MACROECONOMIC VARIABLES AND EQUITY SECURITIES' MARKET INDICES: CASE OF THE NAIROBI SECURITIES EXCHANGE

Boniface O. Owino
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SUPERVISORS
Ms. Susan A. Ayako
Dr. Wilfred N. Nyangena

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DECLARATION

This research paper is my own work and it has not been submitted for any degree or examination in any other university.

Signature: …… DATE.....

BONIFACE O. OWINO

X50/63408/2011

This research paper has been submitted with our approval as the university supervisors.

Signature: …… DATE: ……

MS. SUSAN A. AYAKO

SCHOOL OF ECONOMICS

UNIVERSITY OF NAIROBI

Signature: …… DATE: ……

DR. WILFRED N. NYANGENA

SCHOOL OF ECONOMICS

UNIVERSITY OF NAIROBI

DEDICATION

To family and friends for encouragement, advice, and continuous support

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ABSTRACT

The purpose of this study was to determine the short-run and long-run effects of domestic and European Union's macroeconomic variables on the Nairobi Securities Exchange's 20-share index using co-integration tests, Granger causality tests, and the VECM. The study used monthly time series data covering the period 1993 to 2013. The dataset included Kenya's 91-day Treasury bill rate, inflation rate, and the NSE 20-share index, as well as, EU's inflation rate, quantity of money (M3), industrial production index, and the FTSE 100 index (UK). The Augmented Dickey Fuller (ADF) tests revealed that the variables were non-stationary i.e. I(1) in their levels, but stationary in their first difference. The Johansen-Juselius co-integration test showed that the variables had a long-run relationship i.e. co-integrated. Granger causality tests revealed unidirectional causal relationships running from Kenya's 91-day T-bill rate and EU's M3 to the NSE 20-share index. Similarly, the NSE 20-share index Granger caused EU's inflation rate and industrial production index. The VECM results showed that the 91-day T-bill rate had a negative and significant effect on the NSE 20-share index in the short run. EU's M3, industrial production index, and the FTSE 100 index had a positive and significant effect on the NSE 20-share index in the short-run. In the long-run, EU's industrial production index, and Kenya's 91-day T-bill rate had a positive effect on the NSE 20-share index. By contrast, EU's M3 and the FTSE 100 Index had a negative effect on the NSE 20-share index. Overall, the NSE converges to its long-run equilibrium in 36 months. In light of these findings, investors at the NSE should take into account changes in both Kenya's and EU's macroeconomic variables in their investments' decisions.

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LIST OF ABBREVIATIONS AND ACRONYMS

ADF	Augmented Dickey Fuller
APT	Arbitrage Pricing Theory
ARDL	Autoregressive Distributive Lag
CAPM	Capital Asset Pricing Model
CPI	Consumer Price Index
EU	European Union
EUIP	EU's industrial production index
FTSE100	The London Stock Exchange's FTSE 100 Index
I^K	Kenya's Treasury Bills rate
ICT	Information and Communication Technology
INF^{EU}	EU's inflation rate
INF^K	Kenya's inflation rate
$M3^{EU}$	EU's broad money i.e. M3
NASDAQ	National Association of Securities Dealers Automated Quotations
NASI	Nairobi Securities Exchange All Share Index
NSE	Nairobi Securities Exchange
PVM	Present Value Cash Flow Model
T-Bill	Treasury Bill
UK	United Kingdom
UMP	Unemployment
US/ USA	United States of America
VAR	Vector Autoregressive
VCEM	Vector Error Correction Model

DEFINITION OF TERMS

Corporate governance: refers to the duty and powers that a board of directors of an organization has to direct and control it so that it may achieve its objectives and meet the goals of relevant stakeholders.

Gearing/ leverage: refers to the level of a firm's debt compared with its equity capital. It is measured by various ratios, which include debt-to-equity ratio and equity ratio

Subsidiary: is a company in which at least 50% of the shares are owned by another company, often referred to as the parent/ holding company

Associate company: is a corporation that is partly owned by another company. The parent company often owns between 20% and 49% of shares in the associate company

Tapering: refers to the program to diminish quantitative easing

Quantitative easing: refers to an expansionary monetary policy where the central bank purchases debt securities to increase the supply of money in order to manipulate lending interest rates

Industrial production: is a macroeconomic aggregate that includes the output of the manufacturing, services, construction, mining, and energy sectors

CHAPTER ONE
INTRODUCTION

1.1 Background

The total returns on equity securities consist of two components namely, the dividend and capital gain or loss (Jones, 2010). Dividend refers to the periodic cash flows or income paid by a corporation to holders of its equity shares. On the other hand, capital gain or loss refers to the appreciation or depreciation of the price of an equity security over a period. It is the difference between the price at which the equity security is purchased and the price at which it is sold at the end of the holding period (Jones, 2010). In this context, a price change is an important determinant of the total returns on equity securities, especially, in a market where investors focus on capital gains rather than cash dividends. For instance, capital gain is important to most investors at the Nairobi Securities Exchange (NSE) since the cash dividends paid by the listed companies are often very low (Capital Markets Authority, 2013). Consequently, financial investors have to understand the factors that determine the prices of equity securities and consider such factors in their investments' decisions in order to improve their earnings.

According to Shubiri (2010), the prices of equity securities are influenced by firm specific variables, as well as, factors that are external to the firm. The firm specific factors/ variables include profit margins, net corporate cash flows, price-earnings (P/E) ratio, and asset utilization ratios (Shubiri, 2010). Firm specific factors also include the nature of corporate governance, as well as, the characteristics of the balance sheet such as gearing/ leverage, net assets, and liquidity. The external factors include industry regulation and government policies; domestic and global macroeconomic variables; international trade policies; equities market structure and conduct; and national and global politics (Shubiri, 2010). Conceptually, the price of an equity security or instrument is determined by the expected total cash dividends in perpetuity and the expected discount rate (Cochrane, 1998). The dividend paid at time t+1 is a function of among other factors, the nature of future growth opportunities and macroeconomic variables that affect firm profits at time t+1. These include interest rate, exchange rate, inflation, industrial production, and unemployment rate (Cochrane, 1998). The discount rate, on the other hand, consists of the risk-free rate and the risk premium. Risk-free rate refers to the interest earned from an investment with no default risk, whereas the risk premium refers to the return in excess

of the risk-free rate. The risk premium compensates financial investors for taking the default risk associated with investing in an equity security. Cochrane (1998) asserts that new information entering the market is likely to affect the prices of equities through its impact on the risk premium and the default risk-free rate proxied by a number of interest rates, such as the 91-day T-bills rate and the Central Bank Rate (CBR).

Fama (1970) asserts that prices of equity securities will fully reflect all available information concerning the state of the economy and firm specific factors if the equity market is efficient.[1] Equity prices react only to new information (unexpected changes) concerning the state of the economy and firm specific factors. Burton (2006) defines an efficient equity market as a market in which financial investors cannot earn more than average returns on their investments if they do not take above-average risks. The implication of market efficiency is that the information available at time t cannot be used to predict the prices of equity securities at time t+1 (Fama, 1970). However, several studies have shown that equity markets are not always efficient (Alshogeathri 2011; Savasa and Samiloglub 2010; and Naik and Padhi 2012).

Inefficiency implies that equity prices do not fully reflect all available information at time t. Implying that changes in equity prices are not random. This further implies that changes in equity prices at time t+1 can be predicted from information available at time t. This perspective is supported by the empirical studies that have found that macroeconomic variables have lagged effects on equities' prices and hence returns (Chen, Roll, and Ross, 1986; Anaraki 2010; Cochrane, 1991a, 1996). In particular, gross domestic product (GDP), inflation rate, interest rate, quantity of money, and exchange rate have been found to influence prices of equity securities (Fama, 1981; Chen, Roll, and Ross, 1986). Therefore, changes in Kenya's macroeconomic variables are expected to influence equity prices at the Nairobi Securities Exchange. Additionally, changes in the macroeconomic variables of Kenya's major trading partners are likely to affect equity prices at the NSE by influencing the level of economic activity and firm profits in the country. It is against this background that this study sought to determine the effect of domestic and the European Union (EU) macroeconomic variables on the Nairobi Securities Exchange market indices.

[1] Efficiency as used in this study refers to the use of available information in the valuation of equities.

The NSE has two official indices namely, the All-share index (NASI) and the 20-share index. Other indices include the FTSE-NSE Kenya 15-index, the FTSE NSE Kenya 25-index, and the AIG 27-share index. The FTSE-NSE Kenya 15 index and the FTSE-NSE Kenya 25 index were introduced in November 2011 by the FTSE Group in partnership with the NSE. The FTSE-NSE Kenya 15 index monitors the performance of the 15 largest firms, which are periodically assessed and selected based on their market capitalization. The FTSE-NSE Kenya 25 index monitors the performance of the 25 most liquid counters at the NSE. The AIG 27-share index was introduced by the American International Group (AIG). It tracks the performance of the 27 best performing counters, which are selected based on their market capitalization.

The All-share index was introduced in 2008. It is calculated based on the market capitalization of all listed firms irrespective of their performance. This means that it reflects the total value of all the firms that are listed at the NSE. The NSE 20-share index has been in use since 1966. It is a price-weighted index that is computed as a geometric mean of the average daily closing prices of 20 selected counters. The selection is done using 12 months data concerning each of the constituent companies' market capitalization, number of shares traded, number of deals, and turnover. This study considered the effects of macroeconomic variables on the NSE 20-share index because it covers the period 1991 to 2013.

1.2 Statement of the Problem

Kenya's macroeconomic variables have fluctuated in the last two decades. This include the low inflation rate of 1.6% in 1995 vs. the high inflation rate of 26% in 2008 and 43% in 1993; very low GDP growth rate of 0.6% in 2001 vs. a high GDP growth of 7.1% in 2007; and high lending interest rate of 36% in 1994 vs. low interest rate of 12.5% in 2004 (World Bank, 2013). Asset pricing models show that changes in macroeconomic variables influence equities' prices and returns (Chen, Roll, and Ross, 1986; Fama 1981; Gracia and Yu 2010; and Keray 2009). However, empirical studies on the effect of Kenya's macroeconomic variables on the NSE's market indices have presented mixed results. For instance, Muthike and Sakwa (2009) found that the 91-day T-bills rate and inflation rate have no statistically significant effect on the NSE 20-share index. By contrast, Kimani and Mutuku (2013) showed that the inflation rate has a

statistically significant effect on the NSE 20-share index; whereas Ochieng and Oriwo (2012) found that the 91-day T-bills rate has a statistically significant effect on the NSE All Share Index (NASI).

The implementation of trade and financial liberalization policies has increased the economic integration between Kenya and the European Union (Gertz, 2009). Consequently, exogenous macroeconomic shocks originating from the EU are likely to affect the balance sheets, net cash flows, and profits of local firms, and their ability to pay dividends. As a result, equity prices at the NSE are expected to change as investors react to new information concerning the state of the EU economy and the discount rate in order to benefit from the expected increase in dividends or to avoid expected capital losses (Culp & Cochrane, 2003). Despite the increasing level of trade and financial integration between the EU and Kenya, little attention has been given to the possible effects of changes in the EU macroeconomic variables on the NSE market indices. The existing studies have focused on the effect of the EU and the USA macroeconomic variables on emerging equity markets in Latin America, the Middle East, and the Far East. In Africa, the studies have focused on the effect of EU macroeconomic variables on equity securities' market indices in South Africa and the countries in the Middle East and North Africa (MENA) region.

Therefore, the purpose of this study was to determine the effect of both domestic and the EU macroeconomic variables on the NSE 20-share index. Although equity securities' market indices are affected by several factors including macroeconomic variables, industry regulation, as well as, national and global politics, this study focused only on the effect of select macroeconomic variables on a market index. In this study, effect as a concept was used in reference to an increase or decrease in the NSE 20-share index in response to a change in domestic or the EU macroeconomic variables. The research question was: what is the effect of Kenya's and the EU macroeconomic variables on the NSE 20-share index? The study adopted two hypotheses. First, Kenya's macroeconomic variables have a statistically significant effect on the NSE 20-share index. Second, the EU macroeconomic variables have a statistically significant effect on the NSE 20-share index.

1.3 Objectives of the Study

The broad objective of the study was to analyze the relationship between the NSE 20-share index and both foreign (EU) and domestic macroeconomic variables.

The specific objectives of the study were:

i. To determine the effect of Kenya's macroeconomic variables on the NSE 20-share index
ii. To determine the effect of European Union's macroeconomic variables on the NSE 20-share index
iii. To infer policy measures that could be adopted by Kenya's financial investors, the government of Kenya and the authorities at the NSE to make investment decisions (investors) and to improve the market's performance (government and NSE's authorities)

1.4 Justification of the Study

The NSE plays an integral role in the development process in Kenya by providing and accelerating growth opportunities through investments, speculation, and hedging. It promotes economic growth by facilitating mobilization of domestic and foreign financial capital, thereby increasing investments. Moreover, it enables companies and the government to raise equity capital at low costs and to reduce their dependence on bank loans, which are often subject to interest rate fluctuations (Adam & Tweneboah, 2007). In this regard, a study that focuses on the effect of domestic and foreign (EU) macroeconomic variables on equity securities' market index should be of interest to investors generally, the NSE authorities, and the government of Kenya. This is because the NSE 20-share index is used to monitor the equity market's performance.

For the government, understanding the effect of domestic and the EU macroeconomic variables on the equity market index is important for macroeconomic policy formulation. For instance, investments from the EU are subjected to sudden withdrawal. This could destabilize the economy through depreciation of the exchange rate and capital flight. Additionally, an understanding of the effect of domestic macroeconomic variables on the equity market index would enable the government to improve the performance of the NSE through public policy.

For the authorities at the NSE, the effect of the EU macroeconomic variables on the NSE 20-share index will illustrate the level of integration between the NSE and equity markets in the EU. This will enable the authorities to formulate appropriate policies to increase the participation of foreign investors, thereby improving the performance of the market in terms of high liquidity, market capitalization, and trade volume.

For Kenya's financial investors, the findings of the study are expected to provide insights that may inform their speculation and hedging decisions. For the EU investors, the level of integration between the NSE and the EU equity markets will shed light on whether the NSE provides diversification opportunities or not.

1.5 Organization of the Study

The subsequent sections are organized as follows. Chapter two provides a brief context for the study. Chapter three focuses on the theoretical and empirical literature, whereas chapter four focuses on the methodology of the study. The results are presented in chapter five. Chapter six includes the discussion of the results, policy recommendations, and conclusion.

CHAPTER TWO

CONTEXT FOR THE STUDY

2.1 The Effect of European Union Macroeconomic Variables

According to Jones (2010), world equity securities markets are undergoing rapid evolution due to technological advancements, regulatory changes, and elimination of barriers to international trade. These factors have led to the development of more interlinked economies, thereby improving the level of equity market synchronization globally (Ali, Butt, & Rehman, 2011). Moreover, advancements in information and communication technologies (ICT) facilitate cross-border trading in equities by enhancing sharing of information, online trading/ processing of transactions and flow of financial capital (Laopodis, 2012).

In Kenya, the government has focused on integrating its economy with the rest of the world through financial and trade liberalization policies. This has involved elimination of import quotas, reduction of import duties, signing bilateral/ multilateral trade agreements with other countries, as well as, removal of capital account and foreign exchange restrictions (Gertz, 2009). These reforms have contributed in part to increased trade and financial integration between the EU and Kenya (Gertz, 2009). As indicated in Table 1, the EU is the second largest export destination of Kenya's goods after the Common Market for Eastern and Southern Africa (COMESA) region. Table 2 indicates that the EU is the single largest source of Kenya's imports. Figure 1 shows that the value of Kenya's exports to and imports from the EU has been increasing in the last ten years. These trends suggest that the EU is one of Kenya's major trading partners.

Table 1: Value of Kenya's Exports by Destination (in percentage)

	Years				
Region	**2008**	**2009**	**2010**	**2011**	**2012**
COMESA	35.33	35.94	36.06	38.55	37.25
European Union	30.08	30.13	27.00	26.84	24.25
Far East	13.12	12.71	13.56	13.31	13.44
Middle East	5.06	6.14	8.11	7.00	8.92
America (USA, Canada, other)	7.01	6.03	6.47	5.86	6.09
Non-COMESA African Countries	6.96	6.22	5.28	5.17	6.11
Eastern Europe	1.18	1.99	2.05	2.09	2.29
Other countries	1.26	0.83	1.45	1.18	1.67
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

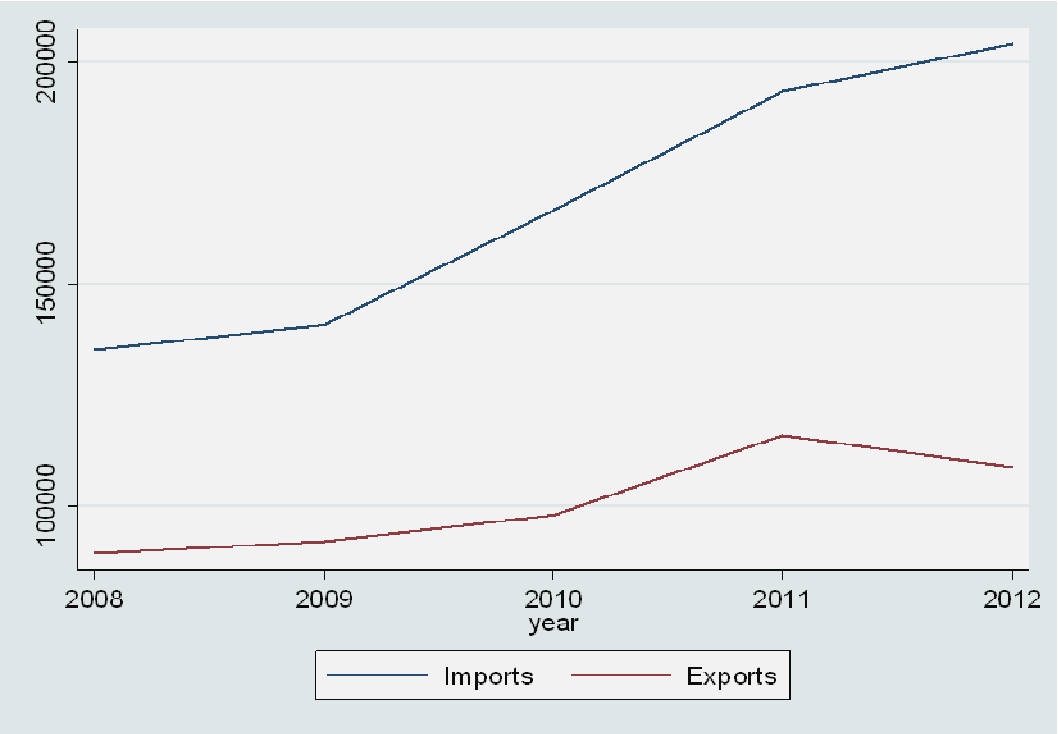
Source: The Kenya National Bureau of Statistics (KNBS)

Table 2: Value of Kenya's Imports by Country/ Region of Origin (in percentage)

	Year				
Region/ Country	**2008**	**2009**	**2010**	**2011**	**2012**
European Union (EU)	19.39	19.42	19.80	18.32	16.58
India	11.95	10.67	11.02	11.96	14.35
China	8.38	9.55	12.88	11.58	12.29
United Arab Emirates	15.02	11.50	12.39	16.02	11.02
Other Far East Countries	11.36	11.10	12.50	9.49	10.80
America (USA, Canada, other)	5.75	8.32	5.94	6.37	8.77
Non-COMESA African Countries	6.66	9.17	6.75	6.46	4.76
COMESA	3.73	3.24	4.38	4.45	4.53
Japan	5.92	6.26	6.22	4.55	4.64
Saudi Arabia	3.42	3.53	3.45	4.31	4.91
Eastern Europe	2.32	2.61	1.97	2.20	1.78
Other Middle East Countries	5.84	4.06	2.18	3.79	4.95
Other Countries	0.26	0.58	0.53	0.50	0.61
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Source: The Kenya National Bureau of Statistics (KNBS)

Figure 1: Value of Kenya's Imports from and Exports to the EU in millions of KES



Source: Based on data from the Kenya National Bureau of Statistics (KNBS)

Williams and Liao (2006) assert that financial and trade integration increases the speed and ease with which macroeconomic risks that affect the prices of equities and market indices are transmitted from one market to another. In particular, changes in the macroeconomic variables of one country not only affect the prices of equity securities in that country, but also in foreign equities markets (Ho, 2011). Consequently, changes in the EU macroeconomic variables are likely to affect equity prices at the NSE through the demand channel. For instance, an increase in unemployment rate in the EU will reduce the demand for Kenya's exports in the region. The resulting reduction in export earnings from the EU is likely to cause a decline in consumption in Kenya, thereby reducing the profits of listed firms and their ability to pay cash dividends. This will lead to a fall in equity prices as investors sell equity securities in order to invest in more profitable securities or business ventures.

Exchange rate is also an important channel through which macroeconomic shocks from the EU can affect equity prices in Kenya. The level of consumption in Kenya will decline if the Kenya shilling exchange rate depreciates. The depreciation will make imports from the EU to be more

expensive, thereby reducing consumption. Although export earnings to the EU will improve due to the exchange rate depreciation, the net effect of the currency depreciation might be negative since the value of Kenya's imports from the EU exceeds the value of exports to the EU. This will negatively affect the level of economic activity and the financial performance of listed companies. Thus, the NSE 20-share index will decline.

Improved economic performance in the EU is also expected to increase Diaspora remittances from the region. The resulting increase in aggregate demand in Kenya is expected to improve corporate earnings and the NSE 20-share index. The reverse effect is likely to occur during economic downturn in the region. EU investors' reaction to world macroeconomic news such as the 2013 tapering or reduction of quantitative easing by the Federal Reserve Bank of the US is also likely to affect equity prices at the NSE. For instance, tapering may lead to an increase in lending interest rates in the US and the UK. As a result, EU investors could change their portfolios by selling equities at the NSE to purchase interest-bearing instruments in the UK and the US. This will reduce the prices of equities and market indices at the NSE.

2.2 Reforms at the NSE

The Nairobi Securities Exchange was established and registered in 1954 under the Societies Act as an association of stockbrokers. In 1991, the NSE was transformed into a limited liability company, limited by guarantee (NSE, 2013). In 1994, the computerized delivery and settlement system (DASS) was introduced in order to improve efficiency and transparency in trading. In 1995, foreign financial investors were allowed to trade at the NSE. Additionally, the government abolished foreign exchange controls in order to enhance the participation of foreign financial investors (Gertz, 2009). The Central Depository System (CDS) was launched in 2004, thereby automating settlement of transactions.

In 2006, the process of demutualizing the NSE was initiated. Demutualization refers to the separation of the ownership of a securities exchange market from the right to trade on it. Demutualization led to the conversion of the NSE from a company limited by guarantee to a company limited by shares in 2011. Furthermore, it has improved the governance of the bourse by facilitating effective management, prevention of conflict of interest, and elimination of

malpractices such as price manipulation (Capital Markets Authority , 2013). Demutualization has also led to the adoption of modern ICT to improve trading activities. For instance, the Broker Back Office (BBO) operations were launched in 2011 to facilitate trading through the internet. Currently, the process of linking trading activities at the NSE with trading in other bourses in East Africa and other regions is ongoing.

These reforms have contributed in part to the development of the NSE and its attractiveness to local and foreign investors. For instance, some listed companies at the NSE are subsidiaries or associates of EU companies. EU investors hold at least 20% stake in at least 34.4% (21) of listed companies at the NSE.[2] Investors from the EU are likely to sell their equities at the NSE to avoid losses if they expect future returns to decline due to poor economic growth in Kenya. Their exit from the market in large numbers is likely to exert a downward pressure on equity prices, thereby reducing the NSE 20-share index. On the other hand, EU investors are likely to diversify their portfolios by purchasing more equities at the NSE in order to avoid losses when economic growth in the EU is declining and future returns on equities is expected to reduce. The resulting increase in equity prices will improve the NSE 20-share index.

[2] Based on the audited and published annual financial results of listed companies as at May 2013

CHAPTER THREE
LITERATURE REVIEW

3.1 Theoretical Literature Review

3.1.1 Arbitrage Pricing Theory

According to the APT, the risk of holding an equity security comes from macroeconomic (systematic) and idiosyncratic factors. Macroeconomic risk factors have a systematic effect on the entire equity securities market and cannot be eliminated through portfolio diversification (Roll & Rose, 1980). By contrast, idiosyncratic risk factors are unique to each equity security and can be eliminated in a broadly diversified portfolio. Consequently, an efficient market rewards only the risks originating from the nature of the industry of the firm (Rose, 1976).

Pricing equity securities using the APT is based on the law of one price and no arbitrage. Arbitrage is a "trading strategy that generates a riskless profit" (Jones, 2010). However, arbitrage opportunities do not exist in efficient equity markets. If arbitrage opportunities exist, investors will aggressively exploit them in order to increase their earnings. Thus, arbitrage profit opportunities are quickly dissipated. In this regard, a financial investor has to take some risk and make some net investments in order to earn a positive expected rate of return on equity securities (Berry, Burmeister, & McElroy, 1988). The absence of arbitrage implies that the prices of two equity securities with the same risk/ payoff profile must be equal, that is, the law of one price holds.

The APT pricing model expresses the rate of return on an equity security as a linear function of multiple factors including macroeconomic variables. Mathematically, the APT model is expressed as:

$$R_i = E(R_i) + b_{i1}F_1 + b_{i2}F_2 \cdots + b_{ik}F_k + \varepsilon_i \qquad (1)$$

Where

R_i denotes the random rate of return on thei^{th} asset

$E(R_i)$ denotes the expected rate of return on the i^{th} asset

b_{ik} denotes the sensitivity of the i^{th} asset's return to the factor F_k

F_k denotes the k^{th} factor (systematic risk) that affects the returns on equities

ε_i is a white noise error term (unsystematic risk factors)

The APT model is based on the following assumptions:

i. Equity markets are competitive

ii. There are no transaction costs in equity markets

iii. There are enough securities to diversify away unsystematic risks

iv. There are no arbitrage opportunities. Consequently, investors are not able to make zero net investments and riskless portfolios that earn a positive profit

Macroeconomic Factors in the APT Model

According to Azeez and Yonoezawa (2003), the APT lacks theoretical guidance for the selection of the appropriate set of macroeconomic variables to be included in the APT model. This limitation is both a strength and weakness of the model. It is a strength because it allows the researcher to choose the variables/ factors that provide the best explanation for his sample. It is a weakness because the model cannot explain changes in asset returns in terms of limited and easily identifiable factors such as equity betas in the case of the capital asset pricing model (CAPM) (Rose, 1976).

From equation 1, investors price equity securities by determining the effect of the factor sensitivities on the rate of return on equity securities (Cochrane, 1998). If the factor sensitivities indicate that a change in certain macroeconomic variables (systematic risk factors) will increase the rate of return, equity prices will increase. If financial investors expect the rate of return on equities to increase, they will demand more equity instruments in order to increase their earnings. The increase in demand will bid up the prices of equity securities, thereby increasing the market index. Conversely, the equity market index will decline if the factor sensitivities indicate that the rate of return on equities will reduce due to a change in various macroeconomic factors.

3.1.2 The Present Value Cash Flow Model (PVM)

According to the PVM, the current price of an equity security is determined by its expected future cash flows (dividends) and future discount rate. The factors that determine future profits and hence, future dividend streams of an equity security will affect its present value or price (Culp & Cochrane, 2003).

The PVM is presented as follows:

$$P_{i,t} = \sum_{n=1}^{\infty} \frac{E(D_{i,t+n})}{(1+k_i)^n} \quad (2)$$

Where P_i is the equity's current price (at time t); $(D_{i,t+n})$ denotes future discounted cash flows (dividends); $1 + k_i$ is the discount factor in which k_i is the discount rate; E is the expectation operator.

From equation 2, it can be deduced that any macroeconomic factor that affects either the dividend stream or the discount rate or both will affect the current price of the equity security. The level of real economic activity, measured by GDP growth or variation in aggregate industrial production, is considered an important determinant of equity prices (Culp & Cochrane, 2003). A rise in aggregate industrial production leads to increased corporate earnings, which in turn improves the present value of listed firms. This leads to increased demand for investments in equity securities, which ultimately increases equities' prices and market index (Chen, Roll, & Ross, 1986). Conversely, a reduction in aggregate industrial production will lead to a decline in equities' prices, which in turn reduces the equity market index. A high unemployment rate reduces aggregate consumption and corporate earnings. Consequently, the equity securities' market index is expected to decline when unemployment rate is increasing and vice versa.

The effect of inflation on equity prices is empirically mixed. Fama (1981); Chen, Roll and Rose (1986); and Mukherjee and Naka (1995) provided evidence of a negative relationship between inflation and equity prices. Since equity prices can be viewed as the discounted value of expected future cash dividends, a rise in inflation may increase the nominal risk-free rate, and hence the discount rate, which in turn causes a decline in equities' prices. According to Fisher (1930) and Ratanapakorn and Sharma (2007), inflation is positively related to equities' prices. In this respect, investing in equity securities is recommended as a hedge against inflation (Fisher, 1930).

The relationship between the quantity of money and equity prices is also ambiguous. According to the portfolio theory, a rise in money supply may lead to portfolio change from non-interest bearing assets to financial assets such as equity securities, thereby enhancing equities' prices (Ratanapakorn & Sharma, 2007). In addition, an increase in money supply may lead to improved economic growth, which in turn improves corporate earnings and equities' prices. However, if

the increase in money supply raises inflation, the discount rate will increase. As a result, the prices of equity securities and the market index will reduce.

A reduction in lending interest rates lowers the cost of borrowing. This serves as an incentive to companies to invest since they can borrow cheaply to finance their expansion, which in turn improves their equity prices. However, if a substantial amount of equity securities are purchased with borrowed money, a rise in lending interest rate will increase the cost of investing in equity securities. The resulting reduction in demand for equity securities will lead to price depreciation and a decline in the market index.

3.1.3 Modeling the Relationship between Equity Market Index and Macroeconomic Variables

Stationarity Test and Cointegration Analysis

Most macroeconomic and financial time series data such as equity prices, dividends, consumption, inflation rate, and income have theoretical long-run relationships. These variables evolve overtime; thus, their mean and variance are not constant i.e. the series are non-stationary (Hendry & Juselius, 1999). Using non-stationary time series data can lead to incorrect conclusion that two variables are related when they are actually not related. In this case, the variables are said to have a spurious relationship.

The common methods of transforming non-stationary to stationary series involve de-trending or differencing the data. However, these techniques often lead to a loss of long-run information about the relationship between the variables, as well as, the omitted variable bias (Baltagi, 2011). In response to these drawbacks, Granger (1969) introduced the co-integration technique (test) to analyze non-stationary time series without losing important long-run information. Given two variables Y_t and X_t, which are integrated of order one i.e. $Y_t \sim I(1)$ and $X_t \sim I(1)$. Y_t and X_t are said to be integrated if their linear combination,$\hat{\mu}_t = Y_t - \hat{\beta}_t$ is stationary or $\hat{\mu}_t \sim I(0)$. In this case, the two variables have a long-run relationship. The order of integration of the variables can be determined by testing for stationarity through methods such as the Augmented Dickey Fuller (ADF) test and the Phillips-Perron test (Wooldridge, 2011).

The techniques for testing for co-integration include the Johansen-Juselius co-integration test, Engle-Granger co-integration test, and Autoregressive Distributive Lag (ARDL) bounds tests. Unlike the Johansen-Juselius co-integration and the ARDL bounds tests, the Engle-Granger test does not identify multiple co-integrating vectors. It also fails to accommodate the possibility of simultaneity in the causal relationship among variables (Hendry & Juselius, 1999). Consequently, this study used the Johansen-Juselius co-integration test because of its simplicity and ability to identify multiple co-integrating vectors. According to Johansen and Juselius (1990), the vector error correction model should be used to estimate the long-run and short-run relationships between co-integrated variables.

3.2 Empirical Literature Review

3.2.1 Domestic Macroeconomic Variables

Using data for the period 1995 to 2000, Junkin (2011) analyzed the effect of aggregate industrial production, gross domestic product, inflation, 91-day Treasury bill rate, and exchange rate on South Africa's FTSE/JSE All Share Index. The Johansen co-integration test and VECM were used in the analysis. Additionally, the researcher tested for unit root using the ADF and KPSS stationarity tests. Junkin (2011) found a positive relationship between exchange rate and FTSE/JSE All Share index in the short-run and long-run. Inflation rate was found to be negatively related to the FTSE/JSE All Share Index in the short-run and long-run (Junkin, 2011). This finding confirms that of Kimani and Mutuku (2013) who found a negative relationship between the NSE 20-share index and inflation rate in Kenya. However, the 91-day Treasury bill rate and aggregate industrial production had no statistically significant relationship with the FTSE/JSE All Share Index. Given the trade and financial integration between South Africa and countries such as China and the UK, the FTSE/JSE All Share index is also likely to be affected by changes in foreign macroeconomic variables. However, the researcher considered only domestic macroeconomic variables, thereby ignoring the effects of macroeconomic shocks originating from foreign countries that are likely to influence the FTSE/JSE All Share Index.

Using annual data for the period 1976 to 2009, Muthike and Sakwa (2009) analyzed the effect of macroeconomic variables on Nairobi Securities Exchange's 20-share index. Their data set included the NSE 20-share index, 91-day Treasury bill rate, quantity of money (M2), inflation

rate, exchange rate, and industrial production. The researchers used Pearson product moment correlation analysis to determine the relationship between the variables. Pearson product moment correlation measures the strength of a linear association between two variables (Muthika & Sakwa, 2009). The researchers found that only quantity of money and real exchange rate had a significant and positive relationship with the NSE 20-share index. The results of Muthike and Sakwa (2009) are consistent with those of Hassan and El-Gezery (2010) who found that exchange rate and quantity of money had positive and statistically significant relationship with Egypt's equity market index. However, the study by Muthike and Sakwa (2009) did not determine the long-run and short-run relationships that are likely to exist between the NSE 20-share index and the macroeconomic variables. Thus, it does not provide information concerning the speed with which the index is likely to adjust to its long-run equilibrium after deviating in the short-run.

Yahyazadehfar and Babaie (2012) studied the effect of nominal interest rate and gold price on Iran's equity market index. The study used data for the period March 2001 to April 2011 (Yahyazadehfar & Babaie, 2012). The researchers used the Johansen-Juselius co-integration test and the VECM for data analysis. They found that nominal interest rate had a negative and statistically significant relationship with Iran's equity market index in the short-run and long-run. This study does not provide a complete picture of the relationship between equity securities market indices and macroeconomic variables since it considered only the domestic nominal interest rate.

Kimani and Mutuku (2013) analyzed the effect of inflation, deposit interest rate, gross domestic product, terms of trade, and exchange rate on the Nairobi Securities Exchange's 20-share index using quarterly data for the period 1998 to 2010. Their analysis involved conducting stationarity test using the ADF test, co-integration test using the Johansen-Juselius co-integration test, and constructing the error correction model (ECM). The analysis indicated a statistically significant long-run negative relationship between the NSE 20-share index and inflation, deposit interest rate, and exchange rate. GDP and terms of trade were positively related to the NSE 20-share index (Kimani & Mutuku, 2013). The researchers concluded that international trade is important in the determination of equity prices since the exchange rate and terms of trade had a statistically

significant effect on the NSE 20-share index. Moreover they assert that the negative effect of deposit interest rate on the NSE 20-share index suggest that equity securities and bank deposits are substitute investments. However, Kimani and Mutuku (2013) did not analyze the effects of foreign macroeconomic variables on the NSE 20-share index. Besides, their study used a short sample period, which excluded significant fluctuations in Kenya's macroeconomic variables that occurred before 1998.

Naik and Padhi (2012) used Johansen co-integration test, VECM, and Granger causality test to study the relationship between macroeconomic variables and the Indian stock market index (BSE Sensex). Their data set covered the period 1994 to 2011 and included monthly BSE Sensex, aggregate industrial production, wholesale price index, quantity of money (M2), 91-day Treasury bill rate, and real effective exchange rate. The researchers found that the BSE Sensex index had a long-run positive relationship with quantity of money and industrial production (proxy for real economic activity). By contrast, BSE Sensex Index had a long-run negative relationship with wholesale price index (proxy for inflation). However, 91-day Treasury bill rate and real effective exchange rate had no long-run significant relationship with the BSE Sensex Index (Naik & Padhi, 2012). The macroeconomic variables had no statistically significant short-run relationships with the market index. The Granger causality test revealed a bi-directional causality between aggregate industrial production and BSE Sensex. This suggests that the growth rate of real output is important in pricing equity securities. The Granger causality test also revealed causality from BSE Sensex to wholesale price index, but not vice versa. Quantity of money was also found to Granger cause BSE Sensex. The findings by Naik and Padhi (2012) might not hold in Kenya since India's equities market is much larger and more efficient than the NSE. Besides, India's economy is much larger/ more developed than that of Kenya.

In his analysis of equities market reaction to macroeconomic variables in Nigeria, Terfa (2010) found a statistically significant short-run relationship between Nigeria Stock Exchange's All Share Index and the minimum rediscounting rate (MRR). Exchange rate had a positive relationship with the index in the long-run. The 91-day Treasury bill rate and inflation rate had negative but insignificant relationships with the market index. However, Terfa (2010) did not consider the effects of foreign macroeconomic variables on Nigeria's equities market indices.

The results of his study are based on data for the period 1985 to 2008. The analysis was done using co-integration tests and the error correction model. Unit roots tests were done using the ADF tests.

Hassan and El-Gezery (2010) used data for the period 1993 to 2009 to analyze the effect of macroeconomic variables on equity securities' prices in Egypt. The data set consisted of monthly HFI index (Egypt's equity market index), inflation rate, quantity of money (M2), and exchange rate. The researchers estimation techniques included the ADF test for stationarity; Jerque-Bera test for normality, and Granger causality test. Additionally, they used the vector autoregressive model (VAR) to determine the relationship between the macroeconomic variables and the HFI index. Hassan and El-Gezery (2010) found a bidirectional causal relationship between the HFI index and three macroeconomic variables namely, inflation, exchange rate and interest rate. Moreover, quantity of money (M2) Granger caused the HFI index but not vice versa (Hassan & El-Gezery, 2010). The VAR model revealed that exchange rate had a positive relationship with HFI index, whereas interest rate and quantity of money had a negative relationship with the HFI index. Inflation rate had a negative but insignificant relationship with the HFI index. This contradicts the findings of Kimani and Mutuku (2013) that shows that inflation had a significant negative relationship with the market index in Kenya. Although Hassan and El-Gezery (2010) found that all their variables were I(1), they did not test for co-integration. They modeled the time series in their first difference (stationary), which is likely to have resulted into loss of information concerning the long-run relationship between the market index and the macroeconomic variables.

In Ghana, Adam and Tweneboah (2007) analyzed the effect of macroeconomic variables on equity securities market index using Johansen co-integration test and VECM. Their data set covered the period 1991 to 2006 and included quarterly Ghana Equity Index, inflation, exchange rate, deposit interest rate, and net foreign direct investment (FDI). The researchers performed unit root tests using the ADF and Phillips-Perron tests. The co-integration test revealed long-run positive relationship between the Ghana Equity Index and inflation (CPI), as well as, FDI. By contrast, the long-run relationship between the Ghana Equity Index and exchange rate and interest rate was negative (Adam & Tweneboah, 2007). The positive relationship between

inflation and the Ghana Equity Index supports the argument by Fisher (1930) that investing in equity securities is a hedge against inflation. The VECM showed that all the macroeconomic variables had statistically significant short-run relationships with the Ghana Equity Index and the signs of the coefficients were similar to those of the long-run relationships. Addo and Sunzuoye (2013) also found that deposit interest rate had a negative relationship with Ghana's equity market index. However, Adam and Tweneboah (2007) did not examine the existence of causal relationships between the market index and the macroeconomic variables.

Addo and Sunzuoye (2013) also studied the effect of interest rate (deposit) and 91-day Treasury bill rate on the equity market index in Ghana for the period January 1995 to December 2011. Using Johansen co-integration test and VECM, the researchers showed that interest rate and 91-day T-bill rate have short-run and long-run relationship with Ghana's equity market index (GEI). In particular, there was a negative, but insignificant relationship between 91-day T-bill rate and the GEI. On the other hand, interest rate had a negative and statistically significant relationship with GEI (Addo & Sunzuoye, 2013). In this regard, the researchers argued that an increase in interest rate motivates investors to invest in fixed deposits and T-bills rather than equity securities. Hence, the prices of equity securities fall. Nonetheless, the researchers excluded foreign macroeconomic variables that are also likely to influence the GEI.

Kralik (2012) used data for the period 2002 to 2011 to estimate the effect of macroeconomic variables on equity market index in Romania. The data set consisted of monthly BET-F1 (Romania's equity market index), aggregate industrial production, wholesale price index, exchange rate, foreign exchange reserve, lending interest rate, quantity of money (M2), and oil prices. The researcher employed the ADF test to test for unit root; Johnasen-Juselius co-integration test and the VECM to analyze the effect of the macroeconomic variables on the equity market index. Oil price was positively related to BET, whereas exchange rate, lending interest rate, 91-day T-bill rate were negatively related to BET in the short and long-run (Kralik, 2012). This contradicts the findings by Bellalah, Levyne and Masood (2013), which showed that lending interest rate had a positive and statistically significant effect on equity market indices in the USA and China in the long-run and short-run. Although Romania is a member of the EU, this

study does not provide information on how changes in the union's macroeconomic variables influence BET-F1.

Hosseini, Lai and Ahmed (2011) analyzed the effect of crude oil prices, quantity of money (M2), industrial production, and inflation rate on equity market index in China and India. They used monthly data for the period 1999 to 2009. They used the ADF test, the Johansen-Juselius co-integration test, and the VECM to analyze the long-run and short-run relationship between the equity market index and the macroeconomic variables. In the short-run, the results indicated that crude oil prices had a negative, but insignificant relationship with the Chinese equity market index (CEI). Quantity of money had a positive, but insignificant effect on CEI. Only inflation had a positive and significant effect on CEI. In the long-run, quantity of money and inflation rate had a positive effect on CEI, whereas industrial production had a negative effect on CEI (Hosseini, Ahmad, & Lai, 2011). In India, crude oil price and industrial production had positive and significant short-run relationship with India Stock Exchange Index (BSE). Quantity of money had a negative, but insignificant effect on BSE, whereas inflation had a negative and significant effect on BSE in the short-run. By contrast, industrial production had a positive and significant effect on BSE in the long-run. Although India and China are major trading partners of Kenya, Hosseini, Lai and Ahmed (2011) failed to examine the possible effects that changes in these countries' macroeconomic variables are likely to have on equity market indices in Kenya.

Bellalah, Levyne and Masood (2013) studied the long-run relationship between terms of trade, oil prices, lending interest rate, quantity of money (M3), industrial production and equity market index in China, the USA and Japan. The researchers employed the ADF tests for stationarity and the Autoregressive Distributive Lag (ARDL) technique for testing for co-integration to analyze the effect of the aforementioned macroeconomic variables on equity market indices for the period January 2005 to May 2010. The researchers used the ARDL technique due to its advantage of not requiring all variables to be I(1) as in the case of Johansen co-integration test. Bellalah, Levyne and Masood (2013) found that interest rate, industrial production, and quantity of money (M3) had a positive and statistically significant effect on equity market indices in the USA and China in the long-run and short-run. In Japan, interest rate had a positive and significant relationship with the equity market index in the short-run and long-run. Industrial

production had a positive, but insignificant relationship with the Japanese equity market index in the short-run (Bellalah, Levyne, & Masood, 2013). Terms of trade had a long-run significant positive effect on equity market indices in all the three countries. However, in the short-run terms of trade had a negative effect on equity market index in the USA and Japan, whereas in China the short-run effect was negative. The findings of Bellalah, Levyne and Masood (2013) are based on data from developed countries. Thus, they might not hold in developing countries such as Kenya where equity markets are underdeveloped.

Using the ARDL technique, Savasa and Samiloglub (2010) showed that the Turkish equity market index has a long-term relationship with various macroeconomic variables. The variables included quarterly Turkey's quantity of money (M2), aggregate industrial production, real effective exchange rate, lending interest rate, and Istanbul Stock Exchange's 100-index, as well as, USA's Federal Funds rate for the period January 1986 to March 2008. In the long-run, the researchers found that all the macroeconomic variables, except quantity of money and industrial production had significant negative relationships with the equity market index. The negative relationship between the market index and lending interest rate suggests that high cost of borrowing negatively affects the demand for equity securities (Savasa & Samiloglub, 2010). In the short-run, only money supply had a positive effect on the equity market index, whereas the effect of exchange rate was negative. Although this study considers the relationship between Turkish equity market index and several macroeconomic variables, it ignores the effect of reference interest rates such as the 91-day T-bill rate that normally influence valuation of equity securities.

Ochieng and Oriwo (2012) used data for the period March 2008 to March 2012 to determine the relationship between Nairobi Securities Exchange's All-share index (NASI) and three macroeconomic variables namely, lending interest rate, inflation rate, and the 91-day Treasury bill rate. They used the ARDL bound test to determine if there was co-integration between the NASI and the three macroeconomic variables. According to Ochieng and Oriwo (2012), ARDL was the preferred econometric method since it allows for simultaneous estimation of the short-run and long-run parameters of the model. The time series data used in this study was tested for heteroskedasticity, autocorrelation, and multi-collinearity. The lending rate was eliminated from

the final model because it was found to be correlated with the 91-day Treasury bill rate (Ochieng & Oriwo, 2012). The researchers found that the 91-day Treasury bill rate had a negative relationship with NASI. This finding contradicts that of Naik and Padhi (2012) who found that 91-day T-bill rate had no relationship with equity market index in India. Inflation had a positive but insignificant relationship with NASI. This study used data for a short sample period of only 4 years. Thus, it does not capture much of the reforms that have occurred at the NSE, as well as, the fluctuations in Kenya's macroeconomic variables that are likely to have influenced the NSE indices before 2008.

Alshogeathri (2011) studied the effect of macroeconomic variables on equity securities market index in Saudi Arabia using Johansen-Juselius co-integration test and the VECM. The data set for this study covered the period January 1993 to December 2009 and includes monthly Tadawul All-share Index (TASI), quantity of money (M1 and M2), inflation (CPI), short-term interest rate, nominal effective exchange rate, oil price, and the Standard and Poor's (S&P) 500 index. The Johansen-Juselius co-integration test revealed that M2 and the price of oil had a positive long-run effect on the Tadawul All-share index. By contrast, M1, short-term interest rate, inflation and the S&P 500 (proxy for USA's equity market index) had a negative long-run effect on the Tadawul All-share index. Exchange rate had no statistically significant effect on the index. The negative effect of inflation on TASI suggests that equity securities are not a good hedge against inflation. The co-movement between the S&P500 index and TASI suggest that Saudi Arabia's equity securities market is integrated with the USA's equities markets (Alshogeathri, 2011). However, the study does not shed light on the effect of foreign macroeconomic variables on TASI since the researcher did not consider US macroeconomic variables in his analysis. The results of the VECM indicated that a short-run negative relationship exist between the Tadawul All-share index and M1 and inflation rate. Additionally, the Saudi equity securities market converges to equilibrium within six months.

3.2.2 Foreign Macroeconomic Variables

In their study of foreign macroeconomic variables' influence on equity market indices, Samitas and Kenourgios (2007) concluded that Poland, Czech Republic, Slovakia, and Hungary are neither perfectly integrated nor segmented from foreign equities markets. This conclusion was

based on co-integration test, causality tests, and the VECM analysis. Unit root tests were conducted using ADF and Phillips Perron tests. The data set covered the period 1990 to 2004, and included US and German's quarterly industrial production and interest rate. In the long-run, the researchers found that US industrial production had a significant positive relationship with Poland's equity market index. By contrast, US interest rate had a significant negative effect on Poland's equity market index. German's industrial production and interest rate Granger caused equity market indices in Poland, Czech Republic, Slovakia, and Hungary (Samitas & Kenourgios, 2007). Additionally, there were significant short-run relationships between German's industrial production and interest rate with market indices for the four markets. By contrast, USA's industrial production and interest rate had no short-run effect on any of the four European equity markets' index. Samitas and Kenourgios (2007) considered only developed countries in Europe. Thus, their study does not provide information concerning the likely effects of US and EU macroeconomic variables on equity market indices in developing African countries such as Kenya.

Gracia and Yu (2010) found that USA's macroeconomic variables have statistically significant effects on equity market indices in China. In particular, the US equity securities market index (Dow Jones Industrial Average) and consumer confidence index (CCI) had a significant and positive relationship with the Shanghai Composite Index (equity market index for China) in the short and long-run. By contrast, US industrial production had a negative relationship with the Shanghai Composite Index in the long-run (Gracia & Yu, 2010). The study does not provide insights on the effect of EU macroeconomic variables on equities market indices in other countries since the researchers considered the US as the only source of foreign macroeconomic shocks. The results of the study are based on Johansen co-integration test and the VECM. The diagnostic tests that were conducted include unit root test using the ADF and normality test using the Jarque-Bera test. The data set covered the period January 2000 to July 2009.

Vera-Juarez and Garza-Gracia (2010) employed Johansen-Juselius co-integration test, Granger causality tests, and VECM to study the effect of industrial production and lending interest rates in China and the US on equity securities' market indices in Mexico, Chile, and Brazil. In this study, unit root test was done using the ADF and Phillip-Perron tests. The researchers used data

for the period January 2000 to December 2009, which consisted of monthly equity market indices for each country and the USA's and Chinese interest rate and aggregate industrial production. US industrial production had a positive and statistically significant effect on equity market indices in Mexico and Chile, but not in Brazil in the short-run and long-run. On the other hand, US interest rate had a positive effect on equity market indices in Brazil and Chile and a negative effect on Mexico's equity market index in the long-run (Vera-Juarez & Garza-Gracia, 2010). The researchers argued that since Mexico's economy is highly linked to that of the US, a rise in US interest rate raises the cost of investing in equities in Mexico, which in turn leads to a decline in Mexico's equity market index. Chinese industrial production had a positive and significant effect in Mexico, but no effect on equity market indices in Chile and Brazil. By contrast, Chinese interest rate had a positive short-run and long-run relationship with equity market indices in Brazil and Chile. However, Chinese interest rate was negatively related to Mexico's equity market index in the long-run. The researchers did not consider the possible effects of foreign quantity of money and inflation rate on market indices in Mexico, Chile, and Brazil.

Using Johansen-Juselius co-integration tests and VECM, Nasseh and Strauss (2000) found that domestic and foreign macroeconomic variables significantly affected equity market indices in France, German, Italy, Netherlands, Switzerland, and the UK. In this study, the macroeconomic variables included quarterly short-term interest rates, and aggregate industrial production index for each country for the period 1995 to 2000. For every pair of the countries included in the study, the researchers found that domestic and foreign industrial production had a positive and significant relationship with equity market indices in the long-run and short-run. By contrast, domestic and foreign short-term interest rates had a negative relationship with equity market indices (Nasseh & Straus, 2000). However, the study failed to determine the existence of causal relationships between the equity market indices and the foreign macroeconomic variables.

Anaraki (2010) analyzed the response of equity prices in the European Union to changes in the United States' macroeconomic variables. He used data for the period 1999 to 2009, which included USA's quantity of money (M2), Federal Fund rate, industrial production index, inflation rate, NASDAQ industrial index, Dow Jones (DJ) index, as well as, EU's quantity of

money (M2), industrial production index, inflation, EUDJ (European Dow Jones), and exchange rate. The researcher used Johansen-Juselius co-integration test, Granger causality test, and VECM in his analysis. Additionally, he conducted unit root test using the ADF test. The Granger causality test indicated that the US macroeconomic variables and equity market indices Granger caused EUDJ (Anaraki, 2010). The VECM results showed that the US Federal Reserve fund, industrial production index, USDJ, and NASDAQ had statistically significant positive effect on EUDJ only in the short-run. This finding suggests that the US and EU equity markets are integrated.

3.3 Overview of the Literature

The literature reviewed show evidence of long-run and short-run relationships between various macroeconomic variables and equity securities' market indices. Co-integration test and the VECM have widely been used in the literature to investigate the long-run and short-run relationships between macroeconomic variables and equity market indices. Despite the efforts made by earlier researchers, the results are still mixed. For example, inflation rate has been found to have a positive relationship with market indices in some countries and a negative relationship in other countries. Additionally, the effect of foreign macroeconomic variables on domestic market indices have mostly been done in developed and emerging markets in Asia, Latin America, and Europe. The African continent has been given little attention in this regard. Consequently, the objective of this study was to contribute to the existing literature by analyzing the effect of both domestic and foreign macroeconomic variables on market indices in the context of a developing African country.

CHAPTER FOUR
METHODOLOGY

4.1 Model Specification

This study followed the approach adopted by Gracia and Yu (2010) to estimate the relationship between macroeconomic variables and stock market indices. These researchers used the Johansen-Juselius co-integration test and the VECM in their study. Gracia and Yu (2010) modeled the Shanghai Composite index as a function of China's quantity of money (M1 and M2), short-term interest rate, long-term interest rate, and exchange rate, as well as, US Dow Jones Industrial Average index (DJIA), industrial production index, and consumer confidence index. They first tested for unit roots in their data using the ADF test and found that all the variables were non-stationary in their levels, but stationary after the first difference. Therefore, using the ordinary least squares (OLS) method and the variables in their levels was not appropriate since it would lead to spurious regression. Since all the variables were integrated of order one, the researchers concluded that the Johansen-Juselius co-integration test was appropriate for testing for co-integration. The trace and maximum eigenvalue tests revealed that the time series had more than one co-integrating vectors. Consequently, it was necessary to estimate a vector error correction model (VECM) to determine the long-run and short-run relationships between the Shanghai Composite index and the macroeconomic variables.

This study considered five macroeconomic variables namely, Kenya's inflation rate and discounting interest rate proxied by the 91-day T-bill rate, as well as, the European Union's quantity of money (M3), industrial production index, and inflation rate. Based on the arbitrage pricing theory, the present value cash flow model, and empirical evidence, it is hypothesized that the NSE 20-share index is a function of several variables. The hypothesized relationship is given as:

$$LNSEI = f(LINF^{K}, LI^{K}, LM3^{EU}, LINF^{EU}, LEUIP, LFTSE100) \qquad (3)$$

Where

L denotes natural logarithm

$NSEI$ is Nairobi Securities Exchange's 20-share Index

INF^{K} is Kenya's inflation rate

I^K is Kenya's interest rate (91-day Treasury bill rate)

$M3^{EU}$ is European Union's quantity of money (M3)

INF^{EU} is European Union's inflation rate

$EUIP$ is European Union's industrial production index

$FTSE100$ is London Stock Exchange's index

The variables were transformed to their natural logarithms in order to linearize the relationship between them and to reduce heteroscedasticity. The FTSE 100 index was included in the model to capture the integration between the NSE and the EU securities markets.[3] It was chosen as a representative EU equity market index because the London Stock Exchange is the largest equity market in the European Union in terms of market capitalization, the number of shares traded, and market turnover (World Federation of Exchanges, 2013).

4.2 Data Sources

This study used monthly data for the period 1993 to 2013. The period was chosen because it is characterized with substantial policy changes at the NSE and in the economy, which influenced the performance of the bourse. These include allowing foreign investors to participate at the NSE, removal of foreign exchange control, introduction of online trading at the NSE, increased value of trade with the EU, and economic liberalization. Kenya's reported inflation rate and the NSE 20-share index data were obtained from KNBS, whereas the 91-day T-bill rate was obtained from the Central Bank of Kenya (CBK). European Union's inflation rate and quantity of money (M3) data were obtained from Eurostats, whereas the FTSE 100 index data was obtained from the FTSE Group's website.

4.3 Estimation Procedure

4.3.1 Descriptive Statistics

The first step was to describe the stochastic properties of all the time series data by calculating their mean, kurtosis, skewness, standard deviation, minimum and maximum values, as well as, testing for normality using the kurtosis-skewness normality test.

[3] This will be captured by the co-movement between the NSE 20-share index and the FTSE 100 index as illustrated by Anaraki (2010) and Alshogeathri (2011) in the empirical literature review.

4.3.2 Unit Root Test

The second step involved conducting unit root tests using the Augmented Dickey-Fuller test to determine the order of integration of each variable. The model for the ADF test was of the form:

$\Delta y_t = \theta + \beta T + \rho y_{t-1} + \sum_{i=1}^{N} \gamma_i \Delta y_{t-i} + \mu_t$ (4)

Where

Δy_t and y_t denote the first difference and the levels of the relevant time series

T denotes the time trend

t denotes the time period

$\theta, \beta, \rho, and\ \gamma_i$ are parameters

μ_t is a white noise residual

The ADF tests the hypothesis:

$H_0: \rho = 0$ implies that the series has a unit root (non-stationary)

$H_0: \rho < 0$ implies that the series has no unit root (stationary)

4.3.3 Co-integration Analysis

In the third step, the Johansen-Juselius co-integration test was used to test for co-integration. The test was based on a $VAR_{(p)}$ of the form:

$Y_t = \mu + A_1 Y_{t-1} + A_2 Y_{t-2} + A_3 Y_{t-3} + \cdots A_P Y_{t-P} + \varepsilon_t$ (5)

Where

$Y_t = (Y_{1t} \cdots Y_{nt})$ is a vector of the variables i.e. the NSE 20-share index, FTSE 100 index, and the macroeconomic variables

The subscript t denotes the time period

μ and A's are matrices of the parameters

The subscript p is the maximum lag length in the model

ε_t is a vector of white noise error terms

4.3.4 Determining the Optimal Lag length of the VAR Model

Using the Johansen-Juselius co-integration test requires specification of the appropriate lag length for the VAR model. A very low lag length can lead to serial correlation, whereas a very high lag length may negatively affect the asymptotic properties of estimates (Hendry & Juselius, 1999). Lutkepohl (2005) and Enders (2010) suggested five criteria for determining the optimal lag-length. These include the sequential modified likelihood ratio (LR) test; the final prediction error (FPE); the Akaike information criterion (AIC); the Schwartz-Bayesian information criterion (SBIC); and the Hannan-Quinn information criterion (HQ). Using a single information criterion may lead to selection of incorrect lag length since different information criteria often identify different lag lengths (Alshogeathri, 2011). Consequently, all the five information criteria were used to test for co-integration sequentially beginning from the lowest lag length to obtain meaningful results.

4.3.5 Co-integrating Vectors

The fourth step was to determine the number of co-integrating vectors. Equation 5 can be rewritten in a VECM form as:

$$\Delta Y_t = \mu + \Pi Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + \varepsilon_t \qquad (6)$$

According to Engle and Granger (1987), if the variables in vector Y_t are $I(1)$ the rank of matrix Π will be $0 \leq r < n$ where r is the number of co-integrating vectors. If the variables are co-integrated, equation 6 indicates that a VAR in first difference is misspecified since it omits the lagged level term ΠY_{t-1}.

Testing for co-integration involved determining the rank (r) of matrix Π, where:

A rank of zero i.e. $r = 0$ means that the variables are not co-integrated

A full rank i.e. $r = n$ (number of variables in the model) implies that all variables are stationary in their levels

A rank greater than zero but less than n i.e. $r \leq (n-1)$ implies that the variables are co-integrated

The rank of matrix Π was determined through two likelihood ratio tests namely, the trace statistic and the maximum eigenvalue test whose test statistics are given as:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{n} ln\left(1 - \hat{\lambda}_i\right) \qquad (7)$$

$\lambda_{max}(r, r+1) = -Tln\ ln(1 - \hat{\lambda}_{r+1})$ (8)

Where $\hat{\lambda}_i$ is the i^{th} largest eigenvalue or characteristic roots of the Π_i matrix and T is the sample size.

The maximum eigenvalue statistic tests the hypothesis:

$H_0(r_0): r = r_0$

$H_1(r_0): r_0 = r_0 + 1$

The trace statistic tests the hypotheses:

$H_0(r): r = r_0$

$H_1(r_0): r > r_0$

4.3.6 The Vector Error Correction Model (VECM)

Finally, a VECM was estimated to determine the long-run and short-run relationships between the NSE 20-share index and the macroeconomic variables. The VECM is given as:

$\Delta Y_t = \mu + \Pi Y_{t-1} + \sum_{i=1}^{p} \Gamma_i \Delta Y_{t-i} + \varepsilon_t$ (9)

Where

Y_t is a vector of the variables (the NSE 20-share index, FTSE 100 index, and the macroeconomic variables)

Δ is the difference operator

p is the order of auto-correlation

μ is a vector of constants

Π is the error correction mechanism

$\Pi = \alpha\beta'$ where α is an $n \times r$ column vector of adjustment parameters

β' is the matrix of the long-run coefficients

Γ_i is the matrix of the short-run coefficients

ε_t is an $n \times 1$ vector of white noise error terms

4.4 Diagnostic Tests

4.4.1 Testing for Stability

The reliability of the inferences made from the parameters of the VECM depends on the stationarity of the co-integrating equations, and whether the appropriate number of co-integrating equations was specified. The companion matrix of a$VECM$ with N dependent variables and r co-

integrating equations has $N - r$ unit eigenvalues (Alshogeathri, 2011). If the model is stable, the remaining eigenvalues are strictly less than one. To check for this stability condition, the eigenvalues of the companion matrix were calculated and plotted.

4.4.2 Testing for Serial Correlation

According to Hendry and Juselius (1999), the finite-sample bias in the estimated parameters can increase, thereby causing serial correlation if the lag length of the VECM is underspecified. In this regard, the Lagrange-multiplier test was used to test for serial correlation in the residuals of the VECM to determine if the model was specified correctly.

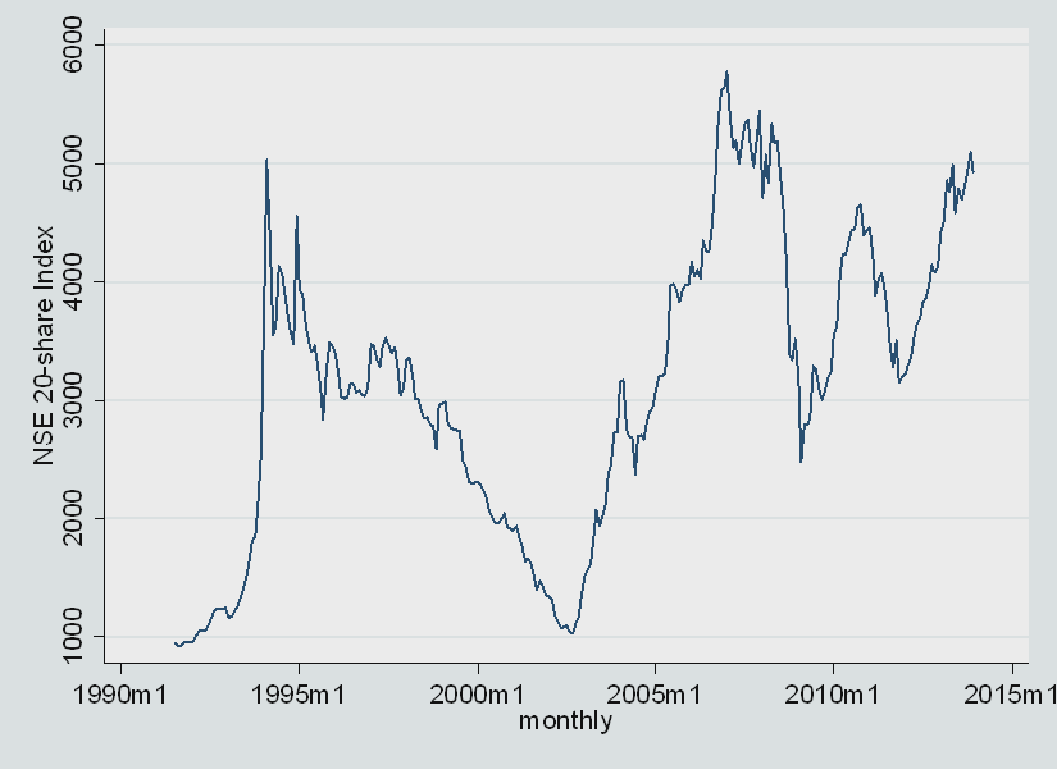
CHAPTER FIVE
EMPIRICAL RESULTS

5.1 Definition of the Variables

The NSE 20-share Index

The NSE 20-share index is a price-weighted index calculated as a geometric mean of the average daily closing prices of 20 selected counters. The index was selected because it is the only index that has a time series of more than twenty years. The monthly data represent the value of the index on the last trading day of the month. Figure 2 shows that the NSE 20-share index has a cyclical variation.

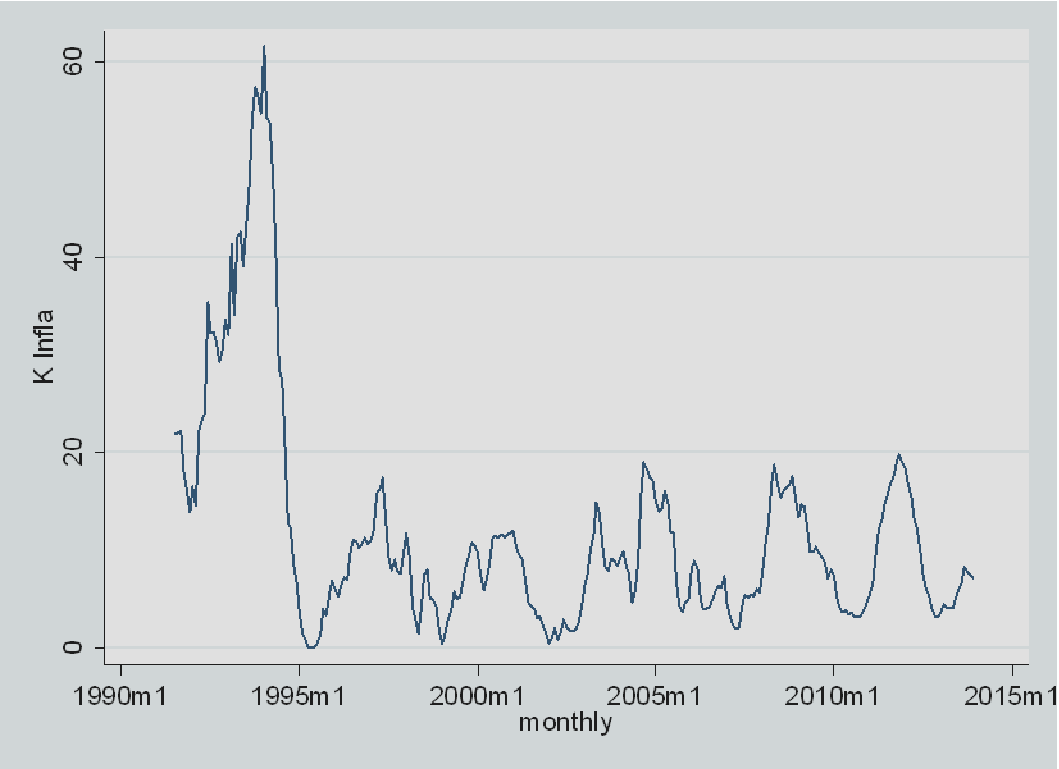
Figure 2: NSE 20-share index



Inflation Rate (Kenya)

The monthly inflation rate figures are calculated by dividing the consumer price index (CPI) at the end of a given month by the CPI at the end of a similar month in the preceding year. The results are multiplied by 100 to get the inflation rate. Figure 3 shows an irregular variation in Kenya's inflation rate.

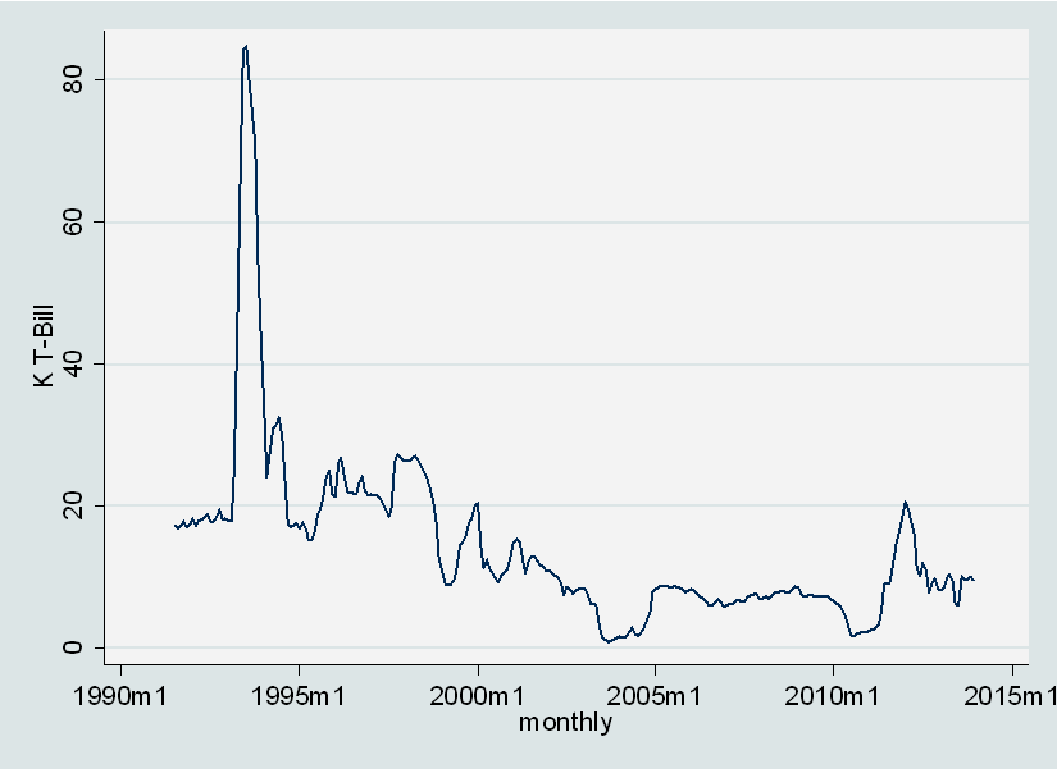
Figure 3: Inflation rate



The 91-day Treasury Bill Rate

The 91-day Treasury bill rate was selected because it is a reference interest rate used in pricing equity securities. Treasury bills are issued by the Central Bank of Kenya (CBK) on a weekly basis through a competitive auction process. However, occasionally the weekly auctions fail if the investors' bids are too high. In this respect, the missing values for the weekly T-bill rate were extrapolated. Thus, the monthly 91-day T-bill rates are the mean of the rates quoted in all weeks in each month. Figure 4 shows a downward trend in the 91-day T-bill rate. The outlier at the beginning of the sample period corresponds to the high inflation rate (over 30%) of the 1993-1994, which led to high interest rates. Similarly, the sharp rise towards the end of the sample period is attributed to the high inflation rate (over 13%) at the beginning of 2012.

Figure 4: 91-day T-bills rate

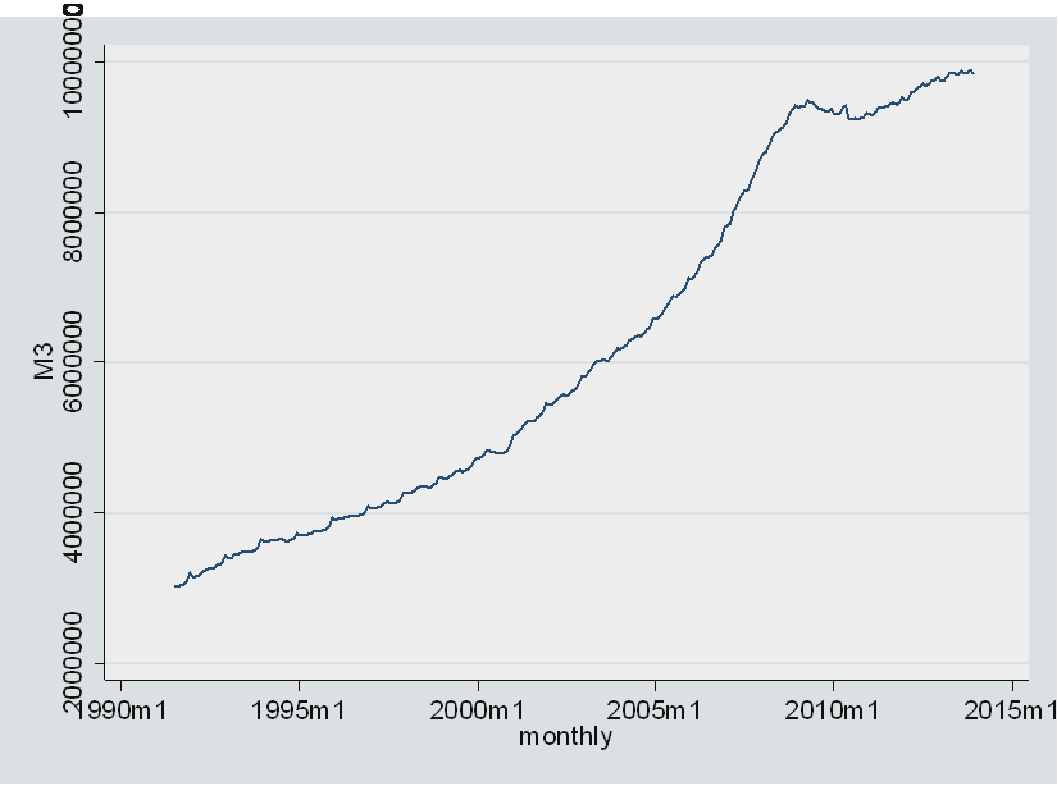


EU's Quantity of Money (M3)

Eighteen (Eurozone) out of the twenty-eight countries within the EU use the Euro, whereas the rest use their own currencies. The Eurozone is Kenya's largest trading partner followed by the UK and Sweden within the EU.[4] Thus, Eurozone's M3 was selected as the representative quantity of money in the EU. M3 includes the currency in circulation, overnight deposits, fixed deposits with a maturity period not exceeding 2 years, repurchase agreements, money market funds, shares/ units, and debt securities that mature within 2 years. Since M3 is the broad money in the Eurozone, it was chosen because it is likely to give a more complete picture of the effect of quantity of money on equity market indices than narrow monetary aggregates such as M1, M2, and M0. The monthly figures represent the total outstanding/ stock of M3 at the end of each month. Figure 5 shows that M3 has an upward trend.

[4] See the KNBS 2013 statistical abstract on Kenya's imports and exports

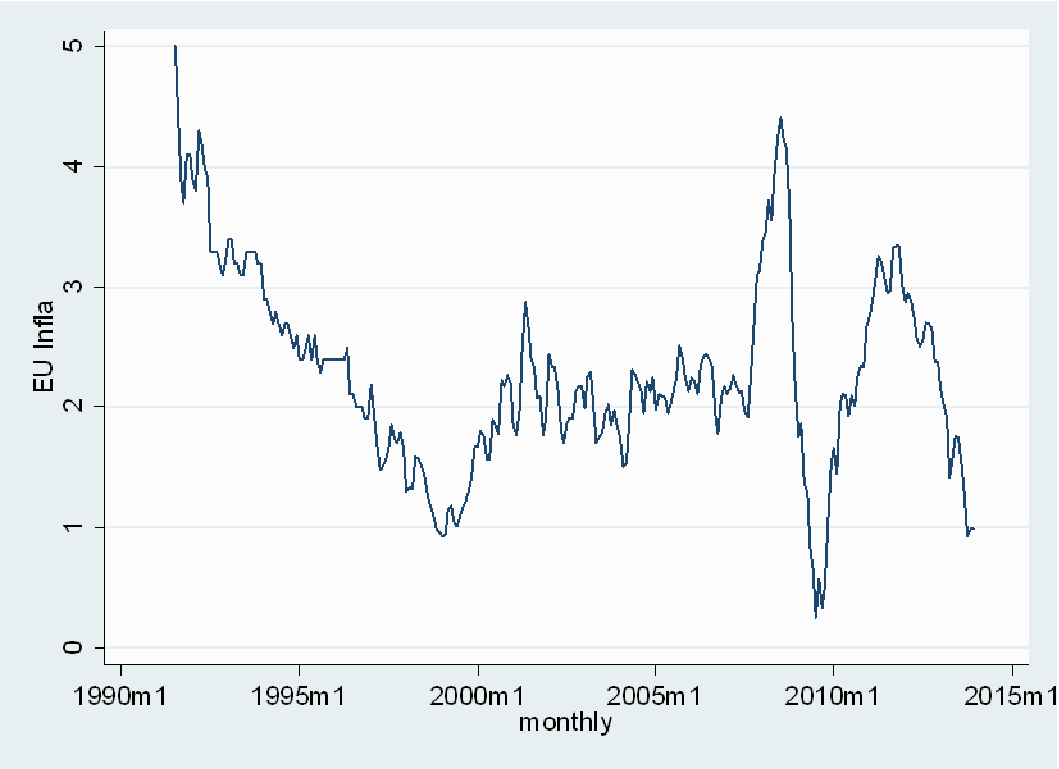
Figure 5: EU's M3



EU's Inflation Rate

EU's inflation rate is derived from the harmonized index of consumer prices (HICP). It is calculated as the percentage change in the HICP. Figure 6 shows a downward trend in EU's inflation rate from 1991 to 1998. Thereafter, it rises in a cyclical pattern until 2007. The sharp rise and fall between 2007 and 2011 is attributed to the 2008/2009 global financial crisis (Anaraki, 2010).

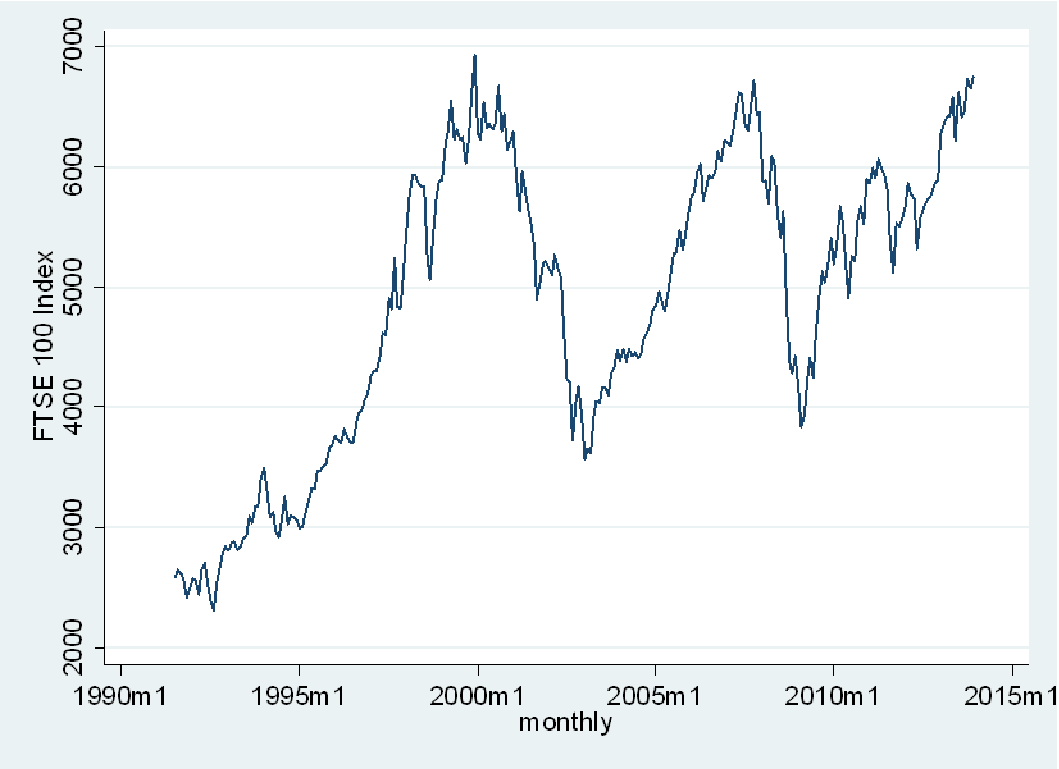
Figure 6: EU's inflation rate



FTSE 100 Index

The FTSE 100 index tracks the performance of the 100 blue chip companies listed at the London Stock Exchange (LSE). It is a weighted index where the weights are the market capitalization of the constituent firms. The index was selected because it represents nearly 81% of the total capitalization of the LSE. It also has a high correlation of 99.6% with the FTSE UK Large Cap Super Liquid Index (LSE, 2014), which tracks the performance of the most liquid counters at the LSE. Thus, it is likely to give a better picture of the performance of the market in terms of both capitalization and liquidity than alternative indices such as the FTSE 250 and FTSE 350. Figure 7 shows an upward trend in the FTSE 100 index.

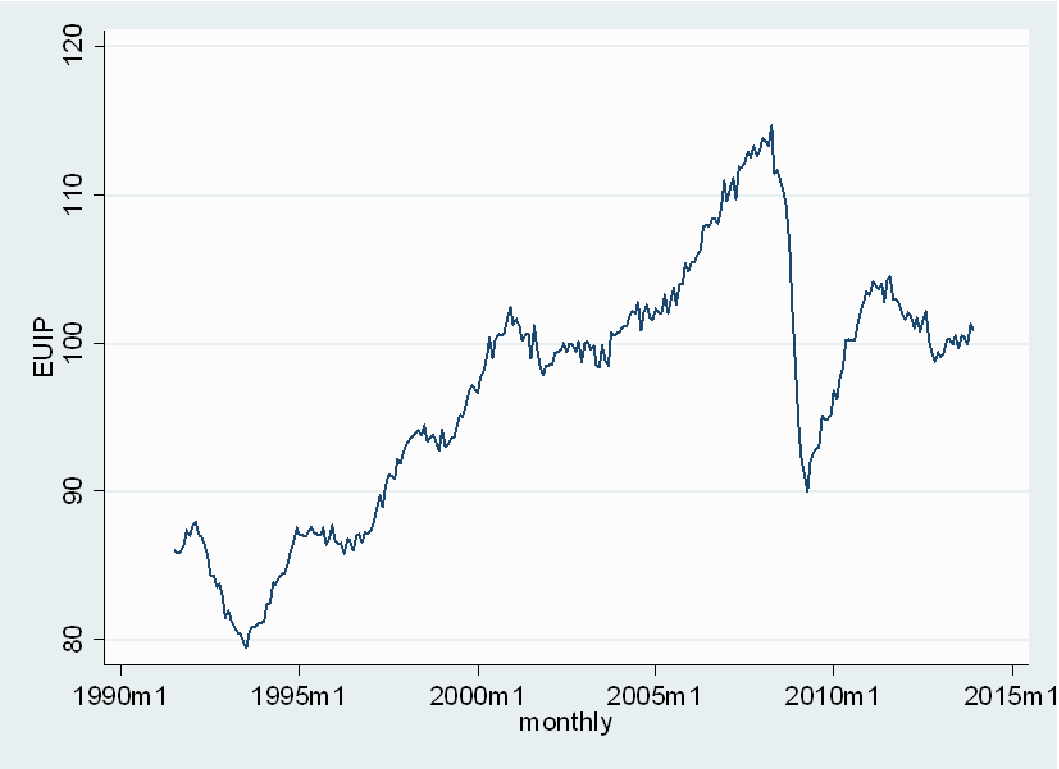
Figure 7: FTSE 100 Index



EU Industrial Production Index

Industrial production index tracks the changes in value addition in the manufacturing, services, mining, and energy sectors in the EU. The index was chosen since it is the most important indicator of economic activity in the EU in the short-run. Besides, data for alternative economic growth indicators such as GDP is released on quarterly rather than monthly basis in the EU. Figure 8 indicates that EU's industrial production index has an upward trend. However, there was a sharp fall and rise in the index during and after the 2008/2009 global financial crisis.

Figure 8: EU's industrial production index



5.2 Descriptive Statistics

Table 3 summarizes the descriptive statistics of each variable. There were a total of 252 observations per variable. The table presents the mean, standard deviation, variance, skewness, Kurtosis, as well as, the maximum and minimum values of each series. The standard deviations suggest that the NSE 20-share index, FTSE 100 index, and M3 are more volatile than other variables. All the series except the NSE 20-share index, EU industrial production index, and the FTSE 100 index are positively skewed. Kenya's inflation rate and T-bill rate seem to be leptokurtic due to their high positive Kurtosis. The remaining variables have positive but low kurtosis, suggesting that their distribution is relatively flat.

Table 3: Descriptive statistics

Variable	Mean	Std. deviation	Variance	Skewness	Kurtosis	Minimum value	Maximum value
NSE 20-share Index	3259.308	1150.667	1324036	-0.040787	2.32133	1027	5774
Inflation rate (Kenya)	10.93552	11.20538	125.5605	2.602562	10.06755	0.03	61.54
91-day T-bill (Kenya)	13.97905	12.98979	168.7347	3.066794	15.15017	0.83	84.67
M3	6427712	2270331	$5.15*10^{12}$	0.2501331	1.501117	3397738	9888642
Inflation rate (EU)	2.17127	0.708005	0.501271	0.274515	3.558961	0.25	4.41
FTSE 100 Index	5040.138	1111.824	1236152	-0.411864	2.00628	2807.2	6930.2
EUIP	97.553	8.218445	67.54284	-0.264482	2.533995	79.46	114.71

5.2.1 Normality Tests

Table 4 presents the results for normality test. The joint skewness/ kurtosis tests indicate that the null hypothesis of normal distribution is rejected at 5% level of significance for all variables. This leads to the conclusion that the time series were not normally distributed.

Table 4: Skewness/ Kurtosis tests for normality

			Joint test	
Variable	Pr(Skewness)	Pr(Kurtosis)	adj chi2(2)	Prob>chi2
NSE 20-share Index	0.786	0.001	9.32	0.0095
Inflation rate (Kenya)	0.000	0.000	.	0.0000
91-day T-bill (Kenya)	0.000	0.000	.	0.0000
M3	0.100	.	.	.
Inflation rate (EU)	0.072	0.085	6.07	0.0482
FTSE 100 Index	0.008	0.000	39.14	0.0000
EUIP	0.083	0.072	6.09	0.0475

5.2.2 Correlation Matrix

Figure 9: Correlation matrix for the variables in their natural logarithms

	LNSEI	$LINF^{K}$	LI^{K}	$LM3^{EU}$	$LINF^{EU}$	LFTSE 100	LEUIP
LNSEI	1.0000						
$LINF^{K}$	-0.0069	1.0000					
LI^{K}	-0.1951*	0.2187*	1.0000				
$LM3^{EU}$	0.4581*	-0.0361	-0.6176*	1.0000			
$LINF^{EU}$	0.0471	0.1919*	0.1000	-0.0251	1.0000		
LFTSE100	0.3217*	-0.2036*	-0.3453*	0.5800*	-0.2464*	1.0000	
LEUIP	0.3145*	-0.1843*	-0.6531*	0.7484*	0.0832	0.7531*	1.0000

*Where * means the coefficient is statistically significant at 5% level of significance*

The correlation between the variables is summarized in figure 9. The figure indicates the expected negative correlation between the NSE 20-share index (LNSEI) and Kenya's inflation rate ($LINF^K$) and T-bill rate **(**LI^K). M3, EU industrial production index (LEUIP) and FTSE 100 index have a positive and statistically significant correlation with the NSE 20-share index. The correlation between EU inflation ($LINF^{EU}$) and the NSE 20-share index is positive but insignificant. The correlations between most of the independent variables are also statistically significant. This suggests that multi-collinearity might be a problem in the time series.

5.2.3 Test for Multi-collinearity

According to Wooldridge (2011), multi-collinearity is likely to exist if all the t-ratios of the coefficients of the variables in a model are not statistically significant, whereas the overall F-statistic is significant. In this respect, an OLS regression was estimated where the natural log of the NSE 20-share index was the dependent variable and the logs of the other variables were independent variables. As shown in table 5, only the coefficient of Kenya's inflation rate and T-bill rate were not statistically significant. The overall F-statistic is significant at all levels of statistical significance.

Table 5: OLS regression

Source	SS	df	MS	Number of obs. = 252
Model	10.3684	6	1.7281	F (5, 264) = 13.23
Residual	31.9894	245	0.1306	Prob> F = 0.0000
Total	42.3578	251	0.1688	R-squared = 0.2448
				Adj. R-squared = 0.2263
LNSEI	Coefficient	Std. Error	t	$p > \|t\|$
$LINF^K$	-0.0091	0.0242	-0.38	0.705
LI^K	0.0170	0.0441	0.38	0.701
$LM3^{EU}$	0.6141	0.1016	6.05	0.000
$LINF^{EU}$	0.1611	0.0740	2.18	0.031
LFTSE100	0.4590	0.1840	2.49	0.013
LEUIP	-1.3799	0.6686	-2.06	0.040
Constant	0.7067	1.9477	0.36	0.717

Given that some coefficients are not statistically significant, the presence of multi-collinearity was further tested by estimating the variance inflation factor (VIFs) for the coefficient of each variable. According to Wooldridge (2011), multi-collinearity is a serious problem if the VIFs exceed 10. As indicated in table 6, the VIFs for all variables are less than 10 and the mean VIF is only 2.99. Thus, multi-collinearity is not a serious problem in the time series.

Table 6: Variance inflation factors (VIFs)

Variable	VIF	$1/VIF$
$LM3^{EU}$	6.33	0.158011
LFTSE100	3.78	0.264395
LI^{K}	2.60	0.384277
$LINF^{EU}$	2.51	0.399180
$LINF^{K}$	1.58	0.631687
LEUIP	1.15	0.866846
Mean VIF	2.99	

5.3 Unit Root Tests Results

Since most of the time series exhibit a trend, the unit root test was conducted using the ADF test, where a time trend was included in model 4. The test was also conducted without a trend term in model 4 to determine the consistency of the results. The results of the ADF tests for the variables in their natural logs are presented in table 7.

Table 7: Results of the ADF Test for stationarity

Variables in their levels		
	Model with intercept only	Model with intercept and trend
	p-value for z(t)	p-value for z(t)
LNSEI	0.2361	0.5992
$LINF^{K}$	0.0156	0.0735
LI^{K}	0.4566	0.6882
$LM3^{EU}$	0.6125	0.9966
$LINF^{EU}$	0.0516	0.1781
LFTSE100	0.2735	0.5580
LEUIP	0.3064	0.9002
Variables in their first difference		
LNSEI	0.0000	0.0000
$LINF^{K}$	0.0000	0.0000
LI^{K}	0.0000	0.0000
$LM3^{EU}$	0.0000	0.0000
$LINF^{EU}$	0.0000	0.0000
LFTSE100	0.0000	0.0000
LEUIP	0.0000	0.0000

The null hypothesis of a unit root was accepted at all significance levels for the NSE 20-share Index (LNSEI), T-bill rate (LI^{K}), EU's M3 (LM3), and FTSE 100 index (LFTSE100) in their levels. However, for Kenya's inflation rate ($LINF^{K}$) the null hypothesis of a unit root was accepted only at the 1% level of significance in the model with only an intercept and at both 1% and 5% in the model with a trend and an intercept. For EU's inflation rate, the null hypothesis was accepted at 1% and 5% in the model with only an intercept, but at all levels in the model that included a trend. All the variables were stationary in their first difference.

5.4 Co-integration Analysis

5.4.1 Selecting the Appropriate Lag length for the VAR model (equation 5)

Table 8 shows the lag lengths selected by the five information criteria. The sequential modified likelihood ratio (LR) selected lag 4, whereas the Schwartz-Bayesian information criteria (SBIC) selected lag 1. The final predictive error criteria (FPE) and the Akaike information criteria (AIC), selected lag 3. The Hannan-Quinn (HQIC) information criteria selected lag 2. Lag 3 was selected since it does not produce serial autocorrelation in the VAR and the VECM.

Table 8: Model selection results

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-328.597				3.5e-08	2.70642	2.74635	2.80559
1	2646.81	5950.8	49	0.000	2.0e-18	-20.8936	-20.5743	-20.1003*
2	2734.78	175.94	49	0.000	1.5e-18	-21.2079	-20.6091*	-19.7204
3	2788.61	107.66	49	0.000	1.4e-18*	-21.2469*	-20.3686	-19.0651
4	2825.19	73.165*	49	0.014	1.6e-18	-21.1467	-19.989	-18.2708

*Where * indicates the selected lag length*

5.4.2 Co-integration Test Results

Table 9: Results of Johansen-Juselius tests for co-integration

Trend: constant		Number of obs. = 249			
Sample: 1993m4 to 2013m12		Lags = 3			
Maximum rank	Parms	LL	Eigenvalue	Trace statistic	5% critical value
0	105	2702.7325	.	189.0591	124.24
1	118	2740.1136	0.25937	114.2969	94.15
2	129	2763.5367	0.17150	67.4507*	68.52
3	138	2778.7159	0.11478	37.0924	47.21
4	145	2788.7786	0.07765	16.9668	29.68
5	150	2792.4958	0.02942	9.5326	15.41
6	153	2795.7523	0.02582	3.0195	3.76
7	154	2797.262	0.01205		

The co-integration test results based on the trace and maximum eigenvalue statistic are presented in table 9. The results show that there were two co-integrating vectors at the 5% significance level. This means that there were long-run relationships between the NSE 20-share index and the macroeconomic variables. In addition, at least one unidirectional causal relationship existed in the system as suggested by the Granger representation theorem. In this respect, it was necessary to test for Granger causality and to estimate the long-run and short-run relationships between the variables using the VECM.

5.4.3 Granger Causality Tests Results

Table 10: Granger causality

LNSEI as dependent variable	Chi2	df	Prob> chi2	Conclusion
Null hypotheses:				
$LINF^{K}$ does not Granger cause LNSEI	2.0469	2	0.359	Accept
LI^{K} does not Granger cause LNSEI	7.638	2	0.022	Reject
$LM3^{EU}$ does not Granger cause LNSEI	11.351	2	0.003	Reject
$LINF^{EU}$ does not Granger cause LNSEI	1.084	2	0.582	Accept
LFTSE100 does not Granger cause LNSEI	4.3767	2	0.112	Accept
LEUIP does not Granger cause LNSEI	0.99403	2	0.608	Accept
LNSE as independent variable				
Null hypotheses:				
LNSE does not Granger cause $LINF^{K}$	0.3764	2	0.828	Accept
LNSE does not Granger cause LI^{K}	3.5046	2	0.173	Accept
LNSE does not Granger cause $LM3^{EU}$	0.7978	2	0.671	Accept
LNSE does not Granger cause $LINF^{EU}$	4.8491	2	0.089	Reject
LNSE does not Granger cause LFTSE100	0.7111	2	0.701	Accept
LNSE does not Granger cause LEUIP	11.769	2	0.003	Reject

The results of Granger causality tests are reported in table 10. Kenya's T-bill rate and EU's M3 were found to Granger cause the NSE 20-share index. However, the NSE 20-share index did not Granger cause the T-bill rate and M3. The remaining macroeconomic variables did not Granger cause the NSE 20-share index. Surprisingly, the null hypotheses that the NSE 20-share index does not Granger causing EU inflation rate and industrial production index were rejected at 10% and 1% significance levels respectively. This implies a unidirectional causal relationship running

from the NSE 20-share index to EU's inflation rate and industrial production index. However, the NSE 20-share index did not Granger cause any other macroeconomic variable.

5.4.4 The VECM Results

Co-integration test is "often sensitive to the presence of deterministic trends" (Hendry & Juselius, 1999). Accordingly, Johansen (1995) assert that the appropriate deterministic trend assumption should be made before estimating the VECM. There are five possible deterministic trends, which are summarized in table 11.

Table 11: Types of deterministic trends

	VAR	Co-integrating relationships
1	No deterministic trends	No intercept and trend
2	No deterministic trends	Has an intercept with no trend
3	Linear trend	Has an intercept only
4	Linear trend	Has a deterministic trend only
5	Quadratic trend	Linear deterministic trend

The unit root tests indicated that the time series were difference stationary. This implies that their mean trend was stochastic. Thus, the VECM (equation 9) was estimated based on the assumption that the VAR had a linear trend, whereas the co-integrating relationships had only an intercept (third option in table 11). Table 12A provides information about the VECM in terms of the fit of each equation, the sample, and the overall model fit statistics. The short-run and long-run coefficients are interpreted as elasticities due to log transformation, i.e. percentage changes.

Table 12A: model fit statistics

Sample: 1993m4 – 2013m12 Log likelihood = 2763.537 Det (Sigma_ml) = 5.40e-19			No. of obs. = 249 AIC = -21.16094 HQIC = -20.42743 SBIC = -19.33864		
Equation	Parms	RMSE	R-squared	Chi2	P>chi2
LNSEI	17	0.063752	0.2724	86.464	0.0000
$LINF^{K}$	17	0.381415	0.1151	30.0352	0.0261
LI^{K}	17	0.139956	0.3047	101.2527	0.0000
$LM3^{EU}$	17	0.005914	0.4461	186.0784	0.0000
$LINF^{EU}$	17	0.14196	0.1019	26.1994	0.0709
LFTSE100	17	0.040976	0.0692	17.16347	0.4433
LEUIP	17	0.008809	0.2421	73.78921	0.0000

Short-run Relationships

The short-run coefficients of the equation where the NSE 20-share index is the dependent variable are reported in table 12B. The adjustment parameter is statistically significant at 1% level of significance. Additionally, it has the expected negative sign. This means that the NSE 20-share index adjusts to its long-run equilibrium after deviating in the short-run. The T-bill rate has a negative and statistically significant relationship with the NSE 20-share index. By contrast, EU's M3, the FTSE 100 index, and industrial production index have positive and statistically significant relationships with the NSE 20-share index in the short-run. However, Kenya's and EU's inflation rates have positive, but insignificant relationships with the NSE 20-share index.

Table 12B: Short-run parameters

LNSEI	Coefficient	Std. error	z	$p > \|z\|$
Adj. parameter	-0.0280	0.0055	-5.09	0.000
LNSEI	0.0574	0.0645	0.89	0.373
$LINF^{K}$	0.0090	0.0108	0.83	0.405
LI^{K}	-0.0772	0.0286	-2.70	0.007*
$LM3^{EU}$	2.6381	0.7027	3.75	0.000*
$LINF^{EU}$	9.99e-06	0.0287	0.00	0.997
LFTSE100	0.2448	0.1090	2.25	0.025**
LEUIP	0.8892	0.4567	1.95	0.052***
Constant	-0.0057	0.0056	-1.02	0.308

*Where *, **, ***, mean significant at 1%, 5%, and 10% respectively*

Long-run Relationships

The long-run coefficients of the variables are presented in table 12C. According to Johansen and Juselius (1990), if more than one co-integrating vectors exist, the first eigenvector is the most important in analyzing the long-run relationships between the variables. Thus, the results of the co-integrating equations were normalized on the NSE 20-share index (LNSEI), i.e. its coefficient was restricted to 1 to identify the betas. Moreover, the coefficient of Kenya's inflation rate was restricted to zero/ dropped.

Kenya's T-bill rate and EU's industrial production index had positive and statistically significant relationships with the NSE 20-share index. By contrast, EU's M3 had a significant negative relationship with the NSE 20-share index. The coefficient of the FTSE 100 index was negative, but significant only at the 10% level of significance. EU's inflation rate had a negative, but statistically insignificant relationship with the NSE 20-share index.

Table 12C: Co-integrating equations

Equation	Parms.	Chi2	P>chi2
Ce1	5	75.4801	0.0000
Ce2	5	71.2944	0.0000

Identification: beta is exactly identified

Johansen normalization restriction imposed

beta	Coefficient	Std. Error	Z	$p > \|z\|$
LNSEI	1	.	.	.
$LINF^{K}$	dropped			
LI^{K}	3.3607	1.2496	2.69	0.007*
$LM3^{EU}$	-19.0883	2.8742	-6.64	0.000*
$LINF^{EU}$	-1.1610	2.0820	-0.56	0.577
LFTSE100	-8.8911	5.2101	-1.71	0.088***
LEUIP	138.3387	20.5180	6.74	0.000*
Constant	-272.1848	.	.	.

*Where *, **, ***, mean significant at 1%, 5%, and 10% respectively*

5.5 Diagnostic Tests

5.5.1 Results of Serial Autocorrelation Tests

The Lagrange-multiplier test was used to test for serial autocorrelation in the residuals of the VECM with 3 lags. The results reported in table 13 indicate that the null hypothesis of no autocorrelation at lag 1 cannot be rejected at 1% level of significance. Similarly, it cannot be rejected at lag 2 and 3 for all levels of significance. The results mean that lag 3 was the appropriate lag length and the model was not misspecified.

Table 13: Lagrange-multiplier test

lag	Chi2	df	Prob> chi2
1	70.7153	49	0.02280
2	53.6990	49	0.29903
3	57.0259	49	0.20135

Ho: no autocorrelation at lag order

5.5.2 Stability Test Results

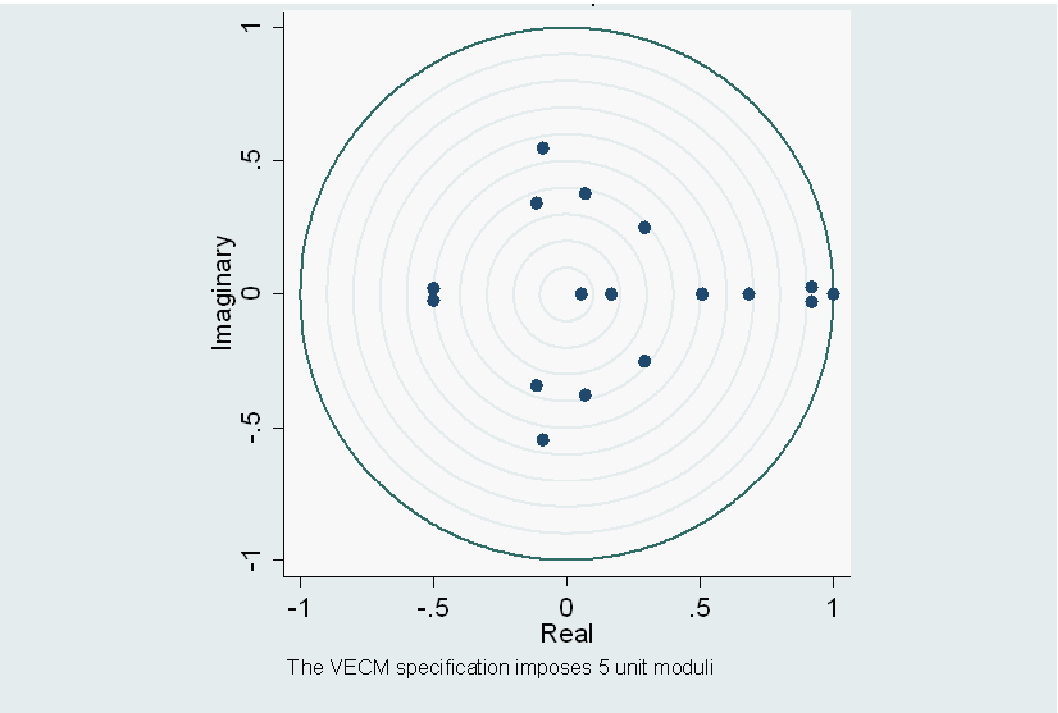
The eigenvalue stability condition was used to test for the stability of the VECM. The eingevalues of the companion matrix and their modulus are reported in table 14. The model had 7 endogenous variables and 2 co-integrating equations. Thus, it had 5 unit eigenvalues as indicated in table 5. The moduli of the remaining eigenvalues were less than. Furthermore, figure 10 indicates that all the remaining eigenvalues fall within the unit circle, implying that the model is stable. The stability test shows that the model was not misspecified.

Table 14: Eigenvalue stability condition

Eigenvalue	Modulus
1	1
1	1
1	1
1	1
1	1
.9180409 + .02762274*i*	.918456
.9180409 - .02762274*i*	.918456
.6830882	.683088
-.08791836 + .5472107*i*	.554228
-.08791836 - .5472107*i*	.554228
.5086894	.508689
-.498318 + .02245548*i*	.498824
-.498318 - .02245548*i*	.498824
.2927187 + .250026*i*	.384964
.2927187 - .250026*i*	.384964
.06989343 + .3784588*i*	.384859
.06989343 - .3784588*i*	.384859
-.111899 + .342707*i*	.360513
-.111899 - .342707*i*	.360513
.1690375	.169037
.05552331	.055523

The VECM specification imposes 5 unit moduli.

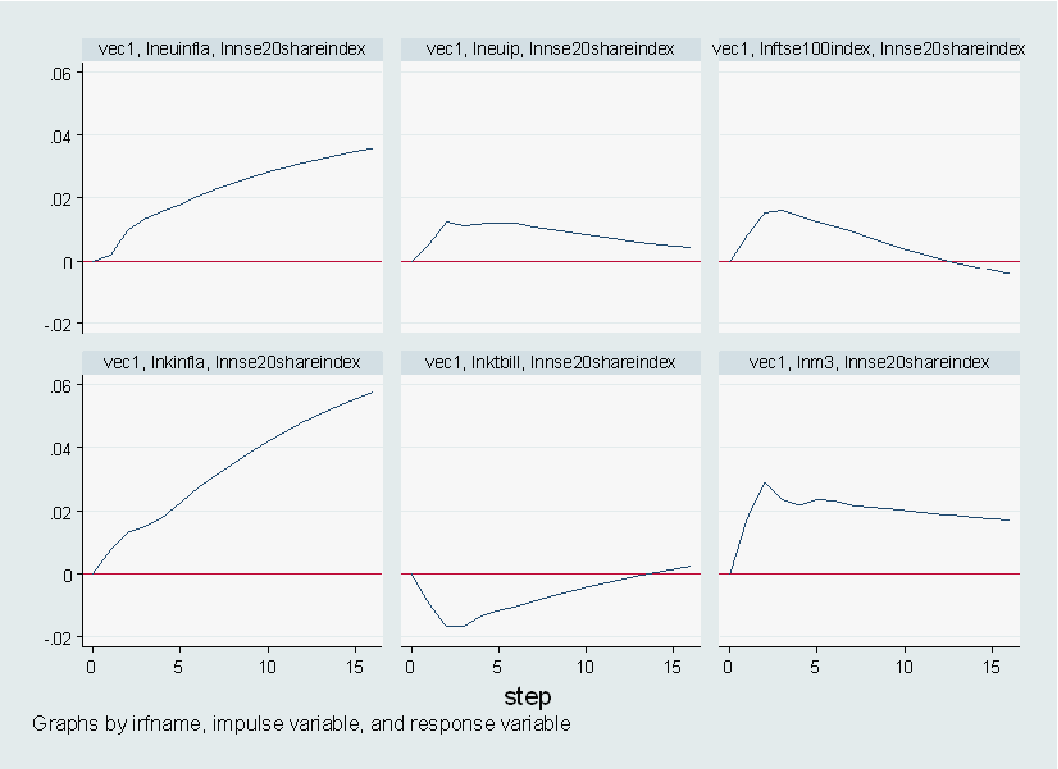
Figure 10: Roots of the companion matrix



5.6 Impulse Response Functions

Impulse response functions were used to determine the effect of an exogenous shock in the macroeconomic variables on the NSE 20-share index. Figure 11 illustrates the response of the NSE 20-share index to shocks in the macroeconomic variables. The effects of a shock in the FTSE 100 index and Kenya's 91-day T-bill rate seem to die out over time. This means that the effects of the shocks are transitory. By contrast, the effects of a shock in EU's inflation rate and M3, as well as, Kenya's inflation rate are permanent since they persist over time.

Figure 11: Impulse response functions



CHAPTER SIX
DISCUSSION

6.1 Causal Relationships

The unidirectional causality from Kenya's 91-day T-bill rate is consistent with the findings of Teker and Aykac (2013) and Hasan and Javed (2009). However, it is inconsistent with the findings of Naik and Padhi (2012). Moreover, the unidirectional causality from EU's quantity of money (M3) supports the findings of Naik and Padhi (2012). According to the efficient market hypothesis, these findings imply that the Nairobi Securities Exchange is an inefficient market with respect to Kenya's 91-day T-bill rate and EU's M3. Specifically, equity prices do not fully reflect the information concerning these two macroeconomic variables in the short-run since they can be used to predict future changes in the NSE 20-share index. Conversely, the lack of causality from Kenya's inflation rate, EU's industrial production index, and EU's inflation rate to the NSE 20-share index implies that the bourse is efficient with respect to these variables.

The unidirectional causality from the NSE 20-share index to EU's inflation rate supports the findings of Ozbay (2009) and Gracia and Yu (2010). Similarly, the unidirectional causality from the NSE 20-share index to EU's industrial production index is consistent with Perales and Robins (2007), but inconsistent with the findings of Sarbapriya (2012). These results indicate that the NSE 20-share index is a lead indicator for EU's industrial production index and inflation rate. The negative and statistically significant adjustment parameter means that the deviation of the NSE 20-share index from its long-run equilibrium is corrected at a rate of 2.8% per month. At this rate, the NSE converges to its long-run equilibrium in nearly 36 months. This rate is relatively slow compared to other bourses. For example, Alshogeathri (2011) found that the Saudi Stock market reverts to its long-run equilibrium in six months, whereas Junkin (2011) found that the Johannesburg Stock Exchange converges to its long-run equilibrium in nearly seven months.

6.2 Short-run Relationships

The negative effect of Kenya's T-bill rate on the NSE 20-share index is consistent with a priori expectation. It implies that financial investors in Kenya consider the 91-day T-bill and equity securities as substitute investments in the short-run. Kralik (2012) and Ochieng and Oriwo

(2012) found similar results in Romania and Kenya respectively. However, Naik and Padhi (2012); Terfa (2010); Addo, and Sunzuoye (2013) did not find a significant relationship between the 91-day T-bill rate and equity market indices in India, Nigeria, and Ghana respectively.

The positive and significant effect of EU's M3 on the NSE 20-share index is consistent with economic theory. In particular, an increase in quantity of money is likely to spur economic growth in the EU, thereby increasing demand for Kenya's exports in the region. The resulting improvement in export earnings and consumption in Kenya is likely to improve the NSE 20-share index. Moreover, increased supply of money could reduce lending interest rates in the EU in the short-run. As a result, EU investors will be able to access cheap financial capital, which they can invest at the NSE, thereby improving the NSE 20-share index. Naik and Padhi (2012); Ratanapakorn and Sharma (2007); and Maysami, Howe, and Hamaz (2004) also found positive relationships between equity market indices and broad money (M3).

The positive effect of EU's industrial production index on the NSE 20-share index underscores the trade and financial integration between Kenya and the EU. An increase in economic activity in the EU measured by the industrial production index is likely to improve disposable income in the region. Consequently, EU investors are likely to have more funds to invest at the NSE. Similarly, the expected increase in demand for Kenya's exports in the EU is likely to improve economic growth in Kenya, which in turn leads to an increase in the NSE-20-share index. The positive effect is supported by the findings of Akbar, Ali, and Khan (2012); Rahman, Noor, and Fauziah (2009); and Ratanapakorn and Sharma (2007). However, it is inconsistent with Gracia and Yu (2010) and Junkin (2011) who found that US industrial production index had a negative relationship with equity price indices in China and South Africa respectively.

The positive relationship between the FTSE 100 index and the NSE 20-share index is consistent with Gracia and Yu (2010) who found that US equity market index (DJIA) was positively related with China's equity market index. Anaraki 2010 also showed that US equity market indices (DJIA and NASDAQ) had positive relationships with EU's equity market indices (EUDJI). The positive relationship indicates that the NSE is integrated with EU's equity markets, particularly, the London Stock Exchange.

6.3 Long-run Relationships

The positive and significant long-run effect of Kenya's 91-day T-bill rate is consistent with Ratanapakorn and Sharma (2007) in US; Kuwornu (2012) in Ghana; Maku and Atanda (2010) in Nigeria; Enyaah (2011) in Ghana; and Sohail and Hussain (2009) in Pakistan. One possible explanation of the positive relationship is that financial investors do not consider equity securities and Kenya's 91-day T-bill as substitute investments in the long-run. In particular, investors are likely to diversify their portfolios by investing in both equity securities and fixed income securities such as T-bills to increase their earnings while minimizing their exposure to adverse macroeconomic shocks in the long-run.

In the long-run, the positive effect of EU's industrial production index becomes significant at 1% rather than 10% as was the case in the short-run. One possible explanation of this finding is that an increase in aggregate industrial production in the EU is likely to stimulate economic growth in Kenya in the medium and long-run rather than the short-run. As a result, the positive spillover effects of improved economic activity in the EU are likely to have a greater effect on the NSE 20-share index in the long-run than in the short-run. Akbar et al (2012) and Rahman et al (2009) also found similar results.

The negative long-run relationship between the FTSE 100 index and the NSE 20-share index is consistent with Alshogeathri (2011) and Malik and Hammoudeh (2007) who found that US S&P500 index had a negative relationship with Saudi Arabia's equity market index. However, it is inconsistent with Anaraki (2010) who found a positive relationship between US and EU market indices in the long-run. The finding is consistent with the argument that frontier and emerging equity securities markets such as the NSE are ideal for foreign investors who are looking for returns that are higher than what they would realize in their home countries in the long-run. In this context, the NSE is an alternative investment avenue to EU investors in the long-run.

The negative and statistically significant long-run effect of EU's M3 on the NSE 20-share index is inconsistent with a priori expectation. Indeed Maysami et al (2004) in Singapore; Mukherjee and Naka (1995) in Japan; and Keray (2009) in Jamaica showed that the relationship between

M3 and equity market indices is positive. However, the negative relationship is consistent with the findings of Fama (1981) in US; Bulmash and Trivoli (1991) in US; Ibrahim and Aziz (2003) in Malaysia; and Hussin et al (2012) in Malaysia. A possible explanation of the negative relationship is that a significant increase in M3 in the EU is likely to enhance access to financial capital through low interest rates. As a result, Kenya's commercial banks, the government, and companies are likely to borrow/ raise financial capital from the EU. The resulting increase in money supply in Kenya is likely to raise inflationary pressures in the long-run. Consequently, the discount rate will increase, thereby reducing the prices of equity securities and the NSE 20-share index.

The effect of EU's inflation rate on the NSE 20-share index is negative but insignificant. Christos (2004) and Terfa (2010) found similar results in Greece and Nigeria respectively. The negative sign implies that investing at the NSE is not a hedge against inflation. The insignificant effect could be attributed to the fact that EU's inflation rate was relatively low and stable over the sample period. The inflation rate averaged 2.17% with a standard deviation of only 0.7%. Thus, its effect on economic growth in the EU and Kenya, as well as, the performance of the NSE was likely to be minimal.

6.4 Conclusions

The main objective of this study was to determine the effects of select domestic and foreign macroeconomic variables on the NSE 20-share index. The results show that the NSE 20-share index can be predicted using information concerning Kenya's 91-day Treasury bill rate and EU's broad money (M3). This suggests that the NSE is an inefficient market with respect to the 91-day T-bill rate and EU's M3. The NSE 20-share index was also found to be a lead indicator for EU's inflation rate and industrial production index. In the short-run, Kenya's 91-day T-bill rate has a negative effect on the NSE 20-share index, suggesting that T-bills and equity securities are substitute investments. EU's M3 and industrial production index have a positive short-run effect on the NSE 20-share index. Similarly, there was a positive relationship between the NSE 20-share index and the FTSE 100 index, which is a sign of integration between the NSE and the London Stock Exchange. In the long-run, Kenya's 91-day T-bill rate and EU's industrial production index have a positive effect on the NSE 20-share index. However, the effect of EU's

M3 is negative. The effects of the FTSE 100 index and the 91-day T-bill rate on the NSE 20-share index are transitory. By contrast, the effects attributed to EU's M3, industrial production index, and inflation rate, as well as, Kenya's inflation rate are permanent. Overall, the NSE reverts to its long-run equilibrium in 36 months.

6.5 Policy Recommendations

An understanding of the effect of domestic and EU macroeconomic variables on the performance of the NSE measured by the NSE 20-share index is invaluable to financial investors, the government, and the management of the NSE. The results discussed in the foregoing paragraphs have the following policy implications.

6.5.1 Financial Investors

Investors at the NSE should consider changes in Kenya's 91-day T-bill rate, as well as, EU's M3 and industrial production index when making their investments decisions. In the short-run, an expected increase in the 91-day T-bill rate is a systematic risk at the NSE. As the 91-day T-bill rate increases, the demand for T-bills is likely to increase at the expense of equity securities ceteris paribus. Moreover, a high T-bill rate is likely to increase lending interest rates, thereby preventing access to credit that investors require to purchase equity securities. The resulting reduction in demand for equity securities is likely to cause capital losses as equity prices depreciate. However, investors should consider rebalancing their portfolios in favor of equity securities when the 91-day T-bill rate is expected to decline. This would enable investors to benefit from the expected capital gain.

An increase in M3 in the short-run is likely to facilitate capital gains as demand for equity securities rise. However, an increase in M3 in the long-run is a systematic risk since it results into a decrease in the NSE 20-share index. Thus, investors should diversify their portfolios in the long-run if EU's M3 is expected to increase substantially. The positive relationship between the NSE 20-share index and EU's industrial production index means that investors are exposed to the risks associated with economic downturn in the EU. For instance, a decline in economic activity in the EU would reduce Kenya's export earnings and the general level of economic activity, which in turn would reduce the performance of the NSE. However, economic decline in

the EU could also motivate EU investors to invest at the NSE to avoid capital losses in their countries, thereby increasing the NSE 20-share index. Evidence of this strategy is illustrated by the long-run negative relationship between the FTSE 100 index and the NSE 20-share index. In this respect, the net effect of changes in EU's economic activity measured by industrial production index is the most important for investments' decisions at the NSE.

6.5.2 The Government

The significant relationships between the NSE 20-share index and EU's macroeconomic variables suggest that investors at the NSE are exposed to the risk of financial contagion emanating from the EU. Financial contagion refers to "the transmission of a financial crisis from one economy to others through trade and financial integration, as well as, irrational behavior (herding effect)" (Claessens & Forbes, 2004). In this respect, the government should reduce Kenya's vulnerability to contagion through improved regulation and supervision of the financial system including the capital market. This will improve the functioning of the financial and capital markets, thereby enhancing their resistance to external shocks. Improving the domestic macroeconomic environment is also likely to reduce the country's vulnerability to contagion.

6.5.3 The Management of the NSE

The statistical significance of the relationship between the NSE 20-share Index and the FTSE 100 Index suggests that the co-movement between the NSE and EU equity markets is strong only in the short-run. In this regard, the management of the NSE should continue to implement reforms that facilitate integration of the bourse with other bourses in the world. This includes linking trading activities at the NSE to trading in major world bourses such as the New York Stock Exchange, the London Stock Exchange, Bombay Stock Exchange among others through online trading platforms. Moreover, the NSE in collaboration with stockbrokers should focus on analysis of domestic and foreign systematic risks to predict shocks that are likely to have adverse effects on the performance of the bourse. This will enable foreign and domestic investors at the NSE to make informed speculative and hedging decisions.

In future, this study can be extended in the following ways. First, the effect of the macroeconomic variables of Kenya's major trading partners such as China, India, and the COMESA countries on the NSE indices should be analyzed. Second, future studies can explore the effect of EU and other countries' macroeconomic variables on the volatility of the NSE 20-share Index. Finally, the effect of foreign macroeconomic variables on the recently introduced NSE's indices such as the All Share Index, FTSE-NSE Kenya 15 Index, and FTSE-NSE Kenya 25 Index can be analyzed in future studies.

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