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

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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. Granger causality test revealed bidirectional causality between NSE 20-share index and Kenya's inflation rate. There was also a unidirectional causality running from Kenya's 91-day T-bill rate and EU industrial production index to NSE 20-share index. In the short-run, Kenya's 91-day T-bill rate and inflation rate had a positive relationship with the NSE 20-share index. In the long-run, T-bill rate and EU's M3 had a positive relationship with the NSE 20-share index. However, EU's industrial production index and FTSE 100 index had a negative relationship with the NSE 20-share index. Overall, the NSE 20-share index converges to its long-run equilibrium in nearly one year.
Keywords: foreign macroeconomic stock market Nairobi Securities Exchange VECM

1. INTRODUCTION

1.1 Background

Total returns on equity securities consist of two components namely, dividend and capital gain. Dividend refers to the periodic cash flows or income paid by a corporation to holders of its shares (Jones, 2010). Capital gain, on the other hand, is the difference between the price at which an equity security is purchased and the price at which it is sold at the end of the holding period. This means that a price change is an important determinant of total returns on equity securities, especially, in a market where investors focus on capital gains rather than cash dividends. Consequently, financial investors have to understand the factors that determine the prices of equity securities and consider such factors when investing in order to improve earnings.

According to Shubiri (2010), prices of equity securities are influenced by firm specific, as well as, external factors. Firm specific factors include profitability, strength of the balance sheet, and corporate governance among others. External factors that affect prices include industry regulation and government policies; domestic and global macroeconomic variables; international trade policies; equity securities' 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 revenue growth opportunities and macroeconomic variables that affect firm profits. Equity securities fully reflect all available information concerning the state of the economy and firm specific factors if the market is efficient (Fama, 1970). However, equity securities markets are not always efficient (Alshogeathri, 2011). Market inefficiency implies that changes in equity prices are not random. Thus, price changes at time t+1 can be predicted from information available at time t. This implies that changes in Kenya's macroeconomic variables are expected to influence equity prices at the Nairobi Securities Exchange.

Globally, 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 development of more interlinked economies, thereby improving the level of equity market synchronization globally (Ali, Butt, & Rehman, 2011). In Kenya, the government focused on integrating its economy with the rest of the world through financial and trade liberalization policies. This 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). According to Williams and Liao (2006), financial and trade integration increases the speed and ease with which macroeconomic risks that affect prices of equities and market indices are transmitted from one market to another. Thus, changes in the macroeconomic fundamentals of Kenya's major trading partners are also likely to affect equity securities' 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 European Union (EU) macroeconomic variables on the Nairobi Securities Exchange market indices. The EU is one of Kenya's major financial and trade partner (KNBS, 2013). The unique contribution of this study is that it estimates the effects of foreign (EU) macroeconomic fundamentals on the NSE 20-share index, which has been ignored in the extant literature.

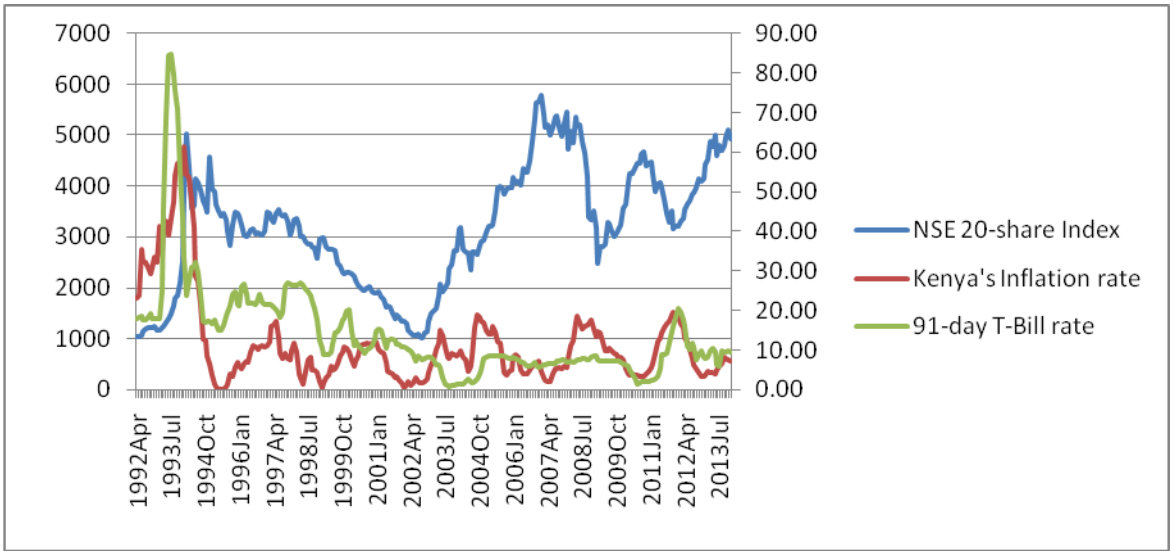
1.2 Statement of the Problem

Kenya's economy experienced significant macroeconomic volatility in the last three decades as shown in figure 1. This included the low inflation rate of 1.6% in 1995 against a high rate of 26% in

2008. 91-day T-bill rate was as high as 84% in June 1993 and as low as 1% in October 2003 (Central Bank of Kenya, 2015). These fluctuations are likely to cause volatility in equity prices, thereby causing losses and capital flight at the NSE. Thus, a clear understanding of the effect of significant fluctuation in macroeconomic variables on equity prices is required by the government and financial investors to formulate public policy and make informed investment decisions respectively. In Kenya, the effects of both foreign and domestic macroeconomic variables on equity prices is not well documented as depicted in the mixed results of existing empirical studies. For instance, Muthike and Sakwa (2009) found that 91-day T-bill rate and inflation rate had no statistically significant effect on the NSE 20- share index. By contrast, Kimani and Mutuku (2013) showed that inflation rate had a statistically significant effect on the NSE 20-share index, whereas Ochieng and Oriwo (2012) found that 91-day T-bill rate had a statistically significant effect on the NSE All Share Index (NASI).

Trade and financial liberalization policies have strengthened 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. 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 EU macroeconomic variables on NSE market indices. Existing studies have focused on the effect of the EU and the US 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 EU macroeconomic variables on the NSE 20-share index.

Figure 1: Fluctuation in Kenya's macroeconomic variables and NSE 20-share index



Source: Graph based on data from CBK and KNBS

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 financial investors and the government of Kenya to make investment decisions and improve the market's performance respectively

2. LITERATURE REVIEW

2.1 Theoretical Literature Review

2.1.1 Arbitrage Pricing Theory (APT)

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. 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 the i^{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 returns on equities

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

According to Azeez and Yonoezawa (2003), the APT lacks theoretical guidance on the selection of the appropriate set of macroeconomic variables to be included in the model. Thus, the researcher has to choose the variables/ factors that provide the best explanation for his sample.

From equation 1, investors price equity securities by determining the effects of the factor sensitivities on the rate of return (Cochrane, 1998). For instance, equity prices will increase if the factor sensitivities indicate that a change in certain macroeconomic variables (systematic risk factors) will boost the rate of return.

2.1.2 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 future dividend streams of an equity security will affect its present value or price (Culp & Cochrane, 2003).

The PVM is presented as follows:

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

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, any macroeconomic factor that affects either the dividend stream or discount rate or both will affect the current price of an equity security. Specifically, economic growth measured by GDP or 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). A high unemployment rate reduces aggregate consumption and corporate earnings. The resulting reduction in expected dividends leads to a decline in equity securities' market index.

According to Fama (1981), inflation has a negative relationship with equity prices. 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. However, inflation rate can also have a positive relationship with equity prices and market index (Fisher, 1930). 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 market index will reduce.

A reduction in lending interest rate lowers the cost of borrowing. This enables companies to expand their operations, 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. The resulting reduction in demand for equity securities will lead to price depreciation and a decline in the market index.

2.2 Empirical Literature

2.2.1 Domestic Macroeconomic Variables

Equity securities markets are considered to be in direct competition with financial markets for investable capital. This implies that investment products in the financial market such as T-bill are alternatives/ substitutes to equities. This perspective is supported by Ochieng and Oriwo (2012) who found that 91-day T-bill rate had a long-run negative relationship with Nairobi Securities Exchange's All Share Index (NASI). Kralik (2012) also found a negative relationship between 91-day T-bill rate and Romanian equity securities market index in the short-run and long-run.

However, investors do not always consider T-bill and equity securities as alternative investment opportunities. Indeed Ratanapakorn and Sharma (2007) in their study of the relationship between macroeconomic variables and stock market returns in the US found that 91-day T-bill rate had a positive relationship with equity market index. Kuwornu (2012) further showed that Nigeria's 91-day T-bill rate had a positive effect on equity market index both in the short and long-run. However, Junkin (2011), Naik and Padhi (2012), and Addo and Sunzuoye (2013) found that 91-day T-bill rate had no short or long-run relationship with equity market indices in South Africa, India, and Ghana respectively.

In their study of factors affecting equity market indices in Iran, Yahyazadehfar and Babaie (2012) supported the thesis that an increase in lending interest rate has a negative effect on equity securities market indices by increasing the cost of investable capital. Hassan and El-Gezery (2010) concurred with Yahyazadehfar and Babaie (2012) in his study of determinants of equity prices, which found a negative relationship between Egypt's equity market index and interest rates. Similar results were found by Terfa

(2010) in Nigeria; Addo and Sunzuoye (2013) in Ghana; Savasa and Samiloglub (2010) in Turkey; and Kralik (2012) in Romani. The negative relationship between lending rate and market indices underscores the importance of reducing the cost of financial capital to boost equity markets' performance.

The expected negative effect of lending interest rate on equity market indices, however, does not hold in all economies due to differences in the level of market and economic development. For instance, in China and the US Bellalah, Levyne and Masood (2013) found a positive relationship between lending interest rate and market indices.

Focusing on the determinants of equity market indices in Kenya, Kimani and Mutuku (2013) found a negative relationship between deposit interest rate and Nairobi Securities Exchange's 20-share index. Adam and Tweneboah (2007) also found similar results in Ghana. These findings suggest that cross market returns differentials is a key determinant of financial investors' choice of investment products.

An increase in quantity of money in circulation can increase the demand for equities, thereby increasing prices and market indices. Naik and Padhi (2012) supported this premise in their study that found a positive relationship between M2 and India's equity market index in the long-run. Hosseini, Ahmad and Lai (2011) and Savasa and Samiloglub (2010) also found positive long-run relationship between M2 and equity market indices in China and Turkey respectively. However, in China, the US, and Japan, Bellalah, Levyne and Masood (2013) found both short-run and long-run positive relationship between quantity of money proxied by M3 and equity market indices. The positive relationship implies that monetary policy matters in equity market development.

An increase in quantity of money can also raise inflationary pressures, which in turn reduces equity prices and market indices. Indeed Hassan and El-Gezery (2010) found that M2 had a negative relationship with equity market index in Egypt. Moreover, M2 Granger caused Egypt's equity market index. Alshogeathri (2011) also established a negative long and short run relationship between quantity of money (M1) and equity market indices in Saudi Arabia.

According to Kimani and Mutuku (2013), inflation rate has a negative long-run relationship with equity market indices. Their finding is consistent with Naik and Padhi (2012) and Alshogeathri (2011) who found similar results in India and Saudi Arabia. The negative effect of inflation on equity prices/ market indices, however, has been disputed in several empirical studies. For instance, Adam and Tweneboah (2007) found a positive and statistically significant relationship between inflation and equity market indices in Ghana. Hosseini, Lai and Ahmed (2011) also found similar results in China and India. The positive relationship supports the argument by Fisher (1930) that investing in equity securities is a hedge against inflation. Nonetheless, Terfa (2010); Hassan and El-Gezery (2010); and Ochieng and Oriwo, 2012 did not find statistically significant relationship between inflation and equity market indices.

Economic growth proxied by measures such as GDP and industrial production index is expected to increase firm profits, thereby improving firm valuation and equity market indices. This argument is consistent with Kimani and Mutuku (2013) who found that GDP had a positive and statistically significant long-run relationship with NSE 20-share index. In India, Naik and Padhi (2012) found a positive relationship between industrial production index and equity market index. This is consistent with Bellalah, Levyne and Masood (2013) Savasa and Samiloglub (2010) who found similar results. Surprisingly, Hosseini, Lai and Ahmed (2011) found a negative relationship between industrial production index and equity market indices in China and India.

A depreciation of local currency makes equities in the domestic market cheaper to foreign investors, thereby improving market performance through the demand channel. Junkin (2011) supported this premise in his study, which showed that exchange rate had a positive relationship with equity market index in South Africa. This is consistent with Terfa (2010), Hassan and El-Gezery (2010) who also found a positive relationship between exchange rate and equity market index in Nigeria, Egypt.

However, a depreciation of domestic currency can also lead to capital flight as foreign investors exit equity markets to avoid exchange rate losses. Thus, a depreciation of local currency can have a negative effect on equity market index. Indeed Kimani and Mutuku (2013) found a negative relationship between the NSE 20-share index and exchange rate in Kenya. Their results are consistent with Adam and Tweneboah (2007), Kralik (2012) and Savasa and Samiloglub (2010) who found similar results in Ghana, Romania, and Turkey.

2.2.2 Effect of Foreign Macroeconomic Variables on Equity Securities Market Indices

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. In the long-run, US industrial production index had a positive and statistically significant relationship with Poland's equity market index. By contrast, US interest rate had a negative effect on Poland's equity market index. Additionally, there were statistically significant short-run relationships between German's industrial production and interest rate with market indices in the four markets. Nonetheless, 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.

In China, Gracia and Yu (2010) found that US consumer confidence index (CCI) had a statistically significant and positive relationship with Shanghai Composite Index (equity market index for China) in the short and long-run. By contrast, US industrial production had a negative relationship with Shanghai Composite Index in the long-run.

According to Vera-Juarez and Garza-Gracia (2010), US industrial production had a positive effect on equity market indices in Mexico and Chile, but not in Brazil in the short-run and long-run. 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. Since Mexico's economy is highly linked to that of the US, a rise in US interest rate increases the cost of investing in equities in Mexico, which in turn leads to a decline in Mexico's equity market index. Vera-Juarez and Garza-Gracia (2010) also found that China's industrial production index had a positive effect on equity market indices in Mexico, but not in Chile and Brazil. 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. These findings suggest that foreign macroeconomic fundamentals affect various countries differently.

Focusing on mature equity markets, Nasseh and Strauss (2000) concluded that foreign macroeconomic variables influence equity market indices in France, German, Italy, Netherlands, Switzerland, and the UK. For every pair of these countries, the researchers found that foreign industrial production had a positive effect on equity market indices in the long-run and short-run. By contrast, foreign short-term interest rate had a negative effect on equity market indices (Nasseh & Straus, 2000).

The study, however, 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 US macroeconomic fundamentals. The researcher found that US industrial production index and Federal Reserve Fund rate Granger caused market index (EU Dow Jones). US Federal Reserve fund and industrial production index had a positive effect on EUDJ only in the short-run.

In sum, the literature reviewed presents mixed results. Additionally, the effect of foreign macroeconomic fundamentals on domestic market indices has mainly been estimated in developed and emerging markets in Asia, Latin America, and Europe. The African continent has been given little attention in this regard. This study sought to fill this gap by estimating the effect of both domestic and foreign macroeconomic variables on market indices in the context of a developing African country.

3. METHODOLOGY

3.1 Analytical Framework

Based on the arbitrage pricing theory and the present value cash flow model, the NSE 20-share index was conceptualized as a function of Kenya's inflation rate, 91-day T-bill rate, as well as, European Union's quantity of money (M3), industrial production index, and inflation rate.

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, they are often 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. 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. 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. Two variables that are integrated of order one have a long-run relationship if their linear combination is stationary.

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 method and the ARDL bounds tests, the Engle-Granger test does not identify multiple co-integrating vectors (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. The vector error correction model (VECM) is used to estimate the long-run and short-run relationships between co-integrated variables.

3.2 Model Specification

The empirical model was defined as:

$$LNSEI_t = \alpha_t + \beta_1 LINF_{K,t} + \beta_2 LI_{K,t} + \beta_3 LM3_{EU,t} + \beta_4 LINF_{EU,t} + \beta_5 LIP_{EU,t} + \beta_6 LFTSE100_{EU,t} + \mu_t \quad 3$$

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 T-bill rate)

$M3_{EU}$ is European Union's quantity of money (M3)

INF_{EU} is European Union's inflation rate

IP_{EU} is European Union's industrial production index

$FTSE100_{EU}$ is London Stock Exchange's index

t denotes time

$\beta_1 \cdots \beta_6$ are parameters to be estimated

α is a constant

μ is a stochastic error term

3.3 Data Sources

This study used monthly data for the period 1993 to 2013. Kenya's reported inflation rate and the NSE 20-share index data were obtained from Kenya Bureau of Statistics (KNBS), whereas the 91-day T-bill rate was obtained from the Central Bank of Kenya (CBK). European Union's inflation rate, industrial production index, and quantity of money (M3) data were obtained from Eurostats, whereas the FTSE 100 index data was obtained from FTSE Group.

3.4 Estimation Strategy

Unit Root Test

The Augmented Dickey-Fuller (ADF) test was used to determine the stationarity of each variable. The ADF test was based on a model of the form:

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

Where:

Δy_t and y_t denote the first difference and levels respectively of the relevant variable

T is a time trend

t denotes time period

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

μ_t is a white noise error term

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)

Co-integration Test

The presence of co-integration was tested using the Johansen-Juselius method. The test is based on a $VAR_{(p)}$ of the form:

$$Y_t = \mu + A_1 Y_{t-1} + A_2 Y_{t-2} \cdots A_p Y_{t-p} + \varepsilon_t \quad 5$$

Where

$Y_t = (Y_{1t} \cdots Y_{nt})$ is a vector of the variables considered in the study

t denotes time period

μ *and* $A's$ are matrices of parameters to be estimated

p is the maximum lag length

ε_t is a vector of white noise error terms

Equation 5 can be rewritten as a VECM of the form:

$$\Delta Y_t = \mu + \pi Y_{t-1} + \sum_{i=1}^{\rho-1} r_i \Delta Y_{t-i} + \varepsilon_t \quad 6$$

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 5 indicates that a VAR in first difference is misspecified since it omits the lagged level term πY_{t-1}.

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

$r = 0$ means the variables are not co-integrated

$r = n$ *(number of variables in the model)* implies that all variables are stationary in their levels

$r \leq (n-1)$ implies that the variables are co-integrated

The rank of matrix π was determined using the trace statistic and maximum eigenvalue test

Vector Error Correction Model (VECM)

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 was defined as:

$$\Delta Y_t = \mu + \pi Y_{t-1} + \sum_{i=1}^{\rho-1} r_i \Delta Y_{t-i} + \varepsilon_t \quad 7$$

Where

Δ is the difference operator

Y_t is a vector of the dependent variables

ρ is the order of autocorrelation

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 a matrix of the long-run coefficients.

r_i is the matrix of the short-run coefficients

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

4. EMPIRICAL RESULTS

4.1 Descriptive Statistics

The summary statistics are presented in table 4.1. There were a total of 249 observations per variable. The NSE 20-share index had a mean of 3636.306 with a standard deviation of 1207.559. This means that the index has been relatively volatile during the sample period. The NSE 20-share index and FTSE-100 index are negatively skewed, whereas the remaining variables are positively skewed. The kurtosis of all variables except 91-day T-bill rate are positive and less than 5, suggesting that their distribution is relatively flat.

Table 4.1: Descriptive statistics

Variable	Mean	Std. deviation	Variance	Skewness	Kurtosis	Min. value	Max. value
NSE 20-share index	3636.306	1207.559	1458198	-0.49683	2.525349	1027	5774
Inflation rate (Kenya)	8.59938	5.13471	26.36523	0.52334	2.07918	0.46	19.72
91-day T-bill (Kenya)	7.23118	3.56365	12.69957	0.82094	5.36978	0.83	20.56
M3	5.38434	2.76435	7.64165	0.20915	2.67422	1	12.4
Inflation rate (EU)	2.22840	0.74005	0.54768	0.30242	4.09297	0.25	4.41
FTSE 100 index	5329.371	825.3419	681189.2	-0.26154	2.04540	3567.4	6749.1
IP (EU)	102.5949	5.20767	27.11987	0.37898	3.02194	89.98	114.71

4.2 Multi-collinearity Test

The results of multi-collinearity test using variance inflation factor (VIF) are resented in table 4.2. The VIFs for all variables are less than 10 and the mean VIF is only 2.92. Thus, multi-collinearity is not a serious problem.

Table 4.2: Multi-collinearity test results

Variable	VIF	1/VIF
LIP_{EU}	6.76	0.148032
$LFTSE100_{EU}$	4.05	0.246982
LI_K	2.75	0.363416
$LINF_{EU}$	1.61	0.621712

$LM3_{EU}$	1.29	0.777550
$LINF_K$	1.08	0.926686
Mean VIF	2.92	

4.3 Unit Root Test Results

The unit root test results are presented in table 4.3. The null hypothesis of a unit root cannot be rejected for all the variables in their levels. However, all the variables are stationary in their first difference.

Table 4.3: ADF test results

Variables	Levels	First difference
	p-value	p-value
$LNSEI$	0.9673	0.0000
$LINF_K$	0.9802	0.0000
LI_K	0.8446	0.0000
$LM3_{EU}$	0.5753	0.0000
$LINF_{EU}$	0.1870	0.0000
$LFTSE100_{EU}$	0.6781	0.0000
LIP_{EU}	0.9223	0.0000

4.4 Co-integration Test Results

Co-integration test results are presented in table 4.4. There are two co-integrating vectors at the 5 per cent significance level. This means that there is a long-run relationship between the NSE 20-share index and the dependent variables. Additionally, at least one unidirectional causal relationship exists as suggested by the Granger representation theorem.

Table 4.4: Co-integration test results

Number of observations = 140 Lags = 4			
Maximum rank	eigenvalue	Trace statistic	5% critical value
0		185.8634	124.24
1	0.37982	118.9783	94.15
2	0.33076	62.7517*	68.52
3	0.17109	36.4815	47.21
4	0.11639	19.1580	29.68
5	0.07432	8.3455	15.41
6	0.03574	3.2501	3.76
7	0.02295		

4.5 Granger Causality Results

Granger causality test results are presented in table 4.5. There is bidirectional causality between the NSE 20-share index and Kenya's inflation rate. There is also a unidirectional Granger causality running from 91-day T-bill rate to NSE 20-share index. This is consistent with Teker and Aykac (2013) and Hasan and Javed (2009). EU's industrial production index also Granger causes NSE 20-share index. The results mean that the NSE is an efficient market with respect to 91-day T-bill rate and EU industrial production index.

There is unidirectional causal relationship running from the NSE 20-share index to EU's inflation rate and FTSE 100 index. The unidirectional causality from the NSE 20-share index to EU's inflation rate is consistent with Ozbay (2009) and Gracia and Yu (2010). The results mean that the NSE 20-share index is a lead indicator for the EU inflation rate and FTSE 100 index.

Table 4.5: Granger causality test results

$LNSEI$ as dependent variable Null hypothesis	Chi^2	$Prob > chi^2$	Conclusion
$LINF_K$ does not Granger cause LNSEI	21.846	0.000	Rejected
LI_K does not Granger cause LNSEI	7.7259	0.005	Rejected
$LM3_{EU}$ does not Granger cause LNSEI	0.91136	0.340	Not rejected
$LINF_{EU}$ does not Granger cause LNSEI	0.30998	0.578	Not rejected
$LFTSE100_{EU}$ does not Granger cause LNSEI	1.4274	0.232	Not rejected
LIP_{EU} does not Granger cause LNSEI	2.8	0.094	Rejected
$LNSEI$ as independent variable			
Null hypotheses			
LNSEI does not Granger cause $LINF_K$	3.6281	0.057	Rejected
LNSEI does not Granger cause LI_K	0.02568	0.873	Not rejected
LNSEI does not Granger cause $LM3_{EU}$	0.08333	0.773	Not rejected
LNSEI does not Granger cause $LINF_{EU}$	11.458	0.001	Rejected
LNSEI does not Granger cause $LFTSE100_{EU}$	36.581	0.000	Rejected
LNSEI does not Granger cause LIP_{EU}	1.6403	0.2000	Not rejected

4.6 The VECM Results

The VECM results are presented in table 4.6. The adjustment parameter is significantly different from zero at 1 per cent significance level. Additionally, it has the expected negative sign. This means that deviation of the NSE 20-share index from its long-run equilibrium is corrected at a rate of 8.76 per cent per month. Thus, the NSE converges to its long-run equilibrium in approximately 12 months.

In the short run, 91-day T-bill rate and Kenya's inflation rate have a positive and statistically significant relationship with the NSE 20-share index. This is consistent with Ratanapakorn and Sharma

(2007) and Kuwornu (2012) who found a positive relationship between 91-day T-bill rate and equity market indices in the US and Nigeria respectively. It also supports Adam and Tweneboah (2007) who found a positive relationship between inflation and equity market index. The results mean that a 1 per cent increase in 91-day T-bill rate and inflation increases the NSE 20-share index by approximately 0.06 and 0.05 per cent respectively. The positive relationship between 91-day T-bill rate and NSE-20 share index suggest that investors do not consider T-bill and equities as substitute investments in the short-run. The positive relationship between inflation and NSE 20-share index is consistent with Fisher (1930) who concluded that investing in equity securities is a hedge against inflation. The coefficients of the remaining variables are not statistically significant in the short run.

In the long-run, Kenya's 91-day T-bill rate has a positive and statistically significant relationship with the NSE 20-share index. The result means that a 1 per cent increase in 91-day T-bill rate increases the NSE 20-share index by approximately 0.15 per cent. The result 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.

EU's M3 has a statistically significant positive relationship with NSE 20-share index. A 1 per cent increase in EU's M3 increases the NSE 20-share index by nearly 0.29 per cent. The result supports Maysami et al (2004); Mukherjee and Naka (1995); and Keray (2009) who found a positive relationship between M3 and equity market indices in Singapore, Japan, and Jamaica respectively. However, the result is at variance with Fama (1981) who found a negative relationship between money supply and equity market indices. The positive and statistically significant effect of EU's M3 on the NSE 20-share index is to be expected because 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.

EU's industrial production index has a negative and statistically significant relationship with the NSE 20-share index. This is inconsistent with a priori expectation and Akbar et al (2012) and Rahman et al (2009) who found a positive relationship between industrial production index and equity market index. However, it supports Hosseini et al (2011) who found a negative relationship between equity market index and industrial production index in China. The result means that a 1 per cent increase in EU industrial production index reduces NSE 20-share index by approximately 9.84 per cent. A possible explanation to the negative relationship is that improvement in economic growth proxied by industrial production is likely to increase equity securities returns in the EU. This can lead to a shift in capital from Kenya to the EU, thereby reducing the NSE 20-share index.

The coefficient of the FTSE 100 index is negative and significantly different from zero at 1 per cent significance level. The result means that a 1 per cent increase in FTSE 100 index reduces the NSE 20-share index by nearly 0.96 per cent. Alshogeathri (2011) and Malik and Hammoudeh (2007) also found that US S&P-500 index had a negative relationship with Saudi Arabia's equity market index. However, Anaraki (2010) found a positive relationship between US and EU market indices in the long-run. EU's inflation rate had a positive, but statistically insignificant relationship with the NSE 20-share index.

Table 4.6: VECM results

	Short-run relationship			Long-run relationship		
$LNSEI$	Coefficient	Std. error	$p > \|z\|$	Coefficient	Std. error	$p > \|z\|$
Adj. Parameter	-0.0876415	0.032015	0.006			
$LNSEI$	0.0079589	0.0929512	0.932	1		
$LINF_K$	0.0454637	0.0246708	0.065	0	Omitted	
LI_K	0.0595328	0.0346749	0.086	0.1537915	0.0594843	0.010
$LM3_{EU}$	0.0344731	0.0210183	0.101	0.2862207	0.0474586	0.000
$LINF_{EU}$	-0.0157508	0.0364561	0.666	0.0021416	0.1325327	0.987
$LFTSE100_{EU}$	-0.179667	0.1486519	0.227	-0.9639686	0.3648232	0.008
LIP_{EU}	0.4457307	0.5138891	0.386	-9.837673	1.519328	0.000
Constant	-0.010265	0.005387	0.057	45.01379		

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

4.7 Serial Autocorrelation Test Results

The Lagrange-multiplier test for serial autocorrelation results are presented in appendix 1. The null hypothesis of no autocorrelation at lag 4 cannot be rejected. This mean that lag 4 is the appropriate lag length and the model was not misspecified.

4.8 Stability Test Results

The model (VECM) had 7 endogenous variables and 2 co-integrating equations. Thus, it had 5 unit eigenvalues and all the remaining eigenvalues fall within the unit circle as indicated in appendix 2. This means that the model is stable.

5. CONCLUSIONS AND POLICY RECOMMENDATIONS

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 causal relationships exist between NSE 20-share index and Kenya's 91-day Treasury bill rate and EU's industrial production index. In addition, the NSE 20-share index converges to its long-run equilibrium in nearly one year. In the short-run, Kenya's 91-day T-bill rate had a positive effect on the NSE 20-share index, suggesting that 91-day T-bill and equity securities are not substitute investments. Kenya's inflation rate also had a positive effect on the NSE 20-share index. In the long-run, Kenya's 91-day T-bill rate and EU's M3 had a positive effect on the NSE 20-share index. However, EU's industrial production index had a negative effect on the NSE 20-share index. Similarly, FTSE 100 index had a negative effect on the NSE 20-share index. In light of these results, investors at the NSE should consider changes in Kenya's 91-day T-bill rate and inflation rate, as well as, EU's M3 and industrial production index when investing. The government should take measures to prevent or alleviate the negative effects of financial contagion that might arise as investors at the NSE respond to changes in EU macroeconomic fundamentals.

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Appendix

Appendix 1: Lagrange-multiplier test results

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. veclmar, mlag(4)

  Lagrange-multiplier test
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lag	chi2	df	Prob > chi2
1	57.0295	49	0.20126
2	57.2666	49	0.19524
3	90.9260	49	0.00026
4	55.5337	49	0.24213

```
  H0: no autocorrelation at lag order
```

Appendix 2: Stability test