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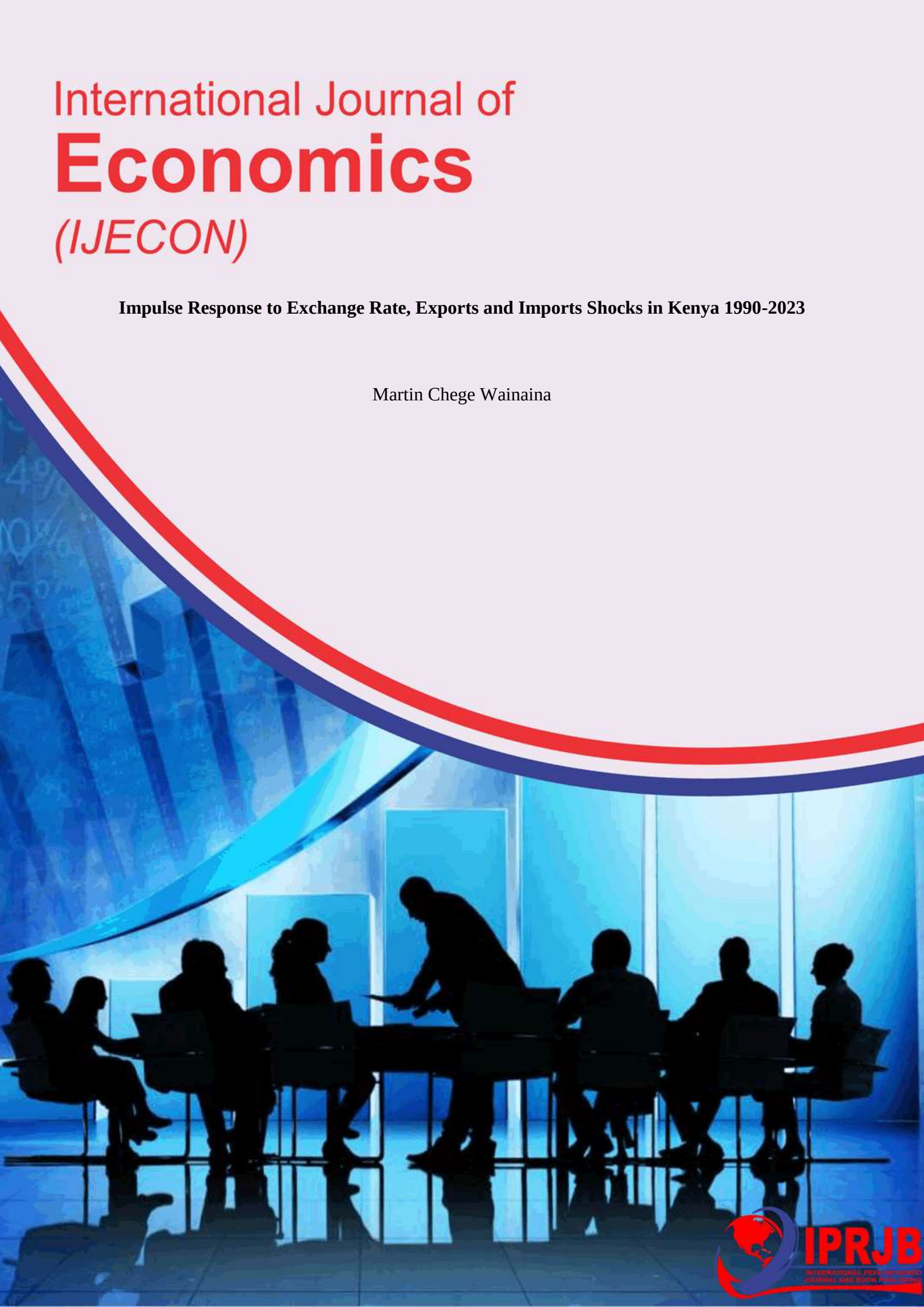

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Abstract

Purpose: This paper explores the trend of exchange rates over the past three decades, forecasts future trends, and investigates the impulse response of exports and imports on exchange rate shocks in Kenya. The study utilizes time series (1990-2022) data from the Central Bank of Kenya (CBK) and the World Development Indicators (WDI).

Methodology: The study employs the Structural VAR (SVAR) model, Vector Error Correction (VECM) model, and Impulse Response (I.R.) analysis to analyze the pass-through effect of exchange rate shocks on exports and imports in Kenya.

Findings: The results of VECM highlighted a long-term relationship between exchange rates, GDP growth, Inflation, and trade volumes. Moreover, the Impulse Response Analysis revealed no instantaneous pass-through effect on imports and exports. However, an appreciation of the Kenyan Shilling led to a significant negative pass-through effect on the volume of imports. Further, the results indicated a one-way causality between the exchange rate and GDP growth rate. Also, the exchange rate and Inflation rate have a one-way granger causality. Moreover, the exchange rate Granger causes the volume of exports, while the volume of Imports Granger causes the exchange rate and the GDP growth rate

Unique Contribution to Theory, Practice and Policy: The study findings emphasize the importance of stable exchange rate policies to mitigate negative impacts on trade. Policymakers should consider strategies to enhance export performance, reduce trade imbalances, and strengthen the economy's resilience to exchange rate fluctuations.

Keywords: *Exchange Rates, Trade Dynamics, Structural VAR (SVAR), Vector Error Correction Model (VECM), Impulse Response Analysis, Granger Causality, Macroeconomic Stability*

JEL Codes: *E31, F31, C32, F14*

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INTRODUCTION

The Kenyan Shilling has underperformed against the major global currencies over the last few years. For instance, the Kenyan currency depreciated nine percent and eight percent against the major international and regional currencies in 2021 and 2022, respectively. In 2023, the official exchange rate of the Kenyan currency against the regional and global currencies worsened. For instance, the Kenya shilling lost 24, 27, and 25 percent against the USD, Sterling pound, and the EURO. Regionally, the Kenya shilling has depreciated 17 and 12 percent against the Ugandan and Tanzanian currencies. The official exchange rate last performed this low in 2008 (Central Bank of Kenya, 2023). The performance of the Kenyan Shilling over the past few years has received much attention from the Kenyan media, scholars, and policymakers.

The Kenya shilling has continued to depreciate despite the Central Bank of Kenya (CBK) interventions. The Central Bank of Kenya utilizes a combination of open market operations and monetary policy to help keep the shillings steady. It also engages in the sale of some of the dollars from the research to the market to manage the supply of the currency in the market. The interventions are meant to prevent undue fluctuations instead of setting the exchange rate. Additionally, the CBK deploys term auctions and repurchase agreements to vary the amount of deposits held by commercial banks relative to statutory deductions. Again, this aims to influence the supply side of market forces, and the changes also impact the interest rates at which credit is taken, consequently leading to the growth of the deposits held by commercial banks.

However, the Central bank introduces very minimal periodic interventions because the country practices a floating exchange rate regime. For this regime, the variations in the value of the Kenyan Shilling are determined by the forces of demand and supply in the foreign currency exchange market. The floating exchange, adopted in 1993, replaced the pegged exchange rate regime where the value of the Kenyan shillings was pegged to the United States dollar. In the pegged exchange rate, the value of the Kenyan shilling would rise with the rise in the value of the Dollar and vice versa. Adopting the floating provides for automatic adjustment of the balance of payment in case of any changes in the exchange rate.

The exchange rate depreciation of a country's currency will likely affect the competitiveness of exports, making imports expensive. Consequently, it affects the growth of a country through changes in aggregate demand, cost of production, external debt, and Inflation (Fukui et al., 2023). This paper explores the trend of exchange rates of the Kenyan currency against regional and international currencies over the past three decades and forecasts future trends of the Kenyan exchange rate. The paper further uses time series (1990-2023) data from the Central Bank of Kenya (CBK) and the World Development Indicators (WDI), the Structural VAR (SVAR) model, and impulse analysis to investigate the impulse response of exports and imports to shocks in the exchange rate. Other macroeconomic variables included in the SVAR model include Inflation and GDP growth.

Prior research, such as Gachunga (2018), Kiptarus et al. (2022), & Nyambariga (2017) has widely focused on the effect of volatility and fluctuation of exchange rates on exports and imports. Deborah (2022) and Ogutu (2014) attempted to analyze long-run relationships even though they did not extensively investigate the interrelationships of exports, imports, and exchange rate shocks. Against this backdrop, this paper's unique contribution to the literature is threefold. First, the paper analyzes the trend of exchange rates, exports, and imports for the past three decades. Secondly, the paper attempts to forecast future trends in exchange rates.

Lastly, the paper analyzes the impulse response of exports and imports to shocks in exchange rates.

Investigating the impulse response to exchange rate, exports, and imports Shocks in Kenya is critical in evaluating the pass-through effect of exchange rate shocks on exports and imports in Kenya. Consequently, this study's findings and policy implications will inform Kenya's trade and economic growth policies. The remainder of the paper is organized as follows: Section Two presents the review of empirical and theoretical literature, Section Three presents data and econometric strategy, Section Four presents' empirical findings and discussion of results and their implication to policy, and lastly, Section Five presents the conclusions of the study.

Problem Statement

The persistent depreciation of the Kenyan Shilling and its fluctuating effects on trade have raised significant concerns among policymakers and stakeholders. Despite numerous studies, there remains a gap in understanding the delayed and immediate pass-through effects of exchange rate shocks on imports and exports in Kenya. Previous research has largely focused on general trends or utilized simpler econometric approaches, leaving critical dynamics unexplored. This study aims to bridge these gaps by employing advanced econometric models such as SVAR and VECM to analyze causal relationships and impulse responses. The findings will benefit policymakers in designing stable exchange rate regimes, academics in expanding the literature on macroeconomic dynamics, and businesses in mitigating trade risks associated with exchange rate fluctuations.

LITERATURE REVIEW

Exchange Rate Regimes in Kenya

The exchange rate is an important marker of the economic growth of a nation, and it plays an important role in determining the level of capital flow and trade dynamics. The changes in the exchange rate affect the repayment of debt, current account balance, interest rates, and Inflation. The exchange rate can also affect the returns of investors' portfolios and, thus, macroeconomic stability (Central Bank of Kenya, 2023). A stable and competitive exchange rate facilitates economic diversification, achieving strong economic growth through scaling up production-related activities (The Kenya Institute for Public Policy Research and Analysis, 2021).

Several factors determine a currency's value. Thus, a country's monetary authority should manage its foreign exchange and the relationship between its currencies and other currencies using exchange rate regimes. An exchange rate regime refers to rules and policies adopted by a country to determine the value of its currency relative to other currencies. A good regime helps retain economic stability and promote global trade (Terra, 2015).

Numerous countries across the world use three common exchange rate regimes. The first regime is the fixed exchange rate regime. In this regime, the Central Bank or the monetary authority of a country works towards maintaining the constant currency value against other countries' currencies or specific commodities like gold. Usually, the purpose of their regime is to ensure that the value of a country's currency is kept within a narrow range. Countries that use the regime include the UAE, Qatar, and Saudi Arabia (Melvin & Norrbin, 2023). One of the regime's advantages is that it encourages foreign direct investment because of the currency's stability. Further, the regime helps to control Inflation in a country. However, the regime is

usually costly to maintain because it requires a country to have a big foreign currency reserve and bypasses the global competitive environment (Melvin & Norrbin, 2023).

The other regime is the floating exchange rate regime. In this regime, a country's currency can change with the changes in the foreign market. A country's currency will fluctuate relative to the happenings in the market; thus, market forces usually determine the rate. However, even with this kind of regime, interventions may be aimed at stopping too many fluctuations. An example of a country with a floating exchange rate regime is Kenya. One of the regime's advantages is that it automatically adjusts the balance of payment. The other advantage is that it reduces the negative effect of external shocks. However, the limitation of the regime is that it limits foreign direct investment, and the level of risks and uncertainties is high (Fratzscher et al., 2019)

The last regime is the pegged exchange rate regime, where the currency is pegged to a value or a band fixed or periodically changed or pegged on another currency. The band is usually determined by a monetary authority or an international bilateral agreement and adjusted regularly in response to economic indicators and conditions. Examples of countries using this regime include China and Ethiopia. The main advantage of the regime is that it reduces uncertainty, and thus, the movement of the currency is more predictable, and the regime has a reliable monetary policy. However, there is heavy reliance on foreign countries and a struggle to correct any imbalances in the balance of payment (Melvin & Norrbin, 2023).

According to The Kenya Institute for Public Policy Research and Analysis (2021), Kenya has undergone several exchange rate regimes. From the 1960s to the 1970s, the country maintained the fixed exchange rate but later pegged it to the United States dollar until 1974. The pegging resulted in an irregular movement of the nominal exchange rate in relation to the Dollar and led to the depreciation of the shillings by 14 percent between 1974 and 1981. From 1982 to 1990, the regime changed to a crawling peg when the country embraced a dual exchange rate until 1993. Kiptarus et al. (2022) assert that Kenya has had three exchange rate regimes: the fixed exchange rate, the managed float regime, and the free float regime. The three regimes in Kenya are the Crawling peg 1973-1982, the managed float 1982-1990, and the free float between 1993- 2005.

In the floating regime, the currency changes its value relative to other currencies. The change in the currency is determined by factors like production, investment, and trade that influence supply and demand. This regime type has no set target for the exchange rate (Mwaniki et al., 2019). Nonetheless, the Central Bank of Kenya regularly participates in the foreign exchange market when there is a need to curtail volatility emanating from build stocks, external shocks, and the effect of government payments and help regulate liquidity in the market (The Kenya Institute for Public Policy Research and Analysis, 2021).

Impact of Exchange Rate on the Kenyan Economy

The exchange rate is a macroeconomic variable that impacts economic growth. It also shows the competitiveness of an economy in the global markets. Abdi et al. (2020) argue that the fluctuation of the exchange rate has serious economic costs that may affect firm profitability, price stability, and the economic stability of an economy. Exchange rate fluctuation or volatility can emanate from the balance of payments, interest rates, and inflations. A balance of trade is defined as the difference between an economy's imports and exports. When the value of an economy's exports is more than that of imports, a surplus in foreign exchange is created, which increases the demand for local currency.

On the other hand, when the imports exceed exports, there is a shortage in foreign exchange, which decreases demand for the local currency, weakening the exchange rate. Kenya has experienced this in recent years because the current deficit has become wider due to increasing imports and low exports. As a result, the exchange rate has depreciated, further widening the current account balance. Since Kenya is an open economy, the trade balance seriously affects the exchange rate.

The other factor that affects the exchange rate is the interest rate. When the interest rate of a country is high, it attracts foreign investment, increasing the demand for the local currency and making it strong. Otherwise, a low interest rate reduces local currency demand, weakening the exchange rate. The Central Bank of Kenya set a benchmark interest rate for commercial banks a few years ago, and as the benchmark fluctuates, it affects the exchange rate. The exchange rate is further affected by easier access to global interest rate information for investors due to the advancement of technology. Finally, when a country experiences increased Inflation, the currency's value is eroded, resulting in decreased demand and a weaker exchange rate. Low inflation rates can increase demand for the local currency, strengthening its exchange rate (Turna & Özcan, 2021).

Additionally, the political and economic environment can also influence the exchange rate. For example, a stable economy is likely to attract foreign investors, increasing demand for the local currency and strengthening its value. Conversely, political instability and economic uncertainty can discourage investors, thus weakening the exchange rate (Benedict et al., 2022). Political instability has also significantly influenced exchange rate volatility in Kenya. For example, during the 2007–2008 post-election violence, the heightened uncertainty and political unrest led to reduced investor confidence, triggering capital flight and weakening the Kenyan Shilling (Okeyo, 2010). The currency depreciated by approximately 25% against major currencies during this period. Similarly, during the 2017 general elections, prolonged political uncertainty following contested results negatively impacted the exchange rate as businesses scaled down operations and foreign investors withheld funds (Rwigema, 2022).

In Kenya, the exchange rate has been fluctuating over the past decade. The rising exchange rate trend has seriously affected employment opportunities, Gross Domestic Product, pricing, interest rates, and wages (Abdi et al., 2020). King'ola (2019) found a strong correlation between the exchange rate and a country's GDP. The research indicates that an increase in the exchange rate leads to a rise in GDP. Wanguru (2019) suggested that an increase in the volatility rate would likely lead to a fall in the market share prices and a decline in market capitalization. A decline in share prices may result in the erosion of investors' wealth since most investors aim to make maximum returns. As a result, investors can divert their investment to economies with stable exchange rates and low perceived risk. The result is that the demand for shares may decline further, reducing market capitalization. Thus, the stability of the exchange rate plays an important role in stock prices.

Exchange Rate Policies in Kenya

Fiaz et al. (2023) argue that exchange rate policy is a critical macroeconomic policy because exchange rate misalignment can significantly affect imports and exports, leading to internal imbalances. Following the COVID-19 pandemic, Kenya has experienced exchange rate volatility, resulting in a sharp depreciation of the Kenyan shillings(Koskei, 2021). The Central Bank of Kenya's responsibility is to develop and implement monetary policy to achieve internal and external stability.

To achieve price and internal stability, the central bank applies a combination of monetary policy tools and instruments like Open Market Operations and statutory requirements. The central bank takes part in the foreign exchange market to acquire foreign exchange to service government imports and official debts, build foreign exchange reserves, and buy and sell foreign exchange to steady the market in times of volatility. The foreign exchange reserves are also used as an instrument of monetary policy, and thus they can be used for liquidity management. According to Ouma & Kihiu (2018), Kenya rescinded all the exchange control laws in the 1990s and adopted an exchange rate system determined by the market. With this kind of policy, there are no controls on foreign exchange, which has attracted short-term capital inflows. Abandoning controls enhanced the investment environment and encouraged economic growth (Ouma & Kihiu, 2018).

Kenya's foreign exchange policy has gone through apparent development over the last three years. In the '60s and '70s, the country maintained a fixed exchange rate, and the currency became overvalued. From the early 1970s, the country maintained exchange rate controls. The reason why the country maintained the controls emanated from the 1971/72 crisis. It helped to conserve foreign exchange and control pressures on the balance of payment. There were other controls on things like interest rates, domestic credit, domestic prices, and imports. The controls were good responses in containing balance of payments and inflationary pressures, although they created major economic distortions. The distortions were not apparent until the 80s (The Kenya Institute for Public Policy Research and Analysis, 2021).

The historical policy regime shifts can be divided into phases: the fixed exchange rate before 1982 and the flexible exchange rate after that. The flexible period can be divided into the crawling peg until 1990 and the floating and dual rates in the 1990s. The crawling peg meant to deal with Inflation did not lead to a high inflation rate compared to the fixed period. However, in 1993, the floating rate led to a fiery inflation rate and an enormous response to interest rates. Although the exchange rate was supposed to be flexible during the crawling, there was a small quantity of control over imports and exchange transactions. This helped to prevent inflationary shocks from speculative attacks and permanent effects on the currency.

The floating exchange rate was expected to have several advantages to the economy. The first advantage is that it would continuously adjust the exchange rates in response to the demand and supply of foreign currencies. The second advantage is that changing the nominal exchange rate instead of reserve levels would equilibrize foreign exchange supply and demand. The third advantage is that it would allow the economy to develop its monetary policy without worrying about the effects of the balance of payments. Further, with the floating systems, any external imbalance would affect the exchange rate, not the reserves (Titus et al., 2022).

A literature survey reveals a bi-directional relationship between the exchange rate and the trade balance and their link with other macroeconomic variables like Inflation and GDP growth. Most past studies have focused on exchange volatility and factors influencing exchange rates. Very few studies have focused on evaluating the impulse response of imports and exports to exchange rate shocks. Further, the study examines how shocks in imports and exports impact the exchange and analyze the trends of exports, imports, and exchange rates over time. Consequently, this study bridged this gap in empirical literature in the Kenyan context.

Theoretical Review

The study on the trends, dynamics, and impacts of exchange rate fluctuations on trade in Kenya aligns well with two economic theories: the Balance of Payments (BOP) Theory and the

Purchasing Power Parity (PPP) Theory. These theories provide a theoretical framework for analyzing the relationship between exchange rate movements, trade dynamics, and macroeconomic variables in the Kenyan context.

The Balance of Payments (BOP) Theory is particularly relevant as it focuses on the relationship between a country's exchange rate and its trade balance, which includes exports and imports. According to this theory, exchange rates adjust to balance the inflows and outflows of foreign exchange. In Kenya's case, persistent trade deficits, driven by high imports and low exports, have significantly influenced the exchange rate of the Kenyan Shilling. The study investigates how these trade imbalances, as reflected in the current account deficit, contribute to currency depreciation and overall economic instability. Using the BOP theory, the study can better explain the macroeconomic implications of Kenya's widening trade imbalance and inform strategies to stabilize Shilling.

The Purchasing Power Parity (PPP) Theory is another key framework for this study. PPP posits that exchange rates between two currencies adjust to reflect differences in price levels between the countries. This theory emphasizes the role of inflation in exchange rate movements, asserting that higher inflation in a country will erode the value of its currency over time. The study explores how inflation in Kenya impacts the Shilling, weakening its competitiveness and affecting trade dynamics. By linking inflationary trends to exchange rate depreciation, the PPP framework helps understand the long-term effects of price level changes on Kenya's trade performance and macroeconomic stability.

Together, these theories offer complementary perspectives. The BOP theory explains the relationship between trade imbalances and exchange rate fluctuations, while the PPP theory provides insights into how inflation influences currency value. Both frameworks apply to Kenya, an open economy where trade and inflation are critical determinants of exchange rate dynamics. Employing these theories enables a comprehensive analysis of Kenya's exchange rate trends and informs practical recommendations for policy interventions to stabilize the economy.

METHODOLOGY

Variables, Data Type and Sources

The study utilized time series data (1990- 2023) from the World Development Indicators (WDI) data. The study used five variables, defined as follows:

The volume of exports (E.V.); Merchandise exports are measured in current U.S. dollars and represent the free-on-board value of items supplied to the rest of the world.

The volume of imports (IV); The cost, insurance, and freight value of items acquired from other countries are shown in merchandise imports, valued in current U.S. dollars.

Exchange rate (E.R.); The exchange rate is the price of the Kenyan shillings in terms of the U.S. dollar set in the currency market authorized by law. Monthly averages (local currency units in relation to the U.S. dollar) are used to determine the annual average.

*Inflation (CPI);*The consumer price index measures Inflation and shows the annual percentage change in the average consumer's cost of purchasing a basket of goods and services.

GDP growth rate (GGR); The GDP growth rate is expressed as a yearly percentage at market prices using constant local currency. The aggregates are provided in U.S. dollars and are based on constant prices from 2015. GDP is the total gross value added by all producers who are

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residents of the country, plus any product taxes and minus any subsidies that are not factored into the product value.

The study used the five variables to analyze the Impulse Response of exchange rates, imports, and export shocks using a Structural VAR (SVAR) model. The primary explanatory variable is the exchange rate. Two more variables, Inflation, and GDP growth rate, are included in the SVAR analysis as control variables. The variables included in the SVAR are selected based on the underlying economic relationship. The five macro variables chosen in the study are assumed to be endogenous from the balance of trade theories (Dogru et al., 2019). The primary goal of a VAR is to identify interrelationships among variables and not parameter estimates, and as such, variables in the VAR need not be stationary. (Sims et al., 1990) recommended against differencing even if the variables contain a unit root. The main reason against differencing is that it may throw out movements in the data (Sims et al., 1990).

Sampling and Sampling Technique

The study utilizes secondary time series data on Kenya's macroeconomic indicators from 1990 to 2023. The range of data was selected to capture long-term trends, policy impacts, and structural changes in Kenya's economy. Moreover, the analysis exclusively focuses on Kenya, maintaining relevance to the research objectives. The dataset comprises five key variables: the volume of exports (EV), the volume of imports (IV), the exchange rate (ER), inflation (CPI), and GDP growth rate (GGR). These variables were chosen for their relevance in explaining trade dynamics, exchange rate movements, and overall economic performance, aligning with the study's objectives.

The study adopted a purposive sampling method to select the required data from secondary sources. This approach ensures the inclusion of variables and data points most pertinent to analyzing Kenya's exchange rate dynamics. The data was extracted from reliable and authoritative secondary sources, including the World Development Indicators (WDI) and the Central Bank of Kenya (CBK).

Empirical Strategy

A Structural (SVAR) seeks to find the impulse responses using automatic restrictions on the structural error covariance matrix. The constituents of a vector of endogenous variables can have contemporaneous relationships. SVAR enables the modelling of contemporaneous and dynamic endogeneity between variables. In a matrix form based on Hamilton (1994), SVAR can be written as follows.

$$B_0 y_t = k + B_1 y_{t-1} + B_2 y_{t-2} + \cdots + B_p y_{t-p} + \mu_t \quad (1)$$

y_t is an endogenous variable, μ_t is a random disturbance term such that $E[\mu_t \mu_t] = D$. A reduced VAR of the structural dynamic model can be obtained from equation (1) as follows.

$$B_0 \boldsymbol{y}_t = B_0^{-1}(k + B_1 y_{t-1} + B_2 y_{t-2} + \cdots + B_p y_{t-p} + \mu_t)$$

$$\boldsymbol{y}_t = c + \Phi_1 y_{t-1} + \Phi_2 y_{t-2} + \cdots + \Phi_p y_{t-p} + \varepsilon_t \quad (2)$$

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$\boldsymbol{y}_t$ is a vector of the five variables included in the SVAR, which depends on its lags and the lags of the other variables in the system.

The study is interested in the effect of a shock in $\varepsilon_{j,t}$ on variable $y_{i,t+s}$, $i,j \in \{1,\dots,5\}$. The study defines $D \equiv Var(u_t)$, $\Omega \equiv Var(\varepsilon_t)$ and $\boldsymbol{A} = \boldsymbol{B}_0^{-1}$ and since $\varepsilon_t = Au_t$ then $\frac{\partial \boldsymbol{y}_{t+s}}{\partial \boldsymbol{\mu}_t'} = \boldsymbol{\Psi}_s \boldsymbol{A}$

Cholesky decomposition of the variance-covariance matrix was used to generate structural shocks, and The impulse responses can be obtained as

$$\begin{bmatrix} \varepsilon_t^{ER} \\ \varepsilon_t^{EV} \\ \varepsilon_t^{IV} \\ \varepsilon_t^{CPI} \\ \varepsilon_t^{GG} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} \end{bmatrix} \begin{bmatrix} \mu_t^{EV} \\ \mu_t^{IV} \\ \mu_t^{ER} \\ \mu_t^{CPI} \\ \mu_t^{GG} \end{bmatrix}$$

Where, μ_t^{EV} defines export shocks; μ_t^{IV} imports shocks; μ_t^{ER} exchange rate shocks; μ_t^{CPI}, inflation shocks and μ_t^{GG} is the GDP growth rate shock. To solve the above matrix system with the n=5 variables, $\frac{n^2-n}{2} = 10$ restrictions are required. This enabled the identification of structural shocks in an endogenous system. Each impulse response contains the effect of a particular shock on one of the variables in the system at an impact time t and the subsequent periods.

Since the study variables were cointegrated, the study estimated a Vector Error Correction Model (VECM). VECM specification was used to capture the long-term relationships among the variables under consideration, incorporating both short-term dynamics and the correction mechanism. The VECM is an extension of the Vector Autoregressive (VAR) model, accounting for cointegration among the variables. The specific VECM specification for this study includes the following equations:

$$\Delta EXRt = \beta_{01} + \beta_{02} \cdot \Delta EXR_{t-1} + \beta_{03} \cdot \Delta GDP_{t-1} + \beta_{04} \cdot \Delta INF_{t-1} + \beta_{05} \cdot \Delta EXP_{t-1} + \beta_{06} \cdot \Delta IMP_{t-1} + \epsilon_{1t} \quad (3)$$

$$\Delta GDPt = \beta_{11} + \beta_{12} \cdot \Delta EXR_{t-1} + \beta_{13} \cdot \Delta GDP_{t-1} + \beta_{14} \cdot \Delta INF_{t-1} + \beta_{15} \cdot \Delta EXP_{t-1} + \beta_{16} \cdot \Delta IMP_{t-1} + \epsilon_{2t} \quad (4)$$

$$\Delta INFt = \beta_{21} + \beta_{22} \cdot \Delta EXR_{t-1} + \beta_{23} \cdot \Delta GDP_{t-1} + \beta_{24} \cdot \Delta INF_{t-1} + \beta_{25} \cdot \Delta EXP_{t-1} + \beta_{26} \cdot \Delta IMP_{t-1} + \epsilon_{3t} \quad (5)$$

$$\Delta EXPt = \beta_{31} + \beta_{32} \cdot \Delta EXR_{t-1} + \beta_{33} \cdot \Delta GDP_{t-1} + \beta_{34} \cdot \Delta INF_{t-1} + \beta_{35} \cdot \Delta EXP_{t-1} + \beta_{36} \cdot \Delta IMP_{t-1} + \epsilon_{4t} \quad (6)$$

$$\Delta IMpt = \beta_{41} + \beta_{42} \cdot \Delta EXR_{t-1} + \beta_{43} \cdot \Delta GDP_{t-1} + \beta_{44} \cdot \Delta INF_{t-1} + \beta_{45} \cdot \Delta EXP_{t-1} + \beta_{46} \cdot \Delta IMP_{t-1} + \epsilon_{5t} \quad (7)$$

Where Δ represents the first difference of the respective variable, EXR is the exchange rate, GDP is the GDP growth rate, INF is the inflation rate, EXP is the volume of exports, IMP is the volume of imports, are the error terms for each equation.

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RESULTS AND DISCUSSION

Diagnostic Testing Results

In constructing the Structural Vector Autoregression (SVAR) model, several requirements need to be met. The diagnostic testing results play a pivotal role in establishing the reliability and robustness of the study.

Augmented Dickey-Fuller (ADF) Test for Stationarity

The study used the ADF test to determine the stationarity of the Exchange rate, export inflation rate, and imports. The results of the ADF test are presented in the table below;

Table 1: Unit Root Test for Stationarity

	Intercept		Trend and Intercept		No Intercept & Trend	
Variable	**Level**	**First Difference**	**Level**	**First Difference**	**Level**	**First Difference**
Exchange Rate	-1.544	-4.982	-2.061	-4.468	2.180	-4.352
	[0.499]	[0.000]***	[0.542]	[0.007]***	[0.992]	[0.000]***
GDP Growth Rate	-4.405		-5.511		-0.417	-7.184
	[0.002]**		[0.001]***		[0.524]	[0.000]***
Inflation	-2.979		-3.468	-6.377	-1.724	-6.496
	[0.048]**		[0.060]	[0.000]***	[0.080]	[0.000]***
Volume of Exports	0.222	-5.076	-3.890		2.950	-7.367
	[0.970]	[0.000]***	[0.028]**		[0.999]	[0.000]***
Volume of Imports	0.371	-5.542	-2.257	-3.471	2.120	-4.735
	[0.978]	[0.000]***	[0.444]	[0.067]*	[0.990]	[0.000]***

Notes: P-values in parentheses [ ]

*** p<0.01, ** p<0.05, * p<0.1

Source: Author's Computation

Table 1 presents the Augmented Dickey-Fuller unit root test for study variables for the three specifications. However, based on the analysis, the Exchange Rate variable exhibits statistically significant unit roots across all specifications, indicating non-stationarity (Level with Intercept: t = -1.544, p = 0.499; First Difference with Trend and Intercept: t = -4.982, p < 0.001; No Intercept & Trend in First Difference: t = 2.180, p < 0.001). Also, the GDP Growth Rate shows statistically significant unit roots in both Levels with Intercept (t = -4.405, p = 0.002) and First Difference with Trend and Intercept (t = -5.511, p = 0.001) specifications, suggesting non-stationarity.

Moreover, Inflation displays significant unit roots in the Level with Intercept (t = -2.979, p = 0.048) and First Difference with Trend and Intercept (t = -3.468, p = 0.060) specifications, implying non-stationarity. The Volume of Exports demonstrates a significant unit root in the First Difference with Trend and Intercept specification (t = -5.076, p < 0.001), while other

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Vol.10, Issue 1, No.2. pp 39 - 67, 2025
www.iprjb.org

specifications suggest stationarity. Finally, the Volume of Imports indicates a significant unit root in the First Difference with Trend and Intercept specification ($t = -5.542$, $p < 0.001$), with other specifications suggesting stationarity. Generally, based on the analysis, all variables are stationary at level, which is a prerequisite for the SVAR model.

Lag Length Selection

Before estimating the Structural Vector Autoregressive model, it is important to select the optimum lag length to be included in the model. However, the results of the lag selection criteria are presented in the table below;

Table 2: Lag Length Selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1555.389	NA	3.74e+40	107.6130	107.8488	107.6869
1	-1460.507	150.5028*	3.12e+38*	102.7936	104.2080*	103.2366
2	-1434.594	32.16719	3.46e+38	102.7306	105.3238	103.5428
3	-1412.491	19.81631	6.92e+38	102.9304	106.7023	104.1117
4	-1363.869	26.82615	4.64e+38	101.3013*	106.2519	102.8518*

Notes: *indicates lag order selected by the criterion
Source: Author's Computation

Criterion

Table 2 demonstrates the lag selection of different criteria. The maximum lag length was determined using the five different selection criteria. Based on the analysis in the above table, the model employed 1 lag since it is preferred by the majority of the criteria (L.R., FPE, and S.C.). However, the estimated model used 1 lag in its interpretation.

Normality Test

A normality test was conducted using the Jarque-Bera to investigate whether the variable suffers from potential outliers. The results are presented in the table below.

Table 3: Jarque-Bera Normality Test

Component	Jarque-Bera	df	Prob.
1	2.139187	2	0.3431
2	5.328280	2	0.0697
3	1.056972	2	0.5895
4	1.802214	2	0.4061
5	0.311995	2	0.8556
Joint	10.63865	10	0.3864

Source: Author's Computation

Table 3 indicates that the overall Jarque-Bera test for all components combined yielded a statistic of 10.64 with 10 degrees of freedom, and the p-value was 0.39, indicating no significant departure from normality for the entire set of components (J.B. = 10.64, df = 10, p =0.39).

Serial Correlation Test

The study adopted the Lagrange Multiplier test for serial correlation to determine whether the residual was serially correlated with the variables. The results are shown below.

Table 4: LM Test for Serial Correlation

Lags	LM-Stat	Prob
1	15.51917	0.9284
2	28.27699	0.2953
3	17.39075	0.8671
4	18.28694	0.8300

Source: Author's Computation

Table 4 above demonstrates the L.M. test for serial autocorrelation of the residual term. However, the analysis from the table indicates serial correlation is absent since the estimated p-value is greater than 0.05. Therefore, we fail to reject the null hypothesis at a 5% significance level and conclude that there is no serial correlation and the model is stable.

Cointegration Test

The study conducted a cointegration test to examine whether the variables are cointegrated. This step helps determine whether there is a long-term relationship between the study variables. The results of the cointegration are presented in the table below.

Table 4: Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.76027	92.94812	69.81889	0.0003
At most 1 *	0.600334	50.10083	47.85613	0.0303
At most 2	0.395945	22.58702	29.79707	0.2670
At most 3	0.218961	7.464301	15.49471	0.5243
At most 4	0.001679	0.050405	3.841466	0.8223

Notes: Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
Source: Author's Computation

Results from the table above indicate that there are two cointegrating equations. This is because the trace statistic for 1 cointegrating equation is greater than the critical value at a 5% significance, and therefore, the null hypothesis was rejected.

Descriptive Statistics Results

The descriptive statistics offer a comprehensive view of the central tendencies and variability of the selected economic indicators (exchange rate, Inflation, GDP growth rate, Exports and Imports Volume). Examining the figures provides key insights into each variable's distribution.

International Journal of Economics
ISSN 2518-8437 (Online)
Vol.10, Issue 1, No.2. pp 39 - 67, 2025
www.iprjb.org

Table 5: Summary Statistics

	EXCHANGE RATE	GDP GROWTH RATE	INFLATION	EXPORTS VOLUME (Billions)	IMPORTS VOLUME (Billions)
Mean	76.11263	3.657111	11.31201	3.82	9.16
Median	77.35201	4.146839	8.864087	3.50	7.23
Maximum	117.866	8.058474	45.97888	7.41	21.20
Minimum	22.91477	-0.799494	1.554328	1.03	1.77
Std. Dev.	23.062	2.313813	9.237396	2.04	6.64

Source: Author's Computation

Table 5 presents the summary statistics for selected macroeconomic indicators between 1990 and 2022. However, from the table analysis, the average Exchange Rate for Kenya during the study period was approximately Shs. 76.11 compared to 1 United States Dollar. The standard deviation was 23.06 during the period, highlighting a noteworthy degree of variability around the mean. The observed range, stretching from 22.91 to 117.87, shows the diverse nature of exchange rate values over the observed periods. The average GDP Growth Rate during the study period was estimated at 3.66%, indicating a moderate average growth with a relatively small standard deviation of 2.31, indicating that Kenya's economic growth during this period was less volatile. A negative minimum value (-0.80) suggests instances of economic contraction, while the maximum value of 8.06 points to periods of robust economic growth.

Moreover, the average Inflation rate stood at 11.31, reflecting a relatively high average inflation rate during the study period. The substantial standard deviation of 9.24 shows the considerable variability in inflation rates over the observed periods. Also, the wide range, from 1.55 to 45.98, highlights the diverse inflation instances in the economy. In addition, the average volume of exports (Bills) was approximately 3.82 billion units, with a standard deviation of 2.04, indicating moderate variability around the mean. The range, from Shs 1.03 to Shs 7.41, suggests a diverse spectrum of export volumes in Kenya's economy during this period. Finally, import volume (Billions) exhibits a mean of Shs 9.16 billion, with a substantial standard deviation of Shs 6.64, indicating significant variability. The broad range from 1.77 to 21.20 shows the diverse nature of import volumes, reflecting varied trade dynamics.

Trend Analysis Results

The study conducted a trend analysis on Exchange Rate, Inflation, Volume of Imports and Exports, and GDP Growth Rate between 1990 and 2022. The trend analysis is essential since it helps provide the study variables' patterns. The analysis is provided in the figures below.

International Journal of Economics
ISSN 2518-8437 (Online)
Vol.10, Issue 1, No.2. pp 39 - 67, 2025
www.iprjb.org

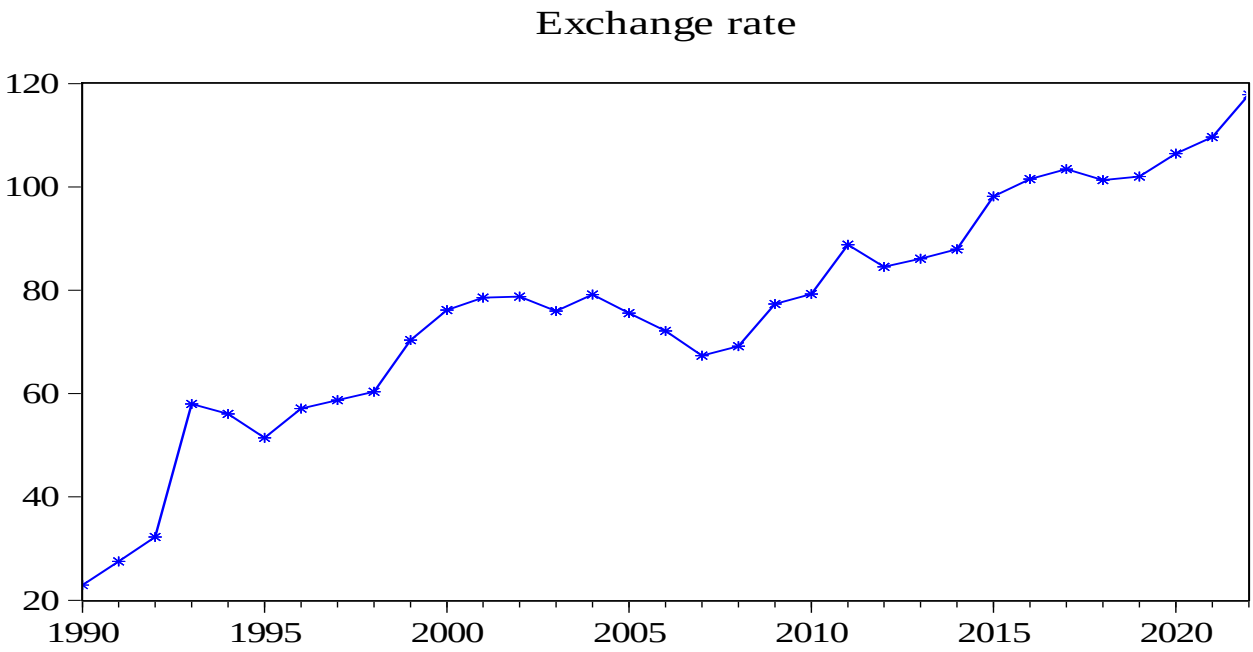

Figure 1: Trend of Exchange Rate (1990 – 2022)

Figure 1 above demonstrates the exchange rate of Kenya Shilling against the United States Dollar. Between 1990 and 2022, there has been an upward trend in the exchange rate, indicating a depreciation of the Shilling against the U.S. dollar, moving from Shs 22.91/ Dollar in 1990 to Shs 117.87/Dollar in 2022. The Kenya Economy has been a net importer over the period, which could be associated with the constant depreciation of the Shilling against the Dollar. Between the 2008-2009 Global Financial Crisis, the Shilling appreciated against the U.S. Dollar. Moreover, the over-dependence on rain-fed agriculture makes the economy vulnerable to droughts, potentially impacting export earnings and the exchange rate.

International Journal of Economics
ISSN 2518-8437 (Online)
Vol.10, Issue 1, No.2. pp 39 - 67, 2025
www.iprjb.org

Figure 2: Trend of GDP Growth Rate (1990 – 2022)

Figure 2 illustrates a dynamic pattern of fluctuations in the GDP growth rate from 1990 to 2022. Over the entire period, the GDP growth rate has an overall positive trajectory. The Kenyan economy generally experiences growth, which is a positive economic development and expansion indicator. In 2010 and 2021, the economy experienced substantial growth, indicating periods of economic expansion. Conversely, 2008 experienced slow economic growth, which could be associated with the 2008 global financial crisis, negatively affecting Kenya's foreign investment. Moreover, in 2020, the economy experienced slow GDP growth rates. The low growth rate in 2020 stems from the Covid-19 pandemic that affected the global economy.

International Journal of Economics
ISSN 2518-8437 (Online)
Vol.10, Issue 1, No.2. pp 39 - 67, 2025
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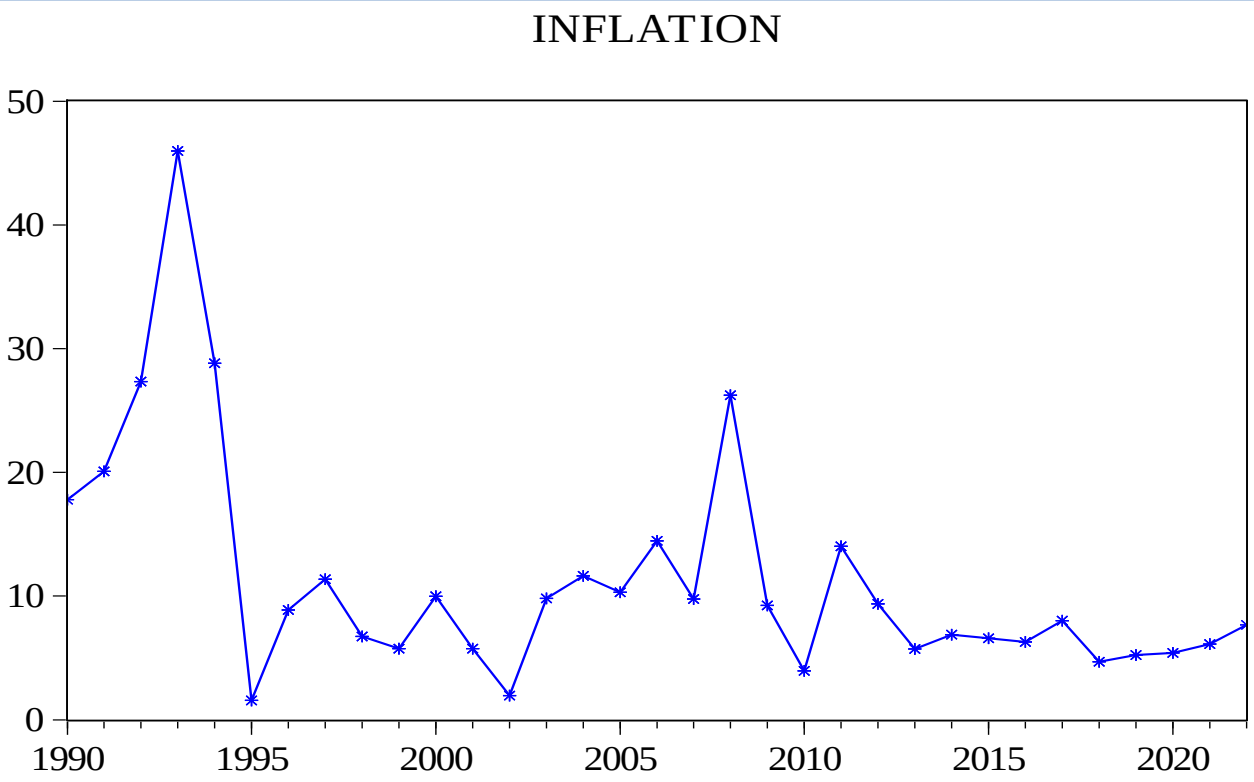

Figure 3: Inflation Trend (1990 – 2022)

The figure presents the trend analysis of Inflation in Kenya's economy between 1990 and 2022. Over the period, the economy's inflation rate remained steady with a downward trend, moving from 17.78 percent in 1990 to 7.66 percent in 2022. However, in 1998, there was a sharp increase in Inflation, which could be associated with the ripple effects of the Global Financial crisis. Also, Kenya's economy recovered from the 2006/07 post-election violence. Between 2013 and 2022, the inflation rate averaged approximately 6.26 percent, indicating stable macroeconomic policies.

International Journal of Economics
ISSN 2518-8437 (Online)
Vol.10, Issue 1, No.2. pp 39 - 67, 2025
www.iprjb.org

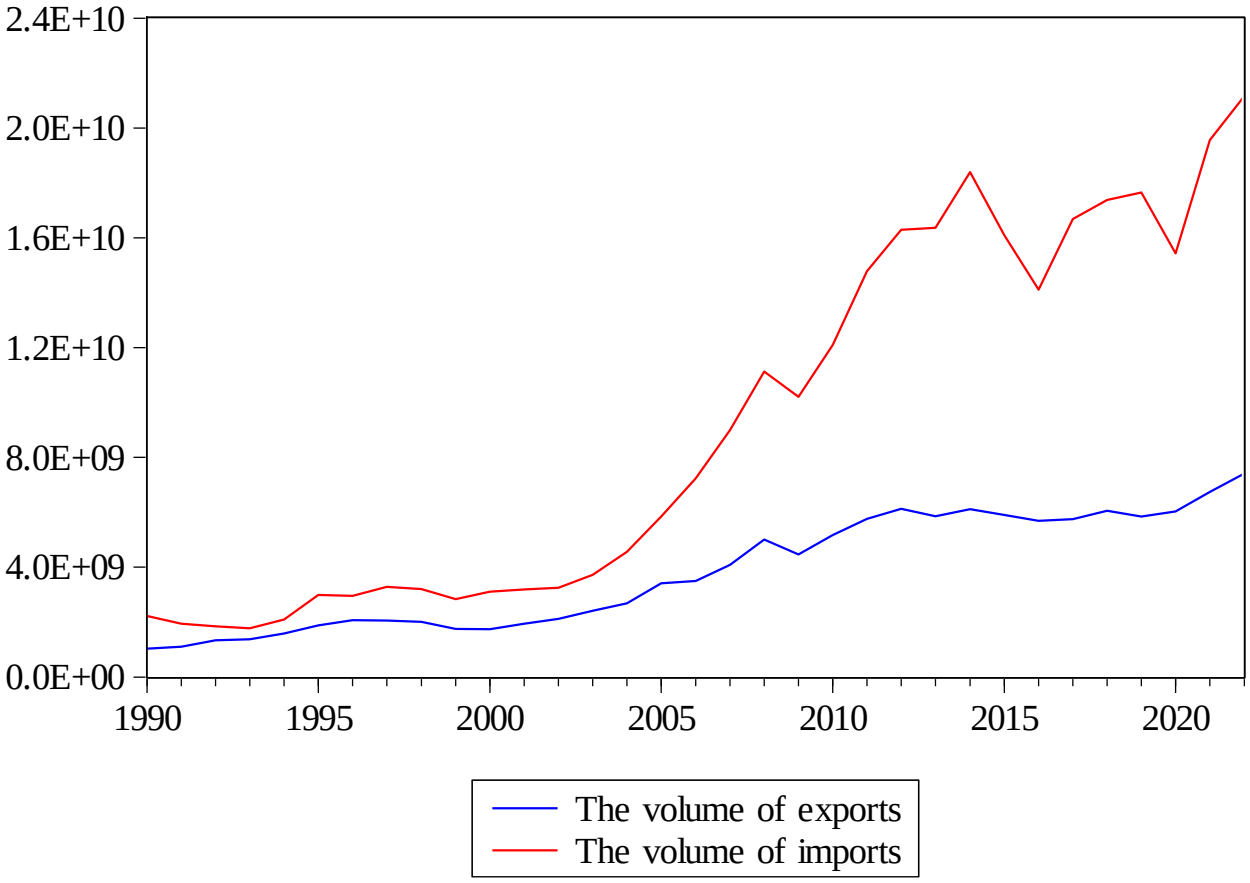

Figure 4: Volume of Exports & Imports Trend (1990 – 2022)

Figure 4 demonstrates the trend analysis of Kenya's economy's exports and import volume between 1990 and 2022. Between 1990 and 2005, even though imports were higher than exports, the gap between the two remained constant. Moreover, based on the analysis, the export volume has remained lower than the import volume. The volume of imports over the period increased at an increasing rate while the exports remained steady. Since 2005, the economy has remained a net importer with no signs of long-term convergence between the two. The widening gap has significant economic implications, particularly in its contribution to the depreciation of the Kenyan Shilling against major currencies such as the United States Dollar. The increasing imports put further pressure on the domestic currency, making it vulnerable to continued depreciation, which could drive inflation and negatively impact the purchasing power of Kenyan consumers. This imbalance highlights the need for strategic economic policies to enhance export competitiveness and reduce reliance on imports to stabilize the currency and foster sustainable economic growth.

Impulse Analysis Results

The study adopted Impulse Response Analysis to help analyze the pass-through effect of exchange rate shocks on exports and imports in Kenya. However, the impulse response analysis was analyzed using the Structural Vector Autoregressive (SVAR) model. The Structural Vector Autoregressive (SVAR) model revealed that export volumes in Kenya respond more slowly to exchange rate shocks than imports. This lag is due to pre-determined export contracts, more prolonged production cycles, reliance on costly imported inputs, and market entry barriers. In

contrast, imports react more quickly because of shorter procurement timelines and immediate demand adjustments. To address these challenges, policymakers should focus on improving production efficiency, reducing reliance on imported inputs, and diversifying export markets to enhance the responsiveness of exports to exchange rate changes.

Structural Vector Autoregressive (SVAR) Model

In constructing the SVAR model, the first procedure was to test the stationarity of the study variables. The study employed the Augmented Dickey-Fuller Test for unit root. All variables had unit roots at the level and became stationary after the first difference. Moreover, the lag selection criteria picked one optimal lag, which was used in estimating the SVAR model. The results from the SVAR model (Appendix I) suggest that a one-unit increase in the lagged exchange rate leads to a 0.747026 unit increase in the current exchange rate. The coefficient is statistically significant ($t = 8.71495$, $p < 0.01$). In addition, a one-unit increase in the lagged GDP growth rate corresponds to a -0.896947 unit decrease in the current exchange rate, and the coefficient is not statistically significant ($t = -1.79211$, $p < 0.05$).

Moreover, the results indicated that a one-unit increase in the lagged inflation rate results in a 0.309530 unit increase in the current Inflation, and the coefficient is not statistically significant ($t = 1.76059$, $p < 0.05$). Additionally, a one-unit increase in the lagged volume of exports leads to a 2.20328 unit increase in the current volume of exports. The coefficient is statistically significant ($t = 5.36100$, $p < 0.01$), indicating a positive impact. Finally, a one-unit increase in the lagged volume of imports corresponds to a 1.01827-unit rise in the current volume of imports. The estimated coefficient is not statistically significant ($t = 1.01827$, $p < 0.01$), suggesting a positive effect.

Vector Error Correction Model (VECM)

The model estimated the Vector Error Correction Model since the cointegration test results indicated a long-term relationship between the variables. However, based on the VECM analysis (Appendix II), the coefficient of the lagged exchange rate of 1.000000 suggests that the lagged exchange rate is part of a long-term relationship with the other variables in the model, indicating that changes in the exchange rate are tied to the long-term dynamics of the system. Similarly, with a coefficient of 63.77633 and a significant t-statistic ($t = 8.23102$, $p < 0.01$), the lagged GDP growth rate contributes significantly to the cointegrating relationship, implying that the long-term equilibrium involves a relationship between the exchange rate and GDP growth rate. Moreover, the estimated coefficient of -1.957224 suggests that Inflation has a long-term relationship with the cointegrating equation. Also, the volume of exports and imports indicates a long-term relationship with the cointegrating equation.

Also, the VECM model output of the error correction terms, which provides the short-run adjustments required to bring the system back to its long-term equilibrium after a shock, indicates that the coefficient of the exchange rate difference of -0.018500 suggests that, on average, about 1.85% of the previous period's deviation from the long-term relationship is corrected in the current period. The coefficient of the GDP growth rate difference of -0.023226 indicates that approximately 2.32% of the previous period's deviation is corrected in the current period. Moreover, the positive coefficient of the inflation difference of 0.038010 implies that, on average, about 3.80% of the previous period's deviation from equilibrium is corrected in the current period. In addition, the coefficient of the export volume difference of 231019.8 suggests a relatively slow positive adjustment in the short term. Similarly, the coefficient of import

volume difference of -2830117 implies a negative short-term correction to the previous period's deviation.

Impulse Response

The study conducted an Impulse Response Analysis to analyze the pass-through effect of exchange rate shocks on exports and imports in Kenya. However, the results are presented in the table below.

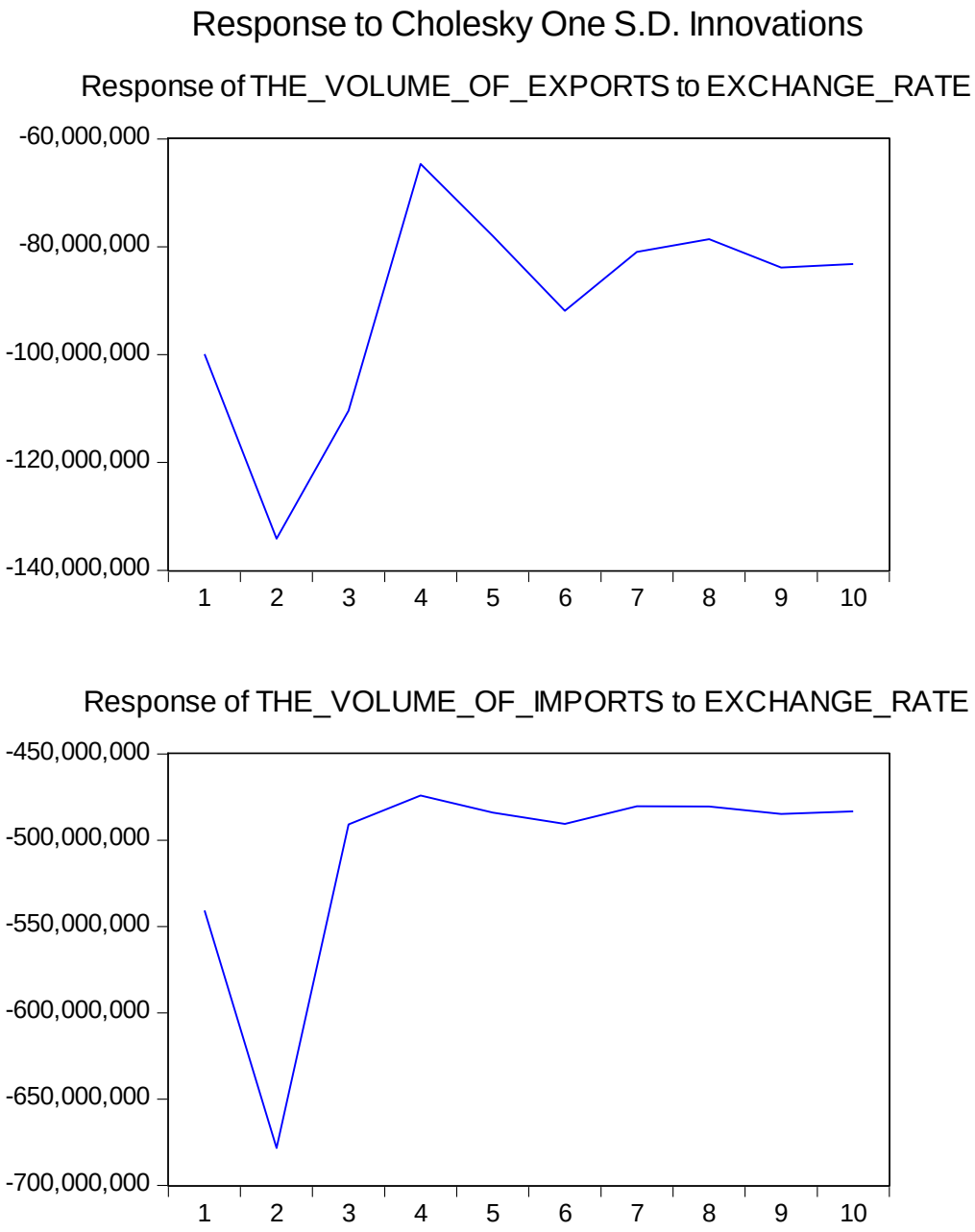

Figure 5: Exchange Rate Pass-Through Effect on Exports and Imports

Source: Author's Computation

Figure 5 presents the results of an Impulse Response Analysis, focusing on the response of the EXCHANGE RATE variable to shocks over 10 periods. Based on the above analysis, there is

International Journal of Economics
ISSN 2518-8437 (Online)
Vol.10, Issue 1, No.2. pp 39 - 67, 2025
www.iprjb.org

no instantaneous exchange rate pass-through effect on imports and exports. However, when the exchange rate increases, meaning an appreciation of the Kenya shilling against the U.S. Dollar, there will be a significant negative pass-through effect on the volume of imports. Between periods 2 and 3, a shock on the exchange rate increases instantaneously and remains relatively constant between periods 4 and 10, with a small positive effect on import volume. Even though the appreciation of domestic currency encourages importation, the decline in the volume of importation in the first period could be associated with slow price adjustment and over-reliance on imported commodities.

On the other hand, with an increase in the exchange rate in the first period, there is a sudden decline in the volume of exported goods between periods 1 and 2. Between the periods 2 and 3, the volume of exports increases suddenly, reaching high levels. Beyond period 4, the volume of exports declines at a small rate, indicating a negative exchange rate pass-through effect on the volume of exported goods.

Forecast Error Variance Decomposition

The study conducted a variance decomposition to understand the contribution of all indicators to the overall variability of exports and import volume in Kenya between 1990 and 2022. The results are presented in the figure below.

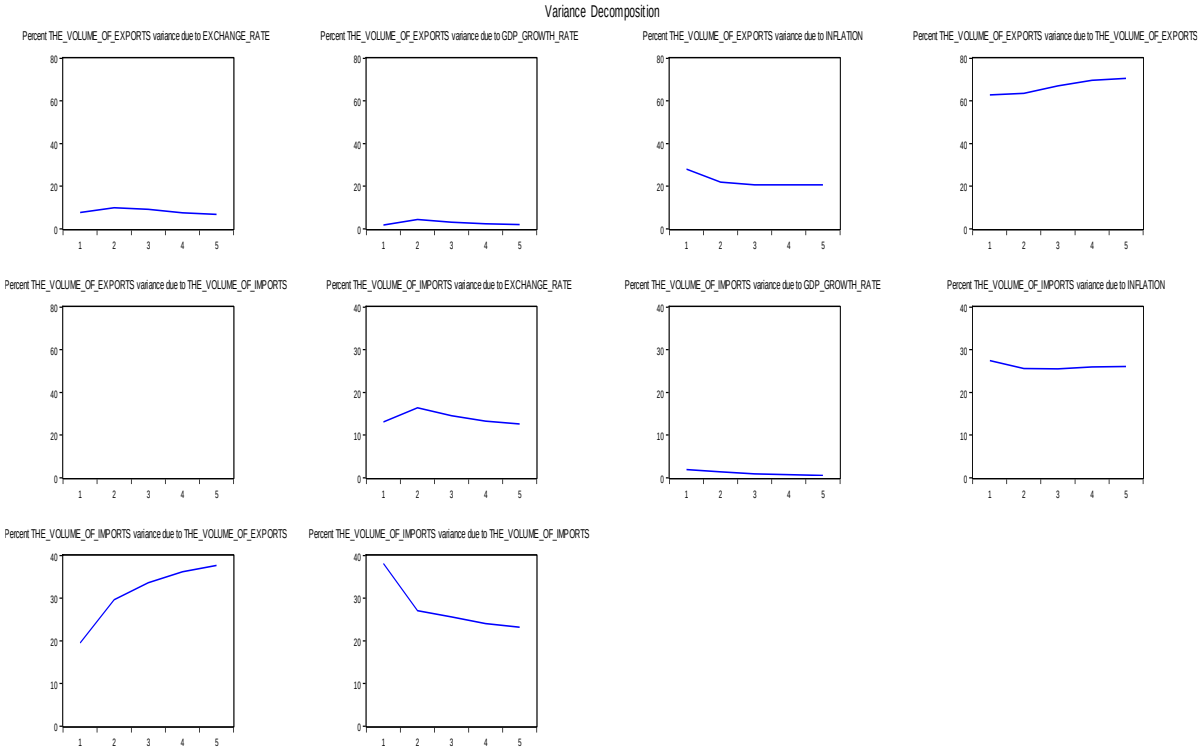

Figure 6: Variance Decomposition Results

Source: Author's Computation

Figure 6 demonstrates the variance decomposition of the macroeconomic indicators on the volume of exports and imports in Kenya's economy between 1990 and 2022. Based on the analysis, both Imports and Exports show a decreasing reliance on past shocks to explain forecast errors, indicating that the two indicators have no long-run interconnectedness. However, for the variance decomposition of Exports in period 1, according to Appendix IV, the majority (62.68%) of the forecast error variance in the volume of exports in the first period

is attributed to its historical shocks. In comparison, about 37.32% of the forecast error variance is attributed to shocks from other variables in the system. Between periods 2 and 10, the importance of own shocks decreases, and the contribution of shocks from other variables becomes more prominent. The contribution from shocks of other variables increases over time, with Inflation and exchange rate being the significant contributors.

Moreover, for the variance decomposition of the volume of imports, in period 1, a significant portion (38.14%) of the forecast error variance in the volume of imports is explained by its past shocks. In comparison, the rest of the variance (61.86%) is attributed to shocks from other variables in the system (Appendix IV). Between periods 2 and 10, the importance of own shocks decreases over time, reaching 21.53% by the 10th period. During the same period, the contribution from shocks of other variables increases; similar to Exports, the key contributors are Inflation and exchange rates.

Granger Causality

Granger Causality is an important technique for investigating whether a one- or two-way causality exists between variables. The study conducted a Granger causality test to examine whether the exchange rate, imports, and exports of Granger cause each other. The Granger causality results in Appendix V indicate one one-way causality between the exchange rate and GDP growth rate. Also, the exchange rate and Inflation rate have a one-way granger causality. Moreover, there is enough evidence to conclude that the exchange rate Granger causes the volume of exports, while the volume of Imports Granger causes the exchange rate. Moreover, the volume of exports and imports both Granger causes the Gross Domestic Product growth rate. Finally, the results indicate that the volume of exports Granger causes the volume of Imports.

Discussion

The study sought to investigate the exchange rate trends and the impulse response to exchange rate, exports and import shocks in Kenya between 1990 and 2023. However, data on macroeconomic indicators for the stated period was collected to achieve the study's primary objective. The findings of this study provide insight into the relationship between exchange rates, trade dynamics, and macroeconomic indicators and the implications of these factors on Kenya's economic performance. The upward trend in the exchange rate of the Kenyan Shilling against the U.S. Dollar between 1990 and 2022 signals a consistent depreciation of the Shilling. The observed upward trend in the exchange rate, indicating a depreciation of the Kenyan Shilling against the U.S. Dollar, is consistent with the experiences of many developing nations. The temporary appreciation during the 2008-2009 Global Financial Crisis aligns with the literature highlighting how economic uncertainties impact exchange rates. Despite occasional fluctuations, the sustained depreciation highlights the challenges faced by the economy of Kenya, resonating with the importance of maintaining a stable and competitive exchange rate for economic growth, as noted by the Central Bank of Kenya (2023) and (Terra, 2015).

Moreover, the persistent trade imbalance, characterized by imports consistently surpassing exports, reflects the challenges many developing economies face. The widening gap between exports and imports has majorly contributed to the depreciation of the Kenyan Shilling, which echoes the concerns raised in existing literature about the sustainability of trade deficits. This aligns with the discussion on exchange rate regimes, emphasizing the implications of such imbalances on a nation's economic stability (Melvin & Norrbin, 2023).

The study findings on the impulse response analysis shed light on the pass-through effect of exchange rate shocks on exports and imports. The significant negative pass-through effect on the volume of imports, especially when the exchange rate appreciates, aligns with expectations. The delayed response in export volumes to exchange rate shocks, with an initial decline followed by an increase and subsequent decline, reflects the complex dynamics of international trade. These findings are consistent with the broader literature emphasizing the impact of exchange rate movements on trade outcomes (Fratzscher et al., 2019).

Moreover, the variance decomposition results reveal a decreasing reliance on past shocks to explain forecast errors in imports and exports. The shift towards contributions from shocks of other variables over time shows the dynamic nature of economic indicators. The dominance of Inflation and exchange rates in explaining forecast errors aligns with their recognized roles in shaping trade outcomes. This is in line with existing literature that emphasizes the need for comprehensive analyses considering multiple factors in economic forecasting (Benedict et al., 2022).

Additionally, the Granger causality test results reveal the causal relationships within the economic system. The findings indicated that only one-way causality exists between the exchange rate and GDP growth, exchange rate and Inflation, and the two-way causality between export and import volumes, which resonates with the complex interdependencies inherent in economic variables. These findings align with the study conducted by Turna & Özcan (2021).

Conclusions and Policy Recommendations

In conclusion, the comprehensive discussion of the findings highlights the interconnectedness of economic indicators and their alignment with existing literature. The study provides valuable insights into Kenya's economic dynamics, emphasizing the impact of global events, policy interventions, and historical context.

In light of the identified depreciation of the Kenyan Shilling, policymakers should evaluate the efficacy of the existing exchange rate regime. Strategic interventions during volatility periods could curb adverse effects on trade balances. Additionally, addressing persistent trade imbalances requires a focus on bolstering exports through diversification and initiatives to fortify domestic production. Further, managing stable inflation rates, especially during global crises, should be a priority, emphasizing the need for stable prices amid changing global economic conditions. Moreover, Policymakers should consider creating incentives for local industries to become more competitive globally, thereby improving export performance. Also, managing stable inflation rates, especially during global crises, should be prioritized, emphasizing the need for stable prices amid changing global economic conditions.

The findings also demonstrate the importance of economic diversification beyond traditional sectors such as agriculture and tourism. Policymakers should prioritize investment in technology, green energy, and financial services to build resilience against external shocks. Furthermore, economic stakeholders, including businesses, investors, and trade organizations, should discuss these policy measures to align efforts with national economic goals. A coordinated approach between government, the private sector, and financial institutions will enhance the effectiveness of policies to stabilize the currency and promote sustainable economic growth.

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International Journal of Economics
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APPENDICES

Appendix I: Structural Vector Autoregressive Model Results

	ER	GGR	CPI	EV	IV
ER (-1)	0.747026	0.038616	-0.295085	6188865.	8405687.
	(0.08572)	(0.03229)	(0.11692)	(5471942)	(2.0E+07)
	[8.71495]	[1.19593]	[-2.52391]	[1.13102]	[0.41369]
GGR (-1)	-0.896947	0.018153	0.035532	53881425	33415848
	(0.50050)	(0.18854)	(0.68266)	(3.2E+07)	(1.2E+08)
	[-1.79211]	[0.09628]	[0.05205]	[1.68642]	[0.28166]
CPI (-1)	-0.190037	0.022068	0.309530	3755477.	638403.4
	(0.12890)	(0.04855)	(0.17581)	(8228357)	(3.1E+07)
	[-1.47433]	[0.45450]	[1.76059]	[0.45641]	[0.02089]
EV (-1)	-5.40E-10	2.60E-09	1.16E-09	1.073745	2.182240
	(3.1E-09)	(1.2E-09)	(4.3E-09)	(0.20029)	(0.74372)
	[-0.17206]	[2.20328]	[0.27122]	[5.36100]	[2.93421]
IV (-1)	9.16E-10	-7.46E-10	7.26E-11	-0.046088	0.323497
	(9.0E-10)	(3.4E-10)	(1.2E-09)	(0.05740)	(0.21313)
	[1.01827]	[-2.20278]	[0.05921]	[-0.80295]	[1.51781]
C	21.26606	-2.661004	24.57974	-3.70E+08	-2.31E+09
	(5.95548)	(2.24340)	(8.12305)	(3.8E+08)	(1.4E+09)
	[3.57084]	[-1.18615]	[3.02592]	[-0.97306]	[-1.63501]
R-squared	0.946994	0.379851	0.482574	0.975678	0.969165
Adj. R-squared	0.936801	0.260592	0.383069	0.971000	0.963235
Sum sq. resids	747.4333	106.0605	1390.520	3.05E+18	4.20E+19
S.E. equation	5.361663	2.019715	7.313107	3.42E+08	1.27E+09
F-statistic	92.90219	3.185088	4.849739	208.5950	163.4397
Log likelihood	-95.82058	-64.57841	-105.7532	-670.9195	-712.9006
Akaike AIC	6.363786	4.411151	6.984574	42.30747	44.93129
Schwarz SC	6.638612	4.685976	7.259400	42.58229	45.20611
Mean dependent	77.77507	3.640394	11.10983	3.91E+09	9.38E+09
S.D. dependent	21.32765	2.348811	9.310725	2.01E+09	6.63E+09

Determinant resid covariance (dof adj.)	2.49E+38
Determinant resid covariance	8.82E+37
Log likelihood	-1624.994
Akaike information criterion	103.4371
Schwarz criterion	104.8113

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www.iprjb.org

Appendix II: Vector Error Correction Model Output

Vector Error Correction Estimates
Date: 01/15/24 Time: 16:28
Sample (adjusted): 1992 2022
Included observations: 31 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
EXCHANGE_RATE(-1)	1.000000
GDP_GROWTH_RATE(-1)	63.77633
	(7.74829)
	[8.23102]
INFLATION(-1)	-1.957224
	(1.40559)
	[-1.39246]
THE_VOLUME_OF_EXPORTS(-1)	-1.74E-07
	(3.7E-08)
	[-4.68687]
THE_VOLUME_OF_IMPORTS(-1)	3.94E-08
	(1.1E-08)
	[3.56565]
C	21.79924

Error Correction:	D(EXCHANGE_RATE)	D(GDP_GROWTH_RATE)	D(INFLATION)	D(THE_VOLUME_OF_EXPORTS)	D(THE_VOLUME_OF_IMPORTS)
CointEq1	-0.018500	-0.023226	0.038010	231019.8	-2830117.
	(0.01425)	(0.00435)	(0.01950)	(795752.)	(3284288)
	[-1.29786]	[-5.33614]	[1.94929]	[0.29032]	[-0.86171]
D(EXCHANGE_RATE(-1))	-0.128381	-0.047416	-0.225150	9745250.	-7765585.
	(0.28577)	(0.08726)	(0.39091)	(1.6E+07)	(6.6E+07)
	[-0.44925]	[-0.54338]	[-0.57596]	[0.61088]	[-0.11794]
D(GDP_GROWTH_RATE(-1))	0.737872	0.357957	-0.962097	16470546	1.38E+08
	(0.68013)	(0.20768)	(0.93038)	(3.8E+07)	(1.6E+08)
	[1.08490]	[1.72361]	[-1.03410]	[0.43380]	[0.88380]
D(INFLATION(-1))	0.065311	-0.044802	0.045846	-8585230.	-23877285
	(0.19125)	(0.05840)	(0.26163)	(1.1E+07)	(4.4E+07)
	[0.34149]	[-0.76716]	[0.17524]	[-0.80411]	[-0.54185]
D(THE_VOLUME_OF_EXPORTS(-1))	1.06E-09	-1.70E-09	5.93E-09	0.057977	1.295685
	(5.3E-09)	(1.6E-09)	(7.3E-09)	(0.29834)	(1.23133)
	[0.19928]	[-1.04334]	[0.81116]	[0.19433]	[1.05227]
D(THE_VOLUME_OF_IMPORTS(-1))	-2.34E-10	2.65E-10	-2.26E-09	0.020402	-0.214224
	(1.3E-09)	(4.0E-10)	(1.8E-09)	(0.07274)	(0.30023)
	[-0.17986]	[0.66647]	[-1.26719]	[0.28047]	[-0.71354]
C	3.152629	0.351626	0.523164	1.49E+08	4.99E+08
	(1.83866)	(0.56144)	(2.51519)	(1.0E+08)	(4.2E+08)
	[1.71463]	[0.62629]	[0.20800]	[1.45104]	[1.17831]
R-squared	0.082204	0.638336	0.214710	0.123238	0.111911
Adj. R-squared	-0.147245	0.547920	0.018388	-0.095953	-0.110112
Sum sq. resids	1013.332	94.48408	1896.221	3.16E+18	5.38E+19
S.E. equation	6.497858	1.984146	8.888713	3.63E+08	1.50E+09
F-statistic	0.358268	7.059997	1.093661	0.562240	0.504051
Log likelihood	-98.03578	-61.26098	-107.7484	-651.0054	-694.9516
Akaike AIC	6.776502	4.403934	7.403121	42.45196	45.28720
Schwarz SC	7.100305	4.727738	7.726925	42.77576	45.61100
Mean dependent	2.914778	0.109945	-0.400891	2.03E+08	6.20E+08
S.D. dependent	6.066556	2.950980	8.971579	3.46E+08	1.42E+09

Determinant resid covariance (dof adj.)	4.08E+38
Determinant resid covariance	1.14E+38
Log likelihood	-1578.136
Akaike information criterion	104.3959
Schwarz criterion	106.2462

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ISSN 2518-8437 (Online)
Vol.10, Issue 1, No.2. pp 39 - 67, 2025
www.iprjb.org

Appendix III: Impulse Response Analysis Results

Effect of Cholesky One SD Exchange Rate Innovation		
Period	VOLUME OF EXPORTS	VOLUME OF IMPORTS
1	-99883287	-5.41E+08
2	-1.34E+08	-6.78E+08
3	-1.10E+08	-4.91E+08
4	-64648613	-4.74E+08
5	-78036089	-4.84E+08
6	-91897359	-4.91E+08
7	-80974496	-4.80E+08
8	-78588433	-4.80E+08
9	-83868074	-4.85E+08
10	-83208031	-4.83E+08

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Appendix IV: Forecast Error Variance Decomposition

Variance Decomposition of the VOLUME OF EXPORTS

Period	S.E.	EXCHANGE RATE	GDP GROWTH RATE	INFLATION	VOLUME OF EXPORTS	VOLUME OF IMPORTS
1	6.497858	7.582109	1.737362	28.00244	62.67809	0.000000
2	9.402588	9.896628	4.398395	21.86379	63.57791	0.263285
3	12.04221	9.203913	3.130415	20.53377	66.95307	0.178828
4	13.97459	7.464181	2.299837	20.58593	69.51841	0.131641
5	15.57737	6.684732	2.009775	20.64348	70.54412	0.117888
6	17.13475	6.444438	1.833462	20.4681	71.14952	0.104478
7	18.56091	6.106029	1.614813	20.40991	71.7775	0.091751
8	19.84771	5.818699	1.470925	20.41685	72.20968	0.083852
9	21.067	5.658641	1.383569	20.38759	72.49174	0.078461
10	22.23023	5.525999	1.299648	20.35795	72.74304	0.073363

Variance Decomposition of the VOLUME OF IMPORTS

Period	S.E.	EXCHANGE RATE	GDP GROWTH RATE	INFLATION	VOLUME OF EXPORTS	VOLUME OF IMPORTS
1	1.984146	13.0431	1.877075	27.42412	19.51994	38.13577
2	2.113121	16.39578	1.302147	25.61754	29.59593	27.08861
3	2.298059	14.49369	0.873707	25.47544	33.56506	25.59211
4	2.406609	13.21659	0.649764	25.95071	36.21546	23.96748
5	2.474045	12.54955	0.521503	26.08078	37.64998	23.19818
6	2.535453	12.15155	0.435513	26.15736	38.61652	22.63906
7	2.595686	11.8133	0.372783	26.23562	39.34208	22.23622
8	2.653809	11.55736	0.326394	26.30015	39.87305	21.94304
9	2.706727	11.3784	0.290791	26.33909	40.27638	21.71534
10	2.76007	11.23049	0.261996	26.37165	40.60446	21.53141

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www.iprjb.org

Appendix V: Granger Causality Test Results

Null Hypothesis:	Obs	F-Statistic	Prob.
GDP GROWTH RATE does not Granger Cause EXCHANGE RATE	32	0.36200	0.5521
EXCHANGE RATE does not Granger Cause GDP GROWTH RATE		8.06983	0.0081
INFLATION does not Granger Cause EXCHANGE RATE	32	0.50734	0.4820
EXCHANGE RATE does not Granger Cause INFLATION		7.95589	0.0086
THE_VOLUME OF_EXPORTS does not Granger Cause EXCHANGE RATE	32	4.01107	0.0546
EXCHANGE RATE does not Granger Cause THE VOLUME OF EXPORTS		1.09915	0.3031
THE VOLUME OF IMPORTS does not Granger Cause EXCHANGE RATE	32	5.17369	0.0305
EXCHANGE RATE does not Granger Cause THE VOLUME OF IMPORTS		2.12227	0.1559
INFLATION does not Granger Cause GDP GROWTH RATE	32	0.35641	0.5551
GDP GROWTH RATE does not Granger Cause INFLATION		4.4E-05	0.9947
THE VOLUME OF EXPORTS does not Granger Cause GDP GROWTH RATE	32	6.07311	0.0199
GDP GROWTH RATE does not Granger Cause THE VOLUME OF EXPORTS		2.69093	0.1117
THE VOLUME OF IMPORTS does not Granger Cause GDP GROWTH RATE	32	3.71120	0.0639
GDP GROWTH RATE does not Granger Cause THE VOLUME OF IMPORTS		0.40708	0.5285
THE VOLUME OF EXPORTS does not Granger Cause INFLATION	32	1.86760	0.1823
INFLATION does not Granger Cause THE VOLUME OF EXPORTS		0.25444	0.6178
THE VOLUME OF IMPORTS does not Granger Cause INFLATION	32	1.61756	0.2135
INFLATION does not Granger Cause THE VOLUME OF IMPORTS		0.25868	0.6149
THE VOLUME OF IMPORTS does not Granger Cause THE VOLUME OF EXPORTS	32	1.05535	0.3128
THE VOLUME OF EXPORTS does not Granger Cause THE VOLUME OF IMPORTS		12.7558	0.0013

Source: Author's Computation