Do exchange rates mediate the relationship between US interest rates, Global Commodity prices and the Kenyan Stock Market?

Akash Singh Dadhley – 137741

Submitted in partial fulfillment of the requirements for the Degree of

Financial Economics at Strathmore University

Strathmore Institute of Mathematical Sciences (SIMS)

Strathmore University

Nairobi, Kenya

2024

DECLARATION

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

Akash Dadhley ..... **[*Name of Candidate*]**

 ..... **[*Signature*]**

24/1/2024 ..... **[*Date*]**

This Research Project has been submitted for examination with my approval as the Supervisor.

Dr. Dan Chirchir ..... **[*Name of Supervisor*]**

 ..... **[*Signature*]**

24 Jan 2025 ..... **[*Date*]**

Strathmore Institute of Mathematical Sciences

Strathmore University

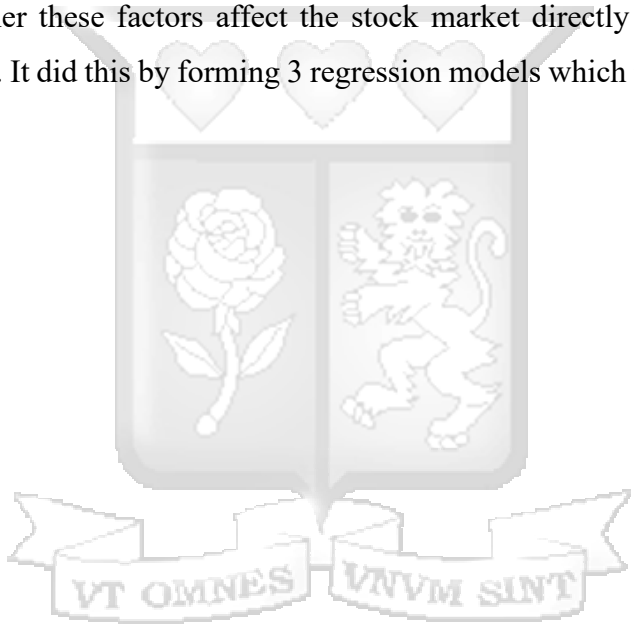
Contents

List of Figures

List Of Tables

Abstract

Previous research has shown the effect of the exchange rate on the local stock market, particularly the Nairobi Securities Exchange. In addition to this, various studies have been conducted to find out the effect of various macroeconomic factors as well as global external factors on the Nairobi Securities Exchange. This study aimed to combine all these elements together. There has not been a particular study to find out whether the exchange rate mediates the relationship between global external factors and the local stock market. Therefore, this research paper aimed to find out whether the exchange rate mediates the relationship between the KES/USD exchange rate as well as global commodity prices and the stock market in Kenya. In other words, the paper aimed to find out whether these factors affect the stock market directly or indirectly through exchange rates. It did this by forming 3 regression models which is a test for mediation.



Chapter 1: Introduction

1.1 Background of study

Growing economies like Kenya are presenting attractive business opportunities for foreign investors (Cavusgil, 1997). One of the avenues for investment include the Kenyan Stock Market.

According to (Kanini, 2015), the stock market is an avenue for transferring funds from investors to companies that need the financing. These companies that require the funding must be listed on the stock exchange and offer shares in exchange for funding. There have been various studies on various factors that affect the Nairobi Securities Exchange, including exchange rates.

A change in the demand and supply of a nation's currency can result in a shift in the value of one nation's currency relative to another. In addition to this, several factors affect the exchange rate including investments into the country, interest rates, inflation rates, money supply, etc. Moreover, (Mbithi, 2009) noted that companies listed on the Nairobi Securities Exchange are exposed to risk due to significant changes in the exchange rates.

Studies have demonstrated the impact of GDP, commodity prices(such as Oil), and exchange rates on security prices of listed companies in Nairobi. However, this paper shows the degree and extent to which US interest rates and global commodity prices affect the KES/USD exchange rate, and the impact of this on local stock prices. Therefore, it attempts to show whether these have a direct or indirect impact on the Nairobi Securities Exchange.

1.1.1 Global External Factors

A local stock market such as the NSE can also be affected by what is happening in the Global economy. However, the factors considered here are the US Interest rates, and global commodity prices.

The cost of borrowing money in an economy is referred to as interest rates. They play a crucial role as it affects consumer spending in an economy, business investment,

inflation as well as economic growth. The Federal Open Market Committee (FOMC), which is made up of five Federal Reserve Bank Presidents and seven governors of the Federal Reserve Board set interest rates in the US. Hence, we need to understand how strongly this decision will affect the KES/USD exchange rate, as well as actions by foreign investors regarding lending their capital to locally listed firms. Recently, the Federal Reserve has signaled a rate cut due to easing inflation and a cooling job market. Therefore, it is important to include this factor to enable us to understand how it will affect our local market.

On the other hand, commodities are raw materials to aid in output. Examples include coal, oil as well as gold. Unlike consumer products used for consumption, commodities serve as inputs. Therefore, they are included in the study to see whether movement in such prices affect local production costs and hence share prices. We also need to understand whether this figure affects exchange rates and if it captures the effect of movement in commodity prices on the local stock market (if any).

1.1.2 Foreign Exchange Rate

Foreign exchange rates refer to the price of one country's currency relative to another country's currency. Initially, exchange rates were determined by the adoption of the Structural Adjustment Programme (SAP) in 1986. However, thereafter Kenya adopted to a floating exchange rate system. Therefore, supply and demand affect the price of the currency of the Kenyan Shilling against various currencies such as the United States.

Companies are exposed to foreign exchange risk due to fluctuations in the supply and demand of the currency. For example, companies importing raw materials will witness an increase in their cost of production due to currency depreciation. This can therefore lower profit margins and thus reduce stock prices. Therefore, this was included in the model as it is important to see whether exchange rates have a mediating impact with regard to global external factors.

The reason for this study was the major volatility in the KES/USD exchange rate in recent years. For example, our currency significantly depreciated to lows of KSH 162 per USD in January 2024. In addition, foreign investors recently have been withdrawing their capital from our local markets.

1.1.3 Stock Market Performance

The effectiveness of a company's share trade on the stock market is referred to as stock market performance. However, the measurement of this concept is done using key indicators such as the NSE 20 Share index. This monitors the market capitalization-based performance of the top 20 equities.

The market capitalization of each listed company is multiplied by the respective share price then aggregated to compute the indices which reflect the overall stock market performance. If the index increases for example, it represents a collective movement in the stock prices of the companies therefore indicating the market is trending upwards.

Studying stock market performance is important for several reasons. Firstly, it represents as a measure of economic health, signifying investor confidence and economic growth. However, it is particularly relevant in this case as we want to know the effect of exchange rates on stock market performance as well as global external factors on the stock market.

1.1.4 Global External Factor and Stock Market Performance

US Interest Rates and Share prices in Kenya

Global capital flows have an impact on Kenyan share prices and interest rates in the US. Changes in the interest rates in the US affect global capital flows. For example, when the US interest rates fall, investors may shift capital towards emerging markets such as Kenya to achieve higher returns. This injection of capital into our local stock market will put an upward pressure on share prices as demand for Kenyan stock increase.

Commodity prices to share prices in Kenya

Global commodity prices influence share prices in Kenya. This is because commodity prices can affect inflation rates in the economy, which could lead to a rise in production costs of listed firms. This in turn leads to a fall in profit margin and therefore a decline in share prices of listed firms. For instance, a rise in oil prices increases transportation and production costs, which in turn leads to higher prices of products. This therefore

reduces consumer spending and corporate profits thereby negatively impacting stock prices.

1.1.5 Stock market in Kenya

According to (Odhiambo, 2014), stock market development is important in economic development. The Nairobi Stock Exchange was formed in 1954 with 46 listed companies as a principal stock exchange in Kenya. It operates under the oversight of the Capital Markets Authority (CMA) and includes a variety of securities including equities, bonds and derivatives. As mentioned earlier, there are 64 listed companies, which include retail investors, institutional investors and foreign investors. The portion of which foreign investors are significant and impacts market liquidity and volatility. In Q2 2023, foreign investor participation was 44.95%. Additionally, foreign investors held a 60% market share in equity trading on the Nairobi Securities Exchange.

There are currently 64 listed companies varying across eleven sectors such as Agriculture, Commercial and Services, Telecommunication and Technology, Automobiles and Accessories, Banking, Insurance, Investment, Manufacturing and Allied, Construction and Allied, Energy and Petroleum and Growth and Enterprise management segment. As of 7th May 2024, it had 9,539,700 shares traded with a market capitalization of KES 1,623.79 billion. There are roughly 17 million shares traded every day on the NSE.

1.2 Research Problem

Numerous studies have been conducted to demonstrate how fluctuations in currency rates impact the Nairobi Securities currency's performance. Research by (Nyamute, 1998) in Kenya looked at the connection between stock prices and financial variables such the money supply, interest rates, inflation rates, and currency rates. where a positive relationship between stock prices and exchange rates. In a similar vein, (Kisaka, 2008) investigated the same causal link and discovered a positive correlation between Kenyan stock prices and exchange rates. To demonstrate the same impacts. (Mwanza, The effect of foreign exchange rates on the performance of the Nairobi Securities Exchange, 2014) also employed a multiple linear regression using the NSE 20share index as the dependent variable and interest rates, inflation, and foreign exchange rates as the independent variables. The analysis discovered that the NSE's performance is not significantly impacted by exchange rates.

Even though there has been studies on the foreign exchange effects on a firms financial performance in Kenya (Mbithi, 2009), very few studies have been done on the extent market the exchange rate is explained through US Interest rates and global commodity prices as well as the relationship between these factors and the performance of the Kenyan stock market(if any).

Therefore, this study adds to the growing gaps of literature. This is because it adds to the literature of the effect of US Interest Rates and global commodity prices on the local stock market with which there is none. In addition, it adds to the literature of transmission mechanisms. It helps in investigating the specific channels through which the exchange rate affecting the NSE is essential.

Therefore, these studies discussed have shown varied results. This study, however, will contribute to the growing literature and bring more factors into the model. It will attempt to find out if the exchange rate takes care of the noise in terms of the US market and global macro factors. If it does, it will attempt to find out the impact on the Kenyan market.

1.3 Research Objectives

This research paper attempts to find out whether US interest rates and global commodity prices influence the Nairobi Securities Exchange as well as the strength and direction of the effect.

In addition to this, since we are attempting to find out whether these global macroeconomics factors are mediated by the exchange rate, we need to find out whether these global macroeconomic factors affect the exchange rate as well as the strength and direction of the impact.

Lastly, we will attempt to find out whether exchange rates mediate the impact between these global external factors and the exchange rate in Kenya.

1.4 Research Questions

The questions this paper attempts to answer are:

- Do US interest rates and global commodity prices have an impact on local stock market prices?
- Do these global external macro factors have an impact on the exchange rate?
- Does the exchange rate mediate the relationship between these factors and the local market or do these factors affect the local market directly?

1.5 Importance of the Study

This study can help retail as well as institutional investors in the Nairobi Securities Exchange. It can help them guide their investment decisions when buying securities in the Nairobi Securities Exchange. This is because if significant relationships exist between these factors and local stock prices, investors can use these rates to predict future stock prices.

The planning of capital raising by companies listed on the local stock market will also benefit from this study. If this study finds that foreign investors allocate their capital to the local stock market with movements in the US interest rate, it can help them plan and make sound decisions that resonate with the US interest rate. Commodity prices can also affect companies' profitability and financial stability. Therefore, businesses exposed to commodity prices risk need to account for this. Therefore, this study can enable them to make informed decisions about risk mitigation strategies.

In addition, it can help policymakers design more effective monetary and fiscal policies aimed at stabilizing the stock market during periods of exchange rate volatility or global economic uncertainty.

Moreover, this study can also help financial analysts and advisors to provide more accurate forecasts and recommendations to clients. Therefore, the results of this study can enhance the quality of investment advice.

It will also be significant since the results will advance both current knowledge and research. Additionally, it will greatly benefit the academic community in the field of financial economics and provide opportunities for others to conduct additional study in this field.

Chapter 2: Literature Review

2.1 Introduction

Moreover, what other researchers have done relating to this study is going to be explored and in addition, what they found out on a specific macroeconomic variable. It is also broken down into separate sections, firstly it looks at the theoretical framework that anchors the study. The second section looks at the factors affecting stock market performance and in addition, the final section summarizes some of the empirical research done by other researchers.

2.2 Share price and market theories

Investors and economic agents are interested in the prices of shares as it enables them to transfer wealth from the current period to future periods. They are therefore curious about the range of variables that influence share price fluctuations. The two primary hypotheses that aim to explain share price movement are the Behavioral Finance theory and the Efficient Market Hypothesis theory.

Efficient Market Hypothesis

This theory essentially holds that all information influencing a share price is promptly reflected in the price, with one main assumption that investors are rational. The theory was proposed in 1960 by (Fama, Efficient Capital Markets: A Review of Theory and Empirical Work , 1965). But during the following decades, an increasing number of investigations divided the theory into three categories: weak, semi-strong, and strong.

In 1970, Eugene Fama published in his article, the distinction between three forms of efficiency – weak, semi-strong and strong. Returning to (Fama, 1969), the weak form EMH states that prices reflect all historical information and therefore prices move according to a random walk. Therfore, investors cannot yield abnormal profits from investing in these assets.

The EMH in its semi-strong form, states that assets reflect all public information. Hence, this theory assumes that prices change rapidly to incorporate any other new public information in the market.

The strong form of EMH assumes that prices reflect all available information in the market, which includes all historical information regarding the share, all new public information (semi-strong form) and all private information regarding the financial asset. Therefore, an efficient stock market instantly takes into account all available information regarding economic variables if economic activity influences stock prices.Therefore, trading strategies cannot work in this form of efficiency and hence investors cannot consistently earn above average returns.

Behavioural finance theory

The foundation of EMH is the presumption that people are rational and act in their own best interests. However, over the years, other studies have emerged in which assumes that individuals are not always rational and security pricing should consider the behavior of investors. This led to another branch of finance referred to as behavioral finance. For example, behavioral finance suggests that markets could overreact or underreact to news and events which eventually leads to temporary mispricing of stocks. As a result, this could contribute significantly to share price movements.

(Sewell, 2007) defined behavioral finance as "the study of how psychology affects how financial professionals behave and how that influences markets." As a result, behavioral finance frequently aims to clarify how certain models might be built to forecast financial events when certain agents do not act entirely rationally.

Three heuristics—representativeness, overconfidence, and anchoring—that are used when making judgments in the face of uncertainty were outlined by two psychologists, Amos Tversky and Daniel Kahneman.

Representativeness is the tendency to make judgments based on stereotypes. For example, investors will assume that a company which has been enjoying healthy growth profits in the past will continue the same trend and enjoy healthy growth in profits in the subsequent years. However, they may not realize the random nature of profits of a firm and the past may not always be a representation of the future.

The second heuristic is overconfidence, which occurs when investors overestimate the accuracy of their projections due to their tendency to be overconfident. It is the result of a false sense of knowing. Additionally, it might be the result of people's experiences, even though most investors don't often beat the market.

The third heuristic is anchoring. When a relevant value (an anchor) is available, people in numerical prediction start with the anchor and alter it to get the final answer. This allows them to create estimates. Perhaps the anchor is recommended by the articulation of the issue, or it can be the outcome of an incomplete calculation. Adjustments are usually insufficient in both situations. People frequently refuse to modify their opinions once they have been formed, even in the face of pertinent new facts. Let's say that investors believe firm A has above-average long-term earnings potential. Abruptly, A announces substantially lower earnings than anticipated. Investors will continue to believe that the company is above average because to anchoring, and they won't respond appropriately to the negative news.

2.3 Exchange Rate Theories

The theories relating to exchange rates are discussed below:

Law of One Price

According to this law, similar products shall be offered for sale at the same price in several marketplaces. It helps in explaining arbitrage opportunities as well as the relationship between prices and exchange rates. If LOP does not hold, then arbitrage opportunities exist, which is a risk-free profit-making opportunity by buying low in one market and selling high in another market. Three presumptions must hold for the LOP to be valid. First, there should be no transaction costs. Second, there ought to be no trade restrictions like taxes or tariffs. Finally, the products need to be the same.

Purchasing Power Parity (PPP)

The concept dates back to the sixteenth century, and in 1918 Swedish economist Gustav Cassel developed it. It was created to illustrate how relative pricing levels and shifts in those levels affect exchange rates between two nations. Two justifications exist. According to absolute PPP, the ratio of a constant basket of goods between two countries should be the same as the exchange rate between two currencies. Conversely, relative PPP implies that the difference in the rates of price increases between two countries should match the rate of change in the exchange rate between the two. However, because of things like transaction costs, trade obstacles, and variations in the quality, this idea seldom holds up in the near run.

2.4 Factors affecting Stock Market Performance in Kenya

These variables will act independent and control variables to ensure that the results are attributed to the variables being tested and increases the reliability of the study in relation to global external factors and stock market performance.

1. GDP Growth of Kenya

In general, there tends to be a positive correlation between GDP and stock prices since GDP is associated with increased business activity and higher corporate earnings. This in turn leads to high stock prices as investors expect higher profits and returns from companies.

(Levine, 1998) investigated the connection between the stock market and economic expansion, with a major emphasis on the relationship between banks and found a strong positive correlation between stocks and GDP thereby showing a relationship.

2. Interest Rates

It plays a crucial role in an economy in terms of borrowing, spending as well as investor activity in a particular economy that has an overall effect on economic growth.

There is an expected inverse relationship between interest rates and stock market performance in Kenya. This could be explained by three reasons. Firstly, for example, as interest rates fall investors look for other investment alternatives like stocks in comparison to bonds, which leads to an increased demand for equities and hence better performance. In addition, when interest rates fall, it leads to cheaper borrowing. This encourages companies, particularly those listed on the stock exchange, to borrow and

hence invest those funds. This leads to increased earnings and hence an increase in stock prices. Moreover, interest rates are also used in valuation models. Therefore, a lower interest rate reduces the discount rate, which in turn increases the present value of future cash flow and potentially leads to higher stock prices.

There are various studies done in different countries, for example, (Arango, 2002) found a negative relationship between interest rates and stock prices. However, (Chirchir, 2014), additionally investigated the relationship between changes in interest rates and stock prices for Kenya from October 2002 to September 2012 and discovered no meaningful causal association between the two. The causal relationship's negative sign, however, lends some support to our theory.

3. Inflation Rates

There typically tends to be a negative relationship between inflation and stock prices as persistent inflation leads to increased production costs for companies. These cost pressures reduce profit margins which in turn leads to lower stock returns.

(Roll, 1983) did plenty of research in the area and found that stock returns are negatively related to both expected and unexpected inflation. They did point out that this did not suggest causation, though. Rather, because stock returns indicate a series of events leading to an acceleration of the rate of monetary expansion, they are perceived to be negatively correlated with changes in projected inflation that occur concurrently.

2.5 Empirical Evidence done from other researchers

(Mwanza, 2014) used a multiple regression analysis, representing the Nairobi Securities currency using the NSE20 share index, in order to investigate how foreign exchange rates affect the operation of the exchange. This approach was used to estimate how sensitive pricing fluctuations were. The findings indicate that foreign exchange rates influence stock values in a beneficial way.

However, even though these were contradicting views, another study was done during a different time period to show the effect of exchange rates on the local stock market. This study was done between January 2004 to December 2014 by (Mumbe, 2015). The study used a vector error correlation model and concluded that "the stock market and exchange rate market do not have a causal relationship." Thus, a study will be necessary

in this work to determine whether or not there is an influence in a relevant time period, even though the direction of the relationship between exchange rates and stock prices is unclear.

On the other hand, studies between GDP and stock prices were done by (Alexius & Spang, 2018). The study examined the long-term equilibrium relationship for the G7 countries between stock prices, domestic GDP, and trade-weighted GDP (foreign GDP). The average GDP of the G7's open economies is composed of 60% imports and 60% exports. Canada, France, Germany, Italy, Japan, the United States, and the United Kingdom are among its members. The empirical findings demonstrate that higher stock prices are typically seen in nations with faster GDP growth.

In addition, although significant studies have not been done on the relationship between U.S Interest rates and stock prices in Kenya in the Nairobi Securities Exchange(NSE), a study has been done on the relationship between share prices and interest rates in Kenya by (Chirchir, 2014) between the period October 2002 and September 2012. The methodology included Toda and Yamamoto(1995) method for causlity testing between the NSE 20 share index and the weighted average lending rate by commercial banks. The results showed “no signficant causal relationship between interest rate and share price.”

However, another study was done to show the effect of macroeconomic variables and stock market returns by (Kirui & Onono, 2014) in Kenya. Their model used the Engle-Granger two-step method and TGARCH model to analyse quarterly data from 2000 to 2012. Their key findings included that “exchange rate showed a significant relationship with stock returns whereas GDP, Inflation and Treasury bill rate indicated insignificant relationship.”

Lastly, a study was conducted to analyse the effects of commodity prices, in particular, oil prices on Stock Market performance in Kenya, (Gatuhi, 2013), focusing on diesel prices due to its industrial significance. Regression analysis is used in the study to look at the relationship between diesel prices, interest rates, exchange rates, and stock market performance. According to the study's findings, "the performance of the stock market is significantly correlated with both diesel prices and interest rates." On the other hand,

the link between interest rates and diesel prices is negative, despite the former being positive. The results also showed that, while there was a positive correlation between overall oil consumption and exchange rates and stock market performance, it was not statistically significant. Furthermore, because rising oil prices are frequently viewed as inflationary, this study recommends that policy makers take these macroeconomic factors into account when making decisions to lessen the effects of oil price shocks on the economy.

2.6 Conclusion

Therefore, it is clear that no study has been done to show whether the exchange rates have a mediating effect or whether these factors affect the local stock market directly. It is also shown how these factors affect the exchange rate as well as the Nairobi Securities Exchange. Therefore, this study will add to the growing literature of the Nairobi Securities Exchange and enable investors as well as other agents interested in the Nairobi Securities Exchange to make well informed decisions.

Chapter 3: Methodology

3.1 Research Design

Research design is an outline, framework, and approach for conducting an inquiry to find solutions to the problems or research questions. In order to examine secondary data and assess the research hypothesis, this study will employ an empirical design. This study design will contribute to the development of new results as well as expanding on what is already known in the field.

3.2 Population and sample design

There are several variables used in this study. Firstly, we are attempting to find out whether the interest rates in the United States and commodity prices influence the Nairobi Securities Exchange (NSE). To represent US interest rates, we will use the monthly data for the federal funds rate in the United States. Therefore, it will help us understand whether consumers allocate their capital in the United States or choose to diversify in avenues such as the Nairobi Securities Exchange. The S&P GSCI index (Goldman Sachs Commodity index) will be used in this study. This is because it tracks the performance of 24 commodity futures contracts across different sectors such as energy, agriculture, industrial metals and precious metals. In addition, these commodities affect our local firms listed on the NSE as they are used as inputs to the production process and variations in these prices can affect cost of production and hence profits. In addition, some firms are also exporters of such commodities.

To represent overall stock prices, the NSE 20 share index was selected as a proxy. This market capitalization weighted index tracks the top 20 companies listed on the securities exchange in terms of performance. Moreover, the other regression analysis involves finding whether these factors have an impact on the exchange rate. The other variable added to the regression are exchange rates stated as the number of Kenya shillings that one US dollar can buy. The last regression analysis involves all these variables and hence the same data is used to perform the regression analysis. All consists of average monthly observations from January 2019 to December 2023.

Control variables will also be added to the model. These control variables include the Gross Domestic Product (GDP) of Kenya as it affects the overall economic activity and hence the local stock market. In addition, the inflation rate of Kenya as it affects the overall purchasing power and hence investment decisions of firms and individuals. Lastly, interest rates in Kenya are also included as they influence borrowing costs and thus investor behavior.

3.3 Data Collection Method

The data depends on secondary data collected from various sources. The NSE20 index data is collected from the Nairobi Securities Exchange. The exchange rate data is collected from the Central Bank of Kenya. In addition, the federal funds rate which is used to represent the interest rates is obtained from the Federal Reserve Economic Data (FRED). It is maintained by the Federal Reverse Bank of St. Louis. The S&P GSCI index is obtained from various credible sources such as yahoo finance. The data for the control variables, such as GDP growth, interest rates and inflation rates are obtained from the Central Bank of Kenya.

3.4 Data Analysis Method

This involves testing the mediating effect. Before going into the details of this test, it's important to look at the work of (Baron & Kenny, 1986) where they state it is important to distinguish between moderator and mediator variables and why they cannot be used interchangeably. This study elucidates the concept of moderator factors, which are variables that impact the direction and intensity of the link between an independent and dependent variable. These variables might be quantitative (reward level) or qualitative (gender, race). Conversely, mediator variables can be used to test a causal chain using a set of regression equations and describe the process by which an independent variable effects a dependent variable. Thus, the purpose of this study is to precisely check for mediation.

We first introduce a route diagram as a model for illustrating a causal chain in which three variables are involved: the independent variable, the mediator, and the outcome (dependent) variable. This will help better comprehend what mediation means. As a result, the independent variable's direct impact and the mediator's impact are the two pathways that feed into the outcome variable.

There is also the path from the independent variable to the mediator. According to (Baron & Kenny, 1986) a variable function as a mediator the following conditions are met:

i. Variations in levels of the independent variable significantly account for variations in the presumed mediator
ii. Variations in the mediator significantly account for variations in the dependent variable
iii. When the first two are controlled, a previously significant relation between the independent and dependent variables is no longer significant, with the strongest demonstration of mediation occurring when Path c is zero.

Consequently, three regression equations should be used to test for mediation, and distinct coefficients for each equation should be estimated and tested.

Regression 1

The first regression involves regressing the mediator on the independent variable. In this case, it involves regressing the exchange rate on the global external factors as represented below:

$$\boldsymbol{Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \varepsilon}$$

Dependent variable Y – Foreign exchange rate obtained from Central Bank of Kenya website.

Independent variable $\boldsymbol{X_1}$ – Federal funds rate; used as a representative of US interest rates

Independent variable $\boldsymbol{X_2}$ – S&P GCSI index; used as a representative of commodity prices.

βo – Constant term

βi – Sensitivity of an exchange rate i to a set of k variable

ε – Error term

Regression 2

The second regression involves regressing the dependent variable on the independent variable which is the NSE20 index against the global external factors while including some control variables as represented below:

$$\boldsymbol{Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + B_5 X_5 + \varepsilon}$$

Dependent variable Y – NSE20 index.

Independent variable X_1 – Federal funds rate; Used to represent interest rates in the United States. It is set by the Federal Open Market Committee (FOMC) of the Federal Reserve and is a key tool of monetary policy.

Independent variable X_2– S&P GCSI index; used as a representative of commodity prices.

Control variable X_3 – GDP growth of Kenya; used as a control variable.

Control variable X_4 - Interest Rates in Kenya; used as a control variable/

Control variable X_5 – inflation rates in Kenya; used as a control variable.

βo – Constant term

βi – Sensitivity of a stock i to a set of k variable

ε – Error term

Regression 3:

Lastly, it involves regressing the dependent variable on both the independent variable and the mediator which is represented below.

$$\boldsymbol{Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + B_5 X_5 + B_6 X_6 + \varepsilon}$$

Dependent variable Y – NSE20 index

Independent variable X_1 – Foreign exchange rate represented by the Kenyan Shilling price of one U.S dollar obtained from Central Bank of Kenya website.

Independent variable X_2 – Federal funds rate; Used to represent interest rates in the United States. It is set by the Federal Open Market Committee (FOMC) of the Federal Reserve and is a key tool of monetary policy.

Independent variable X_3– S&P GCSI index; used as a representative of commodity prices.

Control variable X_4 – GDP growth of Kenya; used as a control variable.

Control variable X_5 - Interest Rates in Kenya; used as a control variable.

Control variable X_6 – inflation rates in Kenya; used as a control variable.

βo – Constant term

βi – Sensitivity of a stock i to a set of k variable

ε – Error term

Therefore, the specific test in terms of mediation is the three regression equations formed. In addition to this, the null hypothesis is the independent variable does not affect the dependent variable through the mediator and this therefore means:

i. The coefficient of the global external factors in the first equation is zero
ii. The coefficient of the global external factors is zero in the second equation
iii. The coefficient of the exchange rates is zero in the third equation

Therefore, a rejection of the null hypothesis means that mediation is present. This test is important as it helps determine if the mediator variable, which is the exchange rates, explains the relationship between the global external factors and the local market represented by the NSE20 index.

Our data analysis method includes various regression models. However, when performing a regression analysis several assumptions need to be met for the model to be valid. Hence, we will perform the diagnostic tests to ensure that these assumptions are met:

I. **Linearity**

This indicates that there is a linear relationship between each predictor variable and the dependent variable. This ought to be true for all three of the regressions in which there is a linear relationship between the independent, mediator, and dependent variables. This is crucial because the model's predictions could be skewed or inaccurate if the relationship is not linear.

Testing for Linearity

The best plot to use when assessing linearity is a residual plot. A plot of the independent or predictor variables on the horizontal axis and the residuals (errors) on the vertical axis is part of this. We shall carry out this action for every regression.

When creating the plot, a linear relationship is indicated if the residuals are dispersed randomly and lack a discernible pattern along the x axis. However, non-linearity is implied if patterns, like a curve, are displayed.

Addressing the model in case of non-linearity

In the event that the models prove to be non-linear, the relationship will be linearized by transforming the independent, mediator, and outcome variables. The variables' square or logarithmic roots may be included in this.

II. **Independence of Errors (Autocorrelation)**

An essential component of a linear regression model is this. This suggests that the model's errors ought to be independent of one another and change across observations. This holds relevance for statistical inferences since it may result in understated standard errors, which in turn produce skewed significance tests.

Testing for Independence of Errors

In this test, we'll look for evidence of both the independence of the errors and the presence of a significant autocorrelation, or significant correlation, between the errors. The Durbin Watson Test (DW), which determines whether autocorrelation is present, will be used. To execute it, the DW statistic is utilized:

$$\frac{\sum_{t=2}^{n}(e_t - e_{t-1})^2}{\sum_{t=1}^{n} {e_t}^2}$$

The value ranges from 0 to 4 where:

- A value close to 2 suggests no autocorrelation
- A value below 2 indicates positive autocorrelation
- A value above 2 indicates negative autocorrelation

Addressing Non-Independence of Errors

We could add lag variables for the predictors or the dependent variable if the regression is formed and it is discovered that the errors are not independent.

III. **Homoscedasticity**

Another crucial premise in classical linear regression is homoscedasticity, which holds that the variance of the error terms is constant. This will suggest that the confidence

intervals are reliable because the estimated coefficients are impartial and effective and the standard errors are precise.

Testing for Homoscedasticity

We will use the formal homoscedasticity test, the Breusch-Pagan test, to determine whether there is homoscedasticity. The process will go like this: first, the regression will be done in order to determine the residuals. The residuals will next be squared and regressed on the initial independent variable. Finally, a chi-squared distribution will be used to analyze the test statistics. The presence of heteroscedasticity is shown by a p-value less than 0.05.

Addressing Heteroscedasticity

We can apply transformations to the predictor variables or dependent variables to address heteroscedasticity and stabilize the variance. A log transformation or a square root transformation might be used in this situation.

IV. **Normality of Errors**

Given that it presumes that the residuals or mistakes in each regression have a normal distribution, this is a crucial assumption. This is significant because it makes the confidence interval tests and t-tests for the regression coefficients valid.

Testing for Normality of Errors

We can create a quantile-quantile (Q-Q) plot, which compares the quantiles of the residuals with the quantiles of a normal distribution, to test for the normality of errors. By doing this, it is ensured that the residuals have a normal distribution, and if that is the case, the points should fall on the diagonal line.

Addressing non-normality of errors

We can use transformations like logarithmic or square root to change our variables if it turns out that the errors are not normally distributed.

V. **No multicollinearity**

Furthermore, the independent variables in our regression need not have a strong correlation with one another for it to be valid. The coefficient estimations may vary

significantly as a result of this. Furthermore, it may have an impact on hypothesis test results, resulting in misunderstandings.

Testing for multicollinearity

In order to test multicollinearity we can use the Variance Inflation Factor (VIF). This is calculated using the formula:

$$\frac{1}{1 - R_i^2}$$

Where R_i^2 is the coefficient of determination from the regression of predictor i on the remaining predictors.

Addressing in the case of multicollinearity

It is possible to eliminate the highly correlated predictors from the model if there is severe multicollinearity.

Finally, it is critical that time series be stationary when working with time series models. This indicates that there is no long-term variation in the mean or variance. This is critical because projections and model estimations that are based on non-stationarity may be inaccurate.

Chapter 4: Data Analysis and Interpretation

4.1 Introduction

We begin by providing the descriptive statistics which help describe and give a picture of the data under the study. In addition to this, this chapter describes all the tests done to ensure the assumptions are met with the econometric model to provide reliable estimates. Finally, the findings of the inferential analysis are presented to determine the acceptance of the research hypotheses.

4.2 **Descriptive Statistics**

The summary statistics for the variables are displayed below. These variables include the NSE20 index, the KES/USD exchange rate, the Federal Funds Rate, S&P GSCI index, GDP of Kenya, Interest Rates of Kenya as well as Inflation Rates of Kenya. The summary statistics include the mean, median, maximum, minimum, standard deviation, skewness and kurtosis of the monthly data obtained. Mean refers to where the center of the data lies, standard deviation is a measure of the spread of the data. In addition, skewness is a measure of negative or positive symmetry of a symmetry of a distribution of a series around its mean, and kurtosis is a measure of the fat tails of the distribution.

	NSE20	KES_USD	FED_FUNDS	SP_GSCI	GDP	Interest Rates	Inflation
Mean	1973.455	114.7465	0.01864333	505.0152	25668.18	0.081875	0.06259333
Median	1864.4	109.8461	0.0155	524.905	26022.95	0.07875	0.0594
Maximum	2949.2	153.2353	0.0533	786.45	29137.62	0.125	0.0878
Minimum	1457.6	100.0428	5e-04	255.54	18703.19	0.07	0.0465
Std. Dev.	410.8059	13.93445	0.0191317	124.7726	2438.204	0.01314541	0.01239004
Skewness	0.98784	1.288436	0.6596212	0.09135794	-0.8983549	0.9280205	0.805616
Kurtosis	2.748767	3.749426	2.012874	2.343813	3.310332	3.362474	2.390452
Obs.	60	60	60	60	60	60	60

Table 1Summary Statistics

The data shows there is high spread of the NSE20 and the GDP of Kenya. This implies it significantly deviates from the mean and hence it implies the NSE20, and the GDP of Kenya are highly variable.

Furthermore, all of the data tend to have fat tails and a high peak, which is known as a leptokurtic distribution.

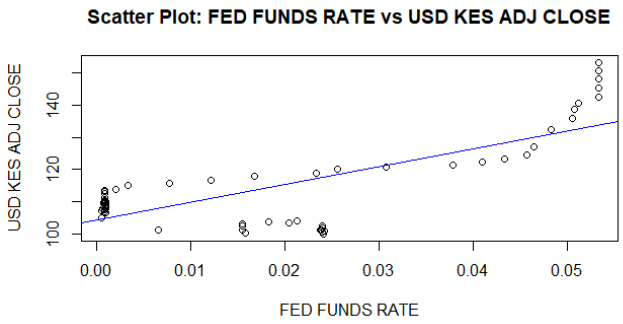
4.3 Diagnostic Tests

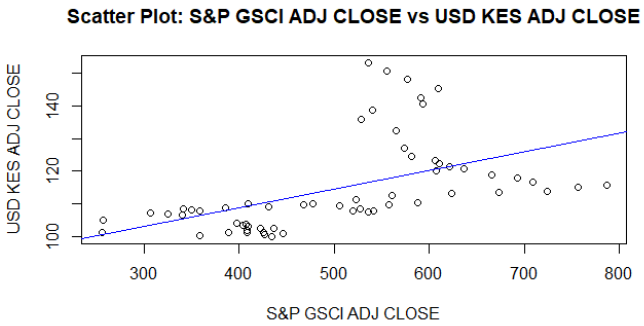
Before talking about the statistical test results, a few diagnostic tests were run to make sure the findings were reliable and the coefficients were accurate. The tests include the test for linearity, autocorrelation, homoscedasticity, normality of errors and multicollinearity. The tests are described below as well as the transformations necessary for the assumptions to hold.

4.3.1 Test for Linearity

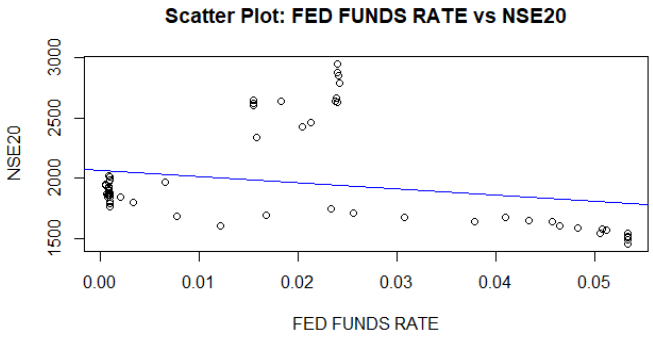
For accurate and reliable estimates of the predictors the relationship between each predictor variable and dependent variable should be linear. This ought to be true for all the regressions to ensure the estimates are not skewed. To test for linearity a plot of the dependent variable against each predictor variable was done in each of the regressions. If the relationship is approximately linear, a roughly straight-line trend in the scatter plot should be seen between the dependent variable and each predictor. A straight line trend in all the plots confirms the linear relationship between each of the predictors and the dependent variable. Results of the study are shown in the figures below.

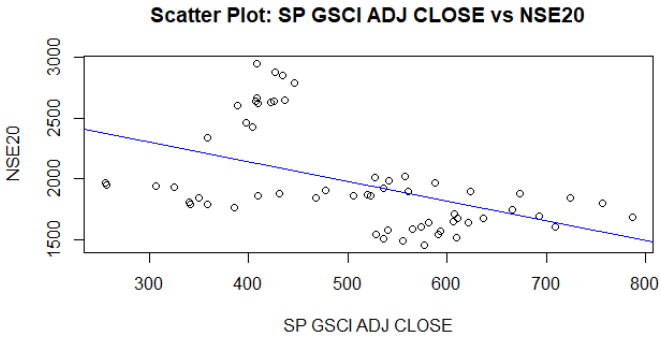
Regression 1

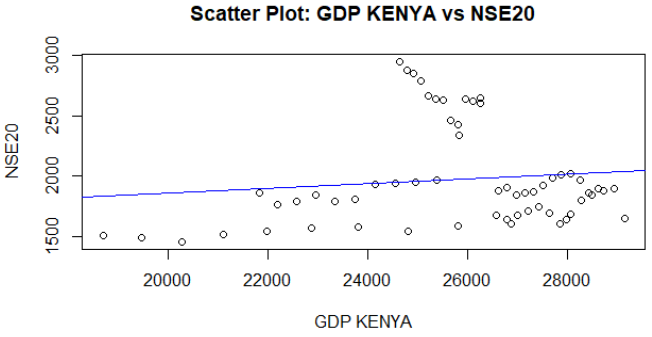


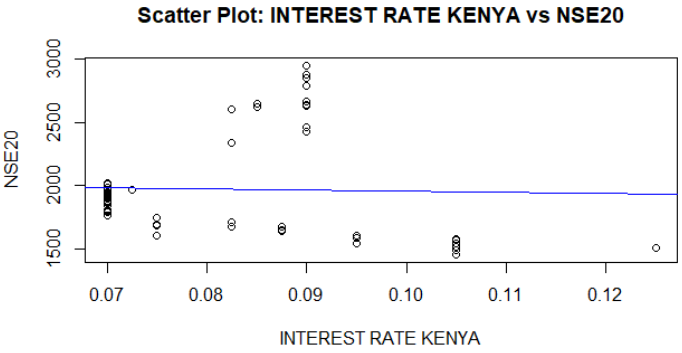


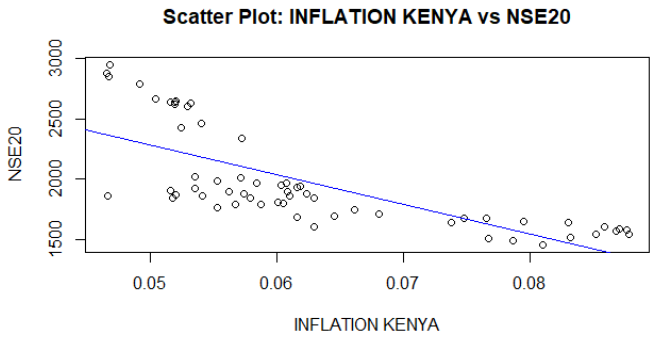
Regression 2



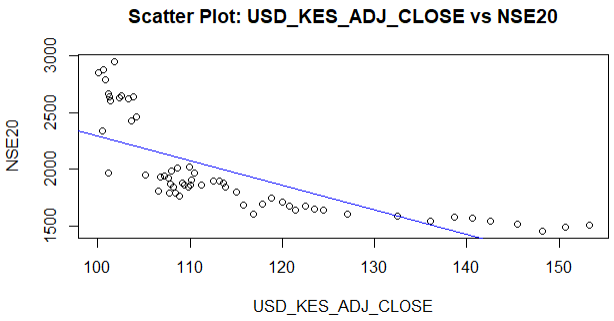


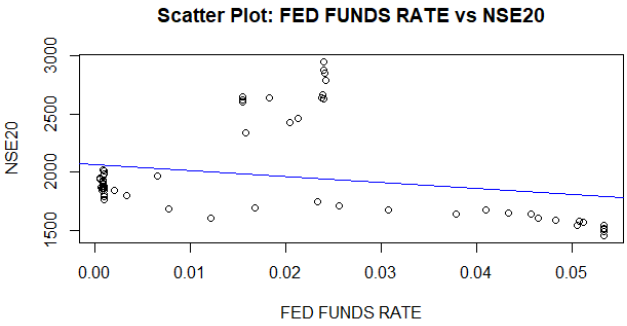






Regression 3





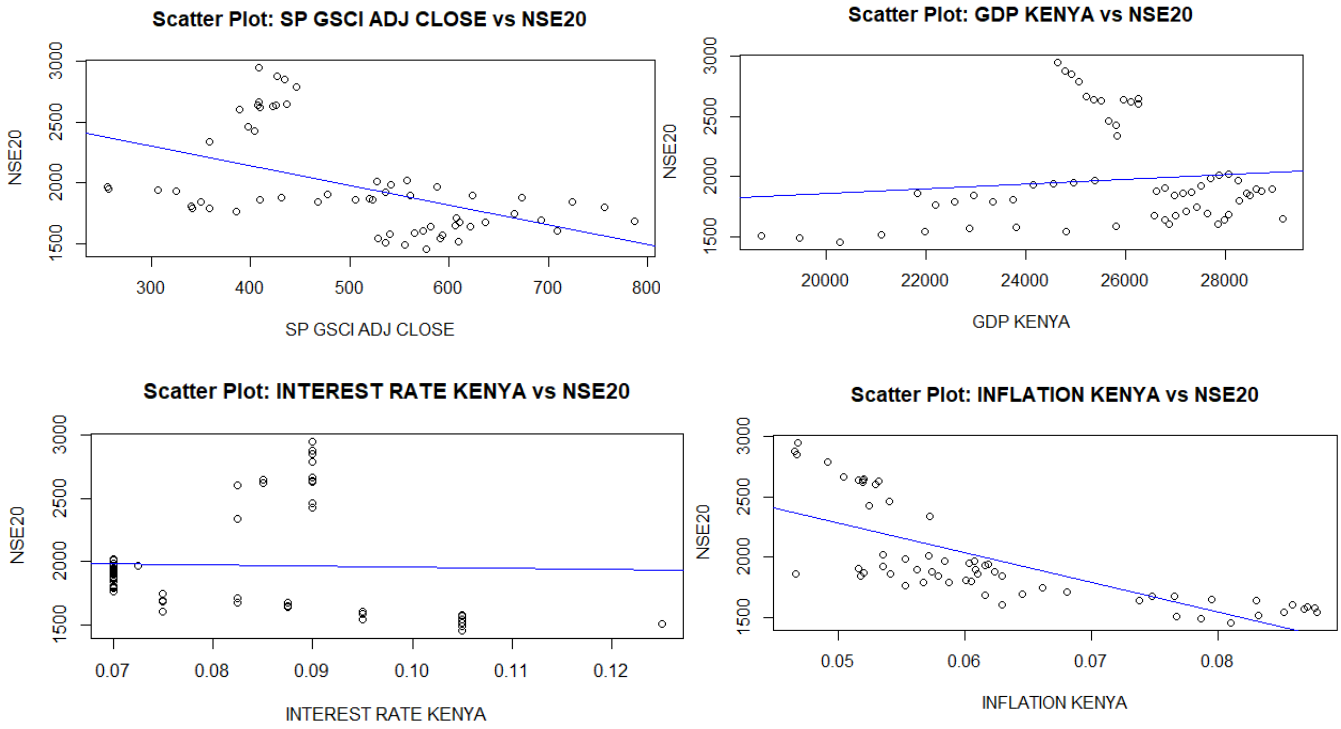


Figure 1Linearity Tests

4.3.2 Testing for Independence of Errors (Autocorrelation)

An essential component of a linear regression model is for the errors to be independent of one another. If this does not hold it may result in understated standard errors which in turn can skew the significance tests. The Durbin Watson test in R is used for this test, and the results are shown below. No autocorrelation is indicated by a value near 2.

Regression 1

```
        Durbin-Watson test

data:  reg_1
DW = 0.083673, p-value < 2.2e-16
alternative hypothesis: true autocorrelation is greater than 0
```

Figure 2 DW Test Regression 1

This implies that A DW statistic close to 0 (like 0.083673) suggests a strong positive autocorrelation in the residuals, meaning that residuals from one observation are positively correlated with residuals from previous observations. This violates the assumption of independence of errors. To address this, lagged variable of the KES/USD exchange rate was included as a predictor variable. This led to a DW test of:

```
        Durbin-Watson test

data:  reg_1_lagged
DW = 2.0119, p-value = 0.358
alternative hypothesis: true autocorrelation is greater than 0
```

Figure 3 Lagged DW Test Regression 1

This test shows a DW test statistic of 2.0119. The null hypothesis is that there is no autocorrelation and since the p-value is relatively high it implies there is not enough evidence to reject the null hypothesis of no autocorrelation.

Regression 2

The results for the DW test for the second regression are shown below:

```
        Durbin-Watson test

data:  reg_2
DW = 0.73967, p-value = 1.836e-10
alternative hypothesis: true autocorrelation is greater than 0
```

Figure 4 DW Test Regression 2

A DW test statistic of 0.73967 implies strong positive autocorrelation. In addition, the small p-value implies there is enough evidence to reject the null hypothesis of no autocorrelation. To address this, we can use robust standard errors that will be used in the statistical tests. The robust standard errors are shown below:

```
t test of coefficients:

                      Estimate  Std. Error t value  Pr(>|t|)
(Intercept)          1.6003e+03  8.3408e+02  1.9187   0.06032 .
FED_FUNDS_Rate       9.2752e+03  6.4735e+03  1.4328   0.15768
SP_GSCI_ADJ_CLOSE   -1.1396e+00  1.9527e-01 -5.8362 3.118e-07 ***
GDP_KENYA            7.1057e-02  7.5645e-03  9.3935 5.970e-13 ***
INTEREST_RATE_KENYA  1.3935e+04  8.4533e+03  1.6484   0.10507
INFLATION_KENYA     -3.4973e+04  3.9050e+03 -8.9558 2.918e-12 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Figure 5 DW RSE Regression 2

Regression 3

The results for the DW test for the 3rd regression is shown below:

```
        Durbin-Watson test

data:  reg_3
DW = 0.96364, p-value = 1.08e-07
alternative hypothesis: true autocorrelation is greater than 0
```

Figure 6 DW Test Regression 3

The DW statistic of 0.96364 implies strong positive autocorrelation and a low p-value implies there is enough evidence to reject the null hypothesis of no autocorrelation. Similarly, to address this we can use robust standard errors which will be used in the statistical tests. These are shown below:

```
t test of coefficients:

                       Estimate  Std. Error t value  Pr(>|t|)
(Intercept)          3.7983e+03  7.3796e+02  5.1471 3.949e-06 ***
USD_KES_ADJ_CLOSE   -2.7576e+01  4.7493e+00 -5.8064 3.674e-07 ***
FED_FUNDS_Rate       2.6331e+03  4.6316e+03  0.5685 0.5720993
SP_GSCI_ADJ_CLOSE    1.4826e-01  2.6876e-01  0.5516 0.5835206
GDP_KENYA            8.2873e-03  1.1910e-02  0.6958 0.4895771
INTEREST_RATE_KENYA  2.3034e+04  5.9368e+03  3.8799 0.0002909 ***
INFLATION_KENYA     -1.4110e+04  4.5647e+03 -3.0912 0.0031750 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Figure 7 DW RSE Regression 3

4.3.3 Testing for Homoscedasticity

This test determines whether the error terms' variance is constant. This assumption is important to hold true to ensure that the confidence intervals are trustworthy, and the standard errors are precise which can be used in hypothesis tests. To test of homoscedasticity, the Breusch-Pagan test is employed. The null hypothesis implies homoscedasticity is present whereas the alternative implies heteroscedasticity is present and hence the variance of errors is not constant. Heteroscedasticity is present if the p-value is less than the selected significance level of 0.05, which indicates that the null hypothesis is rejected. The results for the regressions are shown below.

Regression 1

```
        studentized Breusch-Pagan test

data:  model_lagged
BP = 3.1662, df = 3, p-value = 0.3667
```

Figure 8 Homoscedasticity Test Regression 1

The high p-value of 0.3667 is higher than the significance level of 0.05, indicating the presence of homoscedasticity and insufficient evidence to reject the null hypothesis.

Regression 2

```
        studentized Breusch-Pagan test

data:  reg_2
BP = 8.4798, df = 5, p-value = 0.1317
```

Figure 9 Homoscedasticity Test Regression 2

The high p-value of 0.1317, which is greater than the significance level of 0.05 implies there is not enough evidence to reject the null hypothesis and hence homoscedasticity is present.

Regression 3

```
        studentized Breusch-Pagan test

data:  reg_3
BP = 11.603, df = 6, p-value = 0.07143
```

Figure 10 Homoscedasticity Test Regression 3

The p-value of 0.07143, which is greater than the significance level of 0.05 implies there is not enough evidence to reject the null hypothesis and hence homoscedasticity is present.

4.3.4 Testing for Normality of Errors

An important assumption for a regression analysis to hold true is that the residuals or errors have a normal distribution. This is important as it leads to reliable and accurate estimates of the coefficients of the predictors. In addition, it makes the confidence interval tests and t-tests for the regression coefficients valid. To test for normality of errors, the Shapiro-Wilk test is implied. The residuals are assumed to be normally distributed by the null hypothesis. The null hypothesis is rejected and it is suggested

that the residuals are not normally distributed if the p-value is less than the selected significance level of 0.05. The results for the regressions are shown below.

Regression 1

```
        Shapiro-Wilk normality test

data:  residuals(model_lagged)
W = 0.8004, p-value = 1.381e-07
```

Figure 11 Normality Test Regression 1

The small p-value of 1.381e-07 which is less than the significance level of 0.05 implies we reject the null hypothesis of normality of errors. In order to fix this, I used a log transformation to shift the regression's dependant variable to the log of the KES/USD exchange rate. Then came the Shapiro-Wilk test results.

```
        Shapiro-Wilk normality test

data:  residuals(model_1_transformed)
W = 0.98559, p-value = 0.7009
```

Figure 12 Log Normality Transformation Regression 1

The p-value of 0.7009 implies we fail to reject the null hypothesis and thus the assumption of normality of errors is satisfied.

Regression 2

```
        Shapiro-Wilk normality test

data:  residuals(reg_2)
W = 0.95441, p-value = 0.02524
```

Figure 13 Normality Test Regression 2

The p-value of 0.02524, implies we reject the null hypothesis of normality of errors. To address this, robust standard errors are used which can be used in the hypothesis tests. The results are shown below.

```
t test of coefficients:

                       Estimate  Std. Error t value  Pr(>|t|)
(Intercept)          7.2926e+00  3.8159e-01 19.1111 < 2.2e-16 ***
FED_FUNDS_Rate       3.2632e+00  2.9436e+00  1.1086   0.27253
SP_GSCI_ADJ_CLOSE   -5.7828e-04  9.1327e-05 -6.3320 4.983e-08 ***
GDP_KENYA            3.6134e-05  3.6168e-06  9.9906 7.071e-14 ***
INTEREST_RATE_KENYA  6.8406e+00  3.8693e+00  1.7679   0.08272 .
INFLATION_KENYA     -1.5669e+01  1.7204e+00 -9.1079 1.678e-12 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Figure 14 Normality RSE Regression 2

Regression 3

```
        Shapiro-Wilk normality test

data:  residuals(reg_3)
W = 0.97389, p-value = 0.2253
```

Figure 15 Normality Test Regression 3

The p-value of 0.2253 implies that you fail to reject the null hypothesis of normality of errors. This implies that the assumption of normality holds.

4.3.5 Testing for multicollinearity

Multicollinearity implies when one of the predictors has an exact linear relationship with another. This is a problem as to estimate B-hat OLS, X must be invertible. To be invertible, any two columns should not have an exact linear relationship with another column. Therefore, B-hat OLS cannot be estimated when it is exactThe Variance Inflation Factor (VIF) test is used to check for multicollinearity. Multicollinearity is indicated by a VIF value of 10 or higher. The results are shown below

Regression 1

```
 FED_FUNDS_Rate SP_GSCI_ADJ_CLOSE        Lag_USD_KES
       2.417950           1.409458           3.026039
```

Figure 16 Multicollinearity Test Regression 1

The results imply there is no multicollinearity present.

Regression 2

FED_FUNDS_Rate	SP_GSCI_ADJ_CLOSE	GDP_KENYA	INTEREST_RATE_KENYA
19.287611	1.956441	2.504338	14.202667

INFLATION_KENYA
4.495891

Figure 17 Multicollinearity Test Regression 2

The high VIF values of 19.287611 and 14.202667 for Fed Fund Rate and Interest Rate suggest that these predictors are highly correlated with other predictors in the model. One of the solutions is to drop a variable if it is not a variable of interest. Therefore, dropping interest rates from the regression leads to these results.

FED_FUNDS_Rate	SP_GSCI_ADJ_CLOSE	GDP_KENYA	INFLATION_KENYA
2.833664	1.922033	1.858683	2.887687

Figure 18 Multicollinearity Adjusted Regression 2

Therefore, this shows that there is no multicollinearity present as none of the variables have VIF values greater than 10.

Regression 3

USD_KES_ADJ_CLOSE	FED_FUNDS_Rate	SP_GSCI_ADJ_CLOSE	GDP_KENYA
16.458539	21.087596	4.834743	5.115181

INTEREST_RATE_KENYA	INFLATION_KENYA
15.797598	11.943439

Figure 19 Multicollinearity Test Regression 3

These results show that multicollinearity is present due to the VIF values of 16.458539, 21.087596, 15.797598 and 11.943439 for KES/USD exchange rate, Fed Funds Rate, Interest Rate and Inflation Rate respectively. To address this, the highly collinear variables will be dropped when they are not the variable of interest. Therefore, dropping interest rates and inflation leads to the VIF values of.

USD_KES_ADJ_CLOSE	FED_FUNDS_Rate	SP_GSCI_ADJ_CLOSE	GDP_KENYA
5.577893	2.418024	3.735446	3.365274

Figure 20 Multicollinearity Adjusted Regression 3

Since none of the VIF values are greater than 10 then it implies that there is no multicollinearity present.

4.4 Regression Analysis

4.4.1 Regression 1

The model has been transformed to ensure all the assumptions hold and are met for the regression results to be valid and reliable. Therefore, after all the transformations the first regression comes to:

$$\boldsymbol{Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon}$$

Where:

Dependent variable Y – Log (USD_KES_ADJ_CLOSE)

Independent variable $\boldsymbol{X_1}$ – FED_FUNDS_Rate

Independent variable $\boldsymbol{X_2}$ – SP_GSCI_ADJ_CLOSE

Independent variable $\boldsymbol{X_3}$– Lag_USD_KES

```
Call:
lm(formula = log(USD_KES_ADJ_CLOSE) ~ FED_FUNDS_Rate + SP_GSCI_ADJ_CLOSE +
    Lag_USD_KES, data = Historical_Data)

Residuals:
       Min         1Q     Median         3Q        Max
-0.0143001 -0.0033823 -0.0005806  0.0035740  0.0098401

Coefficients:
                    Estimate Std. Error t value Pr(>|t|)
(Intercept)        3.785e+00  7.895e-03 479.436  < 2e-16 ***
FED_FUNDS_Rate    -1.415e-01  5.502e-02  -2.572   0.0128 *
SP_GSCI_ADJ_CLOSE  3.448e-05  6.441e-06   5.353 1.67e-06 ***
Lag_USD_KES        8.160e-03  8.451e-05  96.559  < 2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.0052 on 56 degrees of freedom
Multiple R-squared:  0.998,     Adjusted R-squared:  0.9979
F-statistic:  9445 on 3 and 56 DF,  p-value: < 2.2e-16
```

Figure 21 Regression 1 Results

The goodness of fit is represented by the R-squared. The results imply that 99.8% of the variation in the KES/USD exchange rate is explained by the regression. This suggests a strong fit. In addition to this, all the predictors are seen to be statistically significant as they have a p-value of less than 0.05.

From the findings, when all the variables are held constant, the KES/USD exchange rate is 3.785. The results also show a negative relationship between the Fed Funds Rate and the KES/USD exchange rate. This shows that a 1 unit increase in the Federal Funds

Rate leads to a -14.15% decline in the KES/USD exchange rate, holding all other factors constant.

In addition, there is a positive relationship between global commodity prices. The results imply that a 1 unit increase in global commodity prices leads to a 0.003448% increase in the KES/USD exchange rate, holding all other factors constant.

4.4.2 Regression 2

The model has been transformed to ensure all the assumptions hold and are met for the regression results to be valid and reliable. Therefore, after all the transformations the first regression comes to:

$$\boldsymbol{Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon}$$

Dependent variable Y – NSE20

Independent variable $\boldsymbol{X_1}$ – FED_FUNDS_Rate

Independent variable $\boldsymbol{X_2}$ – SP_GSCI_ADJ_CLOSE

Independent variable $\boldsymbol{X_3}$– GDP_KENYA

Independent variable $\boldsymbol{X_4}$ – INFLATION_KENYA

```
Call:
lm(formula = NSE20 ~ FED_FUNDS_Rate + SP_GSCI_ADJ_CLOSE + GDP_KENYA +
    INFLATION_KENYA, data = Historical_Data)

Residuals:
    Min      1Q  Median      3Q     Max
-477.20  -94.07   19.93  117.34  290.37

Coefficients:
                   Estimate Std. Error t value Pr(>|t|)
(Intercept)        3.235e+03  2.948e+02  10.975 1.79e-15 ***
FED_FUNDS_Rate     1.958e+04  1.773e+03  11.043 1.42e-15 ***
SP_GSCI_ADJ_CLOSE -1.067e+00  2.239e-01  -4.767 1.41e-05 ***
GDP_KENYA          5.504e-02  1.127e-02   4.884 9.33e-06 ***
INFLATION_KENYA   -3.995e+04  2.764e+03 -14.453  < 2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 154.8 on 55 degrees of freedom
Multiple R-squared:  0.8676,    Adjusted R-squared:  0.858
F-statistic: 90.14 on 4 and 55 DF,  p-value: < 2.2e-16
```

Figure 22 Regression 2 Results

The results imply that 86.76% of the variation in the NSE20 is explained by the regression. This suggests a strong fit. In addition to this, all the predictors are seen to be statistically significant as they have a p-value of less than 0.05.

From the regression, when all variables are constant the NSE20 index is 3235. In addition, there is a positive relationship between the Federal Funds Rate and the NSE20 index. A 1 unit increase in the Federal Funds Rate leads to a 19580 unit increase in the NSE20 index, assuming all other variables remain constant. Moreover, there is a negative relationship between global commodity prices and the NSE20. A 1 unit increase in global commodity prices leads to a 1.067 unit decrease in the NSE20, with all other variables remaining constant.

Lastly, for the control variables, a positive relationship can be seen between GDP of Kenya and the NSE20. A 1 unit increase in the GDP of Kenya leads to a 0.05504 unit increase in the NSE20, holding all other factors constant. In addition, a negative relationship can be seen between Inflation and the NSE20. A 1 unit increase in inflation leads to a -0.0003995 unit decrease in the NSE20, holding all other factors constant.

4.4.3 Regression 3

The model has been transformed to ensure all the assumptions hold and are met for the regression results to be valid and reliable. Therefore, after all the transformations the first regression comes to:

$$\boldsymbol{Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon}$$

Dependent variable Y – NSE20

Independent variable $\boldsymbol{X_1}$ – USD_KES_ADJ_CLOSE

Independent variable $\boldsymbol{X_2}$ – FED_FUNDS_Rate

Independent variable $\boldsymbol{X_3}$– SP_GSCI_ADJ_CLOSE

Independent variable $\boldsymbol{X_4}$ – GDP_KENYA

```
Call:
lm(formula = NSE20 ~ USD_KES_ADJ_CLOSE + FED_FUNDS_Rate + SP_GSCI_ADJ_CLOSE +
    GDP_KENYA, data = Historical_Data)

Residuals:
    Min      1Q  Median      3Q     Max
-348.68 -147.55   18.02  126.41  323.17

Coefficients:
                   Estimate Std. Error t value Pr(>|t|)
(Intercept)        8.231e+03  6.853e+02  12.010  < 2e-16 ***
USD_KES_ADJ_CLOSE -4.670e+01  4.039e+00 -11.563 2.39e-16 ***
FED_FUNDS_Rate     1.560e+04  1.937e+03   8.052 7.18e-11 ***
SP_GSCI_ADJ_CLOSE  8.735e-01  3.692e-01   2.366  0.02152 *
GDP_KENYA         -6.349e-02  1.793e-02  -3.541  0.00082 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 183.1 on 55 degrees of freedom
Multiple R-squared:  0.8149,    Adjusted R-squared:  0.8014
F-statistic: 60.53 on 4 and 55 DF,  p-value: < 2.2e-16
```

Figure 23 Regression 3 Results

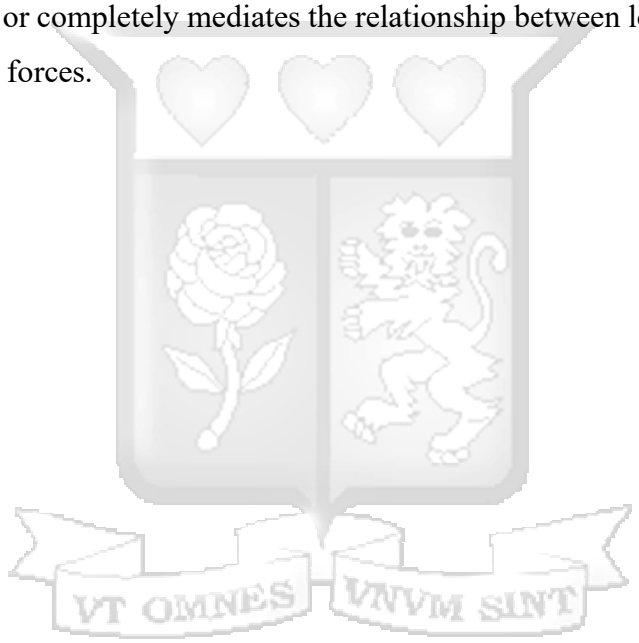
The results imply that 81.49% of the variation in the NSE20 is explained by the regression. This suggests a strong fit. In addition to this, all the predictors are seen to be statistically significant as they have a p-value of less than 0.05.

From the regression, when all variables are constant the NSE20 index is 8231. There is a negative relationship between the KES/USD exchange rate and the NSE20. A 1 unit increase in the KES/USD exchange rate leads to a decline in the NSE20 by -46.70 units, assuming all variables remain constant. In addition, there is a positive relationship between the Federal Funds Rate and the NSE20 index. A 1 unit increase in the Federal Funds Rate leads to a 15600 unit increase in the NSE20 index, assuming all other variables remain constant. Moreover, there is a negative relationship between global commodity prices and the NSE20. A 1 unit increase in global commodity prices leads to a 0.8735 unit decrease in the NSE20, all other variables remain constant.

Lastly, for the control variables, a negative relationship can be seen between GDP of Kenya and the NSE20. A 1 unit increase in the GDP of Kenya leads to a 0.006349 unit decrease in the NSE20, holding all other factors constant.

4.5 Overall Results

All things considered, the final regression shows whether the KES/USD exchange mediates the interactions between the local stock market, international commodity prices, and US interest rates. It discovered a statistically substantial negative relationship between the NSE20 and the KES/USD exchange rate. Additionally, it discovered a statistically significant positive relationship between the NSE20 index and the Federal Funds Rate. Finally, the model discovered a statistically significant inverse relationship between the NSE20 index and global commodity prices. Therefore, even though the KES/USD exchange rate affects the NSE20, the US Interest rates and global commodity prices also influence it. This suggests that the KES/USD exchange rate either partially or completely mediates the relationship between local stock market and global external forces.



Chapter 5: Discussion, Conclusion and Recommendation

5.1 Introduction

A summary of the research findings and a conclusion drawn from them are presented in this chapter. Additionally, there are suggestions for additional research to attempt and determine how this study might be expanded upon and enhanced. Lastly, there will be a section regarding some of the limitations of this study.

5.2 Summary of Findings and Discussion

This study attempted to answer the following questions by formulating three regressions: Does the US interest rates and global commodity prices have an impact on the KES/USD exchange rate? Does the US interest rates and global commodity prices have an impact on the local stock market (NSE20)? Does the exchange rate mediate the relationship between these factors and the local stock market or do these factors affect the local stock market directly?

The data used was secondary data collected from credible sources. The Nairobi Securities Exchange is the source of the NSE20 index data. The Central Bank of Kenya is the source of the currency rate information. Additionally, the Federal Reserve Economic Data (FRED). provides the federal funds rate, which is used to indicate interest rates. It is maintained by the Federal Reverse Bank of St. Louis. The S&P GSCI index is obtained from various credible sources such as yahoo finance. The Central Bank of Kenya provides the statistics for the control variables, which include GDP growth, interest rates, and inflation rates.

5.2.1 The relationship between Exchange Rates, US interest rates and commodity prices

The first regression sought to find out whether Federal Funds Rate and the global commodity prices influence the KES/USD exchange rate. The Federal Funds Rate and the KES/USD exchange rate were shown to be negatively related in this study. This implies that an increase in the Federal Funds Rate leads to an appreciation of the Kenyan Shilling. These findings disagree with (Akinbobola & Asekunowo, 2015), “an

increase in the Federal Funds Rate leads to depreciation of Sub-Saharan currencies, including the Kenyan Shilling, due to the withdrawal of foreign capital and diminished demand for local currencies."

Additionally, it discovered that the KES/USD exchange rate and global commodity prices were positively related. This implies that an increase in global commodity prices leads to a depreciation in the Kenyan Shilling. This study is in line with results from (Were, Kamau, & Karingi, 2001) who found that "fluctuations in international oil prices have a significant impact on Kenya's exchange rate, where higher oil prices typically result in the depreciation of the Kenyan Shilling due to increased import costs."

5.2.2 The relationship between NSE20, US interest rates and commodity prices

The second regression's aim was to find out whether the Federal Funds rate and global commodity prices have an impact on the NSE20 index. The analysis discovered a positive relationship between the NSE20 share index and the Federal Funds rate. However, this is contradictory to what some other researchers have found. For example, (Ngugi, Amanja, & Muriithi, 2009) noted that "global interest rates, such as the U.S. Federal Funds Rate, affect foreign investment flows into the Nairobi Securities Exchange. Higher U.S interest rates often lead to capital outflows from the NSE, resulting in downward pressure on indices like the NSE20."

The analysis discovered a negative relationship between the NSE20 and global commodities prices. This is consistent with some studies done. For example, (Kariuki & Rotich, 2016) found that "increases in global oil prices lead to higher costs for energy-dependent industries in Kenya, negatively impacting stock prices and causing a decline in the NSE20 index."

5.2.3 The relationship between the NSE20, Exchange Rates, US interest rates and commodity prices

The third regression now combined all the factors to check whether the KES/USD exchange rate mediates the relationship between Federal Funds Rate, Global Commodity prices and the stock market in Kenya. The study shows that there is a negative relationship between the KES/USD exchange rate and the NSE20 share index. This implies a depreciation in the Kenyan shilling leads to a decline in the NSE20 share index. This finding is in line with other researchers such as (Were, Kamau, & Karingi,

2001) who found that “a depreciation of the Kenyan Shilling against the U.S. Dollar increases import costs, which can reduce profitability for the companies listed on the NSE, resulting in a decline in the NSE20 index.” The other variables, such as Federal Funds Rate and global commodity prices, also show that they are statistically significant. Although this study found that the KES/USD exchange rate does not mediate the relationship between global external factors and the stock market, it contradicts some of the literature out there. A study by (Hau & Rey, 2005) found that “Exchange Rate movements significantly mediate the impact of monetary policy and global capital flows on equity markets. For example, a depreciation of a country’s currency can increase export competitiveness, positively affecting equity prices in export-driven sectors.”

5.3 Conclusion of the study

This study’s main aim was to find out whether exchange rates mediate the relationship between US interest rates (as represented by the Federal Funds Rate), Global Commodity Prices (as represented by the S&P GSCI Index) and the stock market in Kenya. Therefore, the main goal was to find out whether these factors affect the Kenyan stock market directly or indirectly, through the exchange rates.

As mentioned earlier, the null hypothesis is that there is no mediation effect. This represents where the coefficient of the global external factors in the first regression is equal to zero. In addition, the coefficient of the global external factors in the second regression is equal to zero. Lastly, the coefficient of exchange rates is zero in the third regression. However, from our results we can see that the coefficients in all the regressions are not equal to zero and are statistically significant. In other words, they are statistically different from zero. However, in the third regression even though both the exchange rates and the global external factors are present, the coefficient of the global external factors is statistically significant. This could imply that the exchange rate **partially mediates the relationship between the global external factors and the Kenyan stock market.** This means that these factors affect the stock market directly and therefore investors should consider these factors when investing in the Kenyan stock market.

5.4 Limitations of the study

The study's time frame is one of its weaknesses. This study employed secondary data from credible sources. However, monthly data for a 5-year period leading to 60 data points. A longer time period could be employed for future studies.

Furthermore, significant variables like domestic monetary policy that affect the currency rate and the Kenyan stock market might not be included in the model. This could lead to an incomplete understanding of the mediating role of the exchange rate.

5.5 Recommendations of the study

Based on the study's results, this section presents policy proposals and examines their real-world implications for various stakeholders, such as listed businesses, institutional and retail investors, legislators, and financial advisors.

In order to develop policies that lessen the negative effects of falling global commodity prices, policymakers could work with industry partners to provide incentives or subsidies to impacted industries.

Macroeconomic indicators can be used as prediction tools by both institutional and retail investors. When making investing selections, both retail and institutional investors should keep an eye on the KES/USD exchange rate changes and the Federal Funds Rate. They can predict changes in stock prices by knowing that U.S. interest rates have a positive correlation with the NSE20 index.

These findings can help listed companies who are planning to raise money align their capital-raising efforts with the cycles of U.S. monetary policy. Businesses can schedule their equity or debt offerings appropriately if overseas investor engagement rises in tandem with increased U.S. interest rates.

Finally, by incorporating these insights into forecasting models, financial analysts and advisors may be able to give clients more precise and fact-based recommendations. The study emphasizes how crucial it is to factor in changes in U.S. interest rates, commodity price patterns, and currency rates when forecasting stock prices.

5.6 Recommendations for Further Studies

The current study focused on whether the exchange rates mediate the relationship between US interest rates, Global commodity prices and the NSE20 share index. Future studies could explore the role of other macroeconomic variables as mediators. For example, these include inflation rates, foreign direct investment (FDI), or trade balances and whether they mediate the relationship between US interest rates, global commodity prices and the Kenyan stock market.

Further studies could also include other global interest rates, such as the Bank of England rates to explore whether they affect the Kenyan stock market through the KES/USD exchange rate. Further studies could also include other global factors like global economic growth (US GDP growth) or global inflation trends like US or Eurozone inflation or generally any other factor that affects both the KES/USD exchange rate and the Kenyan stock market performance. This helps you to better analyses how the exchange rate mediates broader economic influences on the NSE20.

References

Abor, J. (2005). The effect of capital structure on profibability: an empirical analysis of listed firms in Ghana.

Adjasi, C., Harvey, S. K., & Agyapong, D. (2008). Effect of Exchange Rate Volatility on the Ghana Stock Exchange.

Akinbobola, T. O., & Asekunowo, V. O. (2015). The effects of monetary policy on exchange rate stability in Sub-Saharan Africa. *Journal of Economics and International Finance, 7(5)*, 98-112.

Alexius, A., & Spang, D. (2018). Stock Prices and GDP in the long run.

Aliber, R. Z. (1973). The Interest Rate Parity Theorem: A Reinterpretation .

Arango. (2002). Relationship between Interest Rate and Stock Price: Empirical Evidence from Developed and Developing Countries.

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology* .

Cavusgil, S. (1997).

Chirchir, D. (2014). THE RELATIONSHIP BETWEEN SHARE PRICES AND INTEREST RATES: EVIDENCE FROM KENYA.

Fama, E. F. (1965). Efficient Capital Markets: A Review of Theory and Empirical Work . *The Journal of Finance*.

Fama, E. F. (1969). The Adjustment of Stock Prices to New Information. *International Economic Review*.

Gatuhi, S. K. (2013). Influence of Oil Prices on Stock Market Performance in Kenya.

Hau, H., & Rey, H. (2005). Exchange rates, equity prices, and capital flows. The Review of Financial Studies. 273–317.

Kanini, M. J. (2015).

Kariuki, D., & Rotich, G. (2016). The effect of oil price on stock returns in Kenya: A case study of Nairobi Securities Exchange. *International Journal of Finance and Accounting*, 45-60.

Kirui, E., & Onono, N. H. (2014). Macroeconomic Variables, Volatility and Stock Market Returns: A Case of Nairobi Securities Exchange, Kenya.

Kisaka, E. N. (2008). An Analysis of the Efficiency of the Foreign Exchange Market in Kenya,. *EconomicBulletin*, 1-13.

Levine, T. B. (1998). Stock Markets, banks, and growth: Panel evidence.

Mbithi, M. A. (2009). The effect of foreign exchange rates on the financial performance of firms listed at the Nairobi Securities Exchange.

Mumbe, K. A. (2015). THE DYNAMIC RELATIONSHIP BETWEEN STOCK PRICES AND EXCHANGE RATES: A CASE OF KENYA.

Mwanza, C. N. (2014). *The effect of foreign exchange rates on the performance of the Nairobi Securities Exchange.*

Mwanza, C. N. (2014). *The Effect of Foreign Exchange Rates on the Performance of the Nairobi Securities Exchange.* Nairobi.

Ngugi, R. W., Amanja, D., & Muriithi, M. (2009). Capital market, financial deepening and economic growth in Kenya. *Journal of African Business, 10(1)*, 105-129.

Nyamute, W. (1998). The relationship between stock prices and exchange rate, Interest rates, money supply, inflation rate (Unpublished MBA dissertation), University of Nairobi, Nairobi.

Odhiambo, S. N. (2014). The Dynamics of Stock Market Development in Kenya.

Roll, R. G. (1983). The Fiscal and Monetary Linkage between Stock Returns and Inflation. *Journal of Finance*.

Sewell, M. (2007). Behavioural Finance.

Solnick, B. (1987). Using Financial Prices to Test Exchange Rate Models: A Note. *The Journal of Finance*.

Were, M., Kamau, A., & Karingi, S. (2001). Understanding the reform process in Kenya. *Journal of African Economies, 10(Suppl_1)*, 1-42.

Wurgler, M. B. (2007). Investor Sentiment in the Stock Market. *The Journal of Economic Perspectives*.