EFFECT OF MACROECONOMIC VARIABLES ON STOCK MARKET VOLATILITY IN KENYA

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Effect of Macroeconomic Variables on Stock Market Volatility in Kenya

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other University.

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This thesis has been submitted for examination with our approval as University Supervisors

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DEDICATION

I dedicate this work to my loving parent.

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I give all the glory and honor to God for bringing me this far. I wish to express my sincere gratitude to Prof. Willy Muturi for his inspiring guidance, scholarly interpretations and valuable criticisms. I wish to thank Dr. Martin Mbewa for his invaluable contributions to this work. I thank my family, for their prayers and inspiration. I appreciate everybody who contributed to this work.

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ACRONYMS AND ABBREVIATIONS

ADF	Augmented Dickey Fuller
AIC	Akaike Information Criterion
AIMS	Alternative Investment Market Segment
APT	Arbitrage Pricing Theory
AR	Autoregressive
CAPM	Capital Asset Pricing Model
CBK	Central Bank of Kenya
CMA	Capital Markets Authority
CPI	Consumer Price Index
CSAD	Cross Sectional Absolute Deviation
CSSD	Cross Sectional Standard Deviation
ECT	Error Correction Term
EMH	Efficient Market Hypothesis
FEX	Foreign Exchange Rate
GARCH	Generalised Autoregressive Conditional Heteroskedasticity
GDP	Gross Domestic Product
HI	Herding Index
INF	Inflation

INT	Interest Rate
IPO	Initial Public Offerings
JB	Jarque-Bera test
KNBS	Kenya National Bureau of Statistics
LFEX	Logarithm of Foreign Exchange Rate
LGDP	Logarithm of Gross Domestic Product
LM	Lagrange Multiplier
LSV	Lakonishok Shleifer and Vishny
MEV	Macroeconomic Variables
MIMS	Main Investment Market Segment
MPT	Modern Portfolio Theory
NASI	The Nairobi Securities Exchange All Share index
NSE	Nairobi Securities Exchange
NSE20	Nairobi Securities Exchange 20 Share Index
OLS	Ordinary Least Squares
PP	Phillips- Perron
PS (2006)	Patterson & Sharma (2006)
PVM	Present Value Model
SC	Schwarz Criterion

SMV	Stock Market Volatility
STATA	Statistics and Data General Data Analysis Software
TBILL	Treasury Bills
VAR	Vector Auto regression
VECM	Vector Error Correction Model
VIF	Variance Inflation Factor
WFE	World Federation of Exchanges

DEFINITION OF TERMS

Herding : It is the average tendency of a group of investors to buy (or sell) particular stocks at the same time, relative to what would be expected if investors traded independently (Chiang et al. 2010).

Intentional herding: Intentional herding is more sentiment-driven and involves imitating other market participants, resulting in simultaneous buying or selling of the same stocks regardless of prior beliefs or information sets (Kremer, 2012).

Market wide herding: A form of herding arising when investors in the market ignore the individual characteristics of stocks and instead follow the performance of the market (Henker, J. Henker, G & Mitsios, 2006)

Stock Market Volatility: Stock market volatility is the fluctuation in the price of broad stock market index over a defined period. It is the dispersion and not the direction of changes in price (Ambrosio, 2007).

Unintentional herding: Unintentional herding occurs when investors are attracted to stocks with certain characteristics such as higher liquidity, (Falkenstein, 1996), or when investors rely on the same factors and information, leading them to arrive at similar conclusions regarding individual stocks (Hirshleifer , Subramayan &Titman, 1994).

Volatility: Volatility is the relative rate at which the price of a security moves up and down within a very short period of time (Taylor, 2007).

ABSTRACT

Stock market volatility is widely regarded as one of the factors that erode investor confidence in African markets. This happens when a sharp fluctuation in share prices is not explained by changes in fundamental economic factors. Theories in finance have for long viewed macroeconomic variables as predictors of stock market volatility, while studies in behavioral finance have associated stock market volatility with investor behavior, particularly the herding behavior. This study sought to examine the relationship between macro-economic variables and stock market volatility in Kenya. Specifically, the study examined the direct relationship between each of the four selected macro-economic variables namely; interest rates, inflation rate, foreign exchange rate, gross domestic product, and stock market volatility. The study further explored the moderating effect of investor herding behaviour on the direct relationship between selected macro-economic variables and stock market volatility. The study adopted a descriptive research design and targeted all companies listed on the Nairobi Securities Exchange from January 2001 to December 2014. The study used secondary data on interest rate, exchange rate, inflation rate and GDP, covering a period of 14 years. The data was obtained from the Kenya National Bureau of Statistics and the Central Bank of Kenya. Data on share prices and market indices was acquired from the Nairobi Securities Exchange. Stock market volatility was measured by computing the standard deviation of the Nairobi Securities Exchange daily and monthly returns over the 14 year study period. The study used a market-wide herd index which was calculated using the Cross Sectional Standard Deviation (CSSD) method. Data was analyzed using E-views version 8. The study employed both correlation and regression analysis. Results from correlation analysis found that there was a significant relationship between all selected macro-economic variables and stock market volatility. However, when the long run and short run causal relationship was tested using vector error correction model (VECM) and

granger causality test, the study found that interest rate and inflation granger cause stock market volatility both in the short run and long run in Kenya, while GDP and exchange rate did not have a direct causal relationship with stock market volatility. The study also established that investor herding behaviour had no direct causal relationship with stock market volatility, however, investor herding behaviour was found to significantly moderate the relationship between exchange rate and stock market volatility on the Nairobi Securities Exchange. The study findings were limited to selected macro-economic variables and methods used in measuring and analysing the relationship. Further studies are recommended to investigate other macro-economic variables in order to understand their effect on stock market volatility in Kenya. The study recommends a strict monetary policy and control of factors contributing to change in inflation and interest rates which the study finds to be the key variables contributing to stock market volatility.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Stock market volatility is a critical phenomenon facing emerging markets today. It is associated with diminished investor confidence, mispricing of shares and reduced participation in the market. Porteba (2000) posits that a volatile stock market weakens investor confidence and drives down investor spending. Daly (1999) also notes that volatility of stock markets erodes confidence in the capital market when sharp fluctuation in share prices is not explained by changes in fundamental economic factors. According to Karolyi (2001), excessive stock market volatility undermines the usefulness of stock prices as a measure of the true intrinsic value of the firm.

Volatility of stock markets is mostly associated with unstable macroeconomic environment which is a common manifestation among emerging markets. Mollah and Mobarek (2009) observe that emerging markets are highly volatile due to unstable micro economic environment. In the wake of the global financial crisis of 2007, and the effect it had on the global economy, policy makers and investors have increasingly sought to understand factors that affect proper functioning of stock markets. The WFE (2008) report identifies stock market volatility as one of the factors. Forgha (2012) observes that stock market volatility has attracted immense interest among economists, stock market analysts, government regulatory and policy makers. Policy makers and practitioners are interested in understanding the causes and possible remedies for volatility of stock markets which is singled out as one of the main reason for the underperformance of African markets. As Nyong (2005) observes, the interest in volatility of stock markets is driven by its implications to economic growth. Orabi et al. (2015) posits that policy makers are interested in the main determinants of volatility and

its spillover effects on real activities. This study therefore, seeks to examine the effect of macro-economic variables on stock market volatility in Kenya..

1.1.1 Stock market volatility in Kenya

In Kenya, the sessional paper No. 10 of 2012 on Vision 2030 identifies market volatility as a major challenge facing the Nairobi Securities Exchange. The Kenya financial sector stability report (2010), reports that the Nairobi Securities Exchange witnessed volatility from 2008 through 2010. According to NSE (2011), the Nairobi Securities Exchange witnessed drastic volatility in the last six months of 2011. During this time, the NSE 20 share index recorded a variance from a high of 4495 points to a low of 3733 points with market capitalization declining from Sh1192.28 billion to Sh1049.56 billion.

According to Corradi, Distaso and Mele (2006), understanding the origins of stock market volatility has long been a topic of considerable interest to policy makers and financial analysts. Orabi and Algurran (2015) affirm that policy makers are interested in the main determinants of volatility and its spillover effects on real activities. By understanding the determinants of stock market volatility, policy makers will be able to forecast possible trends in the market and manage the risk facing market players. Corradi *et al*. (2006), posits that predicting stock market volatility constitutes a formidable challenge but also a fundamental instrument to manage the risk faced by investors.

1.1.2 Stock Market Volatility and Macro-Economic Variables

Stock market volatility has for long been linked to a number of factors ranging from macro-economic to behavioral. Caner and Onder (2005), outline sources of stock market volatility as dividend yield, exchange rate, interest rate, inflation rate and movement of world market index. Abugri (2008), Caner and Oder. (2005), and Granger, Hwang and Young (2000) identifies inflation rate, interest rate, exchange rate, dividend yield and money supply as notable factors influencing stock market volatility.

Theories in finance have strongly linked stock market volatility to changes in macro-economic variables. One such theory is the Arbitraged Pricing Theory (APT) and the Efficient Market Hypothesis (EMH). The APT, suggested by Ross (1976) and efficient market hypothesis by Fama (1970) have for long been used by researchers to explain the relationship between changes in macro-economic variables and stock market volatility. The efficient market hypothesis holds that prices adjust rapidly to new and relevant price sensitive information (Dowling, 2005). Part of the sensitive information that prices would adjust to according to the EMH is information on changes in macro-economic variables such as interest rate, inflation and exchange rate. The theory complements the philosophy underlying fundamental analysis which suggests that the intrinsic value of a security is partly determined by the underlying economic variables.

The APT, developed by Stephen Ross in 1976 as an alternative to the capital asset pricing model (CAPM), explains the relationship between return and risk and relates the expected return of a share to the return from the risk-free asset and a series of other common factors that systematically affect the expected return of a share (Balla, 2006). The common factors in this theory are the various macro-economic variables which affect share prices and can be a source of volatility in stock markets. However, the APT does not specify which macroeconomic variable is most responsible for stock market volatility. This leaves researchers with an open field to explore the numerous macro-economic variables and establish which of the factors has the highest prediction powers for stock market volatility. This study is therefore contributing to this endeavor by focusing on the effect of interest rate, inflation, exchange rate and gross domestic product on stock market volatility. The study also explores the moderating effect of investor herding behavior on stock market volatility.

1.1.3 Investor Behavior and Stock Market Volatility

The emergence of behavioral finance has brought about a paradigm shift from the traditional finance theory in explaining certain occurrences in stock markets.

Behavioral finance associates stock market volatility to the behavior of investors in the market rather than economic fundamental. According to Shiller (2000), stock market volatility is due to fundamental shift in investors' behavior. Shiller (2000) observes that a shift in investor behavior is driven less by economic fundamental and more by sociological and psychological factors. Proponents of behavioral finance have identified a number of behavioral biases as key in explaining stock market volatility. One of the most cited behavioral bias is the herding behavior. Shefrin (2000) notes that price adjustments are not only due to the arrival of new information but also due to market conditions or collective phenomena such as herding. This affirms the effect that herd behavior has on stock markets. Tan, *et al.*, (2008) also posits that the influence of investor herds' drives prices away from their fundamental values. According to Christie and Huang (1995), investor herds are frequently used to explain stock market volatility. This study therefore explores the effect of investor herd behavior on the Kenyan market.

The study draws guidance from a number of behavioral finance theories. Among the behavioral theories that underpin the relationship between investor herd behavior and stock market volatility are; information cascade theory and prospect theory. The information cascade theory postulates that individuals make decisions based on observation of others without regard to their own private information (Hirshleifer, 2001). The prospect theory proposes that people are not rational and therefore do not make investment decisions based on economic fundamentals but rather on psychological factors (Kahneman & Tversky, 1979)

1.1.4 Investor Herding Behavior in Kenya

Herding takes place when investors mimic others ignoring their own substantive private information (Sias, 2004). This is a common phenomenon in emerging markets, due to the capital market environment which is said to encourage the manifestation of herd behavior (Gelos & Wei, 2002). According to Kallinterakis (2007), some of the factors that promote herding behavior in emerging market are;

information asymmetry, feedback trading, institutional risk management systems, market manipulation and size of firms listed on the securities market.

A few studies have investigated the relationship between stock market volatility and herd behavior in Kenya and confirmed the presence of herd behavior. Kimani (2011), Werah (2006), Aduda and Muimi (2011), (2012) and Yenkey (2012) found that investors on the Nairobi Securities Exchange are influenced by behavioral biases; key among them is the investor herd behavior. Werah (2006) found that the behavior of investors at the NSE is to some extent irrational in regard to fundamental estimations as a result of anomalies such as herd behavior. Yenkey (2012) studied how nascent investors invested on the Nairobi Securities Exchange following initial public offerings and found that newly recruited investors who joined the Securities through IPOs, presented herd-like behavior by mimicking the trading behavior of experienced institutional investors. Findings in these studies affirm that herding is a common phenomenon on the Nairobi Securities Exchange. However, little is known about the effect of herding behavior on the Nairobi Securities market. This is due to the very few studies done to examine the relationship between investor herding behavior and stock market volatility in Kenya. This therefore, calls for the need to investigate the effect of investor herd behavior on the volatility of the Kenyan market.

1.2 Statement of the Problem

Volatility of stock markets threatens economic growth and efficient allocation of resources. According to Daly (1999) volatility of security markets erodes confidence in the capital market, reduces liquidity and discourages wide participation. The sessional paper No. 10 of 2012 on Kenya Vision 2030 highlights market volatility as one of the leading problems facing the Nairobi Securities Exchange. According to the financial sector stability report, (2010), the Nairobi Securities Exchange witnessed volatility in 2008 through 2010, during this time; the volatility index stood at 56.93, rose to 150.16 in March 2010 and dropped to 67.84 in June 2010. According to the NSE report, (2011), the NSE

witnessed drastic volatility in the last six months of 2011 where the NSE 20 share index recorded a variance from a high of 4495 points to a low of 3733 points.

Available literature supports the link between stock market volatility, macroeconomic variables and investor herd behavior. Christie and Huang (1995) opine that investor herds are frequently used to explain market volatility. Tan, *et al.*, (2008), records that the influence of investor herds' drives prices away from their fundamental values. Studies done in Kenya find significant evidence of herd behavior among investors. Wamae (2013) finds that herding influences investment decision making among investment banks in Kenya. Yenkey, (2012), finds that newly recruited investors through IPOs, present significant levels of herding behavior.

Most studies on market volatility in Kenya have focused largely on macro-economic variables. A few studies have investigated the effect of herd behavior on stock market volatility. The purpose of this study, therefore, is to bridge this knowledge gap by investigating the moderating effect of investor herd behavior on the relationship between macroeconomic variables and stock market volatility in Kenya.

1.3 Objectives of the Study

1.3.1 General Objectives

The general objective of this study was to investigate the causal relationship between macro-economic variables and stock market volatility in Kenya.

1.3.2 Specific Objectives

The study aimed at achieving the following specific objectives:

1. To establish the relationship between inflation rate and stock market volatility in Kenya
2. To examine the relationship between interest rate and stock market volatility in Kenya.
3. To establish the relationship between exchange rate and stock market volatility in Kenya
4. To determine the relationship between the gross domestic product and stock market volatility in Kenya
5. To explore the moderating effect of herd behavior on the relationship between macroeconomic variables and stock market volatility in Kenya.

1.4 Hypotheses

To achieve the above objectives, the study sought to test the following null hypotheses:

1. H_0 There is no significant relationship between changes in inflation rate and stock market volatility in Kenya
2. H_0 There is no significant relationship between changes in interest rate and stock market volatility in Kenya.
3. H_0 There is no significant relationship between changes in exchange rate and stock market volatility in Kenya.
4. H_0 There is no significant relationship between changes in the Gross Domestic Product and stock market volatility in Kenya.
5. H_0 Herding behavior does not significantly affect the relationship between selected macroeconomic variables and stock market volatility in Kenya.

1.5 Significance of the Study

This study is of significance and interest to various stakeholders. Policy makers in Kenya would greatly benefit from findings on the causes of stock market

volatility. Knowledge of factors causing stock market volatility is critical to enable policy makers control the direction, magnitude and stability of the economy by adjusting macroeconomic variables if the relationship between stocks returns and economic activity has predictive power to stimulate the growth of the economy.

The Kenyan development plan, encapsulated in the vision 2030, aims to achieve an annual economic growth rate of 10%, with an investment rate of 30% being financed mainly from mobilization of domestic resources. Findings in this study provides the understanding of how studied macro-economic variables affect the performance of the securities exchange and will help policy makers in formulating policies to enable the government actualize the Vision 2030 dream by strengthening the capital markets and raising the requisite capital for envisioned projects.

The study is likely to contribute greatly to the growing literature in behavioral finance particularly herd behavior. Empirical literature documents that emerging markets constitute environments whose institutional structures naturally facilitate the manifestation of herd behavior yet very little is known on the effect of herd behavior on stock markets of emerging economies. Understanding the relationship between stock market returns and macroeconomic fundamentals is important to both academics and policy makers. Since the extent and direction of the relationship is still inconclusive for both emerging and developed economies, this study offers a contribution to literature by examining the relationship between stock market volatility, interest rate, inflation, gross domestic product, foreign exchange rate and investor herding behavior.

Financial analysts and investors have had an interested in understanding the nature of volatility patterns on shares and those events that can explain the persistence of volatility over time. Findings of this study can inform the development of better investment policies by financial analysts which would in turn improve the performance of their investments portfolios.

1.6 Scope of the Study

This study was focused on the effect of macro-economic variables on stock market volatility in Kenya. The study selected four macro-economic variables, namely; interest rate, Gross domestic product, foreign exchange rate and inflation guided by the empirical literature.

The study covered a period of 14 years, from 2001 to 2014. The choice of the period was informed by two reasons. First, the period witnessed vibrant trading and relative stability, except for the 2008 post-election violence. Second, during this period the NSE issued ten IPOs, providing an excellent setting to investigate herding behavior since IPOs are greatly associated with herd behavior. Additionally, a 14 year period assures relatively more reliable findings for a time series study. Robert (2010) notes that the longer the time series period the better and the more data the better. Smolka (1997) opine that time series have to be comparatively longer to deliver reliable results. Many similar studies in Kenya; Kirui et al. (2014), Ouma et al. (2013), Olweny et al. (2011) were conducted during this time. This consequently, presents a level setting to corroborate the findings made in this study with other studies through review of empirical literature over the same period of study.

1.7 Limitations of the Study

The study focused on the effect of macro-economic variables on stock market volatility and also explored the moderating effect of investor herd behavior in the relationship. The study made a number of findings which form part of the recommendation to policy makers and industry. However, a number of limitations were encountered in the course of the study. First, the study investigated four macro-economic variables out of the many macroeconomic variables proposed by finance theory, to be predictors of stock market volatility. It is possible that many macro-economic variables not selected in this study have higher predictive powers

than those investigated in this study. Findings in this study would therefore be limited to macro-economic variables investigated by the study.

Secondly, a number of methods were available to the study for the measurement of stock market volatility and investor herd behavior. The study employed monthly standard deviations of the NASI index as a measure of stock market volatility and CSSD index as a measure of investor herd behavior. This left out other methods which could give different outcomes. The Vector Error Correction Model and the Granger causality test were used to investigate the causal relationship between macroeconomic variables and stock market volatility. Methods like TGARCH and OLS, used in similar studies, may have returned different findings. Findings in this study are therefore limited to the methods adopted in measuring stock market volatility, herding behavior and in data analysis.

Thirdly, the social-political environment changed from time to time due to political and social events over the study period. Such events were non-economic in nature and yet had a significant effect on variables used in this study. One of the events is the 2008 post-election violence which significantly affected market trading on the securities market. The findings in this study are therefore limited by the possible effects of such social political events on study variables.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter reviews the theoretical and empirical literature on the effect of macro-economic variables and investor herding behavior on stock market volatility. The first part reviews theoretical literature while the second part reviews the empirical literature on the relationship between stock market volatility, herding behavior and macro-economic variables. The third part provides a critique of existing literature and presents the research gap.

2.2 Theoretical Review

2.2.1 Arbitrage Price Theory (APT)

The Arbitrage Pricing Theory developed by Stephen Ross in 1976 describes how financial assets are priced given the risk associated with them (Alshogeathri, 2011). The theory proposes that share prices are driven by multiple macro-economic factors (Dincer, 2014). The APT predicts that any anticipated arrival of new information about, exchange rates, interest rates, inflation, GDP, and many other macroeconomic variables will alter share prices through the impact they have on expected return (Chinzara, 2010). This theory explains how changes in macro-economic variables would influence rapid fluctuations in share prices or stock market volatility. The theory has been used in a number of studies to explain the relationship between macro-economic variables and stock market volatility.

Alshogeathri (2011) and Okorafor (2008) are among studies that used the APT to explain the relationship between macroeconomic variables and stock market returns. Amos (2010) studied the APT and empirical evidence in the Nigeria capital market and found that amongst the five macroeconomic variables examined, none of the variables was significant enough to stimulate the stock returns. Arewa, et al. (2013) conducted a study to test the APT on Nigerian stock market, and made findings that provided overwhelming evidence in support of the APT pricing model as a good description of expected return. According to the theory, the expected return of a financial asset can be modeled as a linear function of various macroeconomic variables or theoretical market indices, where the sensitivity to change in each factor is represented by a factor specific beta coefficient (Gay, 2008). Elton *et al.* (2011), opines that the APT can be tested over a class of assets such as common stocks or a small set of stocks that form the stock market index.

As a single-factor model, uncertainty in asset returns comes from a common macroeconomic factor and a firm-specific cause, where the common factor has zero expected value (McMenamin, 2005).

The APT can be mathematically expressed as (Kevin, 2015);

$$R_{it} = r_i^f + \beta_i X_t + \varepsilon_t \quad \text{..... (1)}$$

Where;

R_{it} is the return of the stock *i* at time *t*,

r_i^f is the risk free interest rate or the expected return at time *t*,

X_t is a vector of the predetermined economic factors or the systematic risks and,

β_i is a measure of the sensitivity of the stock to each economic factor included in X_t

ε_t is the error term representing unsystematic risk or the premium for risk associated with assets that cannot be diversified.

The one-factor model can be extended into a multifactor model by allowing for other factors that might affect stock returns by affecting its risk (Gibson, et al., 2010). The model may be modified to incorporate interest rates, inflation, gross domestic product and foreign exchange rate as specified in this study.

The Arbitrage Pricing theory fails to specify the type or number of macro-economic variables to be included in studies (Fabozzi, 2015). Consequently, researchers have examined various factors in attempt to explore factors that influences stock market returns to a great extent. Ross, *et al.* (1987) examined the effect of inflation, gross domestic product, investor confidence, and the shift in the yield curve on stock market returns. Fifield, *et al.*, (2002) endorses GDP, inflation, money supply and short-term interest rates as most suitable macro-economic variables for research in emerging markets. The theory was key to this study in explaining the effect of macro-economic variables on stock market volatility.

2.2.2 The Efficient Market Hypothesis

The Efficient Market Hypothesis developed by Fama (1965, 1970) explains the notion that share prices in the securities market reflect all available information such that traders in the market cannot be able to make abnormal profit regardless of the level of information they possess. The hypothesis holds that prices adjust rapidly and biasedly to new and relevant price sensitive information (Moolman & Toit, 2005). According to Fama (1970), an efficient market is one in which prices always "fully reflect" available information (Pilbeam, 2010). The theory envisages a perfect market where, all the available information regarding a stock's

return and risk are factored into the market price (Westbrook, 2014). It assumes that, stock prices will only be influenced by news or information (Shiller, 1997). Consequently, when any relevant information becomes available, stock prices will move immediately to reflect the new situation (Malkiel, 2003).

The EMH is anchored on the assumptions that, a large number of profit-maximizing investors operate independent of each other, new information regarding securities comes to the market in a random fashion whose announcement overtime is generally independent of one another and, investors adjust security prices rapidly to reflect the effect of the new information (Lee *et al.*, 2009). The theory explains the effect that new information has on share prices and market return. The sensitivity of such information would have an effect on share prices and market return. Hameed and Ashraf (2006) posit that increase in volatility can be attributed to absorption of new information. Karmaka (2006) opines increased volatility which is not explained by fundamental economic factors, tends to cause share prices to be mispriced leading to misallocation of resources. The theory has therefore been able to explain the effect of changes in macroeconomic variables on stock market return and volatility.

According to Marx *et al.*, (2003), the EMH postulates three forms of market efficiency namely; weak form, semi-strong form and strong form. The weak form of market efficiency asserts that asset prices incorporate all relevant past information, such as past asset prices, security dividends, and trading volume (Madura, 2008). The semi-strong form of market efficiency maintains that all publically available information is fully reflected in security prices. Publically available information includes past asset prices, company performance, political news, publicly available analysis or projections and information about expectations of macroeconomic factors.

The strong form market efficiency states that stock prices reflect all relevant information, including information only known to company insiders (Ranganatham & Madhumathi, 2006). In the strong form market efficiency, all

market participants can freely access all available information relevant to forming opinion about the price of a security and no group of investors has monopolistic access to such information as to make abnormal profit.

The efficient market theory assumes that asset prices evolve in a random walk fashion. In this theory, asset prices cannot be predicted, suggesting that investors cannot beat the market. However, a number of studies have provided evidence showing that asset prices can be predicted. Shiller (1984) and summers (1986) found that share prices and returns are predictable. Nyong (2005) based on stock returns in Nigeria, South Africa and Brazil rejected the random walk hypothesis implying that share prices are predictable.

The theoretical foundation of the EMH is based on three key propositions. First, investors are assumed to be rational and value securities rationally. Second, in case some investors are irrational, their trades are random and cancel each other out without affecting prices. Third, rational arbitrageurs eliminate the influence of irrational investors on market (Cullen, 2014). The EMH posits that any fresh news about a security should be reflected in its price promptly and completely and prices should not move as long as there is no new information about the company, since it must be exactly equal to the value of the security. This means non-reaction to non-information (Shleifer, 2000). This position has been challenged in behavioral finance where share prices are found to change based on the influence of behavioral biases even when new information is not witnessed in the market.

The relevance of the efficient market hypothesis to this study is twofold. First, Fama (1970) define a market as efficient if prices always fully reflect all available information. Part of the publicly available information would be a change in the economic fundamentals including; interest rates, inflation, foreign exchange rate and GDP. This theoretical foundation therefore, provides an underpinning for the relationship between macro-economic variables and stock market volatility in this study.

2.2.3 The Present Value Model

According to Attari et al. (2013), the present value models (PVM) using future expected earnings and future expected discount rates has been empirically tested for predicting stock prices. The model explains the dynamic relationship between stock market volatility and economic activities (Semmler, 2006). Sarkar, (2012) opines that the PVM explains the relationship between stock prices and macroeconomic variables Attari et al. (2013) posit that the PVM is useful in establishing a long term relationship among stock prices and macroeconomic variables. In the words of Shiller, (1992), the model states that the price of a share is the present discounted value of the expected future dividends.

The description of this model is that the expected future dividend of company shares reflects the levels of macroeconomic activities. Volatility of share prices and stock market returns would therefore, be influenced by expected future cash flows which are a function of microeconomic variables. The model has been tested and used in a number of studies. Alshogeathri (2011), Osisanwo (2012), Sarkar (2012), Attari et al. (2013) and Oseni (2011) are among studies which have used this model to explain the effect of macroeconomic variables on stock market volatility.

According to the model, the difference between the intrinsic value of a share and its market value represents an overvalued or undervalued stock. The profit opportunities represented by the existence of undervalued and overvalued stocks motivate investors to trade, and their trading moves share prices toward the intrinsic value (Gorton & Allen, 1993). Consequently, investors search for mispriced stocks and their subsequent trading make the market efficient causing shares to reflect their intrinsic values. According to Banerjee (2015) the intrinsic value of a share is the present value of the cash flows the shareholder is expected to receive.

The PVM can be expressed as follows (Semmler, 2006) and (McMillan, 2010):

$$p_t = \sum_{t=1}^{\infty} \frac{E_t(R_t + i)}{((1 + k_t)^i}$$

Where;

p_t is the stock price.

$E_t(R_t + i)$is the expected stream of returns.

k_t are the factors associated with the discount rate of future cash flows.

Factors associated with the discount rate (k_t) are factors which directly or indirectly affect expected returns and later affect stock prices. Consequently, new related macroeconomic information may be analyzed as long as they impact the expectation of stock prices or returns, the discount rates, k_t, or both (Alshogeathri,2011).

The advantage of the present value model is that it can be used to focus on the long run relationship between the stock market returns and macroeconomic variables (Osisanwo, 2012). The present value model was important to this study in explaining the relationship between macro-economic variables and stock returns volatility. The theory relates a change in share prices to the discount rate in the market which is influenced by a change in macro-economic factors. Ackert and Smith (1993) argue that volatility in stock prices is due to either a change in the discount rate or new information concerning future cash flows received by shareholders.

2.2.4 Fisher's Theory

The Fisher's theory of capital and investment was introduced by Irving Fisher in his *Nature of Capital and Income* (1906) and *Rate of Interest* (1907). The theory has its clearest and most famous exposition in his *Theory of interest* (1930). The theory defines the relationship between inflation on one hand and real and

nominal interest on the other hand. The fisher theory states that nominal interest rates in two or more countries should be equal to the required real rate of return to investors plus compensation for the expected amount of inflation in each country (Dimand, 2003). Fama and Schwert (1977) explains the fisher effect theory by stating that, if the market is efficient and reflects all the available information at time t-1, the price of common stocks will get adjusted so that the expected nominal return from t-1 to t is the sum of the appropriate equilibrium expected real rate and the market's assessment of expected inflation rate for the same time period (Waweru, 2014). According to the fisher effect theory, shares serve as hedges against inflation because they represent claims to real assets, which suggest that a positive share price is correlated to expected inflation (Dimand, 2003).

2.2.5 Information Cascade Theory

Investor herding behavior can well be explained by the information cascade theory (Bruun, 2006). Lakonishok *et al.* (1992), Choe *et al.* (1999) and Wermers (1999) contend that volatility is closely related to information-induced herding. According to Anderson (2001), the theory advances a situation where people with private, incomplete information make public decisions in sequence. The first few decision makers reveal their information to subsequent decision makers who follow an established pattern even when their private information suggests that they should deviate from that pattern. Kim et al. (2013) opines that investors who trade after a cascade has started provide no information to subsequent traders because they are merely copying the action of others. Such traders do not base their decision on any information.

In general, the information cascade model is guided by the idea that individuals make decisions based on observation of others without regard to their own private information. Information cascades start in a stock market when investors ignore their own information and instead infer information from a herd (Sias, 2004).

Todd *et al.* (2009) illustrates information cascade by thinking of a person who chooses between two unfamiliar, apparently similar restaurants situated on opposite sides of a street. If it's assumed that a customer has heard other customer's mixed opinions about one of the restaurants (A) and only good things about the other restaurant (B). When approaching the restaurants, the customer notes that restaurant A is more crowded than restaurant B. According to Todd *et al.* (2009), many people would probably then choose restaurant A, without any proof that restaurant A is better than restaurant B. The fact that many people are in restaurant A may thus be enough to attract additional customers, even if they have opposing private information. The explanation for this behavior is that people base their decisions on choices made by others.

The Information cascade theory is advanced from the Avery and Zemsky (1998) and, Bikchandani *et al.* (1992) models. In the two models, if an investment cascade starts in a market, a long sequence of buy or sells trades is expected. According to Bikchandani, *et al.* (1992) model, public information or the arrival of a highly informed investor will quickly stop an incorrect information cascade.

In the Avery and Zemsky (1998) model, price adjustments make it unlikely for cascades to occur and decrease the prolonged existence of cascades. Avery and Zemsky (1998), outlines three conditions which need to be present for herding to occur namely; information asymmetry, value uncertainty and, event uncertainty or uncertainty about whether the value of an asset has changed from its initial expected value.

According to Blasco (2006), the link between investor herd behavior and market volatility was first noted by Friedman (1953) who found that irrational investors destabilized prices by buying when prices were high and selling when they were low. The information cascade theory, which is key to this study, underpins the fact that investors ignore their own current private information to mimic other investors. The herd phenomenon happens when investors in the market move as a group to make similar investment decisions, pushing prices away from their

economic fundamentals. This act by investors results into price momentum and stock market volatility. Bikhchandani et al. (1992) posits that herding behavior leads a group of investors to move in the same direction, pushing stock prices further away from the economic fundamentals, causing price momentum and excess volatility. According to Shiller (2005), herding is a collective irrationality of investors that leads to the mispricing of economic fundamentals.

2.2.6 Prospect Theory

The prospect theory is a behavioral finance theory for decision making under uncertainty developed by Daniel Kahneman and Amos Tversky in 1979. The theory attempts to acknowledge that investors are not rational as presumed by normative theories like the efficient market hypothesis and the expected utility theory. The theory relies on observation of what people should actually do or how they actually behave. It is based on empirical evidence that people do not behave in accordance with the normative models when it comes either to decision making or choices (Lowies, 2012).

The prospect theory views the investment decision making process as driven by irrational factors like herding behavior rather than economic fundamentals as stated by normative theories like the arbitraged pricing theory and the efficient market hypothesis. To this study, the theory introduces another angle of understanding volatility of stock market where irrational behavior like herding guides the investment decision processes causing price momentum and excess volatility. The theory underpins this study by confirming that stock market volatility is not only influenced by changes in the economic fundamental but by investment decisions made based on irrational factors like herding behavior.

Kahneman and Tversky (1979) demonstrated in numerous experiments that the day-to-day reality of decision makers varies from the assumptions held by economists (Goldberg & VonNitzsch, 2001). According to Bing and Jason (2004), the prospect theory can help in understanding the choices and trading behavior of investors in financial markets and to explain asset pricing "anomalies" including the equity premium puzzle, momentum strategy, excess volatility, IPO under-pricing and long-term performance of IPO's. Babaries *et al* (2001) confirms that models based on the prospect theory can explain the high mean excess volatility and predictability of stock returns.

2.4.7 Herding Theory

Herding occurs when individuals mimic others, ignoring their own substantive private information (Scharfstein & Stein 1990). It is the most common behavioral factor in decision making, where investors follow investment decisions taken by the majority. Herding is a major concern for traders and policy makers as it leads to unnecessary volatility and more frequent extreme observations (Demirer, *et al*., 2009).

Herding can either be intentional or unintentional (Bikhchandani & Sharma (2001). Intentional herding involves imitating other market participants, resulting in simultaneous buying or selling of the same stocks regardless of prior beliefs or information sets. Intentional herding can lead to asset prices failing to react to fundamental information, exacerbation of volatility, and destabilization of markets, thus having the potential to create, or at least contribute, to bubbles and crashes on financial markets (Morris & Shin 1999) and (Persuaded, 2000).

Unintentional or spurious herding is mainly fundamental driven and arises because institutions may examine the same factors and receive correlated private information, leading them to arrive at similar conclusions regarding individual stocks (Hirshleifer *et al.*, 1994). Kallinterakis (2007) highlights some of the factors that promote herding behavior in emerging market as information asymmetry, feedback trading, institutional risk management systems, market manipulation and size of firms listed on the securities market.

Information asymmetry is about non availability of information relevant to investment decision making. Information asymmetry a common phenomenon in emerging markets due to incomplete regulatory frameworks, especially in the area of market transparency. Such environments cause deficiency in corporate disclosures and poor quality of information leading to information asymmetry.

According to Gelos and Wei (2002), deficiencies in corporate disclosure and information quality create uncertainty in the market, throw doubt on the reliability

of public information, and as a result impede fundamental analysis. Kallinterakis (2007) argues that in such an environment it is reasonable to assume that investors will prefer to base their trading on observation of others. Accordingly, intentional herding is more likely to occur in less developed markets than in developed markets.

Feedback trading occurs when investors react to information in a similar manner, without necessarily ignoring their own private information. This happens when investors naturally make investment decisions based on the information feed into the market. They sometimes react to common signals in the same way. Such common reaction leads to unintentional herding. A manifestation of this kind of herding is momentum investment. This is also be called positive feedback trading. DeLong, *et al.* (1990); Sentana and Wadhwani (1992) suggest that positive feedback traders buy stocks in a rising market and sell stocks in a falling market, while negative feedback traders follow an investment strategy of "buy low and sell high." According to De Long (1990), positive feedback trading may lead to unintentional herding and could have a destabilizing impact on financial markets.

Risk management systems used by institutional investors are another source of herding behavior. Institutional investors make use of market sensitive risk management systems in their investment management practice. Persaud (2000) and Jorion (2002), argue that market-sensitive risk management systems used by banks, such as Value at Risk (VaR) models, require banks to sell when volatility rises. Thus, banks act like a herd, all selling the same stocks at the same time in response to negative shocks. Although this kind of trading is considered to be unintentional herding, it leads to further slumps in prices.

Group conformity is a psychological manifest in human desire to conform to a majority decision. It is a major reason for herding behavior. According to Bikhchandani *et al.* (1992), Avery and Zemsky (1998) and Park and Sabourian (2011), rational traders copy the investment activity of other market participants because they assume that others have important information. Smith and Bern

(1990), find that 74% of subjects in their study change an individual opinion that appears to be correct in order to conform to group consensus.

The fear of losing one's reputation as an advisor or institution investor, by making a wrong decision, causes most practitioners to mimic majority decisions in order to avoid reputational risk**.** One of the explanations for herding behavior is derived from the reputation based model originally developed by Scharfstein and Stein (1990). According to this model, institutions or professional investors are subject to reputational risk when they act differently from the crowd. An explanation for reputational herding is that failing conventionally is better for one's reputation than succeeding unconventionally. This is because investors who herd are able to share the blame and hide in the herd when making unfavorable investment decisions (Devenow & Welch, 1996). According to Scharfstein and Stein (1990), an unprofitable investment harms a decision maker considerably less when others have made similar investments, which constitutes a reputational reason for investors to ignore private information in favor of trading with the herd. Scharfstein and Stein (1990) observe that investors do not take contrarian positions for the fear of damaging their reputation in the labor market as sensible decision makers. As a result investors ignore their private information and follow market consensus.

The state of the overall market in terms of adverse stages of a business cycles or financial crisis is a source of herding behavior. Chiang and Zheng (2010) find that herding behavior is more apparent during the period in which the financial crisis occurs. Hwang and Salmon (2004) find higher herding measures during relatively quiet periods than during periods when the market is under stress. Platev and Kanaryan (2003) studied four Central Europe markets and find strong evidence of herd influence over market volatility caused by the Asian and Russian crises. Karunanayake *et al.* (2010) show that both the Asian crisis and the more recent global financial crisis significantly increased the stock return volatilities across all of the four markets in their study.

Cross market herding happens when herding in one market is affected by herding in other markets and global stock market volatility. The correlation in herding is due to geographic proximity that produces close trading relation in the region, or to a similar cultural background with less transparency and less public information available, which would induce investors to form a correlated trading decision. Experience from the Asian crisis period indicates that herding behavior tends to display co-movements (Marais *et al.*, 2006). Experience in recent financial crises indicates that it does not matter through which channel the volatility is transmitted, (Corsetti *et al.*, 2005). Whenever negative news develops in a given market, it will soon be learned by participants in other markets. Beirne *et al.* (2009) find evidence of significant stock-return volatility spill overs from the US market to many Pacific-Basin countries.

Market manipulation may also promote herding, as the actions of a group of informed traders may create the impression of a profitable opportunity, thus luring others into it (Van Bommel, 2003). Hirshleifer *et al.* (1994), suggests that investors receive uncorrelated private information. Few early receivers trade aggressively in the initial period, subsequently reversing their positions as the later informed traders adopt the 'follow the leader' strategy (Van Bommel, 2003).

Small firms are usually less transparent than big firms and have less information available to public. Lack of information causes investors to imitate other traders who are perceived to have some information on small firm. The model of intentional herding has shown that there is an inverse relationship between herding and firm size (Kallinterakis, 2007). Unintentional herding, on the other hand, is more likely to occur in larger stocks because institutions have more information in common about these stocks. According to Christoffersen and Tang (2009), herding decreases with data frequency, and that herding should be less significant in stocks with larger size and higher turnover.

2.3 Conceptual Framework

A conceptual framework is a diagrammatic presentation of variables, showing the relationship between the dependent, independent and moderating variables. The purpose of a conceptual framework is to help the reader quickly see the proposed relationship between variables in the study (Mugenda &Mugenda, 2003). This study was based on the framework provided by the efficient market hypothesis as advanced by Fama (1970), the arbitraged pricing theory suggested by Ross (1976) and information cascade theory proposed in the Avery and Zemsky (1998) model and Bikchandani, *et al* .(1992) model.

The frame work for this study is made up of selected macro-economic variables namely; interest rates, inflation, gross domestic product and foreign exchange rate as independent variables and stock market volatility as the dependent variable. Herding behavior is included in the framework as a moderating variable. The conceptual framework below presents the relationship.

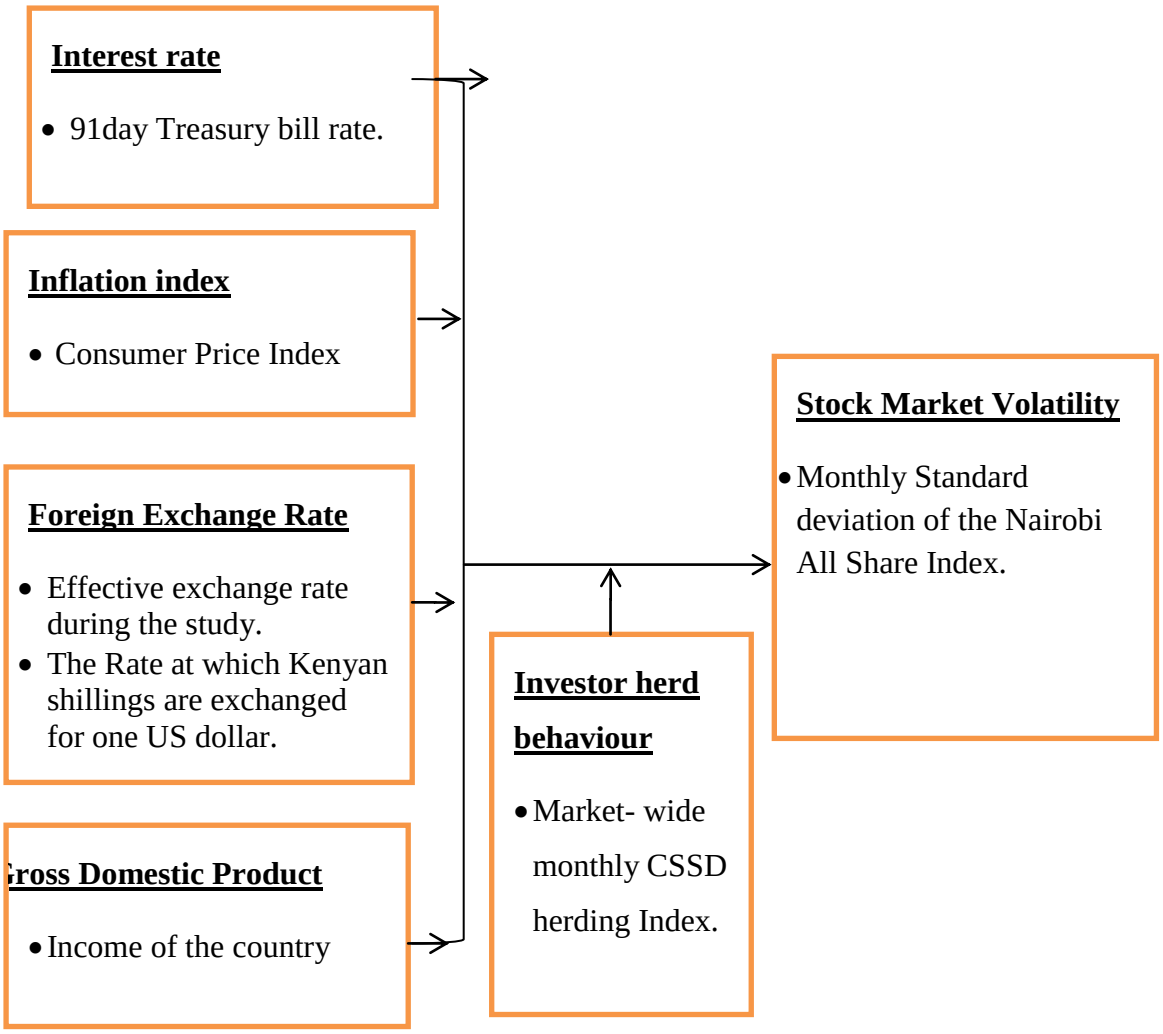

Figure 2. 1: Conceptual Framework

2.4 Review of Empirical Literature

Several studies have examined the dynamic relationships between stock market volatility and macro-economic variables. Limited literature is available on the effect of investor herding behavior on stock market volatility. Majority of the studies have concentrated on developed markets. Empirical literature shows diverse findings motivating more studies to understand the relationship between stock market volatility, macro-economic variables and investor herding behavior. Studies reviewed are in two categories. The first category is made up of studies which investigated the relationship between individual macro-economic variables and stock market volatility, and the second category are studies that investigated the collective effect of a number of macro-economic variables on stock market volatility. The last part of this section reviews empirical literature in relation to the relationship between investor herd behavior and stock market volatility.

2.4.1 Relationship between Interest Rates and Stock Market Volatility

Finance theory proposes that interest rates and stock price have a negative correlation (Hamrita & Abdelkader, 2011). According to Jawad and Ulhaq (2012), interest rate has a more direct effect on financial market whereby an increase in interest rate causes investors to make a change in the structure of their investment, generally from capital market to fixed income securities which leads to a drop in stock prices

Zhou (1996) studied the relationship between term structure of interest rates and stock market volatility on the US Market. The study used the OLS regression method to study the relationship between interest rate and variation of share prices and stock return. The study referred to theoretical literature explaining the effect of discount rates on stock market volatility. The theory proposes that the variance of dividend-price ratios may be accounted for by changing forecasts of discount rate with some unusual characteristics. The study used data on share and bond returns together with McCulloch and Kwon (1993) data set on zero-coupon yields

implied by the yield curve for U.S. Treasury securities. The study found that long term interest rate had an impact on stock returns, especially in the long run. The study observed that high volatility in the stock market returns was related to high volatility of long-term bond yields. The study established that long term interest rate explains a major part of variation in stock market returns.

Arango *et al.* (2002) examined the relationship between market returns and interest rate on the Bogota stock market in Colombia. The study used daily interbank loan interest rate and share price data from January 1994 to February 2000. The study referred to the present value model and the Gordon growth model to underpin the study. The study used the smooth transition regression (STR) approach and GARCH model to examine the behavior of share prices. The study found evidence of a nonlinear and inverse relationship between share prices on the Bogota stock market and interest rate as measured by the inter bank loan interest rate. The interbank loan interest rate is normally affected by a country's monetary policy. Findings in this study inferred that an increase in interest rate led to a drop in share prices although the relationship was said to be nonlinear.

Ahmed (2008) investigated the relationship between aggregate economic variables and stock markets in India and found a positive relationship between interest rate and stock prices on the Indian stock market. Zafar *et al.* (2008) examined the effect of interest rates on stock returns and volatility on the Karachi stock exchange in Pakistan. The study used GARCH models to examine the relationship and covered the period between January 2002 and June 2006. The study found a negative significant relationship between interest rates and stock market returns.

Gan *et al.* (2006) using Forecast Error Variance Decomposition (FEVD), find a positive relationship between interest rates and returns on the New Zealand stock market. Aroni (2011) used a multiple regression method to study factors influencing stock prices on the Nairobi securities Exchange and found that interest rates significantly affect stock prices.

Alam, et al. (2002), used time series and panel regression to study the relationship between interest rate and stock prices in fifteen developed and developing countries namely; Australia, Bangladesh, Canada, Chile, Colombia, Germany, Italy, Jamaica, Japan, Malaysia, Mexico, Philippine, S. Africa, Spain, and Venezuela. The study found that interest rate had a significant negative relationship with share price for all the countries. Olweny *et al.* (2011) studied the effect of macro-economic variables on stock market volatility on the Nairobi Securities Exchange using the TGARCH method and found that interest rate affects stock market volatility.

A review of empirical literature on the effect of interest rate on share prices and stock market volatility indicates generally that majority studies, Zhou(1996), Arango et al. (2002), Ahmed (2008), Zafar et al. (2008), Gan et al. (2006), Aroni (2011), Alam et al. (2002) and Olweny et al. (2011) find that interest rate affects stock prices and market volatility. However, the direction and magnitude of the effect is varied. Whereas, Zhou (1996), Arango et al. (2002) Zafar et al. (2008) and Alam et al (2002), find that interest rate has a negative effect on share prices and market volatility, Ahmed (2008) and Gan et al (2006) find that interest rate has a positive effect on share prices and stock market volatility. It's therefore, safe to conclude, from the reviewed literature, that interest rate affects stock prices and volatility of securities markets.

2.4.2 Relationship between Inflation and Stock Market Volatility

The general understanding of the effect of inflation on share prices and market return is that inflation brings about a general increase in prices of firm inputs causing a general increase in the cost of doing business. Businesses perform poorly as a result of increased inflation hence causing share prices to drop. The drop in prices would cause investors to shift their portfolio towards other assets. This implies that inflation has the potential of influencing a change in share prices and volatility of stock markets.

Finance theory confirms that inflation affects the value of shares in the stock market. Fama (1981) observes a negative relationship between inflation and stock prices. Share prices are negatively impacted by inflation due to the negative correlation between inflation and expected real economic growth. Investors shift their portfolios towards real assets if the inflation rate becomes remarkably high (Hatemi, 2009). Empirical studies on the relationship between inflation and stock market volatility are yet to arrive at a consensus.

Murungi (2012) examined the impact of inflation on stock market returns and volatility using OLS estimation and GARCH techniques on the Nairobi securities Exchange. The study covered the period between July 2000 and August 2012. Findings from the study revealed a negative relationship between stock returns and inflation in Kenya. A change in inflation rate had a significant negative effect on stock market volatility.

Ochieng *et al.* (2012) studied the relationship between macro-economic variables and stock market performance. Using regression analysis, the study found a weak positive relationship between inflation and stock market return. Ouma *et al.* (2014), studied the impact of macroeconomic variables on stock market returns in Kenya, using ordinary least squares and found that there was a positive relationship between inflation and stock prices.

Aroni (2011), using regression analysis finds that inflation significantly affects stock prices in Kenya. Kirui *et al.* (2014), finds an insignificant relationship between inflation and stock prices. Issahaku *et al.* (2013) studied the relationship between macro-economic variables and stock market returns and found a significant long-term relationship between the two variables. Ratanapakom *et al.* (2007) studied the relationship between macroeconomic variables and stock prices, and find that stock prices were negatively related to inflation in the short run.

Majority of empirical literature reviewed with regard to the relationship between inflation rate and stock market volatility show that inflation rate affects share prices and may cause volatility of stock markets. Murungi (2012), and Ratanapakom (2007) finds a negative relationship between inflation and share prices while, Ochieng and Oriwo (2012) and Ouma et al. (2014) find that inflation rate has a positive effect on share prices. The incongruous result begs for more enquiries to endorse the relationship between inflation and stock market returns in Kenya.

2.4.3 Relationship between Exchange Rates and Stock Market Volatility

The effect of changes in exchange rate to share prices and volatility of stock market is well known in finance literature. Barnor, (2014) posit that the appreciation of a local currency has a tendency to hurt exporters and, consequently shares of exporting firms become less attractive. According to Joseph (2002), exchange rate changes affect the competitiveness of firms through their impact on input and output prices as a result of their unattractiveness. The market value of a share of an export-oriented firm is likely to fall. Joseph (2002) observes that when the exchange rate appreciates, exporters will be negatively affected. This happens when an appreciation in the value of a currency causes goods and services of exporting companies to be expensive on the international market. As a result, exports will decline and result into a loss of competitiveness internationally. Consequently, company profits will decline and weaken their attractiveness in the stock market (Mlambo *et al*., 2013). However, empirical studies have returned diverse findings some of which contradict the theory. Asaolu and Ogunmuyiwa (2011), affirms that theoretical economists and empirical researchers have not reached a consensus on the nexus between stock market volatility and foreign exchange rate.

Mlambo, *et al.* (2013) assessed the effect of exchange rate volatility on the Johannesburg Stock Exchange in South Africa. The study used the Generalized Autoregressive Conditional Heteroskedascity (GARCH) model to establish the relationship. Monthly data from 2000 to 2010 was used in the study. The study found a very weak relationship between exchange rate volatility and stock market volatility.

Aslam (2014) examined the relationship between stock market volatility and exchange rate on the Karachi stock exchange in Pakistan. The study covered the period between January 2006 and December 2012 .Using different statistical tools, the study analyzed the causal relationship between both time series and found a weak negative correlation between stock market return and exchange rate. Causality test revealed that there was a bi-directional causal relationship between stock market return and exchange rate.

Ambunya (2012) studied the relationship between exchange rate movement and stock market return volatility on the Nairobi securities exchange in Kenya, covering the period between 2001 and 2011. Using regression analysis, the study found that exchange rate movements greatly affected stock market return volatility and concluded that there is a strong relationship between exchange rate movement and stock market volatility in Kenya.

Muhammad and Rashid (2011) studied the relationship between share prices and foreign exchange rate in Pakistan, India, Bangladesh and Sri-Lanka. The study covered the period between January 1994 and December 2000.Using the Vector Error Correction Model and Granger causality test, the study found no short run association between foreign exchange and share prices in all the four countries. With regard to long run relationship, the study found no long-run relationship between the two variables in Pakistan and India. However, findings revealed a bidirectional long-run causal relationship between exchange rate and share prices in Bangladesh and Sir-Lanka.

Kadir, *et al.* (2011) examined the predictability power of exchange rates and interest rates on stock market volatility and return in Malaysia. The study used monthly Kuala Lumpur composite Index (KLCI) returns, 3 months Malaysia Treasury bond and monthly exchange rate of Ringgit per US Dollar from 1997 January to 2009 November. Using two models based on GARCH, the relationship between exchange rate and stock market returns were found to be negative but significant for exchange rate and insignificant for interest rate.

All empirical studies reviewed in this study established that there was a relationship between exchange rate and stock market volatility. The strength and direction of the relationship was nonetheless varied. Mlambo, Mandera and Sidada (2013) and Aslam (2014) found a weak negative relationship while, Ambunya (2012) and Kadir et al (2011) returned a strong significant relationship between exchange rate and share prices. It can be concluded therefore that empirical literature is in support of a significant relationship between exchange rate and share returns albeit weak in many cases.

2.4.4 Relationship between Gross Domestic Product and Stock Market Volatility

It is generally understood that the economic performance of a country affect business activities in that country. This would naturally imply that the economic performance of a country would impact on performance of firms and their share prices. Therefore GDP which is a measure of the income on a country should have an effect on share prices and stock market volatility. According to Fama (1986), Mukherjee and Naka (1995) and Ibrahim and Aziz (2003), an increase in the real GDP will affect share prices through the impact it has on corporate profit. This happens when there is an increase in the real GDP, where the expected future cash flows in a company improve causing share prices to increase. This study reviewed a few studies to understand their findings in relation to the effect of gross domestic product on share prices and stock market volatility.

Oseni, *et al.* (2011) examined the relationship between macro-economic variables and stock market volatility in Nigeria. The macro-economic variables investigated in the study were; GDP, interest rate and inflation. This study employed EGARCH technique to examine the volatility in stock market and macroeconomic variables, and used LA-VAR Granger Causality test to analyze the relationship between stocks market volatility and macroeconomic variables volatility in Nigeria for the period from 1986 to 2010 using time-series data. The study found a bi-causal relationship between stock market volatility and real GDP volatility. Findings showed absence of causal relationship between stock market volatility and volatility in interest rate and inflation rate.

Attari, *et al.* (2013) studied the relationship between macro-economic volatility and the stock market volatility in Pakistan. The macro-economic variables investigated in the study were; interest rate, inflation, and Gross domestic product. The study applied the Exponential Generalized Autoregressive Conditional Heteroskedasticity (EGARCH). Monthly time series data of the variables for the time period from December 1991 to August 2012 was used in the study. The ADF and ARCH tests was used to check the stationarity and homoscedasticity in the data respectively. The results suggested that there was no causal relationship between GDP and stock market returns. Inflation rate had a casual effect on stock market returns. Findings revealed the existence of unidirectional relationship between stock market returns and interest rate.

Kibria, Kamuaran, Arshad, Perveen and Sajid (2014) investigated the impact of macroeconomic variables on stock market returns in Pakistan. The study investigated the influence of five macroeconomic variables namely; inflation, GDP Per Capita, GDP savings, money supply and exchange rate at KSE 100 index of Pakistan. The study used the annual data of 23 years from 1991 to 2013. Descriptive analysis, correlation analysis, granger causality test and regression analysis were used to study the relationship. The regression analysis results showed that inflation, exchange rate, money supply, GDP per capita and GDP

savings had a positive and significant impact on stock market return (KSE 100 index) in Pakistan.

Hossain and Hossain (2015) examined the relationship between share price and economic growth in the USA, UK and Japan based on quarterly data for a period of 22years from 1991 to 2012.The study used the Engle-Granger co-integration and Granger causality test to determine the relationship. Findings in the study revealed absence of relationship both in the short run and long-run between share prices and economic growth in USA and Japan. Result showed a short run relationship between share price and economic growth in the UK. In terms of causality the study found that change in share price can predict short term economic growth in the USA and UK. A change in the share price was found not to be a predictor for economic growth in Japan.

Adam (2015) examined the relationship between stock prices and economic growth in Indonesia using quarterly stock price index and percentage in GDP data from 2004 to 2013. Using the general univariate causal model (LVAR), the study found that there was a significant positive relationship between share prices and GDP. This meant that an increase in the share price led to an increase in economic growth in Indonesia. Accordingly, an increase in the stock price by 1 per cent led to an increase in the growth of the Indonesian economy by 0.09 per cent.

A review of empirical literature on the relationship between gross domestic product and share prices and by extension stock market volatility reveals mixed findings. Whereas Oseni et al.(2011),Kibria (2014), and Adam (2015) find a significant positive relationship between gross domestic product and share prices which extends to volatility of the stock market, Hossain and Hossain (2015) and Attari et al (2013) find no significant relationship.

2.4.5 A review of other studies with various macro-economic variables

After reviewing empirical literature that examined the relationship between individual or a few macroeconomic variables and stock market volatility, this

section reviews studies which investigated the relationship between various or a number of macro-economic variables and stock market returns. Among the studies are; Hussin, Muhammad, Abu, Awang and et *al.* (2012), Hasan Tarij (2009), Emeka, Aham and Uko . (2013), Aroni (2011), Kirui, Wawire and Onono. (2014), Olweny and Kimani. (2011), Ouma and Muriu (2014) and Olweny (2010).

Hussin *et al.* (2012) investigated the relationship between the development of the stock market and macro-economic variables in Malaysia. The variables used in the study were; industrial production Index (IPI), consumer price index (CPI), aggregate money supply (M3), Islamic interbank rate (IIR) and exchange rate of Malaysia. The study used Vector Auto regression (VAR) model to examine the relationship between the stock market and macroeconomic variables in Malaysia.

In order to specify the VAR model, the study determined the variables stationarity properties or integration order. The Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests were used to determine the variables' stationarity properties or integration order. To determine whether the variables, particularly the stock market index and macro-economic variables were related in the long run, the contegration test used was by Johasen (1988) and Johansen and Juselius (1990). The study also did a Granger causality test in the form of vector error correction model (VECM). Granger Causality test was performed to identify the existence and the nature of Causality relationship between the variables and the stock market return. The study found that macro-economic variables were Granger cause for the stock market return. The study used monthly data for the period from April 1999 to October 2007. Findings of the study show that the stock market returns are co-integrated with the selected macro-economic variables. The stock market returns were found to be positively and significantly related to the industrial production index and the inflation index (CPI) but related negatively and significantly with money supply (M3) and exchange rate. The relationship between the interest rate and the market return was found to be negative but insignificant.

Patra and Poshakwale (2006) studied the relationship between the economic variables and stock market returns on the Athens Stock Exchange in Greece. The study covered the period from 1990 to 1999. The findings revealed a short term and long term relationship between inflation, money supply and trading volume and the stock prices in the Athens stock exchange. The study found no short term and long-term relationship between the exchange rates and stock prices. The data used in this study consisted of monthly closing prices of the ASE general index, Consumer Price index (CPI), Money supply (M3), and Exchange Rate and trading volumes. The variables were tested for stationarity by employing the Augmented Dickey Fuller statistic (ADF). The ADF statistics were found to be significant for all five variables. Granger causality test was used to test the short-run relationship between stock returns and economic variables. Cointegration was tested using the Eagle and Granger (1986) and Johansen and Juselius (1990).

Emeka *et al.* (2013) examined the impact of macro-economic factors on the Nigeria's stock market returns, using Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model and annual data for the period between 1985 and 2009. The study investigated the ability of six macro-economic variables, namely inflation, government expenditure, index of manufacturing output and, interest rates, money supply, and foreign exchange rate to predict market return. Findings of this study revealed that inflation and government expenditure had a positive and significant impact on the market return. Manufacturing output and interest rate were significant and negatively related to the market return, while money supply and foreign exchange rate had no significant influence on the stock returns. The study observed that the volatility of the Nigerian stock market was more influenced by the past volatility than economic news from previous period. The study also observed that, the time varying volatility of the Nigerian stock market was persistent i.e. it took long for the market to go through a market volatility shock. Findings in this study were contrary to other studies in as far as the inflation index is related to market returns.

Barrows and Naka (1994), Mukherjee and Naka (1995) find that inflation negatively influences stock market return. The study used the Augmented Dickey Fuller test to check the stationarity of the variables before carrying out regression. The study also carried out a cointegration test to examine the long run relationship between the stock market return and macro-economic variables. The study preferred GARCH model to OLS model due to inadequacy of the OLS model to analyzing data that changes through time.

Hassan and El Gezery (2010) examined the effect of macro-economic variables on Egyptian stock market return across different types of industries and different levels of economic states. The macro-economic variables investigated in this study were; inflation rate, interest rate, money supply and exchange rate. The study covered the period from 1993 to 2009. Findings in the study showed that the stock market index responded positively to inflation but the coefficient was insignificant. Interest rates were found to be negatively related to the market return at 10% significance level. The exchange rate was found to be positively related to the market return at 5% significance level. Money supply was found to be positively significant to the market return. The study used M2 as a proxy for the money supply in Egypt. The Vector Autoregressive (VAR) model was used to investigate the relationship between macro-economic variables and stock market return. Before inclusion of variables in the VAR model, all the variables had to be checked for stationary, since the model requires that they be stationery. The Augmented Dickey Fuller test was employed to test for unit roots and it was found that all the variables namely share price index, money supply, exchange rate; inflation rate and interest rate were stationary on first differencing at 1 percent level of significance on the basis of the ADF. The Durbin Watson Statistics and the Granger causality test were used to test whether there is one-way or bi-directional causality between Egypt stock market return and macro-economic variables.

Oseni and Mwosa (2011) studied the relationship between stock market volatility and macro-economic variables volatility in Nigeria using EGARCH model. The study used LA-VAR Granger Causality test to analyze the nexus between stock market volatility and macroeconomic variables volatility in Nigeria for the periods 1986 to 2010 using time-series data. The results of the findings revealed that there exists a bi-causal relationship between stock market volatility and real GDP volatility; and there is no causal relationship between stock market volatility and the volatility in interest rate and inflation rate.

Olweny *et al.* (2011) investigated the effect of macro-economic factors on stock return volatility on the Nairobi Securities Exchange in Kenya. Macro-economic variables used in the study were, foreign exchange rate, interest rate and inflation rate. The study used monthly time series data for ten years between January 2001 and December 2010.The study used EGARCH and TGARCH models to investigate the relationship between economic variables and the stock market return. Findings in the study showed evidence that foreign exchange rate, interest rate and inflation rate affect stock market returns volatility. The study used ADF test to test the unit root and the Jarque bera test to test for normality in the time series data variables.

2.4.6 Relationship between Investor Herding Behavior and Stock Market Volatility

Empirical studies show that investor herding behavior leads to inefficiency in stock markets where asset prices display significant deviations from prices expected in an efficient market. According to Gelos and Wei (2002), emerging capital markets constitute environments whose institutional structures naturally facilitate the manifestation of herd behavior. Studies like Blasco et al. (2008), Patterson and Sharma (2006), Chiang et al. (2011), Zafer (2012), Voronkova and Bohol. (2003), Nofsinger et al. (1999) and Seetharam and Britten (2013) have examined herding behavior in various markets and returned diverse findings on its effect on stock prices and market volatility.

Blasco , Corredor and Ferreruela (2008) examined the implications of herding on volatility of the Spanish stock market. The study covered the period between January 1997 and December 2003. Intraday data was used to calculate the herding measure. Herding was measured using the Patterson and Sharma (2006) herding intensity measure which is based on the information cascade models of Bikhchandani *et al.* (1992). Results confirmed that herding had a direct linear impact on volatility for all the volatility measures considered except implied volatility. The findings by Blasco *et al.* (2008) suggest that an increase in herding intensity caused an increase in the stock market volatility.

Chiang and Zieng (2011) examined investor herding behavior in Pacific-Basin equity markets. The study used the asymmetric GARCH model to examine the effect of herding behavior and found that herding is present in both rising and falling markets. The level of herding was found to be time-varying. The study found that herding is positively related to stock returns, but negatively related to market volatility. Herding estimates across markets was found to be positively correlated, signifying co-movement of investor behavior in the region.

Zafer (2012) investigated the effect of institutional herding on stock prices by analyzing quarterly observations of the stock holdings of institutional investors between 1981 and 2008. The study adopted the Yan and Zhang (2009) approach. Herding was measured using the Lakonishok, Shleifer and Vishny (1992) method. The study found that short-term institutional herding tends to stabilize stock prices while long-term institutional herding has a destabilizing impact on stock prices. The study also found the long-term institutional herding was followed by a clear reversal in stock prices.

Voronkova and Bohl (2003), studied institutional traders' behavior among Polish pension fund investors. The study relied on the semi-annual and annual reports for 17 pension funds for the period from 1999 to 2001. The study measured herding using the LSV (1992) approach. The study found that, Polish pension fund investors are to a greater extent involved in herding behavior and more often

pursue feedback trading strategies than their counterparts in mature markets. The study concluded that herding by pension funds do not exerts significant influence on stock prices.

Patterson and Sharma (2005) examined the effect of intraday on market efficiency on the New York stock market using bootstrapped run test and a test of dependence between inter-arrival trade times. The study found no evidence of widespread herding on the New York stock Exchange. Herding was found to be more prevalent in small stocks. The study established that herding caused an upward price pressure. The study found that on the days that the price decrease, investor herding behavior helps to impound fundamental information into security prices thus making markets more efficient.

Nofsinger and Sias (1999) studied herding and feedback behavior among institutional and individual investors using a trader-type identified transaction data. The study found that institutional herding impacts stock prices more than herding by individual investors. Institutional herding was found to be positively correlated to lag returns and appeared to be related to stock return momentum.

Puckett and Yan (2008) examined the short-term institutional herding behavior and its impact on stock prices. The study used the trades of 776 institutional investors from 1999 to 2004. Investor herding was measured using the Lakonishok, Shleifer, and Vishny (1992) and Sias (2004) methods of measuring herding. The study found strong evidence of herding behavior at the weekly frequency. Weekly herds were found to significantly affect the efficiency of security prices. Strong evidence of return reversals following short-term sell herds and weak evidence of return continuations following short-term buy herds was evident in the study.

Seetharam and Britten (2013) analyzed herding behavior during market crisis in South Africa between 1995 and 2011 and found that investor herding was present during bear market periods only. The study found that herding fluctuates before a

market contraction. Herding was seen as an explanatory factor for the existence of a nonlinear market model. The study established that both experienced and inexperienced individuals tend to follow group consensus in times of a market downturn, yet deviate from the group consensus in times of a market upturn.

2.5 Critique of the Existing Literature

A majority of studies reviewed from Kenya, Aroni (2011), Kirui et al. (2014), Olweny et al. (2011), Ouma et al. (2014), Ochieng et al. (2012) and Ambunya (2012), tend to focus largely on the relationship between macro-economic variables and stock market performance and less on stock market volatility. These studies among other studies in Africa have returned contradicting findings. For example, while Kirui (2014) finds exchange rate changes not to affect stock market volatility, Ambunya (2012), Chinzara, (2010), Kadir Selamat, Masunag and Taudi (2011), Aslam (2014), Omorokunwa and Ikponmwosa (2014), Hasan and Tarij (2009), Olweny *et al.* (2011), Waweru (2013) and Kibria, et al (2014), find that changes in exchange rate affects stock market volatility.

Studies reviewed show varying findings on the effect of interest rate, inflation and GDP on stock market volatility. Murungi (2012), and Ratanapakom (2007) finds a negative relationship between inflation and share prices while, Ochieng and Oriwo (2012) and Ouma et al. (2014) find that inflation rate has a positive effect on share prices. Regarding interest rate, while, Zhou (1996), Arango, Gonzalez and Pasada (2002) Zafar, Urooj and Drrani (2008) and Alam (2009), find that interest rate has a negative effect on share prices and market volatility, Ahmed (2008) and Gan, Lee , Young, and Zhang (2006) find that interest rate has a positive effect on share prices and stock market volatility. As for GDP, whereas Oseni and Muosa (2011), Kibria (2014), and Adam (2015) find a significant positive relationship between gross domestic product and share prices which extends to volatility of the stock market, Hossain and Hossain (2015) and Attari and Safdar (2013) find no significant relationship.

The incongruity may be due to the varied methods used in measuring and analyzing data. This leaves a gap in terms of consensus of findings and inadequate literature on stock market volatility in Kenya. Studies reviewed combined varied macroeconomic variable most of which have difference levels of effect on stock market volatility. It is important that studies examine different combinations of many more macroeconomic variables since findings may also vary depending on the sets of variables. The arbitraged pricing theory does not help much in recommending macro-economic variables that affects stock market volatility most. This has sustained a knowledge gap by not specifying which out of the many macro-economic variables predicts stock market volatility.

While finance theory inclines more towards macroeconomic variable as predictors of stock market volatility, little is documented on the influence of investor herding behavior on stock market volatility. According to Gelos and wei (2002), herding is the most common behavioral bias in emerging markets owing to environments whose institutional structures naturally facilitate the manifestation of the behavior. No study known to the researcher has examined the effect of investor herd behavior on stock market volatility in Kenya despite plenty of literature supporting the argument that investor herding behavior causes volatility of stock market.

2.6 Summary

This chapter has reviewed the relevant literature explaining the relationship between interest rate, inflation rate, foreign exchange rate and gross domestic product on one side as independent variable and stock market volatility on the other side as a dependent variable. The review has exposed various knowledge gaps. Studies on the effect of herding behavior on stock market volatility have also been reviewed. This has revealed that little is known about the effect of herding behavior on the Nairobi Securities Exchange. A critique of the available empirical literature has been carried out and research gaps identified.

2.7 Research Gaps

There are many inconsistencies in findings made by reviewed studies with regard to the effect of inflation, interest rate, exchange rate and gross domestic product on stock market volatility. Empirical literature reviewed in this study affirms the fact that many studies done to investigate the relationship between macro-economic variables and stock market volatility in Kenya have returned mixed findings. The inconsistencies in findings provide a need for further inquiry to narrow the findings. There is need for inclusion of numerous macro-economic variables into new studies to identify the most responsible variable that contributes greatly to stock market volatility in order to advice on policy. Furthermore, varied studies have used diverse methods and in different combinations a reason that could explain the inconsistencies in findings. This invites the need for many more studies using different methods to assure consistency in findings.

Despite plenty of evidence from studies conducted in developed and emerging markets like Blasco, Corredor and Ferreira (2008), (2009), Pucket (2004), Voronokov (2004), Zafar (2008), affirming that investor herding behavior has an effect on share prices and stock market volatility, very few studies have investigated the effect of herd behavior on stock market volatility in Kenya. Studies in Kenya have focused on the effect of macro-economic variables on stock market volatility. In view of limited studies and literature on effect of herd behavior and stock market volatility in Kenya, this study finds the need to establish this relationship. This study identifies a knowledge gap from three perspectives, first the inconsistency in findings regarding the effect of macro-economic variables on stock market volatility, limited inquiries made to interrogate the effect of herd behavior in the relationship between macroeconomic variables and stock market volatility and the need to apply different methods to narrow inconsistencies in outcomes.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

Research methodology is the detailed procedure used to answer the research questions; it includes a description of research design, sampling techniques, instrumentation and data analysis techniques (Oso & Onen, 2009). This chapter presents a description of the methodology used in this study. It comprises sections on research design, population and sampling technique, data collection procedure, pilot testing, data processing and operationalization of variables.

3.2 Research Design

According to Saunders, Lewis and Thornhill (2007), research design is the general plan of how research questions would be answered. It is the conceptual structure within which research is conducted (Kothari, 2003). This study sought to examine the effect of macro-economic variables namely; interest rate, inflation rate, gross domestic product and exchange rate on stock market volatility in Kenya. The study adopted a descriptive research design.

A descriptive research attempts to investigate the causes of particular phenomena. According to Polit and Hungler (1999), a descriptive research describes data and characteristics about the population or phenomenon being studied. The study was examining variables that had already been investigated in the past; hence a descriptive research design was most appropriate for the study. According to Gravetter and Forzano (2011), descriptive research design involves measuring a set of variables as they exist naturally. This is true to this study since the macro-economic data fits the descriptive research design. The descriptive research design describes data and characteristics about the population or phenomenon being

studied unlike exploratory research which is particularly useful when the researcher lacks a clear idea of the problems to be met during the study, it estimates the proportion of a population that have the characteristics under study and, it establishes the association among different variables.

A number of researchers have conducted research on the relationship between macro-economic variables and stock market volatility and hence the need to investigate further rather than explore the phenomena. It is for these reasons that the descriptive research design was suggested in this study rather than an exploratory and experimental research design. The study used a quantitative approach. In a quantitative approach, data is measured and analyzed in a numerical form to give precise description. A quantitative research often entails objectivism, positivism and deductive approach (Collis & Hussey, 2009).

3.3 Research Paradigm

This study adopted a positivism which adheres to the view that only "factual" knowledge gained through observation, including measurement, is trustworthy. In positivism studies the role of the researcher is limited to data collection and interpretation through objective approach and the research findings are usually observable and quantifiable (Saunders *et al.,* 2007).

A Positivism philosophy generally refers to philosophical positions that emphasize empirical data and scientific methods. The characteristics of data used in this study are that it's observable, quantifiable and empirical. Additionally, the study is scientific in its approach particularly the methodology adopted. The study therefore adopted a positivism philosophy.

3.4 Population

Polit and Hungler (1999), define a population as the totality of all subjects that conform to a set of specifications, comprising the entire group or field of inquiry and to which the research results can be generalized. The research population for

this study comprised of all companies listed on the NSE between January 2001 and December 2014. The Nairobi Securities Exchange had 60 listed companies as at December 2014. All companies listed on the Nairobi Securities Exchange formed the target population. The unit of analysis was the Nairobi Securities Exchange.

3.5 Sampling Frame

A sampling frame is a list of all items where a representative sample is drawn for the purpose of research. According to Mugenda and Mugenda (2003) a sampling frame is a set of information used to identify a sample population for statistical treatment. Kothari (2004) also notes that the sampling frame must be representative of the population. In this study, the sampling frame was a list of all companies listed on the Nairobi Securities Exchange. The study involved shares of all companies listed on the Nairobi Securities Exchange. The study took the form of a census by including all shares of listed companies. According to Kothari, (2004), a complete enumeration of all items in the population is known as a census.

3.6 Sample and Sampling Technique

A sample is a portion or part of the population of interest. Kothari (2004) define sampling as the selection of some part of an aggregate or totality on the basis of which a judgment or inference about the aggregate or totality is made. This study included all companies listed on the Nairobi Securities Exchange. It therefore took the form of a census by studying all the companies listed on the Nairobi securities exchange.

3.7 Data Collection Instruments

The study collected data from secondary sources. The data was collected from statistical data and reports published by institutions including; the Central Bank of Kenya, the Capital Market Authority and the Kenya National Bureau of Statistics

(KNBS). A secondary data collection instrument was designed and used to collect secondary data.

3.8 Data Collection Procedure

The data was obtained from reports published by the Central Bank of Kenya, the Capital Market Authority and the Kenya National Bureau of Statistics. This includes the economic reviews reports by the Central Bank of Kenya, the CMA quarterly and monthly market reports, the NSE reports on share indices and the KNBS data on economic indicators. Data on share prices was obtained from the Nairobi Securities Market. This study obtained data as described in the table 3.2.

Table 3.1: Source of Data

Data	Description	Source of data
Interest rate	91 day treasury bill rate. The rate is used as a base lending rate by lenders in the market and it was therefore the best measure of interest rate for the study.	Central Bank of Kenya
Inflation rate (CPI)	A measure on inflation using an index of items consumed on day to day basis. Used annual average figures.	Kenya National Bureau of Statistics
Exchange rate	The prevailing exchange rate at the end of every month under study. Number of shillings exchanged for 1 US dollar.	Central Bank of Kenya
GDP	A Measure of the income of a country using a number method.	Kenya National Bureau of Statistics
Herd index	A measure of herding based on CSSD method	Calculated from NSE monthly average share prices data.

3.9 Preliminary Data Analysis

3.9.1 Multicollinearity Test

Multicollinearity is a situation where there is a high degree of inter-correlations among independent variables in a multivariate regression equation (Pesaran, 2015). It is most common with time series data. Multi collinearity can lead to large standard errors especially for OLS estimates (Wooldridge, 2013). To avoid large standard errors, this study carried out a multicollinearity test using the Variance Inflation Factor (VIF) method.

The variance inflation factor estimates how much the variance of a regression coefficient is inflated due to multicollinearity in the model. The VIF was calculated by taking an independent variable and regressing it against every independent variable in the model. This gave R-squared values which were plugged into the VIF formula.

$$\text{VIF} = \frac{1}{1-R_i^2}$$

Where; R_i^2 is the R-squared value form regressed independent variables. The rule of thumb states that there is evidence of collinearity if the mean VIF is greater than unity or if the largest VIF is greater that 10 (Baum, 2006).

3.9.2 Auto Correlation

Auto correlation is the correlation between values of a variable and lagged values of that same variable (Sharifzadeh, 2006). It is a situation in which a time series data is influenced by its historical values. The problem with auto correlation is that it may a model look better than it actually is (Brown, 1991). Auto correlation would most likely lead to invalid results.

This study used the Portmanteau and Lagrange Multiplier tests methods to test for auto correlation. The Portmanteau and Lagrange multiplier tests belong to the class of asymptotic (large sample) tests. These methods are applicable whether there is lagged dependent variable or not. Autocorrelation is said to be present in a variable if the p-values are more than 0.5. The test rejects the null hypothesis that there is no serial correlation up to lag four.

3.9.3 Normality Test

A normality test is used to determine whether a data set resembles the normal distribution. A visual representation of the distribution of test results determines whether it conforms to the bell-shaped normal curve (Katsanos, 2010). The test is designed to detect evidence that the distribution deviates from a normal curve.

Testing for normality is customarily performed by means of the skewness- Kurtosis test. The main reason for its widespread use is its straightforward implementation and interpretation (Lobato & Velasco, 2004). This study used Shapiro wilk test in testing for normality. The test rejects the hypothesis of normality when the p-value is less than or equal to 0.05. The study also tests normality by estimating the skewness and kurtosis of variables and presenting the distribution in a normal curve. The data is normally distributed if the skewness of all variables is below one or in the zero range and kurtosis is within the range of 3.

3.9.4 Stationarity Test

A stationary time series is one whose statistical properties such as mean, variance, and autocorrelation remain constant over time (Jani, 2014). Stationarity is tested to avoid spurious regression where a regression of one on the other variable can have a very high R-squared even if the two variables are totally unrelated.

This study performed a unit root test. A unit root is a feature of process that evolves through time that can cause problems in statistical inference involving time series

model. The study used both Augmented Dickey Fuller test and Phillips –Perron tests to test for stationarity.

3.9.5 Cointegration Test

Cointegration is a statistical property of time series variables. Variables are said to be cointegrated if there exists a stationary linear combination of non-stationary random variables. The study used Johansen-Juselius (1990) to carry out the cointegration test**.**

The idea behind carrying out cointegration test is that, although individually some of the variables are non-stationary, their linear combination could be stationary I (0). The choice of Johansen- Juselius test was for its convenience to use when there are more than two variables. The rule of thumb is that, if two or more series are themselves non-stationary, but a linear combination of the time series is stationary, then the series are said to be cointegrated.

3.10 Data Processing

The study used mainly quantitative data comprising time series observation on interest rate, inflation, foreign exchange rate and Gross domestic product. Data was analyzed using e-views version 8 software package. There are three main objectives of analyzing data. These are getting a feel of the data, testing the goodness of data and testing the hypotheses developed for the research (Sekaran, 2006). Descriptive statistics were used to describe the relationship between macro-economic variables namely; interest rate, exchange rate, gross domestic product, inflation rate and stock market volatility.

This study used both correlation and regression analysis to express the relationship between herding index, macro-economic variables and stock market volatility. A regression model was used to express the relationship between selected macro-economic variables and stock market volatility. The short run and long run relationships between the variables was established by carrying out the granger causality test and then specifying the vector error corrections model

(VECM) whose results are discussed in chapter four and five. The vector error correction model followed the regression model specified in 3.9.1.

3.10.1 Statistical Measurement Methods

The multiple regression models for this study were:

$$SMV = \beta_0 + \beta_1 INF + \beta_2 INT + \beta_3 GDP + \beta_4 FEX + \beta_5 HI + \varepsilon \ldots\ldots\ldots\ldots\ldots (1)$$

$$SMV = \beta_0 + \beta_1 INF + \beta_2 INT + \beta_3 GDP + \beta_4 FEX + \beta_5 HI + \beta_6 INF * HI + \beta_7 INT * HI + \beta_8 GDP * HI + \beta_0 FEX * HI + \varepsilon \quad (2)$$

Where;

SMV is the stock market volatility (standard deviation of the monthly NASI.)

INF is the inflation rate as measured by the consumer price index

INT is the interest rate as measured by the 91 day Treasury bill rate.

GDP is the Gross Domestic Product

FEX is the Foreign Exchange Rate measured by the exchange rate between Kenya shilling and one US dollar

HI is the market –wide herding Index as measure by the Cross Sectional Standard Deviation (CSSD) method.

ε is the error term

3.11 Operationalization of Variables

Table 3.3 Summary of Operationalization of Key Variables

Variable / (Nature)	Indicator	Operational Definition	Data Source
Exchange rate (Independent variable)	Kenya shilling to US Dollar Exchange rate	The monthly changes in the buying rate of a US dollar.	KNBS (Monthly data)
Interest rate (Independent variable)	91day treasury bill rate	The monthly changes in the lending & borrowing rate.	CBK (Monthly data)
Inflation rate (Independent variable)	Consumer price index	Weighted average of prices of consumer items taken periodically at various locations	KNBS (Monthly data)
GDP (Independent variable)	Measure of national income	The market value of all final goods and services produced within a country in a given period.	KNBS (quarterly data)
Stock market volatility (Dependent variable)	Standard deviation of NASI index	It is the dispersion and not the direction of changes in price.	Computed as standard deviation of NASI Index
Herding (Moderating variable)	Herding Index $CSSD_t = \sqrt{\sum_{t=1}^{N} \frac{(r_{rt} - r_{mt})}{N-1}}$	A collective buying and selling actions of individuals in an attempt to follow the performance of the market or any other economic factors or styles.	Index computed using CSSD method

Stock Market Volatility (SMV)

According to Ambrosio (2007) stock market volatility is the fluctuation in the price of broad stock market indexes over a defined period. It is the dispersion and not the direction of changes in price. Volatility can either be measured by using the standard deviation or variance between returns from that same security or market index (Debesh, 2013). Schwert (1990) opines that the most commonly used measure of stock return volatility is standard deviation. According to Schwert (1990) financial economists find the standard deviation to be useful because it summarizes the probability of seeing extreme values of return. When standard deviation is large, the chance of large positive or negative returns is large.

In this study stock market volatility was measured using the standard deviation of the NASI share index. A number of studies have used the standard deviation method as a measure of volatility returning satisfactory findings. Debesh, (2013), Blasco, Corredor and Ferruera (2012), used standard deviation as a measure of stock market volatility. This method is suggested to be suitable in measuring historical stock market volatility. The standard deviation expresses how closely prices of stocks are grouped around the mean or moving average. When prices are closely bunched together, the standard deviation is small. When the price is spread apart, the study observes a relatively large standard deviation. Stock market volatility tends to decline as the stock market rises and increases as the stock market falls (Debesh, 2013).

Inflation (INF)

The Consumer Price Index (CPI) is a key macroeconomic indicator used to monitor price movements and how they affect policy decisions (KNBS, 2010). CPI represents a form of weighted average of prices of consumer items taken periodically at various locations within a given economy. A consumer price index (CPI) is the principal measure of trends in the prices of goods and services that

households consume (Kingsbury, 2000). The study sought to establish the effect of changes in inflation rate on stock market volatility as the first objective. The overall Consumer Price Index (CPI) was used in this study as a measure of inflation rate. Monthly change in the CPI was obtained from the data provided by the Kenya National Bureau of Statistics.

Interest Rate (INT)

The 91 day Treasury bill rate was used by the study as a measure for interest rate. Treasury bills are short-term borrowing instruments issued by the government through the central bank of Kenya. The T-bill rate is used as a benchmark rate for determining the lending rate in the country. A change in the Treasury bill rate causes a corresponding change in all borrowing rate making it the best proxy for measuring interest rate in this study. Treasury bills are sold at discounted price to reflect investor's return and redeemed at face value. The 91day treasury bills mature after a term of 91 days. The study used monthly averages of the 91 day Treasury bill rate over a period of 14 years. The data was obtained from the Central Bank of Kenya.

Gross Domestic Product (GDP)

Gross Domestic Product is a measure of the market value of all final goods and services produced within a country in a given period. It is the most widely followed metric for assessing an economy's performance. This study used the quarterly percentage growth rate of GDP at market prices based on constant local currency as obtained from the Kenya National Bureau of Statistics (KNBS).

Foreign Exchange (FEX)

The foreign exchange rate was measured by the monthly changes in the buying rate of a US dollar. Based on the Dornbusch and Fischer's (1980) approach, a depreciation of the domestic currency makes local firms more competitive, i.e., their export is cheaper in international markets, which increases exports. The

increase translates into higher incomes of these companies and higher stock prices.

Herding Index (HI)

The Investor herding behavior was a moderating variable in the study. Herding, being a non-quantifiable behavior, cannot be measured directly. It can only be inferred by studying related measurable parameters. Measuring herd behavior can be done broadly using two approaches (Vieira, 2015).

The first approach focuses directly on the trading actions of institutional and individual investors. This approach requires detailed and explicit information on the trading activities of the investors and the changes in their investment portfolios. Some of the methods used to measure institutional and individual investor herds are; the LSV measure by Lakonishok *et al.* (1992) and the Portfolio-change measure (PCM) by Grinblatt *et al*. (1995).

The second approach of measuring herd behavior is by group effect of collective buying and selling actions of the investors in an attempt to follow the performance of the market. This is a market-wide measure of herd behavior. The market-wide herding effect is detected by exploiting the information contained in the cross-sectional stock price movements. Some of the contributors to this measure are; Christie & Huang (1995), Chang, *et al.* (2000), Hwang & Salmon (2004), Gleason, Lee and Mathur. (2003, 2004), Patterson, *et al.* (2006), Demirer *et al.* (2006) and Tan *et al.* (2008).

This study was motivated by the second approach of measuring herd behavior, namely return dispersion based models to measure market-wide herding. Three dispersion methods were suggested in this approach as appropriate for this study namely; the cross-sectional standard deviations (CSSD) cross sectional absolute standard deviations (CSAD) and Patterson and Sharma (2006).

This study employed the Christie and Huang (1995) CSSD methodology to measure investor herding behavior. The Christie and Huang (CSSD) herding intensity measure is suitable for this study for the reasons that; it overcomes the problem of intra-interval herding data missing i.e. monthly, weekly, daily or even intra-daily intervals ; it does not assume herding to vary with extreme market conditions and, it considers the market as a whole. This method is based on the information cascade model of Bikhchandani, *et al.* (1992), where herding intensity is measured in both buyer and seller initiated trading sequences. The CSSD method has successfully been used by Christie and Huang (1995), Chang, *et al.* (2000), Gleason *et al.* (2003), Lin and Swanson (2003), Gleason , Mathur and Peterson. (2004), and Demirer and Kutan (2006).

Herding behavior was viewed in this study as a collective buying and selling actions of individuals in an attempt to follow the performance of the market or any other economic factors or styles. Herding is detected by exploiting the information contained in the cross-sectional stock price movements. Market-wide herding was measured by calculating a herding index.

Christie and Huang (1995) contend that if herding behavior occurs in an equity market during period of stress or high volatility, the dispersion should increase at a decreasing rate or simply a negative function of price movements in the case of severe herding. The rationale is that if individuals ignore their beliefs and base their decisions solely on the market consensus during periods of relatively large price movements, the stock returns will not deviate too far from the market return. In short, the dispersion should decrease during periods of extreme price movements when there is herding behavior. This is contrary to the capital asset pricing model which predicts that the dispersion should increase with absolute value of the market return.

In the Christie and Huang (1995) measure of dispersion, the cross-sectional standard deviation is computed as follows:

$$CSSD_t = \sqrt{\sum_{t=1}^{N} \frac{(r_{rt} - r_{mt})^2}{N-1}} \quad (1)$$

Where;

N is the number of stocks or firms in the aggregate market portfolio

r_{rt} is the observed stock return on firm *i* for day *t*.

r_{mt} is the cross sectional average of the *N* returns in the market portfolio for day *t*.

In this test, market stress is associated with the condition when the market returns lie in the upper and lower 1% or 5% of the market return distribution. In the presence of herding behavior, the coefficients of β_1 and β_2 in the following regression should be significantly negative:

$$CSSD_t = \alpha + \beta_1 D_t^L + \beta_2 D_t^u + \varepsilon_t \quad (2)$$

Where D_t^L is = 1, if the market return on day *t* lies in the extreme lower tail of the return distribution, and equal to 0, otherwise; and D_t^u = 1, if the market return on day *t* lies in the extreme upper tail of the distribution, and equal to 0, otherwise. These dummy variables are incorporated to capture differences in investor behavior in extreme up or down against relatively normal markets. If both the coefficients of these dummy variables are significantly positive, then we would empirically conclude that herding behavior is not detected.

To compute the market-wide herding index, daily stock prices of all listed companies for the entire study period were obtained from the Nairobi Securities Exchange and averaged for monthly returns. The CSSD formula was then employed to calculate the herding index.

NASI Index

The NASI is an average measure of the performance of all quoted companies on the Nairobi Securities Exchange. A stock is eligible for inclusion in the NSE All

Share Index (NASI) if it is listed under the Main Investments Market Segment (MIMS) or the Alternative Investment Market Segments (AIMS) of the stock exchange (www.nse.co.ke). All classes of ordinary shares in issue are eligible for inclusion in the NASI, subject to conforming to rules of eligibility. Companies that have a full listing on the main board of the NSE are eligible for inclusion in the NASI, both local and foreign (cross listed) companies. There is no limit to the size, liquidity and free float of the company eligible (www.nse.co.ke).

The index is calculated by first, deriving the initial total market value of listed equity on the Securities Exchange as at base date. (i.e. Market value = total number of shares outstanding * price). This figure is established as the base and assigned a base value of 100. Secondly, the total market value at current prices is derived in the same way the initial total market value was derived at base date. Finally, the new market value is divided by the base value to determine the level of change which is in turn applied to the beginning index value.

The NASI base date is quoted at 100 as on a defined base date, representing a Market Capitalization for that base date. The index is calculated using the formula below;

$$NASI_t = \frac{\Sigma P_t Q_t * 100}{\Sigma P_b Q_b}$$

Where:

P_t is the current price of a stock

Q_t is the current number of outstanding shares

P_b is the price as at base date

Q_b is the number of outstanding shares as at base date

The Nairobi Securities Exchange All-Share Index (NASI) is a market capitalization weighted index consisting of all the securities on the NSE. Prices used to compute the NASI are based on last trade information from the NSE's

Automated Trading System. The index was used to value the stock market volatility. The use of this index was to enhance accuracy of result by using an index that includes all listed company shares in the bourse.

3.11 Summary

In summary, this study used descriptive research design. The population of study was the 60 companies listed on the Nairobi Securities Exchange. Secondary data was obtained from the CBK, CMA, KNBS and NSE. The Nairobi securities exchange all share index (NASI) was used to determine stock market volatility. Herd behavior was measured using CSSD method. The study used regression and correlation analysis to establish the relationship between macroeconomic variables and stock market volatility.

CHAPTER FOUR

RESEARCH FINDINGS AND DISCUSSION

4.1 Introduction

The general objective of this study was to investigate the effect of macro-economic variables on stock market volatility in Kenya. Specific objectives were to establish the relationship between each individual selected macro-economic variable namely; inflation rate, interest rate, exchange rate, gross domestic product and stock market volatility. In addition, the study sought to establish the moderating effect of investor herd behavior on the relationship between inflation rate, interest rate, exchange rate, gross domestic product and stock market volatility.

The study hypotheses stated that, there is no significant relationship between inflation rate, interest rate, exchange rate, gross domestic product (all individually) and stock market volatility, and that herding behavior does not significantly affect the relationship between inflation rate, interest rate, exchange rate, gross domestic product and stock market volatility.

4.2 Response Rate

The study relied on secondary data which was obtained from the Nairobi Securities Exchange, the Kenya National Bureau of Statistics and the Central Bank of Kenya in relation to interest rate, exchange rate, gross domestic product, and inflation rate and share prices. The study used time series data for a period of 14years from January 2001 to December 2014 averaging 167 observations for each of the independent variables out of a possible 168 observations.

4.3 Preliminary Tests

4.3.1 Multicollinearity Test

In research, a test of multicollinearity among independent variable is of high importance since the presence of collinearity leads to increased errors in study results. Multicollinearity occurs when the independent variables, in the case of this study, selected macroeconomic variables, are correlated. According to Barnor (2014), if two or more independent variables are linearly dependent on each other, one of them should be included instead of both since it increases standard errors thereby making the results biased.

A multicollinearity test was conducted on the data based on one of the basic assumptions that regressors should not be mutually correlated. The assumption was that, if more than one of the variables is correlated with others, then multicollinearity is said to be present.

This study employed the variance inflation factor (VIF) approach to test for multicollinearity. The rule of thumb under this method is that if the variance inflation factor of explanatory variables is above ten, then variables are said to be collinear. The variance inflation factor (VIF) results were as shown in Table 4.1. Results in Table 4.1 shows that the explanatory variables are not collinear since the VIF for all the variables are below ten, meaning that multicollinearity does not exist among all explanatory variables in the study. This is consistent with multicollinearity test finding made in similar studies in Kenya. Some of the studies which returned similar findings are; Kirui et al (2014), Aroni (2011), and Olweny (2011).

Table 4. 1: Multicollinearity Results for the Macroeconomic Variables

Variables	VIF
Inflation	1.04633
Interest rate	1.20108
GDP	1.32187
Foreign Exchange rate	1.37713
Herd index	1.09987

4.3.3 Auto Correlation

According to Koutsoyiannis (1993), autocorrelation, refers to the relationship, not between two (or more) different variables, but between the successive values of the same variable. It is a mathematical representation of the degree of similarity between a given time series and a lagged version of itself over successive time intervals.

A number of methods have been used to test autocorrelation. The most common methods are; the Durbin-Watson statistic, Portmanteau and Lagrange Multiplier (LM). This study chose to employ Portmanteau and Lagrange Multiplier (LM) tests. In these methods, autocorrelation occurs if the P-values are more than 0.05. Results in table 4.2and 4.3 indicate that there is no auto correlation since the p-values are less than 0.05 at lag 4 and 2 respectively.

Table 4. 2: VEC Residual Portmanteau Tests Results for Autocorrelation

Null Hypothesis: no residual autocorrelations up to lag 4

Lags	Q-Stat	Prob.	Adj. Q-Stat	Prob.	Df
1	4.876249	NA*	4.906536	NA*	NA*
2	13.76425	NA*	13.90563	NA*	NA*
3	35.30057	NA*	35.84830	NA*	NA*
4	70.72133	0.3230	72.16579	0.2815	66

Table 4. 3: VEC Residual Serial Correlation Lagrange Multiplier Test Results

Null Hypothesis: no serial correlation at lag order 2

Lags	LM-Stat	Prob.
1	52.44605	0.0376
2	41.42835	0.2458

The autocorrelation test results in tables 4.2 and 4.3 are in congruence with results from other similar studies.

4.3.4 Normality Test

A normality test is done to determine whether the sample data has been obtained from a normally distributed population. The study sought to test the normality of the data which is important particularly when parametric tests like correlation and regression analysis are used. The normality of data used was evaluated by determining the skewness and kurtosis values and presenting histograms. The scale of normally distributed data is that its skewness must be equal to 0 and kurtosis equals to 3.

Skewness provides information about the symmetry of the distribution while kurtosis provides information about the peakedness of the distribution (Tabachnick & Fidell, 2007). To test whether the data follow the normal

probability distribution, Shapiro Wilk test for normality was done. The test has a null hypothesis that the data is normally distributed. The test statistics for normality of each variable are shown in table 4.4. From the test results, the normality measures did not indicate extreme departure from normality assumption since, Table 4.4 shows that the skewness of all variables were below one and hence in the zero range while the Kurtosis was within the range of 3.

Table 4. 4: Normality Test Results

Variable	Mean	Standard deviation	Skewness	Kurtosis
Stock Market Volatility	1.192	0.899	0.735	2.541
Interest Rates	7.735	3.650	0.560	4.371
Inflation Rate	8.300	4.917	0.638	2.340
Foreign Exchange	78.530	6.765	0.026	3.500
Gross Domestic Product	335.196	58.182	0.102	1.747

To support findings in Table 4.4, a graphical presentation of histograms for all the macro-economic variables is done. Histograms are able to show the distribution of scores. From figures 4.1, 4.2, 4.3, 4.4 & 4.5 we see that the data for all variables of study were reasonably distributed. These results therefore suggested that the data was suitable for further analysis.

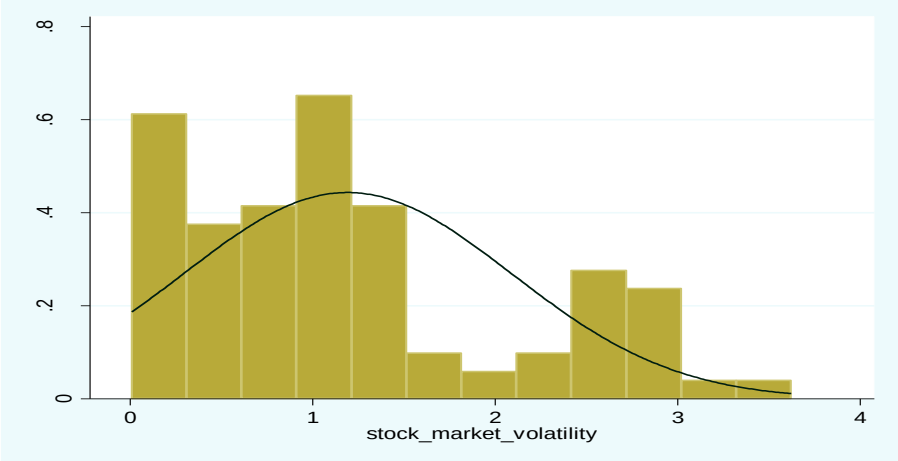

Figure 4. 1: Histogram of Stock Market Volatility

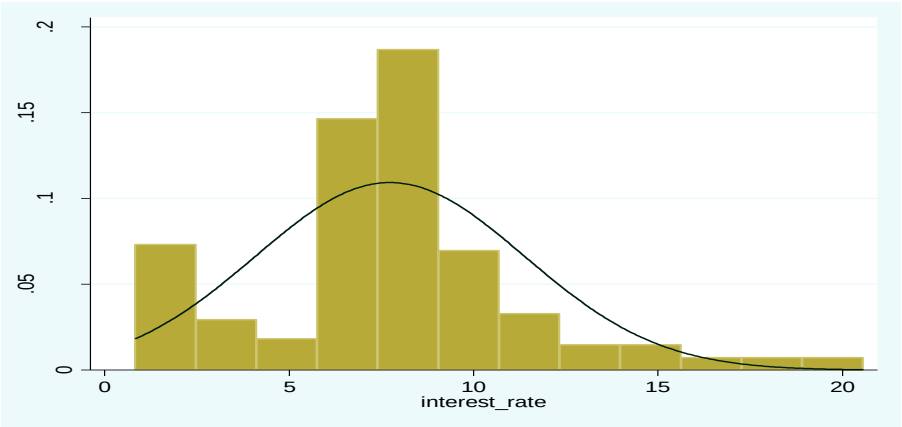

Figure 4. 2: Histogram for the Interest Rate

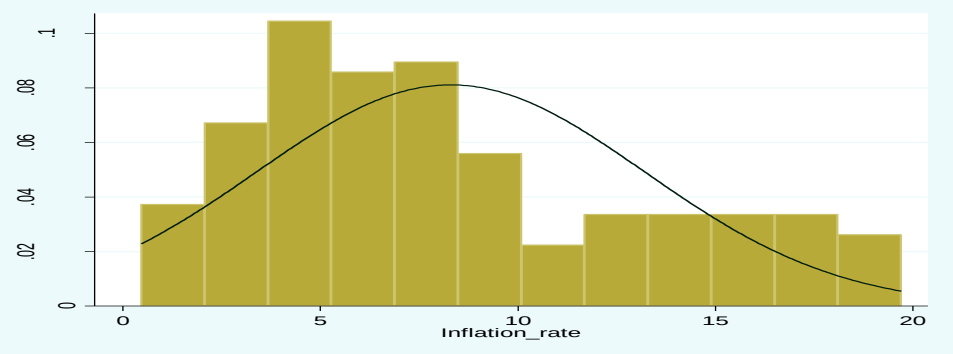

Figure 4. 3: Histogram for Inflation Rate

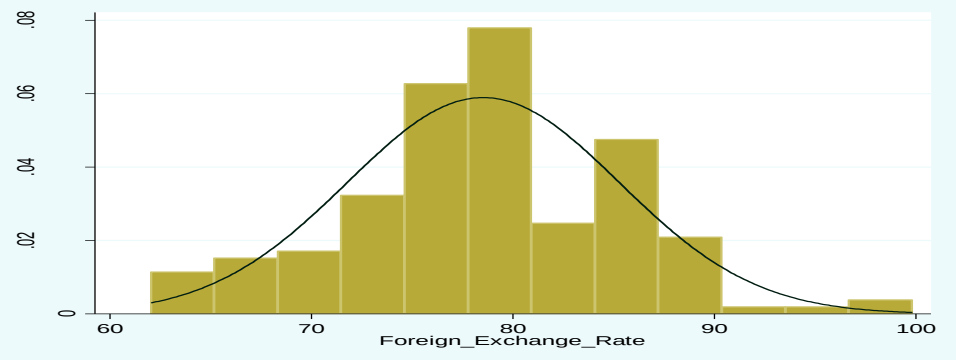

Figure 4. 4 : Histogram for Foreign Exchange Rate

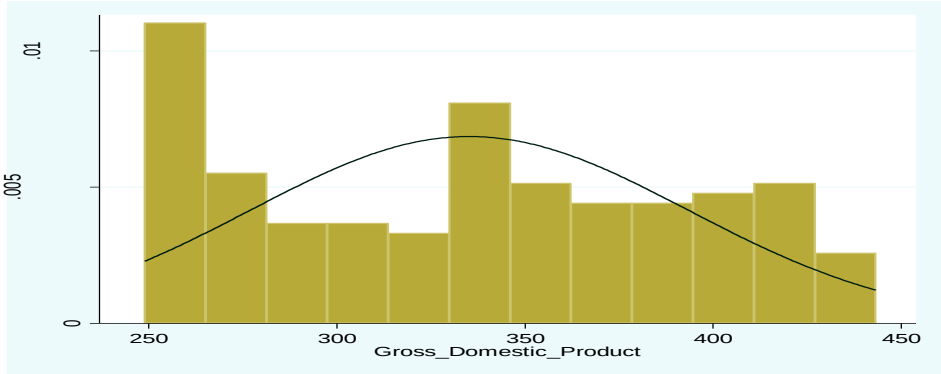

Figure 4. 5: Histogram for Gross Domestic Product

4.4 Descriptive Statistics

Descriptive statistics are basic features of data obtained in the study. This section presents secondary data descriptive statistics. Table 4.5 shows the descriptive statistics for variables used in the study.

Table 4. 5: Summary of Descriptive Statistical for Secondary Data

Variable	Obs.	Mean	Std. Dev.	Min	Max
SMV	168	1.191787	.8990608	.0087774	3.624102
Herding index	167	.7135298	1.104878	.0410549	4.907421
T bill rate	166	7.73488	3.649142	.83	20.56
Inflation rate	167	8.296331	4.917111	.4612105	19.71573
Exchange rate	167	78.52931	6.765172	62.03	99.83
GDP	168	335.196	58.18294	248.88	443.3578

4.4.1 Foreign Exchange Rate

A total of 167 monthly observations were made on the foreign exchange rate between Kenya Shillings and US dollars for a period of 14 years. The exchange rate as indicated in table 4.5 had a mean of 78.53 and a standard deviation of 6.765 over the study period. The rate was at its lowest in March 2008 (figure 4.4). This can be attributed to the violence witnessed after the 2007 general elections. Figure 4.4 indicates that the exchange rate was highest in October 2011. This means that the Kenyan Shilling recorded its highest depreciation in value in

March 2008 and the highest appreciation in value in October 2011. Figure 4.6 shows the exchange rate trend over the study period.

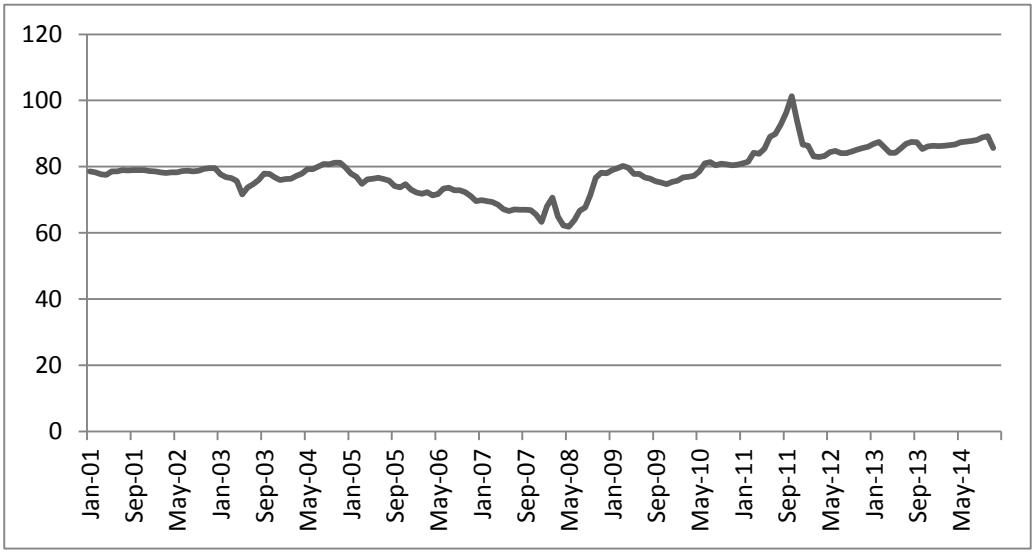

Figure 4. 6: Average Monthly Exchange Rate from January 2001 to December 2014

4.4.2 Interest Rate

Table 4.5 shows that 166 observations were made of the T-bill rate which was used as a proxy for measuring interest rate. The standard deviation for the T-bill data was at 3.649142 with a maximum rate of 20.56% and a minimum rate of 0.83%, while the mean rate was 7.73488%. The lowest T-bill rate was in July 2003 and August 2010, while the highest interest rate was in January 2012 and January 2001. The period between May 2012 and December 2014 shows high variations in the T-Bill rate.

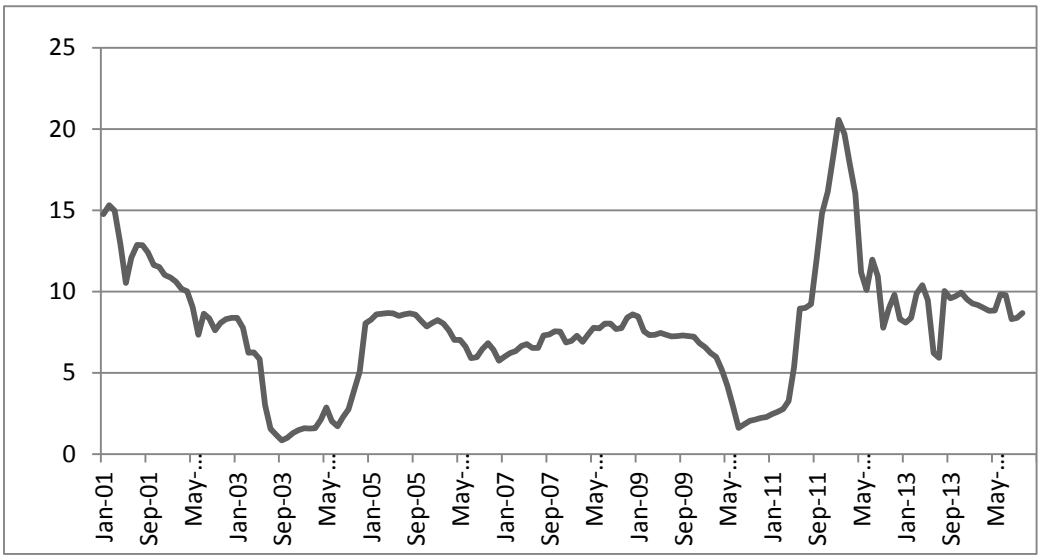

Figure 4. 7: Trend of the Average Monthly T-bill Rate from January 2001 to December 2014

4.4.3 Inflation Rate

A total of 167 observations were made of monthly inflation rate with a mean of 8.30 and standard deviation of 4.91. Figure 4.8 shows that the inflation rate was low in January 2002, March 2007, August 2010 and October 2012. A high inflation rate was witnessed in October 2004, May 2008, and in October 2011. The lowest inflation rate was 0.461 in January 2002 and the highest was 19.72 in October 2011. Figure 4.8 reveals the inflation rate trend over the study period.

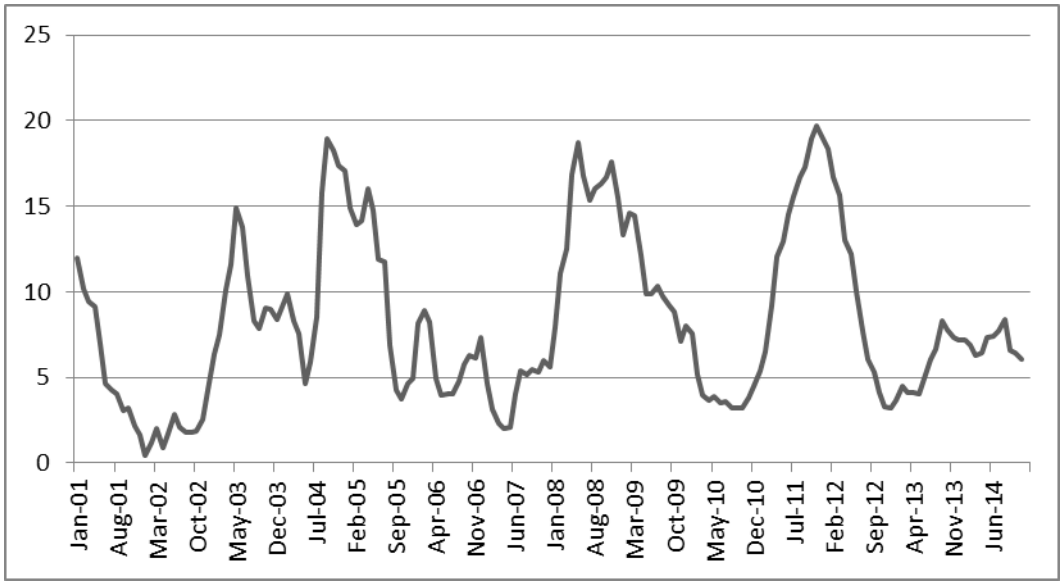

Figure 4. 8: Average Monthly Inflation Rate from January 2001 to December 2014

4.4.4 Gross Domestic Product

The study obtained quarterly data for the Gross Domestic Product and extrapolated the data for the 14 years study period. Table 4.5 shows that GDP had a mean of 335.196 and standard deviation of 58.18294 over the study period. Figure 4.9 shows the extrapolated trend of GDP over the 14 years study period.

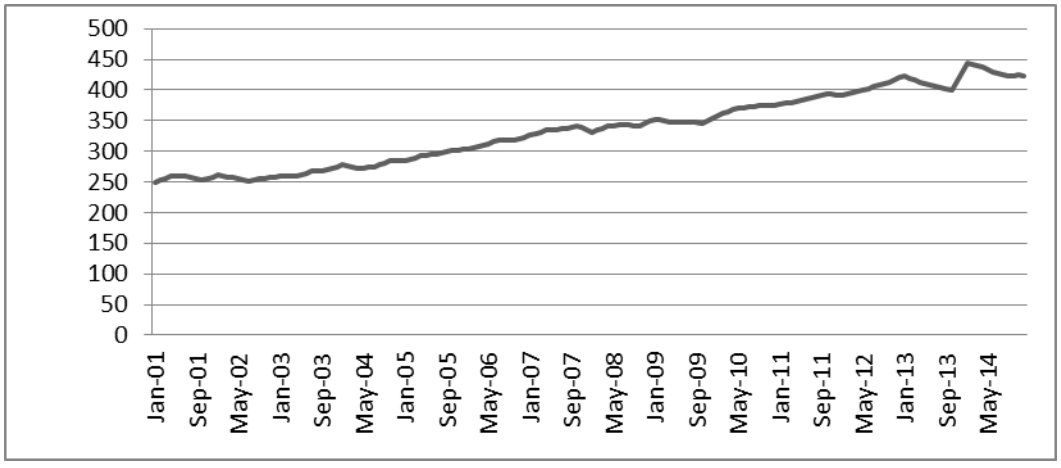

Figure 4. 9: Extrapolated Monthly Average for the Gross Domestic Product

4.4.5 Investor Herding behavior

Herding occurs when individual or group returns converge to the aggregate market return, resulting in decreased dispersion of individual returns from the market return as argued by Gleason et al. (2003). Herding is perceived to occurs when the investors' herding index is low (dispersion is low). When investors herd, individual returns converges to the aggregate market return implying a decreased dispersion.

Figure 4.10 shows that herding was more prevalent between September 2002 and May 2003, between March 2004 and April 2007, between June 2011 and April 2012 as well as between February 2013 and November 2013. The presence of increased herding during 2002, 2003, 2007, 2008 and 2013, can be attributed to the election time following political uncertainty. A total of 167 observations were made with a mean of 0.714 and standard deviation of 1.4878. The lowest index was 0.0410549 in February 2006 and highest was 7.114 in September 2003.

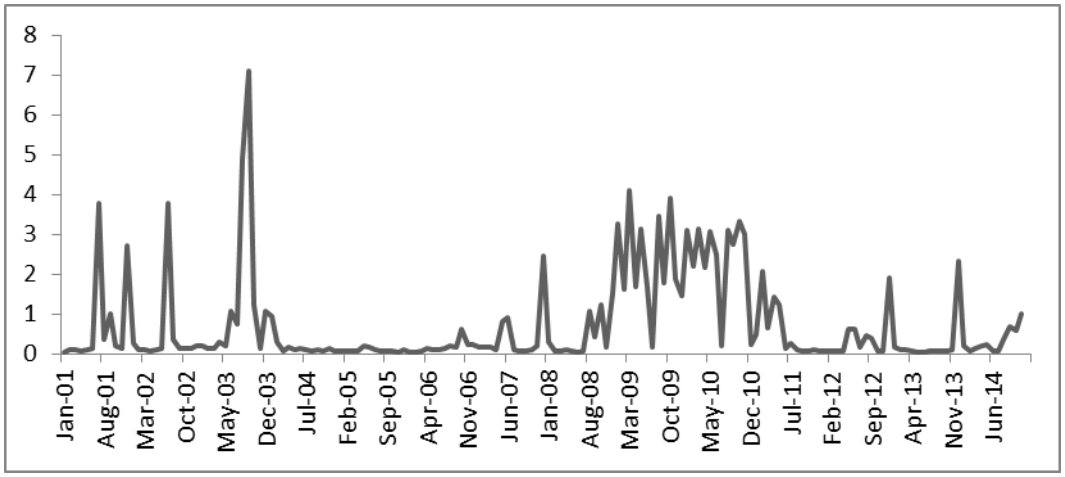

Figure 4. 10: Monthly Herding Index Trend from January 2001 to December 2014

4.4.6 Nairobi All Share Index (NASI)

Figure 4.11 shows that the NASI index was at its lowest between 2001 and 2002. The index rose steadily between 2003 and 2004 to a high of 82 points, then dropped slightly in 2004, and eventually rising to the peak of 110 points in 2007. The index dropped steadily to a low of 50 points between 2007 and 2009. It rose to 70 points between January 2009 and June 2010 and later dropped to 55 points by September 2011.

Figure 4.11 also shows that the index increased steadily from 55 points in September 2011 to 98 points by the end of 2014. The drop in the NASI index between 2001 and 2002 can be attributed to elections and poor performance of the economy. During this time the country registered the lowest economic growth. The rise in the stock market index between 2003 and 2004 can be attributed to improvement in macroeconomic management due to the regime change in 2002. The change bolstered market confidence.

Between 2007 and 2009, the market index dropped by 65 points due to elections and thereafter the post-election violence of 2007 and 2008. The rise in the index between September 2011 and December 2014 was due to a peaceful transition of government.

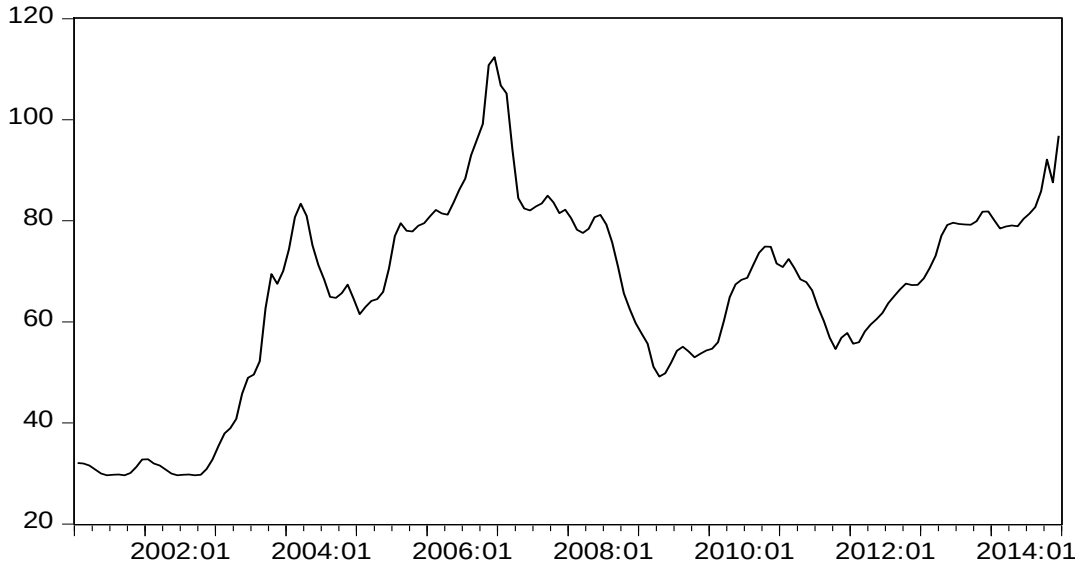

Figure 4. 11: Trend of NASI Index from January 2001 to December 2014

4.4.7 NSE20 Share Index

The NSE 20 Share Index is a price weight index calculated as a mean of the shares of 20 public, listed companies. Figure 4.12 shows that the NSE20 share index recorded low performance in August 2002 at 1062.7 points, March 2009 at 2548.54 points and October 2011 at 3299.84 points. The lowest performance was recorded in September 2002 shortly before the 2002 general elections. The index was highest between January 2007 and April 2008. The period following April 2008 saw a sharp drop in the index following post-election violence. It is important to note that both indices show a similar trend over the study period.

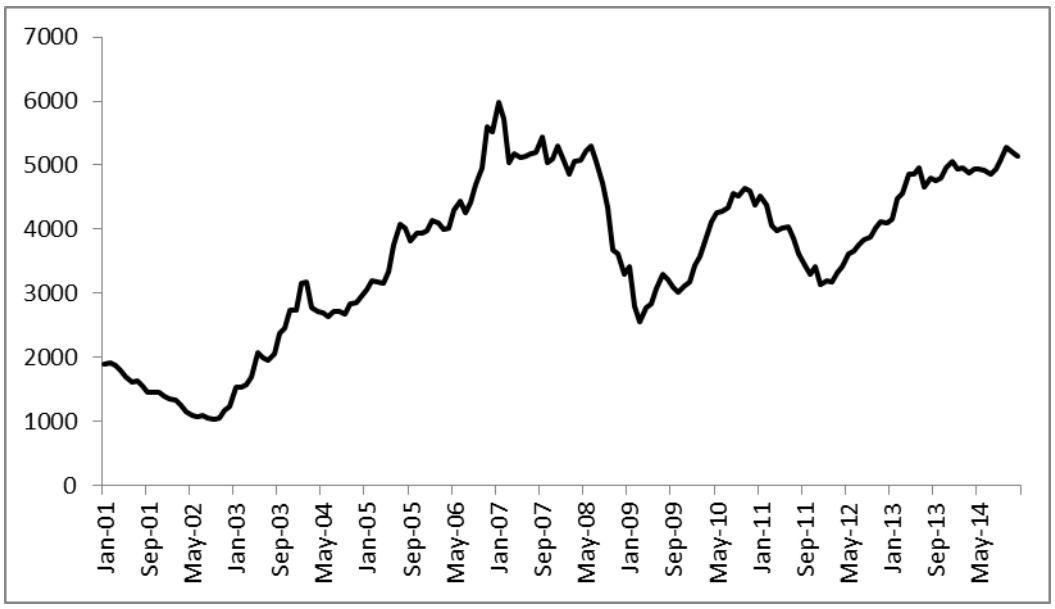

Figure 4. 12: NSE 20 Share Index trend from January 2001 to December 2014

4.3.3 Stock Market Volatility

Figure 4.13 shows general movements in the dispersion of the observed NASI index from its mean, which is a measure of stock market volatility. Figure 4.13 shows that the Nairobi Securities Exchange registered high volatility in June 2001(2.778), June 2002 (2.7533), December 2006 (3.624) and December 2014 (2.421). High volatility during these periods can be attributed to political uncertainty when the country was preparing for elections in 2002, 2006 and 2013 or during and immediately after the 2013 general elections. The bourse registered low volatility in November 2003, October 2004, May 2005, October 2008, April 2010, June 2011 and August 2012. Low volatility during these periods can be attributed to increased confidence in the stock market during the period after a successful general election and change of government in 2003 through 2005 and in 2008 through 2012.

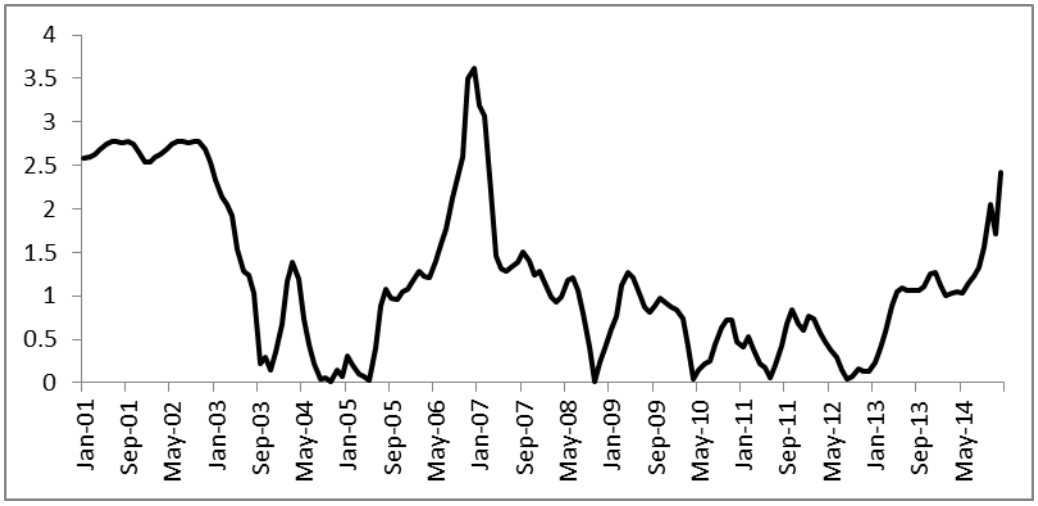

Figure 4. 13: Stock Market Volatility Trend from January 2001 to Dec 2014

4.4 Correlation Analysis

Correlation analysis helps to establish whether there is a relationship between variables of study. The analysis does not necessarily explain causal effect between variables. This study carried out correlation analysis in order to establish if there was any significant relationship between interest rate, inflation rate, foreign exchange rate, gross domestic product, investor herding index and stock market volatility. According to Pallant (2001), correlation analysis is done as a preliminary test whose purpose is to measure the relationship between variables and test the strength of relationship. Correlation analysis is often used in financial analysis to investigate the nature of the relationship between different variables.

Correlation coefficient brings out the magnitude of the relationship between two variables (Mugenda and Mugenda, 2003). A positive coefficient means that there is a positive relationship between variables, while a negative coefficient means that there is a negative relationship between variables. A zero coefficient means that there is no association between the variables (Mugenda & Mugenda, 2003).

However, in some cases, correlation may not necessarily imply causation. Two variables can be correlated and yet one variable does not necessarily cause the other to behave in a certain manner. Feinstein and Thomas (2002) opines that an empirical finding that there is an association does not imply that changes in the one variable are causing the changes in the other, however high the degree of correlation. According to Reiss (2013) non-stationery time series will often be correlated whether or not they are causally related. Table 4.6 shows correlation analysis results.

Table 4. 6: Correlation Analysis

	SMV	**TBILL**	**INF**	**FEX**	**GDP**	**HI**
SMV	1					
TBILL	0.2402***	1				
	(0.0018)					
INF	-0.4535***	0.1894**	1			
	(0.0000)	(0.0145)				
FEX	-0.2737***	0.2650***	0.0943	1		
	(0.0004)	(0.0006)	(0.2253)			
GDP	-0.4837***	0.1657**	0.0817	0.4921***	1	
	(0.0000)	(0.0329)	(0.2941)	(0.000)		
HI	-0.1284	0.2790***	-0.1124	-0.0054	0.0421	**1**
	(0.1012)	(0.0003)	(0.1481)	(0.9446)	(0.5894)	

KEY: *** Significant at 1 per cent
** Significant at 5 per cent

Correlation analysis results in table 4.6 show that there is a positive and significant correlation between Treasury bill rate (interest rate) and stock market volatility (r = 0.2402, p-value= 0.0018). Findings in table 4.6 also reveal that there is a negative and significant relationship between stock market volatility and foreign exchange rate (r = -0.2737 p-value= 0.0004).

The correlation between inflation and stock market volatility is negative and significant (r= -0.4535, p-value 0.0000). Results in table 4.6, indicate that there was a relatively strong negative correlation between GDP and stock market volatility (r= -0.4837 p-value=0.000). Further, the correlation between investor

herding and stock market volatility was found to be insignificant (r -0.1284; p-value 0.1012).

Correlation results in table 4.6 show that there is no significant relationship between investor herding behavior and change in the inflation rate (r = -0.1124, P-value 0.1481). This implies that investor herding behavior has no association with inflation rate on the Nairobi Securities Market. Results similarly revealed that the relationship between investor herding behavior and foreign exchange rate is not significant (r = -0.0054, P – value 0.9446). This indicates that a change in the foreign exchange rate has no direct relationship with investor herding behavior in Kenya.

The correlation between investor herding behavior and GDP was found to be insignificant at five percent level of significance (r= 0.0421, p-value 0.5894). This finding infers that a change in the Gross Domestic Product has no association with investor herding behavior on the Nairobi Securities exchange. The correlation analysis results further show a negative and significant association between investor herding behavior and interest rate (r = -2790, P-value 0.0003). This finding implies that there is an association between herding behavior and a change in the interest rate in Kenya. A change in the interest rate may have an influence on investor herding behavior on the Nairobi Securities Exchange.

4.5 Stationarity and Unit Root Test

A Stationarity test was conducted by the study to determine the statistical properties of the time series data used in the study. The main objective was to ensure that the data is stationary. A stationary time series data is one that exhibits near constant mean, variance and autocorrelation. Stationarity was examined by performing a unit root test. A unit root is a feature of processes that evolves through time that can cause problems in statistical inference involving time series models.

This study employed the use of both Augmented Dickey-Fuller (ADF) test, and Phillips-Perron (PP) tests in testing stationarity of the data. The two methods were used for their comparability. ADF is considered more restrictive than PP. In cases where a variable is not stationary using ADF but stationary using PP, the PP test was used to test results and make judgment as PP has higher power than ADF in the presence of structural breaks (Nyang'oro, 2013). Following this rule, when PP results conflict with ADF results, PP results are interpreted. Table 4.7 shows stationarity test results.

The augmented Dickey Fuller (ADF) statistic, used in the test, is usually a negative number. The more negative it is, the stronger the rejection of the hypothesis that there is unit roots at some level of confidence. Table 4.7 presents the unit root test results obtained from the two standard unit root tests, i.e. the Augmented Dickey Fuller and Phillips Perron tests. In these tests, we consider the variables in levels and in first difference.

The results in table 4.7 indicate that the null hypothesis of unit root cannot be rejected for all the variables in levels. However, it is rejected in first differences. Thus all variables become stationary after differencing them once i.e. each of them is integrated of order one.

Table 4. 7: Unit Root Test Results

Variable	ADF Test		PP Test		Order of Integration of Variable
	At Levels	At First Difference	At Levels	At First Difference	
HI	– 2.460	– 5.930***	– 8.178***	-	-
SMV	– 2.50	– 6.30***	– 2.246	– 7.647***	I(1)
FOREX	– 2.071	– 6.301***	– 1.758	– 9.535***	I(1)
GDP	0.013	– 3.564***	– 0.405	– 5.132***	I(1)
INF	– 2.958	– 5.553***	– 2.956	– 7.575***	I(1)
TBILL	– 3.053	– 4.613***	– 3.042	– 8.991***	I(1)

Note: *** indicates the rejection of the null hypothesis of unit root at 1% level of Significance. For HI, the ADF test indicates non-stationarity, whereas the PP test shows that it is stationary, hence the test is inconclusive for it. We rely on the ADF test for this variable. I (1) indicate that the variable becomes stationary after differencing it once.

4.6 Cointegration Test

Cointegration is a statistical property of time series variables. Two or more time series variables are cointegrated if they share a change of the average value. According to Nelson and Plosser (1982) time series data evolve over time such that their mean and variance are not constant. To address this problem in the time series data, a cointegration test is normally performed.

The idea behind carrying out cointegration test is that, although individually some of the variables are non-stationary, their linear combination could be stationary I (0). This generally indicates that together they are bound by some relationship in the long run. As such, a cointegration test was conducted to test the cointegration between non-stationary time series variables namely; stock market volatility, foreign exchange and gross domestic product.

This study found it necessary to perform cointegration test since relying on non-stationary time series data may lead to wrong conclusion that two variables are related when in reality they are not. Stock and Watson (2006), refer to the phenomenon as spurious regression. The rule of thumb is that, if two or more series are themselves non-stationary, but a linear combination of the time series is stationary, then the series are said to be cointegrated. The Johansen- Juselius (1990) cointegration test was conducted to test the order of cointegrating relationships. The choice of Johansen- Juselius test was for its convenience to use when there are more than two variables since the study had three variables namely; stock market volatility, GDP and Exchange rate.

Table 4.8 shows the Cointegration test results. From table 4.8 the study observes that the hypothesized number of Cointegration relationships being none is rejected at five per cent level of significance, Trace statistic 25.42; p-value 0.0358. Table 4.8 further shows that the hypothesized number of Cointegration relationships being at most 1 is not rejected at five per cent level of significance. Trace statistic 11.53; p-value 0.0675. Therefore, Johansen -Juselius test indicate that there is one co integrating relationship between the log of stock market volatility, log of exchange rate and log of GDP.

Table 4. 8: Cointegration Test Results

SMV FEX GDP

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	P-Value
None *	0.082633	25.41906	24.27596	0.0358
At most 1	0.048227	11.53320	12.32090	0.0675
At most 2	0.021961	3.575174	4.129906	0.0696

4.7 VECM Causality Test Results

Having established the correlation between various variables of the study, a causality test was done to establish the causal effect of inflation, interest rate gross domestic product and exchange rate on stock market volatility and the effect of investor herding behavior in this relationship. The two analysis methods suitable for establishing the causal relationship among variables of the study and appropriate for time series data were identified as the OLS method and the VAR models. Given presence of non-stationarity in the time series data, the Vector Error Correction model (VECM) was found to be most suitable for the study.

Most macroeconomic time series data are trended and therefore in most cases are non-stationary. The problem with non-stationary or trended data is that the use of standard ordinary least squares (OLS) regression procedures can easily lead to incorrect conclusions. According to Asteriou (2007), the OLS method, when used on non-stationary data returns regression results with a very high value of R-squared (sometimes even higher than 0.95) and very high values of *t*-ratios (sometimes even higher than 4), even when the variables used in the analysis have no real interrelationships. Further, the VAR models are popular in studies that use time series data and particularly past studies which have investigated the relationship between macro-economic variables and stock market performance. The popularity of this method is due to the fact that it returns accurate findings and it has ability to perform regression using non- stationery time series data.

This study employed the VAR models in particular the Vector Error Correction Model (VECM) and Granger causality test to determine the causality effect of variables considering the problem of non-stationarity in time series data. The VECM model and Granger causality method captures the long run and short run relationships among variables that are cointegrated in their levels. The long run and short run results of the vector error correction model are presented in table 4.9 and 4.10 respectively. The analysis was guided by regression equations specified below.

***Model I* (without herding interaction)**

$$SMV = \beta_0 + \beta_1 INF + \beta_2 INT + \beta_3 LGDP + \beta_4 LFEX + \beta_5 HI + \varepsilon \ldots. (1)$$

***Model II* (with herding interaction)**

$$SMV = \beta_0 + \beta_1 INF + \beta_2 INT + \beta_3 LGDP + \beta_4 LFEX + \beta_5 HI + \beta_6 INF * HI + \beta_7 INT * HI + \beta_8 LGDP * HI + \beta_0 LFEX * HI + \varepsilon \quad \ldots.. (2)$$

Where;

SMV is the stock market volatility (standard deviation of the NSE20 share index and the NASI.)

INF is the inflation rate as measured by the consumer price index

INT is the interest rate as measured by the 91 day Treasury bill rate.

LGDP is the Logarithm of Gross Domestic Product

LFEX is the Logarithm of Foreign Exchange Rate measured by the exchange rate between Kenya shilling and one US dollar

HI is the market –wide herding Index as measure by the Cross Sectional Standard Deviation (CSSD) method

ε is the error term

The study used the logarithm of the GDP and Foreign Exchange rate due to the underlying rate of growth in the data. Asteriou (2007) suggest that many economic time series data typically have an underlying rate of growth, which may or may not be constant, for example GDP, prices or money supply all tend to grow at a regular annual rate. The GDP and Foreign exchange time series were found to be non-stationary as their mean was continually rising however they are also not integrated as no amount of differencing can make them stationary. The

study took the logarithm of the time series data to turn it into a time series which follows a linear trend and which is integrated.

Table 4.9 shows VECM results for the baseline model 1. Firstly, adjusted R-squared for the first regression model (before interaction) is at 0.23 which is deemed to be reliable with time series data. After interaction with the herding index, R-squared increases to 0.29. It is expected that the R-squared should be higher. However, VECM is restrictive in returning a high R-squared as compared to other methods like the OLS, since it takes into account non-stationarity properties of the time series data to give accurate results.

The R-squared value depends on the predictive powers of selected macro-economic variables on stock market volatility. The Arbitrage pricing theory, on which this study is anchored, does not specify nor identify macro-economic variables that are key predictors of stock market volatility and therefore, researchers are exploring varied macro-economic variables with the intention of identifying variables that contribute most to stock market volatility.

Results in table 4.9, show that cointegration is present in the stock market volatility equation. The coefficient of the speed of adjustment is -0.20 with t-statistic of -4.02. This means that adjustment towards the long run is approximately 20 percent per month.

Table 4.9 presents the regression coefficients, standard errors and t-statistics of variables specified in model I. Model I is a baseline model without the interaction effect of investor herding behavior. Table 4.9 shows the regression coefficients, standard errors and t-statistics of variables specified in model II. It has the interaction effect.

Model I **(without herding interaction, as shown in table 4.9)**

$$SMV = \beta_0 + \beta_1 INF + \beta_2 INT + \beta_3 LGDP + \beta_4 LFEX + \beta_5 HI + \varepsilon \ldots\ldots\ldots (1)$$

Model II **(with herding interaction as shown in table 4.10)**

$$SMV = \beta_0 + \beta_1 INF + \beta_2 INT + \beta_3 LGDP + \beta_4 LFEX + \beta_5 HI + \beta_6 INF * HI + \beta_7 INT * HI + \beta_8 LGDP * HI + \beta_0 LFEX * HI + \varepsilon \quad . (2)$$

Table 4. 9: Vector Error Correction Model Results for Model I

Coefficient	**Model 1 (Without interaction)**
INF (-1)	0.239745 (0.04017) [5.96881]**
TBILL(-1)	-0.118562 (0.06231) [-1.90268]**
LFEX (-1)	2.678194 (2.27881) [1.17526]***
HI(-1)	-0.515755 (0.22791) [-2.26294]
LGDP(-1)	1.056665 (1.07291) [0.98486]***
Constant	-18.21055
Coint Eq. (ECT)	-0.204123 [-4.02863]
R-squared	0.234657
Log likelihood	209.4944
Akaike information criterion	-1.030795
Schwarz criterion	1.370669

Note: The VECM results include 162 observations. Figures not in parenthesis or brackets represents regression coefficient, figures in brackets ( ) represents standard errors, while figures in parenthesis [ ] represents t-statistics. A coefficient is significant if the t-statistic is greater than the critical value at 5% which is 1.96.

KEY: ** Significant at 5 per cent

*** Not significant

Table 4. 10: Vector Error Correction Model Results for Model II

Coefficient	Model 2 (With Interactions)
INF (-1)	0.275373
	(0.04268)
	[6.45168]
TBILL(-1)	-0.128654
	(0.06097)
	[-2.10996]
LFEX (-1)	3.044525
	(2.09936)
	[1.45021]
LGDP(-1)	0.856227
	(0.98545)
	[0.86887]
Constant	-19.23646
Coint Eq (ECT)	-0.238751
	[-4.22063]
HLFEX	-9.836652
	[-3.15157]
HDLGDP	-0.004522
	[-0.23425]
HINF	0.017983
	[1.52640]
HTBILL	-0.003775
	[-0.31827]
R-squared	0.289197
Log likelihood	447.9310
Akaike information criterion	-4.171988
Schwarz criterion	-2.075472

Note: The VECM results include 162 observations. Figures not in parenthesis or brackets represents regression coefficient, figures in brackets ( ) represents standard errors, while figures in parenthesis [ ] represents t-statistics. A coefficient is significant if the t-statistic is greater than the critical value at 5% which is 1.96.

KEY: ** Significant at 5 per cent

*** Not significant

The study established the presence of a long run relationship; by employing the optimal lag length for the VAR system. The study chooses 3 lags based on Akaike Information Criterion (AIC) and Schwarz Criteria (SC). Diagnostic tests were done and returned results presented in Figure 4.16 showing that the inverted roots were within the unit circle which indicates that the VECM was stable and therefore the coefficients are unbiased.

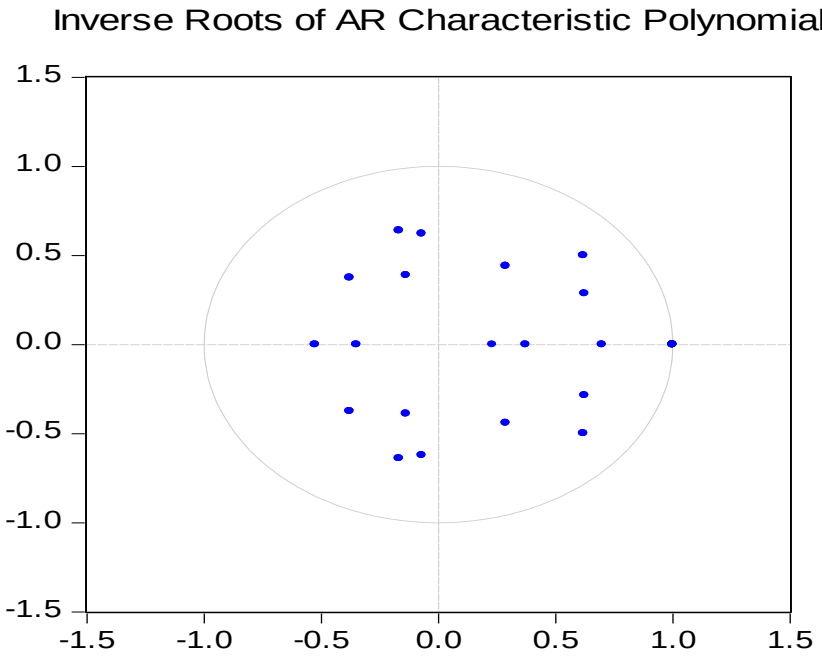

Figure 4. 14: Inverse Roots of the Autoregressive Characteristic Polynomial of the Estimated VAR model

The study employed white test to check for heteroskedasticity. The results show that there was no evidence of statistical significance heteroskedasticity. However, Jacque-Berra test indicated that the residuals were not normally distributed. Non-normality in time series results is quite common, in this regard, the residuals were plotted to evaluate their distribution.

4.9 Granger Causality Tests

Granger Causality tests were performed to investigate the short run causal relationship among the variables. Causality tests can be conducted in two different ways depending on the results of the long run analysis. The Granger test (1969) is suitable for analyzing the short-run relationship if no cointegration exists among the variables. On the other hand, when the variables of interest are cointegrated, the standard Granger test is misspecified and the error correction strategy suggested by Engle and Granger (1987) should be used (Enders, 2004). The Granger test examines whether including lags of one variable have predictive power for another variable.

To check the causal relationship, this study carried out Granger Causality Test using E-Views. The Granger block exogeneity test was done to evaluate causality in the short run relationship of the hypothesized variables. This test was deemed appropriate as it checks for joint significance of each variable and its lags. According to the concept of Granger's causality test (1969, 1988), a time series *X* is said to be causing *Y* when past values of *X* can predict future values of *Y*. In this case we can say that *X* granger causes *Y*. The Granger test is valid only when there is no long-run equilibrium relationship among the examined variables. The Granger Causality Test results are presented in table 4.11.

Table 4.11 shows the Chi-square result for all variables to be 30.06 with p- value of 0.0117. This means that collectively all variables in the short run model explains changes in stock market volatility. However, results further show that herding index (p-value 0.3408), exchange rate (P-value 0.2310) and GDP (P-value 0.6756), have p-values greater than 0.1. This means that investor herding index, foreign exchange rate and GDP have no influence on stock market volatility in the short run. However, changes in inflation rate (p-value 0.0039) and changes in T-Bill (p-value 0.0681) are significant at 1 percent and 10 percent level respectively. This infers that T-Bill (interest rate) and inflation rate have a significant influence on stock market volatility in the short run in Kenya.

Table 4. 11: Granger Causality Test Results (Block Exogeneity Wald Tests)

Dependent variable: D(SMV)

Excluded	Chi-sq.	Df.	P-Value.
D(INF)	13.39024	3	0.0039
D(TBILL)	7.121743	3	0.0681
D(LFEX)	4.297999	3	0.2310
D(HI)	3.349327	3	0.3408
D(LGDP)	1.529136	3	0.6756
All	30.05590	15	0.0117

4.10 Hypotheses Testing

4.9.1 Test of Hypothesis One

H_{O1}: There is no relationship between inflation rate and stock market volatility

The first objective sought to evaluate the relationship between inflation rate and stock market volatility. The null hypothesis stated: There is no relationship between inflation rate and stock market volatility. The long run equation (table 4.9) shows that the coefficient of the inflation rate is 0.24 with t-statistic of 5.96 which is greater than the critical five per cent value of 1.96. Therefore, in the long run the coefficient of inflation is positive and significant.

The short run equation as shown by the Granger causality test (table 4.11) indicates that the test statistic has a chi-square value of 13.39 and a p-value of 0.0039 which is less than 0.05. Therefore in the short run, changes in inflation and its lags jointly influence stock market volatility at one per cent level of significance.

From the short run (table 4.11) and the long run(table 4.9 and 4.10) findings, the null hypothesis stating that, there is no significant relationship between inflation rate and stock market volatility is rejected at five per cent level of significance in both the long run and short run analysis. This means that in the long run, an increase in inflation by one percentage point increases stock market volatility by approximately 24 percentage points.

Findings in this study are comparable to findings made by other studies in Kenya. Ouma *et al.* (2014) studied the impact of macro-economic variables on stock market returns in Kenya using ordinary least squares and found that there was a positive relationship between inflation and stock prices. Ochieng *et al.* (2012) studied the relationship between macro-economic variables and stock market performance in Kenya and found that inflation had a weak and positive relationship with the stock market returns. Mutuku (2014) investigated the dynamic relationship between stock prices and four macroeconomic variables in Kenya using Cointegration and vector auto regressive frame work and found that inflation had a negative effect on equity markets.

In theory, the fisher effect theory explains how in the long run, inflation and the nominal interest rate should move one-to-one, implying that high inflation should increase the nominal stock market return as the real stock market return remains unchanged and therefore compensating investors fully. According to the fisher effect theory, equities serve as a hedge against inflation because they represent claims to real assets. This therefore, implies that a positive stock price is associated with expected inflation and an increase in stock prices (Dimand, 2003).

Hatemi, J. (2009) observes that the reason why inflation negatively impacts equity prices is the negative correlation between inflation and expected real economic growth so that investors shift their portfolios towards real assets if the expected inflation rate becomes remarkably high.

4.9.2 Test of Hypothesis Two

H_{02}: There is no relationship between interest rate and stock market volatility

The second objective sought to examine the relationship between interest rate as measured by the Treasury bill rate and stock market volatility. The corresponding null hypothesis stated: There is no relationship between interest rate and stock market volatility. The long run equation (table 4.9), shows the coefficient of T-Bill rate(interest rate) as 0.12 with t-statistic of -1.90 which is greater than the

critical value of 1.645 at 10 per cent level of significance. Therefore, the coefficient is negative and weakly significant. This means that in the long run a unit increase in interest rate decreases stock market volatility by approximately 0.12 per cent.

The short run relationship as shown by Granger causality test (table 4.11) indicates that changes in T-Bill (interest rate) and its lags had chi-square statistic of 7.1217 with a corresponding p-value of 0.0683 and therefore significant at 10 per cent. This indicates that T-bill (interest rate) and its lags granger cause stock market volatility in the short run. Consequently, at 10 percent level of significance, the study finds a significant relationship between T-bill rate (interest rate) and stock market volatility.

This finding confirm results made in other studies like; Zakaria, (2012), Kadir *et al.* (2011), Chinzara. (2010), Omorokunwa *et al.* (2014), Olweny *et al.* (2011), Waweru (2013) and Ochieng *et al.* (2012), which found that a change in interest rate as measured by the 91 day T bill rate had a negative relationship with stock market returns and volatility.

A number of explanations are suggested by researchers to explain the causal effect of interest rates on stock market volatility. Bernanke (2005) offers two explanations on why interest rates affect stock market volatility. The first reason is that investors value shares by discounting future dividends to the present time. Interest rates serve as a discount rate and a high interest rate makes a given future dividend less valuable in today's money, implying that the value of that share or stock will drop.

The second explanation is that a rise in the interest rate causes investors to sell stocks and invest proceeds of the sales into fixed income instruments such as bonds, treasury bills and term deposits causing decreased demand for stocks and a drop in stock prices. According to Teker and Alps (2014) an increase in the

interest rates may affect the spending of households, cutting down the earnings of companies and ending up with a decrease in the value of the stock.

In theory, the influence of the long-term interest rate on stock prices can be explained by the present value model where the interest rate prevailing in the market is used as a discount rate when determining the present value of a share. According to the present value model, corporate cash flows are discounted by the discount rate and if interest rate increases, the cost of capital and the discount rate will increase as well. As a result, the current value of future cash flows drops thereby causing stock prices to fall. According to the Arbitrage theory, a rise in real interest rate reduces the present value of a firm's future cash flows and causes stock prices to fall.

4.9.3 Test of Hypothesis Three

H_{03}: There is no relationship between Exchange rate and stock market volatility.

The third objective sought to establish the relationship between exchange rate and stock market volatility. The short run relationship as shown by the Granger causality test (Table 4.11) indicates the chi-square value of the exchange rate and its lags as 4.297 with a corresponding p-value of 0.2310. The p-value is greater than 0.10 implying that it is not significant. Therefore, the null hypothesis that exchange rate does not granger-cause stock market volatility is not rejected at 10 percent.

The long run equation shows that the coefficient of the log of the exchange rate is 2.67 with t-statistic of 1.17 which is less than 1.645 and 1.96. Therefore, the coefficient is not significant. This suggests that changes in exchange rate do not have a long run effect on stock market volatility. The results from this study conclude that there is no significant relationship between exchange rate and stock market volatility both in the long run and short run.

Findings from the secondary data seem to agrees with findings made by Forgha, (2012) who studied the efficiency and volatility of stock returns in five markets (Cameroon, Nigeria,South Africa, Egypt and Kenya), using GARCH-M , and found that volatility in all the markets was persistent and that a change in foreign exchange rate had no significant influence on the observed volatility in stock returns. Nieh and lee (2001) investigated the relationship between exchange rate and stock market return in G7 countries (Canada, France, Germany, Italy, Japan, UK and the US), using both the Engle-Granger and Johansen's cointegration tests and found no significant relationship between stock market returns and exchange rates.

In general, empirical findings suggest that there are no long run equilibrium relationships between exchange rate and stock market return in most countries (Tabak, 2006). Choi and Fu (2008) found a very weak or no relationship between stock prices volatility and exchange rates movement. However, many studies have found that exchange rate affects stock market returns.

Chinzara (2010), Abdi Aslam (2014), Omorokunwa *et al.* (2014), Ambunya, (2012), Javed (2009), Olweny *et al.* (2011), Waweru (2013) and Kibria *et al.* (2014*)* ,find that a change in exchange rate affects stock market volatility. Chen and Chen (2012), Fork and Liu (2007), Panagiotidi and Zhang (2011) studied the impact of foreign exchange rate on stock prices and found a strong negative relationship between stock prices and exchange rates as cited by (MAO, 2013). Huang and Yang (2000) examined the relationship between foreign exchange rate and stock market volatility in the South Korea stock market between 1997 and 2000 and found that stock market volatility was significantly related to exchange rate. Mishra (2004) opines that there is no theoretical consensus on the interaction between stock returns and exchange rate.

According to Granger (2000), there are at least two theoretical explanations to the causal relations between stock prices and exchange rates. First the goods market theory otherwise known as the 'flow-oriented model' or the traditional approach

(Dornbusch & Fischer, 1980) and second the stock oriented model. The goods market theory postulates that the appreciation of a local currency will have the tendency to hurt exporters and, cause shares of such firms to be less attractive and then drop in values (Barnor,2014). According to Yucel and Kurt (2003) exchange rate appreciation reduces the competitiveness of export markets and has a negative effect on the domestic stock market. On the other hand, importers increase their competitiveness in domestic markets leading to an increase in profit and share prices. According to Joseph,(2002) international competitiveness of firms directly get influenced by change in exchange rate whether they import inputs or exports output.

Stock oriented models otherwise known as the portfolio approach , postulates that changes in stock prices may influence movements in exchange rates via portfolio adjustments (Tabak, 2006). According to Adjasi and Biekpe (2006), in the "stock oriented model, the exchange rate equates demand and supply for assets (bonds and stocks)". A drop in stock prices causes a reduction in the wealth of domestic investors, which in turn leads to a lower demand for money with ensuing lower interest rates. Lower interest rates encourage capital outflows, which in turn cause local currency depreciation .Thus, expectations of relative currency movements have a significant impact on price movements of financially held assets. This implies that, currency fluctuations may influence stock price movements.

4.9.4 Test of Hypothesis Four

H04: There is no relationship between gross domestic product and stock market volatility

The fourth objective sought to determine the relationship between gross domestic product and stock market volatility. The long run equation (table 4.9) shows that the coefficient of GDP is 1.06 with t-statistic of 0.985 which is less than the critical t values of 1.645 at 10 percent and 1.96 at five per cent. Therefore, the

coefficient is not statistically significant. This implies that gross domestic product has no long run effect on stock market volatility.

The Granger causality test in table 4.11 shows a chi-square test statistic of 1.529 with a corresponding p-value of 0.6756. This means that it is statistically insignificant, implying that the null hypothesis that GDP does not granger cause stock market volatility cannot be rejected at 10 percent level of significance. Therefore, changes in GDP and its lags do not explain stock market volatility in the short run. Since the coefficient of GDP is not significant in the long run and short run, the null hypothesis was not rejected.

According to Rahman, Zidek and Fauziah (2009), the level of real economic activity is a crucial factor in determining stock market returns. The most popular measure of real economic activity is the gross domestic product (GDP). There is a general consensus that an increase in GDP causes stock market returns to increase (Eita, 2012).

Campbell , Lettau, Malkiel and Xu (2001) suggests that stock market volatility has significant predictive power for real GDP growth. However, empirical studies have returned mixed findings on the relationship between GDP and stock market volatility. Kibria *et al.* (2014) finds that GDP per capita and GDP savings had a positive and significant effect on stock market return in Pakistan. Choudhry (2003) analysed the influence of GDP on stock market volatility using an error-correction framework by estimating the short-run and long-run dynamics of GDP components and found that stock market volatility has adverse effects on consumption and investment and therefore there was a relationship between GDP and stock market volatility.

Oseni *et al.* (2011) investigated the relationship between selected macro-economic variables and stock market volatility in Nigeria and found that there exists a bi-causal relationship between stock market volatility and real GDP in Nigeria. Attari *et al.* (2013) found that the stock market in Pakistan was highly volatile;

however, the result of causality suggested that there was no relationship between GDP and stock returns. Wang (2011) investigates the time-series relationship between stock market volatility and macroeconomic variable volatility for China and found that the relationship between stock prices and real GDP is not significant.

Zakaria (2012) investigated the relationship between the volatility of stock market returns and macroeconomic volatilities in Malaysia and found that volatility in GDP does not granger-cause stock market volatility. Findings in this study are, therefore, consistent with findings in other studies like; Zakaria (2012), Wang (2011) and Attari *et al*. (2013) who found that there is no significant relationship between Gross Domestic Product and stock market volatility.

4.9.5 Test of Hypothesis Five

H_{05}: Herding behavior does not affect the relationship between macroeconomic variables and Stock market volatility

The fifth objective sought to explore whether herding behavior has a moderating effect on the relationship between macroeconomic variables and stock market volatility. VECM model was used to estimate equation 2 with the interactive terms specified in the model treated as exogenous variables. Findings in tables 4.13 and 4.14 show that adjusted R-squared improves from 23.46 per cent to 28.91 per cent when herding is introduced as a moderator. This is an improvement by approximately 6 percentage points. Furthermore, the Akaike Information Criterion (AIC) and Schwarz Criterion (SC) indicates that regression model 2 results of table 4.14, represents a better model fit than the results for regression model 1 of table 4.13, since the values of the former are smaller.

The results further show that the error correction term is negative (-0.238) and statistically significant (since t value is -4.22 which is greater than the 5% critical value of 1.96) when interactive terms are included as exogenous variables. The

error correction term of -0.238 means that 23.8 percent of the disequilibrium in the short run is corrected for in the long run.

The results show that the coefficients of all interactive terms are insignificant at 10 percent level except that of the exchange rate. The coefficient for the interaction between exchange rate and herding is -9.836 with a t statistic of -3.15 which is greater than 1.96 in absolute terms. Therefore, the coefficient is significant and negative at 5% level. Thus, the null hypothesis that herding behavior does not affect the relationship between macroeconomic variables and stock market volatility is rejected only for exchange rate. This implies that herding behavior moderates the relationship between stock market volatility and macro-economic variables through exchange rate movements.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents a summary of the major findings, discussions, and conclusions and makes recommendations for practice and suggestions for further research based on the results of these findings.

5.2 Summary of Findings

The general objective of this study was to investigate the moderating effect of the investor herding behavior on the relationship between selected macro-economic variables and stock market volatility in Kenya. Specifically the study sought to determine the relationship between interest rate, foreign exchange, inflation and gross domestic product and stock market volatility with reference to the Nairobi Securities Exchange. In addition, the study sought to explore the effect of investor herding behavior on the relationship between selected macro-economic variables and stock market volatility.

5.2.1 The Relationship between Inflation Rate and Stock Market Volatility in Kenya.

The study established from correlation analysis that there was a significant relationship between change in inflation and stock market volatility. The study carried out causality test to determine the short run and long run causal relationship between inflation rate and stock market volatility. This study established that in the short run, changes in inflation and its lags jointly and significantly influences stock market volatility in Kenya (Chi-square 13.39, p-value 0.0039). This implies that inflation Granger causes stock market volatility in the short-run; in other words, inflation improves the forecast of stock market volatility in Kenya.

The long run analysis, established that a change in inflation significantly influences stock market volatility (t-statistic 5.96). Specifically, the study findings indicate that an increase in inflation by one percentage point increases stock market volatility by approximately 24 percentage points. This implies that investment on the Nairobi Securities Exchange is an effective hedge against inflation according to theory.

5.2.2 The Relationship between Interest Rate and Stock Market Volatility in Kenya.

The study findings on the relationship between interest rates and stock market volatility indicate that there is a significant correlation between stock market volatility and interest rates in Kenya.

In terms of short run relationship between a change in interest rate and stock market volatility, findings indicate that in the short run interest rate and its lags Granger cause stock market volatility. This means that, the T-bill rate improves the forecast of stock market volatility (Chi-Square 7.1217, p-value 0.0683). The study also established that there is a long run relationship between interest rate changes and stock market volatility (t- statistic -1.90). This finding indicates that, in the long run, a unit increase in interest rate decreases stock market volatility by approximately 12 per cent. The relationship between interest rate and stock market volatility was found to be negative and weakly significant.

5.2.3 The Relationship between Exchange Rate and Stock Market Volatility in Kenya

Findings from the study established that there is a significant correlation between stock market volatility and a change in the foreign exchange rate. However, on carrying out a causality test, exchange rate was found not to influence stock market volatility. The study established that, in the short run, exchange rate and its lags do not jointly explain stock market volatility in Kenya. From this finding the study concludes that, exchange rate do not granger cause stock market volatility in

Kenya and therefore do not improve the forecast of stock market volatility (p-value 0.2310). The long run relationship between exchange rate and stock market volatility was also found to be insignificant (t statistic 1.117 which is less than 1.645). This means that exchange rate appreciation or depreciation does not influence stock market volatility in Kenya.

5.2.4 The Relationship between Gross Domestic Product and Stock Market Volatility

The study established that there was a correlation between GDP and Stock market volatility r= -0.4837 p-value=0.000. Findings from the causality test indicate that in the short run, the GDP and its lags do not explain variations in stock market volatility in Kenya. This means that GDP does not Granger cause stock market volatility in Kenya (chi-square =1.529, p-value=0.6756). It also implies that GDP cannot be used to predict stock market volatility in Kenya. Findings in this study on the long run relationship between GDP and stock market volatility indicate that a change in GDP does not cause a change in stock market volatility in Kenya(t statistic= 0.985).

5.2.5 The Moderating Effect of Herding Behavior on the Relationship between Macroeconomic Variables and Stock Market Volatility

The study established that there was no correlation between herding behavior, as measured by the herding index, and stock market volatility in Kenya (r -0.1284; p-value=0.1012). This means that there is no co-movement between herding index and stock market volatility in Kenya. However, after running the base model where herding was an explanatory variable, in terms of causality; the study established that herding affects stock market volatility in Kenya. The study finds that herding reduces stock market volatility in Kenya since the coefficient was negative and significant.

As a moderator, herding does not affect the relationship between stock market volatility and three out of the four macroeconomic variables (interest rate, GDP

and Inflation). The moderating effect of herding behavior was more revealed in the relationship between exchange rate and stock market volatility. The interaction effect of herding in the relationship between exchange rate and stock market volatility was found to be significant. Specifically, the results indicate that when herding is introduced as a moderator, the adjusted r- square improves by 6 percent. The study therefore concludes that herding enhances the effect of exchange rate on stock market volatility. In addition, herding behavior is jointly observed with exchange rate movements.

Table 5.1 Summary of Research Findings and Implications

Objective	Hypothesis	Research findings	Interpretation and implications
To establish the relationship between inflation rate and stock market volatility in Kenya	H_{01} There is no relationship between changes in inflation rate and stock market volatility in Kenya	Findings shows a negative and significant relationship between inflation and stock market volatility (r= -0.4535, p-value 0.0000). The long run equation (VECM) shows that the coefficient of the inflation rate is 0.24 with t-statistic of 5.96 which is greater than the critical five per cent value of 1.96. Therefore, in the long run the coefficient of inflation is positive and significant. . The Granger causality test indicates that the test statistic has a chi-square value of 13.39 and a p-value of 0.0039 which is less than 0.05. Therefore in the short run, changes in inflation and its lags jointly influence stock market volatility at one per cent level of significance.	In the short run, changes in inflation and its lags jointly influence stock market volatility at one per cent level of significance. In the long run, an increase in inflation by one percentage point's increases stock market volatility by approximately 24 percentage points.
To examine the relationship between interest rate and stock market volatility in Kenya.	H_{02} There is no relationship between changes in interest rate and stock market volatility in Kenya.	There is a positive and significant correlation between Treasury bill rate (interest rate) and stock market volatility (r = 0.2402, p-value= 0.0018). The long run equation (VECM), shows the coefficient of T-Bill rate as 0.12 with t-statistic of -1.90 which is greater than the critical value of 1.645 at 10 per cent level of significance. Therefore, the coefficient is negative and weakly significant. This means that in the long run a unit increase in interest rate decreases stock market volatility by approximately 0.12 per cent. The short run relationship as shown by Granger causality test indicates that changes in T-Bill (interest rate) and its lags had chi-square	In the long run a unit increase in interest rate decreases stock market volatility by approximately 0.12 per cent. Interest rate and its lags granger cause stock market volatility in the short run. Consequently, at 10 percent level of significance the study finds a significant

		statistic of 7.1217 with a corresponding p-value of 0.0683 and therefore significant at 10 per cent. This indicates that T-bill rate and its lags granger cause stock market volatility in the short run.	relationship between T-bill rate (interest rate) and stock market volatility
To establish the relationship between exchange rate and stock market volatility in Kenya	H_{03} There is no relationship between changes in exchange rate and stock market volatility in Kenya.	There is a negative and significant relationship between stock market volatility and foreign exchange rate (r = -0.2737 p-value= 0.0004). The Granger causality test indicates the chi-square value of the exchange rate and its lags as 4.297 with a corresponding p-value of 0.2310. The p-value is greater than 0.10 implying that it is not significant. The long run (VECM) equation shows that the coefficient of the log of the exchange rate is 2.67 with t-statistic of 1.17 which is less than 1.645 and 1.96. Therefore, the coefficient is not significant.	There is no significant relationship between exchange rate and stock market volatility both in the long run and short run.
To determine the relationship between the gross domestic product and stock market volatility in Kenya	H_{04} There is no relationship between changes in the Gross Domestic Product and stock market volatility in Kenya.	There was a relatively strong negative correlation between GDP and stock market volatility (r = -0.4837 p-value=0.000). The long run (VECM) equation shows that the coefficient of GDP is 1.06 with t-statistic of 0.985 which is less than the critical t values of 1.645 at 10 percent and 1.96 at five per cent. Therefore, the coefficient is not statistically significant. The Granger causality test shows a chi-square test statistic of 1.529 with a corresponding p-value of 0.6756. This means that it is statistically insignificant.	Gross domestic product has no long run effect on stock market volatility. Changes in GDP and its lags do not explain stock market volatility in the short run. Since the coefficient of GDP is not significant in the long run and short run, the null hypothesis was not rejected.
To explore the moderating	H_{05} Herding	The correlation between investor herding and stock market	The null hypothesis was

effect of herd behavior on the relationship between macroeconomic variables and stock market volatility in Kenya	behavior does not affect the relationship between selected macroeconomic variables and stock market volatility in Kenya.	volatility was found to be insignificant (r -0.1284; p-value 0.1012). Findings show that adjusted R-squared improves from 23.46 per cent to 28.91 per cent when herding is introduced as a moderator. The results show that the coefficients of all interactive terms are insignificant at 10 percent level except that of the exchange rate. The coefficient for the interaction between exchange rate and herding is -9.836 with a t statistic of -3.15 which is greater than 1.96 in absolute terms. Therefore, the coefficient is significant and negative at 5% level.	rejected only for exchange rate. This implies that herding behavior moderates the relationship between stock market volatility and macro-economic variables through exchange rate movements.

5.3 Conclusion

The general objective of this study was to investigate the effect of herding behavior on the relationship between macro-economic variables and stock market volatility. Based on the findings made, this study concludes that herding behavior by investors on the Nairobi Securities Exchange moderates the relationship between exchange rate and stock market volatility.

Based on findings for objective one, the study concludes that there is a short run and long run relationship between inflation and stock market volatility in Kenya. An increase in inflation leads to an increase in stock market volatility by 24 percentage in the long run.

Findings from objective two makes the study conclude that there is a significant but weak short run and long run relationship between interest rate and stock market volatility in Kenya. In the long run, a unit increase in interest rate causes a decrease in stock market volatility by 0.12 percent.

Relating to objective three, the study concludes that there is no significant short run and long run relationship between exchange rate and stock market volatility in Kenya. This means that a change in exchange rate does no directly affect stock market volatility in Kenya both in the short run and in the long run.

As regards objective four, the study concludes that there is no short run and long run relationship between GDP and stock market volatility in Kenya. Based on this finding, it is safe to state that a change in GDP does not affect stock market volatility both in the short run and in the long run.

From the findings made on objective five, the study concludes that herding only moderates the relationship between exchange rate and stock market volatility. Herding has not moderating effect in the relationship between interest rate, inflation and GDP and stock market volatility in Kenya.

5.4 Recommendations

The study offers the following recommendation for both policy and industry based on findings.

5.4.1 Recommendation for Policy

The study offers a number of recommendations for policy in light of the findings made. Inflation is found to be a key contributing factor to stock market volatility in Kenya since an increase in inflation leads to a significant increase in stock market volatility. This informs government monetary policy that stock market volatility can be significantly reduced if the rate of inflation in the country is controlled. In light of this finding, the study recommends a strict monetary policy and control of factors contributing to change in inflation rate in order to reduce stock market volatility. A reduced rate of inflation within allowable limits would reduce volatility in the securities market returns, reduce risk to equity investors , boost investor confidence and raise more capital which can be channeled to critical sectors of the economy and in turn promote economic development growth. This would be in line with the objectives envisioned in the vision 2030 where the stock market is seen as a major source of capital required to enable the actualization of the vision 2030.

The study found that interest rates contribute significantly to stock market volatility. In particular, an increase in the interest rates leads to an increase in the stock market volatility. This study recommends that policies on interest rate controls be observed closely to contain increase in interest rate which is found to contribute to stock market volatility. The study findings show that investor herding in the Securities market causes an increase in stock market volatility through exchange rate changes. The stability of the Kenyan shilling against currencies of key trading partner countries is critical in containing stock market volatility. Policy interventions should be put in place to ensure a stable Kenyan shilling.

5.1.2 Recommendations for Industry

Literature shows that herding manifests due to information asymmetry or lack of proper information required by investors in the market. Herding increases stock market volatility through changes in exchange rate. Herding can be reduced if information is made available to traders in the market. The capital market Authority should make rules which enhance availability of information to investors trading in the market to reduce investor herding behavior.

5.1.3 Study Contribution to Theory

Findings in this study indicate that inflation and interest rates are the two key contributing factors to stock market volatility in Kenya. Herding was found not to affect stock market volatility in Kenya inspite of plenty of literature suggesting that there is a direct linear relationship between herding and stock market volatility. To the contrary this study finds that herding reduces stock market volatility since investors end up investing in a similar manner by mimicking each other thereby bringing about a consensus in the trading pattern and significantly reducing the dispersion of market returns in Kenya.

One of the Key contributions of this study is in the finding that herding significantly moderates the relationship between changes in exchange rate and stock market volatility in Kenya. This implies that a significant part of herding behavior by investors in the securities market in Kenya is triggered by changes in the exchange rate. The findings appeals curiosity on the reason for this phenomena pointing at the possibility that trading patterns of foreign equity investors which is so much informed by changes in the exchange rates may possibly be the key contributor to herding and stock market volatility in the Kenyan Securities Market.

5.1.4 Suggestions for Further Studies

This study examined the effect of investor herding behavior on the relationship between macro-economic variables and stock market volatility. Four macro-economic variables were used in the study out of the numerous macro-economic variables which could be predictors of volatility in the stock market. This study recommends further studies to be done using other macro-economic variables to understand their contribution to stock market volatility in Kenya. The study also recommends more studies to explore the effect of other behavioural factors on the volatility of the Nairobi Securities Exchange.

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APPENDICES

Appendix 1: Letter of introduction

Appendix 22 NACOSTI research Permit

Appendix 3: VECM results for model I

Vector Error Correction Estimates
Sample (adjusted): 2001M05 2014M10
Included observations: 162 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
SMV (-1)	1.000000
INF(-1)	0.239745 (0.04017) [5.96881]
TBILL(-1)	-0.118562 (0.06231) [-1.90268]
LEXCH(-1)	2.678194 (2.27881) [1.17526]
HHI(-1)	-0.515755 (0.22791) [-2.26294]
LGDP(-1)	1.056665 (1.07291) [0.98486]
C	-18.21055

Error Correction:	D(SMV)	D(INF)	D(TBILL)	D(LEXCH)	D(HHI)	D(LGDP)
CointEq1	-0.204123 (0.05067) [-4.02863]	-0.237037 (0.10613) [-2.23346]	0.024881 (0.07210) [0.34508]	0.000385 (0.00171) [0.22573]	0.251315 (0.07779) [3.23051]	-8.18E-05 (0.00044) [-0.18721]
D(SMV (-1))	-0.085675 (0.08274) [-1.03552]	-0.185178 (0.17330) [-1.06853]	0.152587 (0.11774) [1.29600]	-0.002486 (0.00279) [-0.89200]	-0.062888 (0.12703) [-0.49505]	-0.000509 (0.00071) [-0.71289]
D(SMV (-2))	0.126773 (0.08376)	-0.140081 (0.17545)	-0.020443 (0.11919)	-0.001981 (0.00282)	0.002695 (0.12860)	-0.001272 (0.00072)

	[1.51352]	[-0.79843]	[-0.17151]	[-0.70194]	[0.02096]	[-1.76036]
D(SMV (-3))	-0.041205	0.438196	0.163127	-0.004095	-0.060040	-0.000892
	(0.08207)	(0.17191)	(0.11679)	(0.00276)	(0.12601)	(0.00071)
	[-0.50207]	[2.54905]	[1.39677]	[-1.48099]	[-0.47647]	[-1.25972]
D(INF(-1))	-0.007480	0.533763	0.095966	-0.000735	-0.067733	-0.000337
	(0.03908)	(0.08186)	(0.05561)	(0.00132)	(0.06000)	(0.00034)
	[-0.19140]	[6.52079]	[1.72566]	[-0.55839]	[-1.12886]	[-0.99883]
D(INF(-2))	-0.000704	-0.052715	0.053526	1.58E-05	-0.088894	0.000145
	(0.04308)	(0.09024)	(0.06131)	(0.00145)	(0.06615)	(0.00037)
	[-0.01635]	[-0.58414]	[0.87303]	[0.01087]	[-1.34382]	[0.39024]
D(INF(-3))	0.136841	0.003276	0.040327	0.000328	0.081252	-7.96E-05
	(0.04011)	(0.08402)	(0.05708)	(0.00135)	(0.06159)	(0.00035)
	[3.41156]	[0.03900]	[0.70651]	[0.24254]	[1.31933]	[-0.22996]
D(TBILL(-1))	-0.016027	0.248779	0.420896	-0.003197	-0.082341	0.000653
	(0.05337)	(0.11179)	(0.07595)	(0.00180)	(0.08195)	(0.00046)
	[-0.30029]	[2.22534]	[5.54174]	[-1.77806]	[-1.00482]	[1.41776]
D(TBILL(-2))	0.034882	-0.133270	-0.348716	-0.001378	-0.105233	-0.000513
	(0.05548)	(0.11620)	(0.07895)	(0.00187)	(0.08518)	(0.00048)
	[0.62877]	[-1.14688]	[-4.41719]	[-0.73733]	[-1.23545]	[-1.07121]
D(TBILL(-3))	0.116399	0.169584	0.301590	0.001567	-0.151888	0.000679
	(0.05370)	(0.11248)	(0.07641)	(0.00181)	(0.08245)	(0.00046)
	[2.16768]	[1.50773]	[3.94680]	[0.86605]	[-1.84227]	[1.46632]
D(LEXCH(-1))	-2.436497	4.507344	5.940356	0.310143	-3.251180	0.018652
	(2.41442)	(5.05728)	(3.43580)	(0.08134)	(3.70704)	(0.02083)
	[-1.00914]	[0.89126]	[1.72896]	[3.81294]	[-0.87703]	[0.89557]
D(LEXCH(-2))	4.839886	-3.667780	1.526810	-0.297360	-0.472715	-0.011604
	(2.42551)	(5.08050)	(3.45158)	(0.08171)	(3.72406)	(0.02092)
	[1.99541]	[-0.72193]	[0.44235]	[-3.63907]	[-0.12694]	[-0.55462]
D(LEXCH(-3))	-1.940688	10.82260	11.72422	0.225552	2.695621	-0.008877
	(2.38564)	(4.99698)	(3.39484)	(0.08037)	(3.66285)	(0.02058)
	[-0.81349]	[2.16583]	[3.45354]	[2.80642]	[0.73594]	[-0.43137]
D(HHI(-1))	-0.077780	-0.001207	0.010956	0.001775	-0.560457	0.000132
	(0.05324)	(0.11151)	(0.07576)	(0.00179)	(0.08174)	(0.00046)

	[-1.46101]	[-0.01082]	[0.14462]	[0.98969]	[-6.85665]	[0.28810]
D(HHI(-2))	-0.096577	0.049054	0.015199	0.001866	-0.336431	-0.000555
	(0.05783)	(0.12114)	(0.08230)	(0.00195)	(0.08879)	(0.00050)
	[-1.66997]	[0.40495]	[0.18468]	[0.95781]	[-3.78891]	[-1.11303]
D(HHI(-3))	-0.057239	-0.115932	-0.045677	-0.001305	-0.104121	-0.000186
	(0.05204)	(0.10900)	(0.07405)	(0.00175)	(0.07990)	(0.00045)
	[-1.09991]	[-1.06357]	[-0.61681]	[-0.74415]	[-1.30315]	[-0.41339]
D(LGDP(-1))	-5.553426	6.423022	-22.49063	-0.102193	10.47259	0.650617
	(9.03748)	(18.9300)	(12.8606)	(0.30446)	(13.8759)	(0.07796)
	[-0.61449]	[0.33930]	[-1.74880]	[-0.33565]	[0.75473]	[8.34590]
D(LGDP(-2))	-0.373576	-15.29483	24.16373	-0.138658	-12.51104	0.011692
	(11.1123)	(23.2759)	(15.8131)	(0.37436)	(17.0615)	(0.09585)
	[-0.03362]	[-0.65711]	[1.52808]	[-0.37038]	[-0.73329]	[0.12198]
D(LGDP(-3))	7.769601	-10.03105	1.681055	0.251938	6.703161	-0.349305
	(9.04476)	(18.9453)	(12.8710)	(0.30471)	(13.8871)	(0.07802)
	[0.85902]	[-0.52947]	[0.13061]	[0.82681]	[0.48269]	[-4.47715]
C	-0.000792	0.056935	-0.037748	0.000414	-0.020672	0.002108
	(0.05757)	(0.12059)	(0.08193)	(0.00194)	(0.08839)	(0.00050)
	[-0.01375]	[0.47215]	[-0.46076]	[0.21353]	[-0.23386]	[4.24582]
R-squared	0.234657	0.360074	0.378372	0.235438	0.376860	0.506986
Adj. R-squared	0.132252	0.274450	0.295197	0.133138	0.293483	0.441019
Sum sq. resids	57.16435	250.8031	115.7593	0.064879	134.7581	0.004253
S.E. equation	0.634481	1.328992	0.902888	0.021375	0.974167	0.005473
F-statistic	2.291458	4.205301	4.549082	2.301437	4.519912	7.685486
Log likelihood	-145.4931	-265.2709	-202.6453	403.7810	-214.9547	624.4903
Akaike AIC	2.043125	3.521862	2.748707	-4.738037	2.900675	-7.462843
Schwarz SC	2.424309	3.903047	3.129892	-4.356852	3.281860	-7.081659
Mean dependent	-0.001656	-0.016495	-0.026111	0.000870	0.003156	0.002998
S.D. dependent	0.681117	1.560230	1.075474	0.022958	1.158969	0.007320

Determinant resid covariance (dof adj.)	6.69E-09
Determinant resid covariance	3.03E-09
Log likelihood	209.4944
Akaike information criterion	-1.030795
Schwarz criterion	1.370669

Appendix 4: VECM Results for Model II

Vector Error Correction Estimates

Sample (adjusted): 2001M05 2014M10

Included observations: 162 after adjustments

Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
LSMV (-1)	1.000000
INF(-1)	0.275373
	(0.04268)
	[6.45168]
TBILL(-1)	-0.128654

		(0.06097)				
		[-2.10996]				
LEXCH(-1)	3.044525					
		(2.09936)				
		[1.45021]				
LGDP(-1)	0.856227					
		(0.98545)				
		[0.86887]				
C	-19.23646					
Error Correction:	D(LSMV)	D(INF)	D(TBILL)	D(LEXCH)	D(LGDP)	

CointEq1	-0.238751	-0.334102	0.123003	-0.000651	0.000204
	(0.05657)	(0.12167)	(0.08247)	(0.00175)	(0.00051)
	[-4.22063]	[-2.74600]	[1.49141]	[-0.37111]	[0.40033]
D(LSMV(-1))	-0.106497	-0.134911	0.121648	-0.000631	-0.000614
	(0.07977)	(0.17157)	(0.11630)	(0.00247)	(0.00072)
	[-1.33507]	[-0.78632]	[1.04597]	[-0.25499]	[-0.85419]
D(LSMV(-2))	0.115571	-0.106918	-0.041877	-0.001312	-0.001358
	(0.08049)	(0.17311)	(0.11735)	(0.00250)	(0.00073)
	[1.43592]	[-0.61762]	[-0.35687]	[-0.52552]	[-1.87346]
D(LSMV(-3))	-0.067219	0.492946	0.107488	-0.001113	-0.001098
	(0.08177)	(0.17587)	(0.11922)	(0.00254)	(0.00074)

	[-0.82207]	[2.80288]	[0.90162]	[-0.43859]	[-1.49026]
D(INF(-1))	-0.020226	0.519778	0.084926	-5.75E-05	-0.000408
	(0.03779)	(0.08128)	(0.05510)	(0.00117)	(0.00034)
	[-0.53521]	[6.39482]	[1.54139]	[-0.04901]	[-1.19954]
D(INF(-2))	0.015988	-0.047122	0.032122	0.000148	0.000184
	(0.04192)	(0.09016)	(0.06111)	(0.00130)	(0.00038)
	[0.38143]	[-0.52267]	[0.52562]	[0.11378]	[0.48720]
D(INF(-3))	0.135325	0.019608	0.039396	0.000789	-0.000155
	(0.03881)	(0.08348)	(0.05659)	(0.00120)	(0.00035)
	[3.48645]	[0.23488]	[0.69615]	[0.65540]	[-0.44267]

D(TBILL(-1))	-0.024342	0.252385	0.406585	-0.002435	0.000674
	(0.05214)	(0.11215)	(0.07602)	(0.00162)	(0.00047)
	[-0.46684]	[2.25040]	[5.34819]	[-1.50551]	[1.43394]
D(TBILL(-2))	0.041143	-0.143686	-0.341867	-0.001508	-0.000475
	(0.05392)	(0.11597)	(0.07861)	(0.00167)	(0.00049)
	[0.76309]	[-1.23904]	[-4.34898]	[-0.90138]	[-0.97844]
D(TBILL(-3))	0.119758	0.142269	0.291618	0.001569	0.000652
	(0.05234)	(0.11258)	(0.07631)	(0.00162)	(0.00047)
	[2.28808]	[1.26377]	[3.82146]	[0.96647]	[1.38359]
D(LEXCH(-1))	-0.464430	4.177381	6.654016	0.192334	0.018055
	(2.39485)	(5.15097)	(3.49164)	(0.07430)	(0.02158)

	[-0.19393]	[0.81099]	[1.90570]	[2.58867]	[0.83680]
D(LEXCH(-2))	4.256085	-4.244326	1.575975	-0.281297	-0.013939
	(2.34046)	(5.03399)	(3.41235)	(0.07261)	(0.02109)
	[1.81848]	[-0.84313]	[0.46185]	[-3.87402]	[-0.66105]
D(LEXCH(-3))	-0.117519	10.86285	12.83868	0.112278	-0.005169
	(2.37759)	(5.11384)	(3.46647)	(0.07376)	(0.02142)
	[-0.04943]	[2.12421]	[3.70367]	[1.52215]	[-0.24133]
D(LGDP(-1))	-3.196096	13.51491	-22.22821	-0.158491	0.642216
	(8.71463)	(18.7439)	(12.7057)	(0.27036)	(0.07851)
	[-0.36675]	[0.72103]	[-1.74946]	[-0.58621]	[8.17977]

D(LGDP(-2))	-0.909078	-24.92345	24.98809	-0.180799	0.020344
	(10.7360)	(23.0915)	(15.6528)	(0.33307)	(0.09672)
	[-0.08468]	[-1.07934]	[1.59640]	[-0.54282]	[0.21033]
D(LGDP(-3))	9.551227	-7.329223	2.519189	0.198498	-0.357744
	(8.68402)	(18.6780)	(12.6611)	(0.26941)	(0.07824)
	[1.09986]	[-0.39240]	[0.19897]	[0.73678]	[-4.57257]
C	-0.037925	0.132106	-0.018411	-6.58E-05	0.002108
	(0.06540)	(0.14067)	(0.09535)	(0.00203)	(0.00059)
	[-0.57989]	[0.93914]	[-0.19308]	[-0.03243]	[3.57804]
HLEXCH	-9.836652	3.678652	-2.189029	0.598592	-0.003474
	(3.12119)	(6.71321)	(4.55063)	(0.09683)	(0.02812)

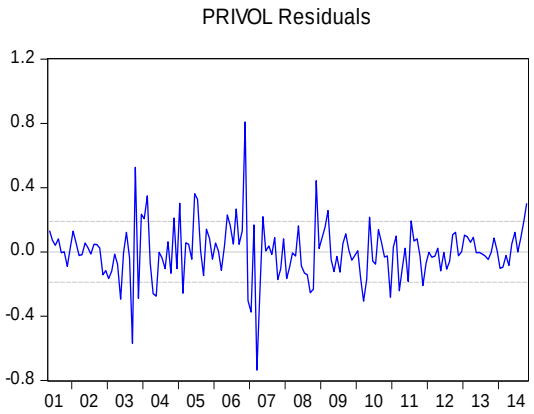
	[-3.15157]	[0.54797]	[-0.48104]	[6.18173]	[-0.12356]
HDLGDP	-0.004522	-0.033640	0.029731	-0.000896	0.000119
	(0.01930)	(0.04152)	(0.02814)	(0.00060)	(0.00017)
	[-0.23425]	[-0.81022]	[1.05637]	[-1.49644]	[0.68271]
HINF	0.017983	0.025024	-0.030817	3.83E-05	-4.80E-05
	(0.01178)	(0.02534)	(0.01718)	(0.00037)	(0.00011)
	[1.52640]	[0.98757]	[-1.79414]	[0.10470]	[-0.45271]
HTBILL	-0.003775	-0.018565	0.004842	0.000542	-4.59E-05
	(0.01186)	(0.02551)	(0.01729)	(0.00037)	(0.00011)
	[-0.31827]	[-0.72765]	[0.27998]	[1.47221]	[-0.42956]

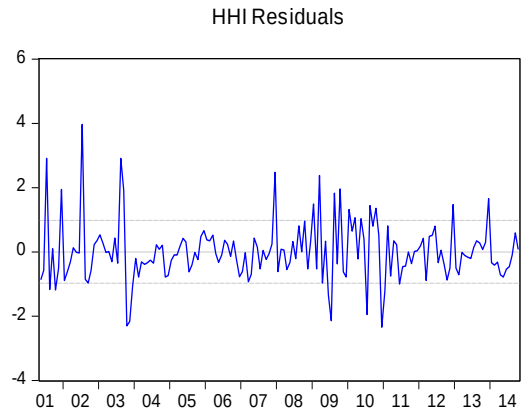
R-squared	0.289197	0.373334	0.393969	0.397817	0.500513
Adj. R-squared	0.188374	0.284446	0.308007	0.312401	0.429663
Sum sq. resids	53.09069	245.6061	112.8550	0.051100	0.004309
S.E. equation	0.613620	1.319806	0.894645	0.019037	0.005528
F-statistic	2.868358	4.200018	4.583059	4.657403	7.064470
Log likelihood	-139.5049	-263.5748	-200.5871	423.1191	623.4337
Akaike AIC	1.981542	3.513269	2.735644	-4.964433	-7.437453
Schwarz SC	2.381786	3.913513	3.135888	-4.564189	-7.037209
Mean dependent	-0.001656	-0.016495	-0.026111	0.000870	0.002998
S.D. dependent	0.681117	1.560230	1.075474	0.022958	0.007320

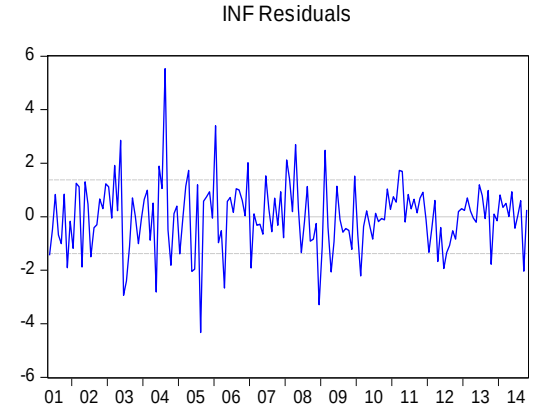
Determinant resid covariance (dof adj.)	5.46E-09
Determinant resid covariance	2.73E-09
Log likelihood	447.9310
Akaike information criterion	-4.171988

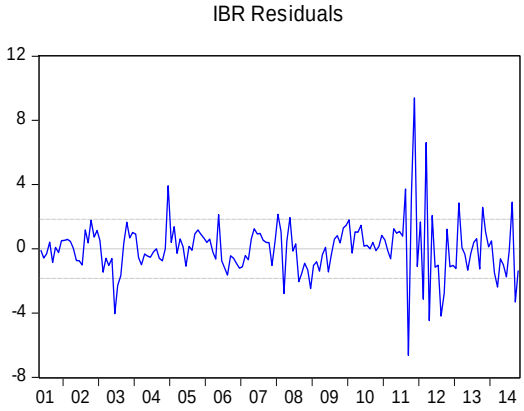
Schwarz criterion	-2.075472

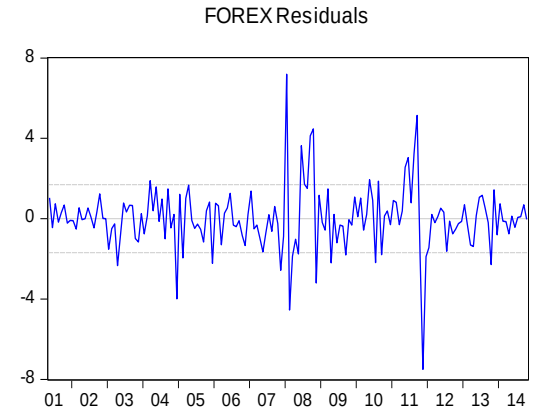
Appendix 5: Estimated Residuals of the VAR MODELS

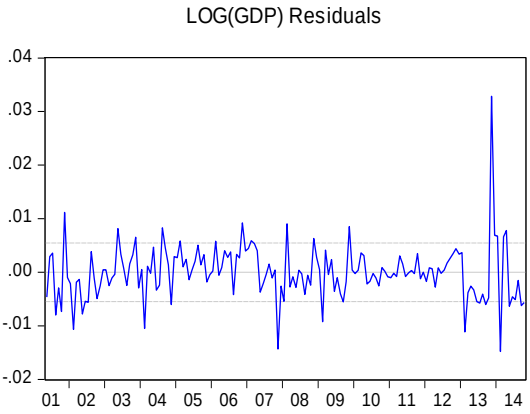












Appendix 6: Auto correlation test results

VEC Residual Serial Correlation LM Tests

Null Hypothesis: no serial correlation at lag order h

Sample: 2001M01 2014M12

Included observations: 162

Lags	LM-Stat	Prob
1	52.44605	0.0376
2	41.42835	0.2458

Probs from chi-square with 36 df.

VEC Residual Portmanteau Tests for Autocorrelations

Null Hypothesis: no residual autocorrelations up to lag h

Date: 12/18/15 Time: 06:50

Sample: 2001M01 2014M12

Included observations: 162

Lags	Q-Stat	Prob.	Adj Q-Stat	Prob.	df
1	4.876249	NA*	4.906536	NA*	NA*
2	13.76425	NA*	13.90563	NA*	NA*
3	35.30057	NA*	35.84830	NA*	NA*
4	70.72133	0.3230	72.16579	0.2815	66

Appendix 7: Companies Listed on the Nairobi Securities Exchange as at December 2014

S. No.	Listed Company
1.	A. Baumann & Company
2.	ARM Cement
3.	B.O.C. Kenya
4.	Bamburi Cement
5.	Barclays Bank Kenya
6.	British American Tobacco - Kenya
7.	British-American Investment Company Kenya
8.	Car & General Kenya
9.	Carbacid Kenya
10.	Centum Kenya
11.	CFC Stanbic
12.	CIC Insurance
13.	CMC Holdings
14.	Co-operative Bank of Kenya
15.	Crown Paints

16. Diamond Trust Bank

17. East African Breweries

18. East African Cables

19. East African Portland cement

20. Eaagads

21. Equity Bank

22. Eveready East Africa

23. Express Kenya

24. Home Afrika

25. Housing Finance Company of Kenya

26. I&M Holdings

27. Jubilee Holdings

28. Kakuzi

29. Kapchorua Tea Company

30. KenGen

31. KenolKobil

32. Kenya Airways

33. Kenya Commercial Bank

34. Kenya Orchards

35. Kenya Power & Lighting

36. Kenya Re

37. Liberty Kenya

38. Limuru Tea

39. Longhorn Kenya

40. Marshalls East Africa

41. Mumias Sugar

42. Nairobi Securities Exchange

43. Nation Media Group

44. National Bank of Kenya

45. NIC Bank

46. Olympia Capital Holdings

47. Pan Africa Insurance Holdings

48. REA Vipingo Plantations

49. Safaricom

50. Sameer Africa

51. Sasini

52. ScanGroup

53. Standard Chartered Bank Kenya

54. Standard Group

55. Total Kenya

56. TPS Serena

57. TransCentury

58. Uchumi

59. Unga Group

60. Williamson Tea Kenya

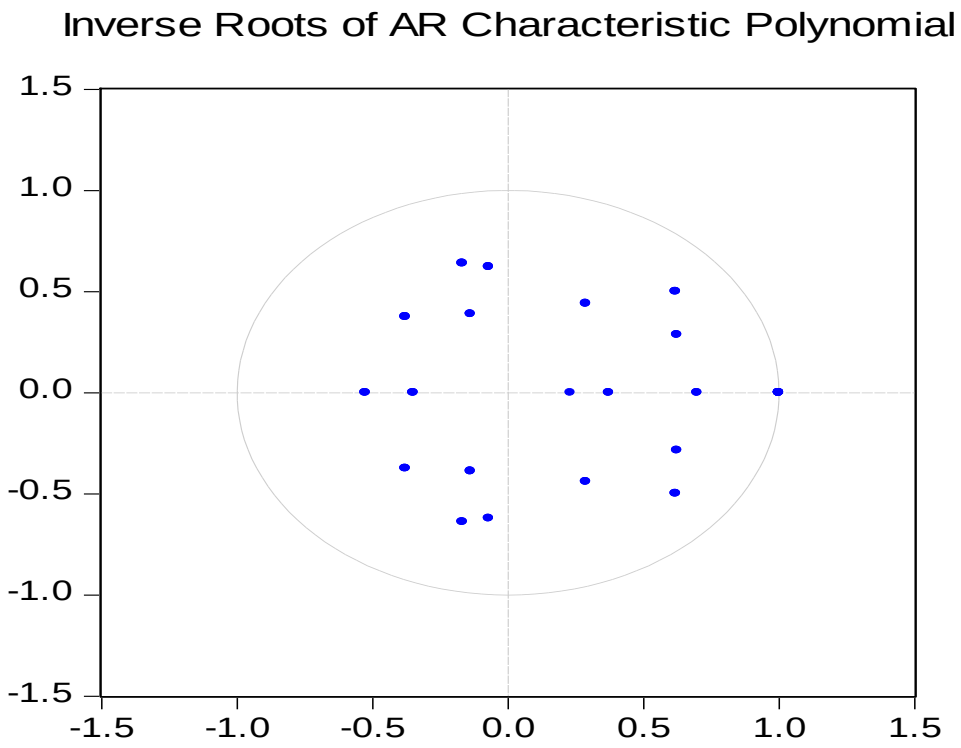
Appendix 8: Secondary Data Collection Schedule

Variables	**Market volatility**	**Interest rate**	**Inflation rate (CPI)**	**Foreign Exchange rate**	**GDP**	**Herd index**
Description	Standard deviation of the NSE all-share index	91 days treasury bill rate	A measure on inflation using an index of items consumed on day to day basis.	The prevailing exchange rate at the end of every month under study	A measure of the income of a country using a number method.	CSSD measure of market-herding index.
Source of data	Nairobi securities Exchange	Central Bank of Kenya	Kenya National Bureau of Statistics	Central Bank of Kenya	Kenya National Bureau of Statistics	Calculated from NSE data.
Period						
2001:						
January						

February						
March						
April						
May						
June						
July						
August						
September						
October						
November						
December						
2002						
to						

2014:						
January						
February						
March						
April						
May						
June						
July						
August						
September						
October						
November						
December						

Appendix 9: Inverse Root of AR Characteristic polynomial



Appendix 10 : Summary of Empirical Literature on Relationship between Macro-economic Variables and Stock Market Volatility.

Author	**Title & Period of Study**	**Variables, Data Analysis & Method Used**	**Findings**	**Critique**
Aroni (2011)	Factors influencing stock prices for firms listed in the Nairobi Stock Exchange. Study period between January 2008 to December 2010.	The study investigated the effect of Inflation, Exchange rate, interest rate and money supply on stock prices. The study used multiple regression analysis.	The study found Inflation, exchange rate and interest rate to significantly affect stock prices while money supply had no significant effect.	The long run and short run relationship was not established by the study. Findings contradict other studies like Kirui (2014), Ouma *et al.*., (2014) who finds inflation and interest rate to have no significant relationship with stock market returns

				in Kenya. Investor behavior not investigated.
Kirui *et al.* (2014)	Macroeconomic Variables, Volatility and Stock Market Returns: A Case of Nairobi Securities Exchange, Kenya. Study period between 2000 to 2012	The study investigated the effect of GDP, Treasury bill rate, Exchange rate & Inflation on stock market returns. The study used Engle-Granger, TGARCH and Regression analysis methods.	The study found GDP, Inflation and the Treasury bill rate have no significant relationship with stock market returns in Kenya.	Findings in this study have contradicted findings in other studies. For example Issahaku *et al.* (2013), Olweny *et al.*. (2011), who found that GDP, Inflation and interest rate have significant influence on stock market returns in Kenya. Investor behavior not investigated.
Issahaku *et*	Macro-	The study	A significant	Contrary to

al. (2013)	economic variables and stock market returns in Ghana: Any causal link? Study period between January 1995 and December 2010	investigated the relationship between Interest rate, inflation, Foreign Direct Investment (FDI) & money supply. Unit root test was performed using ADF, PP and KPSS tests. Vector Error Correction model (VECM) used to establish long-run and short-run relationship	long run relationship exists between stock returns and inflation, money supply and Foreign Direct Investment (FDI) in Ghana. In the short-run, the relationship between stock returns and interest rate, inflation and money supply in Ghana was found to be significant	findings in this study, other studies e.g. Kirui (2014), find no significant relationship both short term and long term, between inflation, interest rate Ouma *et al*.., (2014) and stock market return. No attempt to investigate other factors like investor behavior.
Olweny *et al.* (2011)	The effect of macro-economic factors on stock return volatility in the Nairobi stock exchange,	The study investigated Foreign exchange rate, interest rate and inflation rate. The study used E-GARCH &	The study found Foreign exchange rate, Interest rate and Inflation rate to significantly affect stock market return	The study did not investigate GDP a critical variable that moves with business cycles. No attempt was

	Kenya January 2001 and December 2010	T-GARCH	volatility in Kenya	made to investigate other non-economic variables e.g. investor behavior.
Ouma *et al.*., (2014)	The impact of macroeconomic variables on stock market returns in Kenya. Study period between 2003- 2013.	The study investigated the effect of money Supply, exchange rates and inflation on stock market returns. The study used Ordinary Least Square (OLS) technique to analyze the relationship.	Except for interest rates, there exists a significant relation between stock market returns and macroeconomic variables i.e. Money Supply, exchange rates and inflation affect stock market returns in Kenya	The study finds interest rates not having an influence on stock market return, contrary to other studies like Olweny *et al.* (2011), Issahaku *et al.* (2013) and other who find that interest rates affect stock market returns.
Ochieng *et al.*.,	The relationship	Variables studied were: Lending	91-day T bill rate has a	The study investigated

(2012)	between macro-economic variables and stock market performance in Kenya. Study period , March 2008 to March 2012	interest rate, inflation rate and 91 day Treasury bill (T bill) rate. Data was analyzed using regression.	negative relationship with the NASI while, inflation has a weak positive relationship with the NASI.	only two variables out of the many macro-economic variables. GDP and foreign exchange rate not investigated. Findings contradict findings in other studies.
Olweny *et al.*(2011)	Stock market performance and economic growth Empirical Evidence from Kenya using Causality Test Approach. Study period ; 2001-2010	Used Granger causality test, Augmented Dickey Fuller test, Johansen co-integration	Movement of stock prices in the Nairobi stock exchange reflect the macro-economic condition of the country	Long term and short term relationship not established. No attempt to investigate other causes e.g. investor behavior
Zukarnain Zakaria,	Empirical Evidence on	Relationship between stock	Volatility in inflation and	The study finds that

(2012).	the Relationship between Stock Market Volatility and Macroeconomics Volatility in Malaysia	market returns volatility in Malaysia with five selected macroeconomic volatilities; GDP, inflation, exchange rate, interest rates, and money supply. Volatility was estimated using GARCH (1, 1) models, Macroeconomic volatilities were examined using bi-variate and multivariate VAR Granger causality tests and regression analysis.	interest rates was found to Granger-cause stock market volatility. The volatilities of macroeconomic variables as a group do not Granger cause volatility in stock market returns. The result from regression analysis shows that only money supply volatility is significantly related to stock market volatility	interest rate and inflation affects stock market volatility while other variables do not affect stock market volatility.
Kadir *et al.* (2011)	Predictability Power of Interest Rate and Exchange Rate Volatility	The study examined the predictability power of exchange rates and interest	The relationship between interest rate, exchange rate and KLCI returns were	Interest rate found to be insignificant in explaining stock market

	on Stock Market Return and Volatility: Evidence from Bursa Malaysia	rates on stock market volatility and return. The study used monthly Kuala Lumpur composite Index (KLCI) returns, 3 months Malaysia Treasury bond and monthly exchange rate of Ringgit per US Dollar from 1997 January to 2009 November. The study adopted two models based on GARCH (1,1),	found to be negative but significant for exchange rate and insignificant for interest rate. This means the variables have a certain degree of predictive powers for KLCI returns but weak volatility prediction.	volatility. This is contrary to Ochieng *et al..*, (2012),Olweny *et al.* (2011) but agrees with Kirui *et al.* (2014) and Ouma *et al.* 2014). Findings are mixed on the effect of interest rate on stock market return and volatility.
Chinzara, (2010)	Macroeconomic uncertainty and emerging market. Stock market volatility: The case for South Africa	The study analysed how systematic risk emanating from the macro economy is transmitted into stock market volatility. It also analysed whether financial crises	The study finds that volatility in short-term interest rates and exchange rates significantly affects stock market volatility in South Africa.	Contrary to findings in this study, some studies find interest rate changes not significantly affecting stock market

		affect the relationship between macroeconomic uncertainty and stock market volatility. The study used (AR-GARCH)	The results show that financial crises increases volatility in the stock market.	volatility e.g. Kirui *et al.* (2014) and Ouma *et al.* (2014). The study fails to explore non-economic factors like investor behaviour.
Omorokunwa *et al.* (2014)	Macroeconomic Variables And Stock Price Volatility In Nigeria.	The purpose of study was to examine the relationship between stock price volatility and macroeconomic variables i.e. inflation, exchange rate, GDP and Interest rate. The GARCH model was used. The data ranging from 1980 to 2011.	The study found that interest rate and exchange rate have a weak effect on stock price volatility while inflation is the main determinant of stock price volatility in Nigeria.	This findings are contrary to findings by Oseni *et al.* (2011) and Kirui *et al.* (2011). No investigation done on the effect of investor behaviour.

Oseni *et al.* (2011)	Stock Market Volatility and Macroeconomic Variables Volatility in Nigeria: An Exponential GARCH Approach	The study investigated selected macro-economic variables namely; GDP, Interest rate and inflation. This study employed AR (k)-EGARCH.	The findings show that there exists a bi-causal relationship between stock market volatility and real GDP volatility; and there is no causal relationship between stock market volatility and the volatility in interest rate and inflation rate.	Finding in this study indicate that there is no causal relationship between stock market volatility and interest rate and inflation. This is contrary to findings in other studies e.g. Omorokunwa *et al.* (2014); Ochieng *et al.*., (2012) find the two variables to affect stock market volatility.
Ambunya, (2012)	The Relationship Between Exchange Rate Movement	The study used secondary data collected from the Nairobi Securities	Findings show that there is a strong relationship	

	And Stock Market Returns Volatility At The Nairobi Securities Exchange	Exchange and the Central bank of Kenya for the period 2007-2011. The study regressed stock market returns volatility against exchange rate movement.	between exchange rate movement and stock market returns volatility	

Appendix 11: Summary of Empirical Literature on Effect of Investor Herding Behavior on Stock Market Volatility.

Author	Title	Data and Method Used	Findings
Blasco *et al.* (2006)	The implications of herding on volatility. The case of the Spanish stock market	The study used intraday data from the Spanish stock market and measured market –wide herding using the Patterson & Sharma, (2006).	Herding was found to have a direct linear impact on stock market volatility for all volatility measures considered except implied volatility.
Blasco *et al.* (2009)	Herding, Volatility and Market Stress	The study used intraday data from the Spanish market. Market –wide herding was measured using the Patterson & Sharma, (2006) method.	The study found evidence of a symmetric effect of herding on volatility during extreme market movements.
Patterson & Sharma (2005)	Intraday herding and Market Efficiency	The study used intraday trading data from the New York Stock Exchange. Used bootstrapped run test and a test of dependence between inter-arrival trade times.	The study found no evidence of widespread herding on the New york stock Exchange. Herding was found in small stocks. Herding caused an upward price pressure. The study also found that on the price decrease days, the herding helps impound fundamental information into security prices thus making markets more efficient.
Nofsinger *et al.*,(1999)	Herding and Feedback Trading by Institutional and Individual Investors	Used a small sample of trader-type identified transaction data.	The study found that institutional herding impacts stock prices more than herding by individual investors. Institutional herding was found to be positively correlated to lag returns and appeared to be related to stock return momentum.
Radalj *et al.*, (1993)	Herding, information cascades and	Futures position data from nine different markets.	The study found evidence consistent with herding among small traders was

	volatility spillovers in futures markets	Various time volatility models	found for Canadian dollar, British pound, gold, and S&P 500 and Nikkei 225 futures.
Puckett *et al.*, (2008)	Short-term Institutional Herding and Its Impact on Stock Prices	Using the trades of 776 institutional investors from 1999 to 2004 Used Lakonishok, Shleifer, and Vishny (1992) and Sias (2004) methods of measuring herding.	The study found strong evidence of herding behavior at the weekly frequency. Weekly herds significantly affected the efficiency of security prices. Strong evidence of return reversals following short-term sell herds and weak evidence of return continuations following short-term buy herds
Voronkova *et al..*, (2003)	Institutional Traders' Behavior in an Emerging Stock Market :Empirical Evidence on Polish Pension Fund Investors	Data set relied on the semi-annual and annual reports for 17pension funds for the period from 1999 to 2001 Utilized the measure suggested by Lakonishok, Shleifer, and Vishny (1992) to measure Herding behavior.	The study found that Polish pension fund investors are to a greater extent involved in herd-like behavior and more often pursue feedback trading strategies than their counterparts in mature markets. Trading by the pension fund investors do not exert significant influence on stock prices in Poland.
Zafer, (2012)	Does Investment Horizon Matter? Disentanglin g the Effect of Institutional Herding on Stock Prices	Analysis was based on a sample of quarterly observations of the stock holdings of institutional investors between 1981 and 2008. Used Yan and Zhang (2009), & Lakonishok, Shleifer and Vishny (1992) to measure herding behavior.	The study found that Short-term institutional herding tends to stabilize stock prices. Herding by long-term institutions has a destabilizing impact on stock prices. Long-term institutional herding is followed by a

			clear reversal in stock prices.
Chiang *et al.* , (2011)	Dynamic herding behavior in pacific –basin markets: Evidence and Implications	Used daily stock data from Australia, Hong Kong, Japan, Singapore, US china, Indonesia , Malaysia, South Korea, Thailand and Taiwan Used Asymmetric GARCH	Herding was found to be present in both rising and falling market The level of herding is time varying. Herding is positively related to stock returns, but negatively related to market volatility.