EFFECT OF MACROECONOMIC VARIABLES ON THE STOCK PRICE INDEX OF LISTED COMMERCIAL BANKS IN TH NAIROBI SECURITIES EXCHANGE

BY

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DECLARATION

I declare that the work in this dissertation is my original work and has not been previously published or submitted elsewhere for award of a degree. I also declare that this contains no material written or published by other people except where due reference is made and author duly acknowledged.

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ABSTRACT

This study investigated the effect of macroeconomic variables namely real gross domestic product, real interest rate and exchange rate on the stock price index of listed commercial banks in the Nairobi securities exchange for the period between January 2000 and December 2013 on quarterly time series data. The results were reported using the Johansen cointegration test, vector error correction model (VECM) and causality test, which were reported using outputs from E-views. The general objective of the study was to analyze the effects of macroeconomic variables on the stock price index of listed commercial banks in the Nairobi securities exchange. The study found both short run and long run relationship between stock price index and two explanatory variables, real interest rates and exchange rates but no relationship was found to exist between the explained variable and real gross domestic product.

The cointegration results established that stock price index had a significant and positive long run relationship with real interest rates and exchange rates. The study further found a negative but insignificant long run relationship between the dependent variable and real gross domestic product. VECM results established that stock price index had short run relationship with real interest rates and exchange rates. Real gross domestic product was found to have no short run relationship. In determination of existence or otherwise of causal relationship, Granger causality tests were performed and the results established that there was no causal relationship between stock price index and real gross domestic product however a bidirectional causal relationship real gross domestic product and exchange rate was established. The results further found a unidirectional causal relationships one running from stock price index to real interest rate and another running from stock price index to exchange rate.

From the study findings it was concluded that it is possible to predict the current and the future stock price index values of listed commercial banks in the Nairobi securities exchange by studying the past values of real interest rates and exchange rates. The study further concluded that studying real gross domestic product past values does not help in predicting the present and the future values of stock price index of listed commercial banks in Kenya.

Keywords: Macroeconomic Variables, Stock Price, Real Gross Domestic Product, Real Interest Rates, Exchange rates, Vector Error Correction Model, Cointegration and Time Series.

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DEDICATION

This dissertation is dedicated to my dear wife Selina Mwanziu Kyangavo, and our three children, Tom, Moses and Saprina, who remained as great pillars of solace during the time of the great pressure in working through the readings and the assignments for this study program. It was great pleasure and an ever refreshing experience to have the blessed quartet in my company during those stress evoking moments.

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ACRONYMS AND ABBREVIATIONS

ADF - Augmented Dickey – Fuller Test.

AFCs – Autocorrelation Functions.

AIC – Akaike Information Criterion.

APT - The Arbitrage Pricing Theory.

BIC - Bayesian Information Criterion.

CBK - The Central Bank of Kenya.

CMA - The Capital Market Authority.

CPI - Consumer Price Index.

DJIA – Dow Jones Industrial Average.

DSUs – Deficit Spending Units.

ECT – Error Correction Term.

EGARCH – Exponential Generalised Autoregressive conditionality heteroscedastic.

EMH - The Efficient Market Hypothesis.

ER - Exchange Rate.

FER - Foreign Exchange Rate.

FPE – Final Prediction Error Criterion.

RGDP- Real Gross Domestic Product.

HO – The Null Hypothesis.

H1 – The Alternative Hypothesis.

HQ – Hannan Quinn Information Criterion.

JB –Jarque – Bera Test.

KES – Kenya Shillings.

KNBS- The Kenya National Bureau of Statistics.

LR – Likelihood Ratio Test.

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M2 - Money Supply.

NSE - The Nairobi Securities Exchange Limited.

PCFs – Partial Auto correction Functions.

PVM -The Present Value Model.

OLS - The Ordinary Least Squares.

RINT – Real Interest rate.

SBIC – Scharz Bayesian Information Criterion.

SSUs – Surplus Spending Units.

SOLS – Standard Ordinary Least Squares.

TBR - Treasury Bill Rate.

TGARCH- Threshold Generalized Autoregressive Conditionality Heteroscedastic.

USD – United States Dollar.

US - United States.

VAR – Vector Autoregression Model.

VECM – Vector Error Correction Model.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Stock markets are key component in the economy of every country, since they play an important role of channeling the much required long term capital from the investors to borrowers, they therefore bring investors, savers on one hand and borrowers on the other. Apart from channeling the funds the stock markets at the same time can be used by policy makers as barometer to measure economic growth (Okoli, 2012). Thus stock market gives rise to various stake holders such as the investors, borrowers and policy makers. The policy makers will rely on the stock market estimates as a measure of the market vulnerability and by extension that of the economy (Okoli, 2012). Investors on the other hand require returns on their investments in stocks, they therefore monitor the stocks behaviour in the stock markets as a whole and that of individual firms listed in such markets as well as that of specific industries in order to make sound investment decisions. Borrowers are another set of stakeholders who monitor the stock price movements for their future borrowing purposes.

Stock prices are believed to be influenced by a number of factors including firm specific factors, economic wide factors and government regulations. Thus investors as well as other stakeholders in the stock markets including borrowers and governments need to understand stock price movements and trends as results of these factors that influence the stock prices to change (Naik & Pandi, 2012). Since stock price movements affect the stakeholders differently and depends on various factors which include firm specific (internal) factors such as earnings per share, dividend per share and external factors such as macroeconomic variables and government

regulations, the players must strive to make informed decisions based on the expected effects of these factors on the stock prices.

While the effects of firm specific factors and government regulations on stock prices can be deliberately dealt with and directed towards a certain desired direction by the concerned players and authorities, the effects of macroeconomic (external) factors on stock prices need to be studied, analysed and understood for sound decision making. Macroeconomic variables are system wide factors that include variables such as money supply, interest rates, exchange rates, inflation, and foreign direct investment, balance of payment, gross domestic product, wholesale price index and oil price.

Effect of macroeconomic variables on stock prices has been an issue of debate amongst the academicians and professionals for quite a long time (Maysami, Howe, & Hanzah, 2004). One of the early works on stock pricing is the Efficient Market hypothesis (EMH) developed by Eugene Fama in 1970, which postulates that stock prices change fast to reflect all information as it is received by the stock markets, According to Efficient Market hypothesis an efficient market stock prices fully reflect all the information received by the market at all times such that profiting from price predictions is unlikely (Naik & Pandi, 2012). Fama defined an efficient market as a market in which stock prices adjust swiftly to reflect all available information received by that market, this mean studying all relevant information on factors that affect stock prices is of no use since the stock prices have already adjusted instantly and swiftly to reflect any new information received by the market (Maysami, Howe, & Hanzah, 2004). If the conclusions by the EMH are to be held to be true, then the analyzing or studying past and present information changes in any of the macroeconomic variables should not enable stock prices prediction, since the information

about the macroeconomic variables changes has rapidly been adopted by the stock market already and the current stock prices reflect such information at all time.

In direct contradiction to the conclusions drawn by the EMH, subsequent studies show that stock prices can be predicted by studying and analyzing information of macroeconomic variables. Maysami and Sims (2002) examines the relationship between macroeconomic variables and stock prices in six Asian countries namely Japan, Hong Kong, Thailand, Singapore, South Korea and Malaysia using error correction modeling technique, their results confirms that macroeconomic variables influence stock market indices in all the six countries under the study. But the type and magnitude of the influence of macroeconomic variables used differed from one country to another. Geetha, Mohidin, Chandran and Chong (2011) examined the relationship between stock markets, unexpected inflation rate, expected inflation rate, gross domestic product and interest rate in three different countries namely United State, China and Malaysia. The result indicates that there was no long-run cointegration relationship between stock markets and the macroeconomic variables studied in all the three countries. The result further showed that there was no short-run relationship between stock markets and the macroeconomic variables studied in United State, and Malaysia but there was however short-run relationship between China's stock markets and the unexpected inflation.

Talla, (2013) investigated the impact of changes in selected macroeconomic variables on stock prices of the Stockholm Stock Exchange in Sweden. The study used Multivariate Regression Model computed on Standard Ordinary Linear Square (SOLS) method and Granger causality test. The findings show that inflation, exchange rates have a significant negative influence on stock prices, while interest rates have insignificant negative relationship with stock prices. Money supply is insignificantly positively associated to stock prices. No causal

relationships were found between stock prices and all the predictor variables under study except inflation which had a unidirectional causal relationship running from stock prices to inflation.

In the US, Chen, Roll and Ross (1986) explores the relationships between some seven macroeconomic variables and stock prices, they found out that oil prices, consumption, market index have no relationship with stock prices. They however found significant relationships between stock prices and industrial production, inflation, gross domestic product. Several other studies by Aggarwal (1981), Soenen and Hrnnigar (1988), Bahmani, Oskooee and Sohrabian (1992), Abdalla and Murinde (1997), Smyth and Nandha (2003), Farooq and Keung (2004), Aquino (2004), Aquino (2005), Homma et.al (2005) and Hartmann and Pierdzioch (2007) explored the relationship between foreign exchange rate and stock prices. Results from these studies showed that there is positive relationship between foreign exchange rate and stock prices.

Agrawal, Srivastav and Srivastava, (2010) analyses the relationship between stock market prices and exchanges rates in India and finds that there is a negative correlation between them. The causal relationship is found to be unidirectional running from exchange rate to stock prices. While in Indonesia a study by Yogaswari, Nugroho and Astuti, (2012) examines the effect of macroeconomic variables (inflation, interest rate, and exchange rate) on the stock price movement in Indonesia Stock Exchange. Multiple regression analysis report indicates that there exists a significant relationship between macroeconomics variable (inflation, interest rate, and exchange rate) and stock price in Jakarta Stock Exchange. The change in inflation is giving a positive impact, while change in interest rate and exchange rates is giving a negative impact to the stock price in Jakarta Stock Exchange.

Akani, (2013) investigates the relationship between macroeconomic aggregates namely inflation rates, interest rates and money supply and aggregate stock price in Nigeria. Employing Granger Causality Test and Johansen Cointegration Test in a Vector Error Correction Model (VECM) the findings demonstrates that changes in the macroeconomic variables selected exert a significant impact on aggregate stock price within the period under study. According to this study there existed a negative long-run relationship between inflation rates and aggregate stock price, the two were found to have a unidirectional causality running from inflation to aggregates stock price. A positive significant relationship and bidirectional causality exist between money supply and aggregates stock prices.

Kisaka, and Mwasaru, (2012) examines the causal relationship between exchange rates and stock prices in Kenya. The empirical results indicate that the two variables under study are cointegrated and that exchange rates Granger-causes stock prices in Kenya. Another study by Ochieng, and Oriwo, (2012) investigates the relationship between macroeconomic variables on Nairobi Securities Exchange Share Index (NASI) and sought to determine whether changes in macroeconomic variables can be used to predict the future NASI. Three key macroeconomic variables are examined and they include lending interest rate, inflation rate and 91 day Treasury bill (T bill) rate. Regression method was employed for data analyses, however the lending rate was found to be correlated to 91 day Treasury bill rate and thus it was dropped from the model. The findings from the study indicate that 91 – day T bill rate has a negative relationship with the NASI while inflation has a weak positive relationship with the NASI.

The literature concerning macroeconomic variables and their effects on stock markets prices is well documented, but most of the previous studies have only concentrated on developed economies and little has been done to developing/emerging economies such as Kenya.

Furthermore even in the developed economies the studies have focused on the effects of macroeconomic variables on stock market index as a whole ignoring the effects of these macroeconomic variables on different individual sectors of the economy (Ahmed, 2010, Hussain & Mahmood, 2001). These studies are significant and relevant however stakeholders in the stock markets including investors must understand how stock prices of different sectors in the economy react differently to changes in macroeconomic variables.

The economy of any country consists of several sectors and all are important to that economy, but some sectors such as banking are held with more esteem. Banking sector is among the sectors that are highly regulated in any economy and highly profitable, and it is closely linked to stock markets since both have great influence on the financial system of a country, these factors makes the banking sector a lucrative sector for investment by investors in the stock markets.

Commercial banks play a vital role of intermediation between the deficit spending units (DSUs) and the surplus spending units (SSUs), they perform the function of maturity transformation by taking short term deposits for savers and giving long term loans to borrowers. Commercial banks stability just as is the financial markets' stability is an indicator of a stable financial system and thus policy makers will strive to ensure commercial banks stability. Commercial banks are therefore a key pillar in the financial sector and to the whole economy.

The effect of macroeconomic variables to banking sector is of great importance to stakeholders including investors as they make their investment decisions and portfolio creation, borrows as they position themselves for future borrowing and the regulators as they seek to build a stable financial system. Given the importance of the banking sector to the economy, this study

investigates the effect of macroeconomic variables on stock price index of commercial banks listed in Kenya's stock market.

Stock dealing in Kenya started way back in the 1920's but there was no formal market then to regulate and set rules that would govern trading, therefore trading took place in a gentleman's agreement with professional in other areas such as lawyers, accountants, auctioneers and estate agents acting as the brokers. The Nairobi Stock Exchange Limited (NSE) was started in 1954 as voluntary association of stock brokers and was registered under the societies act. The NSE was situated at the current New Stanley Hotel in Nairobi and has since been renamed Nairobi Securities Exchange Limited (NSE, 2011).

There are currently 44 Commercial banks in Kenya, out of these 3 have significant shareholding by the government and state corporations while 27 are locally and privately owned, 13 are foreign owned and one mortgage finance company, three banks have since been placed under statutory management by the Central Bank of Kenya (CBK). Out of the 44 commercial banks only 11 are listed in the Nairobi securities exchange Limited (CBK, 2014).

The macroeconomic variables effect on stock prices, their trends are of great importance to investors, other stakeholders and the stock markets' stability. Therefore understanding the effects of macroeconomic variables on stock prices is crucial to various players such as investors, policy makers, financial assets analysts and researchers as well. This study therefore investigated the effect of macroeconomic variables on stock prices of listed commercial banks in the NSE and used three macroeconomic variables, namely: Real Interest Rate (RINT), Real Gross Domestic Product (RGDP) and Exchange Rates (ER).

1.2 Problem Statement

A great deal of studies have been carried out on the effects of macroeconomic variables on stock prices, but most of these studies have concentrated on developed economies and little has been done to developing/emerging economies such as Kenya. Furthermore most of these studies have focused on the stock market price as a whole and have ignored individual sectors of the economy such as the banking industry (Ahmed., 2010). Sector by sector analysis is essential since different sectors may react differently to changes in macroeconomic variables which might not be necessarily the same results exhibited by the stock market as a whole.

Studies by Muhammed, (2012) in Ghana, Jawaid and Haq, (2012) in Pakistan and Makan, Ahuja and Chauhan, (2012) in India, found a positive relationship between interest rates and stock prices, whereas studies in Kenya by Aroni, (2011), Gatuhi and Macharia, (2013),Chirchir, (2010), Olweny and Kimani, (2011), Talla, (2013), in Sweden, Lekobane and Lekobane, (2014) in Botswana and Yogaswari, Nugroho and Astuti, (2012) in Indonesia found a negative relationship between the same variables.

Studies by Jawaid and Haq, (2012) in Pakstan, Gatuhi and Macharia, (2013) in Kenyafound a positive relationship between exchange rates and stock prices, whereas in Kenya studies by Kirui, Wawire and Onono (2014), Olweny and Kimani, (2011), and others elsewhere by Yogaswari, Nugroho and Astuti, (2012) in Indonesia and Makan, Ahuja and Chauhan, (2012) in Indiafound a negative relationship between the same variables.

Studies by Olweny and Omondi (2011) in Kenya and Lekobane and Lekobane, (2014) in Botswanafound a positive relationship between gross domestic product and stock prices. In Kenya, Kirui, Wawire and Onono (2014) found insignificant relationships between gross

domestic product and stock prices, they concluded that gross domestic product is not important in explaining stock prices in Kenya.

The results from these studies have failed to reach a consensus on the effects of macroeconomic variables and stock prices. The lack of consensus could be attributed to the methodologies used in different studies, very few of these studies have analysed time series data using a combination of Granger causality test, Johansen cointegration test and vector error correction model methodology which was adapted by this study.

Therefore the aim of this study was to investigate whether the economic fundamentals, namely: real interest rates, exchange rates and real gross domestic product explain the stock price index behaviour, limiting itself to stock price index of listed commercial banks in the Nairobi Securities Exchange. The study used quarterly data for the recent 14 year from 2000 to 2013 to investigate the relationship between macroeconomic variables and the stock price index of listed commercial banks in the Nairobi Securities Exchange. The findings of the study are believed will extend the existing body of literature by providing more insight to the effect of macroeconomic variables on stock price index of the banking sector of a developing country like Kenya.

1.3 Objective of the Study

1.3.1 The General Objective

The general objective of this study was to analyze the effects of macroeconomic variables on stock price index of listed commercial banks in the Nairobi Securities Exchange.

1.3.2The Specific Objectives

(i) To determine the effect of Real Gross Domestic Product on stock price index of listed commercial banks in the Nairobi Securities Exchange.

(ii) To determine the effect of Real Interest Rates on stock price index of listed commercial banks in the Nairobi Securities Exchange.

(iii) To determine the effect of Exchange Rates on stock price index of listed commercial banks in the Nairobi Securities Exchange.

1.4 Research Questions

(i) What is the effect of Real Gross Domestic Product on stock price index of listed commercial banks in the Nairobi Securities Exchange?

(ii) What is the effect of Real Interest Rates on stock price index of listed commercial banks in the Nairobi Securities Exchange?

(iii) What is the effect of Exchange Rates on stock price index of listed commercial banks in the Nairobi Securities Exchange?

1.5 Limitations

According to Mugenda & Mugenda (1999), limitation is an aspect of a research that may influence the results negatively but over which the researcher has no control. The study covers a fairly interesting area and requires a great deal of time and as such time is a limiting factor to this study as well as financial resources to the researcher since he is not sponsored by any corporate to undertake the study. The study used only three macroeconomic variables as predictors of stock prices of listed commercial banks despite the fact that macroeconomic variables are more than three in the economy.

1.6 Scope of the Study

The study used secondary data which was available at the Central Bank of Kenya library and the NSE offices. The period covered was from January 2000 to December 2013. The study used only three macroeconomic variables as predictors and stock price index of listed commercial banks in the NSE as the dependent variable.

1.7 Significance of the Study

This study hopes to offer valuable contributions to theory and practice to the literature in Kenya stock market by evaluating the relationships between the selected macroeconomic variables and the stock prices of listed commercial banks in the NSE. The study hopes to provide useful basis to investors to help them make informed investments decisions. From the policy makers perspective the study hopes to make useful insight for effective formulation and implementation of fiscal and monetary policies that could help stabilize the financial markets and possibly spur economic growth in their economy. Researchers can also use the findings of this study to further study the phenomenon of changes in macroeconomic variables on stock prices.

1.8 Assumptions

The definition of an assumption to the study is any fact that a researcher takes to be true without actually verifying it and that if the fact is not true then the results of the study would not be valid (Mugenda & Mugenda, 1999). The study assumes that macroeconomic variables have some sort of relationship with stock prices. The study further assumes that the selected macroeconomic variables are the most commonly used macroeconomic variables in Kenya.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Thischapterisconcernedwithsurveyingtheworkoftheotherresearcherswhohavestudiedthevariousas pectsofthetopicunderstudy.Itgivesacriticalexaminationon what other scholars have said on the effects of macroeconomic variables namely gross domestic product, real interest rates and exchange rates as on the stock price index.

It offers a background of the concepts as well as providing literature on the topic under study. The chapter also offers a theoretical review and framework, empirical review as well as the conceptual review and frame work on of real gross domestic product, real interest rates and exchange rates as macroeconomic variables on the stock price index. Finally it provides a link of the identified topic to the concept under review while pointing out gaps that warrant this study.

2.2Theoretical Review

Researchers have employed different theoretical frameworks to relate macroeconomic variables and stock prices. The theories that underpin the relationship between macroeconomic variables and stock prices are the efficient market hypothesis (EMH) developed by Fama (1970),the Capital Asset Pricing Model (CAPM), the arbitrage pricing theory (APT) which was propounded by Ross(1976) and the present value model (PVM) also known as the discounted cash flow model. These theories are discussed in this section as they are believed to review relationships between the macroeconomic variables and stock prices.

2.2.1The Efficient Market Hypothesis (EMH)

This model was developed by Eugene Fama (1970) and it postulates that in an efficient market stock prices fully reflect all the information received by the market at all times. Fama defined an efficient market as a market where the stock prices reflect all available information received by that market, this mean that its unlikely to profit from price movement predictions tby studying information on factors that affect stock prices, because according to the EMH the stock prices will already have adjusted instantly to reflect any new information that is received by the market (Malkiel, 2003). If the conclusions by this hypothesis were to be upheld then any sort of analysis of data on macroeconomic variables would be rendered useless as there will be no predictions on the current or future stock prices movements. Upholding the conclusions by EMH will thus invalidate this study.

According to EMH there exist different levels of information and Fama identified three types efficient market each according to the availability of information received by the market. The lowest level of the efficient market is the weak form in which stock prices reflect all past information such that carrying out technical analysis is of no use. The second and middle level of the efficient market is the semi strong form in which stock prices changes swiftly and rapidly to incorporate all information in the weak form and all publically available information. This renders fundamental analysis which includes analysis of company specific factors, industry factors and economic wide factors useless. According to the semi strong form it will be of no use for any study on effects of macroeconomic variables on stock prices to be carried out. The third and the highest form of the efficient market is the strong form in which stock prices reflect all information in the semi strong form as well as information regarded as secret by the company insiders and therefore insider trading is impossible because all the information that is available is

already reflected in the stock prices. In all the three forms of efficient markets reveal that it's of no benefit to try to analyze information in order to predict stock price movements as such information is already reflected in the current stock prices.

This study focused on the semi strong form of efficient market which postulates that the current assets prices fully reflect all past information and all publically available information to determine whether it's possible to predict stock prices by studying information on macroeconomic variables, it used three macroeconomic variables as predictors namely real gross domestic product, exchange rates and interest rates.

2.2.2 Arbitrage Pricing Theory (APT)

The arbitrage pricing theory was developed by Stephen Ross in 1976. The arbitrage pricing theory is a general theory of asset pricing that holds that the expected returns of a financial asset can be modeled as a linear function of various macroeconomic factors or theoretical market indices, where the sensitivity to change in each factor is represented by a factor specific beta coefficient (Alexander, Sharpe and Bailey, 2001).

The model's derived rate of return will then be used to price the financial asset correctly, this asset price should be equal to the expected end of period return discounted at the rate implied by the model. In an event that the prices diverge then arbitrage actions should bring the price back to its correct level. APT assumes that asset returns are related to an unknown number of unknown macroeconomic factors (Alexander, Sharpe and Bailey, 2001). This theory results in arriving in stock prices if stock was the financial asset under consideration and for this reason the researcher considers it relevant to this study.

2.2.3 Present Value Model (PVM)

Present value model (PVM) also called the discounted cash flow is a model that relate stock prices to future expected cash flows (dividends streams) and the future discount rates of these cash flows (Humpe & Macmillan, 2009). It postulates that any macroeconomic variable that influence expected future cash flows or the future discount rates at which these future cash flows are discounted at, should have an influence to the stock prices as well. Expected future cash flows or the future discount rates are known to be influenced by many macroeconomic variables such as interest rates, exchange rates, oil prices, foreign direct investments and gross domestic product. According to Humpe & Macmillan (2009), this model can be used to forecast the long run relationship between the stock prices and macroeconomic variables unlike the arbitrage pricing theories which focuses on short run relationships between the stock prices and macroeconomic variables.

PVM concludes that factors influencing expected profit and future cash flows or dividend streams of the financial asset, would theoretically alter its present value. This provides a firm theoretical ground linking the macroeconomic factors and stock prices (Ahmed, 2010). The PVM has other underlying models such as the Gordon growth model, the two stages Gordon growth model, the three stages Gordon growth model and the H model which incorporate the growth of dividends at different economic levels. Since the theory states that the macroeconomic variable affecting expected future cash flows or the future discount rates also affect stock prices of the firms involved, then the theory is at the centre of the current study.

2.2.4 The Capital Asset Pricing Model (CAPM)

The CAMP model relates the relationship between risk and return in asset pricing, it aims at predicting the expected return of an asset with expected market return, expected return of a risk

asset and the security's specific beta. CAPM has its basis in the construction of an efficient market portfolio that maximizes return, given a certain level of risk or minimizes the risk of a portfolio at a given level of return. The model stipulates that the expected return on a stock is determined by the risk free interest rate and a risk premium subjected to the stock's responsiveness to the overall movement in the market that is its beta coefficient (Humpe & Macmillan, 2009).

The risk premium is the market returns adjusted for the rate of a risk free asset, the market returns are influenced by macroeconomic variables and as such the price of the financial asset in that market will be affected by the same macroeconomic variables (Humpe & Macmillan, 2009). This model links the returns of an asset to its beta, the risk free rate and the premium risk of the market, the future asset's returns are treated as being same as the asset price by the model. The fact this model calculates the asset price by involving the premium risk which is always affected by macroeconomic variables makes it relevant to this study.

2.3 Empirical Review

The relationships between macroeconomic variables and stock prices have extensively been studied. A great deal of studies has been conducted on the effects of macroeconomic variables and stock prices as well as their relationships but most of these studies have concentrated on the developed economies. Little has been done on the developing/ emerging economies like Kenya. The review of the literature shows that many studies have confirmed that there exist relationships between macroeconomic variables and stock prices.

Kown and Shin (1999) uses Engle-Granger co integration and Granger causality test from the Vector Error Correction Model (VECM) and notices that the Korean stock market was cointegrated with a set of macroeconomic variables, while Cheung and Ng (1998) used

Johansen's co integration technique with quarterly data from Canada, Germany, Italy, Japan and the US and concluded that there were long term co-movements between the national stock index and some specific macroeconomic variables such as real oil price, real consumption, real money supply and real GDP in those five countries. They concluded that the stock indices were related to changes in macroeconomic variables.

Chen et al, (1986) explores the relationships between some seven macroeconomic variables and stock prices, they found out that oil prices, consumption, market index have no relationship with stock prices. They however found significant relationships between stock prices and industrial production, inflation, gross domestic product. In Norway a study by Gjerde and Frode (1999) investigated the relationship between macroeconomic variables and stock returns. Their results showed that there exists a positive relationship between oil prices, GDP and stock returns. Their study did not however show any significant relationship between inflation and stock returns.

Olweny, and Kimani, (2011) investigates stock market performance and economic growth empirical evidence from Kenya, using Granger causality test based on the Vector Autoregressive (VAR) model. Findings indicated that economic growth (GDP) and stock market performance (indices) are cointegrated thus they have a long-run relationship. The findings further indicated that there existed unidirectional causal relationship between economic growth and stock market running from the NSE 20-share index to the GDP, that is, a rise in NSE 20-share index causes an increase in real GDP but the reverse was not found to be true. They concluded that the movement of stock prices in the Nairobi stock exchange reflect the macroeconomic conditions of the country and can therefore be used to predict the future path of economic growth.

Geetha, mohidin, Chandran and Chong (2011) examined the relationship between stock markets, unexpected inflation rate, expected inflation rate, gross domestic product and interest rate in three different countries namely United State, China and Malaysia. The result indicated that there was no long-run cointegration relationship between stock markets and the macroeconomic variables studied in all the three countries. The result further shows that there was no short-run relationship between stock markets and the macroeconomic variables studied in United State, and Malaysia. There was however short-run relationship between stock markets and the unexpected inflation in China.

Asma, Amara, Naseem and Sultana, (2013) used inflation, interest rates, gross domestic savings and per capita GDP to examine their impact on the Karachi Stock Exchange stock index in Pakistan. The analysed results indicated that GDP per capital and gross domestic savings have a significant and positive impact on Karachi Stock Exchange stock Index. On the other hand, interest rates and inflation (being measured through CPI) possessed a significant but negative impact on Karachi Stock Exchange stock Index. The study further indicated that explanatory variables under study accounted for about 98% variations of the Karachi Stock Exchange stock Index.

Lekobane and Lekobane, (2014) using VECM framework studied the cointegration of macroeconomic variables and stock market prices in Botswana. Their findings revealed that the variables under study were cointegrated. Positive cointegration was found to exist between stock market prices and real GDP, inflation, diamond index and short-term interest rates, however there was no cointegration between stock market prices and money supply, foreign reserves, exchange rates, long-term interest rates.

Naik and Padhi, (2012) used money supply, whole price index, industrial production index, exchange rates and treasury bills as a proxy of interest rates to investigate their relationships with stock market index in India. Applying the Jahansen's cointegration and vector error correction model they explored the long-run relationship between stock market index and these macroeconomic variables, their analysis revealed that macroeconomic variables and stock market index were cointegrated and hence a long-run relationship exists between them. A positive relationship was found between stock prices and money supply, industrial production index. A negative relationship between inflation and stock prices while exchange rates and short term interest rate were found to be insignificant in determining stock prices in India. The results further indicated that in the long run all macroeconomic variables granger cause the stock prices. There existed bidirectional causal relationship between stock prices and industrial production while unidirectional causal relationship running from money supply and interest rates to stock prices was established and another unidirectional causal relationship running from stock prices to inflation was found to exist.

Ray, (2012) explored the impact of different macroeconomic variables on the stock prices in India, using a multiple regression model and granger causality test. The findings revealed that there existed no causal relationships between interest rates, industrial production index and stock prices but a unidirectional causality was found to exist running from stock prices to inflation, foreign direct investment, gross domestic product, exchange and gross fixed capital formation. However, bi- directional causality existed between stock price and foreign exchange reserve, money supply, crude oil price as well as whole price index. A significant negative effect on stock prices and gold price was established, while balance of trade, interest rate, foreign exchange reserve, gross domestic product, industrial production index and money supply were found to

positively influence the Indian stock prices. Foreign direct investment, inflation, exchange rates and wholesale index on the other hand were not found to have insignificant effects on stock prices in the market studied.

Yogaswari et al, (2012) examines the effect of macroeconomic variables (inflation, interest rates and exchange rates) on the stock price movement in Indonesia Stock Exchange. The analysis results indicated that there existed significant relationships between the studied macroeconomic variables and stock prices. Changes in inflation were found to give a positive impact, while changes in interest rates and exchange rates were found to give negative impacts to stock prices in the Jakarta Stock Exchange.

In Cote'd Ivoire Herve, Chanmalai and Shen, (2011) used five macroeconomic variables namely: Industrial Production Index, Consumer Price index, Domestic Interest Rates, Real Exchange Rates and Real money Supply to explores their relationships with that country's stock market index, they used Johnansen's multivariate cointegration test techniques. Results from the study indicated that only two of the macroeconomic variables under the study were cointegrated with stock prices, signifying some long-run relationships between them and stock market index. Out of the five macroeconomic variables studied, only consumer price index and domestic interest rates were found to affect stock price movement in Cote'd Ivoire. There existed a bi-directional relationship between domestic interest rates and stock prices. The study concluded that macroeconomic factors are not appropriate indicators for future forecast of stock prices movement behaviour in Cote'd Ivoire.

Muhammed, (2012) investigated the effect of interest rates and industrial production on stock prices in the Dhaka Stock Exchange. The study used Autoregressive Integrated Moving Average (ARIMA) model and found that there existed positive relationships between interest

rates and industrial production with market stock prices but the coefficient were statistically insignificant though. Issahaku, Ustarz and Domanban, (2013) sought to find out if there existed any casual link between macroeconomic variables and stock prices in Ghana. The study revealed that a significant long-run relationship existed between stock prices and money supply, inflation and foreign direct investment. Short-run relationships were found to exist between stock prices and interest rates, inflation and money supply. Unidirectional causal relationships were established, running to stock returns from inflation and exchange rate, and others running from stock returns to money supply, interest rate and foreign direct investment has also been revealed. The findings imply that arbitrage profit opportunities existed in the Ghana stock market contrary to the conclusions of the Efficient Market Hypothesis (EMH).

Akani, (2013) investigated the relationship between macroeconomic aggregates namely inflation rates, interest rates and money supply and aggregate stock price in Nigeria. Employing Granger Causality Test and Johansen Cointegration Test in VECM, the findings demonstrated that changes in the selected macroeconomic variables exerted a significant impact on aggregate stock price within the period under study. According to this study there existed a negative long-run relationship inflation rates and aggregate stock price, the two were found to have a unidirectional causality running from inflation to aggregate stock price. A positive, significant relationship and bidirectional causality existed between money supply and aggregate stock prices.

Chirchir, (2010) investigates the relationship between stock prices and interest rates using Toda and Yamamoto (1995) method and found that a negative but insignificant bi- directional causality relationship between the two variables. Aroni, (2011) analyses factors influencing stock prices of firms listed in the Nairobi Securities Exchange using four macroeconomic variables,

namely: inflation, interest rates, Exchange rates and money supply. Multiple regression formula was applied to estimate effect of the selected factors on stock prices. The regression results showed that both exchange rates and interest rates had a significant negative effect on stock prices in Kenya. Money supply had an insignificant positive correlation with stock prices whereas inflation had a significant positive correlation with stock prices.

In their study Gatuhi, and Macharia, (2013) examines the relationship between oil prices, exchange rates, interest rates and other macroeconomic variables and the stock market index in Kenya. Using Pearson correlation and regression to test their relationship and significance, the findings indicated that diesel prices had a significant positive relationship while interest rates had a significant negative relationship with stock market performance. The findings further indicated that both the total oil consumption and exchange rates had an insignificant positive relationship with the stock market performance.

Kutty, (2010) examines the relationship between stock prices and exchange rates in Mexico. The empirical results report that there is a short-run relationship between exchange rates and stock prices and causality running from stock prices to exchange rates, their results further report that there is no long-run relationship between these two variables. Talla, (2013) investigates the impact of changes in selected macroeconomic variables on stock prices of the Stockholm Stock Exchange in Sweden. The study uses Multivariate Regression Model computed on Standard Ordinary Linear Square (SOLS) method and Granger causality test. The findings show that inflation, exchange rates had a significant negative influence on stock prices, while interest rates have insignificant negative relationship with stock prices. Money supply was insignificantly positively associated to stock prices. No causal relationships were found between

stock prices and all the predictor variables under study except a one unidirectional causal relation from stock prices to inflation.

Several studies by Aggarwal (1981), Soenen and Hrnnigar (1988), Bahmani, Oskooee and Sohrabian (1992), Abdalla and Murinde (1997), Smyth and Nandha (2003), Farooq and Keung (2004), Aquino (2004), Aquino (2005), Homma et.al (2005) and Hartmann and Pierdzioch (2007) explored the relationship between foreign exchange rate and stock prices. Results from these studies showed that there is positive relationship between foreign exchange rate and stock prices. Patel, (2012) investigates the effect of macroeconomic determinants namely: exchange rates, oil prices, inflation, interest rates, money supply, gold price, silver price and index of industrial production on the performance of the Indian stock market. The findings revealed that there exists a long run relationship between all macroeconomic variables studied and the Indian stock indices.

Agrawal, Srivastav and Srivastava, (2010) analysed the relationship between stock market prices and exchanges rates in India and found that there was a negative correlation between them. The causal relationship was found to be unidirectional running from exchange rate to stock prices. Makan et al, (2012) employed Granger causality test, regression analysis and correlation analysis to examine the relationship between stock market prices and macroeconomic variables, namely: industrial production index, consumer price index, interest rate (call rate), exchange rate, gold price, oil price and foreign institutional investment. The results indicated that exchange rate, foreign institutional investment and interest rate (call rate) are relatively more significant and are likely to influence stock market prices in India. A positive relation between foreign institutional investment, interest rate (call rate) and stock market prices was established while exchange rate and stock market prices showed a negative relationship.

They simply concluded that in long term the Indian stock market prices are more driven by domestic macroeconomic factors rather than global factors.

Jawaid, and Haq, (2012) explores the effects of exchange rates, interest rates and their volatility on stock prices of banking industry of Pakistan. Cointegration results suggested that there was existence of significant negative long run relationships between exchange rate and short term interest rate with stock prices. On the other hand, positive and significant relationships existed between volatilities of both exchange rates and interest rates with stock prices. Exchange rates and stock prices were found to have a bidirectional causality relationship whereas a unidirectional causality running from short term interest rates to stock prices was established.

In Sri Lanka Menike, (2006) studied macroeconomic variables effect on stock prices. The multivariate regression was run using eight macroeconomic variables for each individual stock. The results indicate that most of the companies reported a high coefficient of determination (R^2) which justified a high explanatory power of macroeconomic variables in explaining stock prices in that country. Negative relationships were found between inflation, exchange rates and stock prices, money supply was found to be insignificant in predicting stock price movements in Sri Lanka.

Mohammad, Hussain and Ali (2009) in Pakistan examines the relationship between foreign exchange rate, foreign exchange reserves, gross fixed capital formation, interest rate, industrial production index, money supply and whole sales price index as macroeconomic variables and stock prices using quarterly data. The results established that all the variables were significantly related to stock prices with both foreign exchange rate and foreign exchange reserves having a higher influence on stock prices than the other variables in the study.

Using data from 1993 to 2002 from five Asian countries namely Malaysia, South Korea, Thailand, Hong Kong, Japan and Australia. Mahmood and Dinnah (2009) investigated the relationships between macroeconomic variables and stock prices. Their result showed that there existed long run equilibrium relationships between stock prices and different macroeconomic variables in the four countries (South Korea, Hong Kong, Japan and Australia). Short run relationships were found to exist in all the five countries except Hong Kong and Thailand. In Hong Kong some relationships were reported on foreign exchange rate and stock prices while in Thailand there were significant interactions between GDP and stock prices.

A study carried by Owusu and Kuwornu, (2011) in Ghana uses four macroeconomic variables interest rates, crude oil price, exchange rates and consumer price index to find out whether they have any relationship with stock market prices in the Ghana context. They used ordinary least squares (OLS) model in the Box-Jenkins time series methodology context in establishing relationship between the variables under that study. The empirical findings indicated that only one explanatory variable had a significant relationship with stock market prices, the consumer price index. The other three independent variables namely: interest rates, crude oil price, exchange rates were found to have insignificant effects on stock market prices in the Ghana.

Adam and Tweneboah, (2008) in Ghana sought to find out if stock prices movement could be predicted using macroeconomic variables. Macroeconomic variables included in the study were foreign direct investments, interest rates (Treasury bill rates), exchange rates and consumer price index. They used Johansen’s multivariate cointegration test and innovation accounting techniques and found out that interest rates and inflation had a very strong significant long-run relationship while consumer price index and foreign direct investments had a weak

long-run relationship. A short-run relationship existed between stock prices and inflation and exchange rates.

Izedonmi, and Abdullahi, (2011) used OLS to investigate the effects of macroeconomic factors on the Nigerian stock returns, the selected macroeconomic variables were inflation, exchange rates and market capitalization. The regression result indicated that all the three macroeconomic factors tested had no significant effects on stock returns in the Nigerian stock exchange market. Asaolu and Ogunmuyiwa (2010) examined the impacts of macroeconomic variables namely: external debt, fiscal deficit, inflation, investment, foreign capital inflow, industrial output and exchange rate on stock prices in Nigeria. The Granger causality test indicated that stock prices do not Granger cause any of the macroeconomic variables studied in Nigeria over the sample period. When considered in pairs only exchange rate was found Granger cause stock prices. The Johansen Cointegration test established that there existed a long run relationship between stock prices and all the macroeconomic variables but that relationship was found to be weak. They interpreted the results to mean that macroeconomic variables are not a leading indicator of stock prices in Nigeria.

Olweny and Omondi (2011) investigates the effects of macroeconomic factors on stock returns volatility on the Nairobi Securities Exchange Limited (NSE) in Kenya. Using interest rate, exchange rate and inflation as macroeconomic variables and employing EGARCH and TGARCH models, the results indicated that exchange rate, interest rate and inflation affected stock returns volatility however the volatility persistence was found to be low which they interpreted to mean that the long-run relationship was insignificant between the predictors and the dependent variable.

Kirui et al, (2014) in Kenya, examines the relationships between the Nairobi Securities Exchange Limited stock returns and a set of macroeconomic variables during the period of January 2000 to June 2012. They used inflation rate, Treasury Bill Rate, Exchange rate, and the Gross Domestic product as the macroeconomic variables. The study established that only exchange rate had a significant effect on stock returns and the relationship between them was negative. Gross domestic product, Inflation and the Treasury bill rate were found to have insignificant relationships with stock returns in Kenya and they thus concluded that these macroeconomic variables were not important in explaining stock returns in Kenya.

Kisaka, and Mwasaru, (2012) examines the causal relationship between exchange rates and stock prices in Kenya. The empirical results indicated that the two variables under study were cointegrated and that exchange rates Granger-causes stock prices in Kenya. A study by Ochieng, and Oriwo, (2012) investigates the relationship between macroeconomic variables on Nairobi Securities Exchange Share Index (NASI) and sought to determine whether changes in macroeconomic variables can be used to predict the future NASI. Three key macroeconomic variables were examined these were lending interest rate, inflation rate and 91 day Treasury bill (T bill) rate. Regression method was employed for the data analyses, however the lending rate was found to be correlated to 91 day Treasury bill rate and thus it was dropped from the model. The findings from the study indicated that 91 – day T bill rate had a negative relationship with the NASI while inflation had a weak positive relationship with the NASI.

The results from these studies have given different results on the same variables and thus they have failed to reach a consensus on the effects of macroeconomic variables on stock prices. The lack of consensus could mostly be attributed to the different methodologies used in these

studies and the level of the economies where they were carried out, very few of the studies has used vector error correction model which was adapted by the current study.

2.4 Conceptual Review

With globalization and liberalization of global financial markets there is a more close relationship between stock prices and macroeconomic variables including real interest rates, exchange rates and real gross domestic product. These variable are viewed as the most important in determining stock market behaviour as they are used to describe the state of macro economy, that investors must monitor closely and use them to forecast the future investment movement in order to make informed investment decisions (Junkin, 2012).

2.4.1 Real Interest Rate

The relationship between interest rate and stock price index is well documented. Real interest rate is considered as the cost of capital and therefore investment decisions by investors are mostly based on the interest rate levels. When the real interest rate increase the cost of borrowing go up and as a result there is a reduction on economic activities in that economy and vice versa. Most companies finance their capital investments through borrowed money and therefore a reduction in real interest rates will serve as an expansionary incentive. This will have a positive effect on the firm's future returns and as such investors will thus expect better future dividends if they invested in such a firm, this will result to increased demand for stock and the stock prices are expected to rise. The inverse will hold true for an increase in real interest rates, the study hypotheses a negative relationship between real interest rates and stock prices.

2.4.2 Exchange Rate

Due to globalization, businesses are affected either directly or indirectly by international trade activities. When international trade occurs currencies of the countries involved are converted from one currency to the other. An exchange rate between the two currencies is used to perform the conversion. When the local currency appreciates against the major currencies say the US dollar, the exports for that country become expensive and thus became less competitive. This has a negative impact on the stock price index if that country is export oriented because firms will export less which affects their profits negatively and which may in turn become less attractive to investors (Muthike & Sakwa, 2012).

In a country that is import oriented like Kenya an appreciation of the local currency makes import cheaper, this means that Kenyan firms importing goods will use less of the Kenya shillings to acquire one US dollar which has the effect of more imports and thus increased profits for the firms. This in turn results in more demand for stock of these firms and thus an increase in stock prices. This study thus hypothesizes a negative relationship between exchange and stock prices.

2.4.3 Real Gross Domestic Product

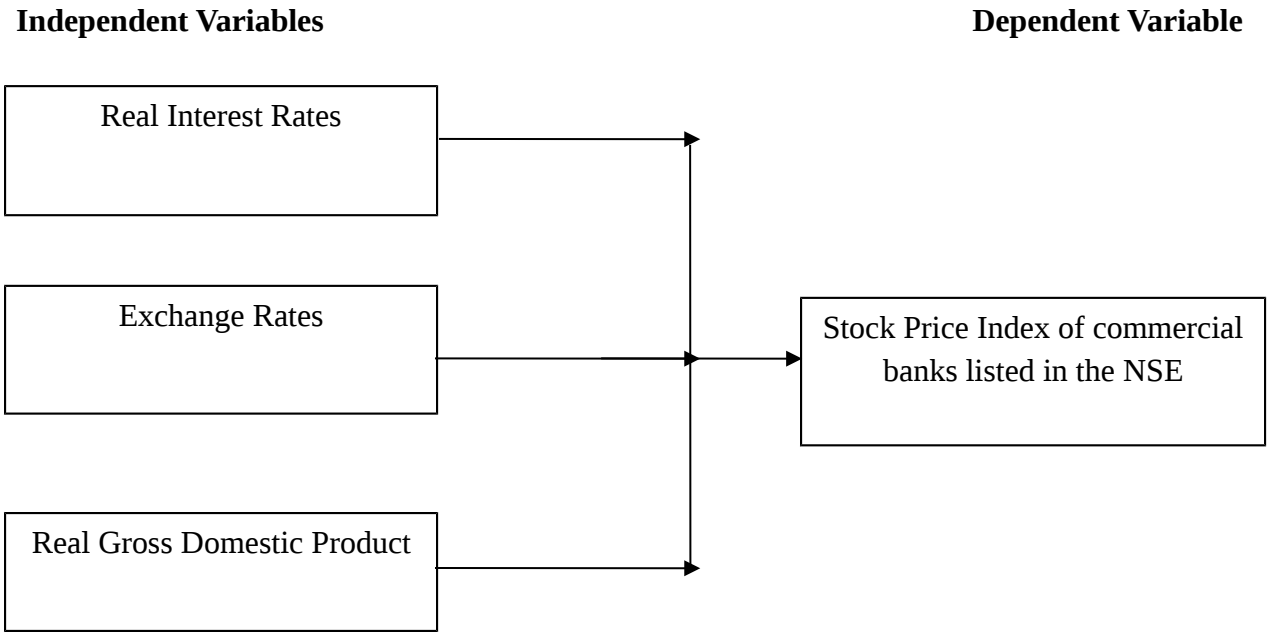
It has been theoretically shown that real gross domestic product increases during economic expansion and decreases during economic recession, thus a change in nominal gross domestic product signal a change in the economy. The real gross domestic product rises with economic growth, as a result of increased ability of firms in such an economy to generate additional cash flows and profits. The expected returns (dividends) of firms in such an economy increases and forces the stock price to increase due to increased stock demand by investors.

Study by Humpe & Macmillan (2007), indicate both US and Japan stock prices are positively related to real gross domestic product. Mukherjee and Naka (1998) indicate that real gross domestic product is the largest positive determinant of Indian stock prices. Maysami et al. (2004) for Singapore indicate that real gross domestic product is positively and significantly related to the stock returns. Tweneboah (2008) indicate the positive relationship between real gross domestic product and Ghana stock index. According to the result of Kaplan (2008), the stock prices have a positive and statistically significant long-run effect on output level implying that stock prices lead real gross domestic product in Turkey. The results of studies for both in development and emerging markets generally indicate positive relationship between real gross domestic and stock prices. This study hypothesis a positive relationship between real gross domestic product and stock prices.

2.5 Conceptual Framework

Figure 1

Conceptual Framework



Source: Author (2016)

2.6 Operationalization of Variables

Table 1

Operationalization of Variables

	VARIABLE	INDICATOR	MEASURE	FORMULAE
Dependent Variable	Stock Price Index	Market Stock price Index of listed commercial banks.	Quarterly Average Market Stock Price Index of listed commercial banks.	$\text{Average} = \frac{\sum_1^n \text{Index}}{n}$
Independent Variables	1. Exchange Rate.	Quarterly exchange rate (Kshs/$)	Quarterly Average Kenya shillings per unit USD (Kes/ $)	As sourced from CBK.
	2. Real Interest rate	Quarterly interest rate.	Quarterly Average of call money rates.	As sourced from CBK.
	3. Real Gross Domestic product(RGDP)	RGDP Growth Rate.	Quarterly of seasonally adjusted GDP rate.	As sourced from CBK.

Source: Author (2016).

Formulae Key.

Where: Q_i is number of shares of each particular bank.

P_i is stock price for each individual bank.

n is the number of months i.e. 3 for quarter of a year.

CHAPTER THREE

RESEARCH METHODOLOGY AND DESIGN

3.1 Introduction

This chapter was concerned with the methodology and procedures used in the study in order to achieve its objectives. The term research design is used to refer to all procedures selected by the researcher for studying a particular set of questions (Kothari, 2009). On the other hand research methodology is the systematic way of finding solutions to these questions (Kothari, 2009). This chapter was concerned with the description of the dataset that was used and the time series data methodology that was used to unveil the dynamism between the variables under study.

3.2 Research Design

This study investigated the effect of macroeconomic variables, namely: Real interest rates, Exchange rates and Real Gross domestic product on stock price index of the listed commercial banks in Kenya. The study used time series data, and was analysed using time series models and procedures.

3.3 Target Population

The population of this study was represented by all the eleven listed commercial banks in Kenya. The listed commercial banks in the NSE are Barclays bank Ltd, CFC Stanbic holdings Ltd, Diamond Trust bank Ltd, Housing Finance Ltd, I &M Holdings Ltd, Kenya Commercial Bank Ltd, National Bank of Kenya Ltd, NIC Bank Ltd, Standard Chartered Bank Ltd and Cooperative Bank of Kenya Ltd. The researcher chose to use the entire target population of all listed

commercial banks because he believes that the study's universe is small enough to be reached and its data is readily available.

3.4 Sampling and Sample Design

This study utilized census sampling technique and employed a quarterly data set for fourteen years on the variables under investigation in order to meet its objectives. The census sampling design was adopted because the number of subjects in the study's universe is quite small, this is informed by the fact that the Kenyan banking sector has only eleven banks listed in the Nairobi Securities Exchange. The data for all the listed banks was obtained and according to Kothari (2009) an enumerated set of all subjects in the population is referred to as census. The researcher preferred this technique because it obtains the highest degree of accuracy than other techniques since no single element from the study population is left out (Kothari, 2009).

3.5 Data Set and Collection Method

The study utilized secondary data, data on stock prices of listed commercial banks was bought from the NSE offices while that of macroeconomic variables was obtained from the Central Bank of Kenya. The study used quarterly time series data of the variables under study for a period covering fourteen years (January 2000 to December 2013). The researcher chose the fourteen year period because he believes that it is long enough to reveal the dynamics that are sought by the study. The year 2000 was preferred to be the base year for the study because the general prices are believed to have been stable, this is supported by the fact that Kenya rebased early the following year.

The quarterly banking sector stock indices were computed using daily stock prices of listed commercial banks and their respective number of shares which were obtained from NSE offices. The stock price index was computed using the following formulae.

$$\text{Index} = \frac{\sum_1^n Q_i P_i}{\text{Index Divisor}} = \frac{\text{Total Market Value for all Companies}}{\text{Index Divisor}} \quad \text{.....3.1}$$

$$\text{Divisor}_t = (\text{Divisor}_{t-1}) \frac{\text{Total Market Value for all Companies}_{\,t}}{\text{Total Market Value for all Companies}_{\,t-1}} \quad \text{.....3.2}$$

The index formulae were adopted from DJIA (2016).

Where: Q_i is number of shares of each particular bank and P_i is stock price for each individual bank. The researcher believes that the length of the period used in the study is to be long enough to give comprehensive and reliable results.

3.6 Methodology

The data was analyzed using both descriptive and inferential methods. Descriptive method revealed descriptive statistics such as mean, medium, standard deviation and frequency distributions, while different inferential methods were employed to reveal the relationships between the variables under study. Preliminary tests for desirable properties of time series data were performed in order to ensure that the appropriate model was used in this study and the results arrived at are reliable and realistic. Time series data was finally analyzed through Johansen's Cointegration test, vector error correction model and granger causality, which were run in E-views statistical software.

3.7 Exploratory of Data analysis

Exploring time series data was found necessary because it reveals data characteristics and properties which enable the researcher to know which models and analytical skills to use while working with the data set in the study.

3.7.1 Trend Analysis

Trend analysis on the variables under study was performed to review their behavior across the time period under study. Line plots graphs were employed to serve this purpose.

3.7.2 Descriptive

Descriptive method reviewed descriptive statistics such as mean, medium, standard deviation and normality probability distributions carried out through skewness and kurtosis. One famous test for normality is the Jarque – Bera test Maysami et al, (2000), which is used to test whether the variables in the study are individually normally distributed.

JB = n [S2 /6 + (K-3)2 /24]……..……..……3.3

These formulas were adopted from Agrawal et al, (2010).

Where K = Kurtosis Coefficient which measures the peakness and the flatness of the variable,

S = Skewness Coefficient which measures the asymptotic of the variable, n = Sample Size.

The Jarque - Bera (JB) measures two properties of normality, the skewness and kurtosis. It assumes asymptotic property of the variable. For a normally distributed variable the

asymptotic coefficient will be equal to zero, any JB test value that is not zero is thus a deviation from the normality assumption. Likewise skewness coefficient for a normally distributed variable is zero while that of kurtosis is three. Deviations from normality assumption necessities transformation of all or some variables into logarithms, which has the effect of instilling normality (Agrawal et al., 2010).

3.7.3 Correlation Matrix.

Multicollinearity occurs if two or more independent variables are correlated with one another, presence of multicollinearity in explanatory variables may result to unreliable results from the regression. The remedy for multicollinearity is that one of the variables should be dropped from the list of variables thus correlation test on the variables was performed and reported in correlation matrix. The multicollinearity decision rule is that a high correlation coefficient between the regressors of absolute 0.8 and above implies the existence of multicollinearity (Adam and Twenoboah, 2008).

3.8 Multiple Regression Model

Past studies have used multiple regression models to examine the effects of macroeconomic variables on stock index. Such studies include Talla, (2013) in Sweden, Menike, (2006) in Sri Lanka, Ochieg' and Oriwo, (2012) in Kenya and Aroni, (2011) in Kenya. It thus became necessary for this study to fit a multiple regression model, diagnostic analysis was performed to evaluate how well the regression model fitted the data.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon_t \quad \text{.....4.2}$$

β_0 is the intercept, $\beta_1, \beta_2, \beta_3$ are independent variables coefficients, ε_t is the error term.

3.9 Post Multiple Regression Model Estimation Tests

Post estimation tests are used to reveal the goodness of the fitted model, if the model is found to be not a good fit it's either re-estimated with different parameters or a different model is used.

3.9.1 Heteroskedasticity

Heteroskedasticity occurs when the variances of the error terms are not constant, this has the consequence of arriving at estimators that are unbiased and consistent but they are inefficient. The variances of the estimated estimators are not the minimum variances. This test was carried out to ascertain whether using regression model in OLS was sufficient to the set of data in this study. According to Pindyck R. S and Rubinfeld D.L, (1998) the null hypothesis of homoskedasticity is rejected if the calculated statistics value exceeds critical table value.

3.9.2 Autocorrelation Test

Serial correlation also called autocorrelation Brooks, (2008) occurs if the error terms over time are correlated with one another. According to Brooks, (2008) the consequences of autocorrelation are the same as those of heteroskedascity, serial correlation test was performed to ascertain whether using regression model in OLS was sufficient to the set of data in this study. The null hypothesis of no autocorrelation is rejected if the calculated statistics value is more critical table value (Brooks, 2008).

3.9.3 Residual Plots

Residual analysis is a post regression estimation test that evaluates the goodness of the fit of the fitted regression model (Greene, 2002). If the graph of fitted versus residuals form a pattern is an indication that the regression model might not be a good fit, this test was performed to evaluate the goodness of the fitted regression model.

The conclusion on whether or not the fitted multiple regression model is appropriate in reporting the data set in the study is arrived at by studying the model's post estimation tests results. If the model found to be appropriate, the study is reported using it, if found to be inappropriate the study goes further to fit other available models.

3.10 Time Series Models

Time series is a process observed in sequence over time, due to this sequential nature of time series, series in time y_t is not independent of series in time y_{t-1}. Time series can be separated into two main categories the univariate ($y_t \in R$ is a scalar) and the multivariate ($y_t \in R^m$ is a vector valued). The primary models for the univariate time series are the autoregressive models (ARs) while those of the multivariate time series are the vector autoregressive models (VARs) (Hansen, 2013).

3.11 Preliminary Tests

Time series data is sensitive to some properties that is they are present affect the results from the data, thus preliminary test were carried to establish the fitness of the data.

3.11.1 Unit Root Test

Stationarity is an important property of time series data, non-stationary data may result into spurious results and conclusions hence time series data must be analyzed to determine whether the series has a unit root (non-stationary) or not. Augmented Dickey Fuller (ADF) test was employed to determine existence or otherwise of stationarity.

3.11.2 Optimal Lag Length Selection

Cointegration may be sensitive to lag length, a lot of lags reduce the power of the test due to loss of degrees of freedom and estimation of additional parameters while too few lags may fail to capture the dynamics of the actual error correction process and thus arriving to poor results. Optimal lag length is thus required to avoid the above pitfalls, there are several criterion of deciding the optimal lag length, they include information based criterion such as Akaike Information Criterion (AIC), the Bayesian Information Criterion (BIC) and the Scharz Bayesian Information Criterion (SBIC) these select a lag with the least value to be the optimal lag length.

Others include likelihood ratio test (LR) which compares a VAR with one with p – 1 lags and the Final prediction error criterion (FPE) which selects the lag with least value to minimize the prediction error (Maysami et al, 2000). Select the information criterion with the least value, but the information criterions give conflicting results on the optimum lag length decision criteria is purely a decision of the researcher, this is informed by the fact that none of the criterion is considered superior to the others but such a decision must be justified.

3.11.3 Cointegration Test

Cointegration means that the series is non stationary and cointegration analysis is used to establish existence or non-existence of long term relationship between two or more variables. The test statistics values are thus compared with the critical value for cointegration test of Engle – Granger approach as provided by Davison and Macknnon (1993). The null hypothesis is that there is no cointegration against an alternative hypothesis that there is cointegration. The null hypothesis is rejected if the absolute statistics test value is greater than the absolute table critical value for cointegration (Brooks, 2008). If the null hypothesis is rejected then it is concluded that the series was cointegrated. Existence cointegration is a pre- condition of fitting a vector Error Correction Model in time series data.

3.12 The Time Series Models Selection

This study has multivariate time series and therefore the available models to study the data set are the vector autoregressive models (VARs) (Hansen, 2013). There are two main models the Vector Autoregression Model and the Vector Error Correction Model. The main difference between the two is that Vector Error Correction Model requires the series to be cointegrated whereas vector autoregression model. Presence or non presence of cointegration dictates which of the two models should be fitted for the data set in the study.

3.12.1 Vector Autoregression Model

Vector autoregression (VAR) is a model in econometrics which captures values and interdependencies between multiple time series and generalizes univariate (ARs) models. All variables in VARs are considered to be endogenous and every variable in the VAR system is a function of its own lagged values (past values) and lagged values of all the other variables in the model. A VAR model is a system of equations equal to the number of variables in the model

(Brooks, 2008). In Vector autoregression Model the series are non-stationary at levels and are not cointegrated, first differencing is thus carried out to induce stationarity before the VAR model is estimated. Thus VAR is integrated to order one I (1).

The VAR model.

$$y_t = \beta_0 + \beta_1 y_{t-1} + \beta_2 y_{t-2} + \ldots + \beta_k y_{t-k} + \mu_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.4$$

Adopted from Brooks, (2008).

Where: β_0 = the models intercept.

$\beta_1, \beta_2, \ldots, \beta_1$ = m x m matrices coefficients that relate to lagged values of the variables to their current values.

t -1, t - 2 …, t - k number of lags.

y_s = the model variables.

3.12.2 Vector Error Correction Model

VAR model does not require the variables to be cointegrated, if the variables are cointegrated the dynamics in the time series is not captured using a VAR model. Another model known as vector error correction (VECM) is used to capture the relationships between the variables. VECM could therefore be described as a restricted and differenced VAR model, used for cointegrated non stationary variables. VECM determines short term dynamics of variables restricting long term

relationships of variables through cointegrating relations, the error correction term represents the deviation from the long run equilibrium.

The VEC Model. Suppose there are four variables y, w, x and z in the model.

$$\Delta y_t = \Gamma(y_{1,2,3,t-1}) + \beta_1 \Delta w_t + \beta_2 \Delta x_t + \beta_3 \Delta z_t + \beta_4 (y_{1\,t-1} - y_1 x_{t-1} - y_2 w_{t-1} - y_3 z_{t-1}) + \mu_t \quad 3.7$$

Adopted from Brooks, (2008).

Where:

$\beta_{1,2\ \&\ 3}$ = 4 x4 first difference coefficient matrices (short run parameters) for w, x and z on y.

Γ = level matrix of the variables in y_{t-1} and contains long run equilibrium relationships and a rank which is equal to the cointegrating vectors.

Δ = difference operator.

$(y_{1\,t-1} - y_1 x_{t-1} - y_2 w_{t-1} - y_3 z_{t-1})$ = the lagged error correction term (ECT).

β_4 = speed of adjustment back to equilibrium.

t -1, t - 2 …, t - k = number of lags.

y = model dependent variables.

3.13 Post Estimation Diagnostic Tests

Various post model fitting tests are employed to check the goodness of the fitted model.

3.13.1 Causality Test

Causality analysis is normally carried out to review the presence of casual relationship between the variables in a study. The Granger causality test was employed to determine the presence or otherwise of these relationships between the dependent variable and the explanatory variables. Causality tests review the causal relationship between variables in the model but do not report the sign of the relationship or how long their effects will last (Brooks, 2008). A variable is said to cause another if the F statistics value is significantly different from zero (Pindyck R. S and Rubinfeld D.L, 1998). The null hypothesis that "Y does not cause X" is thus rejected if F statistic value is significantly different from zero.

3.13.2 Impulse Response Test

Impulse response is one of tests the review information that is not reported by causality tests. Impulse response traces out the responsiveness of the dependent variable in the system to shocks applied to each of the independent variables innovations (error term as it is called in the time series). Each independent variable from each the VECM equations separately a shock (a change of the error term by one unit) is applied to the innovation and the effects over the model are observed over time and noted. If the model is stable the shock should die gradually and if unstable the shock should persist (Brooks, 2008).

3.13.3 Variance Decomposition Test

Variance decomposition is yet another test that reviews information that is not reported by causality tests. It examines the model dynamics by giving the proportion of the movements in the dependent variable that are due to their own shocks and shocks of the other variables. A shock on a variable will affect its own course and is also transmitted to all other variables in the model. Variance decomposition determines how much of the period steps ahead, a forecast error variance of a given variable are explained by innovations of each explanatory variables. In variance decomposition an error term of one variable is introduced to a shock while holding all other error terms constant (Brooks, 2008). The procedure breaks down variance of the forecast error for each of the variables into components such that each variable is explained as a linear combination of its own current innovations value and lagged innovation values of all the variables in the system (Hossain, 2008).

3.13.4 Residual Autocorrelation Test

Autocorrelation test was carried to test whether the right number of lags was included in VECM. According to Thomsen, et, al, (2013) one way of testing goodness of the fitted model is by plotting the autocorrelations for residuals, if big number of the residual autocorrelation points lie outside the significant level lines, then there exist correlation and that the right number of lags was not used in the fitted model, therefore the fitted model is not a good fit, under such circumstances the VECM should be re estimated but with more number of lags than the one used in the previous model.

CHAPTER FOUR

FINDINGS AND DISCUSSION

4.1 Introduction

The tools adopted by this study in determining the effects of macroeconomic variables on stock price index of listed commercial banks in the NSE, included data exploration such as trend analysis, descriptive statistics, the unit root test for stationarity as was proposed by Dickey and Fuller (1976), the Johansen (1990) cointegration test that tests the long run relationships between variables, vector error correction model to reveals short run relationships between the variables under study. Post estimation tests of Impulse response and variance decomposition were performed to establish the length that effects will last. Granger causality test was carried out to determine whether there exist any causal relationships between the variables under study.

Residual autocorrelation test was carried out to find the goodness of the fitted vector error correction model.

4.2 Exploratory of the Data

Exploring time series data was found necessary because it reveals data characteristics and properties which enable the researcher to know which models and analytical skills to use while working with the data set in the study.

4.2.1 Trend Analysis

Trend analysis of the variables under study was performed to establish their behavior across the time period under study. Line plots graphs were employed to serve this purpose. The stock price index of listed commercial banks as shown in figure 4.1 below indicate that they remained fairly stable for the period between 2000 and 2002 but they generally went up in the period between 2003 and 2008. The index appears to have come down to their earlier trading levels immediately after 2008 and remained stable up to 2012. Generally index did not follow any trend but wondered up and down indicating that it followed random walk.

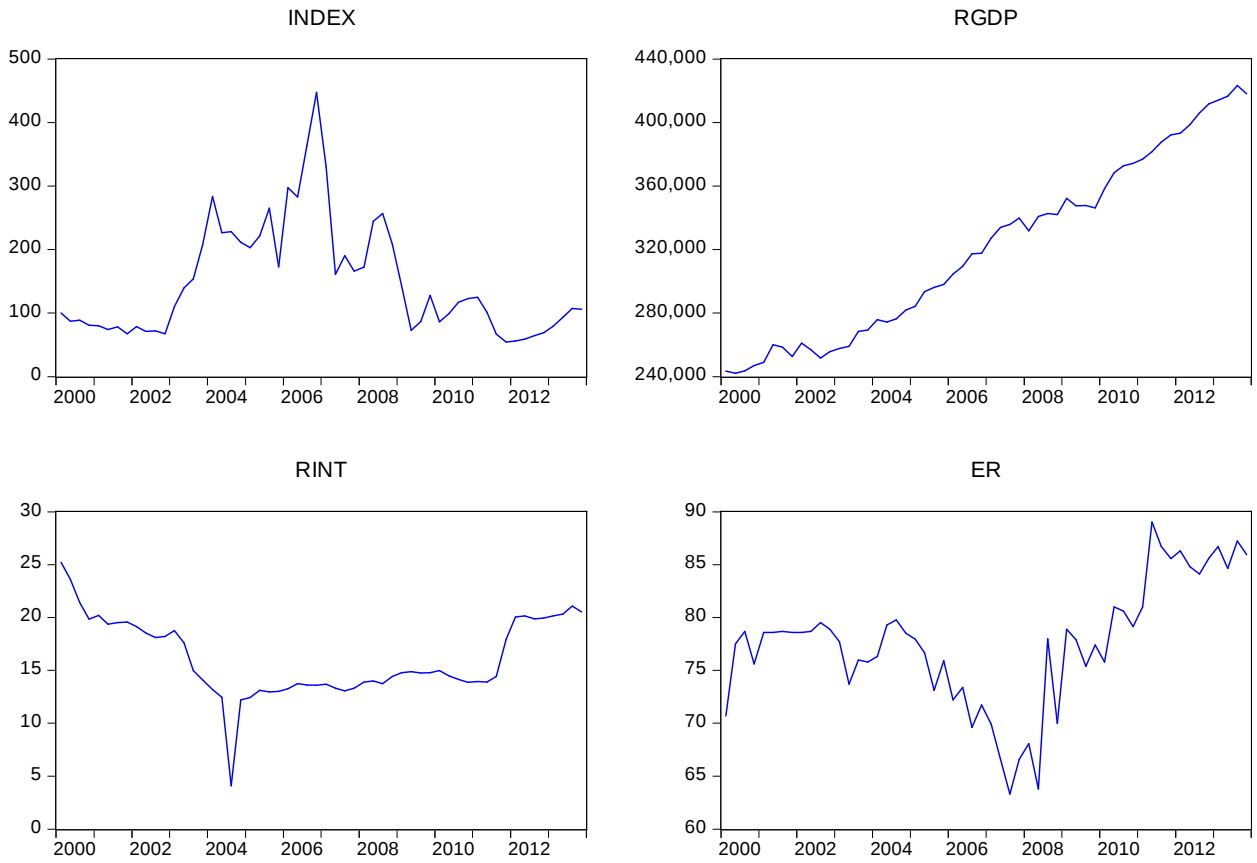
The results for RGDP as given in figure 4.1 indicate that RGDP had a fairly steady growth of almost the same gradient throughout the study period, although it seems to have slowed down a little bit in 2002, 2008 and 2010. The researcher attributed political interferences of general elections held in 2002 and 2008, while the slowdown in 2010 was attributed to constitution referendum. The activities of electioneering are believed to have contributed negatively to RGDP growth. However RGDP was generally found to have had an upward trend during the study period.

The results of RINT from figure 4.1 below show a downward trend between years 2000 and 2004 from about 25% to about 12% for the mentioned years respectively and there was certainly a very big drop between 2004 and 2005 with the lowest level reaching 5% , this might have been caused by deliberate expansionary motives by the government. RINT went up after 2005 reaching to about 12% level and stayed fairly constant at the level up to 2012 when it went up further to about 18% at the close of the study period. RINT was thus found to follow random walk trend.

The final trend analysis was performed on ER using United States of America dollar as the stable major currency to review how the local currency behaved during the study period. The results are presented in figure 4.1 and they review that ER had both upward trend in some years and downward trend in others. Upward trend was noted between years 2000 and 2001 and also between 2008 and 2013 although the general trend was upwards some fluctuations were observed. Downward trend with fluctuations was observed between 2004 and 2008 with the lowest exchange rate being reported in 2007 and 2008 which was at about Kes 65 per 1 USD. The movement of ER as RINT was found to follow the random walk trend.

Figure 2

Line Plots Graphs



Source: Author, (2016)

4.2.2 Descriptive Statistics

Descriptive analysis reveal descriptive statistics such as mean, medium, standard deviation and normality probability distributions which is reported through skewness and kurtosis coefficient. One famous test for normality is the Jarque – Bera test Maysami et al, (2000), which is used to test whether the variables in the study are individually normally distributed.

JB = n [S2 /6 + (K-3)2 /24]……..……4.1

This formula was adopted from Agrawal et al, (2010).

Where K = Kurtosis Coefficient which measures the peakness and the flatness of the variable,

S = Skewness Coefficient which measures the asymptotic of the variable, n = Sample Size.

The Jarque-Bera (JB) measures two properties of normality, the skewness and kurtosis and it assumes asymptotic property of the variable. For a normally distributed variable the asymptotic coefficient will be equal to zero, any JB test value that is not zero is thus a deviation from the normality assumption. Likewise skewness coefficient for a normally distributed variable is zero while that of kurtosis is three. Deviation from normality assumption necessities transformation of all or some variables into logarithms, which has the effect of instilling normality (Agrawal et al., 2010).

Descriptive results are given in table 4.1 and they indicate that Index and RGDP are slightly positively skewed while RINT and ER are slightly negatively skewed. This shows that the skewness of the data is not much pronounced. Kurtosis coefficients which the measure of peakness or the platness of the distribution curves indicate that index and RINT are leptokurtic while RGDP is platykurtic. The coefficient for ER just about the normal distribution kurtosis coefficient of 3. The sample data was concluded to be normally distributed.

Table 2

Descriptive Statistics

	INDEX	RGDP	RINT	ER
Mean	148.6809	321165.9	16.15030	77.50536
Median	113.6150	322425.0	14.77667	78.25000
Maximum	447.1900	423209.0	25.23333	89.00000
Minimum	54.24000	242026.0	4.090000	63.30000
Std. Dev.	88.91314	56833.16	3.674732	5.967493
Skewness	1.211771	0.208384	-0.043105	-0.310970
Kurtosis	4.041401	1.747565	3.746336	2.855899
Jarque-Bera	16.23551	4.065342	1.317048	0.951007

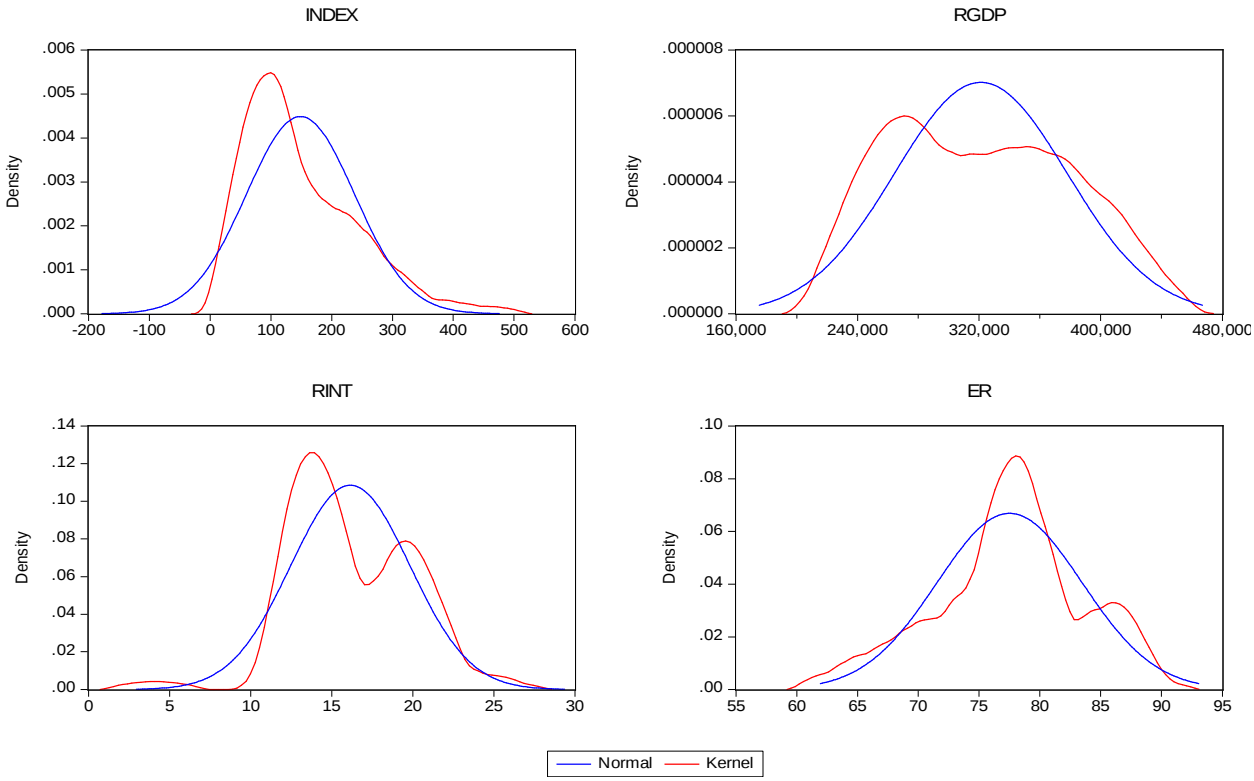
Probability	0.000298	0.130985	0.517615	0.621572
Sum	8326.130	17985289	904.4167	4340.300
Sum Sq. Dev.	434805.0	1.78E+11	742.7011	1958.603
Observations	56	56	56	56

Source: Author, (2016)

The conclusion arrived at in the descriptive statistics above were confirm by distribution curves for the variables in the study, the data is concluded to be normally distributed and thus there was no need to transform the variables.

Figure 3

Distribution Curves



Source: Author, (2016)

4.2.3 Correlation Matrix

Multicollinearity occurs if two or more independent variables are correlated with one another, presence of Multicollinearity in explanatory variables may result to unreliable results from the regression and poses a serious problem to the study results (Adam and Twenoboah, 2008). The remedy for Multicollinearity is that one of the variables should be dropped from the list of variables thus correlation test on the variables was performed. Correlation is a measure that shows the strength and direction in which the variables move together.

Correlation Matrix results are presented in table 4.2 below and they indicate that real gross domestic product is weakly and negatively correlated with the real interest rates. There is a mild and positive correlation between real gross domestic product and exchange rates. Real interest rates and exchange rates were found to have mild and positive correlation relationship.

The multicollinearity decision rule is that a high correlation coefficient between the regressors of absolute 0.8 and above implies the existence of multicollinearity (Adam and Twenoboah, 2008). The correlation matrix results rules out the existence of multicollinearity since all coefficients between the regressors are below the multicollinearity decision rule.

Table 3

Correlation Matrix

	INDEX	RGDP	RINT	ER
INDEX	1.000000	-0.145264	-0.620422	-0.566515
RGDP	-0.145264	1.000000	-0.019794	0.408016
RINT	-0.620422	-0.019794	1.000000	0.348663
ER	-0.566515	0.408016	0.348663	1.000000

Source: Author, (2016)

4.3Multiple Regression Model

Past studies have used multiple regression models to examine the effects of macroeconomic variables on stock index. Such studies include Talla, (2013) in Sweden, Menike, (2006) in Sri Lanka, Ochieg' and Oriwo, (2012) in Kenya and Aroni, (2011) in Kenya. It thus became necessary for this study to fit a multiple regression model and diagnostic analysis from the results was performed to evaluate if the multiple regression model was sufficient for the data set.

Table 4

Multiple Regression Model

Dependent Variable: INDEX
Method: Least Squares
Date: 10/30/15 Time: 23:42
Sample: 2000Q1 2013Q4
Included observations: 56

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RGDP	4.89E-05	0.000233	0.209647	0.8347
RINT	-11.70286	3.516980	-3.327531	0.0016
ER	4.094741	1.327916	3.083584	0.0032

R-squared	0.051595	Mean dependent var	148.6809
Adjusted R-squared	0.015806	S.D. dependent var	88.91314
S.E. of regression	88.20767	Akaike info criterion	11.84935
Sum squared resid	412371.5	Schwarz criterion	11.95785
Log likelihood	-328.7817	Hannan-Quinn criter.	11.89141
Durbin-Watson stat	0.395144		

Source: Author, (2016)

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon_t \quad \text{……..……..……..……..4.2}$$

β_0 is the intercept, $\beta_1, \beta_2, \beta_3$ are independent variables coefficients, ε_t is the error term.

Index = 0.0000489RGDP – 11.703RINT + 4.093ER ……....…….……4.3

(0.000233) (3.516980) (1.327916)

Multiple regression analysis indicates that RGDP has a positive but insignificant relationship with index, while a negative relationship between RINT and index is established. A positive relationship between ER and index was found both relationships between stock price index and the two regressors are significant. The coefficient of determination (R^2) indicates that the regressors in the model explain only 5% of the depended variable.

4.4. Post Multiple Regression Model Estimation Tests

4.4.1 Heteroskedasticity Test

Heteroskedasticity occurs when the variances of the error terms are not constant, this has the consequence of arriving at estimators that are unbiased and consistent but they are inefficient. The variances of the estimated estimators are not the minimum variances. This test was carried out to ascertain whether using a multiple regression model in OLS is sufficient to the study. Heteroskedasticity test was carried out using Breusch-Pagan-Godfrey test and the results were reported in table 4.4 below. According to Pindyck R. S and Rubinfeld D.L, (1998) the null hypothesis of homoskedasticity is rejected if the calculated statistics value exceeds critical table value. The results indicate that the calculated statistics value of 6.203 is less than the critical table value of 7.18 at 5% significant level thus the null hypothesis of existence of homoskedasticity is not rejected and conclude that there existed no presence of heteroskedasticity. This meant that based on this test alone the fitted multiple regression model was a good fit.

Table 5

Heteroscedasticity

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	2.158968	Prob. F(3,52)	0.1040
Obs*R-squared	6.202562	Prob. Chi-Square(3)	0.1022
Scaled explained SS	10.00439	Prob. Chi-Square(3)	0.0185

Source: Author, (2016)

4.4.2 Autocorrelation Test

Serial correlation also called autocorrelation Brooks, (2008) occurs if the error terms over time are correlated with one another. According to Brooks, (2008) the consequences of autocorrelation are the same as those of heteroskedasticity, serial correlation was performed for the same reason as that of heteroskedasticity. The null hypothesis of no autocorrelation is rejected if the calculated statistics value is more critical table value (Brooks, 2008). The Breusch-Godfrey Serial Correlation LM Test was used to test for autocorrelation. The results are presented in table 4.5 below and the indicate that the calculated statistics value of 35.74177 is more than the critical table value of 7.18 at 5% significant level thus the null hypothesis of no autocorrelation is rejected and conclude that there is serial correlation. This implies that the fitted multiple regression model was not a good fit.

Table 6

Autocorrelation

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	45.19380	Prob. F(2,51)	0.0000
Obs*R-squared	35.74177	Prob. Chi-Square(2)	0.0000

Source: Author, (2016)

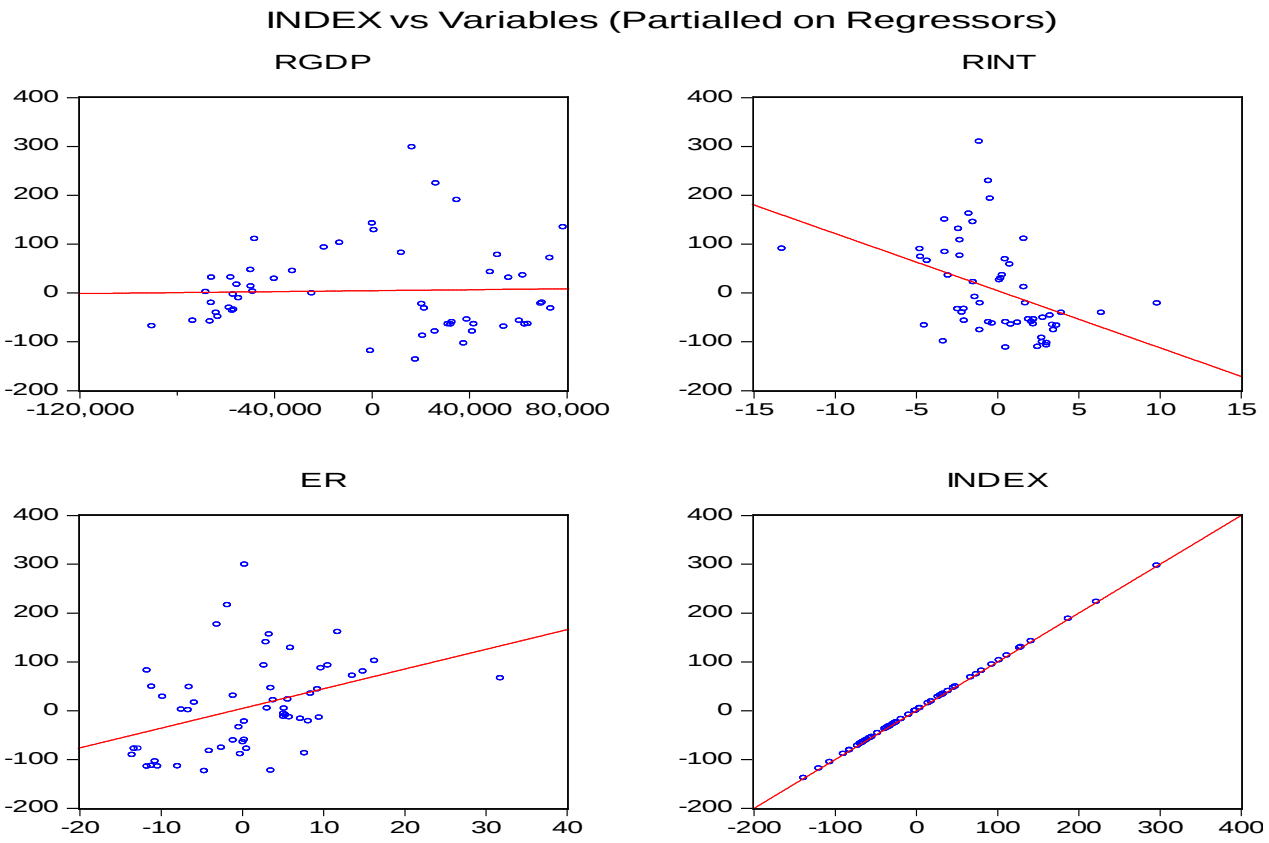
4.4.3 Residual Analysis

Residual analysis is a post regression estimation test that evaluates the goodness of the fit of the fitted regression model (Greene, 2002). If the graph of fitted versus residuals form a pattern is an indication that the regression model might not be a good fit, this diagnostic test was performed to evaluate whether regression model under OLS was sufficient for the data in the study. From

figure 4.3 below the residuals seem to form patterns and that indicate that the regression model may not be a good fit.

Figure 4

Residual Plots



Source: Author, (2016)

Regression model was thus found to be insufficient for analyzing the data in this study because from the post estimation tests results it was established that there is presence of serial correlation and residual analysis had patterns formed by the residual plots, the study thus proceeded to analyze the data using other models that are available for time series data set.

4.5 Time Series Models

This study has multivariate time series and therefore the available models to study the data set are the vector autoregressive models (VARs) (Hansen, 2013). There are two main models the Vector Autoregression Model and the Vector Error Correction Model. The main difference between the two is that Vector Error Correction Model requires the series to be cointegrated whereas vector autoregression model. Presence or non presence of cointegration dictates which of the two models should be fitted for the data set in the study.

4.6 Preliminary Tests

Time series data is sensitive to some properties that is they are present affect the results from the data, thus preliminary test were carried to establish the fitness of the data.

4.6.1 Unit Root Test

Stationarity is an important property of time series data, non-stationary data may result into spurious (misleading) results and conclusions, hence time series data must be analyzed to determine whether the series has a unit root (non-stationary) or not. Augmented Dickey Fuller (ADF) test was employed to determine existence stationarity or otherwise. ADF was chosen because it takes care of autocorrelation in case it is present in the series (Brooks, 2008).

The decision criterion is through comparison of the absolute tau statistic value (tau calculated) and Dickey - Fuller critical table value and if the absolute tau statistic value is greater than the absolute Dickey - Fuller critical table value the null hypothesis that the series has a unit root is not rejected.

The unit root results of the series at level for the three tests (with no constant or trend, with constant and with constant and trend) are reported in tables 4.6, 4.7 and 4.8, they establish that the series has a unit root at level for all the three tests. Therefore the null hypothesis that the series has unit root was not rejected and concluded that the series was non stationary at levels. The series was differenced in order to induce stationarity and the results are presented in tables 4.9, 4.10 and 4.11, all the three tests results show that the series became stationary after differencing once. Thus the series was concluded to be integrated of order one I (1).

Table 7

Unit Root (None)

Null Hypothesis: INDEX has a unit root Exogenous: None Lag Length: 0 (Automatic - based on SIC, maxlag=10)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.999160	0.2813
Test critical values:	1% level	-2.607686	
	5% level	-1.946878	
	10% level	-1.612999	
*MacKinnon (1996) one-sided p-values.			

Source: Author, (2016)

Table 8

Unit Root (Constant)

Null Hypothesis: INDEX has a unit root Exogenous: Constant Lag Length: 0 (Automatic - based on SIC, maxlag=10)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.023469	0.2762
Test critical values:	1% level	-3.555023	
	5% level	-2.915522	
	10% level	-2.595565	
*MacKinnon (1996) one-sided p-values.			

Source: Author, (2016)

Table 9

Unit Root (Constant and Trend)

Null Hypothesis: INDEX has a unit root Exogenous: Constant, Linear Trend Lag Length: 0 (Automatic - based on SIC, maxlag=10)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.061642	0.5551
Test critical values:	1% level	-4.133838	
	5% level	-3.493692	
	10% level	-3.175693	
*MacKinnon (1996) one-sided p-values.			

Source: Author, (2016)

Table 10

First Difference Unit Root (None)

Null Hypothesis: D(INDEX) has a unit root Exogenous: None Lag Length: 0 (Automatic - based on SIC, maxlag=10)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.133159	0.0000
Test critical values:	1% level	-2.608490	
	5% level	-1.946996	
	10% level	-1.612934	
*MacKinnon (1996) one-sided p-values.			

Source: Author, (2016)

Table 11

First Difference Unit Root (Constant)

Null Hypothesis: D(INDEX) has a unit root Exogenous: Constant Lag Length: 0 (Automatic - based on SIC, maxlag=10)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.065839	0.0000
Test critical values:	1% level	-3.557472	
	5% level	-2.916566	
	10% level	-2.596116	
*MacKinnon (1996) one-sided p-values.			

Source: Author, (2016)

Table 12

First Difference Unit Root (Constant and Trend)

Null Hypothesis: D(INDEX) has a unit root Exogenous: Constant, Linear Trend Lag Length: 0 (Automatic - based on SIC, maxlag=10)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.033637	0.0000
Test critical values:	1% level	-4.137279	
	5% level	-3.495295	
	10% level	-3.176618	
*MacKinnon (1996) one-sided p-values.			

Source: Author, (2016)

4.6.2. Optimal Lag Length

Cointegration may be sensitive to lag length, a lot of lags reduce the power of the test due to loss of degrees of freedom and the estimation of additional parameters while too few lags may fail to capture the dynamics of the actual error correction process and thus arriving to poor results (Brooks, 2008).

Optimal lag length is thus required to be determined in order to avoid the above pitfalls, optimal lag length ensures that the estimated model error term is not misspecified (Enders, 1995). The number of lags to be included in the cointegrating vectors must therefore be determined. In choosing the optimal lag length, this study used the information criterion such as Akaike Information Criterion (AIC), the Bayesian Information Criterion (BIC) and the Scharz Bayesian Information Criterion (SBIC) which select a lag with the least value to be the optimal lag length and other lag length criterion which included likelihood ratio test (LR) which

compares a VAR with one with p – 1 lags and the Final prediction error criterion (FPE) which selects the lag with least value to minimize the prediction error (Maysami et al, 2000).

These criterions were preferred because they are more effective than graphical procedures which determine the number of lags by examining autocorrelation function (ACFs) and the partial autocorrelation function (PACFs) patterns. Graphical procedures were found to be subjective which is eliminated by using information criterion procedures (Maysami et al, 2000).

The lag length section results are presented in table 4.14 below and they review that SBIC and HQ criterion prefer one lag while LR, FPE and AIC criterion prefer two lags. When the information criterions give conflicting results on the optimal lag length as is the case in this study, the optimum lag length decision criteria is purely a decision of the researcher, this is informed by the fact that none of the criterion is considered superior to the others. Schwarz Bayesian Information Criterion is strongly consistent but inefficient while Akaike Information Criterion is generally efficient but inconsistent, this basically mean that the average variation in lag lengths from different samples within a given population will be greater in the Bayesian Information Criterion than that of Akaike Information Criterion (Brooks, 2008). Although no criterion is superior to the others the study chose Akaike Information Criterion because of its efficiency property, thus the study chose two lag length to be used in this model as the optimal lag length. The optimal lag length decision is supported by likelihood ratio test and the final prediction error criterion results.

Table 13

VAR Lag Order Selection Criteria

VAR Lag Order Selection Criteria
Endogenous variables: INDEX RGDP RINT ER
Exogenous variables: C
Date: 10/31/15 Time: 02:06
Sample: 2000Q1 2013Q4
Included observations: 52

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1220.542	NA	3.35e+15	47.09778	47.24788	47.15532
1	-1017.270	367.4530	2.50e+12	39.89502	40.6455 0*	40.18273*
2	-996.6127	34.16473*	2.11e+12 *	39.71587*	41.06673	40.23376
3	-986.7098	14.85429	2.75e+12	39.95038	41.90162	40.69844
4	-973.1191	18.29529	3.19e+12	40.04304	42.59467	41.02127

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Source: Author, (2016)

4.6.3 Cointegration

Cointegration reviews long run relationship between variables in a study and the conditions for cointegration are that the series must be non-stationary and integrated of order one, the unit root tests results from this study fulfill these conditions and thus cointegration analysis was performed to establish existence or non-existence of long term relationship between the variables in the study. The null hypothesis was that there are no cointegration relationships against an

alternative hypothesis that there are cointegration relationships. The null hypothesis is rejected if the absolute statistics test value is greater than the absolute critical value for cointegration (Brooks, 2008).

Johansen method for testing cointegration was used, this method was preferred because it employs two cointegration tests simultaneously (Johansen, 1990). The tests are the trace and maximum, the trace statistics (λ trace) is a joint test whose null hypothesis is that there exist less than zero or r or less than r cointegrating vectors (equations) and for the first test r = 0 against an unspecified or general alternative hypothesis that there are more than r cointegrating vectors. The maximum statistics (λ max) on the other hand conducts tests on each Eigen value and has a null hypothesis that there are r cointegrating vectors against an alternative hypothesis of r + 1 cointegrating vectors (Brooks, 2008).The test statistics values are thus compared with the Johansen cointegration rank critical value as provided by MacKinnon-Haug-Michelis (1999) and if the null hypothesis is rejected then it is concluded that the series are cointegrated and there is existence of long run relationship between the series.

If the null hypothesis is rejected in the first test r = 0 a second test r = 1 is performed and if the null hypothesis is rejected a third test r = 3 is performed and so on until when the null hypothesis is not rejected. When the null hypothesis is not rejected the tests end there, the number of rejected test is equal to the number of cointegrating vectors and the rank number. In an event that the two test yield different results trace test is considered more superior than the maximum test (Brooks, 2008).

The cointegration test results are presented in table 4.12 below and the trace test and the maximum test review that there is one cointegrating vector. This was given by the fact that the

null hypothesis is only rejected for the first test and it is not rejected from the second test. Establishing existence of cointegration was necessary in deciding which model between VAR and VEC to be used in the study. Existence of cointegration is a pre- condition of fitting a VECM and it is not a requirement for fitting a VAR model in time series data analysis.

Table 14

The Cointegrating Equation

1 Cointegrating Equation(s):		Log likelihood	-1013.918	
Normalized cointegrating coefficients (standard error in parentheses)				
INDEX	RGDP	RINT	ER	C
1.000000	-0.000646	18.64784	6.176861	-715.5842
	(0.00026)	(4.15124)	(2.61440)	

Source: Author, (2016)

The long run relationships were captured through the coefficients of the cointegrating equation. Table 4.13 above gives the relevant coefficients for the variables in the study, which are modeled in equation 4.4.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon_t \quad \text{.....4.4}$$

β_0 is the intercept, $\beta_1, \beta_2, \beta_3$ are independent variables coefficients, ε_t is the error term.

Index =-715.6 -0.000646RGDP + 18.64784RINT + 6.176861ER ….....4.5

(0.00026) (4.15124) (2.61440)

Table 15

Cointegration Test

Date: 10/31/15 Time: 02:04
Sample (adjusted): 2000Q4 2013Q4
Included observations: 53 after adjustments
Trend assumption: No deterministic trend
Series: INDEX RGDP RINT ER
Lags interval (in first differences): 1 to 2
Unrestricted Cointegration Rank Test (Trace)

No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.384697	48.53983	40.17493	0.0058
At most 1	0.231614	22.80089	24.27596	0.0758
At most 2	0.091474	8.837356	12.32090	0.1788
At most 3	0.068362	3.753000	4.129906	0.0625

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.384697	25.73893	24.15921	0.0304
At most 1	0.231614	13.96354	17.79730	0.1722
At most 2	0.091474	5.084356	11.22480	0.4655
At most 3	0.068362	3.753000	4.129906	0.0625

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Source: Author, (2016)

Cointegration establishes long run relationships between the variables in the study from equation 4.4 above it was reviewed that RGDP had a negative long run relationship with stock price index but the relationship was found to be insignificant, and the study therefore concludes that RGDP is not important in predicting stock price index of listed commercial banks in Kenya.

The cointegration findings from this study are inconsistent with previous studies by Olweny and Omondi (2011) in Kenya and Lekobane and Lekobane, (2014) in Botswana which found a significant and a positive relationship between gross domestic product and stock prices. But are consistent with a study in Kenya by Kirui, Wawire and Onono (2014) which found insignificant relationships between gross domestic product and stock prices and concluded that gross domestic product is not important in explaining stock prices in Kenya.

The cointegration results as presented in table 4.12 and equation 4.4 establish that RINT had a significant and positive influence on stock prices of listed commercial banks in Kenya. These findings from this study are consistent with previous studies by Muhammed, (2012) in Ghana, Jawaid and Haq, (2012) in Pakistan and Makan, Ahuja and Chauhan, (2012) in India, which found a positive relationship between interest rates and stock prices. On the contrary several other studies give the different results from those of this study. Results of studies by Aroni, (2011), Gatuhi and Macharia, (2013),Chirchir, (2010), Olweny and Kimani, (2011),in Kenya, Talla, (2013), in Sweden, Lekobane and Lekobane, (2014) in Botswana and Yogaswari, Nugroho and Astuti, (2012) in Indonesia gave a negative relationship between interest rates and stock prices.

The long run relationship between ER and stock prices of listed commercial banks in kenya was found to be significant and positive by this study. These findings from this study are

consistent with those from previous studies by Jawaid and Haq, (2012) in Pakstan, Gatuhi and Macharia, (2013) in Kenya which found a positive relationship between exchange rates and stock prices. On the contrary the results are inconsistent with studies done previously. Studies in Kenya Kirui, Wawire and Onono (2014), Olweny and Kimani, (2011), Yogaswari, Nugroho and Astuti, (2012) in Indonesia and Makan, Ahuja and Chauhan, (2012) in Indiafound a negative relationship between the exchange rates and stock prices.

4.7 The Time Series Fitted Model

Time series is a process observed in sequence over time, due to this sequential nature of time series, series in time y_t is not independent of series in timey_{t-1}. Time series can be separated into two categories name univariate and multivariate. The primary models for the univariate time series are the ARs while those of the multivariate time series are the VARs (Hansen, 2013). Univariate involves only one explanatory variable while multivariable involves two or more explanatory variables, this study has three independent variables and therefore it uses multivariate models in its analysis. There are two main multivariate models, the Vector Autoregression Model and the Vector Error Correction Model. The main difference between the two is that Vector Error Correction Model requires the series to be cointegrated whereas vector autoregression model. Presence of cointegration was established and thus the study used Vector Error Correction Model to analyze the data set.

4.7.1 Vector Error Correction Model

Several models are available for multivariate analyses which include VAR and VEC models. VAR model reveals short run relationships of the variables and does not require the variables to

be cointegrated, if the variables are cointegrated the dynamics between the multiple time series are not captured using a VAR model but through VEC model. VECM requires the variables to be cointegrated and cointegration requires the variables to be integrated to order one, therefore VECM could be described as a restricted and differenced VAR model, used for cointegrated non stationary variables (Brooks, 2008). VECM determines short term dynamics of variables by restricting for the long term relationships of variables through cointegrating relations while allowing for the short run adjustments back to the long run equilibrium whenever deviations occur. The error correction term represents the adjustment speed of deviations back to the long run equilibrium (Brooks, 2008).

The VEC Model. Suppose there are four variables y, w, x and z in the model.

$$\Delta y_t = \Gamma(y_{1,2,3,t-1}) + \beta_1 \Delta w_t + \beta_2 \Delta x_t + \beta_3 \Delta z_t + \beta_4 (y_{1\,t-1} - y_1 x_{t-1} - y_2 w_{t-1} - y_3 z_{t-1}) + \mu_t \ldots$$

……4.6

Adopted from Brooks, (2008).

Where: $\beta_{1,2\ \&\ 3}$ = 4 x4 first difference coefficient matrices (short run parameters) for w, x and z on y, t -1, t - 2 …, t - k = number of lags.

Γ = level matrix of the variables in y_{t-1} and contains long run equilibrium relationships and a rank which is equal to the cointegrating vectors.

$\Delta =$ difference operator, y = model dependent variables.

$(y_{1\,t-1} - y_1 x_{t-1} - y_2 w_{t-1} - y_3 z_{t-1}) =$ the lagged error correction term (ECT).

β_4 = speed of adjustment back to equilibrium.

The VECM output has two parts, the first part contains coefficient estimates that represent the long run relationships between the variables. The VECM results presented in table 4.15 in the appendix indicate that the long run relationships established are identical with those given by the cointegration test and reported in equation 4.4 earlier in this study. The long run relationships are summarized in the following two equations.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon_t \quad \text{.....4.7}$$

Where:

β_0 is the intercept, $\beta_1, \beta_2, \beta_3$ are independent variables coefficients, ε_t is the error term.

Index = -715.5842-0.000646RGDP + 18.64784RINT + 6.176861ER 4.8

(0.00026) (4.15124) (2.61440)

The second part of the VECM output represents the short run dynamics between the variables. The coefficient estimate corresponding to the cointegrating equation (CointEq1) and the differenced dependent variable (D(INDEX)) represent the model's adjustment speed back to the long run equilibrium, while those corresponding to the first raw and columns two, three and four represent adjustment speed back to long run equilibriums of each individual differenced regressors. According to Brooks, (2008) VECM allows for individual regressors to adjust back to their own long run equilibriums relations and also for collective adjustment of all explanatory variables working together to restore the model's long run equilibrium relationships.

VECM yields an equal number of error correction term equations as the number of variables in the model. The first one relate to the whole model adjustment speed to its long run equilibrium in an event of deviations, the others relate to individual independent variables' adjustment speed to their own long run equilibrium relationships if they had deviated from them. This study developed four VECM equations from the data out and used them to analyze the short run relationships of the regressors and the dependent variable. The equations are based on one cointegrating equation with two lags as it had been identified earlier in this study. The VEC model equations follow a general format as given in equation 4.7 below.

$$\Delta Y_t = \beta_0 + \beta_1 ECT_{t-1} + \beta_2 \Delta X_{2\,t-1} + \beta_3 \Delta X_{3\,t-1} + \beta_4 \Delta X_{4\,t-1} + \varepsilon_t \quad \text{.....4.9}$$

Where: Δ = to the difference operator.

β_0 = the equation intercept.

$X_{2,3\ \&\ 4\ t-1}$ = lagged values of the independent variables.

ECT = the error correction term.

β_1 = coefficient for adjustment speed back to the long run equilibrium.

D(INDEX)=

$$2.83 - \mathbf{0.194}(\mathbf{CointEq1}) + 0.11\mathrm{D}(\mathrm{INDEX}(-1)) + 0.05\mathrm{D}(\mathrm{INDEX}(-2)) - 0.001\mathrm{D}(\mathrm{RGDP}(-1)) + 0.0005\mathrm{D}(\mathrm{RGDP}(-2)) - 0.41\mathrm{D}(\mathrm{RINT}(-1)) - 0.592\mathrm{D}(\mathrm{RINT}(-2)) - 2.17\mathrm{D}(\mathrm{ER}(-1)) - 2.2455\mathrm{D}(\mathrm{ER}(-2)) \dots \dots$$

……..4.10

From equation 4.8 above the adjustment speed rate for the model at which it adjusts back to its long run equilibrium was found to be 19.38% if there are deviations from the long run equilibrium. The statistics coefficient of 0.19377 indicate that the short run deviations have risen above the model long run equilibrium and the model is expected adjust downwards at a speed of 19.38% to restore the long run equilibrium position. The adjustment speed is moderate which can be interpreted to mean that it will take roughly five quarters to restore the model's long run relationship position and that the independent variables work together in the short run to explain stock price index of listed commercial banks in Kenya.

D(RGDP) =

$$4150.23 - \mathbf{3.784}(\mathbf{CointEq1}) + 1.57\mathrm{D}(\mathrm{INDEX}(-1)) + 22.72\mathrm{D}(\mathrm{INDEX}(-2)) - 0.19\mathrm{D}(\mathrm{RGDP}(-1)) - 0.0463\mathrm{D}(\mathrm{RGDP}(-2)) + 23.712\mathrm{D}(\mathrm{RINT}(-1)) + 420.084\mathrm{D}(\mathrm{RINT}(-2)) - 262.011\mathrm{D}(\mathrm{ER}(-1)) + 103.51\mathrm{D}(\mathrm{ER}(-2))$$

……....4.11

D(RINT)=

$$-0.1203 - \mathbf{0.0064}(\mathbf{CointEq1}) + 0.0056\mathrm{D}(\mathrm{INDEX}(-1)) - 0.00723\mathrm{D}(\mathrm{INDEX}(-2)) + 4.36\mathrm{E}-05\mathrm{D}(\mathrm{RGDP}(-1)) - 2.41\mathrm{E}-05\mathrm{D}(\mathrm{RGDP}(-2)) - 0.1853\mathrm{D}(\mathrm{RINT}(-1)) + 0.0015\mathrm{D}(\mathrm{RINT}(-2)) + 0.0404\mathrm{D}(\mathrm{ER}(-1)) \; 0.0564\mathrm{D}(\mathrm{ER}(-2))$$

…….4.12

D(ER) = 0.39 -**0.0199**$^{(\mathbf{CointEq1})}$ + 0.0252D(INDEX(-1))+0.0173 $^{\mathrm{D}(\mathrm{INDEX}(-2))}$ + 9.45E-05

$^{\mathrm{D}(\mathrm{RGDP}(-1))}$-0.00015 $^{\mathrm{D}(\mathrm{RGDP}(-2))}$ + 0.0021D(RINT(-1)) - 0.0936$^{\mathrm{D}(\mathrm{RINT}(-2))}$-

0.5177D(ER(-1))-0.044 $^{\mathrm{D}(\mathrm{ER}(-2))}$……..

……..4.13

The independent variables individual adjustment speed rates back to their own long run equilibriums were found to be 378.44%, 0.64% and 2% for RGDP, RINT and ER respectively. All the three explanatory variables were found to have risen above their own individual long run equilibriums, and the VECM results show that they are expected to decrease at their respective adjustment speed rate in the following period(s) to restore their own individual long run equilibrium.

RGDP was found to have a very high adjustment speed rate such that its deviations from the long run equilibrium position are adjusted swiftly and rapidly such that they may pass unnoticed. The study concluded that RGDP does not have short run effects on the stock price

index of the listed commercial banks in Kenya because the long run equilibrium seems to be maintained at all times through the high error correction term.

RINT on the other hand was found to a significantly very low adjustment speed rate to its own long run equilibrium, it was thus found to adjust gradually and slowly to restore its own long run equilibrium. The VECM results established that ER had a higher adjustment speed rate than RINT but it was also significantly low and adjusting gradually to restore its long run equilibrium. The adjustment speed for RINT and ER were found to be slow enough to enable the short run effects to be felt by the model for a number of periods. The lengths at which these short run effects are still present in the model system indicate that the two regressors have short run relationship with the stock prices of the listed commercial banks in Kenya.

Cointegration analysis establishes only the long run relationships between the variables and VECM on the other hand reviews the rate at which the long run relationships are restored back to their equilibrium in an event that they deviate but they do not report the causal and the length of time to which the relationships will last. To capture all the dynamics of the objectives of the study and to test stability of the model adopted, diagnostic tests were required, and these tests were performed and they included the causality test, impulse response test, variance decomposition test and the residual autocorrelation to establish its stability.

4.8. Post Estimation Diagnostics Tests

Several post model fitting tests were employed to check the goodness of the fitted model.

4.8.1. Causality Test

Causality analysis is normally carried out to review the presence of casual relationship between the variables in a study. The Granger causality test was employed to determine the presence or otherwise of these relationships between the dependent variable and the explanatory variables. A variable is said to cause another if the F statistics value is significantly different from zero (Pindyck R. S and Rubinfeld D.L, 1998). The null hypothesis that “Y does not cause X” is thus rejected if F statistic value is significantly different from zero.

The Granger causality test results were presented in table 4.16. The results established a unidirectional casual relationship running from stock price index to RINT, another unidirectional relationship moving from stock price index to ER was also established. The study concluded that stock price index of listed commercial in Kenya cause RINT and ER. The Granger causality test results further established that there exist a bidirectional casual relationship between RGDP and ER, the study concluded that RGDP movements will cause ER to move and vice versa.

Causality tests review the causal relationship between variables in the model and the direction to which the relationships is running from or to but do not report the sign of the relationships or how long their effects will last (Brooks, 2008). It is for this underlying reason that the study performed further tests to establish the signs of the relationships between the variables and for how long will the variables effects will last.

Table 16

VEC Granger Causality

VEC Granger Causality/Block Exogeneity Wald Tests Date: 10/31/15 Time: 04:51 Sample: 2000Q1 2013Q4 Included observations: 53			
Dependent variable: D(INDEX)			
Excluded	Chi-sq	df	Prob.
D(RGDP)	1.090116	2	0.5798
D(RINT)	0.173481	2	0.9169
D(ER)	0.798854	2	0.6707
All	2.267136	6	0.8936
Dependent variable: D(RGDP)			
Excluded	Chi-sq	df	Prob.
D(INDEX)	1.201835	2	0.5483
D(RINT)	0.881649	2	0.6435
D(ER)	3.392586	2	0.1834
All	4.593703	6	0.5969
Dependent variable: D(RINT)			
Excluded	Chi-sq	df	Prob.
D(INDEX)	3.850578	2	0.1458
D(RGDP)	1.350131	2	0.5091
D(ER)	0.405676	2	0.8164
All	6.457277	6	0.3740
Dependent variable: D(ER)			
Excluded	Chi-sq	df	Prob.
D(INDEX)	8.776234	2	0.0124
D(RGDP)	4.574890	2	0.1015
D(RINT)	0.378265	2	0.8277
All	16.16787	6	0.0129

Source: Author, (2016)

4.8.2 Impulse Response Test

Impulse response is one of tests the review information that is not reported by causality tests. Impulse response traces out the responsiveness of the dependent variable in the system to shocks applied to each of the independent variables innovations (error term as it is called in the time series). Each independent variable from each the VECM equations separately a shock (a change of the error term by one unit) is applied to the innovation and the effects over the model are observed over time and noted. If the model is stable the shock should die gradually and if unstable the shock should persist (Brooks, 2008).

According to Thomsen, Sandanger, Longerman, Johansen and Andernson, (2013) variables to which impulse is required can be specified and so are those to which the response is expected from. To achieve the study's objectives this study chose to give impulse on the regressors and the response to the shocks was observed from the explained variable. The impulse response results in line with the objectives of the study were presented in figure 4.4 and discussed, however a full impulse response functions results for all the variables was presented in figure 4.5 but they were not discussed in this study because they were found to be outside the objectives of the study.

From the results presented in figure 4.4 below it is observed that a shock introduced on stock price index innovation will have no effect on itself in the first and half periods, but thereafter reports a sharp and continuous decline up to the fourth period where it attains a constant trend. These findings indicates that the shock dies after the fourth quarter (one year) and are consistent with the results from VECM analysis which reviewed that the model adjusts back to its long run equilibrium position after one year.

The results further revealed that a shock induced to RGDP innovations will result into an immediate small decrease up to the end of the second period, after which it increases gradually and restores its original position on the fourth period. The findings were concluded to mean that the shock dies out after the ninth month, the regaining of the original position is interpreted to mean that fitted model was stable and that RGDP had insignificant effects on the independent variable.

A shock imposed on RINT error term was found to cause an immediate, small and a gently sloping effect on the explanatory variable up to the third period, after which it stabilizes and remains constant. Therefore effects of a shock on RINT innovation were found to die out after the ninth month. The steady and constant position indicates that the fitted model was stable and a long run relation between RINT and the explained variable was established.

A shock induced on ER innovation show that there will be an immediate and sharp declining effect up to the second period. The shock's effects die out after six months and attain a constant trend thereafter. The steady and constant position indicates that a long run relation between RINT and the independent variable was found and the fitted model was stable.

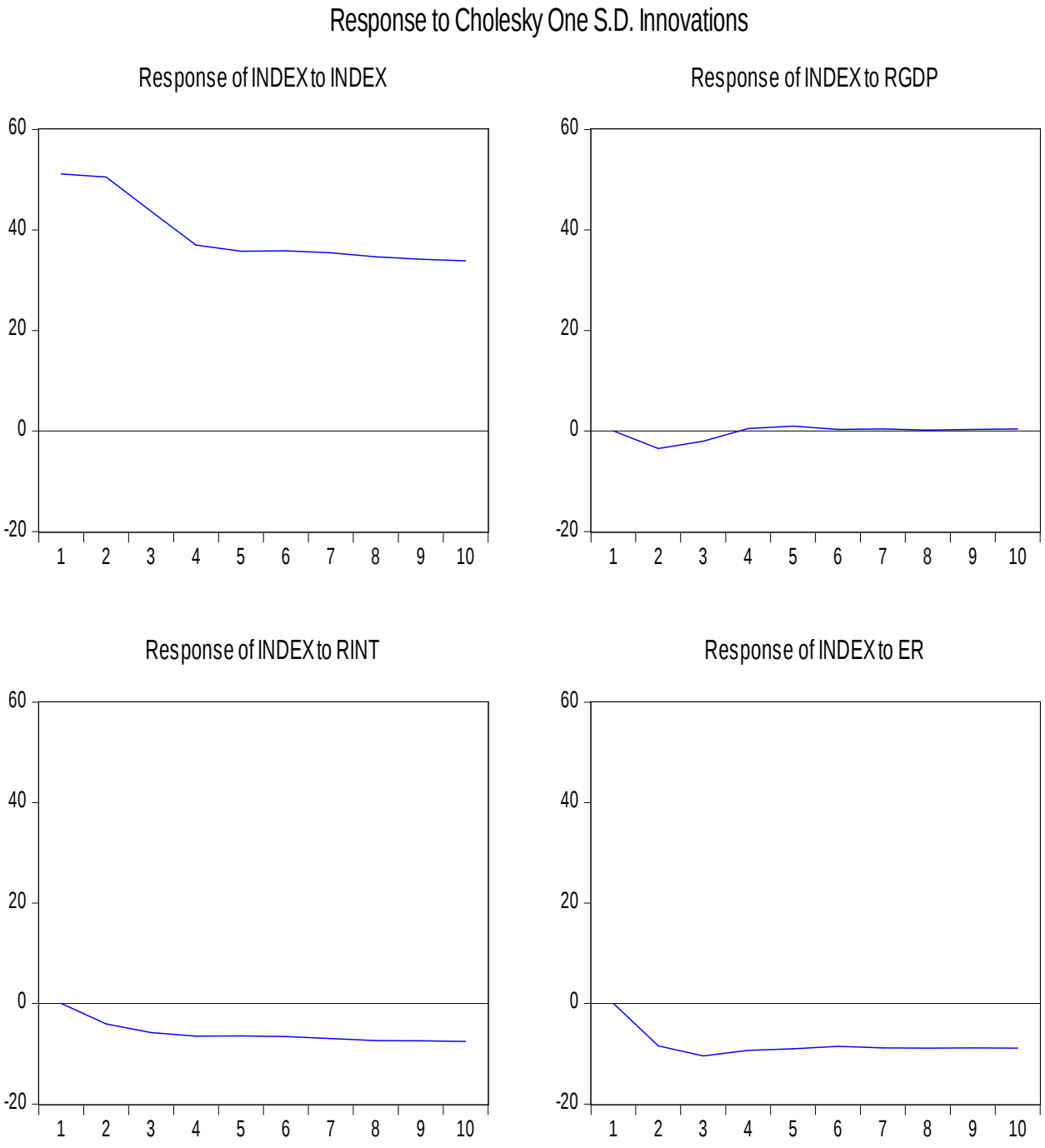
Conclusion Impulse Response Test

The impulse response analysis established that a shock introduced on RGDP innovation will cause an initial reaction but the reaction adjusts back to its original position, which implies that there is no long run relationship between RGDP and the banking sector stock price index in Kenya. A shock introduced each on RINT and ER cause an immediate decrease reaction but dies out after nine and six months for RINT and ER respectively.

They both stabilize and maintain a constant level, but they do not restore their original positions which mean that they have established long run relationships with the banking sector stock price index in Kenya. The establishment of steady and constant positions after initial shock effects on the regressors indicated that the fitted model was stable.

Figure 5

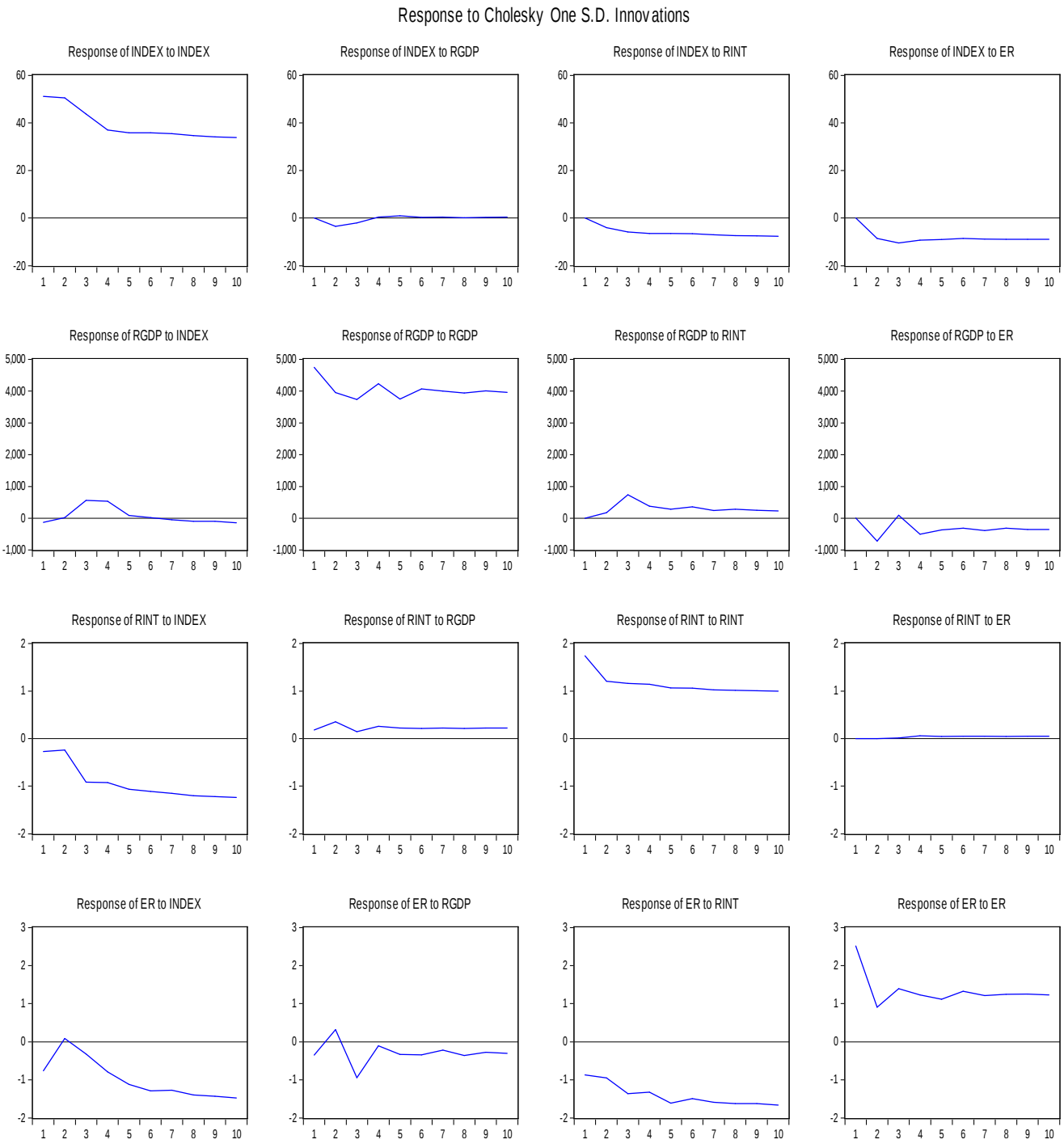
Impulse Response of Index to Regressors



Source: Author, (2016)

Figure 6

Impulse Responses of All Variables



Source: Author, (2016)

4.8.3 Variance Decomposition Test

Variance decomposition is yet another test that reviews information that is not reported by causality tests. It examines the model dynamics by giving the proportion of the movements in the dependent variable that are due to their own shocks and shocks of the other variables. A shock on a variable will affect its own course and is also transmitted to all other variables in the model. Variance decomposition determines how much of the period steps ahead, a forecast error variance of a given variable are explained by innovations of each explanatory variables. In variance decomposition an error term of one variable is introduced to a shock while holding all other error terms constant (Brooks, 2008). The procedure breaks down variance of the forecast error for each of the variables into components such that each variable is explained as a linear combination of its own current innovations value and lagged innovation values of all the variables in the system (Hossain, 2008).

The results for variance decomposition test are presented in table 4.17 and they indicate that in the 2nd quarter changes in index were largely due to its own variations which stood at 98.1%, ER explained only 1.3% while RGDP and RINT explained less than 1% of the changes in index. During the 10th quarter the changes in index were again attributed to its own variations which stood at 93.21%, ER explained a larger proportion compared to what it had explained in the 2nd quarter, it now explained 4.3%. RINT also behaved in the same way as ER has it now explained 2.3% while RGDP still explained less than 1% of the changes in index. The results were also observed at the 15th quarter and the findings were similar to those observed in the 10th quarter though with minor deviations. Index changes were explained at 92.1%, 4.9 and 3.0% by its own variations, ER and RINT respectively. Once more RGDP contributed less than 1% to the changes in index. The final variance decomposition observations were carried out on 20th quarter,

the results still reviewed that much of the index changes was explained by its own variations at 91.4% while ER and RINT explained 5.2% and 3.4% respectively, RGDP on the other hand still explained less than 1%. The variance decomposition conclusions were confirmed by variance decomposition graph whose findings were presented in figure 4.6 below.

ConclusionVariance Decomposition Test

The results from variance decomposition analysed above indicate that ER and RINT are the only explanatory variable that have significant effect on stock price index of the listed commercial banks in Kenya. Although significant relationship was established the extent to which they individually influence stock price index of the listed commercial banks in Kenya was found to be quite low. In the 20^{th} quarter index was explained 91.4% of the changes by its own variations, variations onER and RINT explained 5.2% and 3.4% respectively, RGDP remained largely invisible in explaining index even in the 20th quarter at 0.06%.

The study concluded that RGDP is not important in explaining stock price index of the listed commercial banks in Kenya, RINT and ER explainedstock price index of the listed commercial banks in Kenya although the percentage that they explained was found to be notably low. The stock price index of the listed commercial banks in Kenya was found to respond weakly to shocks in RINT and ER in the short run. The results are consistent with the VECM results which reported a very low coefficient of determination (R^2)of 8.6%, which was interpreted to mean that the explanatory variables in the study only account for 8.6% while 92.4% was explained by other factors that were not in the model. The study concluded that in the short run RINT and ER individaully explain stock price index in Kenya althogh the influence was found to be a weak one. RGDP was found to not to explain stock price index in the short run in Kenya.

Table 17

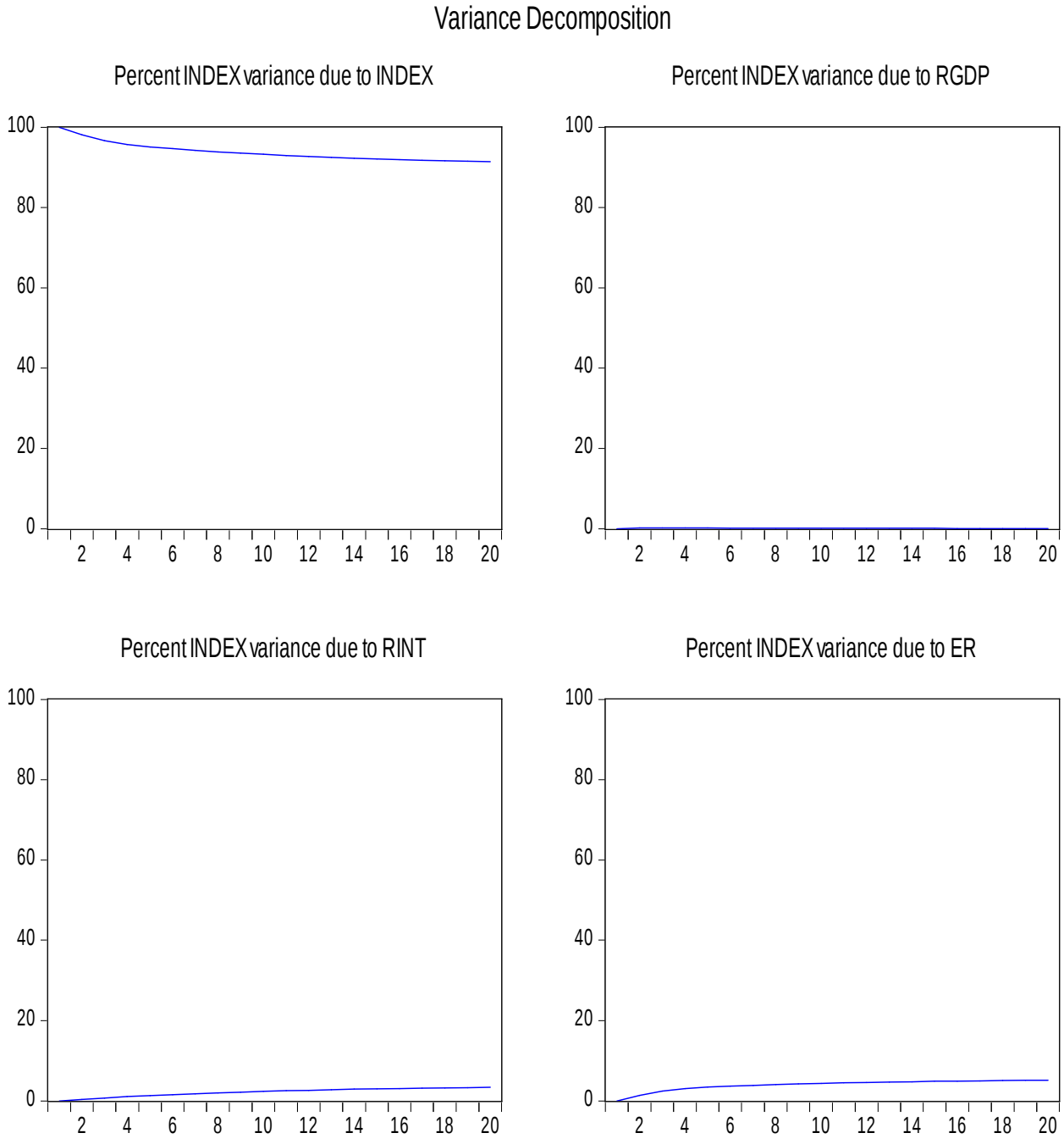
Variance Decomposition Test

Period	S.E.	INDEX	RGDP	RINT	ER
1	51.11329	100.0000	0.000000	0.000000	0.000000
2	**72.57272**	**98.09178**	**0.229407**	**0.311650**	**1.367163**
3	85.56937	96.64018	0.222137	0.674967	2.462714
4	93.91800	95.74758	0.186840	1.039783	3.025800
5	101.1107	95.12774	0.170162	1.299460	3.402639
6	107.8128	94.71294	0.150503	1.514739	3.621818
7	114.0523	94.29862	0.135467	1.727668	3.838250
8	119.7680	93.89729	0.123117	1.943237	4.036353
9	125.0755	93.54666	0.113576	2.136716	4.203049
10	**130.1063**	**93.23143**	**0.105758**	**2.313104**	**4.349713**
11	134.9097	92.95563	0.098926	2.470461	4.474985
12	139.5270	92.70844	0.093092	2.612137	4.586327
13	143.9750	92.48529	0.087947	2.740851	4.685913
14	148.2746	92.28524	0.083429	2.856795	4.774537
15	**152.4444**	**92.10434**	**0.079420**	**2.961902**	**4.854338**
16	156.4967	91.94078	0.075818	3.057222	4.926180
17	160.4429	91.79221	0.072576	3.143925	4.991285
18	164.2914	91.65668	0.069634	3.223120	5.050569
19	168.0497	91.53276	0.066955	3.295597	5.104688
20	**171.7245**	**91.41902**	**0.064505**	**3.362158**	**5.154317**
Cholesky Ordering: INDEX RGDP RINT ER					

Source: Author, (2016)

Figure 7

Variance Decomposition Test



Source: Author, (2016)

4.8.4. Residuals Autocorrelation Test

Autocorrelation test was carried to test whether the right number of lags was included in VECM. According to Thomsen, et, al, (2013) one way of testing goodness of the fitted model is by plotting the autocorrelations for residuals, if big number of the residual autocorrelation points lie outside the significant level lines, then there exist correlation and the right number of lags was not used in the fitted model, therefore the fitted model is not a good fit, under such circumstances the VECM should be re estimated but with more number of lags than the one used in the previous model.

Residual autocorrelation test for the adopted model was carried out and the residual plots results were presented in figure 4.7 above. It was observed that there is no serious problem of autocorrelation. The residuals of the cointegrating VECM have weak or no serial correlation relationships. Within two standard error bounds, only four correlation relationships {(Cor INDEX, RINT (-1))}, {(Cor RINT, RGDP (-1))}, {(Cor INDEX, INDEX (-1))}, and {(Cor ER, ER (-1))} are observed to lie outside the bounds of two.

Conclusion Autocorrelations

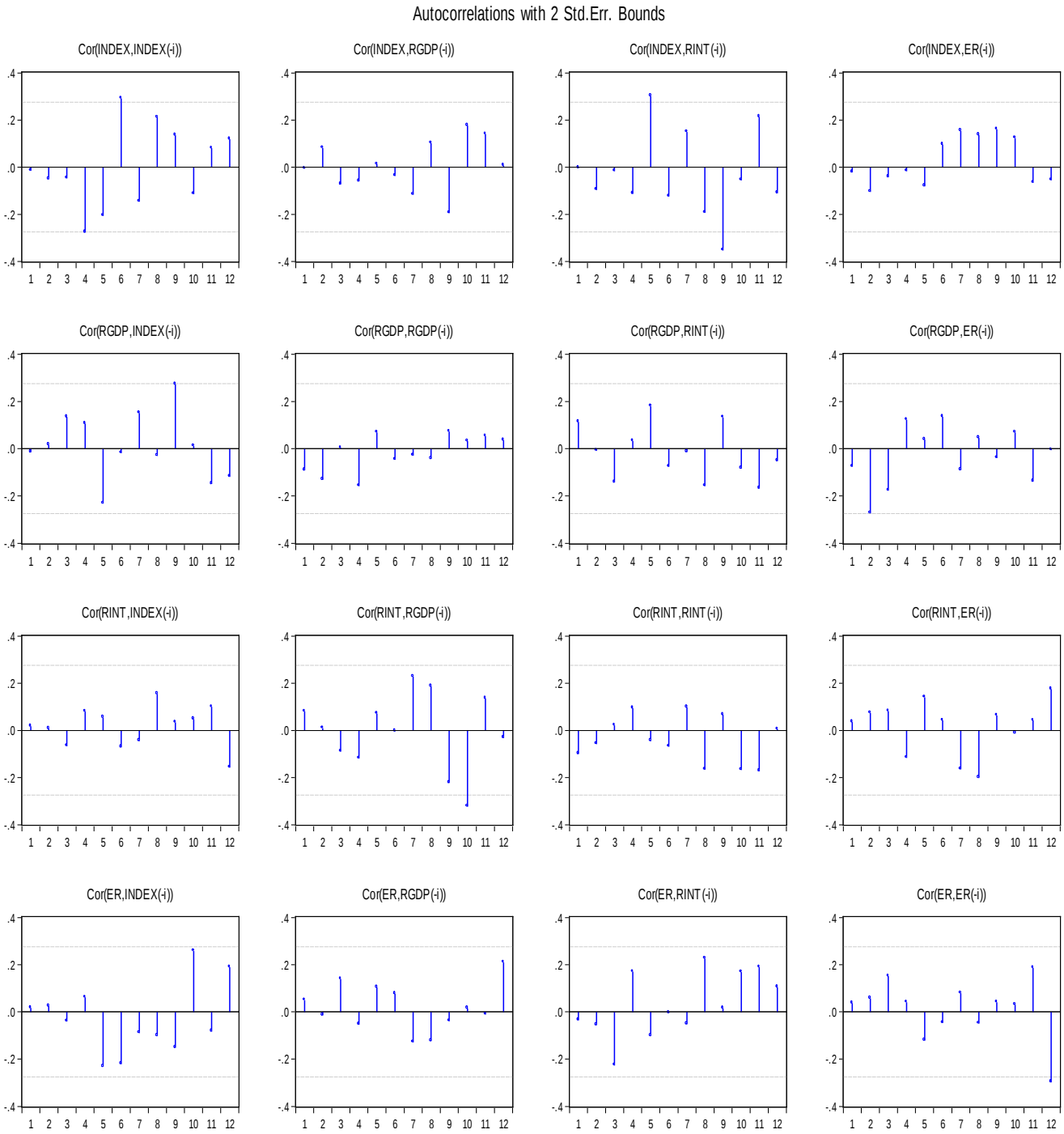
This study therefore concluded that there was no serial autocorrelations problem in the fitted model and therefore the model was found to be a good fit for the data set in this study.

4.9 Conclusion Post Estimation Tests.

The results from all the fitted post estimation tests indicate that the fitted model was a good fit to study the data set in this study.

Figure 8

Autocorrelations for VECM Model



Source: Author, (2016)

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary of findings and discussions, conclusions and recommendations based on the findings and interpretation of the results from the data analysed. This study examined the effects of macroeconomic variables on stock price index of list commercial banks in the NSE for a 14 year period starting January 2000 to December 2013. The findings were discussed in line with the specific objectives of this study. The discussions encompass comparing and contrasting the results of this study with empirical findings from the existing literature.

5.2 Summary of Findings

The study employed quarterly time series data set and used cointegration analysis, VECM and causality analysis and used E-views statistical software for data analyses. To determine the appropriate model and ensure that the study results arrived at were realistic and reliable preliminaries tests for time series data were performed to establish existence or non-existence of problems that are associated with such data. The preliminary tests on the data reported that the data was normally distributed, no multicollinearity was detected between the explanatory variables and no heteroskedasticity was found to exist in the data set, however presence of serial correlation was established.

Multiple regression model which some studies have used to report relationships between macroeconomic variables and stock price index was performed but was found to be inappropriate in reporting the data set used in this study. Post multiple regression estimation tests results from residual plots formed patterns when the residuals plots were plotted, patterns is an indication that the fitted model may not be a good fit, autocorrelation analysis reported that there existed serial

correlation therefore the estimated estimators were found to be unbiased, consisted but inefficient, the study thus concluded that multiple regression model was not appropriate in reporting the study's data set.

Time series data analysis require the series to be stationary, ADF test for stationarity was carried out and the results revealed that the series was non stationary at levels but stationarity was achieved after differencing once. The data was thus found to be integrated of order one I (1) which is a pre-condition for cointegration. Cointegration analysis established existence of cointegration, the cointegration results established a long run relationship between the variables under study. Cointegration analysis was done using the Johansen (1990) procedure, which has an advantage of allowing for autocorrelation correction. The Johansen (1990) procedure was preferred because of the reason that it allows for autocorrelation correction. After establishing the long run relationships of the variables under study, the study went on to test for existence of short run dynamics between the contemporaneous variables using the vector error correction model. The choice of the model was informed by the existence of cointegration, which is a pre – condition for fitting a VEC model and negates fitting of a VAR model.

The study reliability and the stability of the fitted VECM model were studied by fitting post estimation tests also known as diagnostic analysis. The study utilized four diagnostic tests, which were the causality, Impulse response, variance decomposition and serial autocorrelation. Causality test shows the direction, in which the effect of the variables relationships are running to or from, this test established that there were casual relationships between the variables under study. Impulse response test traces out the responsiveness of the dependent variable in the system to shocks applied to each of the independent variables innovations. The results from the impulse response test were found to be consistent with those given by VECM. Variance decomposition

test examines the model dynamics by giving the proportion of the movements in the dependent variable that are due to its own shocks and shocks of the other variables in the study. Variance decomposition test determines how much of the period steps ahead, a forecast error variance of a given dependent variable are explained by innovations of each explanatory variables. The variance decomposition test results confirmed those reported by the fitted VEC Model. The final post estimation test performed was the residuals autocorrelation test which is used to test the goodness of the fitted model, the test investigates whether the right number of lags were included in the model, if after plotting residuals autocorrelation plots and a big number of the residual autocorrelation points lie outside the significant level lines, then there exist correlation and the model is thus not a good fit. The residual autocorrelation plots reported that there was no serial correlation in the residuals of the fitted model, the results imply that the right number of lags were included in the model and the model fitted the data set well. From the results of the four post estimation tests the study concluded that fitted VECM was appropriate in studying the data set in this study.

5.3 Discussions

The first specific objective of this study was to determine the effect of real gross domestic product on stock price index of list commercial banks in the NSE. The cointegration results established that real gross domestic product had a long run negative but insignificant influence on stock price index of list commercial banks in the NSE. VECM results established that no short run relationship between RGDP and stock price index of list commercial banks in the NSE. The study found no causal relationship between RGDP and the explained variable. These findings from this study on the first specific objective were inconsistent with previous studies by Olweny and Omondi (2011) in Kenya and Lekobane and Lekobane, (2014) in Botswana which

found a positive relationship between RGDP and stock prices. The findings were however consistent with a study in Kenya by Kirui, Wawire and Onono (2014) which found insignificant relationships between gross domestic product and stock prices, they concluded that gross domestic product is not important in explaining stock price index in Kenya.

The second specific objective of this study was to determine the effect of real interest rates on stock price index of list commercial banks in the NSE. The long run relationship between these variables were analysed through cointegration test and the results established that RINT had a significant and positive influence on stock price index of list commercial banks in the NSE. Short run relationship revealed by VECM indicates that there exists a short run relationship between RINT and stock price index of list commercial banks in the NSE. The causality results established that there was a unidirectional causal relationship between RINT and stock price index of list commercial banks in the NSE, running from stock price index to RINT this implies that stock price index causes RINT. This study concluded that RINT and the explained variable were positively related and it's possible to predict the current and the future indices values by studying the past values of RINT. These findings from this study on the second specific objective were consistent with previous studies by Muhammed, (2012) in Ghana, Jawaid and Haq, (2012) in Pakistan and Makan, Ahuja and Chauhan, (2012) in India, which found a positive relationship between interest rates and stock prices. On the contrary several other studies give different results from those of this study. Studies by Aroni, (2011), Gatuhi and Macharia, (2013),Chirchir, (2010), Olweny and Kimani, (2011),in Kenya, Talla, (2013), in Sweden, Lekobane and Lekobane, (2014) in Botswana and Yogaswari, Nugroho and Astuti, (2012) in Indonesia which found a negative relationship between interest rates and stock price index.

The third specific objective of this study was to determine the effect of exchange rate on stock price index of list commercial banks in the NSE. The study used cointegration test results found that exchange rate had a positive long run relationship with banking sector stock price index in Kenya. VECM results established existence of short run relationship between ER and stock price index of list commercial banks in the NSE. The causality results revealed that there existed a unidirectional causal relationship between ER and stock price index of list commercial banks in the NSE, running from stock price index to ER this implies that stock price index causes ER. This study concluded that ER and the explained variable were positively related and it's possible to predict the current and the future indices values by studying the past values of ER. These findings from this study on the third specific objective were consistent with previous studies by Jawaid and Haq, (2012) in Pakstan, Gatuhi and Macharia, (2013) in Kenya which found a positive relationship between exchange rates and stock prices.On the contrary the results were inconsistent with studies done previously, Studies in Kenya Kirui, Wawire and Onono (2014), Olweny and Kimani, (2011), Yogaswari, Nugroho and Astuti, (2012) in Indonesia and Makan, Ahuja and Chauhan, (2012) in India which found a negative relationship between the exchange rates and stock prices. This study employed preliminary and post estimation tests to ensure that the results arrived at are realistic and reliable.

5.4 Conclusions

The general objective of this study was to analyze the effects of macroeconomic variables on stock price index of list commercial banks in the NSE. The study investigated the general of objective using some three selected macroeconomic variables namely real gross domestic product, real interest rate and exchange rate. The findings from the study established that real gross domestic product had insignificant and negative influence on stock price index of listed

commercial banks in Kenya. Both exchange rate and real interest rate were found to have significant and positive relationship on stock price index of list commercial banks in the NSE, both in the short run and long run.

The study concluded that by studying the past values of exchange rate and real interest rate it is possible to predict the current and future stock price indices of list commercial banks in Kenya, however real gross domestic product past values are insignificant in predicting the current and future stock price indices of list commercial banks in the NSE.

These results from this study give mixed results with those of the theories adopted by the study, the results are inconsistent with the conclusions of the efficient market hypothesis since past values of the independent variables can be used to predict the dependent variable current and future values. The results are however consisted with present value model which postulates that macroeconomic variables that affect future cash inflows also affect stock prices. The results are also in harmony with conclusions by the capital asset pricing model and the arbitrage pricing theory.

The major findings of this study were that real interest rates and exchange rates had significant and positive effects on banking sector stock price index in the Kenyan stock market. Thus it is possible to predict the present and future values of stock price index by studying past values of real interest rates and exchange rates. However the same could not be concluded for real gross domestic product because the study found an insignificant negative effect of real gross domestic product on stock price index, therefore real gross domestic product was found to be insignificant in explaining stock price index in Kenya.

5.5 Recommendations

The study findings are recommended to various users of such information as they undertake different activities in the society, the identified users include policy makers, investors and researchers.

5.5.1 Policy Makers

Given the significant and positive relationships between exchange rate, real interest rate and the stock prices the government of Kenya should formulated policies that that will ensure stability of the two macroeconomic variables. Stability of these two macroeconomic variables will certainly lead to stable stock prices in the NSE and hence increasing the investor confidence. As a result of this increased stability there will be a significant positive impact on the performance of the Kenyan stock market and hence fostering economic growth.

5.5.2 Investors

Investors should monitor changes in the real interest rates and exchange rates since they were found to significantly and positively influence stock prices. This monitoring is believed will lead sound investment decisions, which will in turn enhance their returns on investments.

5.5.3 Further Study

Further study may be carried out, may be by including additional macroeconomic variables which were not part of this study or by studying different sector other than the banking sector.

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Appendix 1

Data set

	Banking Sector			
YEAR	Stock PriceIndex	RGDP	RINT	ER
2000Q1	100.00	243,430.00	25.2333	70.70
2000Q2	87.37	242,026.00	23.6	77.50
2000Q3	88.94	243,697.00	21.4	78.70
2000Q4	80.73	246,909.00	19.8667	75.60
2001Q1	79.78	248,880.00	20.2	78.60
2001Q2	73.91	259,939.00	19.3667	78.60
2001Q3	78.32	258,558.00	19.5333	78.70
2001Q4	67.61	252,726.00	19.5667	78.60
2002Q1	78.86	261,146.00	19.1333	78.60
2002Q2	71.46	256,814.00	18.5333	78.70
2002Q3	72.13	251,648.00	18.1	79.50
2002Q4	67.32	255,660.00	18.2	78.90
2003Q1	110.30	257,725.00	18.7667	77.70
2003Q2	139.26	259,003.00	17.6	73.70
2003Q3	153.88	268,440.00	14.9767	76.00
2003Q4	207.47	269,239.00	14.0967	75.80
2004Q1	283.71	275,819.00	13.2033	76.30
2004Q2	226.52	274,369.00	12.4633	79.30
2004Q3	228.02	276,246.00	4.09	79.77
2004Q4	211.29	281,902.00	12.2033	78.50
2005Q1	202.91	284,256.00	12.4267	77.93
2005Q2	221.25	293,422.00	13.1033	76.68
2005Q3	265.11	296,165.00	12.9767	73.10
2005Q4	172.83	297,932.00	13.02	75.90
2006Q1	297.25	304,479.00	13.2667	72.20
2006Q2	282.65	309,493.00	13.75	73.40
2006Q3	363.67	317,362.00	13.6333	69.60

2006Q4	447.19	317,668.00	13.5933	71.73
2007Q1	330.07	327,182.00	13.7	69.90
2007Q2	160.88	333,837.00	13.32	66.60
2007Q3	190.38	335,792.00	13.0667	63.30
2007Q4	165.84	339,733.00	13.3167	66.60
2008Q1	172.49	331,800.00	13.8933	68.10
2008Q2	244.29	340,902.00	13.9933	63.80
2008Q3	256.65	342,567.00	13.7433	78.00
2008Q4	208.91	341,929.00	14.4367	69.97
2009Q1	142.89	352,141.00	14.79	78.90
2009Q2	72.82	347,612.00	14.8833	77.90
2009Q3	86.56	347,666.00	14.7633	75.40
2009Q4	127.66	346,127.00	14.7967	77.40
2010Q1	86.28	358,344.00	14.9733	75.80
2010Q2	99.33	368,429.00	14.4767	81.00
2010Q3	116.93	372,779.00	14.15	80.60
2010Q4	122.86	374,366.00	13.89	79.13
2011Q1	124.82	376,859.00	13.9567	81.00
2011Q2	101.30	381,654.00	13.9033	89.00
2011Q3	67.20	387,614.00	14.4167	86.70
2011Q4	54.24	392,179.00	17.92	85.57
2012Q1	56.27	393,098.00	20.0533	86.30
2012Q2	58.82	398,490.00	20.16	84.80
2012Q3	64.26	405,822.00	19.89	84.10
2012Q4	69.18	411,674.00	19.94	85.60
2013Q1	79.06	413,924.00	20.14	86.70
2013Q2	93.47	416,663.00	20.32	84.65
2013Q3	106.97	423,209.00	21.08	87.23
2013Q4	105.96	417,944.00	20.54	85.94

Appendix 11

Table 18

Vector Error Correction Estimates

Vector Error Correction Estimates
Date: 11/11/15 Time: 00:05
Sample (adjusted): 2000Q4 2013Q4
Included observations: 53 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
INDEX(-1)	1.000000
RGDP(-1)	-0.000646 (0.00026) [-2.47428]
RINT(-1)	18.64784 (4.15124) [4.49211]
ER(-1)	6.176861 (2.61440) [2.36263]
C	-715.5842

Error Correction:	D(INDEX)	D(RGDP)	D(RINT)	D(ER)
CointEq1	-0.193771 (0.12528) [-1.54670]	-3.784411 (11.6316) [-0.32536]	-0.006379 (0.00433) [-1.47448]	-0.019846 (0.00685) [-2.89836]
D(INDEX(-1))	0.108239 (0.16479) [0.65682]	1.569513 (15.3002) [0.10258]	0.005569 (0.00569) [0.97854]	0.025231 (0.00901) [2.80126]
D(INDEX(-2))	0.047849 (0.17878) [0.26765]	22.71904 (16.5983) [1.36876]	-0.007246 (0.00617) [-1.17371]	0.017263 (0.00977) [1.76673]
D(RGDP(-1))	-0.000953 (0.00163)	-0.189604 (0.15132)	4.36E-05 (5.6E-05)	9.45E-05 (8.9E-05)

	[-0.58481]	[-1.25299]	[0.77477]	[1.06064]
D(RGDP(-2))	0.000500	-0.046270	-2.41E-05	-0.000149
	(0.00163)	(0.15152)	(5.6E-05)	(8.9E-05)
	[0.30609]	[-0.30537]	[-0.42836]	[-1.66510]
D(RINT(-1))	-0.409085	23.71093	-0.185296	0.002096
	(4.08112)	(378.909)	(0.14094)	(0.22306)
	[-0.10024]	[0.06258]	[-1.31474]	[0.00939]
D(RINT(-2))	-0.591988	420.0838	0.001491	-0.093565
	(4.00617)	(371.951)	(0.13835)	(0.21896)
	[-0.14777]	[1.12941]	[0.01077]	[-0.42730]
D(ER(-1))	-2.173164	-262.0105	0.040427	-0.517667
	(2.49278)	(231.441)	(0.08609)	(0.13625)
	[-0.87178]	[-1.13208]	[0.46961]	[-3.79946]
D(ER(-2))	-2.244500	103.5111	0.056442	-0.044139
	(2.37492)	(220.498)	(0.08202)	(0.12981)
	[-0.94508]	[0.46944]	[0.68818]	[-0.34004]
C	2.828033	4150.229	-0.120294	0.389937
	(10.9798)	(1019.41)	(0.37918)	(0.60012)
	[0.25757]	[4.07119]	[-0.31725]	[0.64976]
R-squared	0.086020	0.141535	0.217739	0.482312
Adj. R-squared	-0.105279	-0.038144	0.054010	0.373958
Sum sq. resids	112340.5	9.68E+08	133.9768	335.6022
S.E. equation	51.11329	4745.583	1.765146	2.793690
F-statistic	0.449663	0.787710	1.329872	4.451286
Log likelihood	-278.1672	-518.3062	-99.77918	-124.1131
Akaike AIC	10.87423	19.93608	4.142610	5.060870
Schwarz SC	11.24599	20.30784	4.514364	5.432623
Mean dependent	0.321132	3287.679	-0.016226	0.136604
S.D. dependent	48.61810	4657.585	1.814835	3.530828
Determinant resid covariance (dof adj.)		1.12E+12		
Determinant resid covariance		4.86E+11		
Log likelihood		-1013.918		
Akaike information criterion		39.92145		
Schwarz criterion		41.55716		

Source: Author, (2016)