MACROECONOMIC DETERMINANTS OF STOCK MARKET RETURNS IN KENYA: 1993-2015

DONALD AKECH OTIENO

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DECLARATION

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

Signature…………………………… Date…………………………………..

Donald A. Otieno

Reg. No: X80/81881/2009

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

Signature…………………………… Date…………………………………..

Dr. Rose W. Ngugi
School of Economics,
University of Nairobi.

Signature…………………………… Date…………………………………..

Prof. Nelson H. W.Wawire
School of Economics,
Kenyatta University.

DEDICATION

This thesis is dedicated to Hellen, Rawlings, Vallarie and Brian.

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ABSTRACT

Debate on the stochastic behaviour of stock market returns, the macroeconomic variables and their cointegrating residuals remains unsettled. There is also no unanimity in the nature of relationship between stock market returns and the macroeconomic variables. Furthermore, the moderating effect of events such as the 2008 Global Financial Crisis on the relation between stock market returns and the macroeconomic variables has attracted very little attention. The purpose of this study was to examine the stochastic properties of stock market returns, exchange rate, inflation rate, interest rate and their cointegrating residuals. The study also determined the relationship between the macroeconomic variables and stock market returns. It equally investigated the moderating effect of the 2008 Global Financial Crisis on the relation between the macroeconomic variables and stock market returns. The study used monthly data from the Nairobi Securities Exchange, Central Bank of Kenya, and Kenya National Bureau of Statistics from 1st January 1993 to 31st December 2015. It employed the Auto-Regressive Fractionally Integrated Moving Average to determine the integration orders of the variables and the cointegrating residuals. The study also used an Auto-Regressive Distributed Lag cointegration test to establish cointegration between the macroeconomic variables and stock market returns. An interaction modelling was adopted to investigate the moderating effect of the 2008 financial crisis on stock market returns with the data being split into pre-crisis period, crisis period; and post-crisis period. Results indicate that all the variables and the cointegrating residuals are fractionally integrated. This implies that shocks to them are highly persistent but eventually dissipate. It also suggests that when each of the macroeconomic variables is driven away from stock market returns, new and undesirable long-run equilibriums might be established if active policy interventions are not undertaken. Stock market returns lead interest rate and month-on-month nflation rate in the short run. This implies that a thriving stock market aids in realizing a macroeconomic stability. The macroeconomic variables are jointly cointegrated with stock market returns with both measures of inflation rate being positively related to stock market returns in the long run. This suggests that investors in the stock market are cushioned from rising inflation rate. A unit increase in exchange rate and inflation rate depresses stock market returns after compared to before the Global Financial Crisis. This implies that policymakers and stock market regulators need to be extra cautious when intervening in the activities of the stock market, especially after turbulences. This thesis is the first to empirically examine fractional cointegration between the macroeconomic variables and stock market returns in Kenya. It is also the first study to examine the moderating effect of the 2008 financial crisis on the relation between the macroeconomic variables and stock market returns in Kenya.

Keywords: Stock returns; ARFIMA models; ARDL-VECM; Interaction models.
JEL Classification: E44, F31, F41, G11, G12, G18.

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ABBREVIATIONS AND ACRONYMS

ADF	Augmented Dickey Fuller
AIC	Akaike Information Criterion
AML	Approximate Maximum Likelihood
AR	Auto-Regressive
ARCH	Auto-Regressive Conditional Heteroscedasticity
ARDL	Auto-Regressive Distributed Lag
ARFIMA	Auto-Regressive Fractionally Integrated Moving Average
ARMA	Autoregressive Moving Average
ASPI	All Share Price Index
BIS	Bank for International Settlements
BRICS	Brazil, Russia, India, China and South Africa
CAPM	Capital Asset Pricing Model
CBK	Central Bank of Kenya
CMA	Capital Markets Authority
CPI	Consumer Price Index
CUSUM	Cumulative Sum of recursive residuals
CUSUMSQ	Cumulative Sum of Squares of recursive residuals
ECM	Error Correction Mechanism
ECT	Error Correction Term
EML	Exact Maximum Likelihood
FE	Fisher Effect
FIECM	Fractionally Integrated Error Correction Mechanism
FIECT	Fractionally Integrated Error Correction Term
FEVD	Forecast Error Variance Decomposition
FCFE	Free-Cash-Flow-to-Equity
FIVECM	Fractionally Integrated Vector Error Correction Model
FMOLS	Fully-Modified OLS
FRBSF	Federal Reserve Bank of San Francisco
GFC	Global Financial Crisis
GPH	Geweke-Porter-Hudak
HAC	Heteroscedasticity and Autocorrelation
IMF	International Monetary Fund
IRF	Impulse Response Function
ISE	Istanbul Stock Exchange Index
JB	Jarque Bera
JCI	Jakarta Composite Index
KLCI	Kuala Lumpur Composite Index
KNBS	Kenya National Bureau of Statistics
KPSS	Kwiatkowski-Philips-Schmidt- and Shin
KSH	Kenya Shillings
LM	Lagrange Multiplier
MA	Moving Average
MLE	Maximum Likelihood Estimator
MPT	Modern Portfolio Theory

MPL	Modified Profile Likelihood
MRP	Market Risk Premium
NBER	National Bureau of Economic Research
NLS	Nonlinear Least Squares
NSE	Nairobi Securities Exchange
OLS	Ordinary Least Squares
PP	Phillips-Perron
REIT	Real Estate Investment Trusts
RCH	Reverse Causality Hypothesis
RR	Rescaled Range
SIC	Schwarz Information Criterion
TEH	Tax Effects Hypothesis
TVECM	Threshold Vector Error Correction Model
UK	United Kingdom
US	United States
USD	United States Dollar
VAR	Vector Auto Regression
VECM	Vector Error Correction Model
WHI	Whittle

OPERATIONAL DEFINITION OF TERMS

Arbitrage: Simultaneous purchase of an undervalued asset or portfolio and sale of an overvalued but equivalent asset or portfolio to obtain a riskless profit on the price differential.

Arbitrage opportunity: Is an opportunity to earn an unexpected positive net profit without risk and with no net investment of money.

Arbitrage portfolio: Is a portfolio that exploits opportunity to make profit with no input of funds.

Continuously compounded return: This is the natural logarithm of the gross return. It is computed as the first difference of the natural logarithm of the NSE 20 Share Index.

Exchange rate: This is the domestic currency units per unit of the USD (i.e. KSH/USD). This study uses the terms nominal exchange rate and exchange rate interchangeably to mean nominal rates.

Inflation: This is defined as the persistent increase in the general prices of goods and services.

Month-on-month inflation rate: Represents the short term inflation rate. It has less variance and high forecast ability and could therefore be helpful in portfolio adjustment.

Year-on-year inflation rate: Captures the long run dynamics of inflation rate. It has high variance and low forecast ability and might aid central banks in tracking the trend of inflation in an economy.

Interest rate: This refers to the cost of money. This thesis used the 3-month Treasury Bills rate and the commercial banks' weighted average lending rate as proxy for interest rate.

Lending rate: Is the amount that the bank charges a borrower in order to make a loan. The thesis employed commercial banks' monthly weighted average lending rate.

Long memory: Is the persistence of the mean of a time series over time

Long memory process: A stationary process where shocks to the series or error correction mechanism dissipate more slowly (hyperbolically).

Mean-reversion: This is the tendency of a time series to fall when its level is above its long run mean and rise when its value is below its long run mean. In other words, a mean-reverting time series tends to return to its long-term mean after experiencing a shock or disturbance.

Short memory process: Is a process where shocks decay faster (exponentially).

Stock market: This is a market which deals with the selling and purchasing of securities that have been issued by publicly quoted companies and the government.

Stock market return: Is the link between end-of-period wealth and an initial amount invested in the stock. It is used as a measure of the stock market performance.

Stock market performance: This refers to how the stock market evolves given the risks and returns of the market.

Stationarity: This refers to a state in which the mean, variance and autocorrelation of a time series are constant over time.

Treasury Bills: Are high yield debt obligations issued by the central bank.

Safe haven asset: Is an asset with low risk or high liquidity or an asset that acts as a hedge during periods of turbulence.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Stock market returns provide useful signals regarding the future state of the economy, including the economic and financial status (Hamrita & Trifi, 2011). Specifically, stock market returns drive the allocation of resources across sectors of the economy. Their stochastic behaviour also provides information concerning market expectations and risk attitudes of investors in the market. Additionally, even though macroeconomists, financial economists and actors in the financial market use stock market indices to understand trends in the economy, describe stock markets and compare returns on specific investments (Hautcoeur, 2011), stock market returns are more preferable because they provide traders and investors with a scale-free summary of the ever rapid inflow of information into the stock market (Lo, Campbell & Mackinlay, 1997).

Equally, given their more attractive statistical properties (Lo *et al*., 1997), stock market returns are useful to policymakers, researchers and stock market participants keen on making various forecasts, developing regulatory rules, constructing portfolio strategies or determining implications for policy. On the whole, understanding the trends of stock market returns is critical to evaluating the events in the financial market, monitoring the evolution of the economy, and placing the economy within the international arena. Nonetheless, stock market returns are systematically influenced by various types of information which arrive randomly every day, every hour or even every second. A key type of such influential information is news regarding the evolution of exchange rate, inflation rate and interest rate (Chen, Roll & Ross, 1986; Gupta & Modise, 2013; Ikoku & Husseini, 2013; Iqbal *et al.*, 2012).

Specifically, uncertainty regarding the movements in exchange rate is a major source of risk for export as well as import-oriented companies/firms listed at a stock market. Furthermore, uncertainty over changes in the exchange rate might hinder the achievement of set macroeconomic targets besides constraining currency trades (Bank for International Settlements [BIS], 2010). Therefore, fund managers, central banks, investment banks, and policy makers closely monitor the exchange rate movements to manage their exposures to exchange rate risk and to formulate better decisions which include better trading policies and policies aimed at realizing macroeconomic stability (Belaire-Franch & Opong, 2005).

Inflation is also a major concern to investors because they expect to be compensated in terms of higher stock market returns to maintain their real returns (Fisher, 1930). This suggests that if the stock market is efficient, then investors expect nominal stock market returns to move on a one-to-one basis with expected inflation rate. However, since expected inflation rate is not observable, actual inflation rate is often a reasonable proxy, based on the theory of rational expectations (Rushdi *et al.*, 2012). On the other hand, inflation poses a serious threat to long-term investors since it erodes the returns of financial assets, including stock market returns, by undermining economic growth (Fama, 1981). This can in turn result into a rise in prevailing interest rates and possibly increase returns of other assets such as stocks of commercial banks. Furthermore, stock market returns often reflect valuation of cash flows over long horizons in the future (Alagidede & Panagiotidis, 2010). Consequently, monthly stock market returns are likely to have stronger relationships with changes in inflation rate projected many months into the future (i.e. year-on-year inflation rate) rather than with changes in current month's inflation rate (i.e. month-on-month inflation rate).

Likewise, interest rate, in the form of a risk free rate, plays a significant role in investment since it is considered as a rate of return on an investment which has a guaranteed or nearly guaranteed payoff. Consequently, investors use the risk free-rate such as the Treasury Bills rate as a reference rate when making investment decisions on the valuation of stocks. Furthermore, since the required rate of return comprises a risk free rate and a risk premium (Sharpe, 1964; Lintner, 1965), an increase in the Treasury Bills rate should translate into a corresponding increase in the required rate of return and, by extension, to a rise in stock market returns. However, since the Treasury Bills commonly compete with stocks as an investment vehicle, investors are likely to reallocate more of their funds to the Treasury Bills and less to stocks following a rise in the Treasury Bills rates. This is because the Treasury Bills are relatively safer since they have a certain payoff from the government.

Furthermore, firms listed at a stock market have an option of obtaining long term financing by issuing additional shares (equity financing) or taking loans from commercial banks (debt financing). However, firms often seek to minimize the cost of funds and maximize existing shareholders' wealth. Therefore, lower lending rates could induce firms to use more loans from banks and issue fewer additional shares with a view to reducing the cost of capital while minimizing the chances of diluting existing shares. Thus, lower lending rates are expected to translate into rising stock market returns. On the other hand, high lending rates might force firms to issue more shares in order to raise investment finances. This could in turn drive down share prices and lead to a decline in stock market returns. Rising lending rates could also increase interest expenses and reduce cash flows and stock market returns. This study therefore hypothesized that commercial banks' weighted average lending rates are negatively related to stock market returns.

Despite the predictions that exchange rate, inflation rate, and interest rate have significant influences on stock market returns (Chen, Roll & Ross, 1986; Burmeister, Roll & Ross, 1994; Ikoku & Husseini, 2013; Iqbal *et al.*, 2012; Gupta & Modise, 2013), empirical evidence on the stochastic properties of the individual variables as well as on the behaviour of the respective cointegrating relationships remains inconclusive. For instance, a group of studies documented that a stock market return is nonstationary at level (Cakan & Ejara, 2013; Erita, 2014; Kimani & Mutuku, 2013) while some authors indicated that the variable is stationary at level (Kganyago & Gumbo, 2015; Ouma & Muriu, 2014).

Fewer authors however reported that the variable is fractionally integrated (Aye *et al.*, 2012; Balparda *et al*., 2015; Nazarian *et al*., 2014). Similarly, a number of studies showed that exchange rate, inflation rate and interest rate are nonstationary at level (Amarasinghe, 2015; Erita, 2014; Kimani & Mutuku, 2013; Kisaka & Mwasaru, 2012; Kuwornu & Owusu-Nantwi, 2011) whereas some asserted that the individual variables are stationary at level (Kganyago & Gumbo, 2015; Ouma & Muriu, 2014). On the other hand, a small section of existing studies indicated that the individual macroeconomic variables evolve over time through non-integer orders of integration (Caparole & Gil-Alana, 2010; Caporale & Gil-Alana, 2011; Caporale & Gil-Alana, 2016).

Studies that reported stationarity of the individual time series suggest that their deviations from the long run mean values (due to exogenous shocks such as economic or financial crises) are corrected fairly fast and policy interventions are therefore not required. On the other hand, studies which concluded that the time series are nonstationary in levels suggest that shocks to the respective time series persist indefinitely and might become explosive if active policy measures are not taken. In contrast, presence of a fractional integration suggests that the time series may be highly persistent but shocks to them eventually disappear, allowing the time series to return to their pre-shock mean values. The traditional stationary/nonstationary dichotomy therefore seems to be too restrictive since a time series can be non-stationary without necessarily being a unit root process (Caporin *et al.*, 2011).

Empirical debate on the cointegrating relationship between each of the selected macroeconomic variables and stock market returns is also inconclusive. For example, some studies concluded that stock market returns and each of the selected macroeconomic variables are cointegrated based on the stationarity of the respective cointegrating residuals (Erita, 2014; Frimpong, 2011; Gohar *et al*., 2014; Jawaid & Anwar, 2012). On the other hand, other authors presented evidence of fractional cointegration between stock market returns and each of the macroeconomic variables (Aloy *et al.,* 2010; Caparole & Gil-Alana, 2016; Kiran, 2011). However, like the unit root case, the cointegrating residual need not necessarily be an I(0) process since adjustment towards long run equilibrium can occur , even though at a much slower rate, as long as the cointegrating residual has an integration order less than one (Cheung, 2007; Okunev & Wilson, 1997). Moreover, two individual variables with fractional integration orders d_1 and d_2 are considered to be fractionally cointegrated as long as their cointegrating residual is integrated of order d_3 which is lower than both d_1 and d_2 (Caparoni *et al*., 2011; Cheung, 2007).

Furthermore, the relationship between stock market returns and each of the macroeconomic variables also depends on shocks from events such financial or political crises (Amaefula & Asare, 2013; Chan, Gup & Pan, 1997; Kimani & Mutuku, 2013; Kganyago & Gumbo, 2015). For instance, stock market returns, exchange rate, inflation rate and interest rate might respond differently before, during and after an occurrence of a financial crisis depending on how investors perceive the crisis (Copeland, Weston & Shastri, 2005).

Additionally, investors may react differently to changes in stock market returns, exchange rate, inflation rate and interest rate before, during and after a financial crisis (Copeland *et al*., 2005). Besides, shocks from the 2008 Global Financial Crisis (GFC) should have different effects on emerging and developed markets owing to differences in exchange rate policies, trade policies and domestic financial systems (Berkmen *et al*., 2012). For example, Ali and Afzal (2012) asserted that the 2008 GFC led to a significant decline in stock market returns in India whereas Chong (2011) revealed that the 2008 GFC did not exert any significant depressing effect on stock market returns in the US.

Moreover, Kohler (2010) stated that several currencies depreciated sharply against the US dollar during the 2008 GFC, possibly owing to capital outflows. For instance, Mwega (2010) argued that the 2008 GFC partly contributed to a significant decline in the current account deficit in Kenya with adverse effects on the exchange rate and foreign exchange reserves between 2008 and August 2009. Mwega (2010) also demonstrated that the 2008 GFC led to substantial capital outflows driven by offloading of shares by foreigners at the Nairobi Securities Exchange (NSE). This could have partly contributed to the 35 percent decline in the NSE 20-Share Index which was witnessed in 2008 (Mwega, 2010).

Furthermore, the 2008 GFC affected the energy and credit default swap markets which often remained insulated from prior crises (Guo, Chen & Huang, 2011). This suggests that the crisis might have significantly influenced the behaviour of commodity prices (inflation rate), bank lending (lending rate) and overall economic growth. For instance, by increasing the likelihood of default on loans, the 2008 GFC could have constrained the ability of commercial banks to transfer credit risk to third parties which might have led to rising lending rates.

A financial crisis could also lead to an economic slowdown and depress capital markets which serve as a major source of investment funds for firms. This could in turn undermine investments and trigger sharp declines in commodity prices and inflation rate (Bermingham *et al*., 2012). Moreover, as commodity prices fall, profits are also likely to drop leading to declining stock market returns. Therefore, shocks from the 2008 GFC could result into both falling inflation rate and declining stock market returns (hence a positive relationship between inflation rate and stock market returns).

On the other hand, periods of a financial turmoil could lead to higher lending rates as commercial banks seek to cushion themselves from credit risks (Illes & Lombardi, 2013). This could in turn depress investments and economic growth and translate into declining stock market returns. Likewise, during periods of a financial crisis, individuals and firms may significantly reduce their uptake of bank loans leading to reductions in lending rates. This could in turn lead to lower investments and reduced cash flows for firms listed at a stock market. For example, International Monetary Fund (IMF, 2009b) revealed that commercial banks in Kenya experienced a significant drop in profits during the second half of 2008 and the first half of 2009. Thus, shocks from a financial crisis may be associated with rising or falling lending rates vis-a-vis declining stock market returns. Hence, the relationship between lending rate and stock market returns can either be positive or negative.

Generally, two theories have been applied to determine the drivers of stock market returns. These include the Capital Asset Pricing Model (CAPM) by Sharpe (1964) and Lintner (1965), and the Arbitrage Pricing Theory (APT) developed by Ross (1976). The CAPM predicts that the rate of return of a specific stock is linearly determined by a single common factor which is the rate of return of the market portfolio. This theory is often regarded as incomplete in describing risk to a stock return since many factors, not just the market rate of return, explain asset returns. Furthermore, no single number can adequately capture a stock's sensitivity to the several different kinds of changes in any given economy. On the other hand, the APT assumes that stock market return is a linear function of several factors. However, APT neither identifies the factors nor the number of factors to be included in the model (Elton *et al*., 2011). Furthermore, various forms of the multifactor model tend to use fundamental factors such as price-to-earnings ratio, degree of liquidity of an asset, and market capitalization (French & Fama, 1993; Pastor & Stambaugh, 2003) which investors find difficult to relate directly to stock market returns.

Nonetheless, to effectively assess and manage investment risks, investment practitioners require a multifactor model which incorporates widely understood economic factors that clearly and significantly affect stock market returns over a long period of time. Such multifactor models need to employ macroeconomic drivers of stock market returns, especially the variables which affect future cash flows of firms and paint a broad picture of the macroeconomy. An example of such a macroeconomic factor model is the five factor model by Burmeister, Roll and Ross (1994) also known as the BIRR model. This model considers the difference between the risky corporate bond and government bond (which represents confidence risk), the difference between the 20-year government bond and the 30-day Treasury Bills rate (which represents an investment time horizon risk), inflation risk (sensitivity to changes in unexpected inflation rate), business cycle risk (sensitivity to unexpected changes in business activity), and market timing risk (sensitivity to movements in stock market that cannot be attributed to other factors).

Therefore, based on these theories, different factors seem to drive stock market returns. However, following Chen, Roll and Ross, (1986); Gupta and Modise (2013); and Ikoku and Husseini (2013), this study applied a macroeconomic factor model within a bivariate and multivariate framework to explain how changes in exchange rate, inflation rate and interest rate influence stock market returns in Kenya.

Stock market returns, exchange rate, month-on-month inflation rate, year-on-year inflation rate, 3-month Treasury Bills rate and lending rate exhibited different evolution paths over the period 1st January 1993 to 31st December 2015. These paths might have been as a result of different factors such as shocks from heightened political activities, financial crises and fluctuations in energy costs. Figure 1.1 shows trends of the KSH/USD exchange rate in comparison to stock market returns.

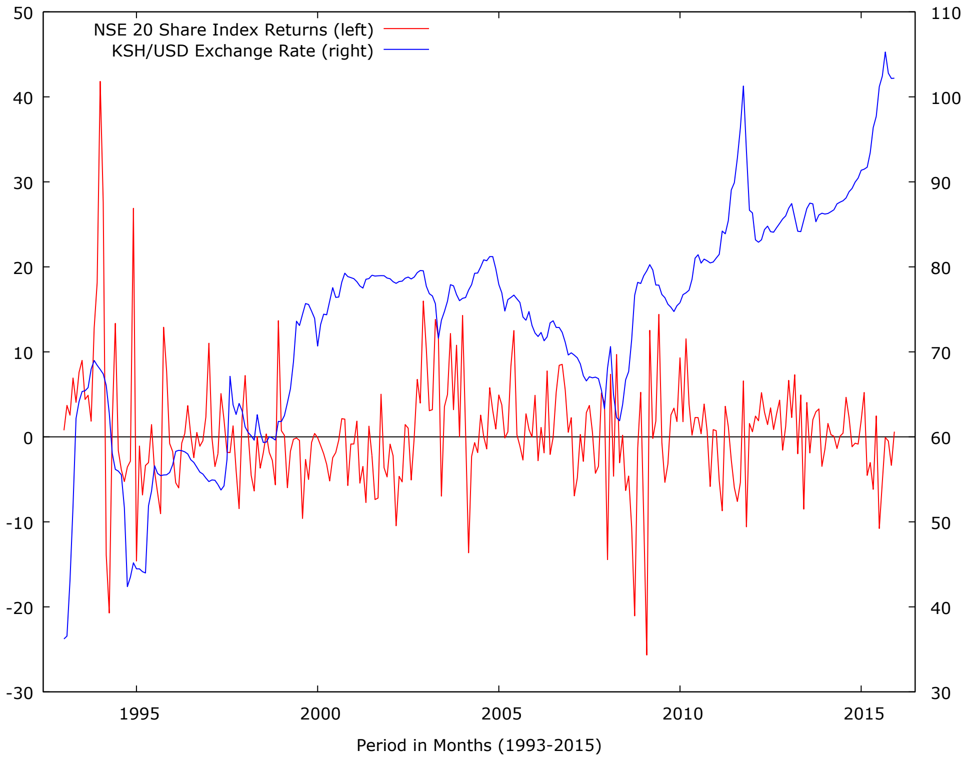

Figure 2.1: The NSE 20 Share Index Returns and KSH/USD Exchange Rate

It is evident from Figure 1.1 that exchange rate was volatile and increased with time while the trend of stock market returns was relatively less volatile and closely reflected a stationary behaviour. Furthermore, the volatility of the exchange rate depicted in Figure 1.1 suggests that the macroeconomic environment during the period was relatively unpredictable which must have lowered the participation of foreign investors and triggered the declines in stock market returns as displayed by the time series plots. For instance, Figure 1.1 shows that exchange rate consistently depreciated while stock market returns were on a downward trend from around 2010 till 2015. This depreciation of the domestic currency, especially from 2013, could possibly have been driven by capital outflows triggered by the high interest rates in the

US following the introduction of the 2013/14 tight monetary policy (i.e., the tapering effect). This capital outflow might have in turn led to the decline in stock market returns as foreign investors scaled down their investments in the Nairobi Securities Exchange (NSE).

Therefore, understanding the behaviour of the exchange rate is particularly critical since foreign investors account for over 50 percent of the participants at the Nairobi Securities Exchange (NSE) (Mwega, 2010; Kestrel Capital, 2014; Ndwiga & Muriu, 2016). In addition, the low stock market returns recorded around 1997, 2002, and between 2007 and 2009 may be attributed to uncertainties associated with the general elections in Kenya. Specifically, the poor performance of the NSE witnessed between 2007 and 2009 might have been due to the effects of the post-election violence coupled with the impact of the 2008 GFC.

Inflation rate is also a significant driver of stock market returns. This is clearly depicted in Figure 1.2 which displays time series plots of the NSE 20 Share Index returns and the two measures of inflation rate namely; the month-on-month inflation rate and the year-on-year inflation rate from 1st January 1993 to 31st December 2015.

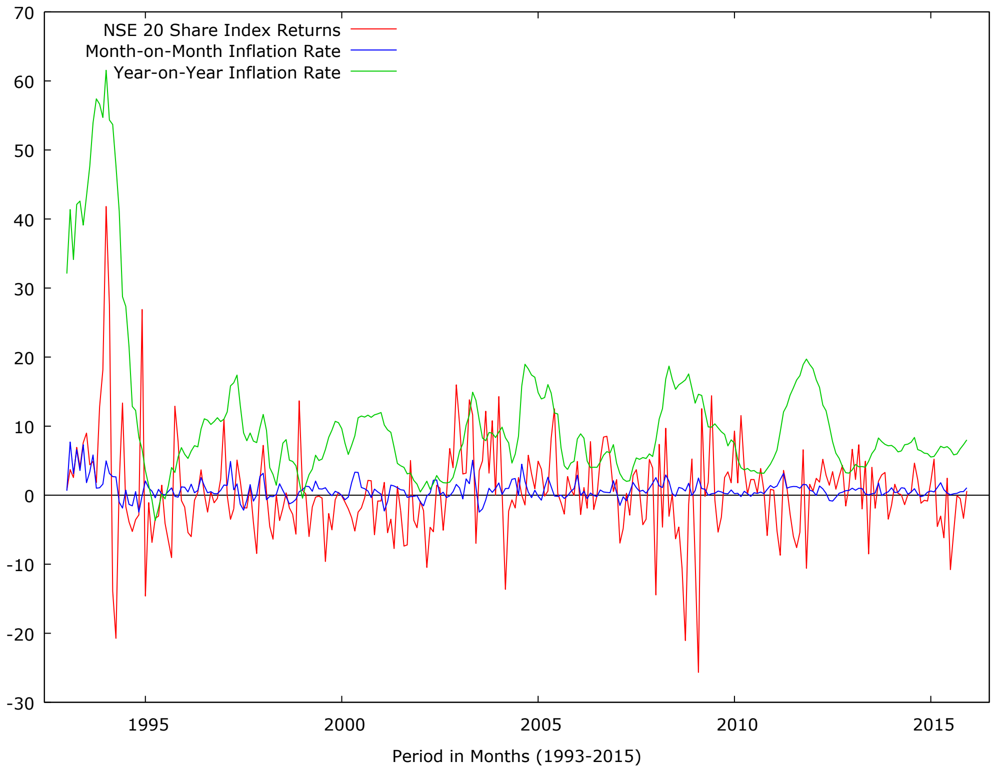

Figure 1.2: NSE 20 Share Index Returns, Month-on-Month Inflation Rate and Year-on-Year Inflation Rate

The time series plots in Figure 1.2 reveal that the month-on-month inflation rate was the least volatile out of the three time series, appearing to have a stationary mean and variance over the sample period. In contrast, the year-on-year inflation rate seems to have been the most nonstationary both in mean and variance. However, the year-on-year inflation rate does not exhibit the trend of a pure nonstationary variable (i.e. it does not continuously trend downwards or upwards). Likewise, the NSE 20 Share Index returns did not exhibit the characteristics of a pure stationary or I (0) time series, given its slow mean reversion (or apparent persistence). On the other hand, the high values of the year-on-year inflation rate between 1993 and 1994 might be attributed to a lag in the effects of the large sums of money distributed to the public by politicians during the 1992 general elections. However, the year-on-year inflation rate appears to have remained fairly high over the period possibly driven by high energy costs. Furthermore, high inflation rates often tend to translate into high interest rate policies which in turn depress the stock market returns through rising cost of capital and reduced investment expansion. Rising inflation rate may also lower the competiveness of a country's exports since it leads to an appreciation of the domestic currency. A stable inflation rate regime is therefore essential in raising and maintaining investor confidence, especially among foreign investors who are the majority at the NSE (Mwega, 2010; Ndwiga & Muriu, 2016).

Investors are also often concerned about fluctuations in interest rate with high interest rates generally expected to result into declining stock market returns (Copeland, Koller & Murrin, 1994; Damadoran, 1998). On the other hand, rising lending rates could constrain the uptake of loans by individuals and corporations and undermine investments as well as overall economic growth. Figure 1.3 compares the time series plots of the stock market returns to those of the two measures of interest rate (i.e. the 3-month Treasury Bills rate and lending rate) from 1st January 1993 to 31st December 2015.

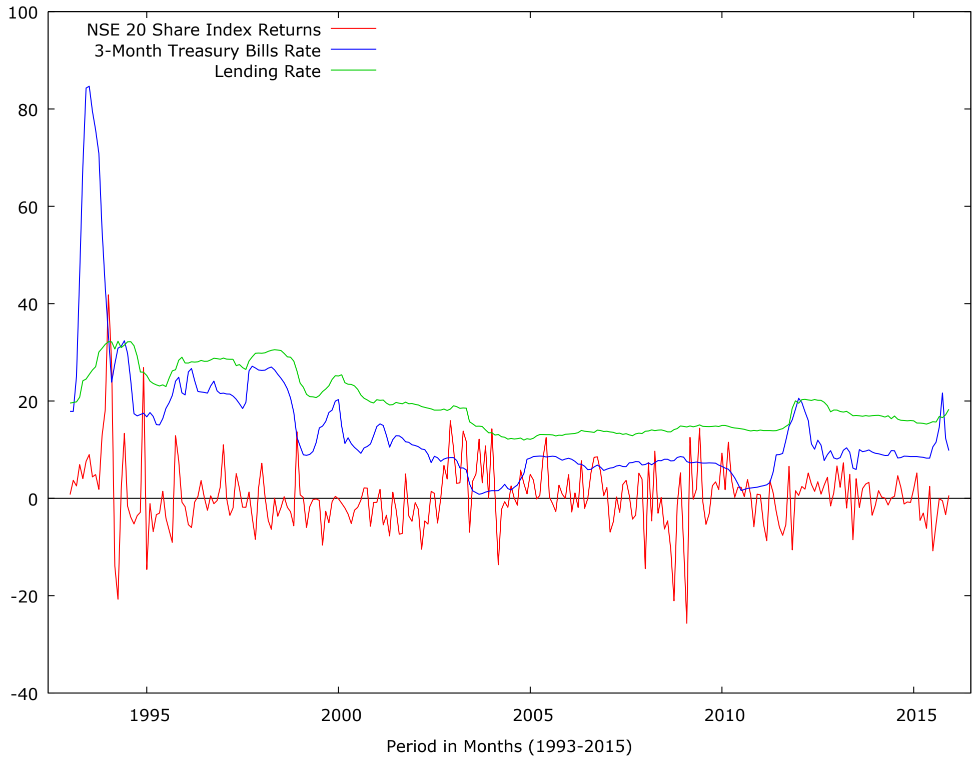

Figure 1.3: The NSE 20 Share Index Returns, 3-Month Treasury Bills Rate and Lending Rate

It is evident from Figure 1.3 that while the NSE 20 Share Index returns seem to have been stationary over the period, the 3-month Treasury Bills rate and lending rate exhibited characteristics of nonstationary time series. However, the two series did not seem to be purely nonstationary since they were not persistently increasing or decreasing with time. Furthermore, the 3-month Treasury Bills rate appears to have been very high between 1993 and 1994. A possible explanation for this is that most investors (especially domestic individual investors) might have shifted from the stock market to the safer government debt instrument following the turbulences of the 1992 general elections. However lending rate and the 3-month Treasury Bills rate remained fairly stable from 2002, probably due to the macroeconomic policies introduced by the new political regime.

1.2 Statement of the Problem

Stock market returns play significant roles in the economy. First, stock market returns act as leading economic and financial indicators and as early warning signs (Hamrita & Trifi, 2011). Second, stock market returns provide a source of information regarding the expectations and risk attitudes of the market. Stock market returns also facilitate an evaluation of investments and offer attractive properties for conducting statistical analyses (Lo, Campbell & Mackinlay, 1997). In summary, stock market returns provide useful information for making various forecasts, developing regulatory rules, constructing portfolio strategies or determining implications of policies.

Clearly, stock market returns are a function of exchange rate, inflation rate, and interest rate (Chen, Roll & Ross, 1986; Gupta & Modise, 2013; Ikoku & Husseini, 2013; Iqbal *et al.*, 2012). It is therefore important to have a clear understanding of the stochastic properties of stock market returns as well as the properties of the individual macroeconomic variables, including those of the respective cointegrating residuals. This is because these properties determine the extent to which the variables or their cointegrating residuals revert to equilibrium levels after experiencing a disturbance.

However, debate on the stochastic properties of stock market returns and each of the macroeconomic variables remains unsettled. For instance, majority of existing studies use standard unit root tests and either conclude that stock market returns are stationary (Kganyago & Gumbo, 2015; Ouma & Muriu, 2014) or nonstationary (Cakan & Ejara, 2013; Erita, 2014; Kimani & Mutuku, 2013) at level.

Similarly, some studies establish that exchange rate, inflation rate, and interest rate are nonstationary at level (Erita, 2014; Kimani & Mutuku, 2013; Kuwornu & Owusu-Nantwi, 2011). In contrast, other studies report stationarity of exchange rate (Kumar & Puja, 2012; Nataraja *et al*., 2015); inflation rate (Kganyago & Gumbo, 2015; Pal & Mittal, 2011) and interest rate (Ouma & Muriu, 2014) at level.

Additionally, vast literature on cointegration presumes that each of the macroeconomic variables and stock market return is I (1) and their cointegrating residuals are I (0) such that deviations from the long run equilibrium are corrected quickly. However, the variables as well as the cointegrating residuals might be long memory processes, suggesting that deviations from long run equilibrium are more persistent but eventually disappear (Caporin *et al*., 2011; Cheung & Lai, 1993; Cheung, 2007; Okunev & Wilson, 1997).

Moreover, whereas most empirical studies employ the error correction model (Gohar *et al*., 2014; Kganyago & Gumbo, 2015; Nataraja *et al*., 2015) to examine causal relationships between the macroeconomic variables and stock market returns, very few studies examine the short run and long run relationships between the macroeconomic variables and stock market returns through the Fractionally Integrated Error Correction Model (FIECM) (Aloy *et al*., 2010; Caparole & Gil-Alana, 2016; Kiran, 2011).

Likewise, shocks from a financial crisis could influence the relationship between the macroeconomic variables and stock market returns (Amaefula & Asare, 2013; Chan, Gup & Pan, 1997; Kganyago & Gumbo, 2015). However, this has attracted very little attention from majority of existing studies which focus more on the main effects (or additive) models (Ouma & Muriu, 2014; Kirui, Wawire & Onono, 2014; Kumar & Puja, 2012; Razzaque & Olga, 2013).

This study therefore examined the relationship between the macroeconomic variables and stock market returns within the context of an Auto-Regressive Fractionally Integrated Moving Average (ARFIMA) framework and product-term regression models. This is because these models are capable of providing a deeper understanding of the stochastic behavior of the individual variables and the relationships between them.

1.3 Objectives of the Study

The main objective of the study was to examine the influence of the selected macroeconomic variables on stock market returns in Kenya. Specifically, the study sought to:

i. Examine the stochastic properties of exchange rate, inflation rate, interest rate, stock market returns and their cointegrating residuals.

ii. Determine the relationship between exchange rate and stock market returns in Kenya.

iii. Establish the relationship between inflation rate and stock market returns in Kenya.

iv. Examine the relationship between interest rate and stock market returns in Kenya.

v. Investigate the effect of the 2008 Global Financial Crisis on stock market returns in Kenya.

1.4 Research Hypotheses

The study tested the following alternative hypotheses:

i. Exchange rate, inflation rate, interest rate, stock market returns and their cointegrating residuals are fractionally integrated.

ii. Exchange rate has a positive effect on stock market returns in Kenya.

iii. Inflation rate has a positive effect on stock market returns in Kenya.

iv. Interest rate has a negative effect on stock market returns in Kenya.

v. The 2008 Global Financial Crisis had an effect on stock market returns in Kenya.

1.5 Significance of the Study

This study extends the literature on unit root and cointegration analyses from the integer-based approach to a fractionally integrated framework which offers a flexible way of examining mean reversion in variables as well as in their cointegrating relationships. Additionally, the study extends existing literature by investigating how the 2008 GFC might have affected the relationship between the macroeconomic variables and stock market returns in Kenya. This has attracted very little attention in existing studies.

Regarding contribution to policy, the results and conclusions from this study could be of interest to stock market participants, researchers, the Central Bank of Kenya (CBK), and the Capital Market Authority (CMA), among others. Clearly, knowledge of the stochastic behaviour of stock market returns, exchange rate, inflation rate and interest rate should aid these stock market participants in understanding the trends in the economy, in designing portfolio strategies and in comparing returns of various investments (i.e. in making investment decisions).

Also, the distinction between stationarity, nonstationarity and long memory in the individual variables might be important from a practical point of view. In particular, this distinction can be usefully incorporated into policy decisions. For instance, if exchange rate, inflation rate, interest rate or stock market returns are expected to be stationary yet they are long memory processes with integration orders less than but close to 1, no active policy intervention might be implemented when a turbulence occurs while in real sense such an action is required. This is because shocks to such time series are likely to persist which could lead to the establishment of a new but harmful equilibrium level in the long run.

Likewise, a clear understanding of long memory properties of stock market returns might be helpful to investors who seek to exploit the existence of arbitrage opportunities in stock markets by constructing arbitrage portfolios. This is because the long memory in stock market returns can be exploited to accurately predict the future trends of the time series and consistently earn profits with zero initial outlay.

Furthermore, the assumption that stock market returns follow a short memory process while they are actually long memory processes has implications for the application of statistical inference and standard asset pricing models. This is because such statistical inferences and asset pricing models often rely on the assumption of short memory and normality. Consequently, the models might fail to provide appropriate results in the presence of long memory.

Equally, if the cointegrating residual for each of the macroeconomic variables and stock market returns is itself a long memory process but is mistaken to be stationary, policy intervention might not be carried out even though such an action is necessary. The reason is because adjustment to long run equilibrium for the long memoried cointegrating residual is much slower and costs associated with the persistence in deviations might be very high. Therefore, understanding the rate of convergence to long run equilibrium can lead to improved predictions and be of significant benefit to stock market participants as well as policymakers.

Finally, understanding the difference in the sensitivity of stock market returns to changes in the macroeconomic variables during and after a financial turbulence in comparison to the period before the turbulence should be of great use to policymakers and investment practitioners. This is because policymakers may need to take such information into consideration while evaluating implications of various policies. On the other hand, investment practitioners should incorporate such information in the design investment strategies aimed at maximizing gains.

1.6 Scope of the Study

The study used monthly data spanning the period 1st January 1993 to 31st December 2015. Moreover, whereas several factors influence stock market returns, this study focused on the macroeconomic factors such as exchange rate, inflation rate and interest rate because they are widely identified as leading determinants of stock market returns (Burmeister, Roll & Ross, 1994; Chen, Roll & Ross, 1986; Gupta & Modise, 2013; Ikoku & Husseini, 2013; Iqbal *et al.*, 2012).

To empirically determine the integration orders of the individual variables, the study employed the ARFIMA-based exact maximum likelihood (EML) estimation strategy by Sowell (1992). The study also conducted residual-based conventional and fractional cointegration analyses to examine the relationship between each of the macroeconomic variables and stock market returns. It also investigated the presence of a causal relationship between each of the macroeconomic variables and stock market returns using an error correction mechanism (ECM) as well as through a fractionally integrated error correction mechanism (FIECM).

In addition, this study employed an Autoregressive Distributed Lag (ARDL) cointegration analysis to examine the joint long run relationship between the macroeconomic variables and stock market returns. It also examined short run and long run causal relationships between the macroeconomic variables and stock market returns using an ARDL-based vector error correction model (VECM).

To investigate the effect of the 2008 GFC on stock market returns, this study split the sample data into three different periods. These included the pre-crisis period (from 1st January 1993 to 31st December 2007); the crisis period (from 1st January 2008 to 30th June 2009); and the post-crisis period (1st July 2009 to 31st December 2015). The choice of these periods was based on previous usages by Usman (2010), Adamu (2010), Ali and Afzal (2012) and the report by the National Bureau of Economic Research (NBER) of 2008.

Additionally, while some of the previous studies considered daily, weekly or even higher frequency data, this study employed monthly data to avoid noise that is associated with high frequency data. Furthermore, most empirical studies investigate the effect of expected values of the macroeconomic variables on expected stock market returns since they focus on testing the efficiency hypothesis. This study however concentrated on examining the effect of actual macroeconomic variables on actual stock market returns. This is because the study based its analysis on the rational expectations theory which assumes that investors utilize all available information optimally to make forecasts such that movements in actual and expected values of the macroeconomic variables are equal (Alagidede & Panagiotidis, 2010; Rushdi *et al*., 2012).

1.7 Organization of the Thesis

This thesis is structured into five chapters. Chapter one presents the motivation of the study and gives a summary of key issues in the existing literature. It also provides the research issue, the research objectives, the specific hypotheses as well as the significance and the scope of the study.

Chapter two provides a review of theoretical and empirical literature on the relationship between each of the macroeconomic variables and stock market returns. Specifically, it identifies the theories that explain the relationship between exchange rate and stock market returns. The chapter also discusses theories which explain the relationship between inflation rate and stock market returns. It equally analyzes the theories that link interest rate to stock market returns. The chapter also discusses the empirical studies on the bivariate relationships between each of the macroeconomic variables and stock market returns. It ends by providing an overview of the literature and pointing out the existing gaps.

In chapter three, the study discusses the methodology. The first section presents the theoretical frameworks adopted by the study. Section two of the chapter contains data types and sources while section three discusses the estimating and testing techniques.

Chapter four presents, discusses and interprets the empirical results of the study. It also links the results to the available theoretical explanations and existing empirical studies. The chapter also offers possible explanations where none is available from existing theories.

Finally, chapter five summarizes the study, highlights the major results and describes how the results may be put into practice by various stakeholders. The chapter also presents the contributions to knowledge and points out the limitations of the study. It also suggests possible directions for future studies.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents the theoretical as well as the empirical literature on the relationship between each of the selected macroeconomic variables and stock market returns. The chapter begins by presenting the theoretical literature on the relationship between exchange rate and stock market returns. It then provides the theoretical literature on how inflation rate influences stock market returns. The theoretical review ends by explaining the relationship between interest rate and stock market returns.

On the other hand, the empirical literature review starts by discussing existing studies on how stock market returns relate to exchange rate. It then presents the empirical studies on the relationship between inflation rate and stock market returns. The empirical literature review then provides existing studies on the relationship between interest rate and stock market returns. The chapter concludes by presenting an overview of the reviewed literature and highlighting the identified research gaps.

2.2 Theoretical Literature Review

2.2.1 Exchange Rate and Stock Market Returns

Within the theoretical literature, which is dominated by two models namely; the traditional or Flow-Oriented model (Dornbusch & Fischer, 1980), and the Portfolio Balance Theory/Stock-Oriented model or Asset Market Approach (Branson, 1983; Frankel, 1983), there is no consensus on the nature of the relationship between exchange rate and stock market returns. For instance, the Flow-Oriented model ,which focuses on the current account or trade balances, hypothesizes that movements in exchange rate influence the competitiveness and profitability of firms and consequently cause changes in stock prices/returns. Specifically, the model argues that an appreciation of the domestic currency should stimulate the stock market of an import-dependent country by making imports cheaper. This in turn should result into a net increase in the stock market returns. In contrast, the model assumes that exchange rate depreciation should depress the stock market of the import-dependent country and translate into a net decline in stock market returns. Thus, the model suggests that a negative effect originates from the exchange rate market to the stock market of an import-oriented country.

Conversely, the Flow-Oriented model asserts that an appreciation of the domestic currency depresses exports of an export-oriented country, causing a negative change in the balance of trade. Consequently, stocks of the exporting companies lose demand in the international market and stock market returns decline. In contrast, the model posits that a depreciation of the domestic currency of an export-oriented country leads to increased demand for exports in the international market thereby boosting the balance of trade and translating into rising stock market returns. This model therefore demonstrates that a positive causality runs from the exchange rate market to the stock market for an export-oriented country. Accordingly, by identifying exchange rate as a driver of stock market returns, the Flow Oriented model serves as a special type of a macroeconomic factor model (Burmeister, Roll & Ross, 1994).

On the other hand, the Stock Oriented model argues that capital flows, not trade flows, determine the changes in exchange rate. Put differently, the model argues that the stock market affects the exchange rate market. In particular, this model asserts that changes in exchange rate are influenced by the supply and demand of domestic assets such as stocks and bonds. This suggests that a persistent increase in domestic stock market returns attracts more foreign investors and translates into an increased demand for the domestic currency. This increased demand causes a rise in the inflow of foreign capital and in turn induces an appreciation of the domestic currency.

The Stock Oriented model also suggests that a decrease in domestic stock market returns leads to a fall in the demand for domestic currency by foreigners. The decreased demand for money in turn translates into lower domestic interest rates and induces capital outflows. As a result, the domestic currency depreciates. Thus the model postulates that the stock market return is the lead variable with a negative causality originating from the stock market to the exchange rate market.

2.2.2 Inflation Rate and Stock Market Returns

Fisher (1930) stated that expected rate of return of a financial asset (reflected by the nominal interest rate) should consist of expected real rate of interest and expected rate of inflation. According to this theory, expected real rate of interest is constant (only depends on the rate of return on capital) while the nominal rate of interest reflects all available information on the future levels of inflation rate. Consequently, the theory asserts that a permanent change in inflation rate should cause an equal change in the nominal interest rate. This suggests that nominal interest rate should respond positively on a one-for-one basis to a change in expected inflation rate.

Generalized to real assets, Fisher's theory (also known as Fisher Effect) suggests that common stock returns should consist of real stock returns and expected inflation rate. With the real stock returns being constant, an increase in expected inflation rate should lead to a one-for-one increase in common stock returns. This strict interpretation of the Fisher Effect suggests that stocks should provide an efficient hedge against rising inflation rates. Hence, if the theory holds, returns from stocks should compensate investors for increases in expected as well as in unexpected inflation rate. Thus by directly relating stock market returns to inflation rate (which is a macroeconomic variable), the Fisher Effect appears to have an intuition similar to that of a macroeconomic factor model.

On the contrary, the Proxy Effect (Fama, 1981) asserts that a negative correlation, which is not causal, exists between stock market returns and inflation rate. The theory argues that this negative correlation is derived from the positive correlation between stock market returns and real economic activity coupled with the negative correlation between inflation rate and real economic activity. According to the theory, rising inflation rate is expected to depress real economic activity. This should in turn negatively affect future corporate cash flows and reduce stock market returns.

Conversely, Feldstein (1980) argued that during inflationary periods, firms are subjected to increased tax liabilities which tend to reduce their real earnings. As result, rational investors develop a tendency to reduce common stock valuations during such periods to account for the effect of inflation. The argument then is that this reduction in valuation causes a decline in stock market returns. In other words, the Tax Effects Hypothesis (TEH) asserts that rising inflation rate increases the tax burden for firms which in turn reduces their real profits and depresses stock market returns. The theory therefore argues that rising inflation rate is negatively correlated with stock market returns. Based on these varied theoretical arguments, it appears that the theoretical literature on the relationship between inflation rate and stock market returns remains mixed and inconclusive.

2.2.3 Interest Rate and Stock Market Returns

Several theories have been used to explain the relationship between interest rate and stock market returns. For instance, Modern Portfolio Theory (MPT) by Markowitz (1959) states that the returns of a financial asset are only influenced by systematic or market risk. The theory asserts that the market risk is highly correlated across securities and includes macroeconomic variables such as interest rate, inflation rate and exchange rate. This theory therefore argues that investors, especially those with long term investment horizons, should only be compensated for bearing the risks posed by the macroeconomic variables (i.e. systematic risks). This is because risks not correlated with the economy (unsystematic risks) can be avoided at zero cost through portfolio diversification.

However, the MPT does not indicate how to measure risk as well as how risk is related to expected or required returns. Sharpe (1964) and Lintner (1965) addressed this limitation of the MPT by introducing the Capital Asset Pricing Model (CAPM). This model asserts that risk is positively related to required returns of an asset through a model represented as:

$$E[R_i] = R_f + \beta_i \left(E[R_m] - R_f \right) \text{...................(2.1)}$$

Where $E[R_i]$ is the return required/desired by investors to induce them into putting their money in equity/stock given the stock's riskiness. It is closely related to expected rate of return which is an individual investor's viewpoint on the future returns on a stock (i.e. the anticipated rate of return). However, expected rate of return is very subjective and depends on probabilities of a full range of returns on a particular stock/investment. Consequently, the required return is often viewed as the minimum level of the expected return an investor requires in order to invest in a particular stock. This implies that if an investor's expected rate of return exceeds his required rate of return, the investor will consider the stock undervalued and worth buying. On the other hand, if the expected return is below the required return, the investor will consider the stock overvalued and worth selling.

The difference between an investor's expected return and the required return is referred to as the expected abnormal return or expected alpha. This expected abnormal return can be positive, negative or zero depending on the efficiency of the stock market. Typically, when stocks are efficiently priced (i.e., when the stock's price equals its intrinsic value), the stock's expected rate of return often equals the investor's required rate of return. This implies that expected abnormal return reduces to zero.

On the other hand, E [Rm] in Eq. (2.1) is the expected return on the market portfolio while β_i measures the sensitivity of security i to the returns of the market portfolio (i.e. the covariance of security i with the returns of the market portfolio). R_f is the risk free rate which represents a rate of return on an asset with assured or almost assured payments. Usually, investors use yields in government debt instruments such as the Treasury Bills rates to represent the risk free rate. Moreover, the risk free rate commonly serves as a rate with which investors compare other investments such that if the rate of return of a planned investment is greater than the risk free rate, that investment is considered worth undertaking.

Conversely, $\left[E(R_m)-R_f\right]$ is the market risk premium (MRP) or the incremental return which investors require in order to invest in stocks rather than in the risk free assets such as the Treasury Bills. Like the required return, the MRP depends strictly on the stock's future cash flows.

Eq. (2.1) thus suggests that an increase in the required rate of return can result directly from an increase in the risk free rate, a rise in the market risk premium or an increase in both risk free rate and market risk premium. Consequently, when investors view the Treasury Bills rate as a risk free rate (i.e. as a component of the required rate of return), they will demand for higher required rate of return when the Treasury Bills rate rises. This suggests a positive relationship between stock market return (which is an estimate, grounded in market data, of the required rate) and the Treasury Bills rate.

However, Treasury Bills often serve as an alternative investment vehicle in comparison to stocks. Consequently, if investors view the Treasury Bills as a competing investment vehicle, an increase in Treasury Bills rate will attract a significant portfolio reallocation from stocks to the Treasury Bills given their assured payments. This suggests a negative relationship between the Treasury Bills rate and stock market returns.

Nevertheless, Eq. (2.1) does not clearly demonstrate how the risk free rate directly relates to stock market returns. This however becomes clearer in the Free Cash Flow to Equity (FCFE) model developed by Copeland, Koller and Murrin (1994) and Damadoran (1998). Therefore assuming that stocks are efficiently priced, the value of a stock should equal its price such that:

$$NR_t = \sum_{t=1}^{\infty} \frac{FCFE_t}{\left\{1 + R_f + \beta_i[\mathrm{E(R_m)} - \mathrm{R_f}]^t\right\}} ....(2.2)$$

where NR_t is the stock market return today, $FCFE_t$ is the free-cash-flow-to-equity at time t and measures the amount of cash flows generated in period t which is available for distribution to common shareholders.

Clearly, the denominator in Eq. (2.2) represents 1 plus the CAPM model represented by Eq. (2.1). Consequently, Eq. (2.2) demonstrates that a rise in the risk free rate increases the denominator (i.e. the discount rate) and results into declining stock market returns. Hence, using the Treasury Bills rate as a proxy for risk free rate, an increase in the Treasury Bills rate should translate into declining stock market returns.

Additionally, assuming that firms listed at a stock market can finance their investments through commercial bank loans (debt financing), rising lending rates are expected to increase interest expenses on loans and reduce investments, including future cash flows. In contrast, lower lending rates should make investment financing cheaper and boost economic growth and future streams of cash flows. This suggests that a negative relationship should exist between lending rate and stock market returns.

These arguments therefore demonstrate that stock market returns are a declining function of Treasury Bills rate and lending rate. This clearly coincides with the predictions of a macroeconomic factor model which takes interest rate as one of the macroeconomic determinants of stock market returns.

2.3 Empirical Literature Review

2.3.1 Exchange Rate and Stock Market Returns

Similar to the theoretical literature, the empirical literature on the relationship between exchange rate and stock market returns suffers from several controversies. The first controversy regards the stationarity of exchange rate and stock market returns as well as that of the rate at which the long run relationship between the two variables is restored following an external shock from political, economic or financial disturbances.

For instance, a group of empirical studies employed standard integration technique (i.e. ADF, PP & KPSS tests) to determine the stationarity of exchange rate and stock market returns but found conflicting results (Jawaid & Anwar, 2012; Kisaka & Mwasaru, 2012; Kumar & Puja, 2012; Kuwornu & Owusu-Nantwi, 2011; Ouma & Muriu, 2014; Zia & Rahman, 2011). Specifically, Kisaka and Mwasaru (2012) used the Augmented Dickey-Fuller (ADF) unit root test and established that exchange rate and stock market returns are nonstationary in their levels as well as in their first differences in Kenya.

On the other hand, ADF test results by Jawaid and Anwar (2012), Kuwornu and Owusu-Nantwi (2011) as well as by Zia and Rahman (2011) challenged the results by Kisaka and Mwasaru (2012). Unlike Kisaka and Mwasaru

(2012), these authors established, based on data from Pakistan, Ghana, and Pakistan respectively, that exchange rate and stock market returns were not stationary in levels but became stationary in their first differences. In contrast, Kumar and Puja (2012), through ADF and PP tests, established that exchange rate was stationary in level form while stock market returns were nonstationary in levels but stationary in first difference in India. However, Ouma and Muriu (2014), through ADF test and data from Kenya disagreed with the rest of the researchers and concluded that both exchange rate and stock market returns were stationary in their level forms.

The paradox then is that if all these results are taken to be correct, exchange rate and stock market returns are at one point stationary and at other times nonstationary in level form. This does not make much economic or financial sense and should pose a dilemma to investors, stock market regulators and policymakers.

These conflicting results could however be attributed to the predominant use of the restrictive I(0)/I(1) dichotomy which assumes that the variables evolve over time only though integer orders of integration (Caporin *et al*., 2011). The existing studies therefore seem to overlook the possibility that evolution of the variables could be through non-integer orders of integration which the standard integration techniques cannot capture (Diebold & Rudebusch, 1991). As a result, by applying exact differencing, such studies tend to either over-or under-difference the variables. This may in turn lead to loss of vital information regarding the behaviour of investors (Huang, 2010).

Results from studies that have applied standard multiple regression techniques to determine the contemporaneous relationship between the selected macroeconomic variables and stock market returns also remain mixed and inconclusive (Ahmad *et al*., 2010; Buyuksalvarci, 2010; Kirui, Wawire & Onono, 2014; Kumar & Puja, 2012; Ouma & Muriu, 2014). For instance, while Ahmad *et al*. (2010) established that depreciation of the exchange rate resulted into rising stock market returns in Pakistan (which provides support for the Flow-Oriented model for export-dependent countries), Buyuksalvarci (2010) contradicted this by showing that exchange rate depreciation instead led to declining stock market returns in Turkey (a stand that is consistent with the Flow-Oriented theory's prediction for an import-dependent country). In direct contrast to these results, Kumar and Puja (2012) demonstrated that depreciation of exchange rate only marginally stimulated the Indian stock market which partially supports the prediction of the Flow-Oriented model for an export-dominated country. However, Ouma and Muriu (2014) as well as Kirui, Wawire and Onono (2014) disagreed with Kumar and Puja (2012), arguing that, instead, exchange rate depreciation had a negative effect on stock market returns in Kenya. This suggests that depreciation of the exchange rate resulted into a decline in stock market returns in Kenya, as predicted by the Flow-Oriented model for an import-dependent firm/country.

In the same vein, consensus lacks in the results of studies that have focused on the long run/ static and dynamic relationships between exchange rate and stock market returns (Cakan & Ejara, 2013; Jawaid & Anwar, 2012; Kisaka & Mwasaru, 2012; Kumar & Puja, 2012; Nataraja *et al.*, 2015; Zia & Rahman, 2011).

For example, Zia and Rahman (2011), using Johansen procedure for co-integration test, showed that stock market returns and exchange rate in Pakistan were not cointegrated. This implies that the evolution paths of the variables were different such that they did not move closely together in the long-run. In contrast, Kisaka and Mwasaru (2012) used an ECM and established that stock market returns and exchange rate were cointegrated in Kenya. This suggests that the variables move closely together in the long run.

Regarding Granger causality, Cakan and Ejara (2013) found a bidirectional linear causality between stock market returns and exchange rate for Turkey, Thailand, Brazil, India, Indonesia, Philippines, Singapore and Poland using standard Granger causality test. This supports both the Flow-Oriented as well as the Stock Oriented models. It also means that a feedback mechanism exists between the stock market and exchange rate markets in these countries.

Cakan and Ejara (2013) however established a linear unidirectional causality from stock market returns to exchange rate for India. This implies that information on stock market returns add significant predictive power in the forecast of future values of exchange rate. It further means that India might implement exchange rate management policies without having adverse effects on the stock market. In contrast, the same authors revealed that exchange rate linearly Granger caused stock market returns for Taiwan which supports the Flow-Oriented model (Dornbusch & Fischer, 1980).

However, using nonlinear Granger causality, Cakan and Ejara (2013) failed to establish causality from stock market returns to exchange rate for Brazil, Poland and Taiwan. They however found a nonlinear bi-directional Granger causality for India, Indonesia, Korea, Mexico, Philippines, Russia, Singapore, Thailand and Turkey. The authors also established that Brazil and Poland exhibited a significant non-linear Granger causality from stock market returns to exchange rate suggesting that stock market returns had predictive power on the future trends of exchange rate. Likewise, Jawaid and Anwar (2012) established a bidirectional causality between exchange rate and stock market returns for Pakistan using standard Granger causality test.

These results seem to suggest that bidirectional rather than unidirectional causality dominates the causal relationship between exchange rate and stock market returns. Nevertheless, some of the studies purely demonstrated that exchange rate was the lead variable thus supporting the Flow-Oriented theory (Kisaka & Mwasaru, 2012; Kumar & Puja, 2012; Nataraja *et al*., 2015). In direct contrast, Zia and Rahman (2011) failed to detect any causality between exchange rate and stock market returns using standard Granger causality test.

On the other hand, a few empirical studies have employed fractional integration and cointegration techniques to determine the extent to which exchange rate, stock market returns and their cointegrating residuals evolve over time (Aloy *et al*., 2010; Balparda *et al.,* 2015; Nazarian *et al*., 2014). In particular, using Robinson (1994) test, Aloy *et al*. (2010) established that deviations from the long run equilibrium between exchange rate and stock market returns in France and the US exhibited slower mean-reversion rate than is assumed under the conventional cointegration test. This implies that the two variables were fractionally cointegrated and that applying conventional cointegration analysis might fail to adequately capture the long memory characteristic of the cointegrating residual.

Likewise, using Robinson's (1994) parametric approach, Balparda *et al*. (2015) established that the NSE 20 Share Index returns had an integration order significantly above 1. This suggests that the stock market index return is neither mean-reverting nor covariance stationary. This also shows that the stock market returns exhibit a higher degree of persistence in Kenya, calling into question results from standard models which assume that the variable evolves over time strictly through integer orders of integration. Furthermore, whereas Balparda *et al*. (2015) established that stock market returns in Kenya possess long memory, no study seems to have examined the possible existence of a fractional cointegration between exchange rate and stock market returns in Kenya.

Similarly, Nazarian *et al*. (2014) argued, using Exact Maximum Likelihood (EML), Modified Profile Likelihood (MPL) and Nonlinear Least Squares (NLS), that stock market return of Iran displayed a non-integer order of integration. This suggests that current shocks to the stock market return persist but eventually disappear albeit at a rate slower than is assumed for stationary variables. A detailed summary of previous studies on the relationship between exchange rate and stock market returns, including methodologies adopted and results is provided in Table A1 at the Appendix.

2.3.2 Inflation Rate and Stock Market Returns

Debate on the previous results on the stationarity of inflation rate, stock market returns and their cointegrating relationship remains unsettled. This is because whereas some of the studies found that inflation rate and stock market returns are nonstationary in levels (Alagidede & Panagiotidis, 2010; Kimani & Mutuku, 2013), implying that the variables do not revert to their long run mean values following a shock, other authors concluded that both variables are stationary in level form (Ouma & Muriu, 2014). Additionally, some authors concluded that stock market returns were stationary whereas inflation rate was nonstationary in level form (Kirui, Wawire & Onono, 2014). These empirical evidences sound contradictory because inflation rate and stock market returns cannot be sometimes stationary in levels but become nonstationary in level form at other different times. The conflicting results could however be attributed to the weaknesses of the conventional unit root tests in determining the integration orders of time series (Diebold & Rudebusch, 1991).

In contrast, other studies challenged the application of the restrictive I (0)/I (1) analysis to the individual time series and instead employed their fractional integration counterparts. For instance, Aye *et al.* (2012) used daily data from Brazil, Russia, India, China, and South Africa (BRICS) over the period 1995:09-2012:07 to examine existence of long memory in stock market returns. The authors employed Whittle estimator (WHI), the GPH estimator, Rescaled range estimator (RR) and Approximate Maximum Likelihood estimator (AML) and demonstrated that the differencing parameter of stock market returns was greater than 0.5 for Russia, India and China. This implies that the variable had nonstationary long memory but was mean reverting (see Table B3 at the Appendix). This further means that shocks to the variable remained persistent but eventually dissipated, letting the variable to return to its long run equilibrium level.

Similarly, Anoruo and Gil-Alana (2011) applied the Whittle function in the frequency domain and Robinson (1994) test to data from ten African countries (Kenya, Morocco, Tunisia, Nigeria, Egypt, Zimbabwe, Mauritius, Botswana, Namibia, and South Africa) and found that the d parameter of stock market returns was greater than one. This suggests that stock market returns in Kenya possess long memory but are not mean reverting. Despite this result, no study seems to have been designed to examine the possible existence of a fractional cointegration between stock market returns and inflation rate in Kenya. Additionally, Caparole and Gil-Alana (2011) employed Robinson (1994) and Whittle estimator to data from the US and supported that the d parameters of inflation rate and stock market returns were greater than one, suggesting long memory and no mean reversion (see Table B3 at the Appendix).

A clear contrast that emerges from these empirical results is that while those for the BRICS revealed presence of stationary long memory and mean reversion in stock market returns, the others indicated that stock market returns individually displayed nonstationary long memory and no mean reverting properties. The results further revealed that ARFIMA models yielded better forecasting results for the selected countries.

Most previous studies also employed regression techniques to examine the relationship between selected macroeconomic variables and stock market returns but failed to consider the possible moderating effects of qualitative independent variables such as the 2008 Global Financial Crisis. For instance, in their analysis, Alagidede and Panagiotidis (2010) used monthly data over the period February 1990 to December 2006 to test for existence of Fisher Effect in Egypt, Kenya, Nigeria, Morocco, South Africa and Tunisia. The authors employed parametric and nonparametric techniques and established a significant positive effect of inflation rate on stock market returns in all the markets excluding Kenya and Tunisia where the effect was positive but weak. This suggests existence of Fisher Effect in these countries and implies that their stock markets act as a hedge against inflation for the investors.

Likewise, Ouma and Muriu (2014), using monthly data from Kenya and ordinary least squares model, supported that stock market returns are positively related to inflation rate. However, the authors did not establish a one-for-one co-movement between the NSE 20 Share Index returns and inflation rate as predicted by the Fisher hypothesis which supports the result by Alagidede and Panagiotidis (2010). This suggests that the stock market in Kenya offers some but not full shelter to investors during periods of rising inflation rate. However, the strong positive effect of inflation rate on stock market returns drew support from Razzaque and Olga (2013) for Kazakhstan whereas the authors established a weak positive effect of inflation rate on stock market returns in Russia and Ukraine. Likewise, Demirhan (2016), using Fully Modified OLS (FMOLS) supported existence of Fisher Effect in Turkey.

In contrast to the first category of results, a group of studies established a negative relationship between inflation rate and stock market returns, suggesting that stock market performance declined during inflationary periods.

For instance, Anari and Kolari (2010) through simulation of data from the US over the period 1959 to 2008 established that inflation rate had a negative effect on stock market returns. This result was attributed to high inflation premium which was factored in the rate used to discount cash flows during inflationary periods. It therefore provided support for the Tax Effects Theory by Feldstein (1980). The negative relationship between inflation rate and stock market returns also got support from Niazi *et al*. (2011) who established the same in Pakistan using a linear regression model and monthly data from 2005 to 2009.

Similarly, while analyzing the effect of inflation rate on the performance of the NSE 20 Share Index, Kimani and Mutuku (2013) used quarterly data from Kenya over the period December 1998 to June 2010 and concluded that inflation rate had a significant negative effect on the NSE 20 Share Index returns. This implies that inflation rate actually erodes the wealth of investors in the Kenyan stock market, a stance that contradicts the results by Ouma and Muriu (2014) as well as Alagidede and Panagiotidis (2010).

Likewise, employing ordinary least squares (OLS) regression on monthly data from the US over the period February 1957 to September 2014, Azar (2015) established a strong negative relation between inflation rate and equity premium. The author however found that the estimated slope on the inflation rate was consistently different from -1 suggesting lack of a perfect negative relationship. On the whole, these results seem to suggest that the respective stock markets did not preserve wealth for investors during inflationary periods.

In direct contrast, using a multiple regression model, Kirui, Wawire and Onono (2014) argued that inflation rate had no impact on stock market returns in Kenya. The authors employed quarterly data over the period 2000 to 2012.This suggests that the Kenyan stock market does not suffer from exposure to inflation risk which contradicts the results by Ouma and Muriu (2014), Kimani and Mutuku (2013), and Alagidede and Panagiotidis (2010).

Likewise, disagreements exist between studies that focused on long run relationship between inflation rate and stock market returns. In particular, Kim and Ryoo (2011) employed a two-regime threshold vector error-correction model (TVECM) and monthly data from the US between 1900 and 2009. They found that stock market returns moved on a one-to-one basis with inflation rate in the long run, thus supporting the predictions of FE (Fisher, 1930). However, Kimani and Mutuku (2013) disputed the existence of FE when they applied Johansen-Juselius VAR-based cointegration test on data from Kenya. The authors instead established a significant negative long run relationship between inflation rate and stock market performance in Kenya, suggesting that the Nairobi Securities Exchange does not provide a hedge against inflationary pressures.

On the contrary, using ARDL bounds cointegration test and monthly data over the period March 2008 to March 2012, Ochieng and Adhiambo (2012) established a positive long run relationship between inflation rate and the NSE All Share Index returns in Kenya. The dissimilarity between the results by Kimani and Mutuku (2013) and Ochieng and Adhiambo (2012) might have been due to the differences in the adopted methodologies. This is because the ARDL procedure adopted by Ochieng and Adhiambo (2012) is considered superior to Johansen-Juselius VAR test when the variables included are a mixture of both I(1) and I(0) (Pesaran *et. al.*, 2001).

On the other hand, Pal and Mittal (2011), using Johansen's co-integration test and error correction mechanism (ECM), supported that a long run relationship existed between inflation rate and stock market returns in India. This suggests that the two variables moved closely together in the long run. However, the authors did not support existence of Fisher Effect since inflation rate was negatively related to stock market returns.

There is also no concurrence on the existence of Granger causality between inflation rate and stock market returns (Ada & Osahon, 2015; Dasgupta, 2012; Frimpong, 2011; Issahaku *et al.*, 2013). For example, Ada and Osahon (2015) found that causality ran from stock market returns to inflation rate in Nigeria, providing evidence in support of the Reverse Causality Hypothesis (RCH) (Geske & Roll, 1983). This means that knowledge of past values of stock market returns could help improve forecasts of inflation rate while the converse is not true. In direct contrast, Dasgupta (2012), using ECM, failed to establish either unidirectional or bi-directional causality between inflation rate and stock market returns in India. This suggests that the variables are driven by different factors in the long run.

On the other hand, Frimpong (2011) used monthly data over the period 1990:11-2007:12 to determine the direction of causality between Databank Stock Price Index returns, 3-month T-Bills rate, cedi/dollar exchange rate and a change in CPI as a proxy of inflation rate in Ghana. The author adopted standard Granger causality test and established that a unidirectional causality runs from inflation rate to stock market returns. The author also found a unidirectional causality from the other macroeconomic determinants to stock market returns. This result implies that past values of the macroeconomic variables are helpful in forecasting the future values of stock market returns which does not agree with Ada and Osahon (2015). Frimpong (2011) however got support from Issahaku *et al.* (2013) who employed Engle-Granger cointegration test, Vector Error Correction Model (VECM), Impulse Response Function (IRF) and Forecast Error Variance Decomposition (FEVD) and established a unidirectional causality originating from inflation rate to stock market returns in Ghana. The authors used monthly data over the period 1995:01-2010:12. These results support that information contained in the macroeconomic variables have predictive power on the performance of the stock market while the converse is not true.

However, a weakness in all these studies is that they seem to assume that the error correction term has to adjust towards equilibrium as envisaged under the standard cointegration framework whereas the equilibrium error term itself might follow a fractionally integrated process (Cheung, 2007; Okunev & Wilson, 1997). This is given credence by Kiran (2011) who applied fractional cointegration framework to monthly data from 1990 to 2009 and established that inflation rate (proxied by oil prices) and stock market returns were fractionally cointegrated for Germany, UK, US and Canada. This suggests a much slower adjustment process and higher overall costs of deviations from equilibrium than would be obtained through standard cointegration and Granger causality frameworks. The result further suggests that policy intervention may be required to drive back the two variables to their long run equilibrium should they be driven apart by either political or economic shocks.

Furthermore, very few studies consider the moderating effect of events such as the 2008 Global Financial Crisis (GFC) on the relationship between stock market returns and inflation rate. This is despite the evidence by Amaefula and Asare (2013) that the 2008 GFC had significant effects on the relation between stock market returns and exchange rate while inflation rate had a nonsignificant effect on stock market returns. This suggests that external shocks could moderate the degree of interdependence between the macroeconomic variables and stock market returns. A detailed summary of previous studies on the relationship between inflation rate and stock market returns, including methodologies adopted and results is provided in Table A2 at the Appendix.

2.3.3 Interest Rate and Stock Market Returns

Previous studies on the stationarity of interest rate and stock market returns remain controversial with some concluding that the two variables are nonstationary in their level form (Erita, 2014; Gohar *et al*., 2014; Pal & Mittal, 2011) which suggests that a shock to each of the variables persists into the indefinite future. Other studies however asserted that stock market returns were stationary at level form (Amarasinghe, 2015; Kirui, Wawire & Onono, 2014) suggesting faster decay of shocks while interest rates are nonstationary in levels (Amarasinghe, 2015; Gohar *et al*., 2014). Some authors also concluded that stock market returns and interest rate were both stationary in level form (Ouma & Muriu, 2014).

These studies however appear to have assumed that stock market returns and interest rate individually evolved over time only through integer orders of integration. The studies therefore failed to consider the possibility of long memory in the individual variables.

The results based on the integer orders of integration have however been challenged by other researchers who considered non-integer orders of integration for interest rate and stock market returns. For instance, Anoruo and Braha (2010) employed Geweke-Porter-Hudak (GPH) semi-parametric and wavelet estimators to returns of real estate investment trusts (REIT) in the US and supported presence of long memory. This suggests that investors in the REITs could develop consistent profitable strategies based on historical data. Similarly, Caparole and Gil-Alana (2010), using Whittle estimator and Robinson (1995) and data from Kenya over the period 1991:07-2009:03, established that lending rate, 3-month Treasury Bills rate and deposit rate had orders of integration greater than 1, suggesting long memory with no mean reversion. A similar order of integration was established for the NSE 20 Share Index returns by Balprada *et al*. (2015) using Robinson (1994) and daily data from Kenya over the period 2001:01-2009:12. Despite these results, no studies have been designed to examine the extent to which stock market returns and interest rate in Kenya may be fractionally cointegrated.

There also exists lack of consensus on the regression results with majority of the studies documenting a negative relationship between interest rate and stock market returns (Amarasinghe, 2015; Ahmad *et al*., 2010; Buyuksalvarci, 2010; Kganyago & Gumbo, 2015; Kuwornu & Owusu-Nantwi, 2011; Noor, Rubi & Catherine, 2011) while others find no significant effect of interest rate on stock market returns (Ado & Sunzuoye, 2013; Kirui, Wawire & Onono, 2014; Ouma

& Muriu, 2014). In particular, using OLS regression and monthly data from Sri Lanka over the period 2007:01-2013:12, Amarasinghe (2015) established that interest rate had significant negative effects on the Sri Lankan All Share Price Index (ASPI). This implies that rising interest rates depress the stock market either through reduction in loan uptake, rising interest expenses on repayment of loans or reduction of competitiveness in the export market.

Likewise, Ahmad *et al*. (2010) employed a multiple regression model and monthly data over the period 1998 to 2009 in Pakistan and established that changes in interest rate and exchange rate had negative effects on stock market returns. This appears to have been supported by Buyuksalvarci (2010) who used monthly data from 2003:01 to 2010:03. The author established that interest rate and exchange rate had negative effects on Istanbul Stock Exchange (ISE-100) Index returns in Turkey. A similar support came from Kganyago and Gumbo (2015) when they established a significant inverse relationship between money market interest rate and stock market returns in Zimbabwe.

Additionally, Kuwornu and Owusu-Nantwi (2011) established that Treasury Bills rate and exchange rate had significant negative effect on stock market returns in Ghana. The authors used monthly data of the 91-day Treasury Bills rate, exchange rate, consumer price index (CPI) and stock market returns from 1992:01-2008:12. The depressing effect of interest rate on stock market returns was also supported by Noor, Rubi and Catherine (2011) in Indonesia and

Malaysia when they used weekly data on Kuala Lumpur Composite Index (KLCI) return, Jakarta Composite Index (JCI) return and 3-month interbank offer rates over the period 1997:01-2009:12.

In contrast, Ado and Sunzuoye (2013) failed to establish any significant negative relationship between the Treasury Bills rate, lending rate and stock market returns in Ghana. Similarly, Ouma and Muriu (2014) concluded that interest rate had no significant effect on stock market returns in Kenya when they estimated the effect of interest rate, inflation rate and exchange rate on stock market returns using a multiple regression model. Likewise, Kirui, Wawire and Onono (2014) used a multiple regression model and resolved that interest rate and inflation rate had no impact on stock market returns in Kenya. These findings seem to suggest that stock market returns in Kenya are not exposed to interest rate risk. The results equally suggest that the stock market fully and immediately incorporates information contained in interest rates which implies an increase in the stock market's efficiency. However, all these studies seem to have paid little attention to the possible moderating effects of qualitative independent variables such as the shocks from the 2008 Global Financial Crisis.

Similarly, previous results based on long run relationship as well as on the direction of causality remain mixed and inconclusive with majority of them adopting standard cointegration and Granger causality frameworks. For instance, Jawaid and Anwar (2012) employed the error correction model (ECM) on monthly short term interest rate and banking sector stock returns from Pakistan over the period 2004:01-2010:12. The authors concluded that a significant negative short-run relationship exists between the short term interest rates and stock market returns. This provides support for the predictions of the Free Cash Flow to Equity model (Copeland, Koller & Murrin, 1994; Damadoran, 1998). It also implies that rising interest rate could depress the performance of the stock market either by reducing the uptake of credit and constraining investments or by shifting investments from stocks to more profitable bank deposits or fixed income securities.

Additionally, previous studies on Granger causality test provide conflicting results on the direction of causality between interest rate and stock market returns. Among such studies include Ado and Sunzuoye (2013), Amarasinghe (2015), Chirchir (2014), Jawaid and Anwar (2012) and Kumar and Puja (2012). For example, Ado and Sunzuoye (2013), Amarasinghe (2015), Jawaid and Anwar (2012) as well as Kumar and Puja (2012) established that a unidirectional causality originates from interest rates to stock market returns in Pakistan, Ghana, India and Sri Lanka, respectively. This suggests that information on the past values of interest rate was critical in predicting future values of stock market returns in the respective countries. However, Chirchir (2014) concluded that a bidirectional causality existed between interest rate and stock market returns in Kenya which implies that the money market and the stock market influence each other. The result by Chirchir (2014) was supported by Erita (2014) who established a bidirectional causality between interest rate and stock market returns in Namibia , implying a feedback mechanism between the money market and the stock market.

In contrast, Gohar *et al*. (2014) established a significant short run and long run relationship between interest rate and stock market returns in Pakistan but failed to establish any form of causality between the two variables. This suggested that though the variables move together in the long run, fundamentals that drive them are different such that past values of one variable do not contain predictive information for the future values of the other. Another surprising result was established by Kganyago and Gumbo (2015) who found a short run causality from stock market returns to money market interest rates, but a long run causality from interest rate to stock returns in Zimbabwe. This suggests that whereas developments in the stock market have implications for the money market in the short run, the events in the money market significantly influence the developments in the country's stock market in the long run.

On the contrary, Akbar *et al*. (2012) applied VECM to examine the relationship between the Treasury Bills rate, CPI and stock market returns over the period 1994 to 2011 in Pakistan. They established that the Treasury Bills rate had a positive relationship with stock returns in the short run. This suggests that investments in the Pakistan stock market continue in the short run even when the Treasury Bills rate is on the upward trend. A possible explanation for this trend may be that investors in Pakistan view the Treasury Bills rate as a risk free rate and demand for higher required rate of return in order to continue investing in the risky stocks rather than shift to the safer Treasury Bills. Another plausible explanation would be that most investors in Pakistan have long investment horizons and are thus not concerned with fluctuations in short term interest rate measures such as the variations in the Treasury Bills rate.

However, a major weakness of these studies is that they are all based on standard cointegration and Granger causality frameworks which assume that adjustment to long run equilibrium is only attained when the equilibrium error is I (0). This however is not a necessary condition (Cheung, 2007; Okunev & Wilson, 1997). Besides, the widely employed error correction models (ECM) and the vector error correction models (VECM) have weak power in detecting nonlinear causality which might exist between the variables (Asimakopoulos, Ayling & Mahmood, 2000) and are only adequately handled by the ARFIMA models.

For instance, Caparole and Gil-Alana (2016) employed Robinson (1994) test to examine cointegration between interest rates from selected countries in Europe. The authors established that various interest rates were fractionally cointegrated. This suggested that the interest rates were driven in the long run by a common set of fundamentals with long memory. Thus, the cointegrating residual between stock market returns and interest rates in Kenya might possess long memory, hence the motivation for the current study.

A detailed summary of the previous studies on the relationship between interest rate and stock market returns, including methodologies adopted and results found is provided in Table A3 at the Appendix.

2.4 Overview of the Literature and Research Gap

These empirical studies leave several questions unanswered: Could the controversy in the existing studies be due to bias introduced by multicollinearity since interest rate, inflation rate and exchange rate are highly correlated variables (Fisher, 1930)? To what degree might the individual variables and their cointegrating residuals be evolving over time through non-integer orders of integration? To what extent could some qualitative factors such as the 2008 Global Financial Crisis (GFC) be moderating the influence of the macroeconomic variables on stock market returns? In other words, to what extent did the effects of changes in the macroeconomic variables on stock market returns differ during and after compared to before the 2008 GFC? For a deeper understanding of the relationship between exchange rate, inflation rate, interest rate and stock market returns, these questions require to be adequately answered.

This is because both theoretical as well as empirical literature review revealed ambiguity regarding the integration orders of the individual macroeconomic variables, stock market returns and their respective cointegrating residuals. These contradicting results might have been as a result of the failure of the majority of the studies to employ bivariate models as well as the more general and flexible fractional integration techniques. In particular, majority of the studies assumed that the individual variables evolved over time through integer orders of integration and therefore simply took the first differences of the variables in order to induce stationarity. This however appeared to be too restrictive (Caporin *et al.*, 2011) and called for an extension to a more general approach such as the fractional integration framework which provides a wide range of mean reversion.

The review of literature also revealed lack of consensus on the existence of a stable long run relationship between the macroeconomic variables and stock market returns. This could have been caused by the apparent common application of Johansen's multivariate cointegration test (Johansen & Juselius, 1990) which requires all the underlying time series to be I(1) and prefers large sample sizes in order to yield efficient estimates. However, in reality, some of the variables are likely to be I (0), others I (1) and others even I (d). This requires a cointegration test such as the ARDL bounds cointegration test (Pesaran, *et al.*, 2001) to effectively determine the presence of a joint long run relationship between the variables.

Moreover, almost all previous studies failed to examine the moderating effect of qualitative events such as shocks from the 2008 GFC on the relationship between the macroeconomic variables and stock market returns. In other words, previous studies appeared to have paid little attention to the possibility of differences in both the intercepts and the slopes which might occur as a result of the effects of events such as the 2008 GFC.

Finally, the literature review revealed a major controversy regarding the sign of the coefficients as well as the direction of causality between the macroeconomic variables and stock market returns. This might be because majority of the studies widely employed the standard Granger causality test to examine the dynamic relationship between the macroeconomic variables and stock market returns. These studies tended to overlook the possibility that the equilibrium errors themselves could be long memory processes (Cheung, 2007; Okunev & Wilson, 1997).

More specifically, no studies had been designed to determine presence of a fractional cointegration between stock market returns and each of the macroeconomic variables using data from Kenya. This is despite the fact that existing studies provided evidence of long memory in the NSE 20 Share Index returns (Balprada *et al*., 2015; Anoruo & Gil-Alana, 2011) as well as in lending rate and 3-month Treasury Bills rate (Caparole & Gil-Alana, 2010).

This study therefore sought to address these gaps in existing studies by adopting a bivariate ARFIMA framework and an interaction modelling. In particular, the study empirically determined the integration orders of stock market returns, exchange rate, inflation rate, interest rate and their respective cointegrating residuals. It also used the product-term modelling to examine how shocks from the 2008 GFC could have moderated the effects of the macroeconomic variables on stock market returns in Kenya. The study also employed the ARDL multivariate cointegration test to examine the joint long run relationship between the macroeconomic variables and stock market returns.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter presents the theoretical frameworks as well as the data types and sources used by the study. The chapter also contains the estimating models and testing techniques used to conduct data analysis.

3.2 Theoretical Framework

3.2.1 Exchange Rate and Stock Market Returns

This study employed the Flow-Oriented theory proposed by Dornbusch and Fischer (1980) which argues that in an open economy, an appreciation of the exchange rate makes exports of exporting firms expensive, resulting into lower profits and declining stock market returns. In contrast, the theory suggests that an appreciation of the exchange rate makes imports cheaper which in turn enhances profits of firms which depend heavily on imported inputs or goods. This results into higher returns of stocks belonging to such firms. This suggests that a negative causality runs from exchange rate to stock market returns for firms with a significant component of imported inputs/goods.

The Flow-Oriented theory however argues that a depreciation of the exchange rate makes exports cheaper in the international markets. This in turn boosts cash flows of exporting firms and leads to rising stock returns. The model therefore suggests that a positive causality originates from exchange rate to the stock market returns for export-oriented firms.

This study therefore treated the Flow-Oriented model as a special form of a macroeconomic factor model. This is because the model directly relates a macroeconomic variable (i.e. exchange rate) to stock market returns.

The Flow-Oriented theory is an alternative to the Stock-Oriented theory which assumes that changes in exchange rate are influenced by the supply and demand of assets such as stocks (Branson, 1983; Frankel, 1983). Nonetheless, this study considered this theory to be inappropriate to examine the effect of exchange rate on stock market returns because it emphasizes that causality originates from stock market returns to exchange rate. This also contradicts the predictions of a macroeconomic factor model.

Thus, in adapting the Flow-Oriented model, it was held that changes in the KSH_t / USD_t exchange rate influenced the behaviour of the NSE 20 Share Index returns. The study therefore modelled the bivariate relationship between the exchange rate and stock market returns as:

$$NR_t = f(EX_t) \qquad (3.1)$$

Such that $f'(EX_t) > 0$, NR_t represented the NSE 20 Share Index returns and EX_t was the KSH_t / USD_t exchange rate. This implied that a depreciation of the exchange rate was expected to result into rising stock market returns as predicted by Dornbusch and Fischer (1980) for an export-dependent firm.

However, the Flow-Oriented theory has a weakness in that it does not consider factors which might modify the relationship between exchange rate and stock market returns. Examples of such a factor are shocks from the 2008 GFC which could be captured in a model using a dummy variable. This is because investors are likely to have different perceptions regarding the stock market, the exchange rate market and the relationship between the two markets before, during and after a financial turbulence (Copeland *et al*., 2005). For instance, other currencies significantly depreciated against the US dollar during the 2008 GFC (Kohler, 2010) which may have been due to panic among the investors and flight to safe haven currencies like the dollar.

Consequently, a financial crisis might change the perceptions of stock market investors leading to a reallocation of funds among assets within an investment portfolio. For instance, foreign investors who comprise the majority in the Kenyan stock market (Mwega, 2010; Ndwiga & Muriu, 2016) appear to have sold most of their shares in 2008 following the effects of the 2008 GFC. This seems to have led to an increase in capital outflows and a decline in stock market prices (Mwega, 2010). Hence, a financial crisis could adversely affect the KSH_t / USD_t exchange rate as well as the NSE 20 Share Index returns.

Thus, to examine how the 2008 GFC might have affected the ability of exchange rate to predict stock market returns in Kenya, this study extended Eq. (3.1) to include a dummy variable for shocks from the GFC. Furthermore, since the 2008 GFC began on January 2008 and ended in June 2009 (Adamu, 2010; Ali & Afzal, 2012; FRBSF, 2010; NBER, 2008; Usman, 2010), this study divided the sample into three distinct periods namely; (a) the period before the GFC crisis (from 1st January 1993 to 31st December, 2007); (b) the period during the GFC crisis (from 1st January 2008 to 30th June 2009); and (c) the period after the GFC crisis (from 1st July 2009 to 31st December 2015). To capture the effects of shocks from the GFC crisis for the three periods, the study constructed three dummy variables namely; $D_{beforeGFC}$ to represent the period before the crisis; $D_{duringGFC}$ for the period during the crisis; and $D_{afterGFC}$ to capture the period after the crisis. $D_{beforeGFC}$ was 1 for the period before the crisis, 0 for other periods; $D_{duringGFC}$ was 1 for the period during the crisis, 0 for other periods; and $D_{afterGFC}$ was 1 for the period after the crisis and 0 otherwise.

To examine the direct effect of the 2008 GFC on stock market returns as well as the moderating effect of the GFC on the relationship between exchange rate and stock market returns for the period during and after the crisis in comparison to the period before the crisis, this study treated the period before the crisis as the reference period. Consequently, the study estimated the following model:

$$NR_t = f(\mathrm{D}_{duringGFC}, \mathrm{D}_{afterGFC}, \mathrm{EX_t}, \mathrm{EX_tD}_{duringGFC}, EX_tD_{afterGFC})..................(3.2)$$

From equation 3.2, the coefficient of $D_{duringGFC}$ measured the average stock market returns during the crisis period compared to the average stock market returns before the crisis. If negative, this indicated that average stock market returns were lower during the crisis relative to the period before the crisis. Likewise, the coefficient of $D_{afterGFC}$ represented the average stock market returns after the crisis compared to average stock market returns before the crisis. The coefficient of EX_t represented the effect of changes in exchange rate on stock market returns when all the dummy variables were equal to zero. This coincided with the effect of changes in exchange rate on stock market returns before the crisis. On the other hand, the coefficients of the product terms ($EX_tD_{duringGFC}$ and $EX_tD_{afterGFC}$) reflected the difference in slopes (effects) of variations in exchange rate on stock market returns during and after the crisis, respectively, in comparison to the period before the crisis (i.e. the effect of a change in exchange rate on stock market returns during/after minus the corresponding effect before the crisis).

For instance, the coefficient of $EX_tD_{duringGFC}$ showed the effect of changes in exchange rate on stock market returns for the period during the crisis minus the corresponding effect for the period before the crisis. This measured whether the net effect of exchange rate variation on stock market returns was the same or different for the period during the crisis and the period before the crisis. In other words, they helped answer the question: Did changes in exchange rate significantly affect stock market returns for the period during the crisis compared to the period before the crisis? On the other hand, the intercept represented the estimated mean stock market returns for the period before the crisis.

This study also examined how stock market returns differed between the three different periods (i.e. before, during and after the crisis) as a function of variations in mean exchange rate. To do this, it treated exchange rate as the moderating variable and mean centered it by subtracting its mean from the original values before substituting the mean centered values in equation 3.2. This yielded:

$$NR_t = f(\mathrm{D}_{duringGFC}, \mathrm{D}_{afterGFC}, \mathrm{EXc_t}, \mathrm{EXc_tD}_{duringGFC}, EXc_tD_{afterGFC}) \ldots\ldots\ldots\ldots\ldots\ldots(3.3)$$

This however drastically changed the interpretation of the coefficients. For example, the intercept in equation 3.3 now measured the average stock market returns when all predictors were equal to zero. This coincided with average stock market returns for the period before the crisis conditional on exchange rate being at its sample mean value (i.e. when $EX_t = 0$) which is equivalent to when $EX_t = EX_{ct}$.

The coefficient of $D_{duringGFC}$ reflected the difference in mean stock market returns between the period during the crisis and the period before the crisis when exchange rate was at its sample mean value (i.e. average stock market returns during minus average stock market returns before at mean exchange rate). On the other hand, the coefficient of the product term $EX_{ct}D_{duringGFC}$ now indicated how this mean difference changed given a one unit increase (depreciation) in exchange rate (i.e. the effect of exchange rate on stock market returns during minus the corresponding effect before the crisis given a unit depreciation when exchange rate was at its sample mean value) .

Moreover, average stock market returns for the period during the crisis were expected to be lower than average stock market returns before the crisis. This is because uncertainty during the crisis is likely to force investors to shift their funds from the stock market to safer investment vehicles. Consequently, this study hypothesized that:

$$f'_{D_{duringGFC}}(\mathrm{D}_{duringGFC}, \mathrm{D}_{afterGFC}, \mathrm{EX}_t, \mathrm{EX}_t\mathrm{D}_{duringGFC}, \mathrm{EX}_t\mathrm{D}_{afterGFC}) < 0 .$$

Likewise, average stock market returns were expected to remain lower after the crisis relative to the period before the crisis as economies slowly regain their growth levels. This yielded the condition:

$$f'_{D_{afterGFC}}(\mathrm{D}_{duringGFC}, \mathrm{D}_{afterGF}, \mathrm{EX_t}, \mathrm{EX_tD}_{duringGFC}, \mathrm{EX_tD}_{afterGFC}) < 0.$$

Furthermore, during the crisis, exchange rates were expected to depreciate more owing to increased capital outflows (Mwega, 2010; Ndwiga & Muriu, 2016) while stock market returns were expected to decline due to increased flight to safer investments (Mwega, 2010). Consequently, a unit increase in depreciation was expected to result into more declines in stock market returns during the crisis compared to before the crisis. This suggested that:

$$f'_{EXtD_{duringGFC}}(\mathrm{D}_{duringGFC}, \mathrm{D}_{afterGFC}, \mathrm{EX_t}, \mathrm{EX_tD}_{duringGFC}, \mathrm{EX_tD}_{afterGFC}) < 0.$$

Likewise, a unit increase in depreciation of the exchange rate was expected to have more adverse effect on stock market returns after the crisis compared to before the crisis. This is because stock market returns were expected to be more sensitive to variations in exchange rate after the crisis due to a slow economic recovery. This suggested that:

$$f'_{EXtD_{afterGFC}}(\mathrm{D}_{duringGFC}, \mathrm{D}_{afterFC}, \mathrm{EX_t}, \mathrm{EX_tD}_{duringGFC}, \mathrm{EX_tD}_{afterGFC}) < 0.$$

However; a unit increase in exchange rate depreciation was expected to have a positive effect on stock market returns for the period before the crisis. This was because the study assumed that firms listed at the stock market were export-dependent (Dornbusch & Fischer, 1980). Therefore:

$$f'_{EXt}(D_{duringGFC}, D_{afterFC}, EX_t, EX_tD_{duringGFC}, EX_tD_{afterGFC}) > 0.$$

Similarly, this study hypothesized that the average stock market returns during the crisis at the average exchange rate would be lower than the average stock market returns before the crisis at the mean exchange rate. This was because additional exchange rate depreciations during the crisis was expected to have stronger depressing effects on stock market returns when exchange rate was at its mean value (because of a higher risk). Moreover, the stock market would already be performing poorly during the crisis period. This suggested that:

$$f'_{D_{duringGFC}}(D_{duringGFC}, D_{afterGFC}, EX_{ct}, EX_{ct}D_{duringGFC}, EX_{ct}D_{afterGFC}) < 0.$$

Likewise, the difference in mean stock market returns between the period after the crisis and the period before the crisis when exchange rate was at its mean value was expected to be negative. This was because at the mean exchange rate, stock market returns after the crises were likely to be lower. This meant that:

$$f'_{D_{afterGFC}}(D_{duringGFC}, D_{afterGF}, EX_{ct}, EX_{ct}D_{duringGFC}, EX_{ct}D_{afterGFC}) < 0\,.$$

On the other hand, an additional unit of exchange rate depreciation was expected to have more depressing effects on stock market returns during the crisis compared to a corresponding effect before the crisis at mean exchange rate. This followed from the fact that stock market returns were more likely to remain low during the crisis owing to flight to safer investments whereas exchange rate would be already weak at its mean value. Consequently, any further depreciation was likely to result into additional uncertainty in the stock market. This suggested that:

$$f'_{EXctD_{duringGFC}}(D_{duringGFC}, D_{afterGFC}, EX_{ct}, EX_{ct}D_{duringGFC}, EX_{ct}D_{afterGFC}) < 0\,.$$

Equally, an extra unit of exchange rate depreciation after the crisis was expected to have more depressing effects on stock market returns compared to the same effect before the crisis at mean exchange rate. This implied that:

$$f'_{EXctD_{afterGFC}}(D_{duringGFC}, D_{afterFC}, EX_{ct}, EX_{ct}D_{duringGFC}, EX_{ct}D_{afterGFC}) < 0\,.$$

Conversely, before the crisis, uncertainty among investors was expected to have remained low. This meant that a unit increase in exchange rate depreciation should have led to an increase in the competitiveness of exports and translated into rising stock market returns even at mean exchange rate level. This implied that:

$$f'_{EXct}(D_{duringGFC}, D_{afterFC}, EX_{ct}, EX_{ct}D_{duringGFC}, EX_{ct}D_{afterGFC}) > 0.$$

This study also created scenarios for average stock market returns during and after the crisis relative to before the crisis at “low”, “medium” and “high” levels of exchange rate. The “low” exchange rate value was constructed by subtracting the standard deviation of exchange rate from the mean of exchange rate and then deducting this (difference) from the original values of exchange rate. The “high” exchange rate value was derived by adding the standard deviation of exchange rate to the mean value of exchange rate and subtracting this (sum) from the original values of exchange rate. “Medium” exchange rate was represented by the mean centered exchange rate values. Consequently, average stock market returns during and after the crisis compared to before the crisis when exchange rate was “average/medium” was obtained directly from equation 3.3 because exchange rate was mean centered.

3.2.2 Inflation Rate and Stock Market Returns

This study adopted the Fisher Effect (Fisher, 1930) which stated that in an efficient money market, nominal interest rates should fully reflect information on expected rate of inflation. This is because real interest rates depend only on the rate of return on capital and are unaffected by changes in the inflation rate. Extended to the stock market, Fisher Effect (FE) implies that if the stock market is efficient, real stock market returns are not influenced by variations in inflation rate leaving the nominal stock market returns to fully anticipate movements in expected inflation rate.

Furthermore, since nominal stock market returns comprise real stock market returns and expected inflation rate, strict interpretation of the FE suggests that nominal stock market returns should have a direct one-to-one relationship with expected inflation rate. This further implies that investors in the stock market should, on average, be fully compensated for changes in expected inflation rate in that a one percent increase in inflation rate should cause a one percent increase in nominal stock market returns. This study therefore assumed that by representing stock market returns as a function of inflation rate, the FE adequately captured the spirit of a macroeconomic factor model.

Specifically, this study hypothesized that if the Kenyan stock market was efficient, it should have set prices of common stocks such that the nominal stock return realized from time t-1 to time t was equated to the real stock return plus expected rate of inflation. This relationship was represented as:

$$NR_{it} / F_{t-1} = nr_{it} / F_{t-1} + E\left(\Pi_{it} / F_{t-1}\right) \quad \text{......................................(3.4)}$$

Where NR_{it} represented the nominal stock return i from t-1 to t, nr_{it} was the real rate of return of stock i from t-1 to t, and Π_{it} was the rate of inflation from t-1 to t. F_{t-1} was the set of information available at time t-1 and E was the expectation operator.

However, while most previous studies employed expected values of the macroeconomic variables and expected stock market returns, this study concentrated on examining the effect of actual inflation rate on actual stock market returns based on the rational expectations theory which assumes that movements in actual and expected values of macroeconomic variables coincide (Rushdi *et al.*, 2012). Furthermore, the adoption of actual values was informed by the fact that to evaluate actual results of an investment, economic agents most often examine the effect of observable macroeconomic variables on observable returns.

Furthermore, to determine whether there was a difference in the extent to which the stock market priced different types of inflation rate, this study considered two measures of inflation rate namely; the month-on-month inflation rate (which represented a short term rate) and the year-on-year inflation rate (which was the long term rate). This consideration was informed by the fact that stock market prices often represent valuations of cash flows projected over a long period into the future (Alagidede & Panagiotidis, 2010). As a result, monthly stock market returns were more likely to have a stronger relationship not with changes in current inflation rate (e.g. month-on-month inflation rate) but with changes in inflation rate projected into the future (e.g. year-on-year inflation rate).

This study therefore modelled the bivariate relationships between each of the two measures of inflation rate and stock market returns as:

$NR_t = f(\mathrm{MOM_t})$..(3.5)

$NR_t = f(\mathrm{YOY_t})$..(3.6)

Where MOM_t represented the month-on-month inflation rate, and YOY_t was the year-on-year inflation rate. Since the stock market was expected to act as a hedge against inflation, the following conditions held: $\frac{\partial NR_t}{\partial MOM_t} > 0$ and $\frac{\partial NR_t}{\partial YOY_t} > 0$.

However, this study postulated that shocks from the 2008 GFC might have directly influenced stock market returns besides moderating the effect of the two measures of inflation rate on stock market returns. For instance, during episodes of a financial turmoil, domestic economies were likely to contract considerably (Bermingham *et al*., 2012) leading to lower profits and thus lower stock market returns. Likewise, during periods of a financial crisis, the resultant economic slowdown could have triggered sharp declines in inflation rate owing to reduced aggregate demand (Bermingham *et al*., 2012). This might have resulted into declining stock market returns and falling inflation rates suggesting a positive relationship between the two variables.

This study therefore used the dummy variable $D_{beforeGFC}$ to represent the period before the 2008 GFC crisis (from 1st January 1993 to 31st December, 2007); $D_{duringGFC}$ for the period during the 2008 GFC crisis (from 1st January 2008 to 30th June 2009); and $D_{afterGFC}$ for the period after the 2008 GFC crisis (from 1st July 2009 to 31st December 2015). $D_{beforeGFC}$ took the value 1 for the period before the crisis, 0 otherwise; $D_{duringGFC}$ was coded 1 for the period during the crisis, 0 otherwise; and $D_{afterGFC}$ was 1 for the period after the crisis and 0 otherwise.

The effect of the two measures of inflation rate on stock market returns for the period during and the period after the crisis compared to the period before the crisis was investigated using the models represented as:

$$NR_t = f(\mathrm{D}_{duringGFC}, \mathrm{D}_{afterGFC}, \mathrm{MOM}_t, \mathrm{MOM}_t\mathrm{D}_{duringGFC}, \mathrm{MOM}_t D_{afterGFC}) \text{......(3.7)}$$

$$NR_t = f(\mathrm{D}_{duringGFC}, \mathrm{D}_{afterGFC}, \mathrm{YOY}_t, \mathrm{YOY}_t\mathrm{D}_{duringGFC}, \mathrm{YOY}_t D_{afterGFC}) \text{........(3.8)}$$

The coefficient of $D_{duringGFC}$ in equation 3.7 reflected the mean stock market returns during the crisis period relative to the mean stock market returns before the crisis. A positive coefficient indicated that stock market returns were, on average, higher during the crisis compared to before the crisis. On the other hand, the coefficient of the product term $MOM_t D_{duringGFC}$ measured the effect of changes in the month-on-month inflation rate on stock market returns for the period during the crisis minus the corresponding effect for the period before the crisis. The coefficient of MOM_t represented the effect of a change in the month-on-month inflation rate on stock market returns for the period before the crisis. If positive, it suggested that a unit increase in the month-on-month inflation rate led to an increase in stock market returns before the crisis began. The intercept measured the predicted mean stock market returns for the period before the crisis. A similar interpretation applied to equation 3.8.

To examine the difference in stock market returns during and after the crisis compared to before the crisis, taking the two measures of inflation rate as the moderating variables, this study substituted the mean centered values of the month-on-month inflation rate and the year-on-year inflation rate in equations 3.7 and 3.8. This yielded:

$$NR_t = f(\mathrm{D}_{duringGFC}, \mathrm{D}_{afterGFC}, \mathrm{MOM_{ct}}, \mathrm{MOM_{ct}D}_{duringGFC}, \mathrm{MOM_{c\,t}}D_{afterGFC}) \text{......(3.9)}$$

$$NR_t = f(\mathrm{D}_{duringGFC}, \mathrm{D}_{afterGFC}, \mathrm{YOY_{ct}}, \mathrm{YOY_{ct}D}_{duringGFC}, \mathrm{YOY_{c\,t}}D_{afterGFC}) \text{........(3.10)}$$

The coefficient of $D_{duringGFC}$ in equation 3.9 now measured the difference in mean stock market returns between the period during and before the crisis when the month-on-month inflation rate was at its mean value. On the other hand, the coefficient of the product term $\left(MOM_{ct}D_{duringGFC}\right)$ indicated the extent to which this mean difference changed for a one unit increase in the month-on-month inflation rate (i.e. the effect of a unit increase in the month-on-month inflation rate on stock market returns for the period during minus the corresponding effect before the crisis when the month-on-month inflation rate was at its mean value).

Furthermore, shocks from a financial crisis such as the 2008 GFC were expected to depress the economy, including the stock market during the crisis period (Bermingham *et al*., 2012). This suggested that:

$$f'_{D_{duringGFC}}(D_{duringGFC}, D_{afterGFC}, MOM_t, MOM_t D_{duringGFC}, MOM_t D_{afterGFC}) < 0 .$$

Likewise, after a financial crisis, the economy was expected to recover albeit at a slower pace. This implied that average stock market returns were likely to be lower after than before a financial crisis. This implied that:

$$f'_{D_{afterGFC}}(D_{duringGFC}, D_{afterGFC}, MOM_t, MOM_t D_{duringGFC}, MOM_t D_{afterGFC}) < 0 .$$

Additionally, a unit increase in the month-on-month inflation rate was expected to significantly depress stock market returns during the crisis relative to the period before the crisis. This was because during a crisis, economic activities were expected to remain depressed and stock market returns were likely to be highly sensitive to variations in inflation rate. Consequently:

$$f'_{MOMtD_{duringGFC}}(D_{duringGFC}, D_{afterGFC}, MOM_t, MOM_tD_{duringGFC}, MOM_tD_{afterGFC}) < 0.$$

Equally, a unit increase in the month-on-month inflation rate was expected to reduce stock market returns after the crisis compared to before the crisis. This was because stock market returns were likely to remain sensitive to variations in inflation rate in an economy that was slowly recovering from a financial crisis. This suggested that:

$$f'_{MOMtD_{aferGFC}}(D_{duringGFC}, D_{afterGFC}, MOM_t, MOM_tD_{duringGFC}, MOM_tD_{afterGFC}) < 0.$$

Moreover, average stock market returns should have been lower during the crisis compared to the period before the crisis when the month-on-month inflation rate was at its sample mean value. This is because average month-on-month inflation rate was expected to create a more uncertain macroeconomic environment during a crisis period relative to before a crisis. This implied that:

$$f'_{D_{duringGFC}}(D_{duringGFC}, D_{afterGFC}, MOM_{ct}, MOM_{ct}D_{duringGFC}, MOM_{ct}D_{afterGFC}) < 0.$$

Similarly, average stock market returns were predicted to be lower after a crisis compared to before a crisis at mean month-on-month inflation rate. This is because medium month-on-month inflation rate was likely to increase uncertainty among investors in an economy that was just emerging from a financial crisis. This yielded:

$$f'_{D_{afterGFC}}(\mathrm{D}_{duringGFC}, \mathrm{D}_{afterGFC}, \mathrm{MOM}_{\mathrm{ct}}, \mathrm{MOM}_{\mathrm{ct}}\mathrm{D}_{duringGFC}, \mathrm{MOM}_{\mathrm{ct}}\mathrm{D}_{afterGFC}) < 0 .$$

Similarly, an extra unit increase in the month-on-month inflation rate was expected to have more depressing effects on stock market returns during a crisis compared to before a crisis when the month-on-month inflation rate was average. Stock market returns should also have declined more sharply after a crisis compared to before a crisis following a unit increase in the month-on-month inflation rate at mean month-on-month inflation rate. Therefore the following conditions were expected to hold:

$$f'_{MOMctD_{duringGFC}}(\mathrm{D}_{duringGFC}, \mathrm{D}_{afterGFC}, \mathrm{MOM}_{\mathrm{ct}}, \mathrm{MOM}_{\mathrm{ct}}\mathrm{D}_{duringGFC}, \mathrm{MOM}_{\mathrm{ct}}\mathrm{D}_{afterGFC}) < 0 .$$

$$f'_{MOMctD_{afterGFC}}(\mathrm{D}_{duringGFC}, \mathrm{D}_{afterGFC}, \mathrm{MOM}_{\mathrm{ct}}, \mathrm{MOM}_{\mathrm{ct}}\mathrm{D}_{duringGFC}, \mathrm{MOM}_{\mathrm{ct}}\mathrm{D}_{afterGFC}) < 0$$

Similar conditions were developed for equation 3.10.

To examine how average stock market returns differed during and after the crisis in comparison to before the crisis as a function of the two measures of inflation rate, this study developed three scenarios. These included scenarios for average stock market returns during and after the crisis compared to before the crisis at “low”, “medium” and “high” values of the month-on-month inflation rate and the year-on-year inflation rate, respectively. The ‘low values’ of month-on-month inflation rate were obtained by subtracting the standard deviation of the month-on-month inflation rate from its mean value and deducting this difference from the original values of the month-on-month inflation rate. The 'medium values' were represented by the mean centered values while the 'high values' were derived by adding the standard deviation to the mean of the month-on-month inflation rate and deducting this sum from the original values. The same strategy was employed to obtain the 'low', 'medium' and 'high' values of the year-on-year inflation rate. The study derived average stock market returns for the period during and after the crisis compared to the period before the crisis at average month-on-month inflation rate and year-on-year inflation rate directly from equations 3.9 and 3.10, respectively. This is because the equations included mean centered values of the two variables.

3.2.3 Interest Rate and Stock Market Returns

Assuming that investors have homogeneous expectations, the price of a stock should converge to the value of the stock at equilibrium, equating expected return of the stock to the required return. Besides, if stocks are efficiently priced, the stock price should be equal to the stock's intrinsic value (i.e. equilibrium price), reducing the expected abnormal return on the stock to zero. This is because an investor's expected return comprises the sum of the required return and the expected abnormal return. Consequently, this study employed the Free Cash Flow to Equity (FCFE) model proposed by Copeland, Koller and Murrin (1994) and Damadoran (1998) to examine the effect of changes in the Treasury Bills rate on stock market returns.

Additionally, since the FCFE model directly relates changes in interest rate to the value or return of an asset (assumed to be equal at equilibrium or in an efficient market), this study viewed the FCFE model as a type of a macroeconomic factor model. The study therefore replaced the risk free rate in the CAPM model in Eq. (2.2) by the 3-month Treasury Bills rate to obtain:

$$NR_t = \sum_{t=1}^{n} \frac{FCFE_t}{\left\{1 + TB3_t + \beta_i[\mathrm{E}(\mathrm{R_m}) - TB3_t]^t\right\}} \text{..........} (3.11)$$

Where $FCFE_t$ represented the forecasted free cash flow to equity from the first month to the n[th] month, $[\mathrm{E}(\mathrm{R_m}) - \mathrm{TB}3_t]^t$ was the market risk premium (MRP) and $TB3_t$ was the 3-month Treasury Bills rate.

This study also assumed that cash flows from investments were projected into the infinite future (or that investors expected the current level of the FCFE to persist into the indefinite future). This made the present value of a stock which promised to pay a sum of FCFE each month, forever, taking the 3-month Treasury Bills rate as the appropriate discount rate, to be derived from equation 3.11 as:

$$NR_t = \frac{FCFE_t}{TB3_t} \text{..........} (3.12)$$

Equation 3.12 therefore suggested that a negative relationship existed between the 3-month Treasury Bills rate and stock market returns.

Moreover, based on Modern Portfolio Theory (MPT) (Markowitz, 1952), investors are likely to treat the 3-month Treasury Bills and stocks as competing assets. Consequently, an increase in the 3-month Treasury Bills rate should trigger a portfolio rebalancing with more funds being reallocated to the 3-month Treasury Bills and less to the riskier stocks. This suggests a negative relationship between stock market returns and the 3-month Treasury Bills rate. In contrast, when investors view the 3-month Treasury Bills rate as a risk free rate (i.e. as a component of the required rate of return), the increase in the 3-month Treasury Bills rate should translate directly into a higher required rate of return, and hence to rising stock market returns (assuming that the stock market returns provide a good estimate of the required returns). Despite this, this study modelled stock market returns as a declining function of the 3-month Treasury Bills rate as follows:

$$NR_t = f(\mathrm{TB3}_t) \qquad (3.13)$$

Such that $\frac{\partial NR_t}{\partial TB3_t} < 0$, (taking the Treasury Bills as competing assets to stock market returns).

This study also assumed that since monthly stock market returns are a function of future streams of cash flows, they could have a stronger linkage with long term interest rates (i.e. lending rate) (Alagidede & Panagiotidis, 2010) than with short term interest rates (i.e. 3-month Treasury Bills rate). Consequently, the study employed the commercial banks' monthly weighted average lending rate as a discount rate in the FCFE valuation model in equation 3.11.

The study again assumed that investors expected corporate profits in the form of FCFE to remain constant indefinitely. It therefore obtained the present value of a stock which promised to pay a sum of FCFE each month, forever, taking the commercial banks' monthly weighted average lending rate as the appropriate discount rate as:

$$NR_t = \frac{FCFE_t}{Lr_t} = \text{..}(3.14)$$

Where Lr_t represented the commercial banks' monthly weighted average lending rate. Additionally, this study assumed that firms in Kenya had a choice to either raise investment funds from the stock market (i.e. equity financing) or borrow the same from the commercial banks (i.e. debt financing). Consequently, at low lending rates, most firms would choose to obtain their investment funds from the commercial banks instead of issuing additional shares which could dilute existing ones and lower stock market returns. In contrast, at high lending rate, most firms would choose to obtain investment financing by issuing new shares (which could lower stock market returns through dilution). This therefore suggested a negative relationship between lending rate and stock market returns. Hence, based on Eq. (3.14) and the likely choice of the sources for investment financing, this study modelled the relationship between lending rate and stock market returns as:

$$NR_t = f(\mathrm{Lr}_t) \qquad (3.15)$$

Such that $\frac{\partial NR_t}{\partial Lr_t} < 0$.

Moreover, during financial crises, investors were likely to shift to safer investment alternatives such as the government securities to preserve their wealth (Mwega, 2010; Ndwiga & Muriu, 2016). For instance, the substantial rise in the US Federal Treasury rates appeared to have attracted significant capital outflows from developing markets. This might have adversely affected the performance of the NSE whose major participants are foreigners (Kestrel Capital, 2014; Ndwiga & Muriu, 2016). Consequently, during a crisis, rising Treasury Bills rates could have depressed the stock market returns as investors shifted their funds from the riskier stocks to the safer Treasury Bills. The financial crisis could also have depressed economic activities and increased risk premium demanded by lenders in order to issue loans (Illes & Lombardi, 2013). Thus, during the financial crisis, rising lending rate was expected to be associated with lower economic activity and extra declines in stock market returns.

Therefore to examine the effect of the 2008 GFC on stock market returns in Kenya, this study constructed three dummy variables namely; $D_{beforeGFC}$ to represent the pre-crisis period (from 1st January 1993 to 31st December, 2007); $D_{duringGFC}$ for the crisis period (from 1st January 2008 to 30th June 2009); and $D_{afterGFC}$ for the post-crisis period (from 1st July 2009 to 31st December 2015). $D_{beforeGFC}$ was 1 for the pre-crisis period, 0 otherwise; $D_{duringGFC}$ was 1 for the crisis period, 0 otherwise; and $D_{afterGFC}$ was 1 for the post-crisis period and 0 otherwise.

The study then evaluated the effects of the two measures of interest rate on stock market returns for the crisis period and the period after the crisis in comparison to the pre-crisis period using the following models:

$$NR_t = f(\mathrm{D}_{duringGFC}, \mathrm{D}_{afterGFC}, \mathrm{TB3}_t, \mathrm{TB3}_t\mathrm{D}_{duringGFC}, \mathrm{TB3}_t D_{afterGFC}) \ldots\ldots\ldots\ldots(3.16)$$

$$NR_t = f(\mathrm{D}_{duringGFC}, \mathrm{D}_{afterGFC}, \mathrm{Lr}_t, \mathrm{Lr}_t\mathrm{D}_{duringGFC}, \mathrm{Lr}_t D_{afterGFC}) \ldots\ldots\ldots\ldots\ldots\ldots(3.17)$$

The coefficient of $D_{afterGFC}$ in equation 3.17 reflected the mean stock market returns after the crisis period compared to mean stock market returns before the crisis. A positive coefficient indicated that stock market returns were, on average, higher after the crisis period compared to the period before the crisis. The coefficient of the product term, $Lr_t D_{afterGFC}$, indicated the difference in the effect of lending rate on stock market returns after compared to before the crisis (i.e. the effect of a unit increase in lending rate on stock market returns after the crisis minus a corresponding effect before the crisis). If positive, it suggested that an increase in lending rate had more positive effects on stock market returns after the crisis compared to before the crisis. On the other hand, the coefficient of Lr_t represented the effect of a unit increase in lending rate on stock market returns before the crisis began. The intercepts in the respective models measured the predicted mean stock market returns for the period before the crisis.

Additionally, this study examined the difference in average stock market returns during the crisis and after the crisis relative to before the crisis at mean values of the two measures of interest rate. This entailed substituting the mean centered values of the two measures of interest rate in equations 3.16 and 3.17 to obtain:

$$NR_t = f(\mathrm{D}_{duringGFC}, \mathrm{D}_{afterGFC}, \mathrm{TB3}_{c\,t}, \mathrm{TB3}_{c\,t}\mathrm{D}_{duringGFC}, \mathrm{TB3}_{ct}D_{afterGFC}) \ldots\ldots\ldots\ldots (3.18)$$

$$NR_t = f(\mathrm{D}_{duringGFC}, \mathrm{D}_{afterGFC}, \mathrm{Lr}_{ct}, \mathrm{Lr}_{ct}\mathrm{D}_{duringGFC}, \mathrm{Lr}_{c\,t}D_{afterGFC}) \ldots\ldots\ldots\ldots\ldots\ldots (3.19)$$

The coefficient of $D_{duringGFC}$ in equation 3.18 now reflected the mean stock market returns during the crisis minus the mean stock market returns before the crisis when the 3-month Treasury Bills rate was average. On the other hand, the coefficient of the product term, $TB3_{ct}D_{duringGFC}$, represented the extent to which this mean difference changed for a one unit increase in the 3-month Treasury Bills rate (i.e. the effect of a unit increase in the 3-month Treasury Bills rate on stock market returns during the crisis minus a corresponding effect before the crisis when the 3-month Treasury Bills rate was at its average value).

Furthermore, since mean stock market returns were, on average, expected to be higher before the crisis compared to during the crisis, the study hypothesized that:

$$f'_{D_{during}GFC}(D_{duringGFC}, D_{afterGFC}, TB3_t, TB3r_tD_{duringGFC}, TB3_tD_{afterGFC}) < 0 .$$

Likewise, average stock market returns were expected to be lower after the crisis due to a gradual economic recovery compared to before the crisis. This implied that:

$$f'_{D_{after}GFC}(D_{duringGFC}, D_{afterGFC}, TB3_t, TB3r_tD_{duringGFC}, TB3_tD_{afterGFC}) < 0 .$$

On the other hand, stock market returns were expected to decline more significantly for a unit increase in the 3-month Treasury Bills rate during the crisis compared to before the crisis. This suggested that $f'_{TB3tD_{duringGFC}}(D_{duringGFC}, D_{afterGFC}, TB3_t, TB3_tD_{duringGFC}, TB3_tD_{afterGFC}) < 0$.

Likewise, the decline in stock market returns in response to a unit increase in the 3-month Treasury Bills rate was expected to be higher after the crisis compared to before the crisis. This suggested that $f'_{TB3tD_{afterGFC}}(D_{duringGFC}, D_{afterGFC}, TB3_t, TB3_tD_{duringGFC}, TB3_tD_{afterGFC}) < 0$.

Additionally, during the crisis, lending rates were expected to rise significantly as banks became extra cautious to avoid possible defaults. This should have exerted extra adverse effects on economic activities during the crisis period and driven stock market returns further downwards. This meant that $f'_{LrtD_{duringGFC}}(D_{duringGFC}, D_{afterGFC}, Lr_t, Lr_tD_{duringGFC}, Lr_tD_{afterGFC}) < 0$.

In contrast, after the crisis, lending rate could have remained high but firms might have chosen to source for investment funds from the stock market. This was likely to drive stock market returns downwards due to dilution effects. Therefore:

$$f'_{LrtD_{afterGFC}}(D_{duringGFC}, D_{afterGFC}, Lr_t, Lr_tD_{duringGFC}, Lr_tD_{afterGFC}) < 0.$$

Stock market returns were also expected to be lower during the crisis relative to before the crisis at the mean 3-month Treasury Bills rate. This was because the average rate of the Treasury Bills was expected to increase the shift of funds from the stock market to the safer Treasury Bills. This suggested that:

$$f'_{D_{during}GFC}(D_{duringGFC}, D_{afterGFC}, TB3_{ct}, TB3_{ct}D_{duringGFC}, TB3_{ct}D_{afterGFC}) < 0 .$$

Similarly, average stock market returns were expected to be lower after the crisis relative to before the crisis at mean 3-month Treasury Bills rate. This implied that:

$$f'_{D_{after}GFC}(D_{duringGFC}, D_{afterGFC}, TB3_{ct}, TB3_{ct}D_{duringGFC}, TB3_{ct}D_{afterGFC}) < 0 .$$

On the other hand, a unit increase in the 3-month Treasury Bills rate was expected to have more depressing effects on stock market returns during compared to before the crisis at mean 3-month Treasury Bills rate. This implied that:

$$f'_{TB3ctD_{duringGFC}}(D_{duringGFC}, D_{afterGFC}, TB3_{ct}, TB3_{ct}D_{duringGFC}, TB3_{ct}D_{afterGFC}) < 0.$$

Likewise, stock market returns were expected to decline more sharply in response to a unit increase in the 3-month Treasury Bills rate after the crisis compared to before the crisis. This suggested that:

$$f'_{TB3ctD_{afterGFC}}(D_{duringGFC}, D_{afterGFC}, TB3_{ct}, TB3_{ct}D_{duringGFC}, TB3_{ct}D_{afterGFC}) < 0.$$

Similar arguments were developed for equation 3.19.

This study also developed three scenarios to investigate how average stock market returns differed during and after the crisis in comparison to before the crisis as a function of 'low', 'medium' and 'high' values of the two measures of interest rate. It derived the 'low' values of the 3-month Treasury Bills rate by subtracting its standard deviation from its mean value and deducting this difference from the original values. The 'medium' value of the 3-month Treasury Bills rate was represented by its mean centered values. However, the 'high' values of the 3-month Treasury Bills rate were obtained by adding its standard deviation to its mean value and deducting this sum from the original values. Average stock market returns for the period during and after the crisis compared to the period before the crisis at average 3-month Treasury Bills rate and lending rate were directly derived from equations 3.18 and 3.19. This is because the equations contained mean centered values of the two measures of interest rate.

3.2.4 Multivariate Cointegration using Auto-Regressive Distributed Lag (ARDL) Model

This study expanded the bivariate macroeconomic models in equations 3.1, 3.5, 3.6, 3.13 and 3.15 by hypothesizing that stock market returns were an unconditional joint function of exchange rate, inflation rate and interest rate. It then sought to get more insight into how the macroeconomic variables and stock market returns converged to long run equilibrium through a multivariate cointegration analysis. This is because cointegration analysis provides a direct test of economic theory and enables utilization of the estimated long-run parameters into the estimation of the short-run disequilibrium relationships (Engle & Granger, 1987).

However, a major limitation of the Johansen's cointegration test is that it requires all the underlying time series to be I(1) for a joint long run relationship between several independent variables and a dependent variable to be effectively determined (Johansen & Juselius, 1990). In reality, some of the variables could be I(0), others I(1) and still others I(d). When this situation arises, the Auto-Regressive Distributed Lag (ARDL) bounds cointegration test (Pesaran *et al.*, 2001) is the most appropriate (Asteriou & Hall, 2007). Moreover, the ARDL bounds test allows flexibility in terms of the lags of the regressors as opposed to the cointegration VAR models where different lags for different variables are not permitted (Pesaran *et al.*, 2001). Additionally, ARDL cointegration test performs well in small samples and is therefore considered superior to the Johansen cointegration approach which requires a large sample size for the results to be valid (Pesaran *et al*., 2001).

This study therefore employed an ARDL model to examine a joint long run relationship between the macroeconomic variables and stock market returns. It adopted a two-step procedure with the first step focusing on the determination of the long run relationship between exchange rate, a measure of inflation rate, a measure of interest rate and stock market returns. ARDL-based Granger causality tests between the macroeconomic variables and stock market returns were conducted in the second step. The first step estimated the following theoretical ARDL models:

$$\Delta NR_t = s_{01} + \sum_{i=1}^{p} v_{i0}\Delta NR_{t-i} + \sum_{i=0}^{q1} v_{i1}\Delta EX_{t-i} + \sum_{i=0}^{q2} v_{i2}\Delta MOM_{t-i} + \sum_{i=0}^{q3} v_{i3}\Delta TB3_{t-i} + L_1 NR_{t-1} + L_2 EX_{t-1} + L_3 MOM_{t-1} + L_4 TB3_{t-1} \quad (3.20)$$

$$\Delta NR_t = s_{02} + \sum_{i=1}^{p} v_{i4}\Delta NR_{t-i} + \sum_{i=0}^{q1} v_{i5}\Delta EX_{t-i} + \sum_{i=0}^{q2} v_{i6}\Delta MOM_{t-i} + \sum_{i=0}^{q3} v_{i7}\Delta Lr_{t-i} + L_5 NR_{t-1} + L_6 EX_{t-1} + L_7 MOM_{t-1} + L_8 Lr_{t-1} \quad (3.21)$$

$$\Delta NR_t = s_{03} + \sum_{i=1}^{p} v_{i8}\Delta NR_{t-i} + \sum_{i=0}^{q1} v_{i9}\Delta EX_{t-i} + \sum_{i=0}^{q2} v_{i10}\Delta YOY_{t-i} + \sum_{i=0}^{q3} v_{i11}\Delta TB3_{t-i} + L_9 NR_{t-1} + L_{10} EX_{t-1} + L_{11} YOY_{t-1} + L_{12} TB3_{t-1} \quad (3.22)$$

$$\Delta NR_t = s_{04} + \sum_{i=1}^{p} v_{i12}\Delta NR_{t-i} + \sum_{i=0}^{q1} v_{i13}\Delta EX_{t-i} + \sum_{i=0}^{q2} v_{i14}\Delta YOY_{t-i} + \sum_{i=0}^{q3} v_{i15}\Delta Lr_{t-i} + L_{13} NR_{t-1} + L_{14} EX_{t-1} + L_{15} YOY_{t-1} + L_{16} Lr_{t-1} \quad (3.23)$$

where the parameters L_i, i=0, 2, …………,16 were the long run multipliers while v_{ij} where j=1,2,………………,15 represented the short run dynamics of the ARDL model. However, p = lag length of stock market returns, while q_1, q_2, and q_3 were the lag lengths of exchange rate, inflation rate measures and interest rate measures, respectively.

Evidence of a joint long run co-movement between the macroeconomic variables and stock market returns implied that the variables adjusted to long run equilibrium following a shock. This further suggested that the short run and long run granger causality between the variables could be meaningfully estimated using an error correction model (Engle & Ganger, 1987). Therefore, this study treated each variable in equations 3.20 to 3.23 as a dependent variable. It then developed four granger causality models from each of the equations to analyze the short run as well as long run granger causality between the variables.

3.3 Data Types and Sources

This study employed published quantitative time series and a qualitative data type in the form of dichotomous dummy variables. Specifically, the study used monthly time series data with the full sample period ranging from 1st January 1993 to 31st December 2015 which yielded a total of 276 observations. The justification for the choice of the sample period was based mainly on the availability of data for all the variables used in the study. The period was also chosen such that adequate sample sizes were obtained for examining the effects of the macroeconomic variables on stock market returns over the period before, during and after the occurrence of the 2008 GFC.

The period before the beginning of the GFC was set between 1st January 1993 and 31st December 2007 and provided 180 observations. The period during the crisis was from 1st January 2008 to 30th June 2009 and yielded 18 observations. The period after the crisis ran from 1st July 2009 to 31st December, 2015 and had 78 observations. The selection of these periods was based on the reports by the Federal Reserve Bank of San Francisco (FRBSF) of 2010, and the National Bureau of Economic Research (NBER) of December 2008 which stated that the 2008 GFC began on December 2007 and ended in June 2009. Additionally, the periods were chosen based on previous studies by Usman (2010), Adamu (2010) and Ali and Afzal (2012).

The variables of the study comprised monthly NSE 20 Share Index drawn from the Nairobi Securities Exchange as well as monthly average KSH_t/USD_t exchange rates, 3-month Treasury Bills rates, and commercial banks' monthly weighted average lending rates obtained from the Central Bank of Kenya (CBK). The study also obtained the month-on-month inflation rate and year-on-year inflation rate from the Kenya National Bureau of Statistics (KNBS).

The dependent variable was the NSE 20 Share Index returns. This variable measures the movement of returns of the twenty most liquid companies listed on the Nairobi Securities Exchange (NSE). It is a standard variable in the literature and has been used by Kirui, Wawire and Onono (2014), Kimani and Mutuku (2013) and Balparda *et al*. (2015). The independent variables were the KSH_t/USD_t exchange rate, the 3-month Treasury Bills rate, the lending rate, the month-on-month inflation rate, the year-on-year inflation rate, and a dummy variable for the 2008 GFC. The moderating variable was the dummy variable which indicated presence or absence of shocks from the 2008 GFC.

Exchange rate is a key policy instrument in Kenya (Bank of International Settlements [BIS], 2014) and changes in the variable reflect the stability and predictability of the macroeconomic environment. Declining values of the exchange rate imply appreciation of the domestic currency and results in deterioration of a country's competitiveness as exports become more expensive making trading partners to shift to relatively cheaper sources. In contrast, appreciation of the exchange rate makes imports cheaper and is thus favourable for stock returns of firms that heavily rely on imported inputs or goods. On the other hand, a depreciation of the exchange rate enhances a country's competitiveness. Studies that have used this variable include Aloy *et al*. (2010), Cakan and Ejara (2013), and Kirui, Wawire and Onono (2014).

The month-on-month inflation rate is the monthly percentage change in the consumer price index (CPI) series. It measures the short run inflation dynamics and has less variance which enhances its forecast ability. It is thus used mostly by active financial investors to adjust their portfolios. This variable has been widely used as a proxy of inflation rate by Buyuksalvarci (2010), Alagidede and Panagiotidis (2010), Kimani and Mutuku (2013), and Kganyago and Gumbo (2015).

On the other hand, the year-on-year inflation rate represents the yearly percentage change in CPI series. It reflects the long run dynamics of inflation rate and has high variance which constrains its forecast ability. This however makes the variable more suitable for monitoring trends of inflation rate by central banks. This variable has been used by Ada and Osahon (2015).

The 3-month Treasury Bills rate is a short term central bank rate and reflects the interest rate that the government pays for borrowing in the short term using a security that matures in three months. It has been widely used in previous studies by Caporale and Gil-Alana (2010), Ouma and Muriu (2014), Issahaku *et al*. (2013), and Kumar and Puja (2012). Lending rate is a long term interest rate and represents charges on commercial banks' loans. It therefore reflects a true cost of investment. This variable has however been used by few studies which include Ado and Sunzuoye (2013), and Caporale and Gil-Alana (2010).

The dummy variable for the 2008 GFC measures the presence or absence of shocks from the 2008 GFC. This qualitative variable has been used by very few studies among them Adamu (2010), Usman (2010) and Ali and Afzal (2012).

Table 3.1 provides details regarding the computation, notations and measurement of stock market returns, exchange rate, month-on-month inflation rate, year-on-year inflation rate, 3-month Treasury Bills rate, lending rate and the dummy variable used in the study.

Table 3.1: Description and Computation of the Variables

Variable name	Notation	Variable Description /Computation	Measurement level
Monthly NSE 20 Share Index nominal returns	NR_t	Proxy for the Security Exchange's performance. Computed as percentage change in closing NSE 20 Share Index between successive months as: $NR_t = \ln\left(\frac{NSE_t}{NSE_{t-1}}\right)\times 100$, where NSE_t is the closing NSE 20 Share index at time t.	percentage
Monthly exchange rate	EX_t	$EX_t = \frac{KSH_t}{USD_t}$ is the exchange rate for month t.	Ratio
Month-on-Month inflation rate	MOM_t	Monthly percentage change in Consumer Price Index series computed as: $MOM_t = \ln\left(\frac{CPI_t}{CPI_{t-1}}\right)\times 100$ where CPI_t is the value of consumer price index at month t. MOM_t captures the short run inflation dynamics, has less variance and high forecast ability which could be helpful in portfolio adjustment.	percentage
Year-on-Year inflation rate	YOY_t	Is the yearly percentage change in the CPI series computed as: $YOY_{Jan2010} = \left(\frac{CPI_{Jan2010}}{CPI_{Jan2009}} - 1\right)\times 100$. YOY_t captures long run dynamics of inflation and has high variance and low forecast ability. Might hence be helpful in tracking the inflation trend by the central bank.	percentage
3-month Treasury Bill rate	$TB3_t$	The short term central bank rate taken as a risk free rate. Interest rate that the government pays for borrowing in the short term.	percentage
Monthly lending rate	Lr_t	The commercial banks' monthly weighted average lending rate. The amount that a lender charges a borrower in order to make a loan.	percentage
Qualitative moderator variable (Global Financial Crisis)	D_{GFC}	Dummy variable for the Global Financial Crisis (GFC). It takes the value 1 for the period before the crisis, 0 otherwise; 1 for the period during the crisis, 0 otherwise; and 1 for the period after the crisis, 0 otherwise. The three periods were chosen following the FRBSF (2010), NBER (2008), Usman (2010), Adamu (2010) and Ali and Afzal (2012).	Binary independent variable

Notes: FRBSF is Federal Reserve Bank of San Francisco, and NBER is the National Bureau of Economic Research.

3.4 Estimating and Testing Techniques

This study began by transforming the NSE 20 Share Index into the NSE 20 Share Index returns through continuous compounding to make modelling their statistical behaviours over time easier (Lo, Campbell & Mackinlay, 1997). Furthermore, economic and finance theory suggests that long-run equilibrium relationship exists among nonstationary time series. Besides, if variables are I (1), then cointegration techniques might be useful in modelling their long run relationships (Engle & Granger, 1987). However, successful application of regression models requires some procedure for inducing stationarity in the data since stationarity or nonstationarity of a time series can strongly influence its behaviour and properties such as persistence of shocks (Granger & Joyeux, 1980; Hosking, 1981). For instance, shocks to nonstationary time series could be infinitely persistent while those to fractionally integrated variables may be persistent but mean-reverting (Granger & Joyeux, 1980).

Consequently, most researchers adopt differencing operations with a single differencing being the most often required to achieve stationarity. This study therefore conducted standard unit root tests as a first step in the analysis to determine the stationarity and nonstationarity of the individual variables. The study applied the Augmented-Dickey-Fuller (ADF) 1979, Phillips Perron (PP) 1988 and the Kwiatkowski-Philips-Schmidt- and Shin (KPSS) 1992 tests, respectively. The tests were conducted using models with an intercept only as well models including both the intercept and trend. The optimal number of lags was chosen based on the model with the lowest AIC.

However, the problem with exact differencing is that it may be too strong for the observed time series and might remove some of the essential information regarding the behaviour of investors in the stock market (Huang, 2010). To avert this possible loss of vital information, this study employed a model based on fractional integration that permits the difference parameter to take on non-integer values (Granger, 1980; Granger & Joyeux, 1980; Hosking, 1981; Tkacz, 2001). It specifically adopted the Exact Maximum Likelihood (EML) estimation technique of Sowell (1992) to empirically determine the memory parameters of the individual time series and their cointegrating residuals.

Specifically, the study adopted the ARFIMA framework (Granger & Joyeux, 1980; Hosking, 1981) represented as:

$$\Phi(1-L)^{d} Y_t = \theta(1-L)\zeta_t \text{..} (3.24)$$

Where Y_t was the variable of interest, $(1-L)^{d}$ was the fractional differencing operator, $\Phi(\mathrm{L})$ and $\theta(\mathrm{L})$ were autoregressive and moving average polynomials, respectively such that $\Phi(\mathrm{L}) = 1 - \phi_1 \mathrm{L} - \text{.................}\phi_p \mathrm{L}^{p}$

and $\theta(L) = 1 - \psi_1 L - .... - \psi_q L^q$. L was the lag, d was the fractional differencing parameter while ζ_t was white noise error term.

Advantages of using EML estimation are that: (a) it facilitates the simultaneous estimation of short memory as well as long memory parameters; (b) the estimator performs well in finite samples; (c) it generates normally distributed estimates of the memory parameter, especially when $d > 0$ (Dalhaus, 2006); and (d) the estimation yields an efficient estimator (Miller & Miller, 2003). This means that the d estimate can be subjected to tests based on normality assumptions such as the t test.

Nevertheless, since cointegration does not identify direction of causality and speed of adjustment to long run equilibrium (Engle & Granger, 1987), this study also employed the error correction model (ECM) and fractionally integrated error correction model (FIECM) to examine the short run dynamics as well as the long run Granger causality between each of the macroeconomic variables and stock market returns. Additionally, the study extended the bivariate cointegration test to a multivariate framework using the autoregressive distributed lag (ARDL) cointegration analysis. It also employed an ARDL-based Granger causality test to examine the short run as well as the long run causality between the variables. In addition, the study used a product-term model to examine how shocks from the 2008 GFC moderated the relationship between the macroeconomic variables and stock market returns.

This study constructed sixteen competing ARFIMA models, ranging from ARFIMA (0, d, 0) to ARFIMA (3, d, 3), for each variable. It then chose the best model based on the significance of the AR and MA components, non-significant portmanteau test, nonsignificant Jarque Bera test, and non-significant ARCH test (see chosen models in Table B1 at the Appendix). However, some models which failed the normality test were chosen because non-normality was not considered a serious issue. This is because non-normality only affects the validity of hypothesis tests in small samples while the study had a fairly large sample size (n=276).

In contrast, the study strictly chose models that passed non-autocorrelation test because presence of autocorrelation leads to smaller standard errors of the estimated parameters and thus larger t-ratios, thereby overestimating the significance of the estimated parameters. The study also strictly included models with the lowest AIC. It however, included some models with significant ARCH tests since ARCH effects do not affect estimation of the memory parameter (Hauser & Kunst, 1998). The significance of the AR and MA components was determined using the t-test.

In summary, the best models for the individual time series and the cointegrating residuals were chosen as follows:

i. Models with significant AR and MA coefficients were selected while those with one or more insignificant coefficients were dropped;
ii. Models with significant portmanteau test were dropped; and
iii. Models with the smallest AIC were chosen.

Additionally, this study conducted two sided hypotheses tests to verify if the individual variables as well as the cointegrating residuals were indeed fractionally integrated. It tested the null hypothesis of short memory ($Ho: d = 0$) against the alternative of long memory ($H1: d \neq 0$) as well as the null hypothesis of permanent memory $(Ho: d = 1)$ versus the long memory alternative $(H1: d \neq 1)$.The tests were based on t test at 5 percent level of significance. The AIC was preferred because it overfits models (i.e. it includes many parameters) in situations of small samples while the Bayesian variants such as the Schwarz Information Criterion (SIC) underfits models (Green, 2003).

3.4.1 Empirical Models for Exchange Rate and Stock Market Returns

This study followed Aloy *et al*. (2010), but instead of using Robinson (1994) test, it applied the EML estimation technique by Sowell (1992) to determine the short run as well as the long run parameters of exchange rate and stock market returns. The advantage of EML test over Robison's test is that it simultaneously measures both short term behaviours of the time series through the AR and MA components as well as the long run behaviour through the d parameter. Robinson (1994) test does not provide information on the short-term properties of the process.

The following univariate ARFIMA models were employed:

$(1-L)^{d1} NR_t$...(3.25)

$(1-L)^{d2} EX_t$..(3.26)

Where $(1-L)^{d1}$ was the fractional differencing operator for stock market returns, L was the lag and d_1 was the fractional differencing parameter for stock market returns. The other variables were as defined in Table 3.1. The models were estimated using EML estimator (Sowell, 1992).

This study also examined the presence of both conventional as well as fractional cointegration between exchange rate and stock market returns in a bivariate framework. It used the conventional as well as fractional cointegration test procedures based on the respective cointegrating residuals.

For instance, to test the hypothesis that exchange rate was cointegrated with stock market returns, this study determined the stationarity of the cointegrating residual obtained from the static regression of stock market returns on exchange rate (Engle & Granger, 1987). It used the ADF, PP and KPSS unit root tests.

On the other hand, this study hypothesized that exchange rate and stock market returns were each fractionally integrated and were driven by the same fundamentals in the long run. This implied that their cointegrating residual was also fractionally integrated. It therefore fitted the following ARFIMA model to the cointegrating residual (Cheung & Lai, 1993; Cheung, 2007) to estimate its order of integration:

$$(1-L)^{d3} Rnrex_t \text{...} (3.27)$$

Where $Rnrex_t = NR_t - \hat{\alpha}_1 EX_t$ was the cointegrating residual obtained by regressing stock market returns on exchange rate.

However, if stock market returns and exchange rate were found to be cointegrated, an error correction mechanism was the most appropriate model to capture the short run as well as the long run dynamics between the two variables (Engle & Granger, 1987). Furthermore, if two variables were cointegrated, Granger causality existed at least in one direction (Engle & Granger, 1987). This study therefore estimated the following Granger causality model:

$$\left.\begin{aligned}\Delta NR_t &= \eta_1 + \sum_{j=1}^{p} \Pi_{11}^{j} \Delta NR_{t-j} + \sum_{j=1}^{q} \Pi_{12}^{j} \Delta EX_{t-j} + \kappa_1 Rnrex_{t-1} + \kappa_{1t} \\ \Delta EX_t &= \eta_2 + \sum_{j=1}^{p} \Pi_{21}^{j} \Delta NR_{t-j} + \sum_{j=1}^{q} \Pi_{22}^{j} \Delta EX_{t-j} + \kappa_2 Rnrex_{t-1} + \kappa_{2t}\end{aligned}\right\} \ldots\ldots (3.28)$$

where κ_1 and κ_2 were the adjustment parameters with their sizes representing the speed of adjustment to long run equilibrium, $Rnrex_{t-1}$ was the error correction term lagged one period, Π^{i}_{jk} were the coefficients of the AR terms , while η_1 and η_2 were the long run estimates of the unconditional mean values. Short run causality was assessed by testing the null hypotheses: $H_0 : \Pi^{j}_{12} = 0$ and $H_0 : \Pi^{j}_{21} = 0$ for all j. However, the study examined the long run causality by testing the null hypotheses: $H_0 : \kappa_1 = 0$ and $H_0 : \kappa_2 = 0$. If both Π^{i}_{11} and Π^{i}_{22} turned out to be significant, the study concluded that there was presence of serial dependence on the stock market returns and the exchange rate, respectively. On the other hand, if both Π^{i}_{12} and Π^{i}_{21} were not significant, the study concluded that there was no transmission from the stock market returns to the exchange rate and vice versa. However, if Π^{i}_{12} was found to be significant but Π^{i}_{21} was not, the study concluded that a short run unidirectional causality ran from exchange rate to stock market returns.

Conversely, if both Π^{i}_{12} and Π^{i}_{21} were found to be significant, the conclusion was that a bi-directional short run causality existed between the variables. On the other hand, if κ_1 was found to be statistically significant but κ_2 was not, the study concluded that exchange rate unidirectionally Granger caused stock market returns in the long run. If both κ_1 and κ_2 were statistically significant, it implied a bidirectional long run causality between the two variables. The optimal number of lag lengths was chosen from models with the lowest Akaike Information Criterion (AIC).

On the contrary, most economic and financial time series such as stock market returns and exchange rates are neither nonstationary in levels nor stationary in first difference (Teyssiere & Kirman, 2007). To capture this possibility of long memory, the study employed the more general concept of the fractionally integrated error correction mechanism (FIECM).This is because the cointegrating residuals themselves might possess long memory (Cheung, 2007; Okunev & Wilson, 1997).

Therefore, to test for a difference in the speed of adjustment to long run equilibrium when the time series possessed long memory, this study used the following Granger causality model based on fractionally differenced data:

$$\left.\begin{aligned}(1-L)^{d1}\,\mathrm{NR}_t &= \lambda_0+\varphi_1(1-L)^{d3}\,\mathrm{Rnrex}_{t-1}+\sum_{i=1}^{m}\Gamma_{11}{}^{i}(1-L)^{d1}NR_{t-i}+\sum_{i=1}^{n}\Gamma_{12}{}^{i}(1-L)^{d2}EX_{t-i}+\chi_{1t}\\(1-\mathrm{L})^{d2}\,\mathrm{EX}_t &= \lambda_1+\varphi_2(1-L)^{d3}\,\mathrm{Rnrex}_{t-1}+\sum_{i=1}^{n}\Gamma_{21}{}^{i}(1-L)^{d1}NR_{t-i}+\sum_{i=1}^{m}\Gamma_{22}{}^{i}(1-L)^{d2}EX_{t-i}+\chi_{2t}\end{aligned}\right\}\text{...(3.29)}$$

Where $(1-L)^{d3}Rnrex_{t-1}$ was the fractionally integrated error correction term (FIECT) lagged one period, and $(1-L)^{d1}\,\mathrm{NR}_t$ represented fractionally differenced stock market returns. Short run fractional causality between the variables was tested by the null hypotheses: $H_0 : \Gamma^i{}_{12} = 0$ and $H_0 : \Gamma^i{}_{21} = 0$ for all i while long run fractional causality was examined by testing the null hypotheses: $H_0 : \varphi_1 = 0$ and $H_0 : \varphi_2 = 0$. If both $\Gamma^i{}_{12}$ and $\Gamma^i{}_{21}$ were significant, the study concluded that there was a bidirectional short run fractional causality between exchange rate and stock market returns. Likewise, if both $H_0 : \varphi_1 = 0$ and $H_0 : \varphi_2 = 0$ were rejected, the conclusion was that a bidirectional long run fractional causality existed between the two variables. The optimal number of lag lengths was chosen from models with the lowest AIC.

Based on the model given by Eq. (3.1) this study estimated a bivariate long run relationship between exchange rate and stock market returns using the following estimating model:

$$NR_t = \alpha_o + \alpha_1 \Delta EX_t + \upsilon_{1t} \quad \text{...(3.30)}$$

Where NR_t and ΔEX_t were stock market returns and first differenced exchange rate because of the apparent nonstationarity exhibited in Figure 1.1. However, if application of the unit root test to the residual from regressing stock market returns on exchange rate established that the cointegrating residual was stationary (i.e. stock market returns and exchange rate were cointegrated), the study proceeded to use the levels of both variables in the regressions. This study expected α_1 to be positive according to the Flow Oriented model (Dornbusch & Fischer, 1980) for an export-dependent firm.

This study also tested the direct effect of the 2008 GFC on stock market returns as well as the moderating effect of shocks from the 2008 GFC on the relationship between exchange rate and stock market returns. It divided the sample period into (a) the period before the 2008 GFC crisis (from 1st January 1993 to 31st December, 2007); (b) the period during the 2008 GFC crisis (from 1st January 2008 to 30th June 2009); and (c) the period after the 2008 GFC crisis (from 1st July 2009 to 31st December 2015). Three dummy variables were used to capture the three different periods with $D_{beforeGFC}$ representing the period before the crisis; $D_{duringGFC}$ for the period during the crisis; and $D_{afterGFC}$ for the period after the crisis. $D_{beforeGFC}$ was coded 1 for the period before the crisis, 0 for other periods; $D_{duringGFC}$ was 1 for the period during the crisis, 0 for other periods; and $D_{afterGFC}$ was is 1 for the period after the crisis, and 0 otherwise.

The study then estimated the direct effect of the 2008 GFC on stock market returns as well as its moderating effect on the relationship between exchange rate and stock market returns during and after the crisis period in comparison to the period before the crisis. This was done by estimating the following model derived from equation 3.2:

$$NR_t = \beta_0 + \beta_1 \mathrm{D}_{duringGFC} + \beta_2 \mathrm{D}_{afterGFC} + \beta_3 \mathrm{EX_t} + \beta_4 \mathrm{EX_t D}_{duringGFC} + \beta_5 EX_t D_{afterGFC} + \varepsilon_{1t} \quad (3.31)$$

Where $D_{duringGFC}$, $D_{afterGFC}$ and EX_t were as defined earlier. β_0 in equation 3.31 measured the mean stock market returns for the period before the crisis while β_1 represented the average stock market returns during the crisis period compared to the average stock market returns before the crisis (i.e. average stock market returns during minus average stock market returns before the beginning of the 2008 GFC). A negative β_1 demonstrated that average stock market returns were lower during the crisis period relative to the period before the crisis. β_3 represented the effect of a change in exchange rate on stock market returns for the period before the crisis. On the other hand, β_4 reflected the effect of a unit depreciation of exchange rate on stock market returns during the crisis period minus the corresponding effect before the crisis (i.e. it is the net effect of a depreciation in exchange rate on stock market returns). If positive, this suggested that an extra depreciation in exchange rate had a higher positive effect on stock market returns during the crisis compared to a corresponding effect before the crisis.

To examine how stock market returns differed over the three periods (i.e. before, during and after the 2008 GFC) as a function of the mean exchange rate, this study derived the following model from equation 3.3:

$$NR_t = \beta_6 + \beta_7 D_{duringGFC} + \beta_8 D_{afterGFC} + \beta_9 EX_{ct} + \beta_{10} EX_{ct} D_{duringGFC} + \beta_{11} EX_{ct} D_{afterGFC} + \varepsilon_{2t} \text{.....(3.32)}$$

Where EX_{ct} was mean centered exchange rate and β_6 measured the average stock market returns when all predictors were equal to zero. This coincided with average stock market returns for the period before the crisis conditional on exchange rate being at its sample mean value. β_7 represented the average stock market returns during the crisis minus the corresponding average stock market returns before the crisis at the mean of exchange rate (that is the differential intercept). If positive, it indicated that average stock market returns during the crisis were higher than average stock market returns before the crisis at the mean exchange rate. β_9 captured the effect of changes in exchange rate on stock market returns before the crisis conditional on the exchange rate being at its mean value. β_{10} measured the effect of a unit depreciation of exchange rate on stock market returns during the crisis minus a corresponding effect before the crisis when exchange rate was at its average value. A positive β_{10} suggested that an extra unit of exchange rate depreciation translated into more increase in average stock market returns during the crisis period compared to before the crisis at mean exchange rate. The study expected the following conditions to hold:

$\beta_0 > 0,\ \beta_1 < 0,\ \beta_2 < 0,\ \beta_3 > 0,$

$\beta_4 < 0,\ \beta_5 < 0,\ \beta_6 > 0,\ \beta_7 < 0,\ \beta_8 < 0,\ \beta_9 > 0,\ \beta_{10} < 0,$ and $\beta_{11} < 0.$

This study also determined how average stock market returns varied during and after the crisis in comparison to before the crisis at low, medium and high values of exchange rate.

3.4.2 Empirical Models for Inflation Rate and Stock Market Returns

This study employed an ARFIMA model to empirically determine the integration orders of the two measures of inflation rate and stock market returns following Aye *et al*. (2012). However, unlike Aye *et al*. (2012) who used the Geweke-Porter-Hudak (GPH) estimator, this study employed the parametric EML estimator (Sowell, 1992) which has the capability to simultaneously estimate the short memory as well as the long memory parameters of the variables of interest. The study therefore estimated the following univariate ARFIMA models:

$$(1-L)^{d1} NR_t \qquad (3.33)$$

$$(1-L)^{d4} MOM_t \qquad (3.34)$$

$$(1-L)^{d5} YOY_t \qquad (3.35)$$

Where $(1-L)^{d1}$ was the fractional differencing operator for stock market returns with d_1 being the fractional differencing parameter for stock market returns. MOM_t was the month-on-month inflation rate, and YOY_t was the year-on-year inflation rate.

To test the hypothesis that the two measures of inflation rate were each cointegrated with stock market returns, this study estimated the stationarity of the respective cointegrating residuals namely; $Rnrmom_t$ and $Rnryoy_t$ using the ADF, PP and KPSS unit root tests.

However, assuming that the individual variables were each fractionally integrated (Teyssiere & Kirman, 2007), this study fitted ARFIMA models to each of the cointegrating residuals derived from regressing stock market returns on each of the measures of inflation rate to test for existence of fractional cointegration (Cheung & Lai, 1993; Cheung, 2007). It used the following models:

$$(1-L)^{d6} Rnrmom_t \qquad (3.36)$$

$$(1-L)^{d7} Rnryoy_t \qquad (3.37)$$

Where $Rnrmom_t$ and $Rnryoy_t$ were the cointegrating residuals obtained by regressing stock market returns on the month-on-month inflation rate, and on the year-on-year inflation rate, respectively.

Presence of cointegration between variables implied that causality existed in at least one direction (Engle & Granger, 1987). Consequently, this study applied the following error correction models to examine the short run and the long run dynamics between each of the measures of inflation rate and stock market returns:

$$\left.\begin{aligned}\Delta NR_t &= \varpi_0 + \sum_{j=1}^{m} K_{11}^{j}\Delta NR_{t-j} + \sum_{j=1}^{n} K_{12}^{j}\Delta MOM_{t-j} + \sigma_o ECT1_{t-1} + \Im_{1t}\\ \Delta MOM_t &= \varpi_1 + \sum_{j=1}^{m} K_{21}^{j}\Delta NR_{t-j} + \sum_{j=1}^{n} K_{22}^{j}\Delta MOM_{t-j} + \sigma_0 ECT1_{t-1} + \Im_{2t}\end{aligned}\right\}\text{......(3.38)}$$

$$\left.\begin{aligned}\Delta NR_t &= \varpi_2 + \sum_{k=1}^{m} w_{11}^{k}\Delta NR_{t-k} + \sum_{k=1}^{n} w_{12}^{k}\Delta YOY_{t-k} + \sigma_1 ECT2_{t-1} + \Im_{3t}\\ \Delta YOY_t &= \varpi_3 + \sum_{k=1}^{m} w_{21}^{k}\Delta NR_{t-k} + \sum_{k=1}^{n} w_{22}^{k}\Delta YOY_{t-k} + \sigma_1 ECT2_{t-1} + \Im_{4t}\end{aligned}\right\}\text{......(3.39)}$$

Where $ECT1_{t-1}$ was the error correction term from regressing stock market returns on the month-on-month inflation rate lagged one period, and the other variables were as defined in Table 3.1. The optimal lag lengths were determined from the models with lowest AIC.

But most economic and financial time series are neither nonstationary in levels nor stationary in first difference (Teyssiere & Kirman, 2007). This study therefore employed a fractionally integrated error correction model (FIECM) because the cointegrating residuals themselves might have possessed long memory (Cheung, 2007; Okunev & Wilson, 1997). It adopted the following models:

$$\left.\begin{aligned}(1-L)^{d1}NR_t &= \varpi_4+\sum_{i=1}^{m}p_{11}^{i}(1-L)^{d1}NR_{t-i}+\sum_{i=1}^{n}p_{12}^{i}(1-L)^{d4}MOM_{t-i}+\sigma_2\, fdRnrmom_{-1}+\Im_{5t}\\(1-L)^{d4}MOM_t &= \varpi_5+\sum_{i=1}^{m}p_{21}^{i}(1-L)^{d1}NR_{t-i}+\sum_{i=1}^{n}p_{22}^{i}(1-L)^{d4}MOM_{t-i}+\sigma_2\, fdRnrmom_{-1}+\Im_{6t}\end{aligned}\right\}\text{..........(3.40)}$$

$$\left.\begin{aligned}(1-L)^{d1}\,\mathrm{NR}_t &= \varpi_6+\sum_{i=1}^{m}\phi_{11}{}^{i}(1-L)^{d1}NR_{t-i}+\sum_{i=1}^{n}\phi_{12}{}^{i}(1-L)^{d5}YOY_{t-i}+\sigma_3\, fdRnryoy_{-1}+\Im_{7t}\\(1-\mathrm{L})^{d5}\,\mathrm{YOY}_t &= \varpi_7+\sum_{i=1}^{n}\phi_{21}{}^{i}(1-L)^{d1}NR_{t-i}+\sum_{i=1}^{m}\phi_{22}{}^{i}(1-L)^{d5}YOY_{t-i}+\sigma_3\, fdRnryoy_{-1}+\Im_{8t}\end{aligned}\right\}\text{...........(3.41)}$$

Where $fdRnryoy_{t-1}=(1-L)^{d6}Rnryoy_{t-1}$ was the fractionally integrated error correction term (FIECT) derived from regressing stock market returns on the year-on-year inflation rate lagged one period, and $(1-L)^{d5}\,YOY$ was the fractionally differenced year-on-year inflation rate. The optimal number of lag lengths was chosen from models with the lowest AIC.

To examine the long run relationship between each of the measures of inflation rate and stock market returns, this study derived the following models from equations 3.5 and 3.6:

$$NR_t=\vartheta_0+\vartheta_1 MOM_t+\omega_{1t}\text{..(3.42)}$$

$$NR_t=\vartheta_2+\vartheta_3 YOY_t+\omega_{2t}\text{.................................(3.43)}$$

where MOM_t was the month-on-month inflation rate, YOY_t was the year-on-year inflation rate while ϑ_1 and ϑ_2 measured the long run effect of the month-on-month inflation rate and year-on-year inflation rate on stock market returns, respectively.

Clearly, the effect of changes in inflation rate on stock market returns should differ depending on the presence or absence of shocks from the 2008 GFC (Moore & Wang, 2014). Hence, to determine the effect of the 2008 GFC on stock market returns, this study divided the sample period into (a) the period before the 2008 GFC crisis (from 1st January 1993 to 31st December, 2007); (b) the period during the 2008 GFC crisis (from 1st January 2008 to 30th June 2009); and (c) the period after the 2008 GFC crisis (from 1st July 2009 to 31st December 2015).

This study then constructed three dummy variables namely: $D_{beforeGFC}$ to represent the period before the crisis; $D_{duringGFC}$ to capture the period during the crisis; and $D_{afterGFC}$ to denote the period after the crisis. $D_{beforeGFC}$ was coded 1 for the period before the crisis, 0 otherwise ; $D_{duringGFC}$ was 1 for the period during the crisis, 0 otherwise; and $D_{afterGFC}$ was 1 for the period after the crisis, and 0 otherwise. The following models were then derived from equations 3.7 and 3.8 to estimate the direct effects of the 2008 GFC on stock market returns. The models were also used to determine the moderating effect of the 2008 GFC on the relationship between each of the measures of inflation rate and stock market returns during and after the crisis period in comparison to the period before the crisis.

$$NR_t = \phi_0 + \phi_1 D_{duringGFC} + \phi_2 \mathrm{D}_{afterGFC} + \phi_3 \mathrm{MOM}_t + \phi_4 \mathrm{MOM}_t \mathrm{D}_{duringGFC} + \phi_5 \mathrm{MOM}_t D_{afterGFC} + \gamma_{1t} \text{......(3.44)}$$

$$NR_t = \phi_6 + \phi_7 \mathrm{D}_{duringGFC} + \phi_8 \mathrm{D}_{afterGFC} + \phi_9 \mathrm{YOY}_t + \phi_{10} \mathrm{YOY}_t \mathrm{D}_{duringGFC} + \phi_{11} \mathrm{YOY}_t D_{afterGFC} + \gamma_{2t} \text{........(3.45)}$$

Where ϕ_0 in equation 3.44 was the average stock market returns before the crisis, ϕ_1 measured the average stock market returns during the crisis period compared to average stock market returns before the crisis. If positive, ϕ_1 indicated that stock market returns were, on average, higher during the crisis compared to before the crisis. ϕ_3 reflected the effect of a unit increase in the month-on-month inflation rate on stock market returns before the crisis began. A positive ϕ_3 showed that a unit increase in the month-on-month inflation rate led to an increase in stock market returns before the crisis began. On the other hand, ϕ_4 measured the effect of a unit increase in the month-on-month inflation rate on stock market returns for the period during the crisis minus the corresponding effect for the period before the crisis. A positive ϕ_4 therefore suggested that a unit increase in the month-on-month inflation rate had a higher positive effect on stock market returns during the crisis compared to a corresponding effect before the crisis. A similar interpretation held for the coefficients in equation 3.45.

To examine how stock market returns differed over the three periods (i.e. before, during and after the crisis) as a function of the mean value of each measure of inflation rate, the study derived the following models from equations 3.9 and 3.10:

$$NR_t = \phi_{12} + \phi_{13} D_{duringGFC} + \phi_{14} D_{afterGFC} + \phi_{15} MOM_{ct} + \phi_{16} MOM_{ct} D_{duringGFC} + \phi_{17} MOM_{ct} D_{afterGFC} + \gamma_{3t} \text{...(3.46)}$$

$$NR_t = \phi_{18} + \phi_{19} D_{duringGFC} + \phi_{20} D_{afterGFC} + \phi_{21} YOY_{ct} + \phi_{22} YOY_{ct} D_{duringGFC} + \phi_{23} YOY_{ct} D_{afterGFC} + \gamma_{4t} \text{....(3.47)}$$

Where ϕ_{12} in equation 3.46 was the average stock market returns for the period before the crisis at the mean month-on-month inflation rate, ϕ_{13} was the average stock market returns for the period during the crisis minus the average stock market returns for the period before the crisis at the mean month-on-month inflation rate. If positive, ϕ_{13} suggested that stock market returns were higher during the crisis compared to before the crisis at the mean month-on-month inflation rate.

On the other hand, ϕ_{15} measured the effect of a unit increase in the month-on-month inflation rate on stock market returns before the crisis period when the month-on-month inflation rate was at its mean value. Therefore a positive ϕ_{15} implied that when the month-on-month inflation rate was at its mean value, a unit increase in its value had a positive effect on stock market returns before the crisis began. ϕ_{16} measured the extent to which the mean difference in average stock market returns between the crisis period and the period before the crisis changed in response to a unit increase in the month-on-month inflation rate when the month-on-month inflation rate was held at its mean value. If positive, ϕ_{16} indicated that for a unit increase in the month-on-month inflation rate, average stock market returns during the crisis increased by a bigger margin compared to average stock market returns before the crisis when the month-on-month inflation rate was average. A similar interpretation was applied to the coefficients of equation 3.47. The study hypothesized that:

$\phi_0 > 0,\ \phi_1 < 0,\ \phi_2 < 0,\ \phi_3 > 0,\ \phi_4 < 0,\ \phi_5 < 0,\ \phi_6 > 0,\ \phi_7 < 0,\ \phi_8 < 0,\ \phi_9 > 0,\ \phi_{10} < 0,$
$\phi_{11} < 0,\ \phi_{12} > 0,\ \phi_{13} < 0,\ \phi_{14} < 0,\ \phi_{15} > 0,\ \phi_{16} < 0,\ \phi_{17} < 0,\ \phi_{18} > 0,\ \phi_{19} < 0,\ \phi_{20} < 0,$
$\phi_{21} > 0,\ \phi_{22} < 0,$ and $\phi_{23} < 0.$

The study also estimated the average stock market returns for the period during and after the crisis in comparison to the period before the crisis at low, medium and high values of the two measures of inflation rate.

3.4.3 Empirical Models for Interest Rate and Stock Market Returns

This study followed Balparda *et al*. (2015) and adopted an ARFIMA model to determine the integration orders of stock market returns and each of the measures of interest rate namely; the 3-month Treasury Bills rate and the commercial banks' monthly weighted average lending rate. However, while Balparda *et al*. (2015) used Robinson's (1994) parametric approach, this study employed the EML (Sowell, 1992) based on the following models:

$(1-L)^{d1} NR_t$..(3.48)

$(1-L)^{d8} TB3_t$.................................(3.49)

$(1-L)^{d9} Lr_t$.................................(3.50)

Where $(1-L)^{d1} NR_t$ denoted the fractionally differenced stock market returns, $(1-L)^{d8} TB3_t$ represented the fractionally differenced 3-month Treasury Bills rate, and $(1-L)^{d9} Lr_t$ was the fractionally differenced commercial banks' weighted average lending rate.

This study examined the stationarity of the respective cointegrating residuals, namely $\mathrm{Rnrtb}3_t$ and Rnrlr_t to determine presence of a bivariate cointegration between each measure of interest rate and stock market returns. It used the ADF, PP and KPSS unit root tests.

However, the study hypothesized that the 3-month Treasury Bills rate, lending rate and stock market returns might have been fractionally integrated variables (Teyssiere & Kirman, 2007). Therefore, following Cheung (2007), it applied the following univariate ARFIMA models on the respective cointegrating residuals to investigate presence of a bivariate fractional cointegration between each measure of interest rate and stock market returns:

$(1-L)^{10} Rnrtb3_t$..(3.51)

$(1-L)^{d11} Rnrlr_t$...............................(3.52)

Where $Rnrtb3_t$ and $Rnrlr_t$ are the respective cointegrating residuals.

To determine presence of causal effects between each of the measures of interest rate and stock market returns (Engle & Granger, 1987), this study estimated the following ECM models:

$$\left.\begin{aligned} \Delta NR_t &= \gamma_0 + \sum_{j=1}^{m} \Phi_{11}^{j} \Delta NR_{t-j} + \sum_{j=1}^{n} \Phi_{12}^{j} \Delta TB3_{t-j} + \psi_0 Rnrtb3_{t-1} + G_{1t} \\ \Delta TB3_t &= \gamma_1 + \sum_{j=1}^{m} \Phi_{21}^{j} \Delta NR_{t-j} + \sum_{j=1}^{n} \Phi_{22}^{j} \Delta TB3_{t-j} + \psi_0 Rnrtb3_{t-1} + G_{2t} \end{aligned}\right\} \ldots..(3.53)$$

$$\left.\begin{aligned} \Delta NR_t &= \gamma_2 + \sum_{k=1}^{m} \theta_{11}^{k} \Delta NR_{t-k} + \sum_{k=1}^{n} \theta_{12}^{k} Lr_{t-k} + \psi_1 Rnrlr_{t-1} + G_{3t} \\ \Delta Lr_t &= \gamma_3 + \sum_{k=1}^{m} \theta_{21}^{k} \Delta NR_{t-k} + \sum_{k=1}^{n} \theta_{22}^{k} \Delta Lr_{t-k} + \psi_1 Rnrlr_{t-1} + G_{4t} \end{aligned}\right\} \ldots.(3.54)$$

Where ψ_1 was the adjustment coefficient which showed how fast deviations from the long run equilibrium disappeared. The short run causality was examined by testing: $Ho : \theta_{12} = 0$ and $\text{Ho} : \theta_{21} = 0$ for all k while the long-run causality was investigated, for instance, by testing: $Ho : \psi_1 = 0$. The optimal lag lengths were determined from the models with lowest AIC.

But economic and financial variables are more likely to possess long memory (Teyssiere & Kirman, 2007) making it unsuitable to employ the conventional ECM to investigate short run and long run causality between such variables. This study therefore adopted the following fractionally integrated error correction models (FIECMs) (Cheung, 2007; Okunev & Wilson, 1997) to determine causal effects between each measure of interest rate and stock market returns:

$$\left.\begin{aligned}(1-L)^{d1} NR_t &= \gamma_4 + \sum_{i=1}^{m} \Upsilon_{11}^{i}(1-L)^{d1} NR_{t-i} + \sum_{i=1}^{n} \Upsilon_{12}^{i}(1-L)^{d8} TB3_{t-i} + \psi_3\, fdRnrtb3_{t-1} + G_{5t} \\ (1-L)^{d8} TB3_t &= \gamma_5 + \sum_{i=1}^{m} \Upsilon_{21}^{i}(1-L)^{d1} NR_{t-i} + \sum_{i=1}^{n} \Upsilon_{22}^{i}(1-L)^{d8} TB3_{t-i} + \psi_3\, fdRnrtb3_{t-1} + G_{6t}\end{aligned}\right\}\text{....(3.55)}$$

$$\left.\begin{aligned}(1-L)^{d1} NR_t &= \gamma_6 + \sum_{i=1}^{m} \Theta_{11}^{i}(1-L)^{d1} NR_{t-i} + \sum_{i=1}^{n} \Theta_{12}^{i}(1-L)^{d9} Lr_{t-i} + \psi_4\, fdRnrlr_{t-1} + G_{7t} \\ (1-L)^{d9} Lr_t &= \gamma_7 + \sum_{i=1}^{m} \Theta_{21}^{i}(1-L)^{d1} NR_{t-i} + \sum_{i=1}^{n} \Theta_{22}^{i}(1-L)^{d9} Lr_{t-i} + \psi_4\, fdRnrlr_{t-1} + G_{8t}\end{aligned}\right\}\text{...(3.56)}$$

where $fdRnrtb3_{t-1}$ and $fdRnrlr_{t-1}$ were fractionally integrated error correction terms (FIECTs) lagged one period, ψ_3 and ψ_4 were the long run adjustment parameters, $(1-\mathrm{L})^{d1}\,\mathrm{NR_t}$, $(1-\mathrm{L})^{d8}\,\mathrm{TB3_t}$, and $(1-\mathrm{L})^{d9}\,\mathrm{Lr_t}$ were fractionally differenced stock market returns, 3-month Treasury Bills rate, and lending rate, respectively. The study examined the short run causality by testing: $Ho: \Upsilon_{12} = 0$ and $Ho: \Upsilon_{21} = 0$ for all i in equation 3.55 as well as $Ho: \Theta_{12} = 0$ and $Ho: \Theta_{21} = 0$ for all i in equation 3.56. The long-run causality was investigated by testing: $Ho: \psi_3 = 0$ and $Ho: \psi_4 = 0$ in equations 3.55 and 3.56. The optimal lag lengths were chosen from models with the lowest AIC.

Moreover, based on Figure 1.3, this study assumed that the 3-month Treasury Bills rate and lending rate were nonstationary variables requiring to be differenced first before being used to determine the long run relationship between each of the variables and stock market returns. It however subjected the residuals from regressing stock market returns on each of the measures of interest rates to a stationarity test and established existence of a stable long run relationship between each of the measures of interest rate and stock market returns. Consequently, the study derived the following models from equations 3.13 and 3.15 to estimate the long run effect of each of the two measures of interest rate on stock market returns:

$$NR_t = \Gamma_0 + \Gamma_1 TB3_t + \rho_{1t} \text{....................................}(3.57)$$

$$NR_t = \Gamma_2 + \Gamma_3 Lr_t + \rho_{2t} \text{.............}(3.58)$$

Where $TB3_t$ is the 3-month Treasury Bills rate, and Lr_t is the lending rate.

To investigate the extent to which the 2008 GFC might have affected stock market returns, this study separated the data into (a) the pre-crisis period (from 1st January 1993 to 31st December, 2007); (b) the crisis period (from 1st January 2008 to 30th June 2009); and (c) the post-crisis period (from 1st July 2009 to 31st December 2015). It then developed three dummy variables namely: $D_{beforeGFC}$ for the pre-crisis period; $D_{duringGFC}$ for the crisis period; and $D_{afterGFC}$ for the post-crisis period. $D_{beforeGFC}$ was 1 for the pre-crisis period, 0 otherwise ; $D_{duringGFC}$ was 1 for the crisis period, 0 otherwise; and $D_{afterGFC}$ was

1 for the post-crisis period, and 0 otherwise. This study then derived the following models from equations 3.16 and 3.17 to estimate the direct effect of the 2008 GFC on stock market returns. It also used equations 3.59 and 3.60 to determine the moderating effect of the 2008 GFC on the relationship between each of the measures of interest rate and stock market returns for the crisis period and the post crisis period in comparison to the pre-crisis period.

$$NR_t = \Lambda_0 + \Lambda_1 D_{duringGFC} + \Lambda_2 D_{afterGFC} + \Lambda_3 TB3_t + \Lambda_4 TB3_t D_{duringGFC} + \Lambda_5 TB3_t D_{afterGFC} + \angle_{1t} \text{........(3.59)}$$

$$NR_t = \Lambda_6 + \Lambda_7 D_{duringGFC} + \Lambda_8 D_{afterGFC} + \Lambda_9 Lr_t + \Lambda_{10} Lr_t D_{duringGFC} + \Lambda_{11} Lr_t D_{afterGFC} + \angle_{2t} \text{.......(3.60)}$$

where Λ_0 was the average stock market returns for the pre-crisis period , Λ_1 measured the average stock market returns during the crisis period minus average stock market returns before the crisis period, and Λ_3 represented the amount by which stock market returns changed following a unit increase in the 3-month Treasury Bills rate before the crisis began. A positive Λ_1 indicated that average stock market returns were higher during the crisis compared to before the beginning of the crisis. Likewise, a positive Λ_3 suggested that a unit increase in the 3-month Treasury Bills rate contributed to an increase in stock market returns before the crisis.

On the other hand, Λ_4 denoted the difference in the average stock market returns between the crisis period and the period before the crisis following a unit increase in the 3-month Treasury Bills rate. If positive, Λ_4 demonstrated that a unit increase in the 3-month Treasury Bills rate had a higher positive effect on stock market returns during the crisis compared to before the crisis. A similar interpretation was applied to the coefficients of equation 3.60.

This study also investigated the extent to which average stock market returns differed during and after the crisis in comparison to before the crisis period as a function of the mean values of the two measures of interest rate. This was determined through the following models derived from equations 3.18 and 3.19:

$$NR_t = \Lambda_{12} + \Lambda_{13} D_{duringGFC} + \Lambda_{14} D_{afterGFC} + \Lambda_{15} TB3_{ct} + \Lambda_{16} TB3_{ct} D_{duringGFC} + \Lambda_{17} TB3_{ct} D_{afterGFC} + \angle_{3t} \text{..........(3.61)}$$

$$NR_t = \Lambda_{18} + \Lambda_{19} D_{duringGFC} + \Lambda_{20} D_{afterGFC} + \Lambda_{21} Lr_{ct} + \Lambda_{22} Lr_{ct} D_{duringGFC} + \Lambda_{23} Lr_{ct} D_{afterGFC} + \angle_{4t} \text{................(3.62)}$$

where $TB3_{ct}$ and Lr_{ct} were mean centered values of the 3-month Treasury Bills rate and lending rate, respectively.

From equation 3.61, Λ_{12} measured the average stock market returns for the period before the crisis at the average 3-month Treasury Bills rate. Λ_{13} denoted the average stock market returns during the crisis less the average stock market returns before the crisis when the 3-month Treasury Bills rate was held at its mean value. If positive, Λ_{13} implied that average stock market returns during the crisis were higher than average stock market returns before the crisis at the mean 3-month Treasury Bills rate.

On the other hand, Λ_{15} measured the effect of a unit increase in the 3-month Treasury Bills rate on stock market returns for the period before the crisis when the 3-month Treasury Bills rate was at its mean value. A positive Λ_{15} suggested that a unit increase in the 3-month Treasury Bills rate resulted into an increase in stock market returns before the crisis began when the 3-month Treasury Bills rate was at its mean value. Λ_{16} represented the effect of a unit increase in the 3-month Treasury Bills rate on stock market returns during the crisis minus a corresponding effect before the crisis when the 3-month Treasury Bills rate was average. A positive Λ_{16} suggested that a unit increase in the 3-month Treasury Bills rate had a larger positive effect on the stock market returns during the crisis compared to a corresponding effect before the crisis when the 3-month Treasury Bills rate was average. A similar interpretation was applied to the coefficients of equation 3.62. The study hypothesized that:

$$\Lambda_0 > 0,\ \Lambda_1 < 0,\ \Lambda_2 < 0,\ \Lambda_3 > 0,\ \Lambda_4 > 0,\ \Lambda_5 > 0,\ \Lambda_6 > 0,\ \Lambda_7 < 0,\ \Lambda_8 < 0,\ \Lambda_9 < 0,$$
$$\Lambda_{10} < 0,\ \Lambda_{11} < 0,\ \Lambda_{12} > 0,\ \Lambda_{13} < 0,\ \Lambda_{14} < 0,\ \Lambda_{15} < 0,\ \Lambda_{16} < 0,\ \Lambda_{17} < 0,\ \Lambda_{18} > 0,$$
$$\Lambda_{19} < 0,\ \Lambda_{20} < 0,\ \Lambda_{21} < 0,\ \Lambda_{22} < 0,\ \Lambda_{13} < 0.$$

This study also estimated average stock market returns for the period during and after the crisis relative to the period before the crisis at low, medium and high values of each of the measures of interest rate.

3.4. 4 Empirical Models for the ARDL Cointegration Analysis

To obtain a deeper understanding of the long run relationship between the macroeconomic variables and stock market returns, this study extended the residual-based cointegration analysis conducted using the ADF, PP and KPSS tests to a multivariate cointegration analysis based on the ARDL bounds cointegration test. This is because the ARDL is a flexible approach for determining a cointegrating relationship between variables some of which might be I(0), others I(1) and still others, I(d) with d being a non-integer (Asteriou & Hall, 2007). The conventional Johansen multivariate cointegration test cannot handle such a situation since it requires all the underlying series to be *I*(1) (Johansen & Juselius, 1990).This study therefore derived the following ARDL estimating models from equations 3.20 to 3.23:

$$\Delta NR_t = \alpha_{01} + \sum_{i=1}^{p} h_{i0}\Delta NR_{t-i} + \sum_{i=0}^{q1} h_{i1}\Delta EX_{t-i} + \sum_{i=0}^{q2} h_{i2}\Delta MOM_{t-i} +$$

$$\sum_{i=0}^{q3} h_{i3}\Delta TB3_{t-i} + \aleph_1 NR_{t-1} + \aleph_2 EX_{t-1} + \aleph_3 MOM_{t-1} + \aleph_4 TB3_{t-1} + \cap_{1t} \text{......................(3.63)}$$

$$\Delta NR_t = \alpha_{02} + \sum_{i=1}^{p} h_{i4}\Delta NR_{t-i} + \sum_{i=0}^{q1} h_{i5}\Delta EX_{t-i} + \sum_{i=0}^{q2} h_{i6}\Delta MOM_{t-i} +$$
$$\sum_{i=0}^{q3} h_{i7}\Delta Lr_{t-i} + \aleph_5 NR_{t-1} + \aleph_6 EX_{t-1} + \aleph_7 MOM_{t-1} + \aleph_8 Lr_{t-1} + \bigcap_{2t} \ldots\ldots\ldots\ldots(3.64)$$

$$\Delta NR_t = \alpha_{03} + \sum_{i=1}^{p} h_{i8}\Delta NR_{t-i} + \sum_{i=0}^{q1} h_{i9}\Delta EX_{t-i} + \sum_{i=0}^{q2} h_{i10}\Delta YOY_{t-i} +$$
$$\sum_{i=0}^{q3} h_{i11}\Delta TB3_{t-i} + \aleph_9 NR_{t-1} + \aleph_{10} EX_{t-1} + \aleph_{11} YOY_{t-1} + \aleph_{12} TB3_{t-1} + \bigcap_{3t} \ldots\ldots(3.65)$$

$$\Delta NR_t = \alpha_{04} + \sum_{i=1}^{p} h_{i12}\Delta NR_{t-i} + \sum_{i=0}^{q1} h_{i13}\Delta EX_{t-i} + \sum_{i=0}^{q2} h_{i14}\Delta YOY_{t-i} +$$
$$\sum_{i=0}^{q3} h_{i15}\Delta Lr_{t-i} + \aleph_{13} NR_{t-1} + \aleph_{14} EX_{t-1} + \aleph_{15} YOY_{t-1} + \aleph_{16} Lr_{t-1} + \bigcap_{4t} \ldots(3.66)$$

Where parameters $\aleph_i$, i=0, 2… 16 represented the long run coefficients while h_{ij} (where j=1, 2,………………, 15) were the short run dynamics. P was the lag length of stock market returns while q_1, q_2, and q_3 were the lag lengths of exchange rate, measures of inflation rate and measures of interest rate, respectively.

The study performed an F test of the null hypothesis that the macroeconomic variables and stock market returns were not cointegrated $(H_0: \aleph_1 = \aleph_2 = \aleph_3 = \aleph_4 = 0)$ against the alternative hypothesis that the variables were cointegrated $(H_1: \aleph_1 \neq \aleph_2 \neq \aleph_3 \neq \aleph_4 \neq 0)$. The F-statistic computed for equations 3.63 to 3.66 were $F(\text{NR}_t/\text{EX}_t, \text{MOM}_t, \text{TB3}_t)$;

$F(NR_t / EX_t, MOM_t, Lr_t)$; $F(NR_t / EX_t, YOY_t, TB3_t)$; and $F(NR_t / EX_t, YOY_t, Lr_t)$.

However, exact values for the F-test are not available for cointegration tests involving a mixture of I (0), I (1) and even I (d) variables. To circumvent this, the study used the bounds on critical values for an asymptotic distribution of F statistic developed by Pesaran *et al*. (2001). The lower bound of the critical values are set based on the assumption that all of the variables in the model are I(0) while the upper bound assumes that all the independent variables are I(1). The decision rule is to reject the null hypothesis of no cointegration if the computed F-statistic exceeds the upper bound which indicates that all the variables are I (1). Thus if the coefficients of the lagged macroeconomic variables in equations 3.63 to 3.66 were jointly significant, based on the F-test, with computed F statistic being higher than the upper critical value, the study concluded that a joint long-run equilibrium relationship existed between the macroeconomic variables and stock market returns. On the other hand, if the computed F-statistic was below the lower bound, all the variables were considered to be I(0) and presence of a cointegration was rejected. A value of the computed F-statistic between the two bounds led to indecision regarding cointegration.

This study also conducted diagnostic and stability tests to examine the functional form of the ARDL model as well as the normality, autocorrelation and heteroscedasticity in the residuals. It also carried out stability tests on the parameters of the models using the cumulative sum of recursive residuals (CUSUM) as well the cumulative sum of squares of recursive residuals (CUSUMSQ).

Evidence of an adjustment of the variables to long run equilibrium following any shock suggested that the short run and long run Granger causality between the variables could be meaningfully estimated using the error correction model (Engle & Ganger, 1987). This study therefore considered every variable in each of the equations 3.63 to 3.66 as a dependent variable and derived four Granger causality equations for each of the equations. This yielded the following ARDL-based Ganger causality models:

$$\left.\begin{aligned}
\Delta NR_t &= q_{01} + \sum_{i=1}^{p} w_{0i}\Delta NR_{t-i} + \sum_{i=0}^{q1} w_{1i}\Delta EX_{t-i} + \sum_{i=0}^{q2} w_{2i}\Delta MOM_{t-i} + \sum_{i=0}^{q3} w_{3i}\Delta TB3_{t-i} + \coprod_1 ECT1_{t-1} + \wp_{1t}.\\
\Delta EX_t &= q_{02} + \sum_{i=1}^{p} w_{4i}\Delta EX_{t-i} + \sum_{i=0}^{q1} w_{5i}\Delta NR_{t-i} + \sum_{i=0}^{q2} w_{6i}\Delta MOM_{t-i} + \sum_{i=0}^{q3} w_{7i}\Delta TB3_{t-i} + \coprod_2 ECT1_{t-1} + \wp_{2t}\\
\Delta MOM_t &= q_{03} + \sum_{i=1}^{p} w_{8i}\Delta MOM_{t-i} + \sum_{i=0}^{q1} w_{9i}\Delta NR_{t-i} + \sum_{i=0}^{q2} w_{10i}\Delta EX_{t-i} + \sum_{i=0}^{q3} w_{11i}\Delta TB3_{t-i} + \coprod_3 ECT1_{t-1} + \wp_{3t}\\
\Delta TB3_t &= q_{04} + \sum_{i=1}^{p} w_{12i}\Delta TB3_{t-i} + \sum_{i=0}^{q1} w_{13i}\Delta NR_{t-i} + \sum_{i=0}^{q2} w_{14i}\Delta EX_{t-i} + \sum_{i=0}^{q3} w_{15i}\Delta MOM_{t-i} + \coprod_4 ECT1_{t-1} + \wp_{4t}
\end{aligned}\right\} \ldots(3.67)$$

$$\left.\begin{aligned}
\Delta NR_t &= r_{01} + \sum_{i=1}^{p} X_{0i}\Delta NR_{t-i} + \sum_{i=0}^{q1} X_{1i}\Delta EX_{t-i} + \sum_{i=0}^{q2} X_{2i}\Delta MOM_{t-i} + \sum_{i=0}^{q3} X_{3i}\Delta Lr_{t-i} + \subset_1 ECT2_{t-1} + \eta_{1t} \\
\Delta EX_t &= r_{02} + \sum_{i=1}^{p} X_{4i}\Delta EX_{t-i} + \sum_{i=0}^{q1} X_{5i}\Delta NR_{t-i} + \sum_{i=0}^{q2} X_{6i}\Delta MOM_{t-i} + \sum_{i=0}^{q3} X_{7i}\Delta Lr_{t-i} + \subset_2 ECT2_{t-1} + \eta_{2t} \\
\Delta MOM_t &= r_{03} + \sum_{i=1}^{p} X_{8i}\Delta MOM_{t-i} + \sum_{i=0}^{q1} X_{9i}\Delta NR_{t-i} + \sum_{i=0}^{q2} X_{10i}\Delta EX_{t-i} + \sum_{i=0}^{q3} X_{11i}\Delta Lr_{t-i} + \subset_3 ECT2_{t-1} + \eta_{3t} \\
\Delta Lr_t &= r_{04} + \sum_{i=1}^{p} X_{12i}\Delta Lr_{-i} + \sum_{i=0}^{q1} X_{13i}\Delta NR_{t-i} + \sum_{i=0}^{q2} X_{14i}\Delta EX_{t-i} + \sum_{i=0}^{q3} X_{15i}\Delta MOM_{t-i} + \subset_3 ECT2_{t-1} + \eta_{3t}
\end{aligned}\right\}..(3.68)$$

$$\left.\begin{aligned}
\Delta NR_t &= s_{01} + \sum_{i=1}^{p} y_{0i}\Delta NR_{t-i} + \sum_{i=0}^{q1} y_{1i}\Delta EX_{t-i} + \sum_{i=0}^{q2} y_{2i}\Delta YOY_{t-i} + \sum_{i=0}^{q3} y_{3i}\Delta TB3_{t-i} + \notin_1 ECT3_{t-1} + \varnothing_{1t} \\
\Delta EX_t &= s_{02} + \sum_{i=1}^{p} y_{4i}\Delta EX_{t-i} + \sum_{i=0}^{q1} y_{5i}\Delta NR_{t-i} + \sum_{i=0}^{q2} y_{6i}\Delta YOY_{t-i} + \sum_{i=0}^{q3} y_{7i}\Delta TB3_{t-i} + \notin_2 ECT3_{t-1} + \varnothing_{2t} \\
\Delta YOY_t &= s_{03} + \sum_{i=1}^{p} y_{8i}\Delta YOY_{t-i} + \sum_{i=0}^{q1} y_{9i}\Delta NR_{t-i} + \sum_{i=0}^{q2} y_{10i}\Delta EX_{t-i} + \sum_{i=0}^{q3} y_{11i}\Delta TB3_{t-i} + \notin_3 ECT3_{t-1} + \varnothing_{3t} \\
\Delta TB3_t &= s_{04} + \sum_{i=1}^{p} y_{12i}\Delta TB3_{t-i} + \sum_{i=0}^{q1} y_{13i}\Delta NR_{t-i} + \sum_{i=0}^{q2} y_{14i}\Delta EX_{t-i} + \sum_{i=0}^{q3} y_{15i}\Delta YOY_{t-i} + \notin_4 ECT3_{t-1} + \varnothing_{4t}
\end{aligned}\right\}....(3.69)$$

$$\left.\begin{aligned}
\Delta NR_t &= t_{01} + \sum_{i=1}^{p} z_{0i}\Delta NR_{t-i} + \sum_{i=0}^{q1} z_{1i}\Delta EX_{t-i} + \sum_{i=0}^{q2} z_{2i}\Delta YOY_{t-i} + \sum_{i=0}^{q3} z_{3i}\Delta Lr_{t-i} + \not\subset_1 ECT4_{t-1} + \Xi_{1t} \\
\Delta EX_t &= t_{02} + \sum_{i=1}^{p} z_{4i}\Delta EX_{t-i} + \sum_{i=0}^{q1} z_{5i}\Delta NR_{t-i} + \sum_{i=0}^{q2} z_{6i}\Delta YOY_{t-i} + \sum_{i=0}^{q3} z_{7i}\Delta Lr_{t-i} + \not\subset_2 ECT4_{t-1} + \Xi_{2t} \\
\Delta YOY_t &= t_{03} + \sum_{i=1}^{p} z_{8i}\Delta YOY_{t-i} + \sum_{i=0}^{q1} z_{9i}\Delta NR_{t-i} + \sum_{i=0}^{q2} z_{10i}\Delta EX_{t-i} + \sum_{i=0}^{q3} z_{11i}\Delta Lr_{t-i} + \not\subset_3 ECT4_{t-1} + \Xi_{3t} \\
\Delta Lr_t &= t_{04} + \sum_{i=1}^{p} z_{12i}\Delta Lr_{t-i} + \sum_{i=0}^{q1} z_{13i}\Delta NR_{t-i} + \sum_{i=0}^{q2} z_{14i}\Delta EX_{t-i} + \sum_{i=0}^{q3} z_{15i}\Delta YOY_{t-i} + \not\subset_4 ECT4_{t-1} + \Xi_{4t}
\end{aligned}\right\}.......(3.70)$$

where NR_t was the stock market returns, EX_t was exchange rate, MOM_t represented the month-on-month inflation rate, YOY_t was the year-on-year inflation rate, $TB3_t$ captured the 3-month Treasury Bills rate, Lr_t was lending rate while ECT_{t-1} was the error correction term lagged one time period. On the other hand, p was the lag length of the dependent variables while q_1, q_2, and q_3 were the lag lengths of the respective independent variables in every equation.

The short run causality was tested using a joint significance test of the coefficients of the lagged independent variables based on the Wald test (i.e. F-test). For instance, using Eq. (3.67), the null hypotheses tested for the short run causality were: $H_{01}: w_{1i} = 0$ for all i, implying that EX_t did not Granger cause NR_t; $H_{02}: w_{2i} = 0$ for all i, suggesting that MOM_t did not Granger cause NR_t; $H_{03}: w_{3i} = 0$ for all i, meaning that $TB3_t$ did not Granger cause NR_t; $H_{04}: w_{5i} = 0$ for all i, meaning that NR_t did not Granger cause EX_t. The other hypotheses were $H_{05}: w_{6i} = 0$ for all i, suggesting that MOM_t did not Granger cause EX_t; $H_{06}: w_{7i} = 0$ for all i, implying that $TB3_t$ did not Granger cause EX_t; $H_{07}: w_{9i} = 0$ for all i, indicating that NR_t did not Granger cause MOM_t; $H_{08}: w_{10i} = 0$ for all i, showing that EX_t did not Granger cause MOM_t; $H_{010}: w_{11i} = 0$ for all i, indicating that $TB3_t$ did not Granger cause MOM_t; $H_{012}: w_{13i} = 0$ for all i, implying that NR_t did not Granger cause $TB3_t$; $H_{013}: w_{14i} = 0$ for all i, indicating that EX_t did not Granger cause $TB3_t$; and $H_{014}: w_{15i} = 0$ for all i, suggesting that MOM_t did not Granger cause $TB3_t$. On the other hand, the long run causality between the macroeconomic variables and stock market returns was supported if the coefficient of the ECT_{t-1} was negative and significant based on t test.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

Three broad questions guided this study (a) To what extent did exchange rate, inflation rate, interest rate and stock market returns evolve over time through non-integer orders of integration in Kenya? (b) To what extent did the cointegrating residuals between each of the macroeconomic variables and stock market returns in Kenya exhibit long memory characteristics? (c)To what degree did the 2008 Global Financial Crisis moderate the relationship between each of the macroeconomic variables and stock market returns in Kenya?

This chapter provides the descriptive statistics, the results of the correlation matrix analyses of the macroeconomic variables and stock market returns as well as the results of the ADF, PP and KPSS unit root analyses for the individual variables and the cointegrating residuals. The chapter also contains results of EML estimation for the individual variables as well as the cointegrating residuals. In addition, this chapter contains the results of the granger causality tests based on the first differenced as well as fractionally differenced data. The chapter equally presents and discusses the results of the ARDL cointegration and vector error correction models. It also presents and discusses the results of the product-term models which involved investigating the moderating effects of the 2008 GFC on the relation between the macroeconomic variables and stock market returns.

4.1 Descriptive Statistics for the Whole Sample

In this section, the study presents the summary statistics of the stock market returns, exchange rate, the two measures of inflation rate and the two measures of interest rate. The analysis was conducted for the whole sample period as well as for the periods before, during and after the crisis. This allowed the study to examine differences in the effects of the 2008 GFC on the individual variables. Descriptive statistics for the sub-periods are provided in Table B12 in Appendix B.

Table 4.1: Summary of Descriptive Statistics for Whole Sample

	NR_t	$TB3_t$	Lr_t	MOM_t	YOY_t	EX_t
Mean	0.449908	13.62685	19.39308	0.773798	10.53743	73.34422
Median	0.185257	9.255000	18.12000	0.560356	7.528837	75.99450
Maximum	41.81488	84.67000	32.28000	7.704375	61.54215	105.2750
Minimum	-25.66676	0.830000	11.97000	-2.451218	-3.662444	36.23000
Std. Dev.	6.827611	12.49118	5.899076	1.369444	10.80799	12.64166
Skewness	0.960240	3.227846	0.684373	1.587349	2.741012	-0.317937
Kurtosis	9.653515	16.52859	2.170298	8.624176	11.02927	3.135205
Jarque-Bera	551.5112	2584.035	29.46154	479.6657	1087.001	4.860100
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.088032
Sum	124.1745	3761.010	5352.490	213.5682	2908.330	20243.00
Sum Sq. Dev.	12819.48	42908.16	9569.753	515.7288	32123.47	43948.18
Observations	276	276	276	276	276	276

Notes: NR_t is log difference of the NSE 20 Share Index, EX_t is KSH/USD exchange rate, MOM_t is the month-on-month inflation rate, YOY_t is the year-on-year inflation rate, $TB3_t$ is the 3-month Treasury Bills rate, and Lr_t is the commercial banks' weighted average lending rate

Table 4.1 reveals that the mean values of all the variables were positive with exchange rate recording the highest mean, followed by lending rate and the 3-

month Treasury Bills rate. The results also indicate that the mean of the year-on-year inflation rate was much higher than that of the month-on-month inflation rate. In contrast, the mean of the NSE 20 Share Index returns was the lowest which suggests that higher rates of the two measures of inflation rate and the measures of interest rate could have depressed the performance of the stock market. The higher mean value of the 3-month Treasury Bills rate also implies that rising rates of the government's short term security could have attracted other investors from the stock market, leading to declining demand for stocks and falling stock market returns.

Furthermore, all the variables recorded excess positive kurtosis, suggesting that they individually posed lesser risk of extreme outcomes. However, the variables, except exchange rate, had positive skewness which implies that their actual values were likely to deviate further upwards from their mean values. In contrast, the negative skewness of exchange rate indicates that the variable tended to move downwards from its long run mean value (i.e.it was more prone to appreciations). Additionally, the significant Jarque-Bera (JB) test for all the variables suggests that standard investment models, which presuppose existence of normality, may need to be applied with caution.

On the other hand, the high values of the standard deviation (which is a major risk indicator) suggest that the 3-month Treasury Bills rate and exchange rate were the most volatile thereby posing the highest risk while the low standard deviation of stock market return indicated a fairly low risk. However, the month-on-month inflation rate appeared to have been the least volatile which supports the time series plots in Figure 1.2 (see page 14). This low volatility also seems to support the preference given to the variable by portfolio managers in the rebalancing of portfolios. On the other hand, the high standard deviation of the year-on-year inflation rate supports its limited forecast ability which makes it a suitable tool for central banks in tracking the long term trends of inflation rate in the economy.

Additionally, the wide range in the exchange rate (see maximum of 105.28 versus minimum of 36.23) suggests that demand for the domestic currency could have decreased significantly during the period leading to an upward adjustment (depreciation) of the currency. Likewise, the high value of the maximum 3-month Treasury Bills rate in comparison to the minimum value (see maximum of 84.6 versus minimum of 0.83 in Table 4.1) suggests that demand for the government short term debt instrument might have increased significantly over the period.

On splitting the sample into the pre, during and post crisis periods, Table B12 in Appendix B reveals a relatively higher mean stock market returns for the pre-crisis period compared to the mean stock market returns for the whole sample period. This suggests that the 2008 GFC had significant depressing effects on stock market returns since by partialling out the period during and after the 2008 GFC, a significant increase seems to have occurred in stock market returns. Additional evidence for this view was provided by the fact that stock market returns were virtually negative during the crisis period (see Table B12).

Meanwhile, exchange rate appears to have depreciated the most after the crisis, followed by during the crisis while the variable was relatively stronger before the crisis (see Table B12). This suggests that the crisis might have caused panic among foreign investors which could have triggered capital outflows and led to a depreciating domestic currency. This is consistent with the time series plots displayed in Figure 1.1 (see page 12). Additionally, the increased capital outflows could have resulted into panic offloading of shares at the NSE since the trend of the exchange rate depreciation seemed to be associated with declining stock market returns during and after the crisis period (see Table B12).

In contrast, the mean values of both measures of inflation rate were low before the crisis began but increased during the crisis before declining slightly after the crisis (see Table B12). This suggests that shocks from the 2008 GFC could have depressed economic activities during the crisis period leading to scarcity of goods. Consequently, the supply constraint might have triggered an increase in general prices during the crisis period. However, economic recovery and subsequent gradual increase in the supply of goods and services could have eased off pressure on the general prices after the crisis.

On the contrary, the mean values of the 3-month Treasury Bills rate and lending rate were high before the crisis but declined during the crisis before rising slightly after the crisis period. This suggests that demand for the 3-month Treasury Bills and bank loans may have been high before the crisis. However, the onset of the crisis might have scared some investors resulting into withdrawal from investing in the Treasury Bills while firms could have reduced their demand for bank loans in fear of rising cost of capital (debt expenses). These actions might have however gradually reversed as the economy began to recover after the crisis period.

Table B12 also reveals that stock market returns were most volatile during the crisis period. This indicates that the effects of the 2008 GFC might have been stonger during this period. However, the 2008 GFC seems to have created higher risk in exchange rate, the two measures of inflation rate and the two measures of interest rate before the crisis began given the high values of their standard deviations.

4.2 Correlation Matrix of the Macroeconomic Variables and Stock Market Returns

Table 4.2 shows correlation matrix of the macroeconomic variables and stock market returns for the whole sample period.

Table 4.2: Correlation Matrix of the Macroeconomic Variables and Stock Market Returns

	NR_t	EX_t	MOM_t	YOY_t	$TB3_t$	Lr_t
NR_t	1.000	-0.038	0.119	0.256	0.129	0.048
EX_t		1.000	-0.103	-0.186	-0.399	-0.589
MOM_t			1.000	0.468	0.312	0.041
YOY_t				1.000	0.659	0.319
$TB3_t$					1.000	0.673
Lr_t						1.000

Notes: NR_t is log difference of the NSE 20 Share Index, EX_t is the KSH/USD exchange rate, MOM_t is the month-on-month inflation rate, YOY_t is the year-on-year inflation rate, $TB3_t$ is the 3-month Treasury Bills rate and Lr_t is the commercial banks' weighted average lending rate.

These results provide evidence of diverse correlations between several pairs of the variables. For instance, Table 4.2 indicates that stock market returns were negatively correlated with exchange rate. This suggests that a depreciation of the exchange rate could have created uncertainties among the investors resulting into capital outflows. This in turn might have triggered declines in stock market returns. This further supports the predictions of the Flow-Oriented model for import-dependent firms (Dornbusch & Fischer, 1980).

However the two measures of inflation rate and interest rate were positively correlated with stock market returns which supported Fisher Effect (Fisher, 1930). These developments may be explained by various factors. First, an improved economic growth could have boosted profits/cash flows for the firms while rising aggregate demand might have triggered an increase in general commodity prices (i.e. inflation rate). Second, investors could have viewed the Treasury Bills rate as a risk free rate (i.e. as a component of the required rate of return) implying that an increase in the 3-month Treasury Bills rate translated into demands for higher required rate of return in the form of higher stock market returns. Likewise, increased borrowings from commercial banks might have pushed the cost of capital upwards (i.e. lending rate) while the corresponding investments could have stimulated the economy, leading to higher streams of cash flows and rising stock market returns.

4.3 Results of ADF, PP and KPSS Unit Root Tests

This study determined whether the individual macroeconomic variables and stock market returns were stationary or nonstationary in their level forms. To do this, it conducted ADF and PP unit root tests. However, ADF and PP tests are considered weak in aiding decision-making when the null hypothesis is not rejected (Diebold & Rudebusch, 1991). For instance, does failure to reject the null hypothesis indicate that the time series has a unit root? This may not be so because the time series could be integrated of order 2 or I (2). KPSS is therefore considered superior in that it provides a straightforward test of the null hypothesis of stationarity against the alternative of nonstationarity. Table 4.3 presents the results of the ADF, PP and KPSS tests when the intercept and trend were included. Additional results for the ADF, PP and KPSS tests based on models with intercept only are contained in Table B18 in the Appendix B.

Table 4.3: Results of Unit Root Tests using ADF, PP and KPSS Tests (Intercept and Trend)

Variable notations	ADF Test Level	ADF Test 1st Difference	PP Test Level	PP Test 1st Difference	KPSS Test Level	KPSS Test 1st Difference
NR_t	-4.869***	-7.509***	-13.09***	-145.96***	0.085	0.102
EX_t	-3.220*	-10.125***	-3.715**	-11.295***	0.158	0.062
MOM_t	-7.089***	-8.890***	-10.67***	-65.543***	0.127	0.348
YOY_t	-7.514***	-5.426***	-3.045	-13.621***	0.159	0.029
$TB3_t$	-5.623***	-11.819***	-3.794**	-6.128***	0.319	0.049
Lr_t	-1.097	-6.852***	-2.435	-11.943***	0.350	0.096

Notes: *** 1 percent significance level, ** 5 percent significance level. Null hypothesis under the ADF and PP tests is that the variable is I (1). Null hypothesis under the KPSS test is that the variable is stationary. LM critical values are (0.216 at 1 percent, 0.146 at 5 percent). Fail to reject the null hypothesis if computed LM statistic is lower than critical values, reject if higher. NR_t is log difference of the NSE 20 Share Index, EX_t is KSH/USD exchange rate, MOM_t is month-on-month inflation rate, YOY_t is the year-on-year inflation rate, $TB3_t$ is the 3-month Treasury Bills rate and Lr_t is the commercial banks' weighted average lending rate.

The ADF test results suggest that lending rate and exchange rate were the only nonstationary variables in level form which seems to be in agreement with the time series plot displayed in Figures 1.1 and 1.3 (see page12 and page 16). Likewise, the ADF test, including only the intercept, (see Table B18 at the Appendix) indicates that exchange rate and lending rate are nonstationary in level form. On the other hand, the PP test based on intercept and trend fails to reject the null hypothesis of nonstationarity for the year-on-year inflation rate and lending rate. This supports the results from the ADF test for lending rate but disagrees with ADF test results on the stationarity of exchange rate and year-on-year inflation rate. The PP test results based on the model with intercept only (see Table B18) indicate that exchange rate and lending rate are nonstationary in level form. However, all the variables are stationary in their first difference forms.

Clearly, the results of the ADF and PP tests seem to be mixed and inconclusive regarding the nonstationarity of the year-on-year inflation rate and exchange rate. This inconclusiveness might be attributed to the weak power of the ADF and PP tests (Diebold & Rudebusch, 1991). This study therefore used KPSS test to verify the results from the ADF and PP tests. The results of KPSS test contained in Table 4.3 demonstrate that the computed LM statistic were higher than all the critical values for lending rate and the 3-month Treasury Bills rate. The computed statistic was however only higher than the critical values at 5 percent significance level for the exchange rate and the year-on-year inflation rate. Consequently, this study concluded that the exchange rate, 3-month Treasury Bills rate, year-on-year inflation rate and lending rate were nonstationary in level form while the rest of the variables were stationary in their levels. This indicates that shocks to exchange rate, 3-month Treasury Bills rate, year-on-year inflation rate and lending rate persist into the indefinite future and require policy intervention while shocks to stock market returns and the month-on-month inflation rate dissipate fairly fast.

The results for the exchange rate, 3-month Treasury Bills rate, year-on-year inflation rate and lending rate support those by Kuwornu and Owusu-Nantwi (2011), Erita (2014), Kimani and Mutuku (2013) as well as Kisaka and Mwasaru (2012) who established that the macroeconomic variables were nonstationary in levels. On the other hand, the results indicating stationarity of the month-on-month inflation rate and stock market returns are in line with those found by Jawaid and Anwar (2012), Zia and Rahman (2011), Kganyago and Gumbo (2015), Amarasinghe (2015), and Ouma and Muriu (2014).

Evidently, the results from ADF, PP and KPSS tests raise doubts on the true degree of integration of the exchange rate, the 3-month Treasury Bills rate, the lending rate and the year-on-year inflation rate. This inconclusiveness could be attributed to the low power of the standard unit root tests against fractional alternatives and the possibility that most financial and economic time series have non-integer orders of integration (Diebold & Rudebusch, 1991; Teyssiere & Kirman, 2007). Furthermore, time series plots in Figures 1.1 to 1.3 in pages 12, 14 and 16 suggest that each of the variables is neither a purely stationary nor a purely nonstationary process. Consequently, this study employed the ARFIMA model to empirically determine the orders of integration of the individual variables. It specifically used the EML parametric estimator (Sowell, 1992).

4.4 Results of the Exact Maximum Likelihood (EML) Estimations

This study sought to determine to what extent exchange rate, inflation rate, interest rate and stock market returns evolved over time through non-integer orders of integration in Kenya. To do this, it fitted ARFIMA (p, d, q) model, ranging from ARFIMA (0, d, 0) to ARFIMA (3, d, 3), to each of the variables and obtained sixteen competing models. The study then selected the model with both significant AR and MA components, no autocorrelation in residuals and lowest AIC out of the sixteen competing models as the best model for each of the time series. Table 4.4 presents results from the selected models for stock market returns, exchange rate, month-on-month inflation rate, year-on-year inflation rate, 3-month Treasury Bills rate and lending rate described by equations 3.25, 3.26, 3.34, 3.35, 3.49, and 3.50 in pages 106, 114 and 122.

Table 4.4: Results of Long Memory Estimates for the Individual Variables

Variable notation	ARMA(p,q)	$\hat{d}$	$SE(\hat{d})$	$t_{H0:d=0} = \frac{\hat{d}-d}{SE(\hat{d})}$	$t_{H0:d=1} = \frac{\hat{d}-d}{SE(\hat{d})}$
NR_t	(2,2)	0.231	0.05	4.37	-14.61
EX_t	(3,2)	0.454	0.06	7.92	-9.08
MOM_t	(3,3)	-0.590	0.18	-3.25	-5.83
YOY_t	(0,3)	0.494	0.01	55.5	-56.95
$TB3_t$	(1,3)	0.314	0.14	2.29	-5.01
Lr_t	(3,2)	0.404	0.07	5.74	-8.47

Notes: The long memory estimates were analysed at the 5 percent significance level (Gil-Alana, 2001). NR_t is the log difference of the NSE 20 Share Index, EX_t is the KSH/USD exchange rate, MOM_t is the month-on-month inflation rate, YOY_t is the year-on-year inflation rate, $TB3_t$ is the 3-month Treasury Bills rate and Lr_t is the commercial banks' weighted average lending rate. Critical value of t statistic at 5 percent (for two-tailed t test, n>100) is approximately 2.

It is evident from Table 4.4 that all the appropriate models for the individual variables include the AR and MA components except the model for the year-on-year inflation rate which excludes the AR part. On average, higher order models or models with AR and MA parts of order 3 seem to be more suitable for modelling majority of the variables except stock market returns. Moreover, there is no model where the white noise specification of the short memory components or ARMA (0, 0) is preferred.

The results also reveal that the estimated values of differencing parameter range from -0.59 to 0.49 and none of the variables had short memory

$(i.e., d = 0)$. This suggests that all the variables, though exhibiting different levels of persistence, returned to their equilibrium values after experiencing a shock. It further demonstrates that expected future increments or declines in the individual variables are predictable. This suggests that speculators could capitalize on this predictability to consistently make profits with no input of funds.

Furthermore, the negative sign for the d parameter associated with the month-on-month inflation rate indicates that higher values of the variable were often followed by lower values and lower values by higher values. This could possibly be the reason for the apparent low variability in the time series as shown in Figure 1.2 (see page 14) and reflected in the low standard deviation in Table 4.1. On the other hand, the results demonstrate that exchange rate, year-on-year inflation rate, lending rate and the 3-month Treasury Bills rate were fairly persistent but reverted back to their pre-shock levels, although at a slower rate compared to the stock market returns. Additionally, the positive sign of their differencing parameters suggests that increases in each of these variables were followed by increases whereas decreases triggered further decreases.

Moreover, all the differencing parameters were significantly different from 0 and 1, based on the hypotheses tests. This supports that the individual variables were indeed long memory processes. The results, however, contradict Balparda *et al*. (2015) who concluded that the NSE 20 Share index returns had an integer order of integration greater than 1, implying no mean reversion. The results on lending rate and the 3-month Treasury Bills rate also fail to support Caparole and Gila-Alana (2010) who, using data from Kenya, found that the variables had integer orders of integration greater than 1. These differences in the results might however be explained by the adoption of different estimation techniques by the different authors. This is because this study employed the EML procedure which is considered superior to the Robinson (1994, 1995) tests which Balparda *et al*. (2015) and Caparole and Gila-Alana (2010) employed (Dalhaus, 2006; Miller & Miller, 2003).

The mean-reversion in stock market returns is however consistent with that established by Nazarian *et al*. (2014) who concluded that the stock market returns in Iran possessed stationary long memory. However, the result obtained by this study differs from that by Anoruo and Braha (2010) who established that stock market returns in the US possessed long memory with anti-persistence (i.e. negative d parameter) such that increases in stock market returns were followed by decreases and decreases by increases. Additional results on the chosen models for the individual variables are contained in Table B1 in Appendix B.

4.5 Results of Cointegration and Granger Causality Tests

Nonstationary time series often present difficulties in modelling since they violate some of the assumptions of the traditional econometric techniques such as constant mean and variance. However, if a linear combination of two or more nonstationary time series is stationary, then a stable long run relationship exists between the time series (Engel & Granger, 1987). One approach often used to determine existence of such a stable linear long run relationship is testing for stationarity of a cointegrating residual obtained by regressing one of the variables on the other. This is commonly done by using the unit root tests such as the ADF, PP or KPSS test. This study therefore tested the stationarity of the respective cointegrating residuals between each of the macroeconomic variables and stock market returns using ADF, PP, KPSS and EML procedures.

4.5.1 Results of Cointegration Tests using ADF, PP and KPSS Unit Root Tests

Table 4.5 reports the results of the ADF, PP and KPSS unit root tests on the respective cointegrating residuals using models with intercept and trend. Additional results based on models with intercept only are contained in Table B19 in Appendix B.

Table 4.5: Cointegration Test using ADF, PP and KPSS Tests (Intercept and Trend)

	ADF test	PP Test	KPSS Test
Cointegrating residual	Level	Level	Level
$Rnrex_t$	-4.859***	-13.082***	0.082
$Rnrmom_t$	-5.011***	-13.152***	0.075
$Rnryoy_t$	-5.090***	-13.398***	0.063
$Rnrtb3_t$	-5.652***	-12.964***	0.089
$Rnrlr_t$	-4.813***	-13.088***	0.091

Notes: *** 1 percent significance, ** 5 percent significance. Null hypothesis under the ADF and PP tests is that the residual is nonstationary or I(1). Null hypothesis under the KPSS is that the residual is stationary. Fail to reject null hypothesis of stationarity if LM value is lower than all critical values of KPSS test. KPSS (LM) critical values are (0.216 at 1 percent; 0.146 at 5 percent). $Rnrex_t$ represents the cointegrating residual obtained from regressing stock market returns on exchange rate, $Rnrmom_t$ is the cointegrating residual from regressing stock market returns on the month-on-month inflation rate, and $Rnryoy_t$ is the cointegrating residual from regressing stock market returns on the year-on-year inflation rate. Similarly, $Rnrtb3_t$ is the cointegrating residual from regressing stock market returns on the 3-month Treasury Bills rate while $Rnrlr_t$ is the cointegrating residual from regressing stock market returns on lending rate. Critical value of t statistic at 5 percent (for two-tailed t test, n>100) is approximately 2.

The results reveal that the null hypothesis that the cointegrating residuals possess unit root are all rejected, based on ADF and PP tests. This implies that exchange rate, each of the two measures of inflation rate and each of the two measures of interest rate are individually cointegrated with stock market returns. The results from the KPSS test also fail to reject the null hypothesis of stationarity for all the cointegrating residuals (since all the computed KPSS values are lower than the KPSS critical values). This supports the results from the ADF and PP tests that a stable long run relationship exists between exchange rate, each of the two measures of inflation rate, each of the two measures of interest rate and stock market returns.

Likewise, the results of ADF and PP tests based on models with intercept only support presence of cointegration between each of the macroeconomic variables and stock market returns (see Table B19 at the Appendix). The computed KPSS statistic for the models with intercept only are also lower than the KPSS critical values which makes the study fail to reject the null hypothesis of stationarity for all the cointegrating residuals. This implies that all the cointegrating residuals are stationary.

However, the ADF, PP and KPSS tests have weak power in detecting non-integer orders of integration (Diebold & Rudebusch, 1991). This study therefore employed the EML test to determine the possible presence of fractional cointegration (Cheung, 2007) between each of the macroeconomic variables and stock market returns.

4.5.2 Results of Fractional Cointegration Test using Exact Maximum Likelihood Test

This study investigated the extent to which the cointegrating residuals between each of the macroeconomic variables and stock market returns in Kenya exhibited long memory characteristics. To do this, it fitted an ARFIMA model to the respective cointegrating residuals to determine whether they had integration orders lower than the integration orders of their parent time series (Cheung, 2007). It used equations 3.27, 3.36, 3.37, 3.51 and 3.52 found in pages 107, 115 and 122. Table 4.6 presents the results, including those of the hypotheses tests. Additional results of the selected models for the cointegrating residuals are contained in Tables B1 and B2.

Table 4.6: Hypotheses Tests of d parameters for the Cointegrating Residuals using EML

Cointegrating residual	ARMA(p,q)	$\hat{d}$	$SE(\hat{d})$	$t_{H0:d=0} = \frac{\hat{d}-d}{SE(\hat{d})}$	$t_{H0:d=1} = \frac{\hat{d}-d}{SE(\hat{d})}$
$Rnrex_t$	(2,2)	0.230	0.05	4.33	-15.4
$Rnrmom_t$	(2,2)	0.209	0.05	3.92	-14.8
$Rnryoy_t$	(2,2)	0.067	0.05	1.22	-17.02
$Rnrtb3_t$	(2,2)	0.213	0.05	3.98	-14.72
$Rnrlr_t$	(2,2)	0.228	0.05	4.36	-14.7

Notes: $Rnrex_t$ represents the cointegrating residual obtained from regressing stock market returns on exchange rate, $Rnrmom_t$ is the cointegrating residual from regressing stock market returns on month-on-month inflation rate and $Rnryoy_t$ is the cointegrating residual from regressing stock market returns on year-on-year inflation rate. Similarly, $Rnrtb3_t$ is the cointegrating residual from regressing stock market returns on 3-month Treasury Bills rate and $Rnrlr_t$ is the cointegrating residual from regressing stock market returns on lending rate. Critical value of t statistic at 5 percent (for two-tailed t test, n>100) is approximately 2.

Clearly, results in Table 4.6 reveal that all the cointegrating residuals are stationary non-integer processes. Furthermore, all the differencing parameters are significantly different from 0 and 1 except the cointegrating residual from regressing stock market returns on the year-on-year inflation rate. This supports that the cointegrating residuals are indeed long memory processes. Besides, all the differencing parameters of the cointegrating residuals are less than the absolute values of the differencing parameters associated with the respective parent time series (refer to Table 4.4). This means that despite the individual variables having different non-integer orders of integration, a linear combination with a lower degree of non-integer integration does exist. Consequently, this study concluded that stock market returns are fractionally cointegrated with exchange rate, each of the two measures of inflation rate and each of the two measures of interest rate (Caporin *et a*l., 2011; Cheung, 2007).

These results are consistent with those established by Aloy *et al*. (2010) for US and France, and Kiran (2011) for UK, Germany, US and Canada. The results however indicate that the adjustment towards the long run equilibrium for the relationship between stock market returns and exchange rate was the slowest (most persistent), followed by that between stock market returns and lending rate. The deviation of stock market returns from the 3-month Treasury Bills rate in the long run also took a relatively long time to be corrected. Similarly, stock market returns and the month-on-month inflation rate took fairly long to revert to a long run relationship after experiencing a shock. However, the deviation of stock market returns from the year-on-year inflation rate was the fastest (see $\hat{d} = 0.067$).

These findings are quite in contrast to the assumption made under the conventional cointegration analysis that the deviations from the long run equilibrium for cointegrated variables are I(0) processes such that adjustment towards the stable equilibrium following any shock occurs fairly fast. The results therefore suggest that active policy intervention could be required to induce faster adjustment to equilibrium following any external shocks. Tables B1 and B2 at the Appendix provide summaries of the ARFIMA long memory estimates for the individual variables as well as the cointegrating residuals using EML estimator (Sowell, 1992).

Furthermore, presence of cointegration suggests that a causal relationship between each of the macroeconomic variables and stock market returns could be estimated using Granger causality test based on an ECM (Engle & Granger, 1987) or on a Fractionally Integrated Error Correction Model (FIECM). This study therefore conducted a bivariate Granger causality test to determine the direction of causality and speed of adjustment using both first differenced as well as fractionally differenced data.

4.5.3 Granger Causality Tests using First and Fractionally Differenced Variables

The study estimated error correction models represented by equations 3.28, 3.38, 3.39, 3.53 and 3.54 (see pages 108, 116 and 123) to determine presence of causality between each of the macroeconomic variables and stock market returns. It also estimated the fractionally integrated error correction models (FIECM) given by equations 3.29, 3.40, 3.41, 3.55 and 3.56 (see pages 109, 117 and 124) to test for existence of fractional granger causality between each of the macroeconomic variables and stock market returns. Table 4.7 provides a summary of the results from the ECM and FIECM-based Granger causality tests. More detailed results are contained in Tables B4, B5 and B6 at the Appendix.

Table 4.7: Estimates of Granger causality using First and Fractionally Differenced Data

Dependent notations	Sources of Causation					
	NR_t	EX_t	MOM_t	YOY_t	$TB3_t$	Lr_t
NR_t	-	**[-0.788]*** (0.082)	**[-0.801]*** (0.318)	**[-0.916]*** (-0.0003)**	**[-0.854]*** (-7.546)	**[-0.812]*** (13.026)***
EX_t	**[-0.027]** (-1.547)	-				
MOM_t	**[0.011]** (0.151)		-			
YOY_t	**[- 0.005]** (6.2e-06)			-		
$TB3_t$	**[0.026]** (8.896)**				-	
Lr_t	**[-0.012]** (1.294)*					-

Notes: The coefficients of the error correction terms lagged one period for the ECM-based Granger causality models are in bold within parenthesis while those based on FIECM are in brackets. *** 1 percent significance, ** 5 percent significance. NR_t is log difference of the NSE 20 Share Index, EX_t is KSH/USD exchange rate, MOM_t is the month-on-month inflation rate, YOY_t is the year-on-year inflation rate, $TB3_t$ is the 3-month Treasury Bills rate and Lr_t is the commercial banks' weighted average lending rate.

The results demonstrate that based on the ECM, a significant unidirectional long run granger causality runs from each of the macroeconomic variables to stock market returns. The results specifically indicate that deviation of stock market returns and the year-on-year inflation rate from the long run path is restored at the fastest rate of about 92 percent per month. This seems to be in line with the lowest level of persistence (i.e. $\hat{d} = 0.067)$ reported in Table 4.6. Furthermore, the ECM models reveal that the lowest rate of adjustment towards long run path was at 79 percent per month for the deviations between exchange rate and stock market returns. This also supports the highest persistence of the associated cointegrating residual captured in Table 4.6 (see $\hat{d} = 0.230)$.

However, the ECM tests fail to establish any short run causality between exchange rate and stock market returns (see Table B4 at the Appendix) which supports Kumar and Puja (2012) as well as Zia and Rahman (2011) who established the same for India and Pakistan, respectively. However, the result from the ECM supports presence of a positive long run Granger causality originating from exchange rate to stock market returns (see the positive coefficient of the lagged first as well as fractionally differenced exchange rate in Table B4). This suggests that exchange depreciation led to an increase in stock market returns which is consistent with the predictions of the Flow-Oriented model for export-dependent firms (Dornbusch & Fischer, 1980). The result is also in line with Ahmad *et al*. (2010) who established a positive linkage between exchange rate and stock market returns in Pakistan. This result is however inconsistent with that established in Table 4.1 regarding the low minimum and high maximum value of the exchange rate (which indicated possible upward pressure on the domestic currency, possibly as a result of increased capital outflows) vis a vis the very large negative minimum value of stock market returns. It also disagrees with Kirui, Wawire and Onono (2014) as well as Nataraja *et al*. (2015) who found that exchange rate had a negative long run effect on stock market returns for Kenya and India, respectively.

This study also failed to detect any short run causality between the month-on-month inflation rate and stock market returns as well as between the year-on-year inflation rate and stock market returns (see Table B5 at the Appendix).

However, it concluded that a long run granger causality with a negative sign originated from the month-on-month inflation rate to stock market returns (see coefficient of lagged first difference of MOM_t in Table B5). On the other hand, the study established that a unidirectional long run granger causality of a positive sign originated from the year-on-year inflation rate to stock market returns (see coefficient of lagged first difference of YOY_t in Table B5). These results suggest that whereas the stock market in Kenya does not cushion investors against inflationary pressures in the short run, investors with long investment horizons benefit from increments in stock market returns in response to rising inflation rates in the long run. In other words, the stock market in Kenya provides shelter to investors against inflationary pressures in the long run (Fisher, 1930).

The lack of short run Granger causality from the macroeconomic variables to stock market returns (based on the ECM models) suggests that most investors in the Kenyan stock market may be less concerned about short term fluctuations in exchange rate, inflation rate and interest rate possibly because they have long term investment horizons. This might be because majority of the investors in the Kenyan stock market are foreigners (Mwega, 2010; Ndwiga & Muriu, 2016). However, the presence of a long run Granger causality from the macroeconomic variables to stock market returns demonstrates that investors do certainly reconsider their investment portfolios when fluctuations in the macroeconomic variables persist over a longer duration. These results are consistent with those found by Kim and Ryoo (2011) for the US; Alagidede and Panagiotidis (2010) for Egypt, Nigeria, Morocco, Tunisia, Kenya, and South Africa; Ochieng and Adhiambo (2012) for Kenya; Issahaku *et al.* (2013) for Ghana; and Demirhan (2016) for Turkey.

This study also established that the 3-month Treasury Bills rate and lending rate led stock market returns with a negative sign in the long run (see the coefficients of the lagged first differences of $TB3_t$ & Lr_t in Table B6). This seems to suggest that in the long run, investors in Kenya consider the short term government debt instrument as a competing investment vehicle such that when the rate rises, they reallocate more funds to the portfolio of the 3-month Treasury Bills and less to stocks or equity. Likewise, the negative long run causal effect from lending rate to stock market returns suggests that when banks increase the cost of capital, individual investors and firms reduce the uptake of investment finances. This reduces expansion of existing investments as well as the initiation of new investments and leads to declining cash flows and stock market returns. These results are consistent with those established by Ado and Sunzuoye (2013) and Amarasinghe (2015). However, the results contradict those by Chirchir (2014) and Erita (2014) who found bidirectional long run Granger causality between the two variables in Kenya and Namibia, respectively.

On the contrary, results from the FIECM models revealed that the rate of convergence to long run equilibrium was much lower relative to that found by the ECM models. For instance, the FIECM model established a significant positive long run Granger causality originating from the year-on-year inflation rate to stock market returns but that the variables converged to a long run equilibrium at a mere 0.03 percent per month compared to the rate of 92 percent indicated by the ECM model (see Table 4.7).

Moreover, a few of the FIECM models have nonsignificant coefficients with the correct sign suggesting very weak convergence to long run equilibrium after any turbulence. This indicates that whenever shocks drive each of the macroeconomic variables away from stock market returns, re-establishment of long run equilibrium takes a very long duration. Indeed most of the coefficients of the fractionally integrated error correction terms (such as that of the relationship between lending rate and stock market returns) represent a divergence from equilibrium state. This can be very costly if active policy intervention is not implemented since the variables may wander far away from each other and eventually establish an undesirable equilibrium.

In direct contrast to the results based on the ECM, this study established presence of short run Granger causality between the macroeconomic variables and stock market returns using the fractionally integrated error correction models (FIECMs). For instance, the FIECM models in Table B5 demonstrated that stock market returns negatively Granger caused the month-on-month inflation rate in the short run. This supports the Reverse Causality Hypothesis (RCH) (Geske & Roll, 1983) and suggests that past values of stock market returns add significant predictive power in the forecast of future values of the month-on-month inflation rate in Kenya. More specifically, this result implies that a fall in stock market returns signifies a likely decline in future real economic activity. This could subsequently point to a likely increase in the fiscal deficit which might trigger efforts to monetize the fiscal deficit. Thus, declining stock market returns act as a signal of a likely increase in the month-on-month inflation rate as the government seeks to fill the resultant fiscal deficit. Put differently, this result indicates that stock market returns act as the indicator variable for the month-on-month inflation rate in Kenya.

Likewise, the FIECM results revealed a negative unidirectional Granger causality from the stock market returns to the 3-month Treasury Bills rate (see Table B6). The results also revealed a negative unidirectional Granger causality from stock market returns to the lending rate, again supporting the RCH (Geske & Roll, 1983). This suggests that an increase in past values of stock market returns had predictive power on the future values of the 3-month Treasury Bills rate and lending rate. A possible explanation for these results is that when stock market returns increase, the resultant decline in fiscal deficit is perceived by investors as an indicator of the government's likelihood to adopt lower interest rate policies. In other words, a thriving stock market in Kenya plays a significant role in the realization of favorable money market rates (i.e. lower interest rates) and short term inflation rates.

On the contrary, the FIECM demonstrated that a positive short run unidirectional Granger causality originated from the year-on-year inflation rate to stock market returns (see Table B5). This supports the Fisher Effect (Fisher, 1930) and implies that past values of the year-on-year inflation rate had predictive power on future values of stock market returns in Kenya. This also means that investors in the Kenyan stock market get compensated during inflationary periods through higher stock market returns.

However, the coefficients of FIECTs from regressing stock market returns on the month-on-month inflation rate as well as those from regressing stock market return on each of the measures of interest rate were positive (i.e. they had the incorrect signs). This suggested that the strong short-run dynamics (indicated by the significant coefficients of the lagged fractionally differenced stock market returns) may have partly offset the effect of the FIECT terms **(**Dutt and Ghosh, 1996).

On the whole, the FIECM models provided support for short run Granger causality between the macroeconomic variables and stock market returns while the ECM models did not. This may be because of the inability of the ECM to capture long memory properties which may exist in the individual variables as well as in the cointegrating residuals (Caporin *et al*., 2011; Cheung, 2007; Diebold & Rudebusch, 1991). These results therefore indicate that the relationship between the macroeconomic variables and stock market returns might be more complex than is suggested by existing studies.

4.5.4 Multivariate Cointegration Analysis based on ARDL Cointegration Test

Long-run relationships can exist between a stationary and a nonstationary variable, even between fractionally integrated variables (Asteriou & Hall, 2007). However, the Johansen and Juselius cointegration test (which is widely employed by existing studies) requires all the underlying variables to be I (1). Conversely, the ARDL cointegration test is capable of examining a long run relationship between variables with mixed orders of integration (Asteriou & Hall, 2007; Pesaran *et al*., 2001).

This study therefore used an ARDL cointegration test to estimate the long run relationship between the macroeconomic variables and stock market returns in a multivariate framework. The ARDL test was conducted in two stages. In the first stage, the study determined a long run relationship between exchange rate, each of the two measures of inflation rate, each of the two measures of interest rate and stock market returns. In the second stage, the study conducted Granger causality test to ascertain presence of causal relationships between the macroeconomic variables and stock market returns. Tables 4.8 to 4.11 present summaries of the estimated coefficients of the long run relationship between exchange rate, a measure of inflation rate, a measure of interest rate and stock market returns. They also provide diagnostic tests of the ARDL models presented in equations 3.63 to 3.66 (see pages 129 and 130).

Table 4.8: Summary of Long Run Coefficients using the ARDL Cointegration Test I

Dependent variable: Stock market returns , NR_t			
Regressors are exchange rate, month-on-month inflation rate and 3-month T-Bills rate			
Regressors	**Coefficient**	**S.E**	**t-ratio**
Intercept	-2.789	2.321	-1.202
NR_{t-1}	-0.894	0.129	-6.893***
EX_{t-1}	0.023	0.027	0.832
MOM_{t-1}	1.1563	0.5618	2.058**
$TB3_{t-1}$	0.050	0.044	1.139
ΔEX_t	-0.173	0.258	-0.671
ΔMOM_t	0.3207	0.418	0.768
$\Delta TB3_t$	-0.186	0.351	-0.529
R-squared	0.434	Adjusted R-squared	0.398
$F\left(NR_t / EX_t, MOM_t, TB3_t\right)$ F(4, 255)	**13.06**	P-value(F) = 1.088e-009	
Diagnostic Tests			
Autocorrelation	$\chi_{auto}{}^2(12) = 20.680[0.056]$		
RESET	$F_{RESET} = 3.641[0.028]$		
Normality	$\chi_{Norm}{}^2(2) = 57.399[0.000]$		
Heteroscedasticity	$\chi_{Het}{}^2(16) = 88.396[0.000]$		
Coefficient Stability Tests			
CUSUM	Plot goes slightly beyond the 5 percent significance bounds		
CUSUMSQ	Plot goes slightly beyond the 5 percent significance bounds		

Notes: p-values are in parentheses. *** 1 percent significance, ** 5 percent significance level. NR_t is log difference of the NSE 20 Share Index, EX_t is KSH/USD exchange rate, MOM_t is month-on-month inflation rate, $TB3_t$ is the 3-month Treasury Bills rate.

The computed F-statistic value in Table 4.8 is significantly greater than all the upper bound critical values for the ARDL cointegration test provided by Pesaran *et al*. (2001) and Narayan (2004) at 1 percent, 5 percent significance levels (see Table B11 at the Appendix). Specifically, $F\left(NR_t / EX_t, MOM_t, TB3_t\right) = 13.06$ is greater than the upper bound critical values from Pesaran *et al*., (2001) of 5.17 (at 1 percent and 4.34 (at 5 percent)

(See Table B11). The computed F statistic is also greater than the Narayan (2004) upper bound critical values of 6.42 (at 1 percent) and 4.73 (at 5 percent) (See Table B11).

The significant computed F statistic value indicates that stock market returns**,** exchange rate, the month-on-month inflation rate, and the 3-month Treasury Bills rate are jointly cointegrated. This implies that a mutual long run dependence exists between stock market returns, exchange rate, the month-on-month inflation rate, and the 3-month Treasury Bills rate. Furthermore, the estimated coefficients in Table 4.8 showed that the month-on-month inflation rate had significant positive long run effect on stock market returns which supports the theoretical predictions of Fisher (1930). This is because Fisher (1930) argued that stock market returns should act as a hedge against inflationary pressures. More detailed results are contained in Table B7 at the Appendix.

Similarly, Table 4.9 reports the results of a joint long run comovement between exchange rate, month-on-month inflation rate, lending rate and stock market returns.

Table 4.9: Summary of Long Run Coefficients using the ARDL Cointegration Test II

Dependent variable: Stock market returns , NR_t			
Regressors are exchange rate, month-on-month inflation rate and lending rate			
Regressors	**Coefficient**	**S.E**	**t-ratio**
Intercept	0.698	4.350	0.160
NR_{t-1}	-0.859	0.129	-6.668***
EX_{t-1}	-0.009	0.0369	-0.245
MOM_{t-1}	1.105	0.42664	2.590**
Lr_{t-1}	-0.019	0.093	-0.213
ΔEX_t	-0.169	0.253	-0.670
ΔMOM_t	0.328	0.398	0.823
ΔLr_t	0.016	0.849	0.018
R-squared	0.426	Adj. R-squared	0.385
$F\left(NR_t / EX_t, MOM_t, \mathrm{Lr}_t\right)$ F(4, 255)	**13.22**	P-value(F) =8.589e-010	
Diagnostic Tests			
Autocorrelation	$\chi_{auto}^{2}(12)=17.232[0.141]$		
RESET	$F_{RESET}=2.602[0.076]$		
Normality	$\chi_{Norm}^{2}(2)=62.402[0.000]$		
Heteroscedasticity	$\chi_{Het}^{2}(18)=115.363[0.000]$		
Coefficient Stability Tests			
CUSUM	Plot does not go beyond the 5 percent significance bounds		
CUSUMSQ	Plot goes beyond the 5 percent significance bounds		

Notes: p-values are in parentheses. *** 1 percent significance, ** 5 percent significance level. NR_t is log difference of the NSE 20 Share Index, EX_t is KSH/USD exchange rate, MOM_t is month-on-month inflation rate, and Lr_t is the commercial banks' weighted average lending rate.

Table 4.9 also reveals that the computed F-statistic, $F\left(NR_t / EX_t, MOM_t, \mathrm{Lr}_t\right)=13.22$, was significantly greater than all the upper bound critical values for the ARDL cointegration test provided by Pesaran *et al*. (2001) and Narayan (2004) at 1 percent and 5 percent significance levels (see Table B11 at the Appendix). In addition, results in Table 4.9 indicate that the month-on-month inflation rate positively impacted on stock market returns in long run which is consistent with the theoretical predictions of Fisher (1930). Detailed results can be found in Table B8 at the Appendix.

This study also sought to determine whether exchange rate, year-on-year inflation rate, 3-month Treasury Bills rate and stock market returns were jointly cointegrated. Table 4.10 reports the ARDL cointegration results.

Table 4.10: Summary of Long Run Coefficients using the ARDL Cointegration Test III

Dependent variable: Stock market returns , NR_t			
Regressors are exchange rate, year-on-year inflation rate and 3-month T-Bills rate			
Regressors	**Coefficient**	**S.E**	**t-ratio**
Intercept	-1.452	2.951	-0.492
NR_{t-1}	-0.951	0.147	-6.482***
EX_{t-1}	0.005	0.037	0.136
YOY_{t-1}	0.154	0.089	1.728*
$TB3_{t-1}$	-0.003	0.072	-0.035
ΔEX_t	-0.151	0.260	-0.578
ΔYOY_t	0.328	0.221	1.479
$\Delta TB3_t$	-0.207	0.3461	-0.598
R-squared	0.426	Adj. R-squared	0.397
$F\left(NR_t / EX_t, \text{YOY}_t, \text{TB3}_t\right)$ F(4, 255)	**13.49**	P-value(F) = 5.3228e-010	
Diagnostic Tests			
Autocorrelation	$\chi_{auto}{}^2(12) = 20.159[0.064]$		
RESET	$F_{RESET} = 2.273[0.105]$		
Normality	$\chi_{Norm}{}^2(2) = 70.011[0.000]$		
Heteroscedasticity	$\chi_{Het}{}^2(13) = 147.828[0.000]$		
Coefficient Stability Tests			
CUSUM	Plot goes slightly beyond the 5% significance bounds		
CUSUMSQ	Plot slightly beyond the 5% significance bounds		

Notes: p-values are in parentheses. *** 1 percent significance, ** 5 percent significance level. NR_t is log difference of the NSE 20 Share Index, EX_t is KSH/USD exchange rate, YOY_t is the year-on-year inflation rate, and $TB3_t$ is the 3-month Treasury Bills rate.

The results in Table 4.10 indicate that the computed F-statistic, $F\left(NR_t / EX_t, \text{YOY}_t, \text{TB3}_t\right) = 13.49$, was significantly greater than all the upper bound critical values provided by Pesaran *et al*. (2001) and Narayan (2004) at 1 percent and 5 percent significance levels (see Table B11 at the Appendix). This suggests existence of a joint long run cointegration between the variables included in the ARDL model.

Consequently, this study concluded that the three macroeconomic variables jointly moved with stock market returns in the long run. Table 4.10 further indicates that the year-on-year inflation rate had significant positive long run impact on stock market returns. This is consistent with the predictions of Fisher (1930) and suggests that the Kenyan stock market cushioned investors against rising inflation rates in the long run. Additional results are reported in Table B9 at the Appendix.

Additionally, this study investigated the extent to which exchange rate, year-on-year inflation rate, lending rate and stock market returns were jointly cointegrated. Table 4.11 reports a summary of the ARDL cointegration test while more detailed results are contained in Table B10 at the Appendix.

Table 4.11: Summary of Long Run Coefficients using the ARDL Cointegration Test IV

Dependent variable: Stock market returns , NR_t			
Regressors are exchange rate, year-on-year inflation rate and lending rate			
Regressors	**Coefficient**	**S.E**	**t-ratio**
Intercept	1.066	4.565	0.234
NR_{t-1}	-0.952	0.144	-6.598***
EX_{t-1}	-0.012	0.039	-0.319
YOY_{t-1}	0.166	0.069	2.420**
Lr_{t-1}	-0.067	0.098	-0.686
ΔEX_t	-0.185	0.245	-0.757
ΔYOY_t	0.352	0.216	1.631
ΔLr_t	-0.317	0.861	-0.369
R-squared	0.423	Adj.R-squared	0.388
$F\left(NR_t / EX_t, \mathrm{YOY_t}, \mathrm{Lr_t}\right)$ F(4, 255)	**12.48**	P-value(F) = 2.735e-009	
Diagnostic Tests			
Autocorrelation	$\chi_{auto}{}^2(12) = 16.36[0.175]$		
RESET	$F_{RESET} = 0.709[0.493]$		
Normality	$\chi_{Norm}{}^2(2) = 82.33[0.000]$		
Heteroscedasticity	$\chi_{Het}{}^2(15) = 163.729[0.000]$		
Coefficient Stability Tests			
CUSUM	Plot does not go beyond the 5% significance bounds		
CUSUMSQ	Plot slightly beyond the 5% significance bounds		

Notes: p-values are in parentheses. *** 1 percent significance, ** 5 percent significance. NR_t is log difference of the NSE 20 Share Index, EX_t is KSH/USD exchange rate, YOY_t is the year-on-year inflation rate, and Lr_t is the commercial banks' weighted average lending rate.

The computed F-statistic, $F\left(NR_t / EX_t, \text{YOY}_t, \text{Lr}_t\right) = 12.48$, was significantly greater than all the upper bound critical values provided by Pesaran *et al*. (2001) and Narayan (2004) at 1 percent and 5 percent significance levels (see Table B11 at the Appendix). This suggests that the macroeconomic variables included in the model jointly moved together with stock market returns in the long run. Moreover, Table 4.11 reveals that the year-on-year inflation rate had significant positive long run impact on stock market returns. However, exchange rate and lending rate did not have significant long run effects on stock market returns in the long run.

In summary, the ARDL cointegration test results in Tables 4.8 to 4.11 suggest that stock market returns**,** exchange rate, each of the two measures of inflation rate, and each of the two measures of interest rate were jointly cointegrated. This implies that a mutual long run dependence existed between stock market returns, exchange rate, each measure of inflation rate and each measure of interest rate. Furthermore, the results showed that the Kenyan stock market provides a hedge against inflation (Fisher, 1930).

Furthermore, the results coincide with those found by Demirhan (2016) for Turkey, Ochieng and Adhiambo (2012) for Kenya, Kim and Ryoo (2011) for the US, Issahaku *et al.* (2013) for Ghana, and Alagidede and Panagiotidis (2010) for Egypt, Kenya, Nigeria, Morocco, South Africa, and Tunisia. The results however contradict the significant negative relationship between inflation rate and stock market returns established by Kimani and Mutuku (2013) through the Johansen and Juselius cointegration framework for Kenya as well as by Anari and Kolari (2010) for the US. The results also contradict Pal and Mittal (2011) for India, and Dasgupta (2012) for India.

In addition, the results revealed that exchange rate had a nonsignificant negative long run effect on stock market returns (when lending rate was included in the model) which supports the Flow-Oriented model (Dornbusch & Fischer, 1980) for firms that depend heavily on imported inputs and goods. This appeared to be in line with those found by Jawaid and Anwar (2012) for Pakistan; Kirui, Wawire and Onono (2014) for Kenya; and Nataraja *et al*. (2015) for India. A possible explanation for the negative effect of exchange rate on stock market returns in the presence of lending rate may be that rising lending rate attracted foreign capital inflows which might have caused the domestic currency to appreciate. Consequently, exports may have become less competitive in the international market making stock market returns to decline.

In contrast, inclusion of the 3-month Treasury Bills rate in the models led to a positive long run effect of exchange rate on stock market returns. This seemed to suggest that majority of investors in the Kenyan stock market had long term investment horizons such that fluctuations in short term interest rates (such as the 3-month Treasury Bills rate) did not concern them. Consequently, exchange rate depreciation might have continued to promote exports of firms associated with such investors even in the presence of rising 3-month Treasury Bills rate.

Additionally, the results showed that the 3-month Treasury Bills rate had a nonsignificant positive long run effect on stock market returns when the month-on-month inflation rate was included in the model. This could be taken as evidence that majority of investors in Kenya had long term investment horizons and were not influenced by the fluctuations in the short term interest rate and inflation rate. This result is consistent with those established by Pal and Mittal (2011) for India, and Akbar *et al*. (2012) for Pakistan.

On the contrary, lending rate had a nonsignificant negative effect on stock market returns regardless of the measure of inflation rate included in the model. This could have resulted from high interest expenses, reduced investments, and depressed productivity. Rising lending rates might have also resulted into an appreciation of the domestic currency owing to increased capital inflows. This could in turn have depressed exports and caused stock market returns of export-dependent firms to decline (Dornbusch & Fischer, 1980). This result was in agreement with those established by Ado and Sunzuoye (2013) in Ghana, Jawaid and Anwar (2012) in Pakistan and Erita (2014) in Namibia.

Furthermore, all the models passed the non-autocorrelation test which is a key assumption of the ARDL cointegration test. This implied that the errors in the respective models were serially independent (Pesaran *et al*., 2001). The regression coefficients of the respective models also appeared to be stable since the plots of the cumulative sum of recursive residuals (CUSUM) remained between the 5 percent bounds while those of the cumulative sum of squares of recursive residuals (CUSUMSQ) only slightly went beyond the 5 percent bounds.

4.5.6 Granger Causality Test using ARDL-based Vector Error Correction Model

This study conducted Granger causality tests to determine the direction and sign of short run as well as long run causality between the macroeconomic variables and stock market returns. It estimated the ARDL-based Vector Error Correction Models (VECMs) represented by equations 3.67 to 3.70 (see pages 132 and 133). Table 4.12 provides a summary of the estimated short run and long run relationships between each of the macroeconomic variables and stock market returns.

Table 4.12: Granger Causality Test based on ARDL-based Vector Error Correction Model

Dependent variable: Stock Market Returns , NR_t	
Results for Equation (3.67)	**Wald Test (F-Test Statistic) for lagged first differences of macroeconomic variables**
F statistic $H_{01}: w_{1i} = 0$ for all i: EX_t does not Granger cause NR_t	F(4, 258) = 0.245[0.913]
F statistic $H_{02}: w_{2i} = 0$ for all i: MOM_t does not Granger cause NR_t	F(4, 258) = 1.556[0.313]
F statistic $H_{03}: w_{3i} = 0$ for all i: $TB3_t$ does not Granger cause NR_t	F(2, 258) = 0.650[0.429]
$ECT1_{t-1}$	-0.867***
Results for Equation (3.68)	**Wald Test**
F statistic $H_{01}: x_{1i} = 0$ for all i: EX_t does not Granger cause NR_t	F(4, 256) = 0.330[0.857]
F statistic $H_{02}: x_{2i} = 0$ for all i: MOM_t does not Granger cause NR_t	F(4, 256) = 1.411[0.23]
F statistic $H_{03}: x_{3i} = 0$ for all i: Lr_t does not Granger cause NR_t	F(4, 256) = 0.596[0.666]
$ECT2_{t-1}$	-0.835**
Results for Equation (3.69)	**Wald Test**
F statistic $H_{01}: y_{1i} = 0$ for all i: EX_t does not Granger cause NR_t	F(4, 261)=0.24[0.915]
F statistic $H_{02}: y_{2i} = 0$ for all i: YOY_t does not Granger cause NR_t	F(1, 261) = 3.25[0.0725]*
F statistic $H_{03}: y_{3i} = 0$ for all i: $TB3_t$ does not Granger cause NR_t	F(2, 261) = 0.42[0.65]
$ECT3_{t-1}$	-0.954***
Results for Equation (3.70)	**Wald Test**
F statistic $H_{01}: z_{1i} = 0$ for all i: EX_t does not Granger cause NR_t	F(4, 259) = 0.64[0.63]
F statistic $H_{02}: z_{2i} = 0$ for all i: YOY_t does not Granger cause NR_t	F(1, 259) = 4.04[0.045]**
F statistic $H_{03}: z_{3i} = 0$ for all i: Lr_t does not Granger cause NR_t	F(4, 259) = 0.302[0.876]
$ECT4_{t-1}$	-0.95***

Notes. The asterisk ** indicates the significance at 5 percent level and *** at 1 percent level. NR_t is the log difference of the NSE 20 Share Index, EX_t is the KSH/USD exchange rate, MOM_t is the month-on-month inflation rate, YOY_t is the year-on-year inflation rate, $TB3_t$ is the 3-month Treasury Bills rate, and Lr_t is the commercial banks' weighted average lending rate.

The computed F statistic for all equations in Table 4.12 are nonsignificant except for the null hypothesis that the year-on-year inflation rate did not

Granger cause stock market returns. These results indicate that changes in exchange rate, month-on-month inflation rate, the 3-month Treasury Bills rate and lending rate individually had no causal effect on stock market returns in the short run. This suggests that in the short run, stock market returns remained independent of exchange rate, month-on-month inflation rate, 3-month Treasury Bills rate and lending rate in Kenya. A possible explanation of this outcome is that most investors in Kenya had long investment horizons such that short term variations in the macroeconomic variables did not influence their investment decisions. It also implied that the Kenyan government could implement sound macroeconomic policies in the short run without adversely affecting the performance of the stock market.

The results support the views of Kumar and Puja (2012) who failed to establish any short run causality between exchange rate and stock market returns in India. Likewise, the results coincide with those by Dasgupta (2012) who did not detect any short run causality between inflation rate and stock market returns in India, and Ado and Sunzuoye (2013) who concluded that the 3-month Treasury Bills rate and lending rate did not Granger cause stock market returns in the short run in Ghana.

In contrast, the results demonstrate that a positive unidirectional Granger causality originated from the year-on-year inflation rate to stock market returns thereby supporting the presence of Fisher Effect in Kenya (Fisher, 1930).

Moreover, this result seems to support the view that investors in Kenya had long term investment horizons given the fact that the year-on-year inflation rate is a long term measure of inflation rate.

However, the coefficients of the error correction terms indicate that a significant joint long run Granger causality originated from models including exchange rate, a measure of inflation rate and a measure of interest rate to stock market returns. This provides support for the ARDL cointegration test results presented in Tables 4.8 to 4.11. Additionally, the results imply that even though the exchange rate, the month-on-month inflation rate, the 3-month Treasury Bills rate and lending rate individually did not have a significant impact on stock market returns in the short run, a joint persistent variation in their values significantly influenced the behaviour of stock market returns in the long run.

Moreover, it is worth noting that the long run coefficient in the causality relationship including exchange rate, year-on-year inflation rate and the 3-month Treasury Bills rate as well as that including exchange rate, year-on-year inflation rate and lending rate were significant and close to unity (i.e. 0.95). This suggests that stock market returns crucially depended on the joint movements of the variables in the long run when the year-on-year inflation rate is included.

4.6 Results of the Qualitative Moderator Variable Models

This study examined how shocks from the 2008 GFC moderated the relationship between each of the macroeconomic variables and stock market returns. To achieve this, it estimated single equation models as well as moderated models captured in equations 3.37 to 3.40 (see pages 115, 116 and 117), equations 3.50 to 3.54 (see pages 122 and 123), and equations 3.64 to 3.68 (see pages 130, 132 and 133). The results of the estimating and testing models are presented in Tables 4.13 to 4.15. The study also presents the results of the three different scenarios for average stock market returns using the macroeconomic variables as the moderator variables in Tables B13 to B17 at the Appendix.

4.6.1 Regression Estimates of Stock Market Returns on Exchange Rate

This study examined the extent to which the 2008 Global Financial Crisis moderated the relationship between exchange rate and stock market returns in Kenya using a product-term regression model. Table 4.13 reports the coefficient estimates from regressing stock market returns on exchange rate for the period during and after in comparison to the period before the crisis. The study considered observed values as well as mean centered values of exchange rate. Results of average stock market returns as a function of low, medium and high values of exchange rate are reported in Table B13 at the Appendix.

Table 4.13: Regression Estimates of Stock Market Returns on Exchange Rate

Dependent variable: Stock market returns						
Independent variables	**Bivariate regressions**			**Qualitative moderator regressions**		
Equation (3.30)				**Equation (3.31)**		
	Coefficient	**S.E.**	**t-ratio**	**Coefficient**	**S.E.**	**t-ratio**
Intercept	1.954	2.426	0.805	-0.667	3.085	-0.216
EX_t	−0.021	0.033	−0.629	0.022	0.047	0.4708
$D_{duringGFC}$				1.689	19.448	0.087
$D_{afterGFC}$				17.542	7.086	2.475**
$EX_tD_{duringGFC}$				-0.075	0.286	-0.263
$EX_tD_{afterGFC}$				-0.214	0.086	-2.491**
				Equation (3.32)		
	Coefficient	**S.E.**	**t-ratio**	**Coefficient**	**S.E.**	**t-ratio**
Intercept				1.095	0.953	1.149
EX_{ct}				0.022	0.048	0.471
$D_{duringGFC}$				-4.195	3.649	-1.149
$D_{afterGFC}$				0.745	1.301	0.573
$EX_{ct}D_{duringGFC}$				-0.075	0.286	-0.263
$EX_{ct}D_{afterGFC}$				-0.214	0.086	-2.491**

Notes: The asterisk ** indicates the significance at 5 percent level and *** at 1 percent level. NRt is log difference of the NSE 20 Share Index, EXt is KSH/USD exchange rate. EXct is mean centered value of exchange rate.

The result from equation 3.31, indicates that the mean stock market returns for the period before the crisis was negative while average stock market returns were significantly positive and higher after the crisis compared to before the crisis. This suggests that investors may have panicked at the beginning of the 2008 GFC but revised their perceptions once they began to experience the shocks, with majority of them returning to the stock market after the crisis period. Additionally, this reflects possible existence of resilience in the Kenyan stock market during turbulent periods. It could also imply that the uncertainty among investors during and after the crisis increased the perceived risks associated with the stock market which in turn raised the required or expected rates of return.

The higher average stock market returns during and after the crisis relative to before the crisis also suggest that foreign investors might not have shifted from the domestic stock market despite the onset of the GFC. These deeper insights are not discernible from the bivariate main effects model represented by equation 3.30. This result however appears to contradict those found by Ali and Afzal (2012) who established that the 2008 GFC resulted into a significant decline in stock market returns in India. It also disagrees with Mwega (2010) who concluded that the 2008 GFC triggered a significant capital outflow in 2008 leading to a decline in stock market returns in Kenya.

Additionally, equation 3.31 demonstrates that a unit increase in exchange rate depreciation had larger depressing effects on stock market returns during and after the crisis compared to before the crisis. This suggests that investors might have been more sensitive to variations in the exchange rate during and after the crisis compared to before the crisis. They might have therefore responded to exchange rate depreciations by offloading their shares at the NSE which may have led to significant declines in stock market returns. However, this sensitivity appears to have been highest after the crisis possibly owing to low investor confidence in a stock market just emerging from a financial turbulence. Again, this kind of analysis cannot be drawn from the main effects models such as equation 3.30.

Likewise, equation 3.32 shows that a unit increase in exchange rate depreciation had a positive effect of stock market returns before the crisis when exchange rate was at its mean value. This partially supports the Flow-Oriented model (Dornbusch & Fischer, 1980) for export dependent firms. However, a unit increase in exchange rate depreciation led to a significant decline in stock market returns during and after the crisis compared to before the crisis at the mean exchange rate (see coefficients of $EX_{ct}D_{duringGFC}$ and $EX_{ct}D_{duringGFC}$ in Eq. 3.32).

Indeed, the sensitivity of stock market returns to exchange rate depreciation appeared to have been highest after the crisis compared to before the crisis at mean exchange rate. This might have been possibly due to higher uncertainty regarding a stock market that was just emerging from a financial crisis. However, average stock market returns appeared to have been higher after but lower during the crisis compared to before the crisis when exchange rate was at its mean value. This suggests that the stock market was more buoyant after the crisis but remained depressed during the crisis in comparison to before the crisis when exchange rate was average. This may be because during a crisis, stock market returns are likely to continue to decline in a macroeconomic environment where exchange rate is at is mean value (which represents average exchange rate risk). However, as the economy began to emerge out of the crisis, the stock market performance might have responded positively to the overall economic recovery despite the prevailing exchange rate risk (captured by the mean exchange rate).

On the other hand, when exchange rate was taken as the moderating variable (i.e. scenarios for stock market returns at low, medium and high values of exchange rate), a unit increase in exchange rate depreciation had the same significant depressing effects on stock market returns after the crisis in comparison to the period before the crisis regardless of whether exchange rate was low, medium or high (see Table B13 at the Appendix and Table 4.13). Nonetheless, average stock market returns were significantly higher after the crisis compared to before the crisis at low values of exchange rate relative to when exchange rate was at its medium or high values. This suggests that the effects of the 2008 GFC on stock market returns might have been cushioned by lower exchange rate values (i.e. stable macroeconomic environment) experienced after the crisis period, probably as foreign investors began to return to the domestic stock market.

However, exchange rate had significant depressing effects after the crisis in comparison to before the crisis irrespective of whether it was low, medium or high. This suggests that the stock market is highly sensitive to variations in exchange rate when it is emerging from a crisis regardless of prevailing level of exchange rate. The results support Amaefula and Asare (2013) who established that the global financial crisis had significant effect on the correlation between stock market returns and exchange rate in Nigeria.

4.6.2 Regression Estimates of Stock Market Returns on Inflation Rate

The study employed a product-term regression model to investigate the extent to which the 2008 Global Financial Crisis moderated the relation between inflation rate and stock market returns in Kenya. Table 4.14 reports the coefficient estimates from regressing stock market returns on the month-on-month inflation rate and year-on-year inflation rate for the period during and after in comparison to the period before the crisis. The study used both observed values as well as mean centered values of the two inflation rate measures. Results of average stock market returns as a function of low, medium and high values of the two measures of inflation rate are presented in Tables B14 and B15 at the Appendix.

Table 4.14: Regression Estimates of Stock Market Returns on Inflation Rate

Dependent variable: Stock market returns						
Independent variables	**Bivariate regressions**			**Qualitative moderator regressions**		
Equation (3.42)				**Equation (3.44)**		
	Coefficient	**S.E.**	**t-ratio**	**Coefficient**	**S.E.**	**t-ratio**
Intercept	−0.011	0.469	−0.022	0.149	0.536	0.279
MOM_t	0.595	0.299	1.989**	0.869	0.468	1.860*
$D_{duringGFC}$				0.019	4.428	0.004
$D_{afterGFC}$				1.014	0.919	1.103
$MOM_tD_{duringGFC}$				-3.591	3.494	-1.028
$MOM_tD_{afterGFC}$				-2.339	0.822	-2.844***
				Equation (3.46)		
	Coefficient	**S.E.**	**t-ratio**	**Coefficient**	**S.E.**	**t-ratio**
Intercept				0.823	0.602	1.367
MOM_{ct}				0.869	0.468	1.860*
$D_{duringGFC}$				-2.759	2.685	-1.028
$D_{afterGFC}$				-0.796	0.802	-0.993
$MOM_{ct}D_{duringGFC}$				-3.591	3.494	-1.028
$MOM_{ct}D_{afterGFC}$				-2.339	0.822	-2.844***
Equation (3.43)				**Equation (3.45)**		
	Coefficient	**S.E.**	**t-ratio**	**Coefficient**	**S.E.**	**t-ratio**
Intercept	−1.256	0.556	−2.259**	-1.305	0.800	-1.630
YOY_t	0.162	0.037	4.389***	0.191	0.0715	2.669***
$D_{duringGFC}$				4.945	12.239	0.404
$D_{afterGFC}$				3.111	1.3711	2.269**
$YOY_tD_{duringGFC}$				-0.644	0.840	-0.766
$YOY_tD_{afterGFC}$				-0.386	0.143	-2.702***
				Equation (3.47)		
	Coefficient	**S.E.**	**t-ratio**	**Coefficient**	**S.E.**	**t-ratio**
Intercept				0.707	0.509	1.389
YOY_{ct}				0.191	0.072	2.669***
$D_{duringGFC}$				-1.842	3.857	-0.478
$D_{afterGFC}$				-0.961	0.845	-1.137
$YOY_{ct}D_{duringGFC}$				-0.644	0.840	-0.766
$YOY_{ct}D_{afterGFC}$				-0.3864	0.143	-2.702***

Notes: The asterisk ** indicates the significance at 5 percent level and *** at 1 percent level. NRt is log difference of the NSE 20 Share Index, MOMt is the month-on-month inflation rate, and YOYt is the year-on-year inflation rate. MOMct, and YOYct, are mean centered values of the respective variables.

Table 4.14 reveals that that a unit increase in the month-on-month inflation rate and the year-on-year inflation rates had significant positive effects on stock market returns before the crisis began at the realized as well as at the average values (see Eqs. 3.44 to 3.47). This agrees with the Fisher Effect (Fisher, 1930) and is in line with Ochieng and Adhiambo (2012) as well as with Alagidede and Panagiotidis (2010). However, a unit increase in the month-on-month inflation rate and the year-on-year inflation rate caused a decline in stock market returns during and after the crisis compared to before the crisis with the depressing effects being highest after the crisis period.

Similarly, stock market returns declined significantly following a unit increase in the month-on-month inflation rate and the year-on-year inflation rate during and after the crisis compared to before the crisis when the two measures of inflation rate were at their mean values (see Eqs.3.46 and 3.47). Again, stock market returns appeared to have declined the most after the crisis in comparison to before the crisis at the mean values of the two measures of inflation rate. This suggests that general price increases after periods of financial turbulence significantly undermined the performance of the stock market regardless of the level of inflation rate. A plausible explanation for this state of affairs is that investors often expect the government to increase interest rates in order to tame rising inflation rate after an occurrence of a financial crisis. This perception possibly leads to reallocation of funds from stocks to alternative investment vehicles such as Treasury Bills and bonds which causes stock market returns to decline.

However, whereas equations 3.44 and 3.45 demonstrate that average stock market returns were higher during and after the crisis in comparison to before the crisis at realized values of each of the two measures of inflation rate, equations 3.46 and 3.47 reveal that average stock market returns were lower during and after the crisis relative to before the crisis at mean values of the two measures of inflation rate. This suggests that shocks from the 2008 GFC had positive effects on stock market returns during and after the crisis compared to before the crisis at observed values of the two measures of inflation rate possibly because investors had overcome their initial negative overreaction to the onset of the 2008 GFC. However, a macroeconomic environment with medium values of the two measures of inflation rate during and after the crisis periods might have induced fears of a likely worsening economic situation which could have led to extra declines in stock market returns. Again, these details could not be gleaned from the usual main effects models given by equations 3.42 and 3.43.

This study also investigated the effect of the 2008 GFC on the relation between inflation rate and stock market returns at low and high values of the month-on-month inflation rate and year-on-year inflation rate. Tables B14 and B15 at the Appendix present the scenarios of average stock market returns as a function of the low and high values of the two measures of inflation rate.

It is evident from Table B14 that a unit increase in the month-on-month inflation rate had the same significant positive effect on stock market returns before the crisis at both low and high values of the variable. The same applied to stock market returns at low and high values of the year-on-year inflation rate (see Table B15). However, a unit increase in the month-on-month inflation rate led to a significant decline in stock market returns after the crisis compared to before the crisis at both low and high values of the variable (see Table B14). Likewise, a unit increase in the year-on-year inflation rate led to a significant decline in stock market returns after compared to before the crisis at both low and high values of the variable (see Table B15). These results suggest that the Kenyan stock market remained highly sensitive to any increases in inflation rate after a crisis regardless of the prevailing inflation rate.

The models also showed that stock market returns generally declined during compared to before the crisis for a unit increase in either measure of inflation rate, regardless of the level of inflation rate. This suggests that any increases in inflation rate depressed the performance of the stock market performance during a financial crisis.

On the other hand, Table B14 demonstrated that average stock market returns were significantly higher after the crisis compared to before the crisis at low month-on-month inflation rate. However, average stock market returns declined significantly after the crisis compared to before the crisis at high values of the month-on-month inflation rate. Likewise, average stock market returns were significantly higher after the crisis compared to before the crisis at low values of the year-on-year inflation rate but declined significantly after the crisis compared to before the crisis at high values (see Table B15). This suggests that lower values of inflation rate boosted the performance of the Kenyan stock market when it was emerging from a crisis. In other words, a stable macroeconomic environment was vital for a stock market recovering from a financial turmoil.

These results are in agreement with those found by Ali and Afzal (2012) who established that the 2008 GFC resulted into a significant decline in stock market returns in India.

4.6.3 Regression Estimates of Stock Market Returns on Interest Rate

The study determined the extent to which the 2008 Global Financial Crisis influenced the relationship between interest rate and stock market returns in Kenya using a product-term regression model. Table 4.15 reports the coefficient estimates from regressing stock market returns on the 3-month Treasury Bills rate and lending rate for the period during and after in comparison to the period before the crisis. The study used observed values as well as mean centered values of the 3-month Treasury Bills rate and lending rate. Results of stock market returns as a function of low and high values of the 3-month Treasury Bills rate and lending rate are contained in Tables B16 and B17 at the Appendix.

Table 4.15: Regression Estimates of Stock Market Returns on Interest Rate

Dependent variable: Stock market returns						
Independent variables	**Bivariate regressions**			**Qualitative moderator regressions**		
Equation (3.57)				**Equation (3.59)**		
	Coefficient	**S.E.**	**t-ratio**	**Coefficient**	**S.E.**	**t-ratio**
Intercept	−0.518	0.605	−0.856	-0.207	0.822	-0.251
$TB3_t$	0.071	0.033	2.169**	0.065	0.042	1.568
$D_{duringGFC}$				14.422	27.379	0.527
$D_{afterGFC}$				0.601	1.462	0.411
$TB3_tD_{duringGFC}$				-2.285	3.394	-0.673
$TB3_tD_{afterGFC}$				-0.080	0.119	-0.676
				Equation (3.61)		
	Coefficient	**S.E.**	**t-ratio**	**Coefficient**	**S.E.**	**t-ratio**
Intercept				0.681	0.620	1.099
$TB3_{ct}$				0.065	0.042	1.568
$D_{duringGFC}$				-16.720	18.998	-0.880
$D_{afterGFC}$				-0.492	0.989	-0.497
$TB3_{ct}D_{duringGFC}$				-2.285	3.394	-0.673
$TB3_{ct}D_{afterGFC}$				-0.080	0.119	-0.676
Equation (3.58)				**Equation (3.60)**		
	Coefficient	**S.E.**	**t-ratio**	**Coefficient**	**S.E.**	**t-ratio**
Intercept	−0.633	1.415	−0.448	1.118	2.379	0.470
Lr_t	0.0559	0.069	0.799	-0.012	0.123	-0.101
$D_{duringGFC}$				-97.944	58.407	-1.677*
$D_{afterGFC}$				-7.831	4.896	-1.599
$Lr_tD_{duringGFC}$				6.594	4.094	1.611
$Lr_tD_{afterGFC}$				0.439	0.269	1.624
				Equation (3.62)		
	Coefficient	**S.E.**	**t-ratio**	**Coefficient**	**S.E.**	**t-ratio**
Intercept				0.878	0.591	1.486
Lr_{ct}				-0.012	0.123	-0.101
$D_{duringGFC}$				29.936	21.193	1.413
$D_{afterGFC}$				0.674	0.867	0.777
$LrctD_{duringGFC}$				6.594	4.094	1.611
$LrctD_{afterGFC}$				0.439	0.269	1.624

Notes: The asterisk ** indicate the significance at 5 percent level and *** at 1percent level. NRt is log difference of the NSE 20 Share Index, TB3t is the 3-month Treasury Bills rate and Lrt is the commercial banks' weighted average lending rate. TB3ct and Lrct are mean centered values of the respective variables.

The results in Table 4.15 reveals that the 2008 GFC had insignificant effects on the relationship between the two measures of interest rate and stock market returns during as well as after the crisis in comparison to the period before the crisis. For instance, whereas equations 3.59 and 3.61 indicate that a unit increase in the 3-month Treasury Bills rate had a nonsignificant positive effect on stock market returns before the crisis; equations 3.60 and 3.62 demonstrate that a unit increase in lending rate had a nonsignificant negative effect on stock market returns before the crisis. This could possibly be due to the fact that investors in the Kenyan stock market had long investment horizons and continued to invest in the stock market despite the lucrativeness of the Treasury Bills. However, the investors tended to scale down their investments when long term interest rates (lending rates) rose.

On the contrary, a unit increase in the 3-month Treasury Bills rate seemed to have induced a decline in stock market returns during and after the crisis compared to before the crisis both at observed values as well as at mean values of the 3-month Treasury Bills rate. This could possibly be due to flight to safer investments such as the Treasury Bills and reduction in allocations to stocks during such periods. Conversely, a unit increase in lending rate led to higher stock market returns during and after the crisis compared to before the crisis both at observed values as well as at mean values of lending rate. This might have been due to perception among the investors that the rising lending rates were in response to an attempt by the government to drive down inflation rate during and after the crisis with a view to stimulating the economy. Consequently, investments in the stock market could have increased during and after the crisis in anticipation of an improved economy despite the rising lending rate.

Average stock market returns however appeared to have been higher during and after the crisis compared to before the crisis at observed values of the 3-month Treasury Bills rate but lower during and after the crisis relative to before the crisis at average values of the 3-month Treasury Bills rate. This suggests that the 2008 GFC had more adverse direct effects on stock market returns when the 3-month Treasury Bills rate was at its medium value (i.e. investors seemed to be more sensitive to shocks during and after a crisis when interest rate was at a medium value). In contrast, average stock market returns were lower during and after the crisis compared to before the crisis at observed values of lending rate (see Eq.3.60). The opposite situation however obtained when lending rate was at its mean value (see Eq. 3.62). This demonstrated that shocks from the 2008 GFC had less direct depressing effects on stock market returns during and after the crisis in comparison to before the crisis at mean lending rate. A possible explanation for this is that investors might have viewed the average lending rate as an intention by the government to lower inflation rate in order to stimulate the weak economy.

However, when the 3- month Treasury Bills rate and lending rate were taken as the moderating variables, average stock market returns were higher during and after the crisis period compared to the period before the crisis at high and medium rather than low values of lending rate (see Table B17). In fact, average stock market returns significantly declined during the crisis period when lending rate was low (see Table B17). A possible explanation for this relationship is that medium or high lending rates attracted capital inflows which in turn stimulated economic growth leading to rising profits. The other plausible explanation is that medium or high lending rates might have signaled that the government intended to reduce inflation rate with a view to stimulating economic growth which could have encouraged investors to enhance their investments in the stock market.

CHAPTER FIVE

SUMMARY, CONCLUSION AND POLICY IMPLICATIONS

5.1 Introduction

This chapter presents the summary of the study, conclusions and policy implications of the results obtained by this study. The chapter also contains the contributions made to knowledge as well as the limitations of the study. It also suggests possible areas for further research.

5.2 Summary of the Study

Debate on the stochastic behaviour of stock market returns, the macroeconomic variables and their cointegrating residuals remains unsettled. There is also no unanimity in the nature of relationship between stock market returns and the macroeconomic variables. Furthermore, the moderating effect of events such as the 2008 Global Financial Crisis on the relation between stock market returns and the macroeconomic variables has attracted very little attention. The purpose of this study was to examine the stochastic properties of stock market returns, exchange rate, inflation rate and interest rate as well as the properties the respective cointegrating residuals. The study also determined the relationship between the macroeconomic variables and stock market returns in a bivariate as well as multivariate framework. It equally investigated the moderating effect of the 2008 Global Financial Crisis on the relation between the macroeconomic variables and stock market returns.

The study employed the ARFIMA-based exact maximum likelihood estimation technique to empirically determine the integration orders of the individual variables and that of the respective cointegrating residuals. It also used the residual-based cointegration test to examine the presence of bivariate cointegration between each macroeconomic variable and stock market returns. The study equally investigated whether a joint cointegration existed between the macroeconomic variables and stock market returns using an Auto-Regressive Distributed Lag (ARDL) cointegration test.

This study also examined the presence of causality between each of the macroeconomic variables and stock market returns using standard Granger causality tests as well as Fractionally Integrated Error Correction Models. It also employed an ARDL-based VECM to determine existence of causality between the macroeconomic variables and stock market returns.

Finally, this study employed the product-term regression model to determine the extent to which the 2008 GFC moderated the relationship between each of the macroeconomic variables and stock market returns.

The ARFIMA-based EML estimation revealed that the difference parameters for all the individual variables were non-integer values less than 1 and significantly different from 0 and 1. The EML test also established that the cointegrating residuals between stock market returns and each of the macroeconomic variables had non-integer orders of integration less than 1 and significantly different from 1 and 0.

The ARDL cointegration test revealed that the macroeconomic variables were jointly cointegrated with stock market returns. Specifically, the ARDL test revealed that stock market returns were strongly positively related to the month-on-month inflation rate and year-on-year inflation rate in the long run. The estimation model also predicted that lending rate had weak negative long run causal effect on stock market returns. However, the long run relationship between stock market returns and either exchange rate or the 3-month Treasury Bills rate was not clear from the ARDL cointegration model.

The Granger causality tests based on the ECM failed to establish short run causality from any of the macroeconomic variables to stock market returns and vice versa. The ECM models however indicate presence of a positive long run Granger causality from exchange rate to stock market returns which is in line with the predictions of Flow Oriented Model for export-dependent firms (Dornbusch & Fischer, 1980). The ECM results also reveal a significant positive unidirectional Granger causality from the year-on-year inflation rate to stock market returns which agrees with the Fisher Effect (Fisher, 1930). However, the ECM test reveals that the month-on-month inflation rate had a negative long run causal effect on stock market returns which supports the Proxy Effect (Fama, 1981) or the Tax Effect Hypothesis by Feldstein (1980).

Additionally, the ECM test results demonstrate that a negative long run Granger causality originated from the 3-month Treasury Bills rate and lending rate to stock market returns. In direct contrast, results from the FIECM models demonstrate presence of a negative unidirectional short run causality from the stock market returns to the month-on-month inflation rate, the 3-month Treasury Bills rate and lending rate. These results are in line with the Reverse Causality Hypothesis (Geske & Roll, 1983). The results from the FIECM models also indicate that the year-on-year inflation rate unidirectionally Granger caused stock market returns in the short run with a positive sign. This result is in agreement with that established by the ARDL-based VECM test and supports the Fisher Effect (Fisher, 1930).

Additionally, results from the FIECM models indicate that the convergence to long run equilibrium whenever shocks drove each of the macroeconomic variables away from stock market returns tended to be very slow compared to the convergence rate revealed by the ECM models. The FIECM models however do not detect any long run Granger causality between the other macroeconomic variables and stock market returns possibly owing to the neutralizing effect of the Granger causality between the variables in the short run.

In general, the FIECM models provide support for short run Granger causality between the macroeconomic variables and stock market returns while the ECM models do not. This suggests that the relationship between the macroeconomic variables and stock market returns might be more complex than has been demonstrated by existing studies (which are not based on ARFIMA models).

The product-term models revealed that a unit increase in exchange rate had significant depressing effects on stock market returns after compared to before the 2008 GFC irrespective of whether exchange rate was low, medium or high. The results also show that average stock market returns were significantly higher after the crisis compared to before the crisis at low values of exchange rate. Additionally, the results indicate that a unit increase in exchange rate had positive effects on the stock market returns before the 2008 GFC at low, medium or high values of the macroeconomic variable.

The product-term models also revealed that a unit increase in either measure of inflation rate had significant depressing effects on stock market returns after compared to before the 2008 GFC irrespective of whether each of the measures of inflation rate was low, medium or high. The results also showed that average stock market returns were significantly higher after the crisis compared to before the crisis at low values of both measures of inflation rate. Moreover, the results indicate that a unit increase in either measure of inflation had significant positive effects on the stock market returns before the 2008 GFC at low, medium or high values of the macroeconomic variable.

In contrast, the 2008 GFC had insignificant effects on the relationship between the two measures of interest rate and stock market returns during as well as after the crisis in comparison to the period before the crisis. The results also show that average stock market returns were relatively the same during and after compared to the before the crisis at low, medium and high values of the 3-month Treasury Bills rate and lending rate. Likewise, a unit increase in either measure of interest had the same effects on the stock market returns during and after in comparison to before the 2008 GFC at low, medium or high values of the variables.

5.3 Conclusions

The results of this study generated a number of conclusions pertaining to the five research objectives. The first objective concerned determination of the integration orders of exchange rate, inflation rate, interest rate, stock market returns and the respective cointegrating residuals.

In view of the results, this study concluded that exchange rate, inflation rate, interest rate and stock market returns in Kenya were long memory processes. This was inconsistent with the conventional I(0)/I(1) results reported by most existing studies. Likewise, this study concluded that each of the macroeconomic variables was fractionally cointegrated with stock market returns contrary to the conventional cointegration that majority of existing studies have documented.

The second objective concerned the relationship between exchange rate and stock market returns. The results suggested that majority of companies listed at the NSE were export-oriented. This was because exchange rate positively granger caused stock market returns in the long run. However, the Kenyan stock market remained independent of the changes exchange rate in the short run.

In regard to the third objective which sought to determine the effect of inflation rate on stock market returns, the study concluded that Fisher Effect existed in Kenya. This was because the ARDL cointegration test revealed that both measures of inflation had positive long run effect on stock market returns. The study also concluded that the Kenyan stock market played a key role in stabilizing the short term inflation rate.

Based on the fourth research objective regarding the relationship between interest rate and stock market returns, the study concluded that investors in Kenya treat the 3-month Treasury Bills and stock market returns as competing assets. The study also concluded that high bank charges depressed the performance of the stock market returns in Kenya. Equally, this study concluded that a thriving stock market was critical in realizing a sound macroeconomic environment in Kenya.

Finally, based on the fifth research objective regarding the extent to which the 2008 GFC moderated the relationship between each of the macroeconomic variables and stock market returns, the following conclusions were drawn: First, the 2008 GFC had significant effects on stock market returns. Second, the 2008 GFC significantly moderated the relation between exchange rate and stock market returns. Third, the relationship between inflation rate and stock market returns differed significantly in the presence of shocks from the 2008 GFC. Fourth, the 2008 GFC did not have a significant effect on the relation between interest rate and stock market returns.

5.4 Policy Implications

In light of the conclusions, the following implications would be of interest to policy-makers, stock market practitioners, stock market regulators, traders and the Central Bank of Kenya.

First, the Central Bank of Kenya needs to closely monitor the evolution paths of the individual variables with a view to inducing faster mean-reversion whenever they are exposed to shocks. This is because the study established that the variables take a long duration to return to their pre-shock levels.

Second, investment practitioners and arbitrageurs can capitalize on the long memory phenomenon to design investment strategies that consistently yield higher-than- average returns. This is because the presence of long memory makes it easy to predict the future trends of the variables.

Third, practitioners in the stock market need to be extra cautious while applying the standard statistical inferences and asset pricing models such as CAPM and APT. This is because these analytical procedures presuppose that the variables have normal distributions and short memory. The asset pricing models need to be revised to take into account the existence of long memory in the variables.

Fourth, policymakers need to take the long memory phenomenon into consideration while evaluating implications of various policies. In particular, policy makers need to induce re-adjustment to long run equilibrium whenever each of the macroeconomic variables is driven away from the stock market returns. This is because the presence of long memory in the cointegrating residuals suggests that adjustment to long run equilibrium is slower. Consequently, each of the macroeconomic variables and stock market returns may settle at an unfavorable new equilibrium level whenever the variables are driven apart from each other by political, economic or financial turbulences.

Fifth, the Capital Markets Authority needs to work closely with the CBK to develop and promote policies that make exports attractive. This is because the study established that exchange rate depreciation improved the performance of the stock market in Kenya.

Sixth, investors in the Kenyan stock market need not worry even during periods of rising inflation rate. This is because the stock market provides shelter against inflationary pressures.

Seventh, the CBK needs to develop policies which maintain low cost of borrowings in order to boost the performance of the stock market. This is because this study revealed that high cost of borrowing depresses the stock market.

Eighth, the Kenyan government needs to work closely with the CMA to improve the performance of the stock market in order to realize a favorable macroeconomic environment. This is because this study established that a thriving stock market in Kenya plays a critical role in reducing interest rate and inflation rate levels.

Ninth, the Central Bank of Kenya needs to develop policies that maintain low and stable exchange rate, inflation rate and interest rate to sustain investor confidence in the stock market, especially during and after turbulences. This is because this study revealed that low values of the macroeconomic variables tend to boost prospects of the stock market during and after compared to before a financial crisis.

Finally, policymakers as well as stock market regulators need to be extra cautious when intervening in the activities of the Kenyan stock market, especially after financial or political turbulences. This is because this study established that a unit increase in exchange rate and inflation rate had significant depressing effects on stock market returns after compared to before the 2008 GFC.

5.5 Contributions to Knowledge

This study breaks new ground along three main dimensions. First, the study is methodologically innovative in the sense that it was the first one to extend Granger causality analysis from the conventional test to the ARFIMA-based Granger causality analysis using data from Kenya.

Second, this study was theoretically innovative in the sense that it extended the more restrictive standard I (0)/I (1) stationarity theory to the more general fractional integration and cointegration framework. This extension allowed for a greater degree of flexibility in the specification of the dynamic behaviour of the individual variables as well as their cointegrating residuals. Specifically, this was the first study to examine the presence of fractional cointegration between each of the macroeconomic variables and stock market returns in Kenya using EML estimation technique.

Finally, this study was empirically innovative in the sense that it extended the widely used additive regression model to a product-term modelling. This provided an exceptional means of examining the moderating effects of shocks from the 2008 GFC on the relationship between the selected macroeconomic variables and stock market returns. This was the first study to have examined the moderating effects of the 2008 GFC on the relationship between the macroeconomic variables and stock market returns using the product-term model.

5.6 Limitations of the Study and Areas for Further Research

Although this study identified several areas in which existing literature on stock market returns and their determinants was inadequate, it did not address all of them. In particular, no studies have been conducted in Kenya regarding the relationship between stock returns of various sectors of the stock market and the macroeconomic variables using an ARFIMA framework.

Second, studies that examine how stock returns of the various sectors of the economy respond to changes in macroeconomic variables as a function of political or financial turbulences remain rare. Therefore, the analysis conducted in this study can be extended to this area.

Finally, the present study was limited to Kenya. Future studies could consider extending the current study by conducting a similar one within a group of emerging stock markets.

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APPENDIX A:SUMMARY OF EMPIRICAL LITERATURE

Table A1: Summary of Empirical Literature on Exchange Rate and Stock Market Returns

Author(s)	Objective	Countries covered	Variables considered	Framework	Key results	Period and data frequency
Aloy *et al*. (2010)	Relationship between stock indices and exchange rate	US and France	▪ CAC40 index, ▪ the Dow Jones index, ▪ the Euro/USD exchange	▪ Robinson (1994) test	▪ Variables are fractionally cointegrated	1999:01 - 2008:01 Daily
Buyuksalvarci(2010)	Impact of macroeconomic variables on stock market	Turkey	▪ Exchange rate, ▪ Stock returns. ▪ Consumer price index, ▪ interest rate, ▪ Productions index, ▪ Oil price.	▪ Multiple regression model	▪ Interest rate, oil price and foreign exchange rate have a negative impact on stock returns, ▪ Money supply has positive impact on ISE-100 Index returns, ▪ Inflation has no significant impact on stock return.	2003:01-2010:03 Monthly
Ahmad, Rehman and Raoof (2010)	Impact of exchange rate and interest rate on stock returns	Pakistan	▪ Short term interest rate, ▪ Exchange rate (Rs/US $), ▪ Stock market returns (KSE-100).	*Multiple regression models	▪ Change in interest rate has negative impact on stock returns, ▪ Significant positive impact of changes in exchange rate on the stock returns, ▪ Supports traditional/Flow-Oriented model for export-oriented firms.	1998 - 2009. Yearly
Kuwornu and Owusu-Nantwi (2011)	Effect of Macroeconomic variables on stock market returns	Ghana	▪ Exchange rate ▪ Ghanaian Stock Market Index returns (GSE All Share Index (ASI) ▪ 91 Treasury Bills rate ▪ Inflation rate ▪ Crude oil price.	▪ ADF test ▪ Multiple regression	▪ Variables not stationary in levels but stationary in first difference ▪ Presence of long equilibrium relationship between the exchange rate , interest rate, inflation rate and stock returns ▪ Positive effect of inflation rate on stock prices ▪ Negative effect of exchange rate and Treasury Bills rate on stock returns.	1992:1-2008:12 Monthly data
Zia and Rahman (2011)	Dynamic exchange rate-stock return relationship	Pakistan	▪ Karachi Stock Exchange (KSE) 100 ,and ▪ Exchange rate	▪ ADF test ▪ Johansen co-integration test,	▪ Stock index and exchange rate non-stationary in levels ▪ Stationary at first difference,	1995:01-2010:01. Monthly

			(Pak Rupee per USD).	▪ Granger causality test.	▪ No causality in either direction, ▪ No long run relationship between the variables (no co-movement in long run as per Johansen cointegration test).	
Kisaka and Mwasaru (2012)	Causal linkages between exchange rate and the NSE 20 Share Index.	Kenya	▪ NSE 20 Share Index return ,and ▪ Nominal KSH/USD exchange rate.	▪ ADF test ▪ Bivariate VAR Model, ▪ Johansen's cointegration test, ▪ Standard Granger-causality test.	▪ NSE 20 Share Index is I(1)) in levels, ▪ KSH/USD is I(1) in levels, ▪ Both are I(0) in first difference ▪ Exchange rate and NSE 20 Share Index are cointegrated, ▪ Exchange rate Granger causes NSE 20 Share Index.	1993:11-1999:05 Monthly
Jawaid and Anwar (2012)	Effects of interest rate, exchange rate and their volatilities on banking stock returns.	Pakistan	▪ Short term interest rate; ▪ Exchange rate, and ▪ Banking industry stock returns	▪ ADF test ▪ Johansen and Juselius (1990) cointegration test, ▪ Standard Granger causality test	▪ All variables are I(1) in levels. ▪ All variables are I(0) at first difference, ▪ Long run relationship exists between exchange rate and stock returns, ▪ Exchange rate has significant negative effect on stock returns in the long-run, ▪ Bidirectional causality between exchange rate and stock prices, and ▪ Unidirectional causality from interest rate to stock prices.	2004:01-2010:12 Monthly
Kumar and Puja (2012)	Impact of money supply, whole sale price, Treasury Bills rates and exchange rates on stock market index.	India	▪ Bombay Stock Exchange (BSE) index, ▪ Exchange rate, ▪ Treasury bills rate, and ▪ Money supply	▪ ADF, PP and KPSS unit root tests, ▪ Multivariate Johansen's co-integration, and ' ▪ VECM-based Granger causality test.	▪ Exchange rate is I(0) in levels, ▪ Stock index is (I(1) in levels, ▪ Others are I(1) in levels , ▪ Exchange rate has insignificant positive effect on the stock market Index, ▪ No short run causality between exchange rate and stock Index,	1994:04–2011:06 Monthly data

					▪ Long run causality from all variables to stock index, ▪ Unidirectional causality from stock price to inflation and from interest rates to stock prices.	
Cakan and Ejara(2013)	Relationship between exchange rates and stock prices.	Brazil, India, Indonesia, Korea, Mexico, Philippines, Poland, Russia, Singapore, Taiwan, Thailand and Turkey	▪ Respective stock market indices, and ▪ Exchange rates in local currency per USD.	▪ ADF test, ▪ Linear Granger causality test, ▪ Non-linear Granger causality tests.	▪ Both series are I(1) in levels but I(0) in the first differences, ▪ Stock indices linearly Granger cause exchange rates for Turkey, Thailand, Brazil, India, Indonesia, Philippines, Singapore and Poland, ▪ Exchange rates linearly Granger cause stock prices for Turkey, Thailand, Brazil, Indonesia, Korea, Mexico, Philippines, Poland, Singapore and Taiwan. ▪ Overlapping countries indicate bi-directional causalities. ▪ No support for a non-linear Granger causality from stock prices to exchange rates for Brazil, Poland and Taiwan. ▪ Nonlinear bi-directional Granger causality for India, Indonesia, Korea, Mexico, Philippines, Russia, Singapore, Thailand and Turkey ▪ Non-linear Granger causality from stock prices to exchange rate for Brazil and Poland, ▪ No significant causal relations in either direction for Taiwan, ▪ Most countries show significant bi-directional causalities.	May 1994 to April 2010 Daily

					▪ Support both portfolio balance and the goods market theories.	
Kimani and Mutuku (2013)	Impact of macroeconomic variables on stock returns	Kenya	▪ NSE 20 Share Index returns ▪ CPI ▪ Deposit rate ▪ Exchange rate	▪ ADF ▪ PP ▪ OLS	▪ NRt is I(1) in levels ▪ Ext is I(1) in levels ▪ Covariance nonstationary	
Nazarian *et al*., (2014)	Long Memory Analysis of stock returns	Iran	▪ Tehran Stock Exchange (TSE) Index returns.	▪ ADF, PP, KPSS ▪ Exact Maximum Likelihood (EML) ▪ Modified Profile Likelihood (MPL) ▪ Nonlinear Least Squares (NLS).	▪ Stock returns possess long memory.	25/03/2009-22/10/2011 Daily
Ouma and Muriu (2014)	Impact of macroeconomic variables on stock market returns.	Kenya	▪ NSE 20 Share Index, ▪ KSH/USD, ▪ Inflation rate, ▪ 91 Day Treasury Bills rates, and ▪ Gross Domestic Products.	▪ ADF ▪ CAPM ▪ APT ▪ Multiple regression	▪ Variables are I(0) in levels, ▪ Significant negative effect of exchange rate on stock Index, ▪ Positive relationship between inflation and stock Index, ▪ 91-Day T-bill rate has no impact the returns.	2003:01-2013:12 Monthly
Kirui, Wawire and Onono (2014)	Effect of macroeconomic variables on stock returns.	Kenya	▪ 91-day Treasury Bill Rate, ▪ KSH/USD, ▪ NSE 20 Share index return, and ▪ CPI.	▪ Regression, and ▪ Engle-Granger causality test	▪ Exchange rate has a significant negative effect on the NSE 20 Share Index returns, ▪ Inflation and the Treasury Bills rate have insignificant effect on stock returns.	2000-2012 Quarterly
Nataraja, Sunil and Nagaraja (2015).	Relationship between exchange rates and IT stock returns.	India	▪ CNX IT Nifty returns ,and ▪ Exchange rates.	▪ ADF test ▪ Correlation coefficient matrix, and ▪ Granger causality test.	▪ Exchange rate and CNX IT returns are I(0) at the level form , ▪ Negative correlation between CNX IT returns and Exchange rate, and ▪ Negative causality from exchange rates to IT stock returns negatively.	2011:01 - 2015:03 Daily
Balparda, Caparole and Gil-Alana, (2015).	Statistical properties of the NSE-20 Share Index	Kenya	▪ NSE 20 Share Index returns.	▪ ADF ▪ PP ▪ KPSS ▪ Robinson's (1994) test.	▪ NSE 20 Share Index is I(1) in levels, ▪ Integration of NSE 20 Share Index is above 1. ▪ Presence of long memory with no mean reversion	01/2001-12/2009. Daily

Table A2: Summary of Empirical Literature on Inflation Rate and Stock Market Returns

Author(s)	**Objective**	**Countries covered**	**Variables considered**	**Framework**	**Key results**	**Period and data frequency**
Alagidede and Panagotidis (2010)	Test long-run Fisher Effect	Egypt, Kenya, Nigeria, Morocco, South Africa, Tunisia	▪Stock market returns ,and ▪CPI	▪KPSS ▪PP ▪Parametric/ nonparametric cointegration test ▪Johansen's (1995) cointegration test.	▪All variables are I(1) in levels, ▪Stock prices and consumer prices are cointegrated, ▪Strong long-run FE for all markets, except Kenya and Tunisia where there is weaker FE, ▪Stock market provides a hedge against rising inflation.	▪1990:2-2006:12 ▪Monthly data
Anari and Kolari (2010)	Test FE	US	▪Stock returns, and ▪Inflation rate.	▪Simulation	▪Negative short run relationship because of the inflation premium, and ▪Negative long run effect.	▪1959-2008 ▪Annual
Anoruo and Gil-Alana (2011)	Examine behavior of stock prices using fractionally integrated techniques	(Kenya, Morocco, Tunisia, Nigeria, Egypt, Zimbabwe, Mauritius, Botswana, Namibia, and South Africa).	▪Absolute stock index returns	▪Whittle function in the frequency domain estimation, and ▪Robinson (1994) test	▪Long memory for Kenya, Morocco, Tunisia, Nigeria and Egypt ▪No mean reversion since $d \geq 1$,and ▪Positive fractional degrees of integration.	▪1993-2006 ▪Daily & monthly
Pal and Mittal (2011)	Examine the long-run relationship between stock returns and macroeconomic variables.	India	▪BSE Sensex Index return , ▪S&P CNX, Nifty, ▪364-day T-Bills rate, ▪Inflation rate ,and ▪Exchange rates.	▪Johansen's co-integration test and ▪Error Correction Mechanism (ECM)	▪Long-run relationship between inflation and returns, ▪No FE since inflation has a significant negative impact on both the BSE Sensex and the S&P CNX Nifty, ▪Interest rates have a significant positive impact on S&P CNX Nifty only, and ▪Foreign exchange rate has a significant negative impact only on BSE Sensex.	▪1995:1-2008:12 ▪Quarterly
Niazi *et al*.(2011)	Investigate inflation-return relationship	Pakistan	▪Inflation rate, and ▪Stock	▪Linear regression model	▪Negative linkage, and ▪Reject FE.	▪2005-2009 ▪Monthly

			returns.			data
Kim and Ryoo (2011)	Test FE	US	▪Stock return, and ▪Inflation rate.	▪A two-regime threshold vector error-correction model	▪Long run FE supported	▪1900-2009 ▪Monthly
Kiran (2011)	Examine existence of fractional cointegration.	France, Germany , Japan UK , US, Italy, and Canada	▪Oil prices ,and ▪Stock indices.	▪Robinson (1994) test	▪Error correction term fractionally integrated only for UK, Germany, US and Canada	▪1990-2009 ▪Monthly
Caparole and Gil-Alana (2011)	Determine if prices are I(1) or prices are I(d) with d < 1.	US	▪Stock market prices, ▪Long term interest rate (10-year Treasury Bonds), and ▪Consumer price index.	▪Robinson (1994), ▪Whittle estimator, and ▪Robinson (1995a).	▪Both individual series are nonstationary with integration orders equal to or higher than 1, ▪No mean reversion, ▪Bivariate fractional cointegration with cointegrating residuals having integers between [0.5,1]	▪1871:01-2010:06 ▪Monthly
Frimpong (2011)	Relationship between inflation and stock returns	Ghana	▪Databank stock Price Index returns, ▪3-month T-Bills rate, ▪cedi/dollar exchange rate, and ▪Change in CPI.	▪Granger causality test	▪Unidirectional causality from inflation to stock returns, and ▪Unidirectional causality from other macro-determinants to stock returns.	▪1990:11-2007:12 ▪Monthly
Aye *et al.* (2012)	Examine of long memory in daily stock market returns.	Brazil, Russia, India, China, and South Africa (BRICS).	▪Stock index returns	▪Whittle estimator (WHI) , ▪GPH estimator, ▪Rescaled range estimator (RR), ▪Approximate maximum likelihood estimator (AML).	▪ Size of d for Russia, India and China is greater than 0.5, ▪Presence of long memory.	▪1995:9-2012:7 ▪Daily
Ochieng and Adhiambo (2012)	Investigate the relationship between inflation rate and NSE All Share index (NASI).	Kenya	▪NASI , and ▪Inflation rate	▪Autoregressive distributed lag (ARDL) bound test.	▪NASI is positively affected by inflation rate, ▪Support long-run weak FE.	▪2008:3-2012:3 ▪Monthly
Dasgupta (2012)	Determine stock returns-macroeconomic variables relationship.	India	▪Wholesale price index, and ▪BSE Index return.	▪Johansen's (1995) test	▪No short run relationship between inflation rate and stock returns, and ▪Negative relationship between stock returns and inflation rate in long run.	▪2007:04-2012:03 ▪Monthly data

Kimani and Mutuku (2013)	Impact of inflation, Central Depository System (CDS), and other macroeconomic variables on the Nairobi stock market.	Kenya	▪NSE 20-share index returns, ▪CPI, ▪Central Depository System, ▪Deposit rate, and ▪Net effective exchange rate.	▪ADF test, ▪Multiple regression (no structural breaks), ▪Johansen-Juselius VAR based cointegration, ▪ECM Granger causality test.	▪Variables are I(1) in levels, ▪Cointegrating relationships present, ▪Negative relationship exists between inflation and stock market performance, ▪A significant negative relationship between the overall stock market performance, deposit rate and net effective exchange rate.	▪1998:12-2010:06 ▪Quarterly data
Razzaque and Olga (2013)	Test FE	Kazakhstan, Russia and Ukraine	▪Stock returns, ▪Current and expected inflation rate.	▪OLS regression, and ▪Cochrane-Orcutt regression method.	▪Weak FE for Russia and Ukraine ▪ Strong FE for Kazakhstan.	▪2001:1-2012:10. ▪Monthly data
Issahaku *et al.*(2013)	Determine causality between macroeconomic variables and stock returns.	Ghana	▪Ghana Stock Exchange (GSE) Index returns, ▪CPI, ▪91-Day Treasury Bills rate, and ▪Exchange rate.	▪ADF,PP,KPSS tests ▪Engle-Granger cointegration test ▪Granger Causality test, ▪IRF, Forecast Error Variance Decomposition (FEVD).	▪Inflation has significant negative effect on stock returns in short run, ▪Unidirectional positive long run causality from inflation to stock returns, and ▪Past values of inflation can be used to predict current returns.	▪1995:01-2010:12 ▪Monthly
Amaefula and Asare (2013)	Test time varying correlation of stock returns relative to exchange rate and inflation rate	Nigeria	▪All Share Index prices of the NSE market, ▪ Exchange rate of naira per unit of one USD, and ▪CPI.	▪Diagonal BEKK (1, 1) model, ▪Multiple regression model.	▪Correlation of stock market returns relative to exchange rate and inflation rate constant over time, ▪The global financial crises have significant negative effect on the correlation between stock returns and exchange rate.	▪1985:01-2010:12. ▪Monthly
Kirui, Wawire and Onono (2014)	Effect of macroeconomic variables on stock returns	Kenya	▪91-day Treasury Bills rate, ▪CPI, ▪NSE 20 Share Index returns, and ▪ KSH/USD.	▪Multiple regression, ▪Engle-Granger two step method.	▪Inflation and the Treasury Bills rate have insignificant effect on stock returns, and ▪ Exchange rate depreciation	▪2000-2012 ▪Quarterly

					causes a decline in stock returns.	
Azar (2015)	Tests the relation between the equity premium and inflation.	US	▪Total Share prices for All shares for the US stock market index, ▪CPI for all items.	▪Simple OLS, ▪OLS with heteroscedasticity and autocorrelation consistent (HAC) robust standard errors (Newey.	▪Strong evidence of a negative relation between inflation and the equity premium , ▪All estimated slopes on the inflation- significantly different from -1.	▪1957:02-2014:09 ▪ Monthly
Ada and Osahon(2015)	To examine the Reverse Causality hypothesis	Nigeria	▪Government stock (GDS), ▪Inflation rate ▪All share index (ASI), and ▪Market Capitalization (MCAP).	▪Johansen (1988) and Johansen and Juselius (1990) cointegration test ▪VECM ▪Forecast Error Variance Decomposition (FEVD) and ▪Impulse Response Functions (IRF).	▪Causality from government stocks to inflation, ▪Support of the reverse causality hypothesis, and ▪Require restrictive monetary policy to reduce stock prices and inflation.	▪1980 – 2011 ▪Annual data
Demirhan, B.(2016	Testing Fisher Effect	Turkey	▪Central Bank rate, ▪Expected inflation rate	▪FMOLS, ▪DOLS, ▪CCR, ▪parsimonious error correction model	▪Strong form of Fisher Hypothesis in the long-run	▪2003:01-2014:08

Table A3: Summary of Empirical Literature on Interest Rate and Stock Market Returns

Author(s)	**Objective**	**Countries covered**	**Variables considered**	**Framework**	**Key results**	**Period and data frequency**
Ahmad, Rehman and Raoof (2010)	Relationship between stock return, interest rates and exchange rates	Pakistan	▪ KSE-100 stock return, ▪ Short term interest rates, and ▪ Exchange rate (Rs/USD).	▪ Multiple regression	▪ Change in interest rate has a significant negative impact, ▪ Significant positive impact of changes in exchange rate, ▪ Support Flow-Oriented model for export-dependent firms.	▪ 1998-2009. ▪ Yearly
Anoruo and Braha (2010)	Examine the long memory properties of REIT returns	US	▪ Equity, ▪ Mortgage, and ▪ Real estate investment trusts (REIT) returns.	▪ KPSS test ▪ GPH semi-parametric, and ▪ Wavelet estimators.	▪ Presence of long memory with anti-persistence, ▪ Suggests that the dynamics of the return series contain predictable components (inefficiency). ▪ Investors can devise profitable strategies by using historical data	▪ 1972:01-2008:06
Buyuksalvarci (2010)	Effects of macroeconomic variables on stock returns.	Turkey	▪ Istanbul Stock Exchange (ISE-100)Index, ▪ Consumer price index, ▪ Money market interest rate, and ▪ Foreign exchange rate.	▪ Multiple regression model	▪ Interest rate, and foreign exchange rate have a negative effect on ISE-100 Index returns, ▪ Money supply positively influences ISE-100 Index returns, ▪ Inflation rate does affect the ISE-100 Index returns.	▪ 2003:1-2010:3 ▪ Monthly
Caporale and Gil-Alana (2010).	Interest rate dynamics.	Kenya	▪ Deposit, ▪ Savings, ▪ lending rates, and the ▪ 91-day Treasury Bills rate.	▪ ADF ▪ Whittle estimator, ▪ Robinson (1995) test.	▪ All series have orders of integration equal to or higher than 1. ▪ No mean reversion in the individual series.	▪ 1991:07-2009:03 ▪ Monthly
Kuwornu and Owusu-Nantwi (2011)	Relationship between macroeconomic variables and stock market returns.	Ghana	▪ 91 day Treasury Bills rate, ▪ Exchange rate, ▪ Consumer price index (CPI) ,and	▪ ADF test ▪ Multiple regression model.	▪ Treasury Bills rate and exchange rate have no significant effect on stock returns, ▪ CPI has significant	▪ 1992:1-2008:12 ▪ Monthly.

			▪ Stock market returns.		positive effect.	
Pal and Mittal (2011)	Relation between macroeconomic variables and stock market performance	India	▪ BSE Sensex Index return , ▪ S&P CNX Nifty, ▪ 364-day T-Bills rates, ▪ Inflation rate, and ▪ Exchange rates.	▪ Johansen's co-integration test, and ▪ ECM	▪ Long-run relationship exists between inflation and returns, ▪ Inflation has a significant negative impact on both the BSE Sensex and the S&P CNX Nifty. ▪ Interest rates have a significant positive impact on S&P CNX Nifty only, ▪ Foreign exchange rate has a significant negative impact only on BSE Sensex.	▪ 1995:1-2008:12 ▪ Quarterly
Noor, Rubi and Catherine (2011).	Relation between exchange rates, interest rates and stock market performances.	Malaysia, Thailand and Indonesia	▪ Kuala Lumpur Composite Index (KLCI) return, ▪ Stock Exchange of Thailand (SET) Composite Index return, ▪ Jakarta Composite Index (JCI) return, ▪ 3- month interbank offer rates ,and ▪ Foreign exchange rates of local currency per USD.	▪ Univariate, ▪ multivariate regression analyses	▪ Significant negative relationship between interest rates and stock returns for Indonesia and Malaysia , ▪ Positive relationship between interest rate, exchange rate and stock market returns for Thailand, ▪ Exchange rate has significant negative effect on stock returns for Malaysia and Indonesia.	▪ 1997:1-2009:12 ▪ Weekly
Ado and Sunzuoye (2013)	Joint impact of interest rate and Treasury Bills rate on stock market returns.	Ghana	▪ Lending rates, ▪ 3- month Treasury Bills rate, and ▪ Ghana stock Exchange (GSE) All-share Index returns.	▪ Cointegration Model, ▪ VECM, ▪ Multiple Regression Analysis	▪ Presence of a joint long-run relationship between interest rate, Treasury Bills rate and stock returns, ▪ OLS results show that Treasury Bills rate and lending interest rate individually have insignificant negative relationship with stock returns, ▪ VECM has negative and significant coefficient, implying that in	▪ 1995:1-2011:12 ▪ Monthly

					the absence of any change in either of the interest rates, GSE Index will increase to correct any deviation from the equilibrium relation. ▪ Treasury Bills rate and lending rate have no impact on stock return in the short run.	
Akbar, Ali and Khan (2012)	Relationship between stock prices and macroeconomic variables	Pakistan	▪ KSE -100 index, ▪ 6-month Treasury Bills rate, ▪ Exchange rate, and ▪ CPI.	▪ Johansen and Juselius (1990) cointegration test, ▪ VECM.	▪ Co-movement of stock prices, T-Bills rate, exchange rate and inflation in the long run , ▪ VECM results show a positive relationship between T-Bills rate and stock prices, ▪ VECM finds a negative relationship between stock prices and inflation, ▪ No significant relation between exchange rate and stock prices.	▪ 1994:04-2011:06 ▪ Monthly
Chirchir (2014)	Effect of interest rate on NSE 20 Share index	Kenya	▪ Weighted average bank lending rate ,and ▪ NSE 20 share index	▪ VAR model, ▪ Toda and Yamamoto (1995) causality test	▪ No significant causal relationship between interest rate and the Share Index, ▪ Negative but nonsignificant bidirectional causality between interest rates and the Share Index	▪ 2002:10-2012:09. ▪ Monthly
Jawaid and Anwar (2012	Effects of interest rates , exchange rates and their volatilities on stock prices	Pakistan	▪ Exchange rate, ▪ Short term interest rate, ▪ Volatilities of exchange rate and short term interest rate and ▪ Banking sector stock prices.	▪ Johansen's Cointegration, ▪ ECM	▪ Exchange rate and short term interest rate move together with stock prices in the long run, ▪ Long run relationship between volatilities of exchange rate and short-term interest rate with stock prices, ▪ Significant negative short-run relationship between both	▪ 2004:1-2010:12 ▪ Monthly

					exchange rates and short term interest rates with stock prices ▪ Significant positive relationship between both volatility of exchange rate and volatility of short term interest rate with stock prices ▪ Bidirectional causality between exchange rate and stock prices, and ▪ Uni-directional causality from short-term interest rates to stock prices.	
Kumar and Puja (2012)	Relationship between BSE Sensex Index and macroeconomic variables.	India	▪ BSE Sensex Index, ▪ 3-month Treasury Bills rate, ▪ Wholesale price index, and ▪ Exchange rate.	▪ Johansen's co-integration, and ▪ VECM	▪ Long-run relationship between BSE Index and all the macroeconomic variables, ▪ Stock prices are negatively related to inflation rate, ▪ Treasury Bills rate and exchange rate are insignificant determinants of stock prices, ▪ Macroeconomic variables cause stock prices in long-run but not in the short-run, ▪ Unidirectional long run causality from interest rates to stock prices and from stock prices to inflation rate.	▪ 1994:04–2011:06 ▪ Monthly
Ouma and Muriu (2014)	Impact of macroeconomic variables on stock returns	Kenya	▪ Money supply (M2), ▪ Exchange rate, ▪ Inflation (CPI), ▪ 91-T B rates , ▪ NSE 20 Share Index returns.	▪ Arbitrage Pricing Theory (APT) and ▪ Capital Asset Pricing Model (CAPM) ▪ Multiple regressions.	▪ Exchange rates has a negative impact on stock returns, ▪ Interest rates and inflation rate are not important in determining long rung run returns of the NSE 20 Share Index.	▪ 2003:01-2013:12 ▪ Monthly
Erita(2014)	Impact of interest rate on stock market returns	Namibia	▪ Namibian Stock Exchange's overall index, ▪ Namibia dollar per USD, and ▪ Treasury Bills	▪ ADF/KPSS ▪ Johansen procedure, ▪ VECM	▪ All variables are I(1) in levels, ▪ Stock market return is negatively related to interest rate, ▪ Long-run relationship	▪ 1996-2012 ▪ monthly data

			rate.		between stock market returns, interest rate, and exchange rate, ▪ Bi-directional causality between stock market returns and interest, and ▪ Exchange rate depreciation causes a decrease in stock returns.	
Gohar, Zaman, and Baloch (2014)	Causal relationship between interest rate and stock prices.	Pakistan	▪ 6-months T-Bills rate ▪ Karachi Stock Exchange (KSE 100 index returns	▪ ADF test ▪ Engel Granger test ,and ▪ ECM-causality	▪ Both variables are I(1) in levels, ▪ Significant short run and long run relationship between the interest rate ,and ▪ No causality in either direction.	▪ 1994 to 2014 ▪ Monthly ▪
Kganyago and Gumbo (2015)	Long run relationship between interest rates and stock market returns.	Zimbabwe	▪ Stock market returns ▪ Inflation rate, ▪ Money supply ,and ▪ Money market interest rates.	▪ ADF test ▪ Multiple regression ▪ Dummy for political risk, ▪ Johansen cointegration tests ▪ VECM	▪ All variables I(0) in levels, ▪ Significant inverse causal relationship between money market interest and stock market returns, ▪ Negative long run causal relationship from interest rate to stock returns, ▪ Short run causality from stock market returns to interest rates, ▪ Political stability improves stock performance.	▪ 2009:04-2013:12. ▪ Monthly
Amarasinghe (2015**)**	Dynamic relationship between interest rate and stock prices	Sri Lanka	▪ All Share Price Index (ASPI), ▪ Not clear on specific measure of interest rate is used.	▪ ADF test, ▪ OLS regression ▪ Standard Granger causality test	▪ stock returns are I(0) in level, interest rate is I(1) in levels, ▪ Significant negative effect of interest rate on stock prices, and ▪ Interest rate Granger cause stock prices but not vice versa.	▪ 2007:01-2013:12. ▪ Monthly
Caparole and Gil-Alana (2016)	Fractional integration and cointegration in interest rates	(Germany, Austria, Belgium, Ireland, Greece, Spain, Italy, Cyprus, Luxembourg, Malta, Netherlands, Austria, Portugal, Slovakia,	▪ Long-term interest rates on government securities with 10-year maturity.	▪ Robinson (1994)	▪ Mixture of nonstationarity and mean reversion, ▪ Various rates appear to be fractionally cointegrated, ▪ German rates are not linked to any others, ▪ Both policy makers and	▪ 2001:01-2011:10. ▪ Monthly

		Finland, in Czech korunas for the Czech Republic, Denmark, Latvia, Lithuania, Hungary, Poland, Sweden, and UK).			market participants to seriously consider the results when making decisions.	

APPENDIX B: PARAMETER ESTIMATES

Table B1: Summary of ARFIMA long memory (differencing parameter) estimates using EML

Part I: Selected model for estimating the d parameter of the NSE 20 Share Index returns											
	AR coefficients			MA coefficients					JB test	Port. test	ARCH 1-1 test
ARMA (p,q)	1	2	3	1	2	3	d	AIC			
(2,2)	1.018 (65.1)	-0.973 (-62.9)		-1.089 (-79.1)	1.000 (51.7)		0.2302 (4.37)	6.606	125.32 [0.000]**	11.45 [0.405]	37.384 [0.000]**
Part II: Selected model for estimating the d parameter of the Exchange Rate											
ARMA (p,q)	AR coefficients			MA coefficients					JB test	Port. test	ARCH 1-1 test
	1	2	3	1	2	3	d	AIC			
(3,2)	1.573 (30.8)	-1.592 (-35.00)	0.780 (17.9)	-0.703 (-19.1)	0.957 (30.4)		0.455 (7.92)	4.188	164.12 [0.000]**	25.625 [0.694]	30.204 [0.000]**
Part III: Selected model for estimating the d parameter of Month-on-Month Inflation rate											
ARMA(p, q)	AR coefficients			MA coefficients					JB test	Port. test	ARCH 1-1 test
	1	2	3	1	2	3	d	AIC			
(3,3)	-0.411 (-5.67)	0.349 (3.76)	0.824 (12.6)	1.427 (8.84)	1.045 (4.69)	0.032 (0.200)	-0.590 (-3.25)	3.248	55.052 [0.0001]**	13.677 [0.134]	0.005 [0.941]
Part IV: Selected model for estimating d parameter of the Year-on-Year Inflation rate											
	AR coefficients			MA coefficients					JB test	Port. test	ARCH 1-1 test
ARMA(p,q)	1	2	3	1	2	3	d	AIC			
(3,3)				0.684 (13.3)	0.695 (9.00)	0.592 (7.64)	0.494 (55.5)	4.524	185.31 [0.000]**	101.45 [0.031]	17.741 [0.000]**
Part V: Selected model for estimating d parameter for the 3-Month Treasury Bills Rate											
	AR coefficients			MA coefficients					JB test	Port. test	ARCH 1-1 test
ARMA(p,q)	1	2	3	1	2	3	d	AIC			
(1,3)	0.738 (6.79)			0.709 (8.09)	0.254 (2.42)	0.2267 (2.96)	0.314 (2.29)	4.463	533.38 [0.000]**	9.3193 [0.593]	36.917 [0.000]**
Part VI: Selected model for estimating d parameter of Lending Rate											
	AR coefficients			MA coefficients					JB test	Port. test	ARCH 1-1 test
ARMA(p,q)	1	2	3	1	2	3	d	AIC			
(3,2)	-0.413 (-10.0)	0.249 (4.40)	0.907 (25.3)	1.371 (25.4)	0.954 (27.2)		0.404 (5.74)	1.908	188.39 [0.000]**	17.468 [0.065]	1.8515 [0.175]
Part VII: Selected model for estimating d parameter of cointegrating residual for stock market returns-Exchange Rate											
	AR coefficients			MA coefficients					JB test	Port. test	ARCH 1-1 test
ARMA(p,q)	1	2	3	1	2	3	d	AIC			
(2,2)	1.018 (65.1)	-0.973 (-62.9)		-1.089 (-79.5)	1.000 (52.2)		0.229 (4.33)	6.606	126.33 [0.000]**	11.320 [0.417]	37.734 [0.000]**
Part VIII: Selected model for estimating d parameter of cointegrating residual for stock market returns-Month-on-Month Inflation Rate											
ARMA(p,q)	AR coefficients			MA coefficients					JB test	Port. test	ARCH 1-1 test

(2,2)	1	2	3	1	2	3	d	AIC			
	1.022 (68.4)	-0.976 (-65.9)		-1.089 (-74.7)	1.000 (48.1)		0.209 (3.92)	6.609	120.26 [0.000]**	11.649 [0.391]	40.606 [0.000]**

Notes: P-values of the significance of the single parameter estimates are provided in square brackets and t-values are in parentheses.

Table B2: Summary of ARFIMA long memory (differencing parameter) estimates using EML

Part IX: Selected model for estimating d parameter of cointegrating residual for stock market returns-Year-on-Year Inflation Rate											
	AR coefficients			MA coefficients					JB test	Port. test	ARCH 1-1 test
ARMA(p,q)	1	2	3	1	2	3	d	AIC			
(2,2)	-0.913 (-15.2)	-0.824 (-13.1)		1.069 (24.3)	0.925 (24.1)		0.067 (1.22)	6.567	102.55 [0.000]**	18.261 [0.076]	31.140 [0.000]**
Part X: Selected model for estimating d parameter of cointegrating residual for stock market returns-3 Month Treasury Bills Rate											
	AR coefficients			MA coefficients					JB test	Port. test	ARCH 1-1 test
ARMA(p,q)	1	2	3	1	2	3	d	AIC			
(2,2)	1.019 (65.4)	-0.973 (-62.7)		-1.089 (-79.9)	1.000 (52.6)		0.213 (3.98)	6.602	125.06 [0.0000]**	11.65 [0.391]	40.369 [0.000]**
Part XI: Selected model for estimating d parameter of cointegrating residual for stock market returns-Lending Rate											
	AR coefficients			MA coefficients					JB test	Port. Test	ARCH 1-1 test
ARMA(p,q)	1	2	3	1	2	3	d	AIC			
(2,2)	1.017 (65.2)	-0.974 (-63.3)		-1.089 (-79.4)	1.000 (51.5)		0.229 (4.36)	6.604	124.22 [0.000]**	11.343 [0.415]	36.567 [0.000]**

Note: P-values of the significance of the single parameter estimates are provided in square brackets and t-values are in parentheses

Table B3: Characteristics of the Memory Parameter

Memory/Shock duration	**d value**	**Mean-reverting**	**Variance of time series**	**ACF**
Short memory/short-lived	$d = 0$	Yes	Finite (Covariance stationary)	Exponential
Long memory/Long lived	$0 < \|d\| < 0.5$	Yes	Finite (Covariance stationary)	Hyperbolic
Long memory/Long-lived	$0.5 \leq \|d\| < 1$	Yes	Infinite (Covariance non-stationary)	Hyperbolic
Infinite memory	$\|d\| \geq 1$	No	Infinite (Covariance non-stationary)	Linear

Source: Ganger (1980), Granger and Joyeux (1980), Hosking (1981), Tkacz (2001)

Table B4: Granger Causality for Stock Market Returns and Exchange Rate

PANEL A: Results from Regressing Stock Market Returns on Exchange Rate						
	First Differenced Model			**Fractionally Differenced Model**		
	Coefficient	**Std. Error**	**t-ratio**	**Coefficient**	**Std. Error**	**t-ratio**
Intercept	−0.011	0.379	−0.029	−1.022	0.892	−1.146
dEXt-1	0.012	0.221	0.053	0.026	0.191	0.138
dEXt-2	−0.295	0.356	−0.827	−0.264	0.381	−0.693
dEXt-3	0.179	0.297	0.603	0.399	0.246	1.621
Rnrext-1	−0.788	0.153	−5.164***	0.082	2.438	0.034
dNRt-1	0.048	0.131	0.366	−0.058	2.455	−0.024
dNRt-2	0.007	0.071	0.095	−0.141	0.098	−1.442
PANEL B: Results from Regressing Exchange Rate on Stock Market Returns						
	First Differenced Model			**Fractionally Differenced Model**		
	Coefficient	**Std. Error**	**t-ratio**	**Coefficient**	**Std. Error**	**t-ratio**
Intercept	0.114	0.099	1.148	0.682	0.265	2.573**
Rnrex-1	−0.027	0.019	−1.425	−1.547	1.243	−1.244
dNRt-1	0.006	0.023	0.285	1.532	1.238	1.238
dNRt-2	0.011	0.022	0.481	0.004	0.016	0.263
dEXt-1	0.339	0.081	4.196***	0.871	0.074	11.829***
dEXt-2	−0.075	0.075	−0.992	−0.177	0.083	−2.144**
dEXt-3	0.059	0.051	1.159	0.168	0.051	3.257***

Notes: Heteroscedasticity and autocorrelation consistent (HAC) standard errors were used to obtain more efficient parameter estimates. *** 1 percent significance, ** 5 percent significance. NRt is log difference of the NSE 20 Share Index, EXt is KSH/USD exchange rate.

Table B5: Granger Causality for Stock Market Returns and Inflation Rate

PANEL C: Results from Regressing Stock Market Returns on Short Term Inflation rate (MOM)						
	First Differenced Model			**Fractionally Differenced Model**		
	Coefficient	**Std. Error**	**t-ratio**	**Coefficient**	**Std. Error**	**t-ratio**
Intercept	−0.034	0.393	−0.086	0.125	0.386	0.325
dMOMt-1	−0.326	0.359	−0.908	0.230633	0.565	0.408
dMOMt-2	−0.262	0.373	−0.702	0.148	0.406	0.364
dMOMt-3	−0.97	0.447	−2.173**	−0.757	0.456	−1.659*
Rnrmomt-1	−0.801	0.142	−5.637***	0.318	0.679	0.467
dNRt-1	0.062	0.125	0.501	−0.285	0.710	−0.402
dNRt-2	0.013	0.066	0.192	−0.04	0.161	−0.275
PANEL D: Results from Regressing Short Term Inflation rate (MOM) on Stock Market Returns						
	First Differenced Model			**Fractionally Differenced Model**		
	Coefficient	**Std. Error**	**t-ratio**	**Coefficient**	**Std. Error**	**t-ratio**
Intercept	−0.032	0.064	−0.505	0.019	0.062	0.301
dNRt-1	0.001	0.011	0.041	−0.143	0.084	−1.691*
dNRt-2	0.019	0.012	1.622	0.062	0.029	2.106**
Rnrmomt-1	0.011	0.013	0.868	0.151	0.084	1.780*
dMOMt-1	−0.409	0.082	−5.012***	−0.044	0.093	−0.469
dMOMt-2	−0.304	0.059	−5.177***	−0.069	0.104	−0.664
dMOMt-3	−0.204	0.077	−2.661***	−0.094	0.067	−1.392
PANEL E: Results from Regressing Stock Market Returns on Long Term Inflation Rate (YOY)						
	First Differenced Model			**Fractionally Differenced Model**		
	Coefficient	**Std. Error**	**t-ratio**	**Coefficient**	**Std. Error**	**t-ratio**
Intercept	0.035	0.403	0.087	−0.054	0.349	−0.155
dYOYt-1	0.195	0.198	0.984	0.277	0.110	2.521**
Rnryoyt-1	−0.916	0.153	−5.994***	−0.0003	0.0001	−1.965*
dNRt-1	0.124	0.162	0.763	0.014	0.116	0.116
dNRt-2	0.055	0.089	0.616	−0.164	0.099	−1.661*
PANEL F: Results from Regressing Long Term Inflation Rate (YOY) on Stock Market Returns						
	First Differenced Model			**Fractionally Differenced Model**		
	Coefficient	**Std. Error**	**t-ratio**	**Coefficient**	**Std. Error**	**t-ratio**
Intercept	−0.054	0.133	−0.408	0.02	0.119	0.168
dYOYt-1	0.329	0.106	3.099***	0.788	0.064	12.291***
dNRt-1	0.003	0.029	0.118	0.003	0.021	0.153
dNRt-2	0.036	0.023	1.557	0.037	0.021	1.782*
Rnryoyt-1	−0.005	0.039	−0.126	6.15e-06	3.76e-05	0.163

Notes: Heteroscedasticity and autocorrelation consistent (HAC) standard errors were used to obtain more efficient parameter estimates. *** 1 percent significance, ** 5 percent significance. NRt is log difference of the NSE 20 Share Index, MOMt is month-on-month inflation rate, and YOY is the year-on-year inflation rate.

Table B6: Granger Causality for Stock Market Returns and Interest Rate

PANEL G: Results from Regressing Stock Market Returns on Short Term Interest Rate (TB-3)						
	First Differenced Model			**Fractionally Differenced Model**		
	Coefficient	**Std. Error**	**t-ratio**	**Coefficient**	**Std. Error**	**t-ratio**
Intercept	−0.022	0.403	−0.054	0.419	0.649	0.645
dTB3t-1	−0.297	0.286	−1.042	−0.502	0.509	−0.985
Rnrtb3t-1	−0.854	0.141	−6.054***	−7.546	6.554	−1.151
dNRt-1	0.079	0.14	0.566	7.552	6.598	1.145
dNRt-2	0.023	0.071	0.323	−0.011	0.127	−0.085
PANEL H: Results from Regressing Short Term Interest (TB-3) on Stock Market Returns						
	First Differenced Model			**Fractionally Differenced Model**		
	Coefficient	**Std. Error**	**t-ratio**	**Coefficient**	**Std. Error**	**t-ratio**
Intercept	−0.043	0.132	−0.328	−0.529	0.310	−1.706*
dNRt-1	−0.029	0.029	−0.996	−8.898	4.055	−2.195**
dNRt-2	−0.022	0.013	−1.624	−0.153	0.064	−2.393**
Rnrtb3t-1	0.026	0.039	0.649	8.896	4.068	2.187**
dTB3t-1	0.652	0.119	5.461***	1.633	0.353	4.621***
PANEL I: Results from Regressing Stock Market Returns on Long Term Interest Rate (Lr)						
	First Differenced Model			**Fractionally Differenced Model**		
	Coefficient	**Std. Error**	**t-ratio**	**Coefficient**	**Std. Error**	**t-ratio**
Intercept	−0.021	0.408	−0.051	−0.806	0.526	−1.532
dLrt-1	−0.065	0.908	−0.072	0.523	0.902	0.579
dLrt-2	0.809	0.621	1.305	0.892	0.873	1.023
dLrt-3	1.015	0.926	1.097	−0.199	0.404	−0.495
Rnrlrt-1	−0.812	0.139	−5.847***	13.026	4.457	2.923***
dNRt-1	0.052	0.137	0.382	−13.012	4.449	−2.924***
dNRt-2	0.007	0.072	0.103	−0.175	0.096	−1.819**
PANEL J: Results from Regressing Long Term Interest (Lr) on Stock Market Returns						
	First Differenced Model			**Fractionally Differenced Model**		
	Coefficient	**Std. Error**	**t-ratio**	**Coefficient**	**Std. Error**	**t-ratio**
Intercept	−0.003	0.038	−0.0894	0.048	0.045	1.078
Rnrlrt-1	−0.012	0.009	−1.4417	1.294	0.704	1.839*
dNRt-1	0.009	0.008	1.0883	−1.298	0.704	−1.843*
dNRt-2	0.005	0.006	0.8383	−0.009	0.006	−1.529
dLrt-1	0.264	0.089	2.967**	0.909	0.098	9.274***
dLrt-2	0.128	0.066	1.948*	0.118	0.102	1.1583
dLrt-3	0.164	0.051	3.234**	0.012	0.041	0.302

Notes: Heteroscedasticity and autocorrelation consistent (HAC) standard errors were used to obtain more efficient parameter estimates. *** 1 percent significance, ** 5 percent significance. NRt is log difference of the NSE 20 Share Index, TB3t is the 3-month Treasury Bills rate and Lrt is lending rate.

Table B7: Estimated Long Run Coefficients using the ARDL Cointegration Test I

Dependent variable: Stock market returns (NRt)			
Regressors are exchange rate, month-on-month inflation rate and 3-month T-bill rate			
Regressors	**Coefficient**	**S.E**	**t-ratio**
Intercept	-2.789	2.321	-1.202
NR_{t-1}	-0.894	0.129	-6.893***
EX_{t-1}	0.023	0.027	0.832
MOM_{t-1}	1.1563	0.5618	2.058**
$TB3_{t-1}$	0.050	0.044	1.139
ΔNR_{t-1}	0.114	0.134	0.855
ΔNR_{t-2}	0.037	0.065	0.561
ΔEX_{t}	-0.173	0.258	-0.671
ΔEX_{t-1}	0.085	0.239	0.356
ΔEX_{t-2}	-0.317	0.363	-0.871
ΔEX_{t-3}	-0.003	0.264	-0.013
ΔMOM_{t}	0.3207	0.418	0.768
ΔMOM_{t-1}	-0.462	0.422	-1.095
ΔMOM_{t-2}	-0.386	0.453	-0.853
ΔMOM_{t-3}	-0.951	0.438	-2.170**
$\Delta TB3_{t}$	-0.186	0.351	-0.529
$\Delta TB3_{t-1}$	-0.173	0.203	-0.855
R-squared	0.434	Adjusted R-squared	0.398
$F\left(NR_t / EX_t, MOM_t, TB3_t\right)$ F(4, 255)	13.059	P-value(F)	1.088e-009
Diagnostic Tests			
Autocorrelation	$\chi_{auto}^{2}(12) = 20.680[0.056]$		
RESET	$F_{RESET} = 3.641[0.028]$		
Normality	$\chi_{Norm}^{2}(2) = 57.399[0.000]$		
Heteroscedasticity	$\chi_{Het}^{2}(16) = 88.396[0.000]$		
Coefficient Stability Tests			
CUSUM	Plot goes slightly beyond the 5% significance bounds		
CUSUMSQ	Plot goes slightly beyond the 5% significance bounds		

Notes: p-values are in parentheses. *** 1 percent significance, ** 5 percent significance. NRt is log difference of the NSE 20 Share Index, EXt is KSH/USD exchange rate, MOMt is month-on-month inflation rate, TB3t is the 3-month Treasury Bills rate.

Table B8: Estimated Long Run Coefficients using the ARDL Cointegration Test II

Dependent variable: Stock market returns (NRt)			
Regressors are exchange rate, month-on-month inflation rate and Lending rate			
Regressors	**Coefficient**	**S.E**	**t-ratio**
Intercept	0.698	4.350	0.160
NR_{t-1}	-0.859	0.129	-6.668***
EX_{t-1}	-0.009	0.0369	-0.245
MOM_{t-1}	1.105	0.42664	2.590**
Lr_{t-1}	-0.019	0.093	-0.213
ΔNR_{t-1}	0.098	0.132	0.737
ΔNR_{t-2}	0.029	0.066	0.433
ΔEX_{t}	-0.169	0.253	-0.670
ΔEX_{t-1}	0.027	0.198	0.135
ΔEX_{t-2}	-0.320	0.319	-1.002
ΔEX_{t-3}	-0.042	0.237	-0.175
ΔMOM_{t}	0.328	0.398	0.823
ΔMOM_{t-1}	-0.495	0.409	-1.214
ΔMOM_{t-2}	-0.448	0.415	-1.080
ΔMOM_{t-3}	-1.078	0.448	-2.407**
ΔLr_{t}	0.016	0.849	0.018
ΔLr_{t-1}	-0.248	0.853	-0.291
ΔLr_{t-2}	0.737	0.696	1.059
ΔLr_{t-3}	0.711	0.806	0.882
R-squared	0.426	Adj. R-squared	0.385
$F\left(NR_t / EX_t, MOM_t, \mathrm{Lr}_t\right)$ F(4, 255)	13.217	P-value(F)	8.589e-010
Diagnostic Tests			
Autocorrelation	$\chi_{auto}^{2}(12)=17.232[0.141]$		
RESET	$F_{RESET}=2.602[0.076]$		
Normality	$\chi_{Norm}^{2}(2)=62.402[0.000]$		
Heteroscedasticity	$\chi_{Het}^{2}(18)=115.363[0.000]$		
Coefficient Stability Tests			
CUSUM	Plot does not go beyond the 5% significance bounds		
CUSUMSQ	Plot goes beyond the 5% significance bounds		

Notes: p-values are in parentheses. *** 1 percent significance, ** 5 percent significance. NR is log difference of the NSE 20 Share Index, EX is KSH/USD exchange rate, MOM is month-on-month inflation rate, YOY is the year-on-year inflation rate, and Lr is the commercial banks' weighted average lending rate.

Table B9: Estimated Long Run Coefficients using the ARDL Cointegration Test III

Dependent variable: Stock market returns (NRt)			
Regressors are exchange rate, year-on-year inflation rate and 3-month TBill rate			
Regressors	**Coefficient**	**S.E**	**t-ratio**
Intercept	-1.452	2.951	-0.492
NR_{t-1}	-0.951	0.147	-6.482***
EX_{t-1}	0.005	0.037	0.136
YOY_{t-1}	0.154	0.089	1.728*
$TB3_{t-1}$	-0.003	0.072	-0.035
ΔNR_{t-1}	0.142	0.151	0.937
ΔNR_{t-2}	0.052	0.081	0.644
ΔEX_{t}	-0.151	0.260	-0.578
ΔEX_{t-1}	0.105	0.254	0.412
ΔEX_{t-2}	-0.297	0.367	-0.810
ΔEX_{t-3}	0.037	0.285	0.129
ΔYOY_{t}	0.328	0.221	1.479
$\Delta TB3_{t}$	-0.207	0.3461	-0.598
$\Delta TB3_{t-1}$	-0.105	0.209	-0.503
R-squared	0.426	Adj. R-squared	0.397
$F\left(NR_t / EX_t, \mathrm{YOY}_t, \mathrm{TB3}_t\right)$ F(4, 255)	13.493	P-value(F)	5.3228e-010
Diagnostic Tests			
Autocorrelation	$\chi_{auto}^{2}(12) = 20.159[0.064]$		
RESET	$F_{RESET} = 2.273[0.105]$		
Normality	$\chi_{Norm}^{2}(2) = 70.011[0.000]$		
Heteroscedasticity	$\chi_{Het}^{2}(13) = 147.828[0.000]$		
Coefficient Stability Tests			
CUSUM	Plot goes slightly beyond the 5% significance bounds		
CUSUMSQ	Plot slightly beyond the 5% significance bounds		

Notes: p-values are in parentheses. *** 1 percent significance, ** 5 percent significance. NR is log difference of the NSE 20 Share Index, EX is KSH/USD exchange rate, MOM is month-on-month inflation rate, YOY is the year-on-year inflation rate, TB3 is the 3-month Treasury Bills rate and Lr is the commercial banks' weighted average lending rate.

Table B10: Estimated Long Run Coefficients using the ARDL Cointegration Test IV

Dependent variable: Stock market returns (NRt)			
Regressors are exchange rate, year-on-year inflation rate and Lending rate			
Regressors	**Coefficient**	**S.E**	**t-ratio**
Intercept	1.066	4.565	0.234
NR_{t-1}	-0.952	0.144	-6.598***
EX_{t-1}	-0.012	0.039	-0.319
YOY_{t-1}	0.166	0.069	2.420**
$TB3_{t-1}$	-0.067	0.098	-0.686
ΔNR_{t-1}	0.147	0.156	0.943
ΔNR_{t-2}	0.058	0.085	0.680
ΔEX_{t}	-0.185	0.245	-0.757
ΔEX_{t-1}	0.043	0.207	0.209
ΔEX_{t-2}	-0.338	0.325	-1.039
ΔEX_{t-3}	-0.040	0.247	-0.163
ΔYOY_{t}	0.352	0.216	1.631
$\Delta TB3_{t}$	-0.317	0.861	-0.369
$\Delta TB3_{t-1}$	-0.217	0.798	-0.272
$\Delta TB3_{t-2}$	0.518	0.662	0.783
$\Delta TB3_{t-3}$	0.297	0.702	0.423
R-squared	0.423	Adj.R-squared	0.388
$F\left(NR_t / EX_t, \text{YOY}_t, \text{Lr}_t\right)$ F(4, 255)	12.480	P-value(F)	2.735e-009
Diagnostic Tests			
Autocorrelation	$\chi_{auto}^{2}(12) = 16.36[0.175]$		
RESET	$F_{RESET} = 0.709[0.493]$		
Normality	$\chi_{Norm}^{2}(2) = 82.33[0.000]$		
Heteroscedasticity	$\chi_{Het}^{2}(15) = 163.729[0.000]$		
Coefficient Stability Tests			
CUSUM	Plot does not go beyond the 5% significance bounds		
CUSUMSQ	Plot slightly beyond the 5% significance bounds.		

Notes: p-values are in parentheses. *** 1 percent significance, ** 5 percent significance. NR is log difference of the NSE 20 Share Index, EX is KSH/USD exchange rate, MOM is month-on-month inflation rate, YOY is the year-on-year inflation rate, TB3 is the 3-month Treasury Bills rate and Lr is the commercial banks' weighted average lending rate.

Table B11: Critical Values for F-Statistic (Pesaran *et al*. 2001; Narayan, 2004)

Critical values for F-statistic. Unrestricted intercept and no trend. Number of regressors (k) is 3.		
Pesaran et al.(2001)	**Lower Bound value**	**Upper Bound value**
1% significance level	4.385	5.165
5% significance level	3.219	4.378
10% significance level	2.711	3.800
Narayan (2004)	**Lower Bound value**	**Upper Bound value**
1% significance level	4.983	6.423
5% significance level	3.535	4.733
10% significance level	2.893	3.983

Table B12: Summary Descriptive Statistics for Periods Before, During and After the 2008 GFC

Variable notation	**Period**	**Mean**	**S.D**	**Skewness**	**Kurtosis**	**Jacque-Bera probability**
NR_t	Pre-crisis	0.856	7.1621	1.588	9.938	0.000
	During crisis	-2.791	10.880	-0.384	2.630	0.762
	Post-crisis	0.2617	4.2696	-0.390	3.436	0.273
EX_t	Pre-crisis	67.705	10.541	-0.761	2.797	0.000
	During crisis	72.462	6.736	-0.297	1.478	0.367
	Post-crisis	86.560	7.141	0.697	3.283	0.037
MOM_t	Pre-crisis	0.812	1.614	1.388	6.662	0.000
	During crisis	1.088	0.934	0.512	2.254	0.547
	Post-crisis	0.614	0.631	0.935	5.594	0.000
YOY_t	Pre-crisis	11.316	12.875	2.317	7.8271	0.000
	During crisis	14.191	3.0379	-0.542	2.242	0.518
	Post-crisis	7.897	4.2654	1.314	3.879	0.000
$TB3_t$	Pre-crisis	16.298	14.531	2.645	11.702	0.000
	During crisis	7.660	0.4875	0.418	2.354	0.657
	Post-crisis	8.839	4.2546	0.772	4.151	0.002
Lr_t	Pre-crisis	21.216	6.4679	0.073	1.634	0.001
	During crisis	14.287	0.4823	0.253	1.529	0.404
	Post-crisis	16.366	1.959	0.584	2.349	0.055

Notes: NRt is log difference of the NSE 20 Share Index, EXt is KSH/USD exchange rate, MOMt is month-on-month inflation rate, YOYt is the year-on-year inflation rate, TB3t is the 3-month Treasury Bills rate and Lrt is the commercial banks' weighted average lending rate.

Table B13: Scenarios of Stock Market Returns as a Function of Exchange Rate

Dependent Variable: NR_t			
Regressors	**Coefficient**	**S.E.**	**t-ratio**
Intercept	0.698	0.636	1.098
$EX_t low$	0.022	0.048	0.471
$D_{duringGFC}$	-2.870	2.789	-1.029
$D_{afterGFC}$	4.526	2.164	2.092**
$EX_t lowD_{duringGFC}$	-0.075	0.286	-0.263
$EX_t lowD_{afterGFC}$	-0.214	0.086	-2.491**
	Coefficient	**S.E.**	**t-ratio**
Intercept	1.267	1.252	1.012
$EX_t high$	0.022	0.048	0.471
$D_{duringGFC}$	-4.769	5.618	-0.849
$D_{afterGFC}$	-0.895	1.352	-0.662
$EX_t highD_{duringGFC}$	-0.075	0.286	-0.263
$EX_t highD_{afterGFC}$	-0.214	0.086	-2.491**

Notes: NRt is the log difference of the NSE 20 Share Index; EXt is the KSH/USD exchange rate. *** 1 percent significance, ** 5 percent significance.

Table B14: Scenarios of Stock Market Returns as a Function of Month-on-Month Inflation Rate

Dependent Variable NR_t			
Regressors	**Coefficient**	**S.E.**	**t-ratio**
	Coefficient	**S.E.**	**t-ratio**
Intercept	-0.369	0.638	-0.577
$MOM_t low$	0.869	0.468	1.860*
$D_{duringGFC}$	2.158	6.254	0.345
$D_{afterGFC}$	2.407	1.246	1.932*
$MOM_t lowD_{duringGFC}$	-3.591	3.494	-1.028
$MOM_t lowD_{afterGFC}$	-2.339	0.822	-2.844***
	Coefficient	**S.E.**	**t-ratio**
Intercept	2.014	1.066	1.888*
$MOM_t high$	0.869	0.468	1.860*
$D_{duringGFC}$	-7.678	4.595	-1.671*
$D_{afterGFC}$	-3.999	1.506	-2.654***
$MOM_t highD_{duringGFC}$	-3.591	3.494	-1.028
$MOM_t highD_{afterGFC}$	-2.339	0.822	-2.844***

Notes: NRt is the log difference of the NSE 20 Share Index; MOMt is the month-on-month inflation rate. *** 1 percent significance, ** 5 percent significance.

Table B15: Scenarios of Stock Market Returns as a Function of Year-on-Year Inflation Rate

Dependent Variable NR_t			
Regressors	**Coefficient**	**S.E.**	**t-ratio**
Intercept	-1.356	0.816	-1.663*
$YOY_t low$	0.191	0.072	2.669**
$D_{duringGFC}$	5.119	12.463	0.411
$D_{afterGFC}$	3.215	1.403	2.291**
$YOY_t lowD_{duringGFC}$	-0.644	0.840	-0.766
$YOY_t lowD_{afterGFC}$	-0.3864	0.143	-2.702***
	Coefficient	**S.E.**	**t-ratio**
Intercept	2.770	1.024	2.706***
$YOY_t high$	0.191	0.072	2.669***
$D_{duringGFC}$	-8.803	6.278	-1.402
$D_{afterGFC}$	-5.138	2.059	-2.495**
$YOY_t highD_{duringGFC}$	-0.644	0.840	-0.766
$YOY_t highD_{afterGFC}$	-0.386	0.143	-2.702***

Notes: NRt is the log difference of the NSE 20 Share Index; YOYt is the year-on-year inflation rate. *** 1 percent significance, ** 5 percent significance.

Table B16: Scenarios of Stock Market Returns as a Function of 3-Month Treasury Bills Rate

Dependent Variable NR_t			
Regressors	**Coefficient**	**S.E.**	**t-ratio**
Intercept	-0.132	0.792	-0.167
$TB3_t low$	0.065	0.042	1.568
$D_{duringGFC}$	11.827	23.534	0.503
$D_{afterGFC}$	0.509	1.357	0.376
$TB3_t lowD_{duringGFC}$	-2.285	3.394	-0.673
$TB3_t lowD_{afterGFC}$	-0.080	0.119	-0.676
	Coefficient	**S.E.**	**t-ratio**
Intercept	-1.908	1.739	-1.097
$TB3_t high$	0.065	0.042	1.568
$D_{duringGFC}$	74.112	115.982	0.639
$D_{afterGFC}$	2.695	4.3568	0.619
$TB3_t highD_{duringGFC}$	-2.285	3.394	-0.673
$TB3_t highD_{afterGFC}$	-0.080	0.119	-0.676

Notes: NRt is the log difference of the NSE 20 Share Index; TB3t is the 3-month Treasury Bills rate. *** 1 percent significance, ** 5 percent significance.

Table B17: Scenarios of Stock Market Returns as a Function of Lending Rate

Dependent Variable NR_t			
Regressors	**Coefficient**	**S.E.**	**t-ratio**
Intercept	0.951	0.872	1.091
$Lr_t low$	-0.012	0.123	-0.101
$D_{duringGFC}$	-8.963	3.967	-2.259**
$D_{afterGFC}$	-1.913	1.419	-1.348
$Lr_t lowD_{duringGFC}$	6.594	4.094	1.611
$Lr_t lowD_{afterGFC}$	0.439	0.269	1.624
	Coefficient	**S.E.**	**t-ratio**
Intercept	0.805	0.995	0.809
$Lr_t high$	-0.012	0.123	-0.101
$D_{duringGFC}$	68.835	45.269	1.521
$D_{afterGFC}$	3.261	2.136	1.527
$Lr_t highD_{duringGFC}$	6.594	4.094	1.611
$Lr_t highD_{afterGFC}$	0.439	0.269	1.624

Notes: NRt is the log difference of the NSE 20 Share Index Lrt is the commercial banks' weighted average lending rate. *** 1 percent significance, ** 5 percent significance.

Table B18: Results of the ADF, PP and KPSS Tests (Intercept Only)

Variable notations	**ADF test**		**PP Test**		**KPSS**	
	Level	**1st Difference**	**Level**	**1st Difference**	**Level**	**1st Difference**
NR_t	-4.871***	-7.435***	-13.077***	-145.339***	0.113	0.013
EX_t	-2.453	-11.376***	-2.336	-11.309***	1.461	0.076
MOM_t	-7.122***	-8.846***	-10.483***	-56.643***	0.27	0.342
YOY_t	-7.641***	-5.343***	-3.057**	-13.592***	0.367	0.064
$TB3_t$	-5.644***	-11.663***	-2.917**	-6.065***	1.079	0.039
Lr_t	-1.756	-6.772***	-1.565	-11.962***	1.301	0.099

Notes: *** 1 percent significance, ** 5 percent significance. Null hypothesis under the ADF and PP tests is that the variable is I (1). Null hypothesis for KPSS test is that the variable is stationary. Fail to reject null hypothesis of stationarity if LM value is lower than all critical values of KPSS test. NRt is log difference of the NSE 20 Share Index, EXt is KSH/USD exchange rate, MOMt is month-on-month inflation rate, YOYt is the year-on-year inflation rate, TB3t is the 3-month Treasury Bills rate and Lrt is the commercial banks' weighted average lending rate. KPSS (LM) critical values are (0.739 at 1 percent, and 0.463 at 5 percent).

Table B19: Cointegration Test Results using ADF, PP and KPSS Unit Root Tests (Intercept Only)

Cointegrating residual notation	**ADF test**	**PP Test**	**KPSS**
	Level	**Level**	**Level**
$Rnrex_t$	-12.822***	-13.091***	0.083
$Rnrmom_t$	-13.049***	-13.155***	0.105
$Rnryoy_t$	-13.5201***	-13.421***	0.075
$Rnrtb3_t$	-12.988***	-12.986***	0.092
$Rnrlr_t$	-12.825***	-13.099***	0.087

Notes: *** 1 percent significance, ** 5 percent significance. Null hypothesis under the ADF and PP tests is that the residual is nonstationary or I(1). Null hypothesis under the KPSS is that the residual is stationary. Fail to reject null hypothesis of stationarity if LM value is lower than all critical values of KPSS test. KPSS critical values are (0.739 at 1 percent, 0.463 at percent). $Rnrex_t$ represents the cointegrating residual obtained from regressing stock market returns on exchange rate, $Rnrmom_t$ is the cointegrating residual from regressing stock market returns on month-on-month inflation rate and $Rnryoy_t$ is the cointegrating residual from regressing stock market returns on year-on-year inflation rate. Similarly, $Rnrtb3_t$ is the cointegrating residual from regressing stock market returns on 3-month Treasury Bills rate and $Rnrlr_t$ is the cointegrating residual from regressing stock market returns on lending rate.