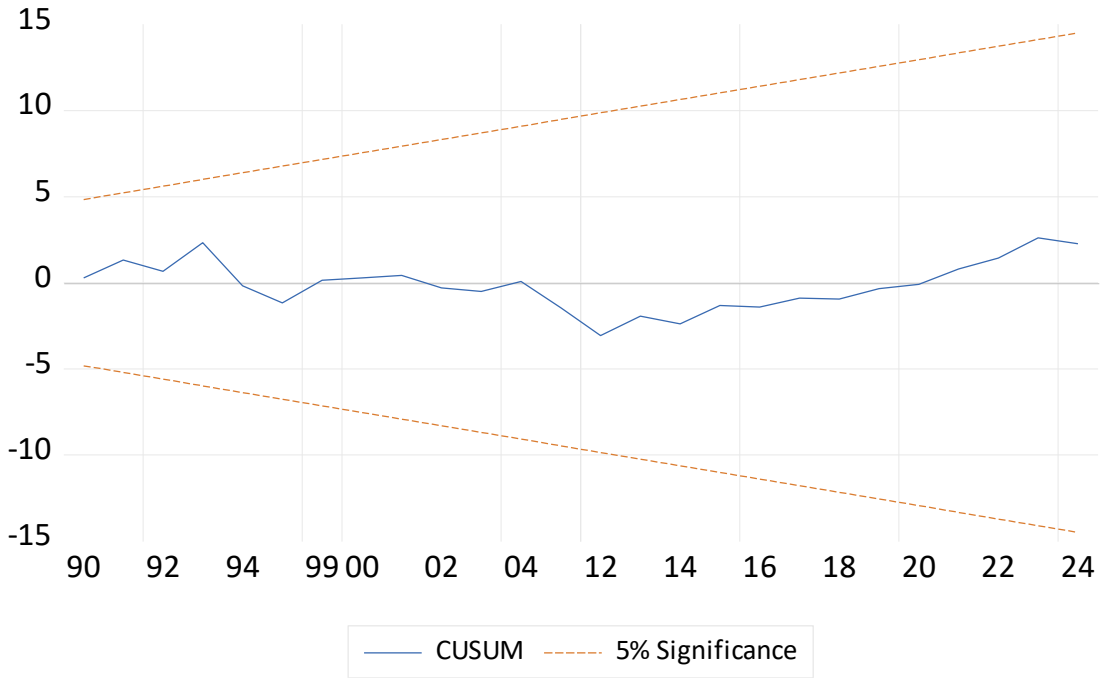

Figure 4.1: CUSUM Model Stability Test.

Results in Figure 4.1 showed that there was no instability of any kind in the study model. This was demonstrated by the variations of the blue lines in the CUSUM test, which remained within the 5% critical bounds.

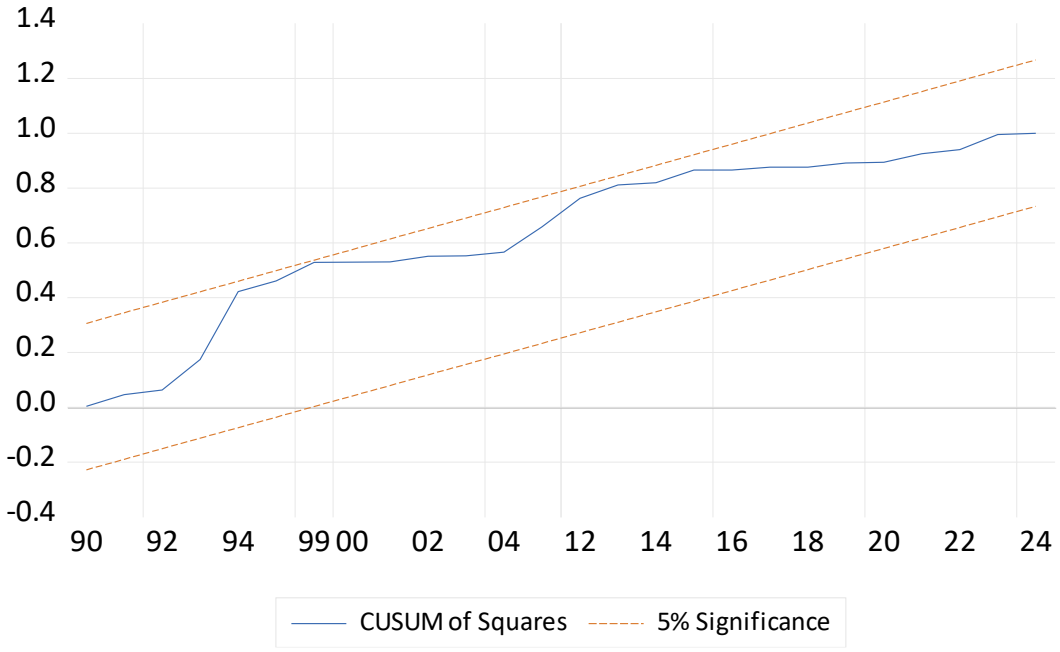

Figure 4.2: CUSUM of Squares Model Stability Test

Furthermore, results as shown in Figure 4.2 confirmed that the CUSUM of squares (CUSUMSQ) test lines also stayed within the 5% significance range, indicating no structural breaks affected the model. Together, these results confirmed that the model residuals met the stability assumptions required for the analysis.

4.8 Test of Hypothesis

Table 4.13 presents the results of the hypothesis tests for both the short-run and long-run regressions, with statistical significance assessed based on the p-values.

Table 4.13: Summary of Hypotheses Testing

Null hypothesis	Decision	
	Long run	Short run
H_{01}: Foreign direct investment has no significant effect on exchange rate volatility in Kenya.	H_{01} is rejected	H_{01} is rejected
H_{02}: Interest rates have no significant effect on exchange rate volatility in Kenya.	H_{02} is accepted	H_{02} is accepted
H_{03}: Inflation rates have no significant effect on exchange rate volatility in Kenya.	H_{03} is rejected	H_{03} is rejected
H_{04}: Money supply has no significant effect on exchange rate volatility in Kenya.	H_{04} is rejected	H_{04} is rejected
H_{05}: Government expenditure has no significant effect on exchange rate volatility in Kenya.	H_{05} is rejected	H_{05} is rejected
H_{06}: `Public Debt has no significant effect on exchange rate volatility in Kenya.	H_{06} is accepted	H_{06} is rejected
Legend: Reject null hypothesis if ($p < 0.05$) and accept null hypothesis if ($p > 0.05$)		

As shown in Table 4.13, the hypothesis test results indicate that foreign direct investment, inflation, and government expenditure had a significant effect on exchange rate volatility in both the long and short run, with their null hypotheses rejected ($p < 0.05$). Interest rates and public debt, however, showed no significant impact in either period, as their null hypotheses were accepted ($p > 0.05$). Money supply was significant only in the long run, but not in the short run. These findings suggest that certain variables consistently influence exchange rate volatility over time, while others have limited or time-dependent effects.

CHAPTER FIVE

DISCUSSIONS

5.1 Introduction

This chapter discusses the research findings and analysis. This section presents regression estimates and a Granger causality discussion of the results.

5.2 Discussion of Descriptive Statistics Findings

As shown in Table 4.1, the descriptive statistics provided insight into the general behaviour and variability of the variables used in this study over the period from 1971 to 2024, covering 54 annual observations for each variable. These indicators include the exchange rate, foreign direct investment (FDI), interest rate, government expenditure, public debt, inflation rate, and money supply. The real effective exchange rate averaged KES 55.49 per USD with a standard deviation of 39.41, indicating substantial volatility. This wide dispersion from a low of KES 7.00 to a high of KES 139.85 reflects Kenya's history of exchange rate fluctuations due to policy shifts, external shocks, and periods of macroeconomic instability. This observation is consistent with findings by Ndung'u (1999), who documented considerable exchange rate volatility in Kenya linked to external economic pressures and inconsistent policy responses. The distribution appeared nearly symmetric and not significantly different from normality, as indicated by a Jarque-Bera p-value of 0.1852.

Table 4.1 shows that foreign direct investment inflows, expressed as a percentage of GDP, had an average of 0.71% but displayed significant variation, with a high standard deviation of 0.68 and a maximum of 3.09%. The strong positive skewness (1.75) and non-normal distribution (Jarque-Bera p-value = 0.0000) suggest that while FDI was

generally low, there were a few years with disproportionately high inflows, possibly linked to major privatizations or donor-supported projects. These findings align with those of Ochieng and Anyango (2015), who noted sporadic spikes in Kenya's FDI inflows, particularly during periods of structural reform or when major infrastructure investments were underway. The table of descriptive statistics also showed that government expenditure was relatively stable, averaging 15.68% of GDP, with a modest standard deviation of 2.52. This narrow range reflects a consistent fiscal policy stance, although some variability occurred. The data showed no significant departure from normality (Jarque-Bera *p*-value = 0.1027), supporting its statistical reliability. These results are similar to those of Popa and Codreanu (2010), who found that in developing economies, government spending tends to be relatively consistent due to long-term budgeting frameworks, except during election years or crises.

Table 4.1 of descriptive statistics showed that public debt levels averaged 47.60% of GDP, ranging from 26.47% to 76.00%, with a standard deviation of 13.38%. This variation may reflect Kenya's increasing reliance on external borrowing in recent decades. The positive skewness and near-normal distribution (Jarque-Bera p-value = 0.1073) suggest moderate debt growth over time with some outliers. These findings echo those of Odera (2015), who observed a steady rise in Kenya's public debt, particularly after 2008, driven by infrastructure financing and fiscal deficits. Further, Table 4.1 shows that interest rates averaged 6.20%, ranging from -10.10% to 21.10%, with a standard deviation of 7.11%. These fluctuations may be attributed to shifts in monetary policy, inflation-targeting regimes, or responses to global economic crises. The nearly symmetrical distribution (skewness of -0.10 and kurtosis close to 3) and high Jarque-Bera probability (0.9575) support the assumption of normality in interest

rate behaviour. This pattern is consistent with findings by Mutuku and Mwalekwa (2019), who noted high variability in Kenya's interest rates due to changing monetary policy approaches.

Table 4.1 of descriptive statistics showed that Inflation averaged 11.31% with high variability (standard deviation of 7.81%), and a maximum of 45.98%, indicating that Kenya experienced several episodes of price instability. The distribution was heavily skewed (2.07) and leptokurtic (kurtosis = 8.91), with a Jarque-Bera p-value of 0.0000, confirming that inflation shocks were frequent and severe in some years. These results align with Ndung'u (1997) and Jattani (2013), who highlighted inflation volatility in Kenya due to food and fuel price shocks, currency depreciation, and external supply constraints. Table 4.1 of descriptive statistics also showed that money supply growth averaged 34.77% with a standard deviation of 4.79. The values were relatively concentrated, ranging from 25.71% to 44.10%, indicating a fairly steady monetary expansion. The near-zero skewness and a Jarque-Bera p-value of 0.2583 suggest that the money supply distribution conformed to normality, making it suitable for further statistical modeling. These findings are in line with Kibiy and Nasieku (2016), who reported that Kenya's monetary policy maintained a consistent growth trajectory, with occasional interventions to manage inflation and liquidity conditions. These visual trends align with the conclusions drawn by Chen and Liu (2018) and Fratzscher and Rieth (2019), who noted that macroeconomic variables tend to exhibit different levels of volatility depending on policy shifts and global economic conditions.

Furthermore, as shown in Appendix V which presents the standardized trends of all variables from 1971 to 2024, Inflation rate (INFR), Foreign direct investment (FDI)

and Interest rates (INTR) show greater fluctuations, especially during the early 1990s and post-2008 periods, possibly reflecting economic shocks. Government expenditure (GE), money supply (MS) and public debt (PD) on the other hand, remained relatively stable over the study period. Such visual trends provide an initial understanding of data behavior before econometric analysis. Appendix VI also shows the trend of Kenya's exchange rate from 1971 to 2024, revealing a general upward trend over the period. This indicates a consistent depreciation of the Kenyan shilling against major foreign currencies. This trend supports findings by Ndung'u (1999) and Oranga (2022), who noted that the shilling's value has weakened over time due to structural imbalances, inflation, and rising external debt. As shown in Appendix VII which illustrates the trend of exchange rate volatility from 1971 to 2024, reveals notable spikes around the early 1990s and post-2020 periods, indicating significant economic disturbances. These periods of heightened volatility are critical to understanding the behavior of the exchange rate in response to macroeconomic shocks and justify the need for econometric modeling. Similar findings were reported by Ndagara *et al.* (2020), who emphasized the importance of macroeconomic stability in controlling exchange rate volatility.

5.3 Discussion of Correlation Analysis Findings

As shown in Table 4.2, the Pearson correlation coefficients reveal significant relationships existed between exchange rate volatility (EXV) and the macroeconomic variables studied. A strong positive correlation was observed between exchange rate volatility and money supply ($r = 0.8303, < 0.05$), indicating that increases in money supply are closely associated with greater exchange rate fluctuations. This finding is consistent with the General Equilibrium Theory, which posits that changes in monetary

aggregates can disrupt macroeconomic stability by influencing inflation, interest rates, and capital flows, ultimately increasing exchange rate volatility (Galí & Monacelli, 2016). Conversely, government expenditure exhibited a strong negative correlation with exchange rate volatility ($r = –0.8070$, $p < 0.05$). This implies that higher government spending may contribute to stabilizing the exchange rate, potentially through mechanisms such as fiscal stimulus or increased investor confidence in the economy. This result aligns with previous studies such as Popa and Codreanu (2010), who found that well-structured fiscal policies, particularly government investment in infrastructure and social programs, reduced exchange rate fluctuations by promoting economic stability. Similarly, Corsetti and Müller (2015) showed that fiscal expansions in open economies can initially appreciate the currency and dampen volatility, especially when such spending signals policy credibility.

Interest rates were moderately and positively correlated with exchange rate volatility ($r = 0.3118$, $p < 0.05$), suggesting that increases in interest rates tend to be associated with greater exchange rate variability. This may reflect the influence of monetary policy adjustments on capital flows and foreign exchange markets. This aligns with the findings of Ndung'u (2000) and Mutuku and Mwalekwa (2019), who observed that interest rate fluctuations significantly impact exchange rate movements in Kenya, particularly during periods of economic uncertainty or policy shifts. The observed relationship is also consistent with the International Fisher Effect (IFE) theory, which posits that differences in nominal interest rates between countries are reflected in exchange rate changes, with higher interest rates often signaling expectations of currency depreciation or increased risk, thereby fueling volatility. On the other hand, foreign direct investment (FDI) showed a weak and statistically insignificant positive

correlation with exchange rate volatility (r = 0.1162, p > 0.10), indicating a limited linear association. Inflation rate and public debt similarly demonstrated weak and non-significant correlations with exchange rate volatility (r = –0.2007 and 0.0928, respectively), suggesting that their direct relationships with exchange rate movements are minimal or potentially nonlinear.

The correlation analysis suggests that money supply, government expenditure, and interest rates have the most pronounced linear relationships with exchange rate volatility in Kenya. These findings provide a foundation for the further econometric analysis conducted in subsequent sections, where the causal effects and dynamics among these variables are examined.

5.4 Discussion of Exchange Rate Volatility Findings

The ARCH Lagrange Multiplier (LM) test results presented in Table 4.3 demonstrate significant volatility in Kenya's exchange rate during the study period. With an *F*-statistic of 107.2168 and an Observed *R*-squared of 42.32774, both having p-values of 0.0000, the null hypothesis of no ARCH effects was decisively rejected. This confirms the presence of autoregressive conditional heteroskedasticity in the exchange rate data, indicating that volatility is not constant over time but exhibits clustering periods of high volatility tend to follow high volatility, and periods of calm follow calm. Such findings are consistent with well-established empirical evidence on exchange rate dynamics in emerging markets (Engle, 1982; Baillie & Bollerslev, 1992), where shocks to exchange rates persistently affect future variability rather than dissipating immediately.

The application of the GARCH (1,1) model further substantiated the nature of exchange rate volatility in Kenya. As shown in Table 4.4 of the results, the estimated GARCH coefficient of 0.8909 was highly significant, confirming strong volatility persistence and the existence of volatility clustering. The GARCH (*p,q*) model is mathematically equivalent to an ARCH (*p+q*) model, indicating a correlation between the error variances over time. The high GARCH coefficient, which is close to one, suggests that past volatility has a long-lasting impact on current volatility, providing clear evidence of volatility clustering. This aligns with findings from Bollerslev (1986), who introduced the GARCH framework to capture such persistent volatility effects in financial time series, and subsequent applications in currency markets (Dungey *et al*., 2006).

5.5 Discussion of Pre-estimation Test Findings

5.5.1 Discussion of Unit Root Test Results

The ADF test results in Table 4.5 indicate that at the level, foreign direct investment (FDI) and inflation (INFL) are stationary, with t-statistics of -6.6499 and -5.2036, and *p*-values of 0.0000 and 0.0001, respectively. These values fall below the 5% significance level, leading to rejection of the null hypothesis that these variables contain a unit root. Economically, this suggests that FDI and inflation demonstrate mean-reverting behavior. Inflation's stationarity reflects the impact of monetary policy instruments, such as inflation targeting and interest rate adjustments, which help contain inflation shocks. The stationarity of FDI could be linked to consistent investor sentiment or regulatory frameworks that anchor investor expectations over the period.

Conversely, exchange rate volatility (EXV), government expenditure (GE), public debt (PD), interest rate (INTR), and money supply (MS) were found to be non-stationary at the level. For example, EXV posted a *t*-statistic of -1.0557 ($p = 0.7265$), GE -0.8659 ($p = 0.7914$), and MS -1.7040 ($p = 0.4235$), all above the 5% significance threshold. However, after first differencing, these variables became stationary ΔGE had a t-statistic of -7.0681 ($p = 0.0000$), ΔPD -6.5292 ($p = 0.0000$), and ΔMS -8.3437 ($p = 0.0000$). This confirms that these series are integrated of order one, I(1).

The implication is that shocks to these macroeconomic variables such as abrupt changes in public spending or interest rates tend to have persistent effects. This is typical in developing economies where fiscal and monetary adjustments may not yield immediate outcomes due to structural rigidities and delayed policy transmission mechanisms. These findings echo earlier empirical evidence by Ndung'u and Ngugi (1999), who found most Kenyan macroeconomic variables, particularly those related to fiscal and monetary policy, to be of order I(1), suggesting persistent trends. Similarly, Mutuku (2013) confirmed the non-stationarity of key macro-financial variables, indicating that their impact on the economy accumulates over time rather than dissipating immediately. Such persistence is often attributed to weak institutional mechanisms, delayed policy effects, and external vulnerabilities like oil price volatility or global capital movements.

The Phillips-Perron Test test results presented in Table 4.6 reaffirm the findings of the ADF test. At the level, foreign direct investment (FDI) and inflation (INFL) were found to be stationary, with adjusted t-statistics of -6.8177 ($p = 0.0000$) and -5.2286 ($p = 0.0001$), respectively. These significant results confirm that both variables fluctuate around a constant mean and do not exhibit unit root behaviour. From an economic

policy perspective, the stationarity of inflation suggests effective inflation control mechanisms by the Central Bank of Kenya, possibly through consistent use of monetary tools such as interest rate targeting. The stationarity of FDI implies that foreign investment inflows during the sample period were relatively stable, possibly influenced by a favorable investment climate or predictable macroeconomic policies.

In contrast, exchange rate volatility (EXV), government expenditure (GE), public debt (PD), interest rate (INTR), and money supply (MS) remained non-stationary at the level. For example, EXV recorded a t-statistic of -1.0249 (p = 0.7380) and INTR -1.4518 (p = 0.1348), both exceeding the 5% significance threshold, which supports the presence of a unit root in these series. However, after first differencing, all five variables became stationary. The first-differenced series ΔINTR, ΔGE, and ΔMS recorded highly significant t-statistics of -7.7845, -7.0816, and -8.6889, respectively, all with p-values of 0.0000. These outcomes confirm that the variables are integrated of order one, I(1), meaning that while they may trend over time, their first differences exhibit mean-reverting behaviour. These patterns align with the ADF results and further corroborate findings from previous empirical studies on Kenya's macroeconomic dynamics. Amutabi (2011) and Odera (2015) emphasized the structural behaviour and long-run trajectory of fiscal and monetary aggregates in Kenya, pointing out their tendency to respond gradually to domestic policy changes and external economic shocks. The confirmation that variables such as government expenditure, interest rates, and money supply are integrated of order one (I(1)) supports this view, reflecting their long-term persistence and evolving nature over time.

Similarly, the current findings resonate with those of Ndung'u and Ngugi (1999) and Mutuku (2013), who established that most macroeconomic variables in Kenya are I(1), while specific financial indicators, including foreign direct investment and inflation, often exhibit stationarity at level (I(0)). The coexistence of I(0) and I(1) variables in the present study highlights the multifaceted nature of Kenya's macroeconomic framework, characterised by ongoing structural transformations, regulatory adjustments, and responsiveness to both domestic and international economic developments.

5.5.2 Discussion of Optimal Lag Selection Results

As shown in Table 4.7 of the results, the Log-Likelihood (Log L) value increased from 135.70 at lag 0 to 315.86 at lag 1 and further to 383.52 at lag 2, indicating improved model fit with higher lag orders. Correspondingly, the Akaike Information Criterion (AIC) decreased from -7.15 at lag 0 to -14.44 at lag 1 and reached its minimum of -15.47 at lag 2, suggesting lag 2 as optimal. The lag length of 2 yielded the lowest AIC value (–15.47), the lowest FPE (6.56e–16), and was also supported by the HQ and LR criteria, confirming it as the most suitable lag for the model. The Likelihood Ratio (LR) test also favoured lag 2, with a significant statistic of 78.93, confirming better explanatory power compared to lag 1. Additionally, the Final Prediction Error (FPE) declined with increasing lag length, further supporting the selection of lag 2. However, the Schwarz Criterion (SC), which penalizes model complexity more heavily, selected lag 1 with a value of -11.97. Despite this, the majority of the criteria, particularly AIC, LR, and FPE, indicate that lag 2 provides the best balance of model fit and parsimony. Based on these results, the ARDL (1, 1, 0, 0, 2, 0, 0) model was selected for further analysis, where exchange rate volatility is lagged once, foreign direct investment (FDI) once, money supply twice, and the remaining variables have no lags.

5.5.3 Discussion of ARDL F-Bounds Cointegration Test Results

The F-Bounds test yielded an *F*-statistic of 8.72, which exceeds the upper critical bounds at the 10%, 5%, and 1% significance levels (2.87, 3.24, and 4.05, respectively). This resulted in the rejection of the null hypothesis of no cointegration, indicating the presence of a significant long-run relationship among the variables. This confirms that the variables move together over time, supporting the appropriateness of the ARDL modeling approach for capturing both short-run and long-run dynamics. Given the mixed integration orders (I(0) and I(1)) of the variables, the ARDL bounds testing framework is well-suited for this analysis.

5.6 Discussion of Econometric Results

5.6.1 Discussion of ARDL Long Run Results

As shown in Table 4.9, FDI exhibited a significant negative relationship with exchange rate volatility, with a coefficient of -0.3637 (p = 0.0196). This indicated that a 1% increase in net inflows of FDI as a percentage of GDP leads to a 36.4% reduction in exchange rate volatility in the long run, holding other factors constant. This finding aligns with prior studies by Kiyota and Urata (2004) and Amondi (2016), which also documented that FDI stabilizes exchange rates by increasing capital availability and productivity. The mechanism behind this relationship can be attributed to the role of FDI in enhancing macroeconomic stability by improving the balance of payments position and increasing demand for the domestic currency. Kiyota and Urata (2004) found that in emerging markets, FDI inflows led to exchange rate appreciation through strengthened capital accounts, while Amondi (2016) observed that FDI in Kenya's real estate and energy sectors increased investor confidence and shilling demand.

Theoretically, this outcome is underpinned by the Interest Rate Parity (IRP) and general equilibrium frameworks, which suggest that capital inflows such as FDI influence currency value through investment-related demand shifts and inter-market adjustments. Increased FDI enhances reserves, reduces reliance on volatile short-term capital, and signals long-term confidence in the economy, thereby mitigating speculative currency pressures and lowering volatility in the foreign exchange market.

The Inflation rate was positively and significantly associated with exchange rate volatility, with a coefficient of 0.5524 ($p = 0.0012$). This suggests that higher inflation exacerbates currency fluctuations, possibly due to eroding purchasing power and heightened uncertainty, consistent with earlier findings from Popa (2010) and Yensu *et al.* (2022). Inflation (INFL), with a coefficient of 0.5524, reveals a strong and significant positive impact on exchange rate volatility. This suggests that rising inflation erodes investor confidence and the purchasing power of the domestic currency, causing it to fluctuate more frequently. The result aligns with Ndung'u (1997) and Mutuku (2013), who documented that inflation led to depreciation of the Kenyan shilling, especially during periods of global oil price surges. The Purchasing Power Parity (PPP) theory provides a theoretical foundation for this relationship by explaining that inflation differentials between countries induce exchange rate adjustments as markets seek to restore parity in purchasing power. Consequently, high inflation creates uncertainty and volatility in the foreign exchange market by affecting both demand for the currency and speculative behavior among investors.

Money supply had the strongest positive effect on exchange rate volatility, with a coefficient of 2.3972 ($p = 0.001$), implying that rapid growth in the money supply

significantly increases exchange rate instability. Money Supply (MS), with the highest coefficient at 2.3972, demonstrates that excessive liquidity significantly amplifies exchange rate volatility. This occurs because an increased money supply without corresponding growth in economic output generates inflationary pressures and fuels speculative activities in the foreign exchange market. These speculative movements create fluctuations in currency value and reduce exchange rate stability. This finding aligns with empirical studies by Chen and Liu (2018) and Fratzscher and Rieth (2019), who reported similar dynamics in China and the European Union, respectively. The General Equilibrium Theory supports this relationship by emphasizing how monetary expansion can disrupt equilibrium across interconnected financial and goods markets, leading to increased volatility in exchange rates.

Government expenditure exhibited a significant negative coefficient of -3.4153 (p = 0.001), indicating that increased government spending contributes to stabilizing the exchange rate in the long run. Government Expenditure (GE), with this negative effect, suggests that higher public spending enhances investor confidence and stimulates economic demand, which in turn reduce exchange rate volatility. This finding aligns with the works of Corsetti and Müller (2015) and Popa and Codreanu (2010), who highlighted that moderate and productive government expenditure improves macroeconomic stability and reduces currency volatility. Contrary to general equilibrium theory, government expenditure appears to reduce exchange rate volatility. Productive spending, often supported by foreign aid or concessional loans, limits inflationary pressures, smooths economic fluctuations, stabilizes investor expectations, and boosts confidence, reinforcing overall stability in the foreign exchange market.

5.6.2 Discussion of ARDL Short Run Results

Table 4.10 of the results revealed that foreign direct investment (FDI) had a positive and statistically significant effect on exchange rate volatility in the short run at the 5% significance level. The coefficient of 0.1831 suggests that a 1% increase in net inflows of FDI as a percentage of GDP would lead to an 18.31% increase in exchange rate volatility in Kenya, holding other variables constant. The p-value of 0.0041 is less than 0.01, leading to rejection of the null hypothesis. This implies that FDI tends to increase short-term exchange rate volatility, likely due to the destabilizing effect of short-term capital inflows and speculative movements. This result aligns with Kiyota and Urata (2004), who found that FDI inflows appreciate the currency by increasing demand for the local currency. Additionally, Mwega and Ngugi (2006) emphasized that while FDI may strengthen the currency, repatriation of profits and volatile capital flows can cause short-term exchange rate fluctuations. Similarly, Ochieng and Anyango (2015) and Amondi (2016) observed that rapid capital movements linked to FDI inflows increase short-run exchange rate volatility despite potential long-term stabilization.

The inflation rate (INFL) had a positive and statistically significant effect on exchange rate volatility at the 5% level, with a coefficient of 0.1926. This indicates that a 1% increase in inflation leads to a 19.26% increase in exchange rate volatility, ceteris paribus. This finding aligns with Kiyota and Urata (2004), who noted that inflationary pressures reduce the purchasing power of the currency, increasing demand for foreign currency and causing exchange rate fluctuations. The result is consistent with the monetary approach to exchange rate determination, which links inflation differentials to exchange rate movements through relative purchasing power parity. Rising inflation

increases uncertainty and speculative pressures, thereby amplifying short-term exchange rate volatility.

Money supply (MS) exhibited a positive and statistically significant effect on exchange rate volatility at the 5% level. The coefficient of 1.1183 implies that a 1% increase in money supply causes a substantial 111.83% increase in exchange rate volatility. This finding supports the monetary model theory, which suggests that an expansionary monetary policy increases liquidity, triggers inflationary expectations, and pressures the exchange rate. It also corroborates empirical studies such as Chen and Liu (2018), who reported that increases in money supply lead to currency depreciation and volatility, and Fratzscher and Rieth (2019), who linked non-sterilized monetary interventions to exchange rate fluctuations.

Government expenditure (GE) had a negative and statistically significant effect on exchange rate volatility at the 5% level, with a coefficient of –0.9065. This suggests that a 1% increase in government spending reduces exchange rate volatility by 90.65%, holding other factors constant. Contrary to general equilibrium theory, government expenditure can reduce exchange rate volatility by limiting inflation, stabilizing expectations, and boosting investor confidence, thereby supporting currency stability. The finding is supported by Corsetti and Müller (2015), who observed that fiscal expansions can stabilize exchange rates, and Li and Zhu (2024), who noted the government spending's role in exchange rate stability under flexible regimes.

Public debt (PD) also had a negative and statistically significant effect on exchange rate volatility, with a coefficient of –0.4218 at the 5% level. This indicates that a 1% increase

in public debt reduces exchange rate volatility by 42.18%. This suggests that increased government borrowing, when effectively managed, may enhance macroeconomic stability by financing productive investments and stabilizing market expectations. The result is consistent with Morenike and Chukwuyem (2024), who found that public debt can reduce short-term exchange rate volatility in certain contexts, and Odera (2015), who linked sound public debt management to enhanced exchange rate stability. The finding can also be explained by the debt-stabilization hypothesis, which posits that prudent borrowing supports fiscal sustainability and exchange rate stability. Contrary to the International Fisher Effect theory, public debt in Kenya appears to reduce exchange rate volatility. Substantial domestic and concessional borrowing, effective fiscal and monetary policies, and strong investor confidence in debt sustainability help limit external shocks and stabilize the currency.

5.6.3 Discussion of Granger Causality Tests Results

As shown in Table 4.11, results revealed a one-way causality running from foreign direct investment (FDI) to exchange rate volatility (EXV) in Kenya. The null hypothesis that FDI did not cause exchange rate volatility was rejected at the 5% significance level (F-statistic = 4.7713, p-value = 0.0337), indicating that FDI significantly influenced exchange rate volatility. Conversely, the null hypothesis that exchange rate volatility does not cause a change in FDI failed to be rejected (F-statistic = 0.3905, p-value = 0.5349), showing no evidence of causality from EXV to FDI. These findings were consistent with existing literature and economic theories. The unidirectional causality from FDI to exchange rate volatility aligned with the investment-led growth hypothesis, which suggested that foreign investment could impact macroeconomic stability, including exchange rates, by influencing capital flows (Khan & Khan, 2013). This was

supported by studies such as Asiedu (2002) and Ayanwale (2007), who emphasized how FDI inflows affected exchange rate dynamics in developing economies.

Further, the results showed bidirectional causality between interest rate (INTR) and exchange rate volatility. Both null hypotheses that interest rate did not cause exchange rate volatility and that exchange rate volatility did not cause interest rate were rejected (F-statistics = 6.7666 and 5.9102, p-values = 0.0133 and 0.0200, respectively), confirming a two-way causal relationship. The bidirectional causality between interest rates and exchange rate volatility reflected the interest rate parity theory and monetary policy transmission mechanisms, where changes in interest rates influenced exchange rates, and exchange rate movements affected monetary policy decisions (Engel, 1996; Dornbusch, 1976). Similar bidirectional relationships were found by Bahmani-Oskooee and Arize (2003) in emerging markets, confirming the interdependence of monetary policy and exchange rate behavior.

Additionally, there was unidirectional causality running from exchange rate volatility to both money supply (MS) and inflation rate (INFL). The null hypotheses that EXV did not cause MS and EXV did not cause INFL were rejected (p-values = 0.0006 and 0.0205), while the null hypotheses that MS and INFL did not cause EXV failed to be rejected (p-values = 0.5776 and 0.2367). The unidirectional causality running from exchange rate volatility to money supply and inflation supported the monetarist perspective that exchange rate fluctuations could influence domestic price levels and monetary conditions through imported inflation and adjustments in money demand (Mishkin, 2007). This direction of causality was also documented in studies by

Ndikumana (2001) and Mutuku (2013), who highlighted the role of exchange rate movements in shaping inflation and monetary aggregates in Kenya.

On the other hand, no causal relationship was found between government expenditure (GE) or public debt (PD) and exchange rate volatility, as the null hypotheses for causality in both directions failed to be rejected (all p-values > 0.05). Thus, these variables did not Granger-cause exchange rate volatility in Kenya. Finally, the absence of causality between government expenditure or public debt and exchange rate volatility was consistent with Ricardian equivalence theory, which argued that fiscal policy variables may have a limited direct impact on exchange rates when agents anticipate future tax adjustments (Barro, 1974). This finding echoed earlier empirical results by Odhiambo (2011), who found weak fiscal policy effects on exchange rate behaviour in the Kenyan context.

5.6.4 Discussion of Diagnostic Test Results

As shown in Table 4.12, the Breusch–Pagan–Godfrey test indicated the presence of heteroskedasticity in the residuals, with an F-statistic of 2.6304 and a p-value of 0.0242. This suggests that the variance of the error terms was not constant, which is common in macroeconomic time-series data affected by fluctuating shocks. To correct for this, the study employed Newey–West heteroskedasticity-consistent standard errors within the ARDL framework, ensuring that coefficient estimates remained efficient and that statistical inferences regarding variables such as FDI were valid.

The ARCH-LM test also revealed significant autoregressive conditional heteroskedasticity (F-statistic = 107.2168, $p < 0.001$), reflecting volatility clustering

typically observed in financial and macroeconomic series. Accounting for ARCH effects strengthens the model's ability to capture time-varying volatility, making the long-run estimates more robust.

Results from the Breusch–Godfrey LM test suggested no evidence of serial correlation in the residuals (F-statistic = 2.1973, p = 0.1330), suggesting that the ARDL model adequately captured the temporal structure of the data. This finding indicates that the lag selection and model specification were appropriate, reinforcing confidence in the short-run and long-run estimates. Similarly, the normality of residuals, as confirmed by the Jarque–Bera test, supports the validity of statistical inference and suggests that the model's predictions are not distorted by non-normal errors.

The mean VIF of 6.63, below the critical threshold of 10, implies that multicollinearity is not a serious concern. This indicates that the explanatory variables contribute independently to explaining exchange rate volatility, which strengthens the reliability of interpreting individual variable effects. The stability tests presented in Figures 4.1 and 4.2 further confirm that the model parameters remained consistent over the study period, indicating that there were no structural breaks. This stability reinforces the robustness of the ARDL model in capturing the relationship between exchange rate volatility and macroeconomic factors.

CHAPTER SIX

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

This chapter presents the study summary of findings, conclusions, recommendations and the proposed areas for further research.

6.2 Summary of Findings

This study investigated the macroeconomic determinants of exchange rate volatility in Kenya using annual data spanning the period 1971 to 2024. Through the application of econometric methods, including descriptive statistics, GARCH modeling, ARDL bounds testing, and Granger causality analysis the study identified the key variables influencing exchange rate volatility in both the short and long run.

The descriptive analysis revealed considerable variability in the real effective exchange rate, underscoring Kenya's exposure to exchange rate fluctuations driven by both internal and external macroeconomic forces. The ARCH-LM and GARCH (1,1) models confirmed the presence of volatility clustering, a common feature in exchange rate behavior, indicating that periods of high volatility tend to be followed by further volatility.

The long-run results of the ARDL model demonstrated that foreign direct investment (FDI), had a negative long-run effect on exchange rate volatility, suggesting that sustained inflows of FDI help to stabilize the exchange rate. This supports the notion that FDI enhances macroeconomic stability by improving foreign exchange reserves,

boosting investor confidence, and reducing speculation in the currency markets. Inflation exhibited a positive and significant long-run impact on exchange rate volatility. This finding indicates that rising inflation contributes to currency instability by undermining purchasing power and increasing market uncertainty. The results align with economic theory, which posits that inflation differentials are a key driver of exchange rate adjustments. Money supply was found to have the most pronounced positive long-run effect on exchange rate volatility. Rapid monetary expansion was associated with greater currency fluctuations, reinforcing concerns that excessive liquidity, particularly in the absence of corresponding economic output, can amplify inflationary pressures and speculative activity in the foreign exchange market. Government expenditure had a significant negative effect on exchange rate volatility in the long run. Increased public spending, especially when directed towards productive investments, appears to support currency stability by fostering economic growth and enhancing investor confidence.

Short-run results from the ARDL model revealed important insights into the immediate dynamics influencing exchange rate volatility in Kenya. Foreign direct investment (FDI) exhibited a positive and statistically significant effect on exchange rate volatility, indicating that increased FDI inflows tend to amplify short-term fluctuations in the exchange rate. Inflation was positively and significantly associated with exchange rate volatility, implying that rising inflation contributes to greater short-term instability in the currency market. Money supply demonstrated a significant positive effect on exchange rate volatility, reflecting that expansions in money supply tend to increase exchange rate instability. Conversely, government expenditure had a negative and statistically significant effect on exchange rate volatility, suggesting that an increase in

government spending reduces exchange rate volatility in short-run. Also, public debt showed a significant negative relationship with exchange rate volatility, suggesting that higher borrowing may enhance macroeconomic stability and reduce currency fluctuations. Additionally

The Granger causality analysis identified several significant causal linkages. Unidirectional causality was found running from FDI to exchange rate volatility, indicating that changes in FDI precede shifts in currency stability. Additionally, bidirectional causality was established between interest rate and exchange rate volatility, suggesting mutual responsiveness. Unidirectional causality was also observed from exchange rate volatility to both money supply and inflation, highlighting the feedback effects of currency movements on broader macroeconomic conditions. The study establishes that FDI, inflation, money supply, and government expenditure are key macroeconomic drivers of exchange rate volatility in Kenya. These findings underscore the importance of stable inflation management, prudent monetary expansion, and investment-promoting fiscal policy as essential tools for exchange rate stabilization.

6.3 Implications of the Study

The findings have several important implications for macroeconomic policy and exchange rate management in Kenya. The long-run negative impact of foreign direct investment (FDI) on exchange rate volatility implies that policies promoting stable and sustained FDI inflows can enhance exchange rate stability. However, the short-run positive effect suggests the need for mechanisms to manage potential short-term fluctuations caused by capital movements.

The significant positive relationship between inflation and exchange rate volatility indicates that maintaining price stability remains critical to minimizing currency fluctuations. Monetary authorities should continue to emphasize effective inflation targeting to support exchange rate stability.

The pronounced positive effect of money supply on exchange rate volatility highlights the importance of aligning monetary expansion with real economic output. Excessive liquidity growth without corresponding economic fundamentals may lead to increased currency instability and inflationary pressures.

Government expenditure's negative association with exchange rate volatility suggests that productive fiscal spending can contribute to currency stability by fostering economic growth and investor confidence. Fiscal policy should prioritize expenditures that strengthen economic fundamentals to support exchange rate management.

The observed negative short-run effect of public debt on exchange rate volatility indicates that responsible borrowing, when properly managed, can enhance macroeconomic stability. Debt management strategies should focus on sustainability and efficient allocation of resources to development projects.

6.4 Conclusion of the Study

This study set out to examine the key macroeconomic determinants of exchange rate volatility in Kenya using annual data from 1971 to 2024. The analysis employed descriptive statistics, correlation analysis, unit root testing, ARDL modeling, and

Granger causality testing to uncover both short-run and long-run relationships between exchange rate volatility and key macroeconomic variables.

The ARDL long-run results showed that foreign direct investment reduces exchange rate volatility over time, while inflation and money supply growth both increased exchange rate volatility by eroding purchasing power and encouraging speculative activity. Government expenditure contributed to exchange rate stability in the long run. In the short run, government expenditure continued to exert a stabilizing effect, while FDI and inflation were associated with increased short-term volatility.

Granger causality results confirmed a unidirectional causal relationship from FDI to exchange rate volatility, bidirectional causality between interest rate and exchange rate volatility, and unidirectional causality from exchange rate volatility to both money supply and inflation.

Overall, the findings point to a dynamic interaction between macroeconomic policy variables and exchange rate behavior in Kenya. Exchange rate volatility is significantly shaped by foreign capital inflows, monetary expansion, price stability, and fiscal activity, with these effects varying across time horizons.

6.5 Recommendations of the Study

The findings of this study might have various policy implications. Firstly, the findings of this study have implications for policies aimed at promoting stable and long-term foreign direct investment (FDI) inflows. The government of Kenya should implement policies aimed at streamlining investment procedures and improving infrastructural

facilities to attract more FDI, which helps stabilize the exchange rate through consistent forex inflows. Further, foreign direct investment (FDI) should be actively encouraged through the development of a stable investment climate, investor protection mechanisms, and tax incentives.

Secondly, the findings of this study have implications for policies aimed at maintaining prudent fiscal policies. Sustained and well-targeted government expenditure is likely to reduce exchange rate volatility. The government of Kenya should focus its spending on productive sectors that enhance economic resilience and investor confidence.

Thirdly, the findings of this study have implications for policies aimed at controlling inflation. The government of Kenya, through the Central Bank of Kenya (CBK), should implement appropriate inflation-targeting frameworks and respond promptly and proactively to supply shocks, as inflation is a strong contributor to exchange rate instability.

Fourthly, the findings of this study have implications for monetary policy tightening. Since money supply expansion is strongly associated with higher exchange rate volatility, the government of Kenya should consider adopting measures which will ensure careful control of M3 growth. The government of Kenya should also adopt measures that will ensure that liquidity injections are well-aligned with the country's output levels.

Fifthly, more USD should be kept in Central Bank reserves to help the economy in times of inflation and recession in order to reduce currency rate volatility. In order to

maintain a stable exchange rate, the government must raise its gross foreign currency reserves, which are often stored in US dollars. Additionally, it must decrease the amount of economic activity that does not contribute to the nation's output. There is a need for the government to reduce the money supply in the economy to moderate exchange rate swings. To prevent unnecessary fluctuations in exchange rates, the government should boost the amount of private demand deposits.

Finally, the findings of this study have implications for policies aimed at improving coordination between fiscal and monetary authorities. The inverse relationship between government expenditure and money supply necessitates the need for policy harmonization in Kenya. The government of Kenya should implement integrated strategies between the Treasury (fiscal authority) and the CBK (monetary authority). This will result in a reduction in policy inconsistencies and volatility.

6.6 Suggestions for Future Study

The limitations of this study included its reliance on available data spanning the period 1971 to 2024, the focus on only six macroeconomic determinants of exchange rate volatility, and the Kenya-specific scope, which limits the generalizability of the findings to other developing countries. Future research should consider incorporating additional macroeconomic variables such as economic growth, market speculation, corruption index, terms of trade, productivity, trade balance, remittances, political stability, and climate change. Including these factors would provide more comprehensive and pragmatic insights into strategies for minimizing exchange rate volatility in Kenya and other developing and developed economies.

Moreover, future studies could benefit from disaggregating foreign direct investment (FDI) into components such as greenfield investments, mergers and acquisitions, and portfolio inflows. This disaggregation would offer a clearer understanding of which types of FDI have stabilizing or destabilizing effects in both the short and long term. Researchers are also encouraged to examine the role of different exchange rate regimes (e.g., fixed, floating, or managed float) in moderating the relationship between macroeconomic variables and exchange rate volatility.

In addition, future research should explore the microeconomic impacts of exchange rate volatility in Kenya. Such studies could assess how fluctuations in the Kenyan shilling (KES) against the US dollar affect specific sectors, businesses, or individual households, thereby enriching the understanding of exchange rate dynamics from both macroeconomic and microeconomic perspectives.

Lastly, future research could also explore the asymmetric effects of macroeconomic variables on exchange rate volatility by employing nonlinear models, such as the Nonlinear Autoregressive Distributed Lag (NARDL) model. Such models would help determine whether positive and negative shocks to key macroeconomic variables exert differential impacts on exchange rate movements, thereby providing a clearer and more detailed understanding of exchange rate behavior.

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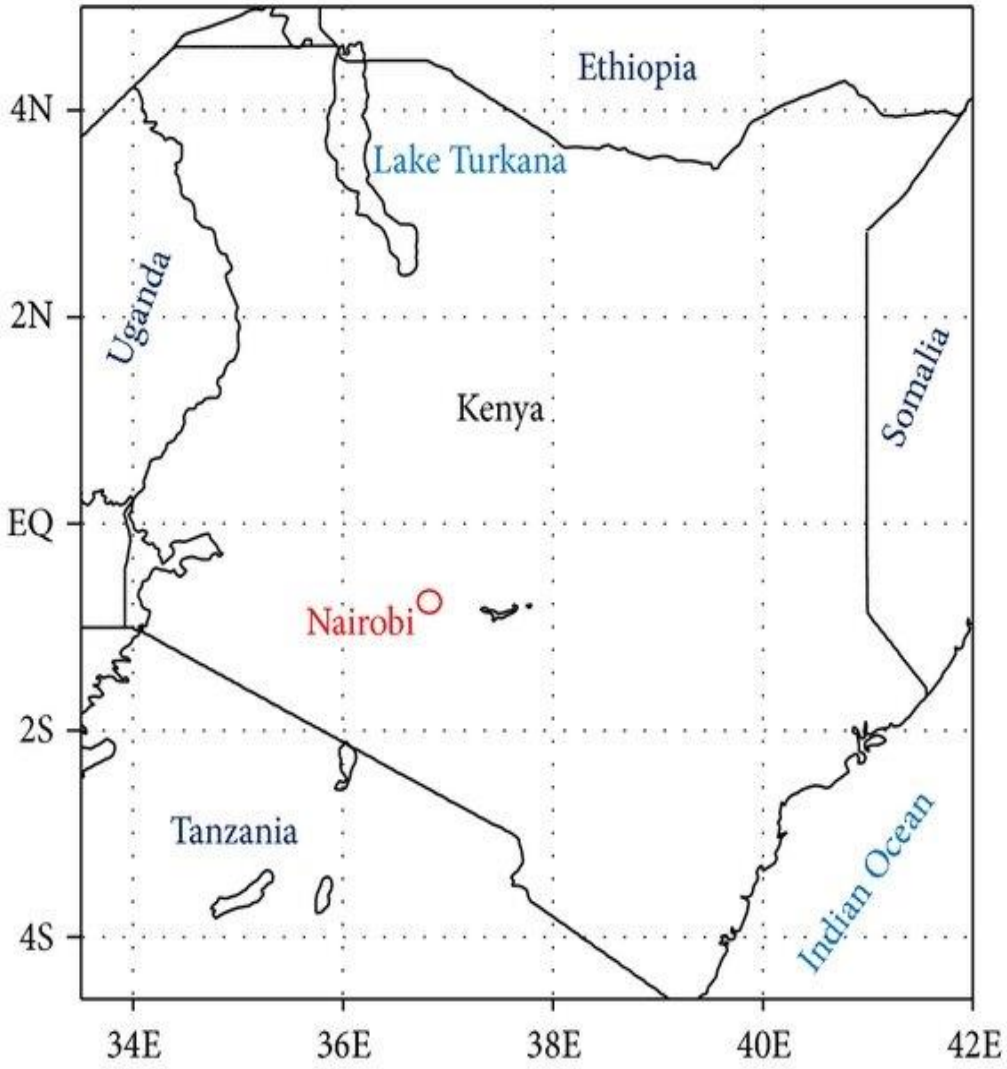
APPENDICES

Appendix I: A map of Kenya showing the location of the study area



Appendix II: Secondary Data Review Matrix

Kindly fill in the below secondary data review matrix on the survey of the effect macroeconomic variables on exchange rate volatility in Kenya for the period between 1971-2024.

Year	FDI	Government expenditure	Public debt	Interest rates (%)	Inflation rates (%)	Money supply	Exchange rates

Thank you for your time and responses.

Appendix III: Introductory Letter

University of Eldoret
Flame of knowledge and innovation

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E-mail: bpgs@uoeld.ac.ke
Website: www.uoeld.ac.ke

OFFICE OF THE DEPUTY VICE-CHANCELLOR (ASA)
(Directorate of Board of Postgraduate Studies)

Our Ref: UoE/B/BPGS/NACO/060 **Date:** 25th June, 2025

The Chief Executive Officer
National Commission for Science, Technology & Innovations
(NACOST)
P. O. Box 30623 - 00100
NAIROBI.

Dear Sir/Madam

SUBJECT: REQUEST FOR RESEARCH PERMIT – JOSEPH NGIGI KINUTHIA (REG.NO.SECO/AEC/M/003/23)

The above subject matter refers.

The above named is a bonafide Masters student in the Department of Applied Economics, School of Business, Economics and Management Sciences. The applicant has completed his coursework and successfully defended his proposal in readiness for commencement of research. His research is entitled *"Effect of Selected Macroeconomic Variables on Foreign Exchange Rates Volatility* in Kenya."

By this letter, I request you to issue Mr. Kinuthia with a research permit to enable him proceed with his survey for him to write thesis.

Your support will be highly appreciated.

Yours faithfully

DIRECTOR
Board of Postgraduate Studies
University of Eldoret.

PROF. SAMUEL LUTTA
DIRECTOR, BOARD OF POSTGRADUATE STUDIES.

Appendix IV: Research License

REPUBLIC OF KENYA

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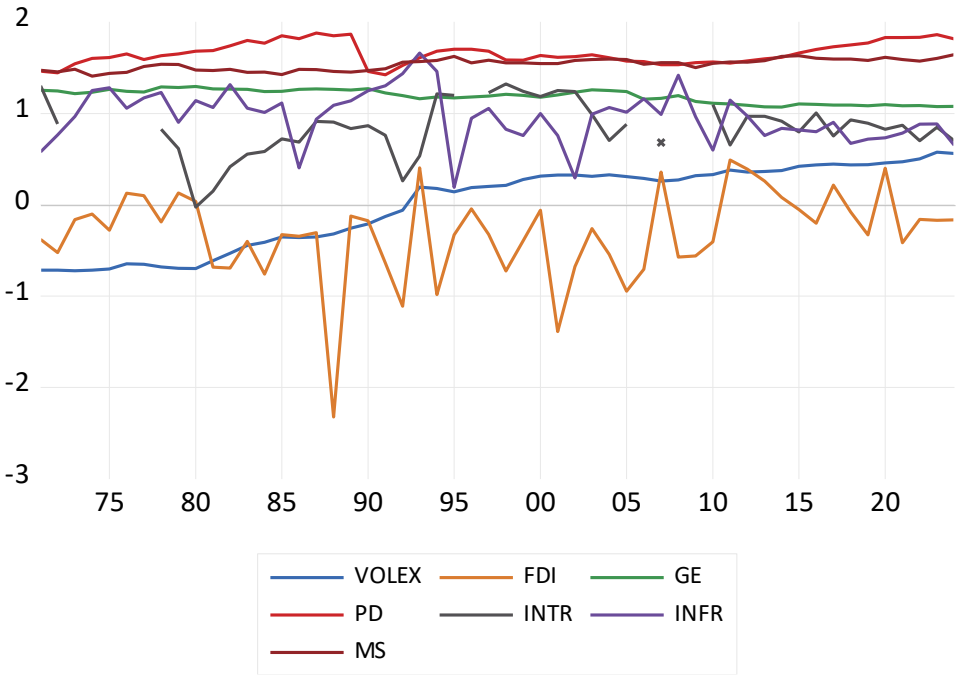
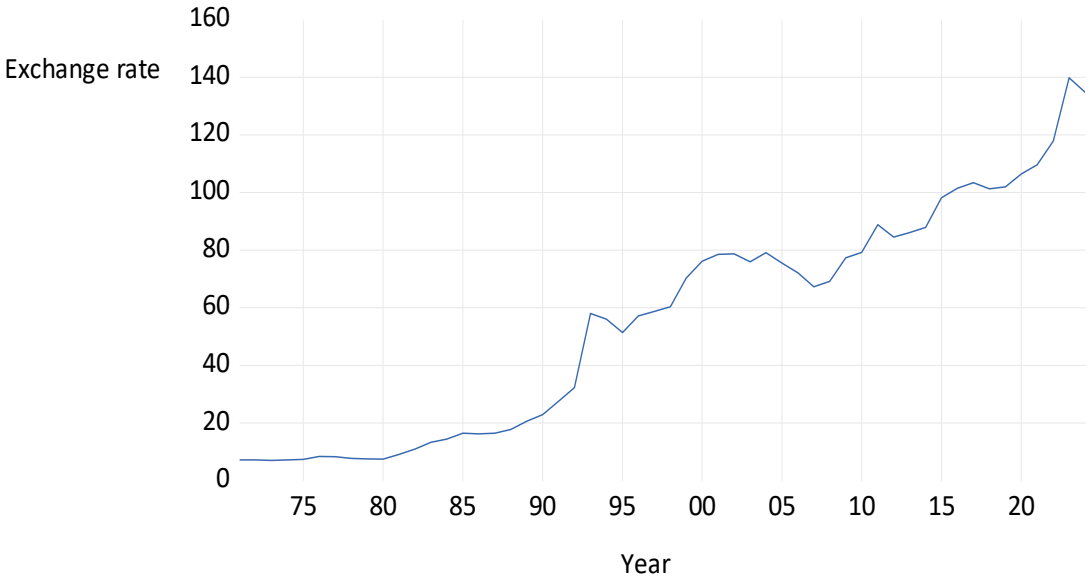
Appendix V: Trends in all the Data Variables



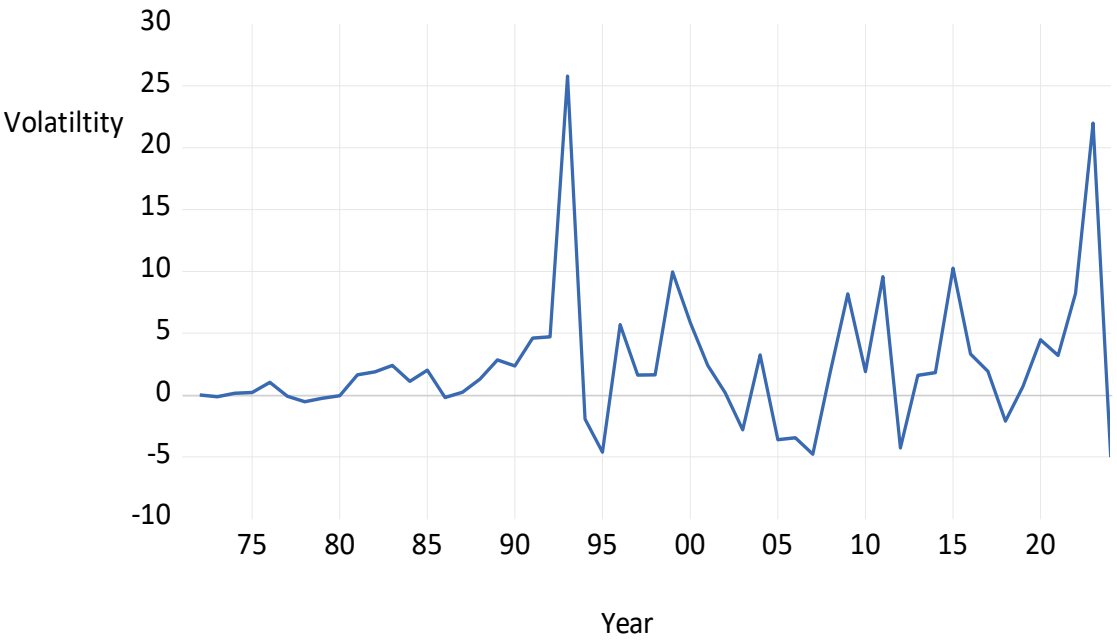
Source: Source: Researcher's Computation from Secondary Data (2025).

Appendix VI: Kenya's Exchange Rate Trend



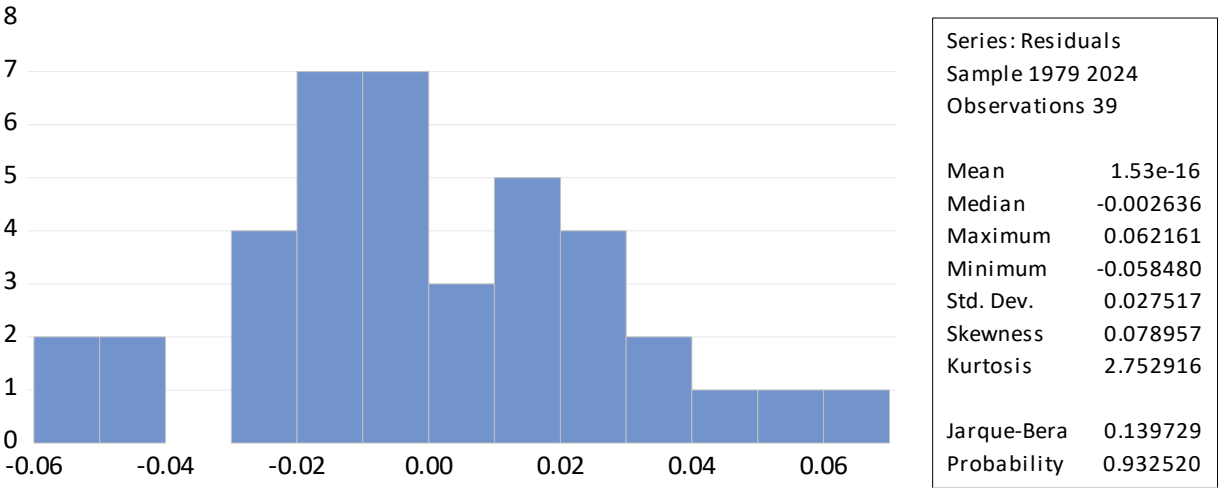
Source: Researcher's Computation from Secondary Data (2025).

Appendix VII: Graph Showing Exchange Rate Volatility



Source: Researcher's Computation from Secondary Data (2025).

Appendix VIII: Jarque-Berra test of Normality



Source: Researcher's Computation from Secondary Data (2025).

Appendix IX: Similarity Report

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