CAUSAL AND COINTEGRATING RELATIONSHIP BETWEEN MACROECONOMIC VARIABLES ON STOCK MARKET PRICES IN NAIROBI SECURITIES EXCHANGE

BY

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DECLARATION

Declaration by the Candidate

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DEDICATION

This thesis is dedicated to my Parents Daniel and Ruth, my wife Beatrice Serem and finally, to my children Alvin Kibet, Abigail Chelimo and Allan Kiprotich Rono

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ABSTRACT

The study of stock market price movements and macroeconomic indicators has been imperative in view of the country's economic growth because the most sensitive segment of any developing economy is its stock market. The buy and sell decision rules are affected by the investors' psychology which exerts influence on the macroeconomic events. The critical question when it comes to this is that how instantaneous the information is transferred to the investors and market analyst and in return, reflects on stock market prices. Therefore, the purpose of this research was to analyze causal and cointegrating relationship between macroeconomic indicators and the stock market prices in the context of Nairobi Securities Exchange, Kenya. The study's specific objectives were; to determine the relation between inflation, exchange rate, interest rate, nominal gross domestic product and stock market prices. Further, the study aimed at investigating the bidirectional Granger causal effect between the selected variables in this study. Efficient Market Hypothesis, Arbitrage Pricing Theory and Capital Asset Pricing Models theories guided this study. The study used longitudinal research design and employed monthly secondary data for the period 2005 - 2018. The data was obtained from Nairobi Stock Exchange, Kenya National Bureau of Statistic and Central Bank of Kenya. Descriptive statistics such as mean, minimum, maximum and standard deviation were computed to understand the nature of data and other general characteristics. Augmented Dickey Fuller, Philip Perron and Clemente-Montañés-Reyes tests confirmed the presence of unit root at levels, and all the variables attained Stationarity after first difference. The Optimum lag length selected was 2. Johansen's cointegration test showed that the variables were cointegrated thus Vector Error Correction Model was estimated. The error correction term was -1.1804 and significant at $p-value$ 0.000 which indicated a long-term relationship among. Jarque-Bera test showed the residuals followed normal distribution. There was no serial correlation among the variables as per Durbin Watson statistic($DW-Stat$ 2.022 $<$ 4). Inflation and interest rate was found to negatively and significantly affect stock market prices with coefficients of -0.8371 ($p-value$ 0.005) and -4.0876 ($p-value$ 0.000) respectively. However, exchange rate and nominal gross domestic product had positive and significant effects on stock prices at 0.0001 ($p-value = 0.012$) and 0.00002 ($p-value =$ 0.000) respectively. It is recommended based on the findings that the government should adopt expansionary monetary policy to enhance credit creation and curb interest rate by stabilizing exchange rate changes thus promoting investment in stocks and shares. There is need for the government to encourage activities that increases gross domestic product since it is an important macroeconomic indicator for health economy.

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ABBREVIATIONS AND ACRONYMS

ACFs	Autocorrelation Functions
ADF	Augmented-Dickey & Fuller
AIC	Akaike Information Criterion
AO	Additive Outlier
APT	Arbitrage Pricing Theory
ARDL	Auto Regressive Distributive Lag
BSE	Bombay Stock Exchange
CAPM	Capital Asset Pricing Model
CBK	Central Bank of Kenya
CBN	Central Bank of Nigeria
CNX	Crisil Index
CSE	Colombo Stock Exchange
DF-GLS	Dickey-Fuller Generalized Least Squares
DGP	Data Generation Process
EMH	Efficiency market hypothesis
ERS	Elliot-Rothenberg & Stock
EXR	Exchange Rate
FPE	Final Prediction Error
FRED	Federal Reserve Economic Data
GDP	Gross Domestic Product
GNP	Gross National Product
HQIC	Hannan Quin Information Criterion
IC	Information Criterion
IMF	International Monetary Fund

INF	Inflation
INR	Interest Rates
KLCI	Kuala Lumpur Composite Index
KNBS	Kenya National Bureau of Statistics
KPSS	Kwiatkowski-Phillips-Schmidt & Shin
LM	Lagrangian Multiplier
NASI	Nairobi All Stock Index
NBSB	Nigeria Bureau Statistical Bulletin
NSE	Nairobi Stock Exchange
OLS	Ordinary Least Squares
S & P	Standard and Poor
SMP	Stock Market Prices
TGARCH	Threshold Generalized Autoregressive Conditional Heteroscedasticity
USA	United States of America
UVAR	Unstructured VAR
VAR	Vector Autoregressive
VECM	Vector Error Correction Model
VMA	Vector Moving Average
WB	World Bank

OPERATIONAL DEFINITIONS OF TERMS

Exchange rate: Is the value of a country's currency verses that of another country or economic zone.

Inflation: The persistent price increase of goods and services over a given period.

Interest rate: Proportion of a loan that is charged as interest to the borrower, typically expressed as an annual or monthly percentage of the loan outstanding.

Long-term: Occurring over or involving a relatively long period of time.

Nominal GDP: The value of all goods and services produced within a country excluding the net income from abroad.

Securities Exchange: Organized and regulated financial market where securities are bought and sold at prices governed by the forces of demand and supply.

Short-term: Occurring over or relating to a short period of time.

Stationary: A property of time series variables where the mean, variance and autocorrelation are constant over time, the statistical property do not change over time.

Stock Market: Refers to a market dealing with exchange of securities issued by companies and the government.

CHAPTER ONE

INTRODUCTION

1.1 Overview

The section presents the background information, statement of the problem, objectives of the study, study hypothesis, the significance and the scope of the study.

1.2 Background Information of the Study

The security market is a crucial institution for a country's economy. It is the market that deals with the exchange of securities issued publicly by listed firms and the government bonds. It is crucial in the sense that it greatly determines the performance of an economy. For any government, the nature and the state of a stock market is of great concern. Under general equilibrium, it is agreed that the stock market plays a very important role in collecting and efficiently allocating funds (Allen & Gale, 2000).

Stock market through investment fund collections, maturity transformation and savings mobilization are required to meet two or more basic requirements of supporting industrialization and ensuring that environment is safe and efficient in discharging their functions. Economic reform programs such as privatization and liberalization have not been completed and in the process of completion in most emerging economies (Henry, 2000). In this case, the prevailing knowledge of the relationship between prices of stock and macroeconomic variables for instance consumption, GDP, industrial production investment is predominantly important by the fact that a stable relationship between these variables is most likely to reform postulated economic models.

1.3 Macroeconomic Variables

Generally, majority of the researchers have come to a common conclusion that macroeconomic variables are statistical pointers or indicators that mirror the general economic condition of a nation at some point in time (Rogers, 1998). The history of computing macroeconomic determinants dates back to the period during the First World War when the fighting nations sought to gauge the abilities of their opponents. Today, enormous range of macroeconomic determinants are frequently published in order to show innumerable inclinations in private together with public life.

(Rogers, 1998) divided macroeconomic variables into three subdivisions; the first is the Procyclic macroeconomic variables which are positively linked with the general condition of the economy. These variables have a tendency of increasing when the economy is on the rise. GDP is a classic example of this category. The second classification is the counter cyclic macroeconomic determinants. These are macroeconomic variables which move in the opposite direction, they decline when the economy is growing and rise when the economy is worsening. Unemployment falls into this category. The third and the last division are the acyclic macroeconomic determinants. The variables have no correlation with the condition of the economy. Kutty (2010) studied of impacts of macroeconomic variables on stock market prices concluded that interest rate, the level of price, inflation rate, money supply together are key variables in knowing the performance of stock prices. Hunjra *et al.*, (2014) investigated the influence of macroeconomic determinants on stock prices in Pakistan by applying granger causality and cointegration analysis. The study results confirmed the existence of short-run affiliation amid the explained and the explaining variables. However, the study did not find any significant relationship between the dependent and independent variables.

1.4 Stock Market Prices

Stock market price also known as share price is the value placed for each share. This value is determined by the market forces of supply and demand. In a case where buyers are more when compared to sellers, the stock market prices will increase because the demand is high. On the contrary, if there are many sellers than buyers, stock market prices will shrink in response to higher supply. If a company is performing well and is making a lot of profit, its share prices will increase because many customers believe that is a good venture. Stock market is a volatile institution, which is very risk in that share prices fall due to various economic downfalls and shocks. However, despite being volatile, it is also known that highly risky investments are associated with higher rate of returns. Bamurange *et al.,* (2019) performed a study on the impacts of selected macroeconomics factors on stock market performance in Kenya.

Mutuku *et al.,* (2015) did a research on dynamic link between stock prices and selected Macroeconomic variables in Kenya. The researchers' findings indicated that macroeconomic variables determine equity marketing in the long run. Rehman *et al.,* (2019) investigated the commonalities of equity market fundamentals and returns co-movements in ten Asian emerging and frontier equity markets. The study results discovered that there is a long run relationship among bilateral equity market co-movement and its determinants. Maina, (2013) studied the association amongst macroeconomic determinants and stock market prices of companies that are listed in the Nairobi Securities Exchange and concluded that stock market prices are positively associated with the macroeconomic variables under the study.

Stock markets affect economic activities through creation of liquidity of capital for investment and contribute to economic development through enhancement of capital

investments. It also links capital deficits and the capital supplly. Fama (1970), Malkiel (1999) stated that if the market is inefficient, the relationship between risk and return is unreliable. Further, the economic activity, capital investments and monetary policy may have long-term effects on stock price movement which may lead to changes in returns and risk premium demand securities. Therefore, this shows there exist evidence of a bi-directional causality and a long run relationship between the movement of stock prices and the macroeconomic variables in economic sector.

There are several considerations to the due assumptions based on strong and persistent relation between macroeconomic variables and the stock prices that has led to revisit of monetary development in Kenya. There was a macroeconomic crisis experienced in Kenya that was associated with loss of money supply control, high inflation, failure of banks and non-banks financial intermediaries and high interest rates. This pushed many businesses into difficulties and generated large non-performing portfolio (Malouche, 2009).

1.5 Problem Statement of the Study

The most sensitive segment for any developing economy is its stock market (Mamun, 2018). The stock price volatility exerts influence on macroeconomic aggregates due to the fact that the macroeconomic events working on the psychology of the investors affects the buy-sell decision rule (Rehman, 2019). The crucial question is how instantaneously this information is transmitted to investors and market analysis at large reflected in the stock prices? When the markets are volatile, there is unprecedented flow of information from one market to the other bringing worry among the potential investors to take the risk, thereby, prompts extensive and in-dept. analysis of the relation between stock prices and the macroeconomic variables.

The economic performance of any economy is reflected by the performance of its stock markets and it is the most crucial component growth of any economy as it provides savings to investors and helps to allocate resources efficiently (Kirui *et al.*, 2014). Owing to improved technologies and liberalization of economic policies, majority of investors have become more interested in prices and performance of stock markets. The increasing interest of market stock performance by investors has necessitated the formulation of economic policies to show how the stock markets perform as shown by Gupta *et al.,* (2001).

Companies trading in NSE have in recent past experienced declining performance in terms of stock prices and this has been escalated by poor performance of economy that has resulted in low savings among investors (Koila *et al.*, 2014). The conflicting findings of various studies such as those of Ouma & Muriu, (2014) on the factors that affect market stock market prices in NSE requires study to unravel these conflicting findings by other researchers. Therefore, this study aimed at evaluating the causal and cointegrating relationship between macroeconomic variables on the stock market prices in Kenya for the period 2005-2018 on monthly basis.

1.6 Objectives of the Study

The objectives of this study were classified into the general objective and specific objectives

1.6.1 General Objective

The general objective of this study was to analyze causal and cointegrating relationship between macroeconomic variables and stock market prices in Nairobi Securities Exchange; Kenya

1.6.2 Specific Objectives

The specific objectives of this study were;

i) To determine the relationship between inflation rate and stock market prices in Nairobi Securities Exchange.
ii) To evaluate the relationship between exchange rate and stock market prices in Nairobi Securities Exchange.
iii) To investigate the relationship between interest rate and stock market prices in Nairobi Securities Exchange.
iv) To find the relationship between nominal GDP and the stock prices in Nairobi Securities Exchange.
v) To analyze Granger causality between selected macroeconomic variables and stock market prices in Nairobi Securities Exchange.

1.7 Research Hypotheses

H_{01} : There is no significant relationship between inflation and stock market prices in Nairobi Securities Exchange, Kenya

H_{02} : There is no significant relationship between exchange rate and stock market prices in Nairobi Securities Exchange, Kenya

H_{03} : There is no significant relationship between interest rate and stock market prices in Nairobi Securities Exchange, Kenya

H_{04} : There is no significant relationship between nominal GDP and stock prices in Nairobi Securities Exchange, Kenya.

H_{05} : There is no significant Granger causality between selected macroeconomic variables and stock market prices in Nairobi Securities Exchange: Kenya.

1.8 The Scope of the Study

The following were covered; stock market prices, inflation rate, exchange rate, nominal interest rate, and GDP. The study analyzed monthly data for the period 2005 - 2018 provided by the Kenya National Bureau of Statistics and Central bank of Kenya. The study examined the general properties of time series variables, causal relationships, and short and long run relationships.

1.9 Significance of the Study

This research is significant in the sense that it informs the policy makers, consultants, managers, planners, managers, regulators, monetary policy committee, financial researchers and potential investors on the stock market status and thereby monitoring the markets on the basis of consistent regulatory framework and alleviating current problem in NSE. The study findings add to the existing literature on the relationship between stock market prices and macroeconomic variables.

The study established that there exists a significant relationship between selected macroeconomic variables and stock market prices. This is useful in policy recommendation to investors who closely pay attention to the exchange rate, inflation, interest rate, economic growth and stock market prices rather than the Treasury bill rate in the long run in their investment decision.

CHAPTER TWO

LITERATURE REVIEW

2.1 Overview

This chapter presents the concepts, the theory applied and empirical literature in understanding the relationship between stock market prices and macroeconomic variables in Nairobi Stock exchange. The last section of this chapter presents the conceptual framework that emanates from the critical evaluation of literature.

2.2 The Concept of Cointegration

Engle and Granger (1987) coined the term cointegration that variables are cointegrated if they possess a stochastic trend in the long run. In economic models, the concept of cointegration is commonly associated with economic theories that shows economic relationship between time series variables for instance purchasing power parity implies that there is long term relationship between money income, prices and interest rate and in the Fisher's presentation shows that there is long term association between interest rate and the rate of inflation (Belke, Dobnik & Dreger, 2011).

In financial economics, cointegration relationship ranges from high frequency relation to low frequency. In high frequency levels the concept of cointegration is motivated by arbitrage arguments and the law of one price implies that assets must sell at the same unit price to avoid arbitrage opportunities and in this case, the cointegration between prices of the trading assets. Similarly, the arbitrage arguments of markets imply that there exists a cointegration between current and future market prices (Caldeira & Moura, 2013). Thus, the cointegrating relationship in these association is defined as the long-term relationship due to the fact the forces in this relationship adjusts the deviation to bring the system into equilibrium long term relationship.

Cointegration have been modelled using long spans and low frequencies time series data that is normally measured annually, bi-annually, quarterly or monthly. Two time series X_t and Y_t are said to be cointegrated if either one of them is I (1). That is, if there is randomness but its linear combination is integrated of order zero denoted as 1(0) according to (Herlemont, 2004). This implies that these variables X_t and Y_t are not cointegrated and in the long run they become cointegrated and no longer assume their random nature but assume a common path.

2.3 Concept of Causality

The concept of causality as have been since the time of Adam Smith and is the central theme in his work, "An Inquiry into the Nature and Causes of the Wealth of Nations"; as it shows that one of the crucial application of economic theory is to give explanations to the link that exist between different causal relation among economic variables (Smith, 2010). The most critical question posed is how to economist relate the existence of causal relationship with a given number of observations. To answer this question, it is necessary to understand the concept of causality and its application in economics.

Statistical concept of pairwise causality was put forward by Granger (1969) is based on F-test which tries to explain the effects of changes in one variable has changes in another variable. It is said that there is granger causality between variables X and Y if the past values of X forecast the present values of Y. The term Granger causality does not imply that a change in one variable causes a change in another variable and it simply implies that there is correlation between past values of one variable and the past values of another variable.

2.4 Theoretical Literature Review

This section discusses the Efficient Market Hypothesis Theory (EMH), Arbitrage Pricing Theory and Capital Asset Pricing Model. Stock market price in an open market is given as the price that a stock sells at a point in time. The stock market price usually fluctuates daily as investors buy and sell stock in a market. A fall in price in stock market is incured when less investors want to buy stocks while a rise in prices occurs when more investors buy stocks.

2.4.1 Efficient Market Hypothesis Theory

An American economist Eugene Fama developed the efficient market hypothesis in the early 1960s. The theory states that at any given time, stock prices fully echo all available information (Fama, 2014). Since all the buyers and sellers have the same information available, price variations are unpredictable and will react to unidentified information for the market. According to Phylaktis and Ravazzolo (2008), there are different ways for the market to acquire information about public companies. The techniques can be different channels and different sources among others.

Over the years the relationship between macroeconomic variables and stock market prices have gained academic attention ranging from scholars to stockbrokers. Earlier studies of various researchers have been on different areas of stock in respect to a response to a change in a single or multiple macroeconomic variable. Majority of the findings have concentrated on stock markets microstructure leaving out other risk factors. In the hypothesis of Fisher (1930), it is shown that equity stocks represent claims against real assets of a business, and it is inferred that stock serves as a hedge against inflation.

Fama (1965) reported that larger changes in stock markets is often followed by changes that explains the cluster effects of stock prices. Other researches such are those of Sharpe (1964), Lintner (1965), Modigliani and Cohn (1979), Nelson (1976), Fama and Schwert (1977), Fama (1981) and Chen *et al.*, (1986) and Fama (1970) showed that a market which is ideal is the one which price predicts accurate information for the purposes of resource allocation. The theory first, postulates that markets are efficient if prices reflect the available information. It proposes that there are three types of markets: weak form markets, semi strong form markets and strong markets. Secondly, it states that the market efficiency per se is no testable and this is referred to as joint hypothesis problem.

The information that reflects share prices is simply historical prices for the weakest efficiency form. In such a situation, one could conclude that technical analysis is not a convenient instrument. Technical analysis is a way to foresee future share prices by observing chronological prices and ascertaining trends (Edwards, Bassetti, & Magee, 2007).. Since past prices are already reflected in the share price in a weak efficiency form market, the investor cannot attain or achieve progress by employing technical investigation. Fama (1970) further classifies state that the weak form of market efficiency reflects that past, the publicly available information while the semi strong form of markets not only reflects the available information, but it also reflects the changes in prices that in turn reflects the new public information. On the other hand, the strong form of market efficiency reflects full information, it adjusts to new available information and furthers reveals the hidden information.

The EMH theory is supported by Fama (1970) particularly in semi strong form of efficiency which shows that all stock prices contain all the relevant information that

include public available information have crucial implications for policy makers and stockbrokers. The theory suggests that the effect of macro-economic variables such as money supply and interest rates on stock prices and that competing profit maximizing investors ensures that all the current relevant information on macro-economic variables is reflected, so that investors in the stock markets are able to earn normal profits through accurate forecasts on future stock price movements.

The debate on monetary policy development has been the main central issue in economics and finance on its influence on stock market development. Several studies in Kenya have shown that there is long-term significant relationship and causality of monetary policy development on stock returns. Profitable venture requires investment in long-term assets, but investors are reluctant to commit their savings for long periods. Savers in liquid equity markets sell their investment quickly and cheaply and since these investments are less risky (Maxwell Fry, Lavan Mahadeva & Sterne, 2000). At the same time, the investing companies enjoy long-term access to capital through equity shares.

The semi-strong efficiency suggests that share prices only reflect the available public information like the annual reports and the company announcements. In the meantime, the market already reflects publicly available information; the investor cannot achieve economic advantage unless he or she has contact with private information. Examples of these insiders and confidential information an investor can contact are the monthly internal reports or procurements that have not yet been publicized (Tames Blanco, & Nsiah, 2010).

The strong form efficiency occurs when all market information, anything from public information to private and confidential information, is replicated in the share prices.

This shows that there is no likelihood for investors to attain a competitive advantage in the market. Even if the investor would have access to a portion of information, he or she cannot foresee the future price movement (Barker, Hendry, Roberts, & Sanderson, 2012).

2.4.2 Arbitrage Pricing Theory (APT)

Arbitrage pricing theory is a universal theory of asset developed by Ross (1976) that demonstrates that the predictable return of a financial asset is a function of various theoretical market indices, whereby a change in each factor is represented by a specific beta coefficient. This theory, alongside with the other multivariate models of asset returns, plays a significant role in the current finance theory. For the multifactor model, the profit of each security is articulated as a linear amalgamation of a small number of factors returns and asset-specific returns. For the capital asset pricing model (CAPM) by Sharpe (1964) and Lintner (1965), for example, the mutual influence is the market return. Recently a number of empirical studies that show robust evidence that stock returns are connected to factors based on macroeconomic, market level and firm-level features.

According to Chen, Roll and Ross (1986), the major identified variables that can be factored in by the arbitrage pricing theory in explaining security returns are surprises in inflation, GNP, yield curve and investor confidence. This is because of their unexpected movements and calling for close monitoring of their timely and accurate information is better justified on economic grounds.

2.4.3 Capital Asset Pricing Model

The CAPM is a model used in finance to determine a theoretically suitable requisite rate of return of an asset to make decisions about adding assets to a well-diversified

portfolio. This model was developed by William Sharpe, a financial economist (Sharpe, 2011). The CAPM model displays a simple theory that conveys a simple result. The theory states that the only reason as to why an investor should make more profit, on average, by investing in one venture rather than another is that one venture is riskier. Not astonishingly, the model has come to control the current financial theory. No matter how much you attempt to diversify your investments, at least some level of risk will not miss. Therefore, business people naturally seek a rate of return that pays compensation for that jeopardy. The CAPM helps to determine investment risk and what return on investment an investor should anticipate. This model begins with the idea that individual investment contains two types of risk.

The first one is the Systematic risk. These are market risks that are not avoidable and cannot be diversified away. Examples are recessions, wars and Interest rates. The second is Unsystematic risk, which is also referred to as "specific risk," this risk relates to individual stocks. In other technical languages, it signifies the constituent of a stock's return that is not associated with the general movement of the market (Macharia, 2018).

It is very hard to quantify or measure the risk of a project or an investment. This challenge arises from the fact that people's perception of risk differs generally. That project which might be very risky to one investor may seem to be fairly safe to another investor. After all, which possible way can one measure beauty and courage, or patience, or risk? (Flyvbjerg, Bruzelius & Rothengatter, 2003).

By definition, the securities market as a whole has a beta coefficient of 1.0. The beta coefficients of individual companies are calculated relative to the market's beta. A beta above 1.0 implies a higher risk than the market average, and a beta below 1.0

implies less risk than the market average (Al-Qaisi, 2011). Most companies' betas fall between 0.75 and 1.50, but any number is possible, including negative numbers; a negative beta would be highly unlikely, however, as it would indicate less risk than a 'risk-free' venture. The beta is found by statistical analysis of individual, daily share price returns in comparison with the market's daily returns over the same period. Financial economist Jensen, Black and Scholes in their study in the year 1972 by the topic "The Capital Asset Pricing Model" found a linear relationship between the financial proceeds of stock portfolios and their betas. They studied the price movements of the stocks on the New York Stock Exchange between 1931 and 1965. Although some studies have raised questions about CAPM's validity, the model is still extensively used in the investment community. Even though it is hard to focus from beta how individual stocks might react to particular moves in the market, investors can probably safely infer that a portfolio of high-beta stocks will move faster than the market in either direction, or a portfolio of low-beta stocks will move less than the market. In general view, CAPM is an important theory because it provides a useful measure that helps investors determine what revenue is worthy for them to earn on an investment, in return for placing their money at a risk venture.

2.5 Empirical Literature Review

The associations between macro-economic variables and stock market prices have been investigated since the Big Bang of 1986. This section of thesis gives an overview of past studies that used macroeconomic factors model to examine stock prices. It is suggested from the literature that there exist a relationship and stock market prices in developing countries, but such relation does not exist in developing economics.

There is a lot of cynics in regard to the relationship that exist between exchange rate, interest rate, inflation rate and GDP fluctuation variables and the financial performance of a firm in terms of its profitability and security returns. Some studies indicate significant relationships between the variables whereas some indicate insignificant relationship between the variables. According to Chen *et al.,* (2001), multi-factor models have been developed as an explanation for the variation in security returns and the extent literature suggests that a wide range of factors explain security returns. The variations have been attributed to such variables as goods prices, money supply, real activity, exchange rates, interest rates, political risks, oil prices, trade sector, budget deficits, domestic consumption, unemployment rate, imports and regional stock market indices and real wage (Menike, 2006). Empirical results regarding the inflationary effect and official exchange rate in cross-country studies and individual country studies are also conflicting (Rutasitara, 2004).

While investigating the effects of exchange rate, interest rate and GDP fluctuation variables on stock prices in the emerging Sri Lankan stock market using monthly data for the period from September 1991 to December 2002, Menike (2006) found that most of the companies reported a higher R^2 justifying higher explanatory power of exchange rate, interest rate, inflation rate and GDP fluctuation variables in explaining stock prices. This was consistent with other emerging market studies where inflation rate and exchange rate reacted negatively in relation to stock prices. Vaz *et al.,* (2006) examined the effect of publicly announced changes in official interest rates on the stock returns of the major banks in Australia during the period from 1990 to 2005. The results indicated that Australian Bank stock returns were impacted positively by the announcement of increased in official interest rates. Furthermore, banks experienced net-positive abnormal returns when cash rates are increased, which is

consistent with the dividend valuation theory that suggests if income effects dominate, then stock returns need not be negatively impacted. Olweny and Omondi (2011) sought to find out the impact of macroeconomic factors on the performance of the stock market. The results showed that Foreign exchange rate, interest rate, and inflation rate, affect stock return volatility.

2.5.1 Exchange Rate and Stock Market Prices

Not until after 1972 all countries of the world were operating under a fixed exchange rate regime where each country's currency relative to the USA dollar had a fixed exchange rate. It is during the period of market liberalization entry that countries started introducing the flexible exchange rate regime. This was after a realization by many investors, analysts, managers and shareholders on the importance of a flexible exchange rate. Using the flexible exchange rate system, the price of currencies is determined by the supply and demand of the currency in the forex market. Given the frequent changes in supply and demand influenced by numerous external and internal factors, this new system is responsible for currency fluctuations (Abor, 2005). These fluctuations exposed companies to foreign exchange risk. Moreover, economies are getting more and more open with international trading and as result companies become more exposed to foreign exchange rate fluctuations. Generally, companies are exposed to three types of foreign exchange risk: translation exposure, transaction exposure and economic exposure (Eiteman *et al.,* 2006). Pilinkus and Boguslauskas (2009) while studying the relationship between exchange rates and stock prices found a positive relationship between exchange rates and stock market prices even though the different methodologies were employed in the two researches. In their research, it is stated that the depreciation in domestic currency can lead to inflationary shocks. This will then decrease the profit as the input for production will become much more

expensive than usual. Thus, the company will suffer from unfavorable news, which causes the demand for the stocks to decreases and will eventually lead to stock price to step-down. Moreover, Gay (2008) and Kyereboah-Coleman and Agyire-Tettey (2012) have determined a similar relationship between the exchange rates and stock prices too. However, there are slight differences between their researches with those discussed earlier. The positive relationship is mainly supported by the impact on the investments made by the investors. The depreciation in domestic currency is an unfavorable change in the exchange rate for investors. This is because their investment returns are reducing, as they have to convert their returns at a lower exchange rate. Most investors will leave the market to avoid a further decrease in earnings or losses. Thus, the demand for stocks will decrease and lead to a decrease in stock market prices. Maysami *et al.*, (2004) and Hinson *et al.*, (2009) also found a positive relationship between exchange rates and stock prices. One of the reasons that contribute to this relationship is due to the export market competency. As the domestic currency strengthens, the cost of imports will be relatively cheaper than before.

Thus, local producers will be able to bring in much-advanced technology or other inputs to improve all aspects of a business. This can help to enhance the firm's position in the international market and thus, creating favorable news to attract more investors to purchase the firm's equity. The demand for stocks will increase and hence, increasing the stock prices too. Muhammad *et al.*, (2009) research also further supported the positive relationship between the two variables. Muhammad *et al.*, (2009) concluded that the appreciation of domestic currency will eventually lead to an increase in stock price because the government will try to increase its foreign reserve, to counter the appreciation level of the currency.

Kandir (2008), Masih, Peters, and Mello (2011), Puah and Jayaraman (2007), Sohail and Hussain (2009), and Granger *et al.,* (2000) showed the existence of negative relationship among the exchange rates and stock prices in their respective researches. The relationship was explained with the volume of exports in the country. The volume of exports will increase as the domestic currency depreciates. This is because domestic goods are now relatively cheaper and entrepreneurs will tend to import more of the goods from the depreciating country, to reduce the cost of production. Transportation cost, storing cost and other relevant costs are assumed to be constant. The increase in exports also signals the increase in the sales of the firm. This will then, increases the profit of the firm, leading to a higher dividend payout and better company performance. All of this, in turn, causes the stock prices to increase, as investors demand more of stocks.

Chopra, (2019) studied the macroeconomic analysis of capital good industry performance in India. The study used monthly time series data spanning from 1999 to 2017. In order to check for Stationarity of the data, the study conducted Augmented Dickey fuller and Philip Perron test. To check for a long run relationship between the study variables, Toda and Yamamoto and Johansen Cointegration test was employed. The study findings revealed that exchange rate alone had a unidirectional relationship by means of closing index value. The cointegration results as per Johansen test revealed that 4 of the variables under the study were cointegrated. Eventually, the study concluded that US dollar and Indian Rupee exchange rate should be stabilized in order to spur the growth of Capital Good Industry.

Gan *et al.,* (2006) research has determined the relationship in the short run and long run. The results had shown a negative relationship existing between the variables in

the short run while on the contrary; the exchange rate is positively affecting the stock prices in the long run. This is because the appreciation of domestic currency can attract more investors in the long run as they realize they can gain more return by investing in the country. They will be able to convert more of their currency if the domestic currency appreciated. Therefore, the demand for stocks will increase and so do the price of the stocks.

Odoyo *et al.,* (2014) conducted a study on the relationship among stock prices and exchange rate in Kenya using time series data from 2012 to 2013. The issue of concern is that economic theory depicts the association amid stock prices and exchange rate, but it fails to describe the direction of the association. The study engaged the Pearson product moment technique to check the extent of correlation among the stock prices and exchange rate. The outcomes showed a significant positive association amid exchange rate and share prices respectively. The results indicated that there was a positive relationship between exchange rates and share prices.

Furthermore, Asmy *et al.,* (2009) examined the relationship between the exchange rates and stock market prices in detail that covers the range from before crisis (the year 1987 until the year 1995) and after crisis (from the year 1999 until the year 2007) by using monthly data in Malasyia. In the study, it is stated that there is a positive relationship between the two variables before the crisis strikes Malaysia. The supporting theory is similar to researches done by Kandir (2008), Puah and Jayaraman (2007), Sohail and Hussain (2009), and Granger *et al.,* (1998). While for the stock prices in Kuala Lumpur Composite Index (KLCI) in Malasyia after the crisis struck, the relationship between the variables then changed to negative. This may due to the

arising uncertainty regarding the inflation rate that resulted from unstable exchange rate movements. As investors are less confident and unsecured with their returns, they tend to move out from the market and thus, causing the stock demand to decreases. Besides, the negative effect on KLCI is much more dominant and thus, causing a downward pressure on stock prices.

Guo and Huang (2010) study also stated that hot money did contribute to volatilities in the stock market due to its short-term characteristics of investment. Such cases normally occur in developing countries as they have relatively higher interest rates than the other countries. Investors will tend to invest in the country to earn the spread between the interest rates difference. These investment funds are normally addressed as hot money.

However, such a sudden surge of hot money into the country will cause the domestic currency to shoot up drastically. The appreciation of the domestic currency is relatively unstable for exporting countries, as it will increase the price of the goods and services. The profit will be relatively lesser than the other countries and investors will tend to reduce their investments in the country. As the demand for the stocks decreases, the price of the stocks will follow suit and thus, showing a negative relationship between the exchange rates and stock prices (McKinnon, & Schnabl, 2009).

Elabed and Zardoud (2019) evaluated the relationship amongst the macroeconomic determinants and stock market returns in Germany. The study used quarterly data from 1990 to 2016 and employed Autoregressive distributed lag model in the analysis. The study findings discovered that exchange rate and the M3 aggregate together with returns from oil export in Germany have no statistically significant

influence on stock market outcomes. Despite this outcome, interest rate showed a negative and statistically significant influence on stock market prices. Inflation was found positively and significantly influence stock market prices.

Kisaka & Mwasaru (2012) investigated the causal link amongst foreign exchange rate and share prices in Kenya for a period of 6 years from 1993 to 1999. The study used monthly data sourced from Nairobi Stock Exchange. The study performed the Stationarity test and the data became stationary after the first difference. Cointegration test was also conducted between exchange rate and share prices. The findings revealed that both variables were cointegrated. Additionally, the study findings showed that exchange rate Granger-causes share prices in Nairobi Stock Market.

2.5.2 Interest Rate and Stock Market Prices

Liquidity theory considers the rate of interest as the amount of salary for the asceticism and untimeliness faced because of taking an asset with a very high liquidity. Also, the rate of interest is a value which bring into equilibrium the aspiration to clamp affluence that are in currency form with the accessible amount of money and not necessarily a payment of investments (Rhodes & Wanna, 2009). The study by Ngugi (2001) argued that interest rate is the fee or a charge that is paid for money. It further stated the rate of interest is an income function. According to this study, the key function of interest rate is to assist in mobilization of finances and guarantee a well-organized employment of resources in enhancement of economic growth and development. The income projected by the lenders is measured by interest rate. Therefore, it should reproduce all the information concerning the forthcoming dynamics in the purchasing power and the risk assumed.

Elly *et al*., (2013) evaluated the connection amongst macroeconomic determinants on Nairobi Stock Exchange. It went ahead to examine if dynamics in macroeconomic determinants might be engaged to focus the future. The research used secondary data sourced from KNBS, NSE and CBK from 2008 - 2012. The major macroeconomic variables used in the analysis were; lending interest rate, 91-day Treasury bill rate and the inflation rate. The analysis found that 91-day Treasury bill had a negative association with the Nairobi all share index (NASI) whereas inflation had a positive association that was weak with the NASI. Owing to research findings, the study concluded that macroeconomic environment should be monitored because dynamics in the macroeconomic variables influenced how the financial market performed hence impacts on decisions of the foreign investors in the domestic markets.

Mohamed and Ahmed (2018) studied the effect of 6 macroeconomic determinants on the returns of stock market in Jordan. The study used yearly time series data from 1976 to 2016. The macroeconomic variables engaged in the study included, Industrial production, Interest rate, supply of money, Gross Domestic Product and Inflation. The study used the Autoregressive Distributed Lag model (ARDL) and the findings found that industrial production has a significant influence on returns of stocks. Interest rate and Money supply showed a positive and significant impact on income of stock market in Jordan.

A study by Willy (2012), the amount that the lenders charge for the borrowed money is the interest rate and the study defines interest rate as the charge or the amount payable for the assets that are borrowed. Risk interest rate arises when the financial market is not stable. When this problem goes beyond certain limits, the profits in the

financial market is negatively affected and the level or the position of the capital declines hence high cost of doing business

Kyereboah-Coleman and Agyire-Tettey (2012), Menike (2006), Yahyazadehfar and Babaie (2012), Abdullah and Hayworth (1993), Rehman *et al.,* (2011) and Kuwormu (2011) have determined a negative relationship between the interest rates and stock prices in their respective researches. Although the researches listed have been done through different methodologies, their findings are supported by similar reasons. The determined negative relationship is supported from a cost perspective where the increase in interest rates will lead to a higher lending rate and thus, higher cost of production. This will cause the profit of the firm to decrease and then, the amount of dividend paid out will decreases too. As investors normally demand a higher dividend, they will logically sell out or reduce the demand of the shares as it offers a relatively lower return. The increase in supply and the decrease in demand of the shares has then, causes the share price to shoot down, which again, proved the negative relationship between the two variables. On the other hand, Muhammad, Hussain *et al.,* (2009) determined a similar relationship too. The research done by these authors is slightly different from the researches that have been discussed previously.

An alternative investment opportunity arises when interest rates increase. Investors are open to more investment choices when the interest rates are looking good and some of the investments may even offer a higher rate of return. For instance, investors would prefer to transfer their investments into saving accounts or interest-bearing security to enjoy a higher rate of return from the increment of interest rates (Van Osnabrugge, & Robinson, 2000). The supply of the shares in the market will then

increase, as investors have to sell their shares to channel their investments to the new investment opportunity. Besides, the demand for the shares will decrease too, as most investors are now investing in other instruments or market that offers a relatively higher return. All this opportunity cost that manipulates the investment decision making affects the supply and demand of the shares in the market and thus, threatening the prices of the shares.

The negative affiliation amongst the interest rates and stock prices is further supported by the researches done by Kandir (2008), Gan *et al.,* (2006), Alam and Uddin (2009) and Mashayekh *et al.,* (2011). Kandir (2008) finding is similar with Muhammad *et al.,* (2009) findings as the negative relationship between the two variables are affected by the opportunity cost, where investors will tend to invest in interest-bearing securities when the interest rate rises and thus, causing the share price to decrease. To add on, Muhammad *et al.,* (2009) result is tally with the research done by Mukherjee and Naka (1995). The research did show the negative relationship between the interest rates and stock return.

In contrast to the findings as stated above, Hussain *et al.,* (2011) and Olowe (2007) also found a positive relationship between interest rates and stock prices. As the interest rate increases, the risk-free rate will increase. It leads to lower risk premiums and attracted risk-averse investors to enter the stock market. The increase in the demand for stocks in the market will drive up the stock prices and hence, proving the positive relationship between interest rates and stock prices. Pal and Mittal (2011) researched on the BSE Sensex market failed to show significant relationship existing in between the two variables in the market. Kurihara and Nezu (2006) also found that

there are no significant relationships between the interest rates and the Japanese stock market.

However, the relationship may cause by Japan's policy as their interest rates are nearing to zero due to the zero-interest rate policy in the year 1999. Besides, another research was done by Alam and Uddin (2009) also found that there is no significant relationship between the interest rate and stock prices in Malaysia and the Philippines. Frimpong (2009) determined a short-term negative relationship between the two variables in the research. However, the interest rates are defined as the Treasury rates in the research. In this context, the negative relationship roots from the asset shifting theory, which is similar to discussion by Muhammad *et al.*, (2009) research. Frimpong (2009) suggests that investors tend to invest in an investment that carries relatively lower risks when the Treasury rates increases. This is because investors that invest in Treasury securities are normally risk-averse. They will try to minimize risk through diversification or shift their investment pattern as the risk of Treasury securities increases along with its rates. Maysami, Lee, and Hamzah (2004) also did further research on the relation between the interest rates and stock prices in the short run and the long run but their researches focus on Singapore's all S-sector indices. The research found a positive short-run relationship among the variables, which contrasts with the findings of Patel (2012). However, Maysami *et al.*, (2004) determined a long-run relationship among the variables and it is shown to have a negative relationship in the long run. The reason for this was due to long-term interest rates might serve as a better proxy for nominal interest rates component and thus, better in determining the discount rate effect to value stocks.

2.5.3 Inflation Rate and Stock Market Prices

Inflation is defined as the change in the general prices of commodities of an economy during a specific time period (Wasseja *et al.,* 2015). The value of money is lost and investment in the money market declines. The impacts of inflation are seen from two angles': the influence on the general demand and effect on the operation cost. When the inflation is escalated, and the income of individuals, commodities will be less demanded because the currencies will have lost value. Likewise, inflation raises the amount of money for operation thus reducing returns.

According to Fisher's theory, real interest rate and inflation is contained in the nominal interest rate (Booth & Ciner, 2001). According to Pandey (2009) money markets are perfect businesses of identical risk and should produce the same profits in various nations.

The nominal interest rate in the economy consists of the real interest rate and the inflation rate. The nominal interest rate will, therefore, adjust to the changes in the inflation rate. This is the theory of the Fisher effect. Pandey (2009) argued that if money markets were perfect the investments of identical risk should offer an equal return in different countries. Such a situation occurs because of arbitrage procedures that will keep the mobilization of money across various nations throughout until stability is met. In a situation whereby real rates of return are similar in two nations, according to Fisher Effect Theory. If the rates of return were the same in two countries, then, as per the Fisher effect, the nominal rates of interest would adjust exactly for the change in the inflation rates. Vong and Chan (2009) argued that available empirical evidence on the relationship between inflation and profitability is inconclusive and hence requires further research.

The stock price-inflation relationship has attracted considerable attention in the theoretical and empirical literature. However, no consensus has emerged as to the relationship between stock prices and inflation. In theory, stocks are assumed to be inflation neutral for unexpected inflation, which should have a negative effect on stock prices (Toporowski, 2000). The standard discounted cash flow model calculates stock prices as the present value of future expected cash flows. As pointed out in the literature, for stocks to be inflation neutral and represent a good long-term hedge against inflation, firms should pass on any increase in inflation rates to future cash flows (Geanakoplos & Zeldes, 2009). On the part of investors, adjusted cash flows should be discounted by the inflation-adjusted rate of return. Alternatively, the investors could discount the real cash flows by the same real discount rate.

Accordingly, the ex-ante real rate of stock returns and inflation rates are influenced by the nominal rate of stock returns. Thus, from the Fisher hypothesis, there is an implication that the investment in securities can hedge against inflation. In other words, stocks and financial asset prices need to move positively with expected inflation in order to serve as a hedge against rising prices. Anything short of this will lead to erosion of assets through inflation (Olufisayo, 2013).

Wasseja *et al., (*2015) conducted a research on the Granger causal affiliation amid macroeconomic determinants and stock prices in Kenya. The study used the secondary data spanning from 1980 - 2012 and used the Vector Autoregressive model. As per Granger causality outcomes, it is proved that movement in the macroeconomic variables had no statistically significant influence on stock prices excluding inflation, exchange and change in stock prices and also seems to be an insignificant factor explaining part of the movement in the macroeconomic variables

excluding interest rate. Again, the regression results found that all macroeconomic variables are equally significant in explaining the difference in the stock prices.

A study in Nigeria found that the relationship between inflation and stock price index exhibited a long run, Olufisayo (2013). In addition, these results provided evidence in support of the Fisher effect in the short run and long run. It further suggested that stocks are good inflation hedges both in the short and long run.

Kandir (2008), Kuwormu (2012) and Asmy *et al.,* (2009) found a positive relationship between the inflation rate and stock prices. It is mainly due to the hedging role of stocks in the market. Normally, investors would prefer to hedge against inflation risk as an unanticipated inflation rate can bring disastrous losses. If investors are to anticipate inflation soon, they will tend to increase their investments since stocks are very good hedging securities in the market. It could help investors to minimize risks and losses, and thus, cause the increase in stock demand. This will, in turn, lead to an increase in stock prices.

Hosseini *et al.,* (2011) research supported the positive relationship between the two variables as stated above. Different from the theories mentioned previously, Hosseini *et al.,* (2011) believe that the positive relationship was caused by the investors' inflation expectation and thus, they demand a higher rate of return to compensate the high risk assumed. To add on, Pal and Mittal (2011) researches showed that S & P CNX Nifty in the Indian capital market has a positive relationship between the two variables too. In the market, the relationship resulted from the changes in interest rates.

An increment in interest rate can boost the increase of stock demand and thus, the elevation in stock prices too. As the interest rate changes are positively correlated with inflation rates, the growth in the inflation rate will indirectly cause the stock price to increase. Maysami *et al.*, (2004) research supported the theory mentioned above too. It stated that the increase in inflation rate may increase the stock price because the increase in inflation rate may show potential growth in real activity. Hence, investors may invest more to capture the opportunities that bring greater earnings since they may be able to get higher profit from the increase in real activity. Contrary to the findings above, Pilinkus and Boguslauskas (2009) and Kyereboah-Coleman and Agyire-Tettey (2012) discovered a negative relationship between inflation rates and stock market prices. This relationship might be cost-related as the increase in inflation rates leads to higher prices of materials. This will, in turn, cause the cost of production to elevate. The increase in cost will corrode the net profit of the firms, causing the dividend payout to be relatively low. Such a situation gives rise to lower demand for the stock and thus lower stock prices as investors would not want to invest in low pay off investments. The increase in the cost of production contributed to lose of investor confidence.

Similarly, Frimpong (2009) has determined a negative relationship between the variables in Ghana but it is supported by different theoretical points of view. In the research of Frimpong (2009), an increase in the inflation rate will promote economic tightening policy as the government would normally try their best to restore the economy back into good shape. Investors will also face difficulties in forecasting future cash flows as the inflation rate give rise to uncertainty in the market. Therefore, investors tend to channel their investment to other alternatives to restrict losses. This will then, lead to a decrease in stock demand and thus lower stock prices.

2.5.4 Gross Domestic Product and Stock Prices

Cyclic fluctuations of booms and recessions characterize most of the world economies. Athanosologlu (2015) states that during boom periods, there high demand for credit as compared to recession periods. Ongore and Kusa (2013) the decline in Gross Domestic Product causes a fall in credit which in turn negates the profitability of banks while a general increase in GDP of a credit has consequential increase in credit and it eventually causes arise in profitability.

Kolapo *et al.,* (2018) investigated the influence of macroeconomic variables on the performance of stock markets in Nigeria using time series data for a period of 29 years. The data for the study was obtained from CBN (Central Bank of Nigeria), NBSB (Nigeria Bureau of Statistical Bulletin), and WB (World Bank). The variables under the study were share index, GDP, money supply, interest rate, inflation and exchange rate. From the analysis, it was found that Gross Domestic Product and money supply (MYS) are significant determinants of stock market performance and further showed a long run relationship among macroeconomic basics and stock market in Nigeria. In addition, all other variables not including money supply and interest rate were found to positively link to performance of stock market. The study adopted the ARDL model for estimation. The study results revealed that shares market performance is caused by the growth of the economy. The study recommended that poverty should be eradicated, and the rate of unemployment should be reduced. Also, the study concluded that interest rate should be controlled to ensure stability of the stock market in Nigeria.

Nasser *et al.,* (2018) investigated the association between Macroeconomic variables and ASEAN Stock Price Index. The dynamism in major economic determinants is the source of instabilities in securities trade. The study used panel data from the five

Asian Tigers including Thailand, Singapore, Malaysia, Indonesia and Philippines. Macroeconomic Determinants engaged in the study namely GDP, interest rate, inflation rate, unemployment and exchange rate. The study used Generalized Least Squares (GLS) Regression model in analysis. The study found a strong and statistically significant relationship of all the macroeconomic variables and stock index.

2.6 Knowledge Gaps

From the literature discussed it is evident that there exist several research gaps on the effect of macroeconomic variables on the performance of stock prices. Earlier studies have shown these studies may not give dynamics in economic environment and equally, the effect of exchange rate, inflation rate and GDP fluctuations are unique to each industry. While macroeconomic factors affect all industries in the economy, the nature and the extent of these effects may differ from one industry to another. This research therefore sought to find out the effect of macroeconomic variables on stock market prices in Kenya.

2.7 Conceptual Framework

The relationship between the variables under study was conceptualized as shown in in figure 2.1 below.

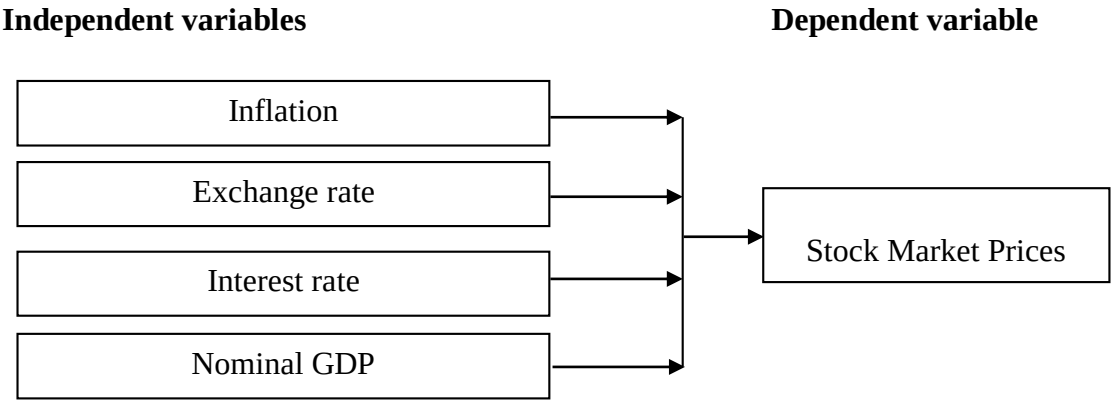


Figure 2.1: Conceptual Framework

Source: Author, 2019

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Overview

The chapter describes; research design, data sources, data analysis, unit-roots test modeling used, cointegration test, optimum lag length selections, Granger Causality and Vector Error Correction Models.

3.2 Research Design

Research design is an all-inclusive plan for data collection in an empirical research project. It is a draft for empirical research meant to answer specific research questions or testing specific hypotheses. The appropriate design for this study is the longitudinal research design that involves single subject being measured repeatedly at regular intervals over some time.

3.3 Data Sources

The study utilized monthly secondary data for the period 2005 - 2018 to analyze the objectives of the study. Gross Domestic Product, interest rate, exchange rate and inflation rate were the selected macroeconomic variables because they are widely used by policy makers to show how an economy is performing over a given period. Macroeconomic data was obtained from published economic reports, annual statistical abstracts published by Kenya National Bureau of Statistics and Central Bank of Kenya. Data on stock prices was sourced from Nairobi Stock Exchange.

3.4 Measurement of Variables

Table 3.1 presents measurement of definition and measurement of variables as used in this study. Stock market prices measured in KShs while inflation rate, exchange rate

and interest rate were all measured in percentage and nominal GDP was measured in Million KShs.

Table 3.1: Measurement of Definition and Measurement of Variables

Variable	Definition	Measurement
Stock market prices	It is the price of a single share of a number of saleable stocks of a company	KShs
Inflation	Persistent price increase of goods and services over a given period	Percentages
Exchange rate	Value of a country's currency verses that of another country or economic zone	Percentages
Interest rate	Proportion of a loan that is charged as interest to the borrower	Percentages
Nominal GDP	Value of all goods and services produced within a country excluding the net income from abroad	Million KShs

Source: Author, 2019

3.5 Data Analysis

Stata 10.0 Econometric Software was used to analyze the data. In this study, several statistical properties were used to show the relationship between variables under study. First, the descriptive statistics were used to describe the general characteristics of the sample; these mainly included the mean, median, and standard deviation and to show the outliers in the sample. Secondly, VECM model was employed to analyze the effect of macroeconomic variables on stock market prices in Kenya while Granger

causality model was used to analyze causality between macroeconomic variables and stock market prices.

3.6 Statistical Properties of the Univariate Time Series Data Set

Unit root tests such as Augmented Dicker Fuller, Philip Perron unit root test are discussed in this. In addition, Clemente-Montañés-Reyes Unit Root Test with one Structural Break is also discussed. Further Stationarity test was also performed in this section. Optimum lag selection, cointegration and model specification is also presented. The last section of this part discuses granger causality and diagnostic checks.

3.7 Unit Root Tests

One of the important properties of the time-series process is the Stationarity of data. A random process or a stochastic process is known to be stationary when its joint distribution doesn't change over time (Stanley *et al.*, 1994). Time series data is stochastic or probabilistic in nature because there is no accurate formula when prediction needs to be done. But usually, time-series data points are weakly stationary in nature that is those data-points, which have constant mean μ, constant variance σ^2, and constant auto-covariance. Auto covariance of (X_t, X_{t-1}) = Auto covariance of (X_{t-2}, X_{t-3}). Therefore; Augmented Dickey–Fuller (ADF), Phillips-Perron Unit Root Test and Clemente-Montañés-Reyes Unit Root Test with one Structural Breaks were performed.

3.7.1 Augmented Dickey–Fuller Test

ADF test was performed on the nested time series model to accommodate serial autocorrelation, auto covariance and covariance (McDowall, McCleary & Bartos, 2019). The model estimated is in equation 3.1.

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{i=1}^{p} \propto_i \Delta Y_{t-1} + \varepsilon_t \quad \text{(3.1)}$$

Where: ΔY_t: Represents first difference of each variable; β_1: Represents the intercept; β_{2t}: Represents the time trend; δ: Represents the co-efficient of the lagged variable. The *"p"* represents the Optimum lag length, and which was selected by; Akaike Information Criteria (AIC) and Swartz-Bayesian Information Criteria (SBIC).

In this model the study tested the pair of hypotheses $H_0 : \phi = 0$ versus $H_1 : \phi < 0$ H1: $\varphi < 0$. The ADF test statistic is based on the *t*-statistic of the coefficient φ from OLS estimation as per Dickey & Fuller (1979). It does not have an asymptotic standard normal distribution, but it has a nonstandard limiting distribution. Critical values were obtained by simulation, for instance, (Dickey, & Fuller, (1979) and Davidson & MacKinnon (1993).

3.7.2 Phillips-Perron Unit Root Test

The Dickey–Fuller unit root test involves fitting the following regression equation;

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

By performing ordinary least squares (OLS), serial correlation may pose a problem in time series analysis. To account for this, the Augmented Dickey–Fuller test's regression includes lags of the first differences of ΔY_t. The Phillips–Perron test involves fitting *I* (1), and the results are used to calculate the test statistics. Phillips and Perron (1988) proposed two alternative statistics; Phillips and Perron's test statistics can be viewed as Dickey–Fuller statistics that have been made robust to serial correlation by using the Newey–West (1987) heteroskedasticity and autocorrelation-consistent covariance matrix estimator.

3.7.3 Clemente-Montañés-Reyes Unit Root Test with one Structural Break

A Philip Perron Andrews and ADF unit root test does not factor in structural breaks in a series. To overcome this issue, the Clemente-Montañés-Reyes (1998) unit root test was also used to incorporate structural breaks. This test allows determining endogenous structural breaks in the data series (Hoque, 2014). Clemente-Montañés-Reyes unit root test based their approach on Perron and Vogelsang (1992) but allow for two structural breaks.

This test is given by the following equations 3.3 and 3.4

$H_0: Y_t = Y_{t-p} + \emptyset_1 DTB_{1t} + \emptyset_2 DTB_{2t} + \varepsilon_t$ ..... (3.3)

$H_0: Y_t = Y_{t-p} + \emptyset_1 DTB_{1t} + \emptyset_2 DTB_{2t} + \varepsilon_t$ ..... (3.4)

In the above equations DTB_{it} is the variable pulse equivalent to 1 if $t = TB_i + 1$ and zero if otherwise and $DU_{it} = 1$ if $TB_i < t\ (i = 1,2 \ldots)$ and if the assumption is violated then it is equal to zero and when the average is modified it assumes time periods TB_1 and TB_2. This further simplified with assumption that $TB_1 = \varphi_1 T(= 1,2)$ where $1 > \varphi > 0$ while $\varphi_1 < \varphi_2$ Clemente-Montañés-Reyes (1998).

3.8 Optimum Lag Length Selection

To tests for the number of tests for cointegration ranks or fit cointegrating in the VECM model lag length must be specified. Tsay (2014) and Paulsen (1984), Nielsen (2001) shows that several methods can be used to select lag length for a VAR model with $I\ (1)$ variables.

The first criterion that was used to determine the optimum number of lags is AIC. The model chooses the maximum number of lags to minimize equation 3.5.

$AIC_p = \ln |\sum_p^n| + 2\frac{M(P^2+1)}{T}$ ..... (3.5)

In this case *M* is the number of parameters in all the equations in the VAR model.

The second method of obtaining the optimum lag number in the model is SBIC. It takes the form of equation 3.6;

$$SBIC = \ln|\sum_p^n| + (lnT)\frac{M(P^2+1)}{T} \quad (3.6)$$

The third criterion applied was HQIC which chooses to minimize equation 3.7;

$$AIC_p = \ln|\sum_p^n|)(2lnlnT)\frac{M(P^2+1)}{T} \quad (3.7)$$

The final form of criterion that was applied is the FPE and minimizes equation 3.8;

$$FPE = \left(\frac{T+M_P+1}{T-M_P-\ 1}\right)\hat{}m|\sum\nolimits_p^{\hat{}}| \quad (3.8)$$

The model form for single series that was used in each of the above information criteria is equation 3.9.

$$IC_{(p)} = \left(\frac{\varepsilon_t'\varepsilon_t}{T-p-K^*}\right) + (p+K)\left(\frac{A^*}{T-p-K^*}\right) \quad (3.9)$$

The model form for multivariate series for each specification in 3.9 is 3.10

$$IC_{(p)} = \log\left(\left|\frac{1}{T}\sum_{t=1}^{T}\hat{\varepsilon}_t\hat{\varepsilon}_t'\right|\right) + (KM^2+M)\cdot\frac{C(T)}{T} \quad (3.10)$$

*K** = 1 for random walk, 2 for random walk with drift, 3 for trend stationary process, The Likelihood Ratio tests was used to test the series for joint hypothesis tests. The significance of all the coefficients of the longest lag was tested. If they were jointly insignificant, the lag was dropped, and the VAR model was re-estimated (Subrahmanyam, 2008).

3.9 Cointegration Test

According to Ndolo (2017) cointegration in time series analysis is described as the existence of long-term relationship between economic variables. The study utilized Johansen – Juselius to test for cointegration. This is justified by the fact that it solves the problem of losing information through detrending and differencing. However, Johansen test for cointegration heavily relies on asymptotic properties and results from small samples are hardly understood (Patterson, 2011).

Let $Y_t = (y_{1t} \dots y_{nt})'$ denote a $n \times 1$ vector of I (1) time series. Y_t Is cointergrated if there exists an $n \times 1$ vector $\beta = (\beta_1, \dots \beta_n)'$ such that $\beta' Y_t = \beta_1 y_{1t} + \dots + \beta_n y_{nt} \sim I$ (0). Nonstationary time series Y_t are cointegrated if there is a linear combination among them that is stationary or I (0). If some elements of β are equal to zero, then only the subset of the time series in Yt with non-zero coefficients are cointegrated. The linear combination $\beta' Y_t$ is often motivated by economic theory and referred to as a long-run equilibrium relationship. The intuition is that $I(1)$ time series with a long-run equilibrium relationship cannot drift too far apart from the equilibrium because economic forces will act to restore the equilibrium relationship according to Kulshreshtha, Nag & Kulshrestha (2001). In this study, the Johansen test for cointegration was employed.

3.9.1 Johansen Test for Cointegration

Johansen Multivariate Co-Integration technique was used to estimate Co-Integration to find out if variances of the model are Co-Integrated. The model estimated is shown in equation 3.11;

$$\Delta Y_t = \alpha \beta Y_{t-1} + \sum_{i=1}^{P} \phi_i^x \Delta Y_{t-i} + \delta_0 + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.11)$$

Where; ΔY_t is the dependent variable; α is the degree of convergence (or rate of) long-term relationship β' is the co-efficient for the long-term relationship and ϕ_i^x is the vector of n by n and will show the short-term relationship.

3.10 Model Specification

The study employed a Vector Autoregressive (VAR), model to estimate and provide empirical evidence on the nature of the causal relationship between stock market prices and changes in macroeconomic variables. The VAR model provides a systematic way to capture rich dynamics between the variables under the study.

3.10.1 The Vector Autoregressive (VAR) Model

A VAR is a model, in which K variables are specified as linear functions of p of their own lags, p lags of the other K – 1 variables, and possibly additional exogenous variables. Algebraically, a p-order VAR model, written VAR (p), with exogenous variables X_t is given by equation;

$$y_t = \nu + A_1 y_{t-1} + \cdots + A_p y_{t-p} + B_0 X_t + B_1 X_{t-1} + \cdots + B_s X_{t-s} + \mu_t, t \epsilon \{-\infty, \infty\} \quad (3.12)$$

Where $y_t = (y_{1t}, \ldots y_{kt})'$ is a $K \times 1$ random vector; A_1 through $A_p$are $K \times K$ matrices of parameters; X_t is an $M \times 1$ vector of exogenous variables; B_0through B_s are $K \times M$ matrices of coefficients; v is a $K \times 1$ vector of parameters ,and; μ_t is assumed to be white noise, $E(\mu_t) = 0$, $E(\mu_t \mu_t') = \Sigma$ $E(\mu_t \mu_s') = 0$ For $t \neq s$.

3.10.2 Vector Error Correction Model

A vector error-correction model (VECM) is a type of VAR that is used with variables that are cointegrated. Although first-differencing variables that are integrated of order one makes them stationary, fitting a VAR to such first-differenced variables results in misspecification error if the variables are cointegrated.

Consider a VAR with p lags in equation 3.13

$y_t = v + A_1 y_{t-1} + A_2 y_{t-2} + \cdots + A_p y_{t-p} + \varepsilon_t$ ..... (3.13)

Where; y_t a $K \times 1$vector of variables; v, a $K \times 1$ vector of parameters; $A_1, \ldots A_p$ is $K \times K$ matrices of parameters; and; ε_t is a $K \times 1$ vector of disturbances. ε_t has a mean of zero, covariance matrix Σ and iid normal over time. Any $VAR(p)$ can be rewritten as a VECM.

Equation 3.12 can be written in VECM form as in equation 3.14

$\Delta y_t = v + \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + \varepsilon_t$ ..... (3.14)

Where $\Pi = \sum_{j=1}^{j=p} A_j - \mathrm{I}_k$ and $\Gamma_i = -\sum_{j=i+1}^{j=p} A_j$

Engle and Granger (1987) showed that if the variable y_t are $I(1)$ the matrix in equation 3.14 has a rank of $0 \leq r < K$ where r is the number of linearly independent cointegrating vectors. If the variables co integrate, $0 \leq r < K$ and equation 3.14 shows that a VAR in first difference is mispecified and it omits the lagged levels term Πy_{t-1},

3.11 Granger Causality

Assume that the information set F_t has the form $(x_t, z_t, x_{t-1}, z_{t-1}, \ldots, x_1, z_1)$ where x_t and z_t are vectors and z_t usually will include y_t and z_t may or may not include other variables than y_t. It is said that x_t is Granger causes y_t with respect to F_t if the variance of the optimal linear predictor of y_{t+h} based on F_t has smaller variance than the optimal linear predictor of y_{t+h}based on z_t, z_{t-1} … for any h. In other words, x_t is Granger causal for y_t if x_t helps predict y_t at some stage in the future.

Granger causality is particularly easy to deal with in VAR models. Let the data be described by the model.

$$\begin{bmatrix} y_t \\ z_t \\ x_t \end{bmatrix} = \begin{bmatrix} \mu_1 \\ \mu_2 \\ \mu_3 \end{bmatrix} + \begin{bmatrix} A'_{11} & A'_{12} & A'_{13} \\ A'_{21} & A'_{22} & A'_{23} \\ A'_{31} & A'_{32} & A'_{33} \end{bmatrix} \begin{bmatrix} y_{t-1} \\ z_{t-1} \\ x_{t-1} \end{bmatrix} + \cdots + \begin{bmatrix} A^k_{11} & A^k_{12} & A^k_{13} \\ A^k_{21} & A^k_{22} & A^k_{23} \\ A^k_{31} & A^k_{32} & A^k_{33} \end{bmatrix} \begin{bmatrix} y_{t-k} \\ z_{t-k} \\ x_{t-k} \end{bmatrix} + \begin{bmatrix} u_{1t} \\ u_{2t} \\ u_{3t} \end{bmatrix} \ldots\ldots (3.15)$$

And it is assumed that

$$\Sigma_u = \begin{bmatrix} \Sigma_{11} & \Sigma_{12} & \Sigma_{13} \\ \Sigma_{12} & \Sigma_{22} & \Sigma_{23} \\ \Sigma_{13} & \Sigma_{23} & \Sigma_{33} \end{bmatrix} \ldots\ldots (3.16)$$

The model in equation 3.16 is a general VAR model –only the data vectors have been partitioned in 3 subsectors, the y_t and the x_t vectors between which tests for causality and the z_t vector, which are conditioned on. In this model, x_t does not Granger cause y_t with respect to the information set generated by z_t if either $A^i_{13} = 0$ and $A^i_{23} = 0$; $i = 1, \ldots, k$ or $A^i_{13} = 0$ and $A^i_{12} = 0$; $i = 1 \ldots k$

This is the way Granger causality is tested.

In this study, the Granger model measures stock market prices (SMP), which is the dependent variable on inflation (INFL), exchange rate (EXR), interest rate (INTR) and gross domestic product (GDP). Granger causality will be conducted on the model to determine the directional link between stock market prices and each of the independent variables.

The model is functionally represented equation 3.17.

$$SMP = f(\, INFL, EXR, INTR, GDP) \ldots\ldots (3.17)$$

The Granger equations for the model are presented in equations 3.18 to 3.25.

$$SMP_t = \sum_{i=1}^{n} \beta_i INFL_{t-1} + \sum_{j=1}^{n} \alpha_j SMP_{t-j} + \mu_t \ldots\ldots (3.18)$$

$$INFL_t = \sum_{i=1}^{n} \lambda_i INFL_{t-1} + \sum_{j=1}^{n} \delta_j SMP_{t-j} + \mu_t \ldots\ldots (3.19)$$

$$SMP_t = \sum_{i=1}^{n} \beta_i EXR_{t-1} + \sum_{j=1}^{n} \alpha_j SMP_{t-j} + \mu_t \ldots\ldots (3.20)$$

$EXR_t = \sum_{i=1}^{n} \lambda_i EXR_{t-1} + \sum_{j=1}^{n} \delta_j SMP_{t-j} + \mu_t$ ..... (3.21)

$SMP_t = \sum_{i=1}^{n} \beta_i INTR_{t-1} + \sum_{j=1}^{n} \alpha_j SMP_{t-j} + \mu_t$ ..... (3.22)

$INR_t = \sum_{i=1}^{n} \lambda_i INTR_{t-1} + \sum_{j=1}^{n} \delta_j SMP_{t-j} + \mu_t$ ..... (3.23)

$SMP_t = \sum_{i=1}^{n} \beta_i GDP_{t-1} + \sum_{j=1}^{n} \alpha_j SMP_{t-j} + \mu_t$ ..... (3.24)

$GDP_t = \sum_{i=1}^{n} \lambda_i GDP_{t-1} + \sum_{j=1}^{n} \delta_j SMP_{t-j} + \mu_t$ ..... (3.25)

3.12 Diagnostic Tests

The following diagnostic tests were estimated; Lomminiki-Jarque-Bera Test for normality, Breusch-Godfrey LM test for Heteroscedasticity, Edgerton and Shukur test for Serial Correlation and Model Stability.

3.12.1 Lomminiki-Jarque-Bera Test for Normality

Lomnicki (1961) and Jarque and Bera (1987) proposed a test for normality based on the skewness and kurtosis of a distribution. The test Jarque-Bera test was used to check the pair of hypotheses;

$H_0: \mathrm{E}(\upsilon_t^s)^3 = 0$ *and* $\mathrm{E}(\upsilon_t^s)^4 = 3$ *versus* $H_1: \mathrm{E}(\upsilon_t^s)^3 \neq 0$ *or* $\mathrm{E}(\upsilon_t^s)^4 \neq 3$ the test statistic that was used in equation 3.26.

$$JB = \frac{T}{6}\left[T^{-1}\sum_{t=1}^{T}(\hat{\upsilon}_t^s)^3\right]^2 + \frac{T}{24}\left[T^{-1}\sum_{t=1}^{T}(\hat{\upsilon}_t^s)^4 - 3\right]^2 \quad \text{..... (3.26)}$$

This statistic has an asymptotic $\chi^2(2)$ distribution if the null hypothesis is correct (Jarque and Bera (1987). In this research also skewness and kurtosis of the standardized residuals is reported.

3.12.2 Breusch-Godfrey LM Test for Heteroscedasticity

The Breusch-Godfrey Lagrangian Multiplier (LM) statistic is based upon the following auxiliary regressions (Breusch 1978; Godfrey 1978). This test was used to test for heteroskedasticity in the model.

$$\hat{\varepsilon}_t = A_1 Y_{t-1} + \cdots + A_p Y_{t-p} + CD_t + B_1 \hat{\varepsilon}_{t-1} + \cdots + B_h \hat{\varepsilon}_{t-h} + \mu_t \quad \text{..... (3.27)}$$

The null hypothesis is: $H_0 : B_1 = B_2 = \cdots = B_h = 0$ and correspondingly the alternative hypothesis is of the form $H_1 : \exists B_i \neq 0 \; i = 1,2,\ldots,h$ for. The test statistic is defined as:

$$LM_h = T(K - tr(\sum\nolimits_R^{-1} \sum\nolimits_e^{\sim})) \quad \text{..... (3.28)}$$

Where $\sum_R^{-1}$ and $\sum_e^{\sim}$ assign the residual covariance matrix of the restricted and unrestricted model, respectively. The test statistic LM_h is distributed $\chi^2(hK^2)$.

3.12.3 Durbin Watson Test for Serial Correlation

Residuals or errors in a prediction are supposed to be independent. To check this, the researcher used Durbin-Watson *d* test which ranges from 0 to 4 with the acceptable range being 1.50 to 2.50. Value close to zero has positive correlation and those variables with values closer to 4 have negative serial correlation. Equation 3.29 was estimated:

$$DW = \frac{\sum_{t=2}^{T}(e_t - e_{t-1})^2}{\sum_{t=1}^{T} e_t^2} \quad \text{..... (3.29)}$$

3.13 Test for Model Stability

Before making statistical inference on estimated VAR or VECM the stability conditions of the estimates were computed. This required that the variables must be covariance stationery.

$$A=\begin{pmatrix} A_1 & A_2 & \cdots & A_{p-1} & A_p \\ I & 0 & \cdots & 0 & 0 \\ 0 & I & \cdots & 0 & 0 \\ \vdots & \vdots & \ddots & \vdots & \vdots \\ 0 & 0 & \cdots & I & 0 \end{pmatrix} \quad \text{..... (3.30)}$$

The model is said to be stable if the modulus of each eigenvalue of matrix A, in equation 3.30 the eigenvalues strictly is less than one and lies inside a unit cycle (Hamilton, 1994; Lutkepohl, 2005 and Stock and King *et al.*, 1987).

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Overview

This chapter presents the results for descriptive and inferential statistics. Conventional Augmented Dickey and Fuller, Phillip and Perron unit root tests were used to test for Stationarity. Clemente-Montane- Reyes unit root test with one structural break were estimated. Johansen cointegration test was also estimated. In the last section of this chapter, model post diagnostic checks were performed.

4.2 Summary Statistics

Descriptive statistics was conducted to understand the behaviour of data, check the presence of outliers and understand the overall nature of the sample. Inflation rate, interest rate and exchange are in percentage form while GDP was in Kenya shillings (millions).

Table 4.1: Summary Statistics

	SMP	INF	EXR	INR	GDP
Mean	106.5511	8.013929	85.25589	15.07250	4274789
Median	97.10000	6.545000	84.82800	14.13000	3999677
Maximum	191.2300	19.72000	105.2930	20.34000	7794735
Minimum	42.89000	1.850000	62.02900	12.12000	1322297
Std. Dev.	40.12899	4.461356	12.31775	2.066517	2178995
Skewness	0.302884	1.171540	0.100439	0.982951	0.272075
Kurtosis	1.727689	3.318477	1.843800	2.964344	1.695480
Sum	17900.58	1346.340	14322.99	2532.180	7.18E+08
Sum Sq. Dev.	268926.1	3323.917	25338.40	713.1721	7.93E+14
Observations	168	168	168	168	168

Note: SMP refers to Stock Market Prices, INF- inflation rate, EXR-Exchange rate, INR-Interest rate and GDP- Gross domestic product
Source, Author, 2019

Descriptive statistics is presented in Table 4.1 that. Stock market prices recorded an average of Ksh.106.55, minimum and maximum price of Ksh.42.89 and Ksh.191.23. The positive value of skewness showed that the variables were rightly skewed away from zero implying there were relatively high values in the data set compared to low

values. Values that follow normal distribution have a skewness of zero and kurtosis of 3. Inflation and interest rate followed a normal distribution since the skewness and kurtosis were approximately close to zero and 3 respectively. Unlike the inflation rate and interest rate, stock market prices, exchange rate and gross domestic product showed non normal distribution characteristics.

4.3 Correlation Analysis

To determine nature of the direction and degree of association among the series under the study, correlation analysis was done. Correlation can be explained by Spearman correlation, Kendall rank, Pearson correlation or Point-Biserial coefficients. Correlation coefficient (ρ) values ranges from $-1 \leq \rho \leq 1$. The value closer to -1 indicates strong negative correlation, values close implies weak correlation while values close to 1 implies strong positive correlation.

Table 4.2: Correlation Matrix Results

	SMP	INF	EXR	INR	GDP
SMP	1.0000				
INF	-0.3135*	1.000			
	(0.0000)				
EXR	0.7657*	-0.1325	1.0000		
	(0.0000)	(0.0869)			
INR	0.1396	0.0653	0.2284*	1.0000	
	(0.0712)	(0.4001)	(0.0029)		
GDP	0.8878*	-0.2386*	0.9427*	0.2482*	1.0000
	(0.0000)	(0.0018)	(0.0000)	(0.0012)	

Note: *Indicates correlation coefficient and the value in parenthesis significance at 5 percent level

Source: Author, 2019

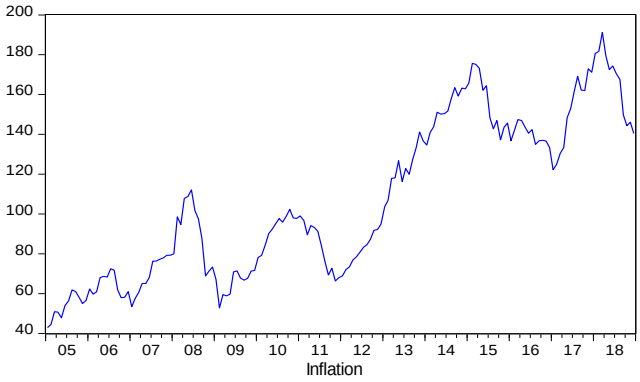
The pairwise correlation can be weak positive or weak negative and likewise can be strong positive or strong negative. Table 4.2 shows correlation coefficients in form of a diagonal matrix. The correlation between stock market prices and inflation was weak negative and statistically significant as shown by $\rho = -0.3135$ and $p = 0.000 < 0.0500$. Moreover, the association between stock market prices and exchange rate and with GDP was a strong positive and a highly significant correlation as shown in Table 4.2. The significant correlation between gross domestic product and other variables indicates that growth in an economy causes inflation to decrease, improves the strength of currency.

4.4 Visual Inspection of Univariate Properties of Variables at Levels

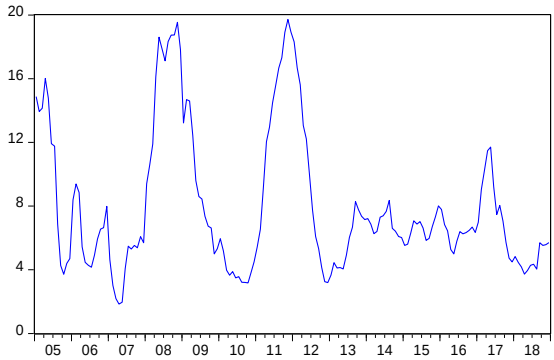
There are several ways can be used to identify properties that a time series variable can exhibit. One of the properties is the seasonality and another, which was dealt with in the next section, is the Stationarity property. Figure 4.1 above shows the visual inspection of univariate properties of time series data under study. From this, it was clear that there were periodic fluctuations (sinusoidal functions). This upward and downward trending with drifts visually confirming the variables are not stationary at levels. Stock market prices showed a downward trend between 2008 and 2009. Inflation attested a sharp rise in the year 2011 and a slight drop between 2017 and 2018.

Exchange rate dropped in 2007 and showed a drop around 2011. Interest rate showed a rise in 2012 and a slight drop in 2018. The GDP exhibited a steady growth from the year 2005 to 2017 and a sudden decline in the year 2018. This seasonality property is important in the sense that it can explain the randomness. A variable that has randomness is said to be identically independent distributed. The variables at level indicates that an upward drift over time.

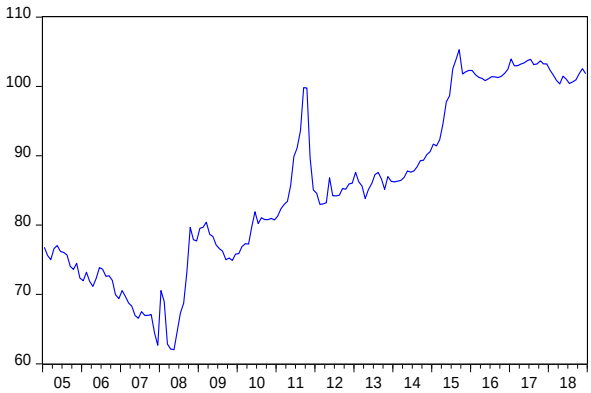
Stock Market Prices



Inflation



Exchange Rate



Interest Rate

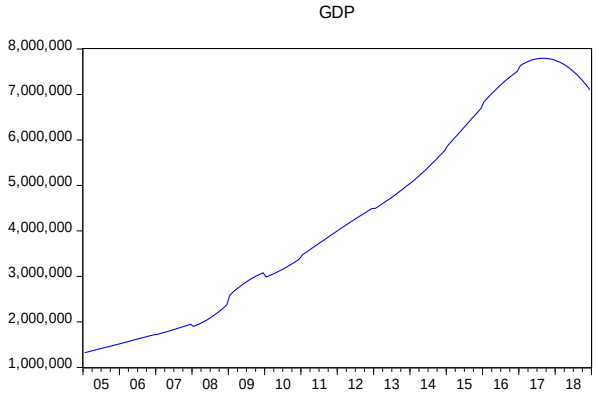
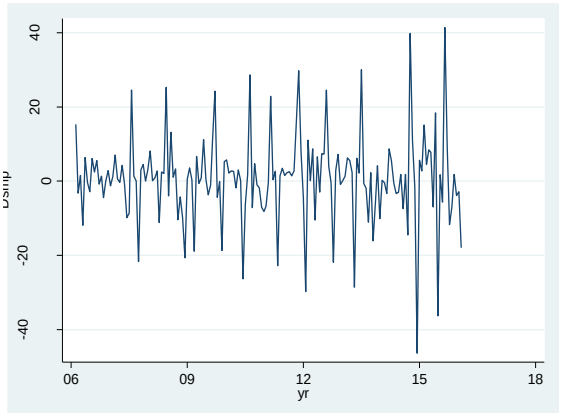


Figure 4.1: Line Plots of Undifferenced Variables

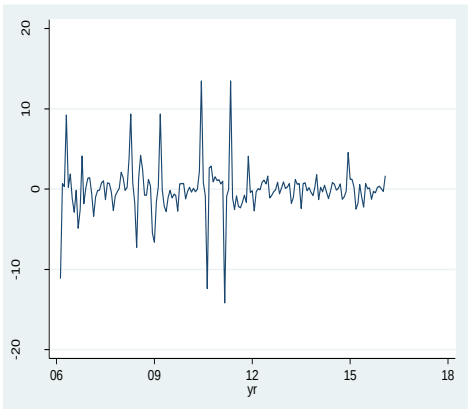
Source: Author, 2019

Figure 4.2 shows graphs of differenced variables. Visual inspection of the differenced variables and it indicates that the series osciliates around its mean suggesting that the the first difference of stock market prices, inflation, interest rates and GDP are stationary at firt difference.

Stock market prices



inflation



Exchange rate

Interest rate

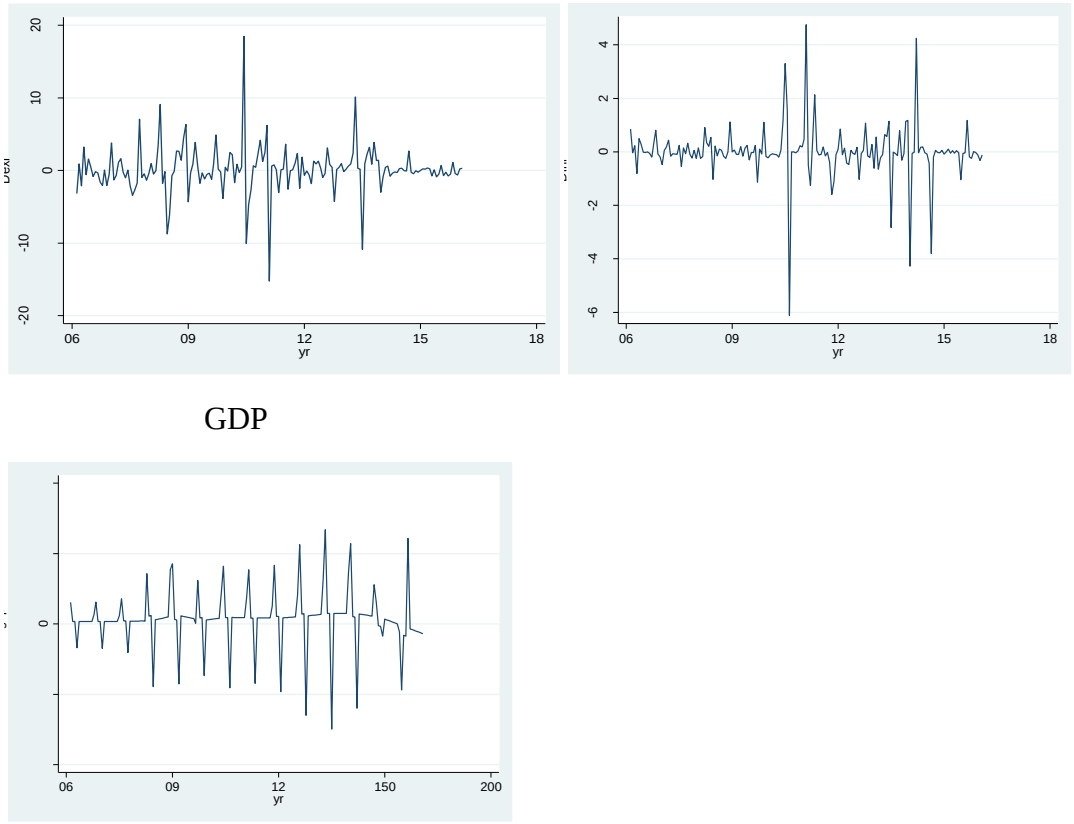


Figure 4.2: Line Plots of Differenced Variables

Source: Author, 2019

4.5 Unit Root Tests

Unit root in a time series studies is a property that is used to test for Stationarity Green (2005). Absence of unit root in a series confirms presence of Stationarity. Estimating regression models with nonstationary time series data leads to meaningless or spurious results in the sense that conclusions based on that results are misleading. Unit root implies that mean and variance changes over time. Series containing unit root are differenced of any order until they attain this Stationarity property. There are several tests for unit root, but this study used, Augmented Dickey Fuller proposed by Augmented Dickey & Fuller (1979) and Phillips-Perron test proposed by Phillips & Perron (1988). The tests is robust with respect to unspecified autocorrelation and

heteroscedasticity in the disturbance process of the test equations (Davidson *et al.*, 2004).

4.5.1 Augmented Dickey Fuller Unit Root Test

The first unit root test adopted was ADF test. The null hypothesis is; the series have unit root against alternative hypothesis that the series are stationary. The results in Table 4.3 indicates Stock market prices, Exchange rate and GDP had unit roots at levels. Whereas inflation and interest rates were stationary, or we can say that they are integrated of order zero denoted as $I\ (0)$. The order at which a variable is said to be stationary is the number of differencing times a variable takes to attain its Stationarity. According to Green (2010), differencing an already stationary variable makes it more stationary though you will lose degrees of freedom. All the variables became stationary upon first difference. The critical reference value for this study was 5 percent. All absolute Mackinnon $Z\ (t)$ values less that absolute critical values of 5 percent confirms the presence of unit roots and the values greater than this critical value confirms Stationarity.

Table 4.3: Augmented Dicker Fuller Test at Levels and at First Difference

At Levels						
Variables	**Z(t)**	**Prob>t**	**Critical values**			**Conclusion**
			1%	5%	10%	
SMP	-2.092	0.24477	-3.488	-2.866	-2.576	Presence of unit root
INF	-4.836	0.0000	-3.488	-2.886	-2.576	No unit root (*I(0)*)
EXR	-1.495	0.5362	-3.488	-2.886	-2.576	Presence of unit root
INR	-3.289	0.0154	-3.488	-2.886	-2.576	No unit root(*I(0)*)
GDP	-0.493	0.8935	-3.488	-2.886	-2.576	Presence of unit root
At First Difference						
Variables	**Z(t)**	**Prob>t**	**Critical values**			**Conclusion**
DSMP	-13.116	0.0000	-3.488	-2.886	-2.576	*I(1)*
DINF	-12.042	0.0000	-3.488	-2.886	-2.576	*I(1)*
DEXR	-13.461	0.0000	-3.488	-2.886	-2.576	*I(1)*
DINR	-13.076	0.0000	-3.488	-2.886	-2.576	*I(1)*
DGDP	-11.172	0.0000	-3.488	-2.886	-2.576	*I(1)*

* I(1) represents the variables that are stationary at first difference
Source: Author, 2019

4.5.2 Phillips Perron Unit Root Test

The test was developed by Phillips and Perron (1988). It tests the null hypothesis of series contains unit root against alternative that the series are stationary. Gujarati (2004) illustrated that using more than one test will promotes consistency and efficient in confirmation that variable is stationary or not. Therefore, this test was performed to check for this consistency. The results presented in Table 4.4 shows that at levels, stock market prices, exchange rate and GDP variables had unit root (their absolute $Z\ (t)$ values were less than 5 percent critical value). However, upon first difference, all the series became stationary or integrated of order one $I\ (1)$. All absolute $z\ (t)$ statistic values were greater than critical values and the p-values were 0.0000 meaning the null hypotheses were rejected and concluded that variables became stationary after first difference.

Table 4.4: Phillips-Perron Unit Root Test

At Levels						
Variables	**Z(t)**	**Prob>t**	**Critical values**			**Conclusion**
			1%	5%	10%	
SMP	-2.092	0.24477	-3.488	-2.866	-2.576	Presence of unit root
INF	-4.836	0.0000	-3.488	-2.886	-2.576	No unit root (*I(0)*)
EXR	-1.495	0.5362	-3.488	-2.886	-2.576	Presence of unit root
INR	-3.289	0.0154	-3.488	-2.886	-2.576	No unit root (*I(0)*)
GDP	-0.493	0.8935	-3.488	-2.886	-2.576	Presence of unit root
At First Difference						
DSMP	-13.521	0.000	-3.488	-2.886	-2.576	*I(1)*
DINF	-12.354	0.0000	-3.488	-2.886	-2.576	*I(1)*
DEXR	-13.820	0.0000	-3.488	-2.886	-2.576	*I(1)*
DINR	-13.472	0.0000	-3.488	-2.886	-2.576	*I(1)*
DGDP	-11.066	0.0000	-3.488	-2.886	-2.576	*I(1)*

* I(1) represents the variables that are stationary at first difference
Source: Author, 2019

4.5.3 Clemente-Montanes and Reyes Unit Root Test with Structural Break

Sometimes the conventional methods of Philip Perron and Augmented Dicker fuller are sometimes inconclusive and confusing and misleading incases of existence of structural breaks in time series and may fail to reject the null hypothesis if the series has a structural break and in such a case, Clemente, Montanes and Reyes (1998) test for Stationarity in the presence of a single structural break in the series (rather than the two breaks identified by their routines) is applied. The test considers the null hypothesis that (rho - 1) is different from zero. A test statistic exceeding the critical value is significant. Critical values are taken from Perron and Vogelsang (1992).

Table 4.5: Clemente-Montañés-Reyes Unit-root Test with Single Mean Shift, AO Model

Variable	Breaks	Coef	t-statistic	P-Value	Optimal break point
INF	*D1*	-2.94059	-4.4690	0.0000	2012M12
EXR	*D1*	20.02981	17.8460	0.0000	2011M2
GDP	*D1*	4.02860e+06	17.7470	0.0000	2015M4
INR	*D1*	1.97712	7.0140	0.0000	2011M4
SMP	*D1*	71.88244	24.0990	0.0000	2013M3

Notes: M denotes months of the year, D1 denotes, dummies

Source: Authors' own compilation, 2019

From the Table 4.5, it was established that inflation had one significant structural break (P-value 0.0000 < 0.050) in December (2012M12). This phenomenon is associated with declining inflation from 18.9 percent in 2011 to 12. 0 percent in 2012. This was as a result of tightened monetary policy by CBK and abundant rainfall which reduced the cost of electricity and pumper harvest in quarter three 2012 which ease food prices.

The analysis showed exchange rate (EXR) experienced a significant structural break in February 2011 (2011M2) ($p - value\ 0.0000 < 0.050$). This optimal break is particularly associated with trickledown effect of Euro Zone economic crisis which affected Kenya's exports to Europe. This is also associated with spillover effects of the 2010 referendum which saw a lot of money pumped into the economy during campaign and this caused Kenyan shillings to weaken against the US dollar (Fengler, 2012).

Optimal significant breakpoint (p-value 0.0000 < 0.050) for GDP was experienced in April 2015 (2015M4). In 2015, financial sector performance declined by approximately 4.13 percent this was due to placement of three commercial banks in Kenya being placed under receivership (Zakaria, 2016).

Interest rate registered a major and significant structural break 2011M4($p-value$ $0.0000 < 0.050$). This is linked to increasing inflation by double digit and as result interest rates escalated due to tightened monetary. In the year 2011, equity markets experienced a relatively strong interest in primary markets and in this year the longest debt instrument was issued (Aduda, 2012).

Stock market prices indicated a significant structural break in 2013M3 ($p-value$ $0.0000 < 0.050$) 2013M3. It was associated with the sharp decline of share price at Nairobi Stock exchange during the period 2012/2013 (Williams, 2014). Graphically, the optimal breaks are shown by graphs in appendix 2.

4.6 Determination of Optimum Lag Length

Table 4.6 reports the estimation of lag length of various criteria used lag length. To tests for the number of for cointegration ranks or fit cointegrating in the VECM model lag length must be specified. Tsay (1984) and Paulsen (1984), Nielsen (2001) showed that several methods can be used to select lag length for a VAR model with I (1) variables. From the output on Table 4.6 the maximum number of lags selected was three. Log likelihood ratio (LR), Final prediction error (FPE) method, Akaike information criterion (AIC) showed that the maximum applicable in this multivariate model was three. Schwarz's Bayesian information criterion (SBIC) and Hannan and Quinn information criterion (HQIC) showed that maximum lag-order was at zero (as indicated by *).

Table 4.6 presents the various criteria such as LL, LR FPE, AIC, HQIC and SBIC used in determination of optimum lag length in this study

Table 4.6: Determination of Optimum Lag length

Lag	LL	LR	DF	P	FPE	AIC	HQIC	SBIC
0	-3843.87				2.2e+14	47.2254	47.264*	47.3203*
1	-3821.92	43.917	25	0.011	2.3e+14	47.2628	47.4939	47.8322
2	-3803.22	37.382*	25	0.053	2.5e+14*	47.3402*	47.764	48.3841
3	-3744.64	117.16	25	0.000	1.7e+14	46.9281	47.5446	48.4465
4	-3729.66	29.968	25	0.225	1.9e+14	47.051	47.8601	49.0439

Source: Author, 2019

It is important to determine the appropriate lag length in estimating the VAR model. Lutkepohl (1993) postulates that that overfitting that is selecting a higher order lag increases the mean square variance of residuals. On the other hand, small lag order generates autocorrelation problem (Ozcicek, 1999). In this study two lags was selected because majority of the criteria predicted maximum lag order at order two.

4.7 Johansen Cointegration Test

Having established the Stationarity and confirmed that the univariate time series are integrated of order one $I(1)$, cointegration tests was essential. In this study, Johansen test was chosen because it is applicable where we have multivariate relationships as opposed to Engle-Granger technique that applies to bivariate relationships (Lutkepohl, 2005; Hamilton, 1994). Johansen's technique also has advantages over other cointegration methods because it does not suffer from a normalization problem and is robust to departures from normality (Nyongesa, 2013). It also supports other superior properties in relation to other techniques (Gonzalo, 1994; and Nyongesa, 2013).

Table 4.7: Johansen Cointegration Test

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. Of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.2248	86.8304	69.8189	0.0012
At most	10.1176	45.3267	47.8561	0.0848
At most 2	0.0682	4.9256	29.7971	0.1641
At most 3	0.0570	13.4044	15.4947	0.1008
At most 4	0.0233	3.8470	3.8415	0.0498

Trace test indicates 1 cointegrating eqn (s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. Of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.2248	41.50370	33.8768	0.0051
At most 1	0.1176	20.4011	27.5843	0.3140
At most 2	0.0682	11.5212	21.1316	0.5953
At most 3	0.0569	9.5573	14.2646	0.2427
At most 4	0.0233	3.8470	3.8415	0.0498

Max-eigenvalue test indicates 1 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, 2019

Cointegration tests technique is a common and important phenomenon in econometrics as it enables the researcher to estimate either VAR of VEC models. When it's detected that there is cointegration between variables in question, Vector Error Correction Model is estimated. Johansen cointegration test procedure involves use of two test statistics, first, trace statistics and second, maximum Eigen value statistics (Cameron and Trivedi, 2005). The results from the analysis showed that the trace statistic is greater than critical value at 5 percent level of significance ($86.83 > 69.819, p-value = 0.0012$) confirming that there is one cointegrating equation. Maximum Eigen value likewise indicates there is one significant cointegrating equation at 5 percent level (maximum eigenvalue was 41.504, which is greater than

33.877 critical value) as shown in Table 4.6 and it was concluded that there was cointegration among the variables which implies a long term association among the variables.

4.8 Vector Error Correction Estimates

After confirming cointegration relationship among the variables then vector error correction model (VECM) was estimated and the results is presented in Table 4.8.Cintegration t implied that there was an error correction that gradually corrects the endogenous variables to a long run relationship through series of partial short run adjustments (Hussain, 2009). Therefore, it required application of VECM which is an appropriate in order to evaluate the short run properties of the co integrated series (Greene, 2008).

Table 4.8: Vector Error Correction Regression Results

				No. Of obs = 165 **R-sq = 0.2878**
	Coef.	**Std. Err.**	**Z**	**P>|z|**
D_dsmp				
_ce1	-1.1804	0.1234	-9.5600	0.0000
Dsmp				
LD.	0.2195	0.1111	1.9800	0.0480
L2D.	0.2995	0.0846	3.5400	0.0000
Dinf				
CLD.	-0.8371	0.3004	-2.7900	0.0050
L2D.	-0.5029	0.2869	-1.7600	0.0790
Dexr				
LD.	0.0001	4.54e-06	2.5100	0.0120
L2D.	-0.0882	0.2756	-0.3200	0.7490
Dinr				
LD.	-4.0876	0.8161	-5.0100	0.0000
L2D.	1.8627	0.7962	2.3400	0.0190
Dgdp				
LD.	0.00002	4.71e-06	4.4700	0.0000
L2D.	0.4431	0.2864	1.5500	0.1220
_cons	-0.0015	0.9006	-0.0000	0.9990

Note: *D* represents difference, LD-Lagged difference, *ce1*-cointegrating equation.
Source: Author, 2019

The VECM results in Table 4.8 showed a negative error term (-1.1804) and significant $(p - value = 0.000)$ coefficient in cointegrating equation *(_ce1)* indicating that any form of short-term fluctuations between stock market prices, inflation, exchange rate, interest rate and GDP gave a stable and a long run relationship. The magnitude of cointegrating term (-1.1804) coefficient represents the speed of adjustment with which the variables converges over time (Hussain, 2009; Lutkepohl, 2005; Hamilton, 1994; and Tsay, 2010).

4.9 Test of Hypothesis

Hypothesis testing is a procedure in which analysts' measures and examines a random sample with an aim of accepting of rejecting a null hypothesis. The test tells the statistical analysts whether the primary hypothesis is true or not. They are used to infer the results performed on sample from a larger population in this case the stock market prices in Nairobi Securities Exchange. The first four hypotheses were answered using vector error correction results presented in Table 4.8 whereas the last hypothesis was test using Granger causality results.

The first hypothesis stated that inflation has no significant relationship with stock market prices in Kenya. From the VEC results showed that the first lagged difference value of inflation was negative (-0.8371) and significant $(p - value = 0.005)$ in relation to stock market prices in NSE. This showed that a unit increase in inflation causes a 0.8371 percent decrease in stock market prices. It implied that this hypothesis was rejected and concluded that inflation was a significant determinant stock market price. Inflation causes stock prices to be volatile and thus investors become uncertain on the market conditions. This reduces demand for new purchases of stock and thus pushes the prices downwards. These findings resonate with the earlier study of Mutuku *et al*., (2015) who did a research on dynamic affiliation

amongst stock prices and the 4 Macroeconomic variables in Kenya. The study utilized time series data for a period of 24 years the study employed VECM in examination and the results confirm that macroeconomic variables determine equity marketing in the long run. Inflation was found to negatively affect stock market prices. The study concluded that stock market prices are negatively affected by inflation. Kirui and Wawire (2014) using threshold generalized autoregressive conditional heteroscedasticity (TGARCH) model also found a negative relationship between inflation and stock market prices in Kenya. These study findings contradicted the findings of Maina (2013) and Evans *et al.,* who showed a positive relationship between stock market prices and inflation Kenya. They investigated the association between macroeconomic determinants together with prices of shares of Companies that are listed in the Nairobi Securities Exchange. The findings of Salameh (1997) found no significant relationship between inflation and stock market. The inconclusive findings may be attributed to other factors that were not investigated by their study.

The second hypothesis stated that there is no significant relationship between exchange rate and stock market prices in NSE. The findings indicated a small, positive and significant ($p - value = 0.012 < 0.05$) coefficient of 0.000114 which shows that a one percent increase in exchange rate causes a 0.000114 percent increase in stock market prices in NSE. The small coefficient of exchange rate implies that it has a small influence on stock market prices in NSE. Ndlovu, *et al.,* (2018) evaluated the relationship of macroeconomic determinants on stock returns in South Africa. The macroeconomic variables engaged in the analysis were: inflation rate, the growth of money supply, interest rate and exchange rate. The study engaged co-integration examinations, vector error correction model, a variance decomposition and

an impulse response function in order to study the connection among the study variables. The study revealed that exchange rate had positive effect on stock prices. The study further found a unidirectional causality running through exchange rates and interest rates to the share price. This concurs with Kitatia *et al.,* (2015) and Mertzanis (2009) and Chirchir (2011) who analyzed the effect of major economic determinants on stock market prices for the companies listed at the Nairobi securities exchange in Kenya. The variables under the investigation included the foreign exchange rate, interest rate and inflation rate on share prices fluctuations. The impact of chosen macro-economic variables on stock exchange deliver significant inferences for financial policy, risk controlling activities, financial securities valuation and government policy in the direction of monetary markets. The data for research was sourced from: CBK, Institute of statistical Kenya and Nairobi Securities Exchange. The model used in the analysis was simple and multivariate regressions. The study therefore concluded that for the case of all listed companies in the Nairobi Securities, exchange rate was found to positively affect stock market prices.

Innocent *et al.,* (2018) investigated the influence of major economic determinants on how the stock market prices perform in Rwanda. The study was done mainly to check on the effects of the major economic determinants which no one had conducted in Rwanda ever. The macroeconomic variables under the investigation included the following; GDP, exchange rate, inflation and interest rate. The study employed time series data that were collected on the monthly basis for a period of six years. The study used the Engel Granger Cointegration experiments in order to evaluate the long run association amongst the variables correspondingly. The research utilized VAR technique in investigating the influence of the stated determinants on stock market presentation. Study findings from the research showed a negative and statistically

significant effect of inflation exchange rate on stock market performance whereas interest rate is negatively insignificant.

The third objective was hypothesized that there is no significant relationship between interest rate and stock market prices in NSE. From the VEC results, the coefficient for interest rate was -4.088 and significant ($p - value = 0.000$) at 5 percent level of significance. It signified that a one percent increase in interest rate would lead to decrease in stock market prices by approximately 4.1 percent. This contradicts the findings of Ndlovu *et al,* 2018, who found that interest rate positively affects the stock market prices and Elly *et al.,* (2013) who evaluated the connection amongst macroeconomic determinants on Nairobi Stock Exchange. The study further examined if dynamics in macroeconomic determinants might be engaged to focus the future. The major 3 macroeconomic used in the analysis were; lending interests rate, 9-day Treasury bill rate and the inflation rate. The analysis found that 91-day Treasury bill had a negative relationship with the NASI whereas inflation had a positive relationship that was weak with the NASI. Owing to research findings, the study concludes that macroeconomic environment should be monitored because dynamics in the macroeconomic determinants had an effect on the performance of the stock market that also impacts decisions of the foreign investors in the domestic markets.

The fourth hypothesis formulated as follows; there is no significant relationship between nominal GDP and the stock market prices in NSE. It was evident that the first lagged value of GDP positively affects stock market prices. It registered a positive and significant coefficient of $0.000021 (p - value = 0.0000)$. This indicated that a one percent increase in nominal GDP causes an approximately 0.000021 percent increase in stock market prices. The findings resonate with previous

studies by Abel (2014) and Akbar *et al.,* Khan (2012). This positive influence of GDP can be associated with the fact that GDP primarily influences financial conditions and consumer confidence. When GDP tends to be optimistic brings great deal and prospects various stocks. High valuation allows companies tendency to borrow more money at cheap rates allowing expanding operations and increasing investments on new projects. A high growth in GDP is an indicator that the firms listed in NSE are performing well and therefore this leads to increase in their market share prices. When GDP is low it will bring a negative influence in purchase of stocks thus causes difficulty for companies to invest on new sources of financing and due to this investment in new more projects will be unlikely. The findings from this study contradicted earlier studies by Willy (2012) and Mutitu (2015) who found a negative association between GDP and stock market prices of manufacturing and agricultural listed in NSE.

4.10 Results of Granger Causality

Since from the previous Johansen test and unit root tests results to confirm the presence of cointegration and Stationarity respectively. Granger causality proposed by Granger (1969) that before estimating Granger causality, the series should have a Stationarity property and the variables in question should have a long-term cointegration relationship present. Granger causality test is needed to determine how guide the relationship between them. He proposed that assume we have two variables X and Y. X is said to Granger cause Y if it is useful in forecasting Y implying that X is able to increase the accuracy of the prediction of Y with respect to a forecast, considering only the past values of Y.

From the Granger causality results presented in the Table 4.9, stock market prices Granger causes exchange rate in NSE during the study period with F-statistic of

8.2626 and probability of 0.0004. It implies that stock market prices can be used to forecast for future exchanges rate. This may be attributed by the fact that fluctuations in stock prices can cause oscillations in foreign exchange rates and in return causes panic among portfolio managers predisposes them to liquidate holdings in their portfolios. Managers may predispose shares in the portfolio when there is appreciation of the foreign currencies. In this case, managers should increase equity shares when they forecast a depreciation of the foreign currencies. This finding supports a study by Toda Yamamoto (1995) who found a bidirectional relationship between share price and exchange rate. Sifunjo (1999) used Granger causality test and established a unidirectional relationship from exchange rates to share price in Kenya. Thus, in their conclusions, stock market prices Grangers causes exchange rate and vice versa. In contrary to this, Smyth and Nandha (2003), Nieh and Lee (2001) and Bahamani-Oskooee and Sohrabian (1992) found no evidence of significant relationship between stock market prices and exchange rates.

John *et al*., (2018) researched on the association amid prices of different stock that are traded in Tanzania, the Dares Salam Stock Exchange. The study used time series daily data spanning from 2011 - 2017. The study utilized the Granger Causality technique with other examinations on the variables and the model itself. From the analysis, the results revealed that there is an association in a short term among the stock prices and exchange rate. Furthermore, Stock Prices Granger Causes exchange rates as demonstrated by Granger Causality and the Impulse test. These judgments are reinforced by the point that instabilities in the Exchange Rates do not affect in the Stock Prices. The study further confirmed that inflation Granger causes interest rate in Kenya $(F - statistic = 5.8682, p - value = 0.0035)$. This unilateral relationship explains that interest rate is caused by the expected inflation rate. Current

interest rates depend on the predicted value of inflation. Central bank normally apply inflation targeting regime uses interest rate as the operational target aimed to achieve the desired inflation rates.

Wasseja *et al.,* (2015) conducted a research on the granger causal affiliation amid macroeconomic determinants and stock prices in Kenya. The study used the secondary data spanning from 1980 to 2012 and used Vector Autoregressive model. As per Granger causality outcomes, it is proved that movement in the macroeconomic variables had no statistically significant influence on stock prices, exchange rate and inflation are insignificant factors explaining part of the movement in the macroeconomic variables excluding interest rate.

Mamun *et al.,* (2018) examined the causality linkage amongst stock market development and economic growth in Bangladesh. The Granger causality analysis concludes that the causal relationship is unidirectional than runs from stock market development to the GDP development.

Innocent *et al.,* (2018) investigated the influence of macroeconomic determinants on how the stock market performance in Rwanda. The study used the Engel Granger Cointegration analysis in order to evaluate the long run relationship amongst the variables respectively. The study results found that stock market price granger causes GDP.

Kisaka and Mwasaru analyzed the link among the foreign exchange rate and share prices in Nairobi Stock Exchange. The outcomes of the study established that the 2 variables were cointegrating and that the exchange rate Granger causes the shares. Nominal GDP Granger causes exchange rates with probability 0.0008. This result elucidates that the gross domestic product (GDP) is a principal indicator used to

measure the power health of a county's economy. Worldwide, avoiding overvaluation of currency is one of the most robust imperatives that be obtained from different experience with growth in economy.

Table 4.9: Pairwise Granger Causality Tests

Pairwise Granger Causality Tests
Lags: 2

Null Hypothesis:	Obs.	F-Statistic	Prob.
INF does not Granger Cause SMP	166	1.75722	0.1758
SMP does not Granger Cause INF		2.35591	0.0981
EXR does not Granger Cause SMP	166	1.43523	0.2411
SMP does not Granger Cause EXR		8.26255	0.0004
INT does not Granger Cause SMP	166	1.50732	0.2246
SMP does not Granger Cause INT		0.80027	0.4510
NGDP does not Granger Cause SMP	166	1.82532	0.1645
SMP does not Granger Cause NGDP		1.44075	0.2398
EXR does not Granger Cause INF	166	0.35531	0.7015
INF does not Granger Cause EXR		0.03128	0.9692
INT does not Granger Cause INF	166	1.38651	0.2529
INF does not Granger Cause INT		5.86817	0.0035
NGDP does not Granger Cause INF	166	2.47658	0.0872
INF does not Granger Cause NGDP		2.10911	0.1247
INT does not Granger Cause EXR	166	1.35933	0.2598
EXR does not Granger Cause INT		0.18099	0.8346
NGDP does not Granger Cause EXR	166	7.42785	0.0008
EXR does not Granger Cause NGDP		0.59231	0.5543
NGDP does not Granger Cause INT	166	0.92632	0.3981
INT does not Granger Cause NGDP		4.80236	0.0094

Source: Author, 2019

Interest rates further Granger causes nominal gross domestic product since there was a significant F-statistic 4.8024 ($p - value = 0.0094 < 0.05$) at 5 percent level of

significance. High interest rates in a small open economy lead to high increase in savings that attract foreign inflows that could lead to currency appreciation.

4.11 Post Diagnostic Tests

The following tests were undertaken to understand the assumptions of the OLS in the time series variables. There tests were; Normality using Jarque-Bera test, Breusch-Pagan-Godfrey Lagrange test for heteroskedasticity, Durbin-Watson test for serial correlation and finally testing for stability of the model (VECM) used.

4.11.1 Normality Test

Jarque-Bera test was used to test for normality of residuals of the estimated VECM model. The null hypothesis states that the residuals of variables are normally distributed while the alternative hypothesis states that the residual are not normally distributed. From the results presented in the figure 4.3, the value for Jarque-Bera was 0.6154 and the probability of 0.7351. Since the probability is greater than 5 percent significance level, the null hypothesis failed to reject the null hypothesis and it was concluded that residuals are normally distributed.

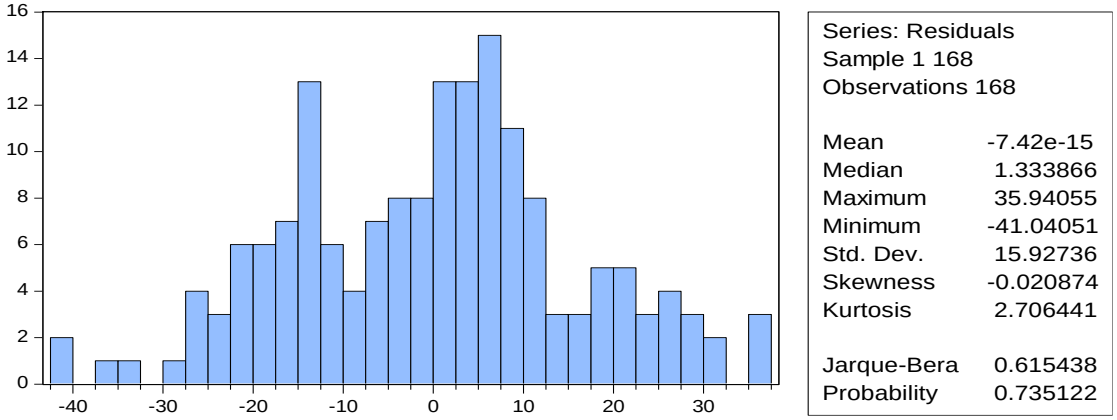


Figure 4.3: Normality Test

Source: Author, 2019

4.11.2 Breusch-Pagan-Godfrey LM test for Heteroskedasticity

Heteroskedasticity (heteroscedasticity) is frequently discussed parametric analysis as an assumption of linear regression. When the variance of residuals is unequal across the range of variables from one variable to another that predicts it, it is said the variables are heteroskedastic. It is assumed that the residuals of the regression model are homoscedastic across all values of the predicted value of the dependent variable. It determines the ability of the regression model to predict dependent variable is consistent across all the values of the dependent variable. In this case, heteroskedasticity measures the ability of regressing the independent variables; inflation, exchange rate, interest rate and nominal GDP on the dependent variable stock market prices.

Table 4.10: Breusch-Pagan-Godfrey Heteroskedasticity Test

F-statistic	9.811453	Prob. F (4,163)	0.0000
Obs*R-squared	32.60041	Prob. Chi-Square (4)	0.0000
Scaled explained SS	26.18430	Prob. Chi-Square (4)	0.0000

Source: Author, 2019

Breusch-Pagan-Godfrey test is a Chi-Squared test statistic distributed with k degrees of freedom. When the p-value is less than 5 percent level of significance, the null hypothesis of homoscedasticity is rejected, and heteroscedasticity is assumed.

Residuals or errors in a prediction are supposed to be independent. To check this, the researcher used Durbin-Watson *d* test ranges from 0 to 4 with the acceptable range being 1.50 to 2.50.

4.11.3: Durbin-Watson test for Serial for Correlation

Table 4.11 presents the results of Durbin-Watson test for Serial for Correlation

Table 4.11: Results of Durbin-Watson Test for Serial for Correlation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INF	-0.073250	0.117993	-0.620804	0.5356
EXR	-0.114961	0.123760	-0.928904	0.3543
INT	-0.048301	0.244242	-0.197759	0.8435
NGDP	5.06E-07	7.19E-07	0.704122	0.4824
C	8.867542	8.433250	1.051498	0.2946
RESID (-1)	0.890022	0.079152	11.24447	0.0000
RESID (-2)	0.039199	0.079576	0.492598	0.6230

R-squared	0.851596	Mean dependent variance	-7.42E-15
Adjusted R-squared	0.846066	S.D. dependent variance	15.92736
S.E. of regression	6.249019	Akaike info criterion	6.543500
Sum squared residuals	6287.089	Schwarz criterion	6.673665
Log likelihood	-542.6540	Hannan-Quinn criterion	6.596327
F-statistic	153.9795	Durbin-Watson stat	2.022896
Prob (F-statistic)	0.000000		

Source: Author, 2019

The results in Table 4.11.3 shows that the probability of Chi-square is 0.000, which is less than 0.05. The null hypothesis was rejected in favour of that alternative hypothesis. Values close to zero have positive correlation and those variables with values closer to 4 have negative serial correlation. From the results above the Durbin-Watson 2.022896 which implied no serial correlation.

4.11.4 Roots of Companion Matrix Test for Model Stability

In times series analysis, misspecification of the model may lead to biased results and therefore testing for model is essential (Farhani and Ozturk, 2015).

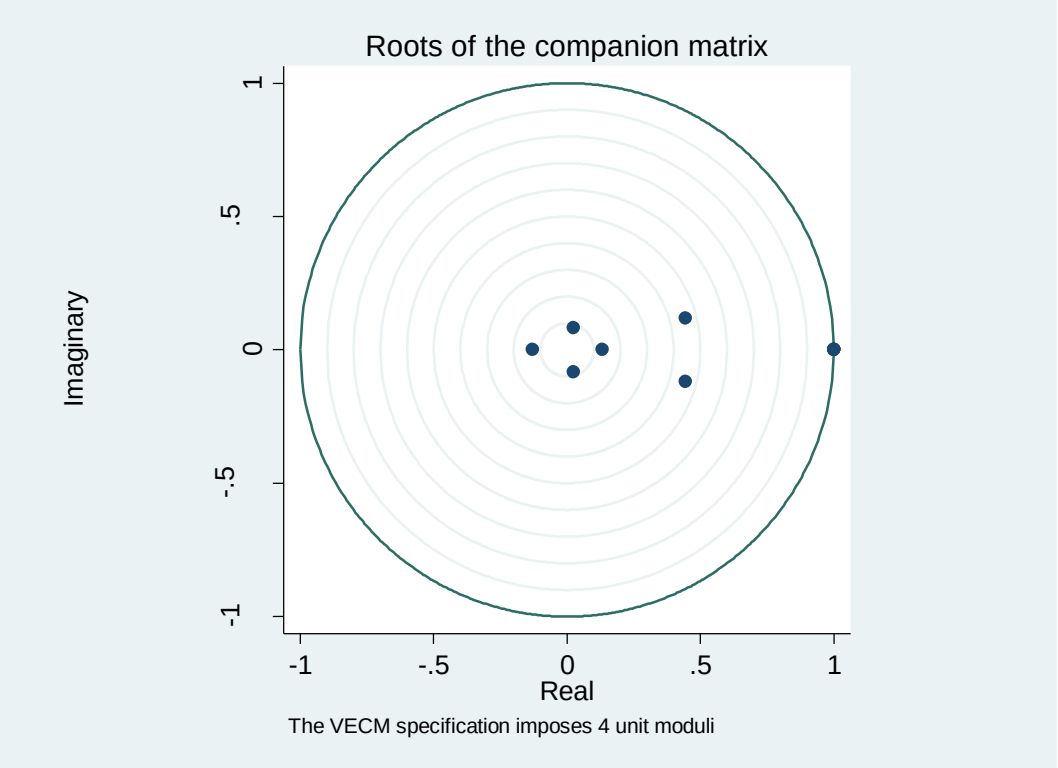


Figure 4.4: Model Stability Test

Source: Author, 2019

Figure 4.4 Shows that all the values lie inside the circle and this confirms that the model was stable.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Overview

This chapter presents the summary of study findings and draws conclusions from the findings based on the study objectives. The Chapter also presents the recommendations made from the findings. In the last part of this chapter, suggestions for further studies are also presented.

5.2 Summary of the Findings

The general objective of the study was to analyze causal and cointegrating relationship between macroeconomic variables on stock market prices in Nairobi securities exchange for the period 2005 - 2018. The specific objectives of this study were: to determine the relationship between inflation and stock market prices at the Nairobi Securities Exchange in Kenya, to evaluate the relationship between exchange rate and stock market prices at the Nairobi Securities Exchange in Kenya, to investigate the relationship between interest rate and stock market prices at the Nairobi Securities Exchange in Kenya, to find the relationship between nominal GDP and the stock price at the Nairobi Securities in Kenya and to analyze Granger causality between macroeconomic variables and stock market prices in Nairobi Securities Exchange in Kenya.

Descriptive statistics were carried out to check for any outliers and describe general characteristics of the sample. Correlation analysis was also carried out to determine the strength and association between variables under study. Augmented Dicker Fuller and Philip Perron unit root were carried out to check for unit root among the variables and it was found out that there was unit root for inflation and interest rate showed no unit root at levels while exchange rates, stock prices and gross Domestic product all

exhibited unit root levels. Upon first difference and it was concluded that they were all stationary at first difference.

Further, Clemente-Montanes and Reyes unit root test with Structural Breaks was applied to check for unit root in presence structural breaks. The test showed that the structural breaks were significant for all the variables and that these structural breaks were associated were variable specific and were associated with certain economic episodes.

Optimal lag length was also determined, and the results attested two lags. Johansen test for cointegration was further carried out to find out for cointegration and the test showed that there were at least three cointegrating equations and this showed that the variables were cointegrated hence long-term association between variables therefore vector error correction model was estimated. This is indicated by significant and negative coefficient of the error correction term. It was established from the vector error correction model that, inflation, exchange rate, interest rates and gross domestic product had negative relationship with stock market prices.

Granger causality was also estimated to show causality between macroeconomic variables and stock market prices in Nairobi Securities Exchange. It was established stock market prices Granger causes exchange rate in NSE during the study period. Furthermore, Stock Prices Granger Causes exchange rates as demonstrated by Granger Causality and the Impulse test. The findings showed that that inflation Granger causes interest rate in Kenya and nominal GDP Granger causes exchange rates with a unidirectional causality.

5.3 Conclusions

The present empirical findings that is helpful in policy recommendation that will be helpful in improving. It was concluded from the vector error correction estimates that showed that the lagged difference value of inflation had a negative relationship with stock market prices in Nairobi stock exchange. The findings concurred with the findings of Chandra (2007) who found out a negative relationship between stock market prices and inflation rate. However, the results contradicted the findings of Gultekin (1983) who found a positive link between inflation and common stocks in the United Kingdom. Owusu and Kuwornu (2011), Bhattarai and Joshi (2009) and Issahaku *et al,* (2013), Elly and Oriwo (2013). Also found a positive and relationship between stock market prices and inflation prices while the findings of Khan and Yousuf (2013) showed no significant relation between inflation and stock market prices and this suggests that inflation is a determinant of stock market prices in Kenya. The negative relationship is in tandem with theory that a rise in inflation causes in stock market prices.

Exchange rate had a positive relationship with stock market prices which implies that an increase in exchange rate increases stock market price in NSE. It disagreed with the findings of Kirui *et al.,* (2014). The findings of Olweny and Omondi (2011), Suriani *et al.,* (2015). Were inconclusive in that it found no significant relationship between exchange rate and stock market prices. This positive and significant relationship between exchange rate and stock market prices shows that an appreciation of exchange rate enhances performance of NSE. Increased participation of foreign investors in the stock markets will increase the prices of share and therefor this implies increased returns in the stock market.

From the vector error correction model results interest rates attested a negative relationship with stock market prices. The value of the coefficient of interest rate was negative association suggests that when interest rates is increased by commercial banks the investors reduces investment in financial markets and this consequently reduces the performance of stock markets in NSE. These findings are consistent with earlier study by Perera (2016), Ado and Sunzuoye (2013). These findings also corroborate with study by Amarasinghe (2015) who found out a negative relationship with between interest rates and stock market prices. However, the results contradict the study by Otieno (2014) who found a positive relationship between stock market prices and interest rate.

GDP was found to positively affect stock market prices in NSE. These findings disagree with earlier findings of Kyangavo (2016) who found out a negative but insignificant relationship between GDP and stock market prices. Kirui *et al.,* (2014) found an insignificant relationship between stock market prices and GDP.

5.4 Policy Recommendations

Based on the findings, the study recommends that government and Central Bank of Kenya should monitor macroeconomic environment since unregulated macroeconomic environment destabilizes the performance of the stock prices in Kenya. The CBK can achieve this through collaboration with the Capital Markets Authority. It is recommended that interest rate should be reduced to encourage investment in the stock market. Reduction of interest in the stock market will propel investment in the stock markets which will also reduce inflation. From the findings, the study also recommends that the government should control and stabilize inflation rate fluctuation which will create investor confidence in the securities market and lower the ever fluctuating.

The results showed that GDP and stock market prices are positively related and therefore the government should encourage activities that increase GDP since it is a primary indicator of an economy's overall health. Increase in GDP implies increased GDP per capita hence enables citizens to invest in stock markets. Any growth or decline in GDP has a corresponding result in the position of the stock market. When business sectors report an increase in earnings and production, the economy will reflect a positive movement in the GDP. Similarly, when the yield of goods and services is low, the economy is affected and consequently stock market prices. When stock markets report increased profits, the country's GDP will expect a significant growth, indicating that its economy is in great condition and that business is good within its sectors. In effect, investors gain confidence in companies, so they trust in the stock market more.

5.5 Suggestions for Further Studies

The following areas are suggested for future research: First, this study used time series data on stock market prices, inflation, interest rate, exchange rate and nominal GDP so, there is need for future researches to incorporate other variables not covered in this study for instance; money supply, foreign direct investment and trade liberalization and secondly, research should be done to determine the effect of macroeconomic variables on stock prices of East Africa Community stock markets.

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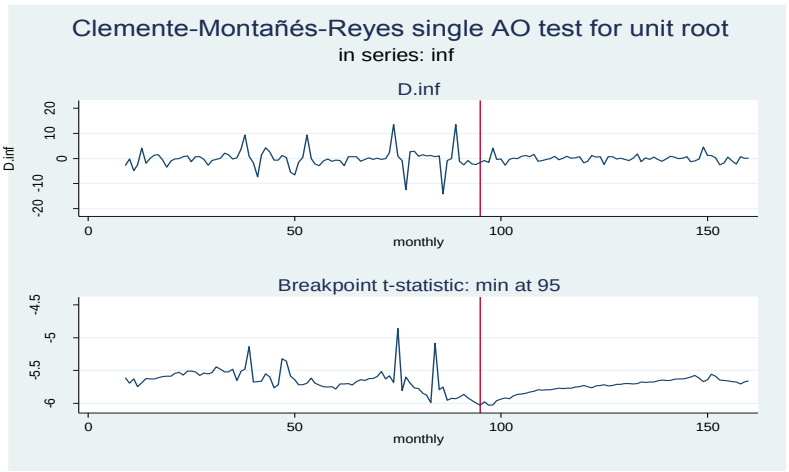
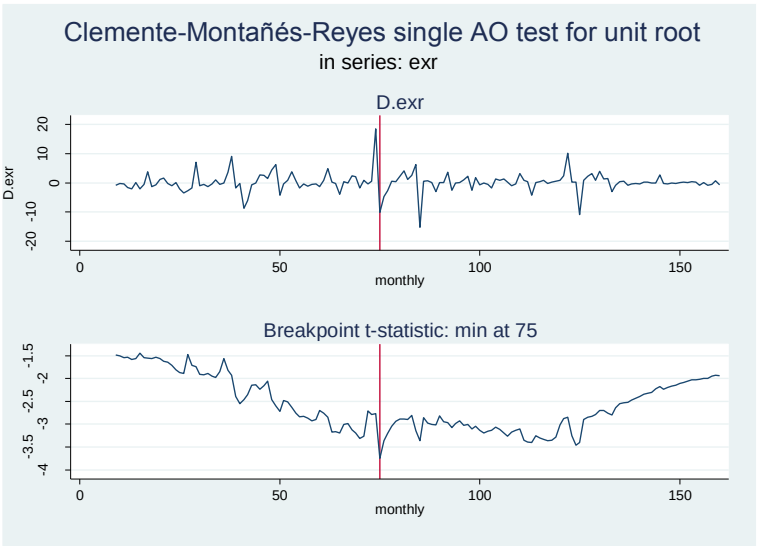
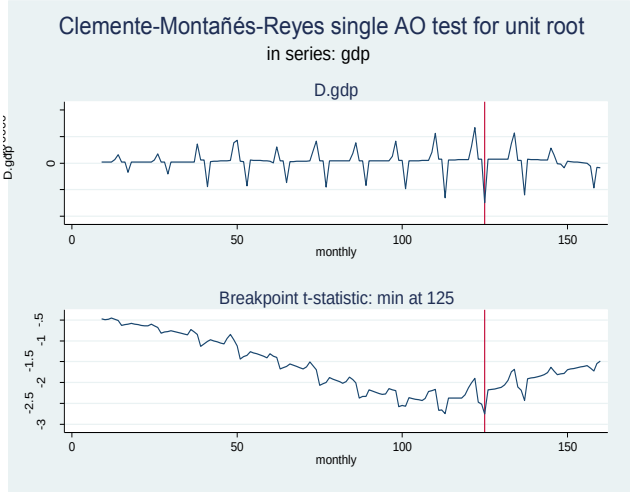
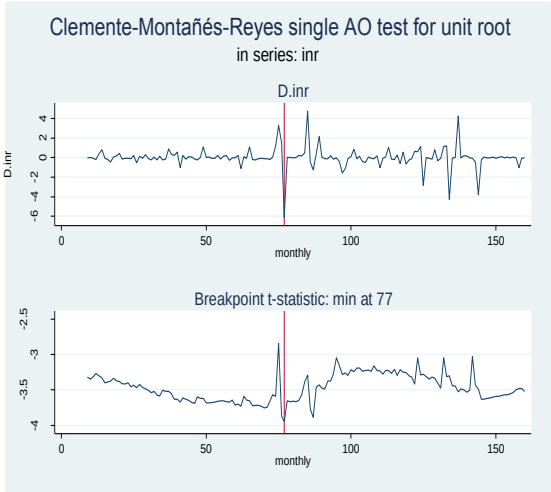
APPENDICES

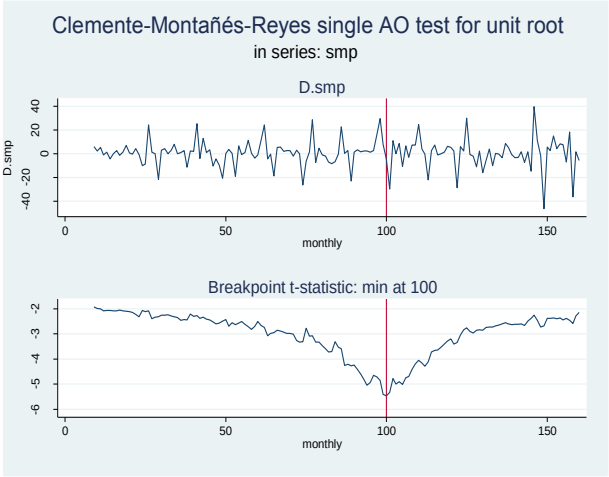
Appendix 1: Clemente – Montane - Reyes Single AO Test for Unit Root






Clemente-Montañés-Reyes single AO test for unit root
in series: gdp
D.gdp
D.gdp
0
0
50
100
150
monthly
Breakpoint t-statistic: min at 125
-1.5
-2
-2.5
-3
-1
-.5
0
50
100
150
monthly


Clemente-Montañés-Reyes single AO test for unit root
in series: inr
D.inr
D.inr
-6
-4
-2
0
2
4
0
50
100
150
monthly
Breakpoint t-statistic: min at 77
-2.5
-3
-3.5
-4
0
50
100
150
monthly


Clemente-Montañés-Reyes single AO test for unit root
in series: smp
D.smp
D.smp
-40
-20
0
20
40
0
50
100
150
monthly
Breakpoint t-statistic: min at 100
-6
-5
-4
-3
-2
0
50
100
150
monthly

Appendix II: Study Data

YEAR/MONTH	INF (%)	EXR (KShs)	GDP (Million KShs)	INR (%)	SMP (KShs)
2005m1	14.87	76.801	1322297	12.12	42.89
2005m2	13.94	75.622	1339205	12.35	44.56
2005m3	14.15	75.017	1356141	12.84	50.93
2005m4	16.02	76.602	1373107	13.12	50.64
2005m5	14.78	77.057	1390102	13.11	47.81
2005m6	11.92	76.206	1407126	13.09	53.89
2005m7	11.76	76.044	1424179	13.09	56.37
2005m8	6.87	75.696	1441262	13.03	61.87
2005m9	4.27	74.078	1458374	12.83	61.05
2005m10	3.72	73.606	1475515	12.97	58.19
2005m11	4.4	74.486	1492685	12.93	54.98
2005m12	4.7	72.367	1509884	13.16	56.47
2006m1	8.39	71.982	1527112	13.2	62.36
2006m2	9.39	73.198	1544370	13.27	59.71
2006m3	8.85	71.872	1561657	13.33	60.93
2006m4	5.44	71.158	1578973	13.51	68
2006m5	4.47	72.27	1596318	13.95	68.61
2006m6	4.28	73.88	1613693	13.79	68.29
2006m7	4.16	73.617	1631097	13.72	72.5
2006m8	4.92	72.624	1648529	13.64	71.81
2006m9	5.93	72.679	1665991	13.54	61.97
2006m10	6.55	72.02	1683483	14.01	57.95
2006m11	6.64	69.948	1701003	13.93	58.13
2006m12	7.98	69.397	1718553	13.74	61
2007m1	4.63	70.537	1726378	13.78	53.4
2007m2	3.02	69.733	1744396	13.64	57.58
2007m3	2.19	68.781	1762851	13.56	60.6
2007m4	1.85	68.306	1781745	13.33	65.1
2007m5	1.96	66.966	1801078	13.38	65.1
2007m6	4.07	66.564	1820849	13.14	68.19
2007m7	5.48	67.509	1841058	13.29	76.29
2007m8	5.3	66.989	1861706	13.04	76.39
2007m9	5.53	66.971	1882792	12.87	77.26
2007m10	5.38	67.114	1904317	13.24	77.91
2007m11	6.08	64.424	1926280	13.39	79.24
2007m12	5.7	62.675	1948681	13.32	79.27
2008m1	9.4	70.561	1902191	13.78	79.99
2008m2	10.58	68.978	1928378	13.84	98.6
2008m3	11.9	62.848	1957912	14.06	94.64
2008m4	16.12	62.136	1990794	13.91	107.78
2008m5	18.61	62.029	2027024	14.01	108.82
2008m6	17.87	64.694	2066601	14.06	112.11
2008m7	17.12	67.318	2109525	13.9	101.74
2008m8	18.33	68.733	2155796	13.66	97.54

2008m9	18.73	73.219	2205415	13.66	87.75
2008m10	18.74	79.653	2258381	14.12	68.84
2008m11	19.54	77.881	2314695	14.33	71.28
2008m12	17.83	77.711	2374356	14.87	73.37
2009m1	13.22	79.544	2591704	14.78	67.17
2009m2	14.69	79.687	2651584	14.67	52.82
2009m3	14.6	80.431	2708336	14.87	59.49
2009m4	12.42	78.662	2761959	14.71	58.86
2009m5	9.61	78.348	2812454	14.85	59.75
2009m6	8.6	77.158	2859820	15.09	70.96
2009m7	8.44	76.607	2904058	14.79	71.43
2009m8	7.36	76.233	2945168	14.76	67.79
2009m9	6.74	74.999	2983149	14.74	66.73
2009m10	6.62	75.239	3018001	14.78	67.68
2009m11	5	74.907	3049726	14.85	71.29
2009m12	5.32	75.82	3078322	14.76	71.64
2010m1	5.95	75.886	2987685	14.98	78.15
2010m2	5.18	76.897	3014895	14.98	79.18
2010m3	3.97	77.331	3043849	14.8	84.43
2010m4	3.66	77.266	3074546	14.58	90.13
2010m5	3.88	79.745	3106986	14.46	92.33
2010m6	3.49	81.917	3141169	14.39	95.1
2010m7	3.57	80.23	3177095	14.29	97.74
2010m8	3.22	81.071	3214764	14.18	95.93
2010m9	3.21	80.778	3254177	13.98	98.92
2010m10	3.18	80.787	3295332	13.85	102.36
2010m11	3.84	80.974	3338231	13.95	98.01
2010m12	4.51	80.752	3382872	13.87	97.82
2011m1	5.42	81.272	3474305	14.03	99.02
2011m2	6.54	82.364	3520542	13.92	96.66
2011m3	9.19	82.989	3566633	13.92	89.5
2011m4	12.05	83.419	3612577	13.92	94.18
2011m5	12.95	85.704	3658374	13.88	93.21
2011m6	14.48	89.864	3704024	13.91	91.36
2011m7	15.53	91.1	3749527	14.14	84.32
2011m8	16.67	93.622	3794883	14.32	76.15
2011m9	17.32	99.832	3840092	14.79	69.38
2011m10	18.91	99.778	3885154	15.21	72.71
2011m11	19.72	89.721	3930069	18.51	66.33
2011m12	18.93	85.068	3974837	20.04	68.03
2012m1	18.31	84.588	4024517	19.54	68.94
2012m2	16.69	82.971	4068778	20.28	72.07
2012m3	15.61	83.056	4112681	20.34	73.47
2012m4	13.06	83.216	4156224	20.22	76.91
2012m5	12.22	86.825	4199408	20.12	78.48
2012m6	10.05	84.233	4242233	20.3	80.75
2012m7	7.74	84.213	4284698	20.15	83.26
2012m8	6.09	84.321	4326805	20.13	84.66

2012m9	5.32	85.283	4368552	19.73	87.38
2012m10	4.14	85.178	4409939	19.04	91.78
2012m11	3.25	85.935	4450968	17.78	92.2
2012m12	3.2	86.029	4491637	18.15	94.86
2013m1	3.67	87.611	4494613	18.13	103.5
2013m2	4.45	86.236	4536131	17.84	106.91
2013m3	4.11	85.639	4578855	17.73	117.91
2013m4	4.14	83.821	4622787	17.87	118.07
2013m5	4.05	85.124	4667925	17.45	126.8
2013m6	4.91	86.008	4714271	16.97	116.31
2013m7	6.03	87.28	4761825	17.02	122.86
2013m8	6.67	87.597	4810585	16.96	119.96
2013m9	8.29	86.646	4860553	16.86	127.35
2013m10	7.76	85.147	4911727	17	133.24
2013m11	7.36	86.993	4964109	16.89	141.17
2013m12	7.15	86.31	5017699	16.99	136.65
2014m1	7.21	86.236	5064196	17.03	134.66
2014m2	6.86	86.326	5120548	17.06	141.05
2014m3	6.27	86.441	5178455	16.91	143.89
2014m4	6.41	86.871	5237918	16.7	151.13
2014m5	7.3	87.797	5298936	16.97	150.2
2014m6	7.39	87.627	5361509	16.36	150.37
2014m7	7.67	87.804	5425638	16.91	151.69
2014m8	8.36	88.394	5491323	16.26	157.94
2014m9	6.6	89.279	5558562	16.04	163.45
2014m10	6.43	89.352	5627358	16	159.23
2014m11	6.09	90.179	5697708	15.94	163.27
2014m12	6.02	90.598	5769614	15.99	162.89
2015m1	5.53	91.674	5875442	15.93	165.8
2015m2	5.61	91.423	5949101	15.47	175.7
2015m3	6.31	92.335	6022957	15.46	175.11
2015m4	7.08	94.6	6097011	15.4	173.2
2015m5	6.87	97.781	6171262	15.26	162.13
2015m6	7.03	98.639	6245711	16.06	164.41
2015m7	6.62	102.521	6320356	15.75	148.39
2015m8	5.84	103.87	6395200	15.68	142.8
2015m9	5.97	105.293	6470240	16.82	146.92
2015m10	6.72	101.8	6545478	16.58	137.28
2015m11	7.32	102.114	6620914	17.16	143.47
2015m12	8.01	102.311	6696546	18.3	145.7
2016m1	7.78	102.283	6835784	18	136.81
2016m2	6.84	101.697	6909151	17.91	142.03
2016m3	6.45	101.334	6980056	17.87	147.44
2016m4	5.27	101.141	7048496	18.04	146.93
2016m5	5	100.831	7114474	18.22	143.61
2016m6	5.8	101.102	7177989	18.18	140.6
2016m7	6.4	101.389	7239041	18.1	142.39
2016m8	6.26	101.359	7297629	17.66	134.94

2016m9	6.34	101.262	7353755	13.86	136.75
2016m10	6.47	101.459	7407417	13.73	137.04
2016m11	6.68	101.877	7458617	13.67	136.61
2016m12	6.35	102.486	7507353	13.66	133.34
2017m1	6.99	103.956	7632779	13.66	122.23
2017m2	9.04	102.975	7673268	13.69	124.89
2017m3	10.28	103	7707973	13.61	130.51
2017m4	11.48	103.222	7736894	13.61	133.28
2017m5	11.7	103.381	7760030	13.71	148.4
2017m6	9.21	103.712	7777383	13.66	152.92
2017m7	7.47	103.911	7788951	13.7	161.35
2017m8	8.04	103.143	7794735	13.65	169.16
2017m9	7.06	103.247	7794735	13.69	162.21
2017m10	5.72	103.694	7788951	13.71	161.99
2017m11	4.73	103.253	7777383	13.68	172.92
2017m12	4.5	103.232	7760030	13.64	171.2
2018m1	4.83	102.357	7736894	13.65	180.6
2018m2	4.46	101.617	7707973	13.68	181.77
2018m3	4.18	100.847	7673268	13.49	191.23
2018m4	3.73	100.361	7632779	13.24	179.53
2018m5	3.95	101.481	7586506	13.25	172.53
2018m6	4.28	101.05	7534448	13.22	174.36
2018m7	4.35	100.408	7476607	13.1	170.46
2018m8	4.04	100.646	7412981	12.78	167.59
2018m9	5.7	100.956	7343571	12.66	149.67
2018m10	5.53	101.847	7268377	12.61	144.35
2018m11	5.58	102.544	7187399	12.55	146.08
2018m12	5.71	101.846	7100636	12.51	140.43

***Source*: Researchers compilation from CBK, KNBS and NSE, 2019**