THE IMPACT OF INFLATION ON STOCK MARKET RETURNS AND VOLATILITY: EVIDENCE FROM NAIROBI SECURITIES EXCHANGE
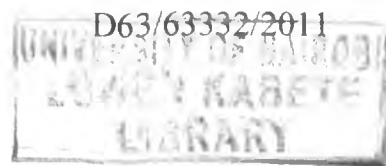
BY

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D63/63332/2011

A RESEARCH PROJECT SUBMITTED TO THE UNIVERSITY OF NAIROBI, DEPARTMENT OF ACCOUNTING AND FINANCE IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF SCIENCE (FINANCE)

OCTOBER 2012

DECLARATION

Declaration by the Student

This research project is my original work and has never been presented to any other examination body. No part of this work should be reproduced without my consent or that of University of Nairobi.

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Declaration by the Supervisor

This research project has been submitted for examination with my approval as the University of Nairobi supervisor.

Name..Dr J. ö ADDM.....Sign..............Date..8/11/12

DEDICATION

To my dear wife, Mrs. Norah Kinya Murithi for the much support she provided throughout my studies.

To my lovely daughter Tanice Makena for her greatest encouragement and motivation throughout the research period.

ACKNOWLEDGEMENT

ABSTRACT

The linkage between stock prices and inflation has been subjected to extensive research in the past decades and has aroused the interests of academics, researchers, practitioners and policy makers globally. This study examined the impact of inflation on stock market return and volatility in the Nairobi Securities Exchange (NSE). Previous research findings have established the existence of a negative relationship between a stock prices and inflation. These findings contradict the hypothesis by Fisher (1930) who argued that stock prices should be positively related with expected inflation, providing a hedge against inflation. A correlational research design was employed to establish whether inflation is associated with stock market return and volatility. Specifically, it sought to answer the question on the effect of inflation on the stock return and volatility in the NSE. Monthly time series data on NSE 20 share index and Consumer Price Index, for the period July 2000 to August 2012 was used in this research. The OLS estimation technique was employed to estimate a single equation relationship with the stock return as the dependent variable and explanatory variable as inflation.

The coefficient for inflation from regression results is high at -0.38 implying that inflation is good at explaining the stock returns. The relationship between stock returns and inflation was found to be negative. This finding opposes the Fisher Hypothesis which states that the two variables are positively correlated in the sense that an increase in inflation leads to a proportional change in nominal market returns consequently hedging against inflation. The R-squared statistic measuring the success of the regression in predicting the values of the dependent variable within the

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sample indicated that only 0.4% of what is happening in the stock market return can be explained by inflation variable. This study applied the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model to assess the impact of inflation on stock market returns and volatility. In addition, the impact of asymmetric shocks was investigated using the EGARCH model developed by Sentana (1995). EGARCH model results established that NSE stock market returns are asymmetric thus EGARCH was preferred over standard GARCH which does not capture asymmetry. Results show weak but significant support for the hypothesis that bad news exerts more adverse effect on stock market volatility than good news of the same magnitude. Furthermore, inflation rate and change in inflation rate were found to have significant negative effect on stock market volatility. However, it was verified that inflation rate itself has significantly higher power of explaining stock exchange volatility than change in inflation whose magnitude is relatively small as indicated by the low value of the EGARCH inflation coefficient. The findings of this study can be helpful to the investors in better understanding the impact of inflation on market risk which helps in selecting the appropriate investment strategy. Measures employed towards restraining inflation in the country, therefore, would certainly reduce stock market volatility and boost investor confidence.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

KNBS – Kenya National Bureau of Statistics

NSE – Nairobi Securities Exchange

MIMS – Main Investments Market Segment

AIMS – Alternative Investment Markets Segment

FISMS – Fixed Income Securities Market Segment

CDS – Central Depository System

ATS – Automated Trading System

EMH – Efficient Market Hypothesis

iid – independently and identically distributed

CPI – Consumer Price Index

VAR – Vector Autoregressive

MVEC – Multivariate Vector Error-Correction

ARCH – Autoregressive Conditional Heteroscedasticity

GARCH – Generalized Autoregressive Conditional Heteroscedasticity

IGARCH – Integrated Generalized Autoregressive Conditional Heteroscedasticity

EGARCH – Exponential Generalized Autoregressive Conditional Heteroscedasticity

TGARCH – Threshold Generalized Autoregressive Conditional Heteroscedasticity

ADF – Augmented Dickey-Fuller test

OLS – Ordinary Least Square

CHAPTER ONE

INTRODUCTION

1.1   Background of the Study

Stock prices can go up and down frequently. These changes apparently reflect the changing demand for that stock and its potential resale value or changing expectations of a company's future performance. Every time a stock is sold, the market records the price at which it changes hands. If, a few seconds, minutes, hours or days later, another trade takes place, the price at which that trade is made becomes the new market price, and so on. Organized securities markets occasionally suspend trading of a stock if its price turns excessively volatile. This happens if there is a severe mismatch between stock's supply and demand or if they suspect that insiders are deliberately manipulating stock's price. In normal circumstances, there is no stock prices official arbiter, (no person or institution that "decides" a price). (Fama, 1965).

The question that arises is, why then do prices fluctuate so much? Majority of stock traders are made up of professionals who buy and sell shares, hoping to profit from small changes in share prices. Since these traders hold stocks for a short term period, they are not interested in such long-term fundamental considerations such as company's profitability or future cash flows.They are pretty interested in such factors mostly regarded as news to market that would affect company's long-term prospects and consequently cause other traders to buy or sell the stock, causing its price to rise or fall. If traders believe that others will buy shares in anticipation that prices will rise, then he or she will buy as well, hoping to sell when the price rises. If others believe the same, then the wave of buying pressure will continue, in fact, cause the price to go up further. (Robert, 2006).

Stock traders seek to guess which stocks other traders will buy. The successful trader is the one who anticipates and outwit the market, buying before a stock's price rises and selling before it falls. Financial firms employ numerous market strategies and technical analysis to evaluate historical stock data, in attempt to uncover the logic behind these price changes. If they could unlock the secret of stock prices, they could arm their traders with the ability to always buy low and sell high. And so traders continue to guess and gamble and, in doing so, send prices turning. For small investors who hold stock for the long term, the volatility of the market can be a source of constant anxiety. Against this background, this study seeks to find out whether inflation has any impact on stock returns and volatility in Kenya Nairobi Securities Exchange. (Aga & Kocaman, 2006).

1.1.1 Inflation

Inflation results when actual economic pressures and anticipation of the future developments cause the demand of goods and services to exceed the supply available at existing prices or when availabe output is restricted by uncertain productivity and marketplace constraints. Inflation refers to a general rise in prices measured against a standard level of purchasing power. Previously the term was used to refer to an increase in the money supply, which is now referred to as expansionary monetary policy or monetary inflation. Inflation is measured by comparing two sets of goods at two points in time, and computing the increase in cost not reflected by an increase in quality. There are, therefore, many measures of inflation depending on the specific circumstances. The most well known are the CPI which measures consumer prices, and the GDP deflator, which measures inflation in the whole of the domestic economy. (Graham, 1996).

2

The prevailing view in mainstream economics is that inflation is caused by the interaction of the supply of money with output and interest rates. Mainstream economist views can be broadly divided into two camps: the "monetarists" who believe that monetary effects dominate all others in setting the rate of inflation, and the "Keynesians" who believe that the interaction of money, interest and output dominate over other effects. Other theories, such as those of the Austrian school of economics, believe that an inflation of overall prices is a result from an increase in the supply of money by central banking authorities. Inflation rate can be divided into expected inflation and unexpected inflation. Expected inflation rate is what the economists and consumers plan for year to year. If inflation is expected over time, the money looses value and people are less likely to hold cash. Unexpected inflation is beyond what economist and consumers expect. In general, the effects of unexpected inflation are much more harmful than the effects of expected inflation. The major effect of unexpected inflation is redistribution of wealth either from borrowers to lenders or in contrast. (Robert & Vittorio, 1994)

1.1.2 Stock Market Return

The market price of a share is the price at which a willing buyer and seller agree to trade in a competitive and open market under all conditions requisite to a fair sale, the buyer and seller each acting prudently and knowledgeably and assuming the price is not affected by undue stimulus. Stock market returns are the returns that the investors generate out of the stock market. This return could be in the form of profit through trading in the secondary market or in the form of dividends given by the company to its shareholders. Stock market returns are not fixed ensured returns and are subject to market risks. Stock market returns are not homogeneous and may change from

3

investor-to-investor depending on the amount of risk one is prepared to take and the quality of his stock market analysis. In opposition to the fixed returns generated by the bonds, the stock market returns are variable in nature. The idea behind stock return is to buy cheap and sell dear. (Choudhry, 1999)

An investor speculates on the basis of fundamental and technical analyses. Fundamental Analysis analyzes relevant data (cash flow, return on assets, history of profits, etc.) associated with the company, which could have an effect on the intrinsic or face value of the stock. This analysis helps in predicting the price movement of the stock based on its fundamental strength. Fundamental Analysis is generally relevant for the long-term. Technical Analysis tries to evaluate the future trend of stock prices by using various statistical tools, charts, etc. Technical analysts focus on the historical price movement of a stock and predict accordingly. They consider that the price movements are repetitive in nature because the psychological setups of the investors are seen to follow a certain pattern. Stock market returns are subject to risk but nowadays there are many derivative instruments like futures, options, etc. for hedging the risk associated with such investments. These tools can also be utilized by many speculators for leverage and speculative purposes. Derivatives are used by many for arbitraging by utilizing the price discrimination between different markets. Hedging and Arbitraging don't give higher returns but do help in minimizing losses and in protecting the capital. (Graham, 1996).

1.1.3 Stock Market Volatility

Stock return volatility, refers to variations in stock price changes during a period of time. This more often is perceived by investors and other agents as a measure of risk. Policymakers and rational investors use market estimate of volatility as a tool to

measure the vulnerability of the stock market. Burgeoning evidences suggest volatility clustering, that is, large (small) shocks tend to follow similar large (small) shocks. This is because real economic variables such as inflation, interest rate, exchange rate etc that derive from these relationships tend to display persistence. This is particularly so for developing economies. (Brooks, 2008).

Volatility breeds uncertainty, which impair effective performance of the financial sector as well as the entire economy. The existence of excessive volatility, or "noise," in the stock market undermines the usefulness of stock prices as a "signal" about the true intrinsic value of a firm, a concept that is core to the paradigm of the informational efficiency of markets (Karolyi, 2001). According to Pindyk (1984) an unexpected increase in volatility today leads to the upward revision of future expected volatility and risk premium which further leads to discounting of future expected cash flows at an increased rate which results in lower stock prices or negative returns today.

According to Karolyi (2001), stock price volatility is higher when stock price decreases than when price increases. Fama (1981) states that stock prices are the reflector of various variables such as inflation, exchange rate, interest rate and industrial production. Generally, Engle and Rangel (2005) provided evidence of impact of overall health of the economy on unconditional market volatility. They concluded that countries with high rates of inflation experience larger expected volatilities than those with more stable prices. In a comparative study on the impact of inflation on conditional stock market volatility in Turkey and Canada, Saryal (2007), established evidence of a strong time varying volatility for stock market returns in

5

both markets, and on the impact of inflation on conditional stock market volatility, the researcher found that the rate of inflation is one of the underlying determinants of conditional market volatility in Turkey, which has higher inflation rate than Canada. Other empirical studies in the area either established weak predictive power of inflation on stock market volatility and returns, for instance, Kaul (1987), Schwert (1989), Davis and Kutan (2003), while others like: Hamilton and Lin (1996), Engle (2004), Engle and Rangel (2005), Rizwan and Khan (2007), etc., established a strong predictive power of inflation on stock market volatility and returns.

1.1.4 Theoritical Impact of Inflation on Stock Market Returns and Volatility

Inflation which is one of the macroeconomic variables is used as an indicator of economic stability of any economy. It has multidimensional impact on the economy of a country: On one hand, it erodes the purchasing power of the domestic consumers and on the other it accentuates variations in the stock market returns by disturbing expectations of stock market investors. It is highly likely that growing inflation pressurize interest rates upwards, a situation which may result in investors moving from the equities market to the bonds market to benefit from the higher returns. It therefore raises a question regarding the nature and direction of relationship between inflation and conditional stock exchange return and volatility. (Izedonmi & Abdullahi, 2011).

Fisher (1930) asserted that the nominal interest rate consists of a real rate plus the expected inflation rate. Fisher Hypothesis stated that expected real rate of the economy is determined by the real factors such as productivity of capital and time preference of savers and is independent of the expected inflation rate. If Fisher effect

6

holds, there is no change in inflation and nominal stock returns since stock returns are allowed to hedge for inflation. This has not been observed. Modigliani and Cohn (1979) investigating into failure of equities to act as hedge against inflation concluded that a major part of the apparent undervaluation of shares was due to cognitive errors on the part of the investors. Investors, they felt, fail to realize that in a period of inflation, part of interest expense is not truly an expense but rather a repayment of real principal. The second and more serious error was the capitalization of long-run profits, a real variable, not at a real rate but rather at a rate that varied with nominal interest rates. Fama (1981) found evidence that the lowering of share prices (due to inflation) can be explained by two correlations: first between inflation and expected level of economic activities, which are negatively correlated (higher inflation bodes lower economic activities) and second between expected economic activities and share prices, which are positively correlated (higher level of economic activities imply higher stock prices). Taking them together would suggest that inflation should lower the stock prices. Inflation here acts as a proxy for lower economic activities in near future and this line of reasoning is called the proxy effect or the proxy hypothesis.

Chinzara (2011) in his study on macroeconomic uncertainty and stock market volatility for South Africa found out stock market volatility is significantly affected by macroeconomic uncertainty. Schwert (1989) in his classic paper studied the relationship between stock market volatility and volatility of real and nominal macroeconomic variables and concluded that movements in inflation and real output have weak predictive power on volatility of stock market and return. Yaya and Shittu (2010) in their paper found out that the previous inflation rates has significant effects on conditional stock market volatility.

7

In principle, the stock market should do well under conditions of strong economic growth and low inflation. Most studies reveals inflation had negative impact on stock return. Based on above argument, I predict that inflation has a negative impact on stock returns and changes in inflation rates, have greater impact in predicting the stock market volatility.

1.1.5 Nairobi Securities Exchange

Stock market is an important institution in a country and is of great concern to investors, stakeholders and the government. Stock market, especially in small economies, plays a vital role in mobilizing economic resources within and from outside the economy to achieve sustainable growth and development. It serves as an important channel through which funds flow from individuals and corporate bodies across the globe to investors residing in a particular economy. (Ogum, Beer and Nouyrigat, 2006). NSE was formed in 1954 as a voluntary organization of Stock brokers and later on registered under the companies act in 1991 phasing out the "call over " trading system in favour of the floor based open outcry system. NSE is a market place where shares and bonds are traded. It is now one of the most active capital markets and a model for the emerging markets in Africa in view of its high returns on investments and a well developed market structure. (www.nse.co.ke).

The Nairobi Securities Exchange comprises approximately 55 listed companies with a daily trading volume of over USD 5 million and a total market capitalization of approximately USD 15 billion. NSE has three market segments namely; the Main Investments Market Segment (MIMS), the Alternative Investment Markets Segment (AIMS) and the Fixed Income Securities Market Segment (FISMS). The MIMS is the

main quotation market, the AIMS provide an alternative method of raising capital to small, medium sized and young companies that find it difficult to meet the strict listing requirements of the MIMS while the FISMS provides an independent market for fixed income securities such as treasury bonds, corporate bonds, preference shares and debenture stocks, as well as short term financial instruments such as treasury bills and commercial papers. Automated bond trading started in November 2009 with the KES 25 billion KenGen bond. NSE Trading hours was revised to start from 09:00 to 15:00. Delivery and settlement is done scripless via an electronic Central Depository System (CDS) which was installed in 2005. Settlement is currently T+4, but moving to T+3, on a delivery-vs-payment basis. The NSE in 2006 introduced an Automated Trading System (ATS) which ensures that orders are matched automatically and are executed on a first come/first serve basis. The ATS has now been linked to the Central Bank of Kenya and the CDS thereby allowing electronic trading of Government bonds. (www.nse.co.ke).

In July 2007, NSE reviewed the Index and announced the companies that would constitute the NSE Share Index. The review of the NSE 20 share index was aimed at ensuring it is a true barometer of the market. The All Share Index has also been added to the older 20 Share Index, going with the growth of the market, and to give another measure of the market dynamics. A dedicated Wide Area Network platform was implemented in 2007 and this eradicated the need for brokers to send their staff to the trading floor to conduct business. Trading is now mainly conducted from the brokers' offices through the WAN. It is still possible to conduct trading from the floor of the NSE. In 2011, the Nairobi Securities Exchange introduced the Broker Back Office System, a comprehensive transaction and information management system for use by

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9

brokers in the market. The system has integrated features that are geared towards ensuring proper controls and best practice in trades transactions and clients' information management. NSE performance as measured by the Nairobi Stock Exchange (NSE) 20-share index has recorded considerable rise and decline since 2007. The NSE 20 Share Index fell by 7.8% to stand at 3,247 points in December 2009 compared to 3,531 points December 2008. The NSE 20 Share Index rose steadily over the first three quarters of 2010 to reach a peak of 4,630 points during the third quarter. The index edged downwards slightly in the fourth quarter but remained relatively high at 4,433 points at the end of December 2010 compared to 3,247 points in December 2009. NSE 20 Share Index reported a 27.7 percent decline, closing at 3,205.02 points at the end of 2011, down from 4, 433 points reported at the end of December 2010. The average NSE 20-Share index for the second quarter of 2012 was on an upward trend, rising by 10% to 3634 against 3298 registered in quarter one. (www.nse.co.ke).

1.2 Research Problem

Researchers believe that the rate of inflation influences the stock market return and volatility. Inflation creates a major problem for analyzing stock market returns over a long period of time. In Kenya where inflation has remained relatively high, it creates a natural bias in the performance of the stock market. Almost every country in the world suffered their worst stock market decline, during a period of high inflation as stocks and other financial assets fail to keep up with the increases in the prices of goods. In addition, also creates extreme volatility in stock market return. High market volatility increases unfavourable market risk premium. According to Poon and Tong (2010), it is critical for policy makers to reduce the stock market volatility and ultimately enhance economy stability in order to improve the effectiveness of the

10

asset allocation decisions. If the government lacks the power to resolve the inflation, the stock value eventually collapses. Inflation seems to affect stock prices but the relationship between unexpected inflation and stock prices is ambiguous. While some studies such as Fama and Schwert (1977) found a significant negative relationship between stock market performance and inflation, studies from Pearce and Roley (1985) and Hardouvelis (1988) found no significant relationship between the two variables.

The Sub-Saharan Africa has been under-researched as far as impact of inflation on stock market return and volatility is concerned. Studies carried out in the African stock markets include, Frimpong and Oteng-Abayie (2006) who applied GARCH models to the Ghana Stock Exchange, Brooks, Davidson and Faff (1997) examined the effect of political change in the South African Stock market. Appiah-Kusi and Pascetto (1998) investigated the volatility and volatility spillovers in the emerging markets in Africa. More recently, Ogum et al., (2006) applied the EGARCH model to the Kenyan and Nigerian Stock Market returns. Locally, Olweny and Omondi (2011) investigated the effect of Macro-economic factors on the stock return volatility on the Nairobi Securities Exchange, Kenya employing EGARCH and TGARCH models. They found that stock returns are symmetric but leptokurtic and not normally distributed. The results showed evidence that Foreign exchange rate, Interest rate and Inflation rate, affect stock return volatility. Kemboi and Tarus (2012) examined macro-economic determinants of stock market development in Kenya. The results indicated that macro-economic factors such as income level, banking sector development and stock market liquidity are important determinants of the development of the Nairobi Stock market. The results indicated that macro-economic

11

stability is not a significant predictor of the development of the securities market. Aroni (2012) analyzed factors influencing stock prices for firms listed in the NSE using inflation, exchange rates, interest rates and money supply. The multiple regression results shown that the factors of inflation, exchange rates, and interest rates were significant except money supply which although it had a positive correlation, the relationship was not significant. The result shows that exchange and interest rates had negative correlation to stock prices whereas inflation and money supply had a positive correlation.

Since the relationship between inflation and stock prices is not clear, it is important for researcher to find out the behavior of the variables. Potentially important relationship between inflation and stock prices in Kenya sucurities markets have not been precisely studied. Researchers have in the past concentrated in other exchanges and very little work has been done to analyse the impact of inflation on stock market returns and volatility locally in Kenya. From the available literature, the NSE has been under-researched as far as impact of inflation on stock market return and volatility is concerned and therefore this study contributes to the small literature available.

1.3 Research Objective

To establish the impact of inflation on stock market return and volatility in the Nairobi Securities Exchange.

1.4 Significance of the Study

The relationship between daily stock market prices, Volatility (measured by standard deviation) and inflation is of great relevance from the policy point of view as they significantly influence the performance of not only the financial sector but the entire

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12

economy. Hence, understanding the nature of stock market volatility has long attracted considerable interest from policy makers and financial analysts. Inflation and stock exchange volatility therefore have important policy implications for the policy makers in developing countries like Kenya.They form the basis for drafting enabling policies and regulations.

Understanding of the impact of inflation on stock market return and volatility is equally important for the financial investors for computing the amount of risk associated with such variation and consequently the risk involved in their investment decisions. Owing to high inflation rate, the NSE has really not performed well as the amount of risk involved in the stock investment has been questioned by the investors. The result of the study will therefore offer investors a foundation upon which to make strategic decisions and choose investment strategy.

The findings and recommendation of this research will contribute to the existing literature available and bridge the knowledge gap that currently exist. The study will provide more information to researchers who may want to carry further research in this area in future as well as serving as the source of reference. The study will also benefit the regulators, brokers, dealers, scolars and academicians.

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CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents the theoritical review, stock market volatility, concept of inflation, review of GARCH model and emperical studies review.

2.2 Theoretical Review

The theories upon which this study is based are discussed here as follows:

2.2.1 Fisher Hypothesis

Fisher (1930) hypothesized that shares are hedged against inflation in the sense that an increase in expected inflation leads to a proportional change in nominal share returns (The two variables are positively correlated). This imply that investors are fully compensated for increases in the general price level through corresponding increases in nominal stock market returns. Thus, the real returns remain unaffected. In other words, the argument is that the real value of the stock market is immune to inflation pressures. However, the Fisher hypothesis has not gone unchallenged. Using data for the postwar period, several authors have found that share returns are not hedged against inflation and use these results as evidence against the Fisher hypothesis. Following the seminal paper of Fama (1981), it has been generally acknowledged that share returns are not simply a function of expected inflation but also of expected income growth. Fama (1981) regressed expected inflation proxies' and share returns without income growth, thus leading to an omitted variable bias. Accommodating expected income growth in the estimates of share returns, Fama (1981) found out that the Fisher hypothesis cannot be rejected.

14

2.2.2 Proxy Hypothesis

The "proxy hypothesis" suggested by Fama (1981) claims that the negative stock return- inflation relation is false. The anomalous stock return-inflation relation is in fact induced by a negative relation between inflation and real activity. Fama's hypothesis predicts that rising inflation rates reduce real economic activity and demand for money. The empirical evidence of the "proxy hypothesis" is mixed and suggests that it is not a complete explanation. Kaul (1987) found some support for the proxy hypothesis, however the findings of Cochran and DeFina (1993) and Caporale and Jung (1997) did not support it. Lee (1992) and Balduzzi (1995) established strong support for the proposition that more than the proxy hypothesis is at work and particularly that the rate of interest accounts for a substantial share of the negative correlation between stock returns and inflation.

2.2.3 Reverse Causality

Geske and Roll (1983) proposes a "reverse causality" explanation and argue that a reduction in real activity leads to an increase in fiscal deficits. Since the Central bank monetises a portion of fiscal deficits, the money supply increases, which in turn increases inflation. The "reverse causality hypothesis" was supported by James, Koreisha and Partch (1985) but rejected by Lee (1992).

2.2.4 Inflation Illusion Hypothesis

The inflation illusion hypothesis of Modigliani and Cohn (1979) point's out, that the real effect of inflation is caused by money illusion. According to Bekaert and Engstrom (2007), inflation illusion suggest that when expected inflation rises, bond yields duly increase, but because equity investors incorrectly discount real cash flows using nominal rates, the increase in nominal yields leads to equity under-pricing and vice versa.

15

2.2.5 The Efficient Market Hypothesis

Ross (1987) states that a market is efficient with respect to a set of information if it is impossible to make economic profits by trading on the basis of this information set and that consequently no arbitrage opportunities, after costs, and after risk premium can be tapped using ex ante information as all the available information has been discounted in current prices. Müslümov, Aras and Kurtuluş (2004) noted that capital markets with higher informational efficiency are more likely to retain higher operational and allocational efficiencies. According to Samuelson (1965) and Fama (1970), under the 'efficient market hypothesis' (EMH), stock market prices must always show a full reflection of all available and relevant information and should follow a random walk process. Successive stock price changes (returns) are therefore independently and identically distributed (iid). Based on the information set, Fama (1970) categorizes the three types of efficient markets as weak-form, semi-strong-form, and strong-form efficient if the set of information includes past prices and returns only, all public information, and any information public as well as private, respectively. The implication here is that all markets can be weak-form but the reverse cannot be the case.

2.3 Concept of Stock Market Volatility

Stock market volatility indicates the degree of price variation between the share prices during a particular period. A certain degree of market volatility is unavoidable, even desirable, as the stock price fluctuation indicates changing values across economic activities and it facilitates better resource allocation. But frequent and wide stock market variations cause uncertainty about the value of an asset and affect the confidence of the investor. The risk averse and the risk neutral investors may

withdraw from a market at sharp price movements. Extreme volatility disrupts the smooth functioning of the stock market. (Brooks, 2008).

In the bullish market, the share prices rise high and in the bearish market share prices fall down and these ups and downs determine the return and volatility of the stock market. Volatility is a symptom of a highly liquid stock market. Pricing of securities depends on volatility of each asset. An increase in stock market volatility brings a large stock price change. Investors interpret a raise in stock market volatility as an increase in the risk of equity investment and consequently they shift their funds to less risky assets. Stock market volatility thus has an impact on business investment spending and economic growth. Changes in local or global economic and political environment influence the share price movements and show the state of stock market to the general public. (Brooks, 2008).

Stock prices tend to show larger fluctuations as compared to volatility of real economic variables. Movements in stock prices have been the central variable of many research studies. Studies of stock market volatility for instance Black (1976), Merton (1980), Christie (1982), Pindyck (1984), Huang and Kracaw (1984), Poterba and Summers (1986), Schwert (1989), Engle (2001), Sadorsky (2003), Beltratti (2006) and Saryal (2007) etc. have reported some stylized facts of which volatility clustering is the most important. It means that large or small shocks are followed by similar large or small shocks. This behavior of stock prices is harmonious with the overall health of the economy. Officer (1973) study related changes in stock market volatility to changes in real economic variables. He noted that variability in stock

prices was unusually high during the period of great depression i.e. 1929-1939 compared with pre- and post-depression periods.

2.4 Concept of Inflation

Inflation is defined as a rise in the average level of price for all goods and services which implies a diminishing purchasing power and increased cost of living. Inflation is considered as one of the economic phenomena that still draw the attention of both developed and developing countries. The importance of inflation, as a macroeconomic variable, comes from its ability to reflect the economic stability of a nation, or the ability of the government to control the economy through its monetary and fiscal policies. Moreover, inflation may give an idea about the trade policy of a nation. Historically, from 2005 until 2012, Kenya Inflation Rate averaged 12.62 Percent reaching an all time high of 31.50 Percent in May of 2008 and a record low of 3.18 Percent in October of 2010. Inflation in Kenya has been relatively high compared to developed countries. In 2009, inflation eased from 2008 16.2% to 9.2%. In 2010, Inflation was contained within the Government's target of 5.0 per cent. The average annual inflation was 4.1 percent in 2010 down from a high of 10.5 percent recorded in 2009. During this period, the stock market experienced recovery until in 2011 when the inflation rate sharply increased to unstable 18%. In 2012,Inflation rate gradually declined from 18% 2011 year end to 12% in may, 8% in July and 6% in August 2012. There is therefore need to determine the impact of inflation rate fluctuations on stock return and volatility. (www.knbs.or.ke)

2.5 GARCH Model

The introduction of ARCH model by Engle (1982) and GARCH model by Bollerslev (1986) and Tailor (1986) saw an increase in researches that seek to investigate the dynamics of conditional stock market volatility in both developed and emerging stock

markets. GARCH models aims to see the effects on both returns and volatility simultaneously. The GARCH model allows the conditional variance to be dependent upon previous own lags. Although the standard GARCH (1,1) model captures the stylized facts of conditional stock return volatility in terms of volatility clustering, it does not capture the asymmetric effect in the conditional variance of information shocks and volatility.

Consider a univariate stochastic process for stock market returns where the information set Ω_t of monthly returns is defined to be $(r_t, r_{t-1}, \ldots\ldots, r_{t-q} \ldots 1)$. The formulation of the standard linear GARCH (1, 1) model based on information set Ω_t of monthly returns r_t is given as:

$$r_t = \mu + \varepsilon_t$$
$$\sigma_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2$$

Where: $\varepsilon_t = \sigma_t z_t$ and $z_t \overset{i.i.d}{\sim} N(0,1)$

σ^2 is measurable with respect to Ω_t, which is the monthly returns. $\omega > 0, \alpha > 0, \beta \geq 0$, and $\alpha + \beta < 1$, such that the model is covariance-stationary, that is, first two moments of the unconditional distribution of the return series is time invariant.

r_t is monthly return on stock market shares and $t = 1, 2, \ldots..t$.

σ_t is known as the *conditional variance* since it is a one-period ahead estimate for the variance calculated based on any past information thought relevant. The conditional variance is changing, but the *unconditional variance* of ε_t is constant and given by

$$\text{var}(\varepsilon_t) = \frac{\omega}{1-(\alpha+\beta)} \text{ So long } \alpha+\beta < 1$$

19

For $\alpha + \beta \geq 1$ the unconditional variance of ε_t is not defined, and this would be termed *'non-stationarity in variance'*. $\alpha + \beta = 1$ would be known as a *'unit root in variance'*.

The parameter μ represents the mean value of the return.

The parameter ε_t denotes the error terms (return residuals, with respect to a mean process) i.e. the series terms. These ε_t are split into a stochastic piece z_t and a time dependent standard deviation σ_t characterizing the typical size of the terms so that $\varepsilon_t = \sigma_t z_t$ where z_t is a random variable drawn from Gaussian distribution centered at 0 with standard deviation equal to 1 i.e. $z_t \overset{i.i.d}{\sim} N(0,1)$.

The parameter α represent the coefficient of the new information arriving in the previous period i.e news about volatility from previous period.

The parameter β represent the coefficient of the past period's forecast variance.

The parameters α and β are the persistence coefficients. The sum of these parameters may be less than, equal to, or greater than unity. In the special case when the persistent parameters α and β sum to unity, the GARCH model reduces to the special case of Integrated GARCH i.e. IGARCH model and therefore there is a unit root in the GARCH process.

2.6 Empirical Studies Review

Research studies have been conducted to determine the effects of inflation on stock market. Most scholars used consumer price index (CPI) to substitute inflation. Most studies reveals inflation had negative impact on stock return. Bodie (1976), stated that equities are a hedge against the increase of price level due to the fact that they represent a claim to real assets and, hence, the real change on the price of the equities

20

should not be affected. In other words earnings should be consistent with the inflation rate, and therefore the real value of the stock market should remain unaltered in the long-run. However, Fama (1981) found a negative relationship between stock returns and stated that the negative association found between stock returns and inflation is the result of two underlying relationships between stock returns and expected economic activity; and expected economic activity and inflation. Expectation of higher future dividend account for a positive relationship between stock returns and inflation while money demand effects account for a negative relationship between expected activity and inflation. This argument is certainly plausible and is supported by compelling empirical evidence. However, something of a puzzle still remains in Fama's (1981) empirical results. Various measures of real activity did not, by themselves, entirely eliminate the negative inflation and stock returns relation.

Kaul (1986) found evidence to show that the relationship between inflation and stock returns are dependent on the equilibrium process in the monetary sector and that they vary if the underlying money demand and supply factors undergo a systematic change. Boudoukh and Richardson (1993) found a strong support for positive relation between nominal stock return and inflation at a long horizon. Luintel and Paudyal (2006) found positive relationships between inflation and stock returns and that the price elasticity of the stock return was greater than unity. This they argued is theoretically more plausible because the nominal return from stock investments must exceed the inflation rate in order to fully insulate tax-paying investors. Otherwise, investors will suffer real wealth losses.

Schwert (1981) analyzed the reaction of stock prices to the new information about inflation. He stated that the important reason to expect a relationship between stock returns and the unexpected inflation was that unexpected inflation contained new information about future levels of expected inflation. Despite of debtor or creditor hypothesis, it was difficult to predict the distributive effects of unexpected inflation on stock returns. The unexpected inflation has variety of effects on the value of the firm, and unexpected increase in expected inflation could cause government policy-makers to react by changing monetary of fiscal policy in order to counteract higher inflation. He found that the stock market seem not react to unexpected inflation during the period of Consumer Price index was sampled on several weeks before the announcement date.

Choudhry (1999) investigated the relationship between stock returns and inflation in four high inflation (Latin and Central American) countries: Argentina, Chile, Mexico and Venezuela during 1980s and 1990s. There were two distinct ways to define stocks as a hedge against inflation. First, a stock was a hedge against inflation, if it eliminates or at least reduces the possibility that the real rate of return on the security will fall below some specific floor value. Secondly, it was a hedge if and only if its real return is independent of the rate of inflation. The result showed a direct one-to-one relationship between the current rate of nominal returns and inflation for Argentina and Chile. It is indicated that stocks act as a hedge against inflation. Further tests were conducted to check for the effects of the leads and lags of inflation. Evidence of a direct relationship between current nominal returns and one-period inflation was also found. Results also show that significant influence on nominal returns was imposed by lags but not by leads of inflation. This result backs the claim

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that the past rate of inflation may contain important information regarding the future inflation rate. These significant results presented may show that a positive relationship between stock returns and inflation is possible during short horizon under conditions of high inflation.

Adrangi, Chatrath and Sanvicente (2000) investigated the negative relationship between stock returns and inflation rates in markets of industrialized economies for Brazil. The study found there was negative relationship between inflation and real stock returns, the finding support Fama's proxy hypothesis framework. The negative relationship between the real stock returns and inflation rate for Brazil persists even after the negative relationship between inflation and real activity is purged. Therefore, real stock returns may be adversely affected by inflation because inflationary pressures may threaten future corporate profits; and nominal discount rates rise under inflationary pressures, reducing current value of future profits and on stock returns. The results support the interesting notion that the proxy effect in the long-run rather than short run.

Geyser and Lowies (2001) studied the impact of inflation on stock prices in two SADC countries which were South Africa and Namibia. The study used simple regression analysis. The South African experience shown that the companies listed in the mining sector are negatively correlated against inflation. The selected companies in various sectors showed slightly positive correlation between stock price changes and inflation. All the selected companies of Namibia except Alex Forbes showed a strong positive correlation between stock price changes and inflation.

23

Loannides, Katrakilidis and Lake (2002) were investigating the relationship between stock market returns and inflation rate for Greece over the period 1985 to 2000. There were arguments that stock market can hedge inflation in line with to Fisher's hypothesis. Another argument was that the real stock market was immune to inflation pressures. This study attempted to investigate whether the stock market had been a safe place for investors in Greece. They used ARDL cointegration technique in conjunction with Granger Causality to test the long-run and short-run effects between the involved variables as well as the direction of these effects. There was a long run negative relationship from inflation to stock market returns over the first sub-period. The findings were consistent with Fama (1981). Bidirectional long run causality resulted in second sub-period. There was a causal effect running from stock market returns to inflation. Evidence was also found that a causal effect running from inflation to stock market returns in second sub-period. The second sub-period showed mixed relationship.

Al-Khazali (2003) investigated the generalized Fisher hypothesis for nine equity markets in the Asian countries: Australia, Hong Kong, Indonesia, Japan, South Korea, Malaysia, the Philippines, Taiwan, and Thailand. It states that the real rates of return on common stocks and the expected inflation rate were independent and that nominal stock returns vary in a one-to-one correspondence with the expected inflation rate. The results of the VAR model indicate the nominal stock returns seem Granger-causally a priori in the sense that most of the forecast error variances is accounted for by their own innovations in the three-variable system; inflation does not appear to explain variation in stock returns; stock returns do not explain variation in expected inflation. The stochastic process of the nominal stock returns could not be affected by

24

expected inflation. The study fails to find either a consistent negative response of stock returns to shocks in inflation or a consistent negative response of inflation to shocks in stock returns in all countries. The generalized Fisher hypothesis was rejected in all countries.

Davis and Kutan (2003) established that inflation and other indicators are weak predictors of the conditional stock exchange volatility in the emerging markets. Contrary to this, Engle and Rangel (2005) found that inflation, GDP growth, and short term interest rate have great positive impact on the unconditional stock exchange volatility. They further found that inflation has high predictive power for the emerging markets than it had for the developed nations like Canada. Using Spline-GARCH model and annual realized volatility they computed the coefficients of the model and found that inflation had weak predictive power of annual realized volatility but they also claimed that annual realized volatility has many drawbacks.

Al-Rjoub (2003) investigated the effect of unexpected inflation on stock returns in five MENA countries: Bahrain, Egypt, Jordan, Oman, and Saudia Arabia. The researcher used TGARCH and EGARCH to catch the effect of unexpected inflation news on stock returns. The EGARCH shown that the unexpected inflation had a negative impact on stock market returns in all the MENA countries. The impact was high and significant in Bahrain, Egypt and Jordan. The leverage effect for Bahrain was negative which indicated the existence of the leverage effect in stock market return during the 1999:01 through 2002:07 sample periods. The impact is asymmetric. The leverage effect for Egypt was positive indicating the non existence of the leverage effect in stock market return during the 1999:01 through 2002:07 sample

25

period. Results were similar for Jordan. For Oman and Saudia Arabia there was no news effect of inflation on stock market data. On the other hand, the TGARCH resulted unexpected inflation, a negative effect on Bahraini (-164.74 with P-value of (0.00)), Jordanian (-92.28 with P-value (0.05)), and Saudi stock market return (-292.2 With P-value of (0.00)). The coefficients of unexpected inflation were negative and highly significant. Only Oman and Egypt showed insignificant results where unexpected inflation shows no effect on stock market return data in the sample period. The study found negative and strongly significant relationship between unexpected inflation and stock returns in MENA countries and indicated the stocks listed in MENA countries stock markets does not feel the high up's and down's movements in the markets. The asymmetric news effect was absent.

Laopodis (2005) examined the dynamic interaction among the equity market, economic activity, inflation, and monetary policy. Researcher looks into the first issue concerning the role of monetary policy. He employed Advanced econometrics methods including cointegration, causality and error-methods such as bivariate and multivariate Vector Autoregressive (VAR) or multivariate Vector Error-Correction (VEC) models. With bivariate results, it was found that the real stock returns-inflation pair weakly support negative correlation between stock market and inflation, meanwhile stock market can hedge against inflation. On the other hand, bivariate results claims a negative and unidirectional relationship from stock returns to FED funds rate in the 1990s but a very weak one in 1970s. With multivariate, he found strong support of short-term linkages in the 1970s along with the same unidirectional linkage between the two in the 1990s. This showed that stock returns do not respond positively to monetary easing, which took place during the 1990s, or negatively to

monetary tightening. There were no consistent dynamic relationship between monetary policy and stock prices. This conclusion seems to contradict Fama's (1981) proxy hypothesis, which said that inflation and real activity were negatively related but real activity and real stock returns were positively related.

Abu (2005) explored the varying volatility dynamic of inflation rates in Malaysia for the period from August 1980 to December 2004. EGARCH model was used to capture the stochastic variation and asymmetries in the financial instruments. Besides modeling the asymmetric effect of shocks to inflation uncertainty, the EGARCH-Mean model was employed to test whether the effect of inflation uncertainty on inflation rate in Malaysia was either positive or negative. In this study, the positive and significant value of β coefficient implies that positive shocks have a greater impact on inflation uncertainty as compared to negative shocks. Another result shows that there was no contemporaneous relationship between inflation uncertainty and inflation level. There was sufficient empirical evidence that higher inflation rate level will results in higher inflation uncertainty.

Saryal (2007) employed GARCH model for the estimation of conditional stock market volatility using monthly data for Turkey from January 1986 to September 2005 and for Canada from January 1961 to December 2005. She examined the two questions. First, how does inflation relate to stock market volatility as estimated by using nominal stock return series? Second, does the relation differ between countries with different rates of inflation? The Canada and Turkey data were selected for comparison on the basis of their inflation level. The countries were selected because Turkey was an emerging market country with a high inflation rate and Canada a

27

developed country with a low inflation rate. She estimated impact of inflation on stock market volatility and found that inflation rate had the high predictive power for explaining stock market volatility in Turkey. However, in Canada it was weaker though still significant. The result suggests that the higher the rate of inflation, the higher the nominal stock returns consistent with the simple Fisher effect. The result showed the rate of inflation was one of the underlying determinants of conditional stock market volatility particularly in a highly inflated country like Turkey. The variability in the inflation rate had a stronger impact in forecasting stock market volatility in Turkey than in Canada.

Olweny and Omondi (2011) investigated the effect of Macro-economic factors on the stock return volatility on the Nairobi Securities Exchange, Kenya. The study focused on the effect of foreign exchange rate, interest rate and inflation rate fluctuation on stock return volatility at the Nairobi Securities Exchange. It used monthly time series data for a ten years period between January 2001 and December 2010. Empirical analysis employed was EGARCH and TGARCH. They found that stock returns are symmetric but leptokurtic and not normally distributed. The results showed evidence that Foreign exchange rate, Interest rate and Inflation rate, affect stock return volatility. On foreign exchange rate, magnitude of volatility is relatively low and significant. This implies that the impact of foreign exchange on stock returns is relatively low though significant. Volatility persistence was found to be low and significant. This implies the effect of shocks takes a short time to die out following a crisis irrespective of what happens to the market. There was evidence of leverage effect which means that volatility rise more following a large price fall than following a price rise of the same magnitude.

Kemboi and Tarus (2012) examined macro-economic determinants of stock market development in Kenya for the period 2000 to 2009, using quarterly secondary data. The hypothesis on the existence of a co-integrated relationship between stock market development and macro-economic determinants was tested using Johansen-Julius co-integration technique. The results indicated that macro-economic factors such as income level, banking sector development and stock market liquidity are important determinants of the development of the Nairobi Stock market. The results also shown that macro-economic stability is not a significant predictor of the development of the securities market.

Aroni (2012) analyzed factors influencing stock prices for firms listed in the Nairobi stock exchange covering the period the period from January 2008 to December, 2010 using inflation, exchange rates, interest rates and money supply. Multiple regression formula was applied to estimate effect of the selected factors on stock prices. The regression results show that the factors of inflation, exchange rates, and interest rates were significant except money supply which although it had a positive correlation, the relationship was not significant. The result shows that exchange and interest rates had negative correlation to stock prices whereas inflation and money supply had a positive correlation.

2.7 Chapter Summary

The linkage between stock market returns and inflation if any has drawn the attention of researchers and practitioners alike particularly since the twentieth century. The foundation of the discourse is the Fisher (1930) equity stocks proclamation. According to the generalized Fisher (1930) hypothesis, equity stocks represent claims

against real assets of a business; and as such, may serve as a hedge against inflation. If this holds, then investors could sell their financial assets in exchange for real assets when expected inflation is pronounced. In such a situation, stock prices in nominal terms should fully reflect expected inflation and the relationship between these two variables should be positively correlated ex ante (Ioannides, Katrakilidies and Lake, (2002). This argument of stock market serving as a hedge against inflation may also imply that investors are fully compensated for the rise in the general price level through corresponding increases in nominal stock market returns and thus, the real returns remain unaltered. The appropriate direction of the relationship or the neutrality between inflation and stock market returns relationship have equally generated a large body of evidence in the empirical literature and until now convergence has not been met. From the reviewed empirical studies, the relationship between inflation and stock market returns was Positive, Negative or Neutral.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter describe the research design, population, sample design, data collection, construction of variables, data analysis and presentation, hypotheses, testing for non-linearity, nomality test, unit root test, correlation test, test for presence of ARCH effects, linear regression model and GARCH model estimation process.

3.2 Research Design

This is a correlational study that establishes whether inflation is associated with stock market return and volatility. Specifically, it sought to answer the puzzle on the effect of inflation on the stock return and volatility in the NSE. Correlational research designs are used to explore casual relationship between variables and predict scores on one variable from research participants' scores on other variables. Correlational research involves tests for statistical relationships between variables. A correlational design was chosen as the most appropriate for this study because it allows researcher to show if variables have a positive or negative relationship and the degree of the relationship as expressed by a coefficient of correlation between the variables being studied. It also allows hypothesis testing to see if the observed relationship is statistically significant.

3.3 Population

The target population consists of all the stocks listed at NSE as at August 2012 (see appendix A). This was an appropriate population and gave a clear picture of the situation in the market.

3.4   Sample

The study used monthly time series data for NSE 20 share index that covers a period of 12 years from July 2000 to August 2012. The NSE 20 share index was selected as the proxy representing the overall stock prices. The NSE 20 index was sampled to be surrogate representative of the different sectors and the general change in price in line with Dubravka and Petra (2010) finding that the market index had the largest statistical signicancy in explaining stock returns. NSE 20 share index measures the performance of 20 blue chip companies cutting across all the 10 sectors in the economy (see appendix B). NSE 20 share index was preferred over NSE All Share Index as a measure of NSE performance because it primarily focuses on price changes amongst the 20 blue chip companies which are carefully selected on the basis of their activity and sector representation. NSE All Share Index include all listed stocks including active, less active and inactive shares which dilute the index thus making it difficult to evaluate minor changes in index caused by macroeconomic variables. (www.nse.co.ke)

3.5   Data Collection

The secondary data used in this study consists of monthly time series data on the stock market index (NSE-20 share index) obtained from the Nairobi Securities Exchange. The inflation data as measured by CPI was obtained from Kenya National Bureau of Statistics.

3.6   Construction of Variables

The series was transformed by taking the first differences of the natural logarithms of the values in each of the series. The transformation was aimed at attaining stationarity in the first moment. The inflation and stock exchange returns variables were calculated as:

32

$$r_t = \ln\left[\frac{Stock\_index_t}{Stock\_index_{t-1}}\right] = (\ln Stock\_index_t - \ln Stock\_index_{t-1})$$

$$\pi_t = \ln\left[\frac{CPI_t}{CPI_{t-1}}\right] = (\ln CPI_t - \ln CPI_{t-1})$$

For the purpose of analysis, based on theoretical framework, inflation was modeled as independent variable and monthly return as the dependent variable.

3.7 Data Analysis and Presentation

Financial econometrics models were employed in the study to analyse the collected data so as to get accurate results. GARCH models was of great importance in data analysis and capturing the effect of inflation on stock return volatility in the NSE. Data analysis and testing was carried out using spread sheet (Ms Excel) and Statistical software (SPSS and E-Views). Data presentation was done using tables and graphs.

3.8 Hypotheses

In this research, the following formulated hypotheses were tested in order to study the behavior of the two variables:

Hypothesis 1: Stock returns and Inflation are normally distributed.

Hypothesis 2: Unit Root exists (i.e. non-stationarity) in both series.

Hypothesis 3: Correlation exists between the two variables.

Hypothesis 3: Inflation is a significant explanatory variable for the stock returns.

Hypothesis 3: Inflation affects both the stock return mean and volatility negatively.

3.9 Testing for Non-linearity

Many models that appear, prima facie, to be non-linear, can be made linear by taking logarithms or some other suitable transformation. However, it is likely that many relationships in finance are intrinsically non-linear. A non-linear model should be used where financial theory suggests that the relationship between variables should be

such as to require a non-linear model. But the linear versus nonlinear choice may also be made partly on statistical grounds-deciding whether a linear specification is sufficient to describe all of the most important features of the data at hand. 'Traditional' tools of time series analysis (such as estimates of the autocorrelation or partial autocorrelation function, or 'spectral analysis', which involves looking at the data in the frequency domain) are likely to be of little use. Such tools may find no evidence of linear structure in the data, but this would not necessarily imply that the same observations are independent of one another. BDS test for independence, as described in Brock, Dechert, Scheinkman and LeBaron (1996) was employed in this study to tests for non-linear patterns in time series.

3.10 Normality Test

The Jarque-Bera (JB) test was be used to test whether stock returns and inflation rates individually follow the normal probability distribution. The JB test of normality is an asymptotic, or large-sample, test. The test statistic was computed as follows:

$$JB = n \left[S^2 / 6 + (K-3)^2 / 24 \right]$$

where n = sample size, S = skewness coefficient, and K = kurtosis coefficient. For a normally distributed variable, S = 0 and K = 3. Therefore, the JB test of normality is a test of the joint hypothesis that S and K are 0 and 3 respectively.

3.11 Unit Root Test (Stationarity Test)

Empirical work based on time series data assumes that the underlying time series is stationary. Broadly speaking a data series is said to be stationary if its mean and variance are constant (non-changing) over time and the value of covariance between two time periods depends only on the distance or lag between the two time periods and not on the actual time at which the covariance is computed[Gujrati (2003)]. A unit root test using Augmented Dickey Fuller (ADF) [Dickey and Fuller (1979, 1981),

34

Gujarati (2003), Enders (1995)] was applied to check whether a series is stationary or not. Augmented Dickey-Fuller (ADF) test applied in the study is the modified version of Dickey-Fuller (DF) test. ADF makes a parametric correction in the original DF test for higher-order correlation by assuming that the series follows an AR (p) process. The ADF approach controls higher-order correlation by adding lagged difference terms of the dependent variable to the right-hand side of the regression. The Augmented Dickey-Fuller test specification is as follows:

$$Y_t = \rho_0 + \beta Y_{t-1} + \eta_1 \Delta Y_{t-1} + \eta_2 \Delta Y_{t-2} + \ldots\ldots + \eta_p \Delta Y_{t-p} + \varepsilon_t$$

Y_t represents time series to be tested, ρ_0 is the intercept term, β is the coefficient of interest in the unit root test, η_i is the parameter of the augmented lagged first difference of Y_t to represent the pth- order autoregressive process, and ε_t is the white noise error term. In carrying out the unit root test; H_0: $\alpha=0$ (non stationary) hypothesis was tested.

3.12 Correlation Test

Correlation is a concept for investigating the relationship between two quantitative, continuous variables. Correlation coefficient (r) measures the strength of the association between the two variables and is calculated as:

$$r_{xy} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2 \sum_{i=1}^{n}(y_i - \bar{y})^2}}$$

3.13 Test for the presence of ARCH effects

Before fitting GARCH (1,1) model to the series, the presence of ARCH effects in the residuals was tested. If there does not exist a significant ARCH effect in the residuals

35

then the ARCH model is unnecessary or mis-specified. A stochastic process

$y_t = c + \varepsilon_t$, is said to be Arch (p) if $\mathrm{var}_{t-1}(\varepsilon_t) = \sigma_t^2$, $\varepsilon_t = z_t \sigma_t$, and $\sigma_t^2 = \omega + \sum_{i=1}^{q} \theta_i \varepsilon_{t-i}$.

Testing the hypothesis of no significant ARCH effects was based on the Lagragian

Multiplier (LM) approach, where the test statistic is given by:

$$LM = nR^2,$$

where n is the sample size and R^2 is the coefficient of determination for the regression

in the ARCH model using the residuals.

3.14 Linear Regression Model

The linear regression model examined the effects of inflation on stock returns.

Inflation rate was included as independent variable and monthly market return as the

dependent variable to the constant linear regression model.

$$r_t = c + \rho \pi_t + \varepsilon_t \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots(1)$$

Where: r_t is the index return in month t, c is the constant term, π_t is the logarithmic

difference of CPI for month t and ε_t is the error term in month t. The regression

models will be estimated using statistical package and hypothesis tested.

3.15 Generalized Autoregressive Conditional Heteroscedasticity Model

Since the distributions of series are stated as nonlinear, the research employed a step-

wise approach, where the standard linear GARCH (1,1) was first applied to capture

the stock returns volatility.

3.15.1 GARCH Model Estimation

Descriptive statistics for Nominal stock returns and inflation (mean, standard

deviation, skewness, Kurtosis, Min, Max and Jacque-Bera statistic) for the entire

then the ARCH model is unnecessary or mis-specified. A stochastic process

$y_t = c + \varepsilon_t$, is said to be Arch (p) if $\text{var}_{t-1}(\varepsilon_t) = \sigma_t^2$, $\varepsilon_t = z_t \sigma_t$, and $\sigma_t^2 = \omega + \sum_{i=1}^{q} \theta_i \varepsilon_{t-i}$.

Testing the hypothesis of no significant ARCH effects was based on the Lagragian

Multiplier (LM) approach, where the test statistic is given by:

$$LM = nR^2,$$

where n is the sample size and R^2 is the coefficient of determination for the regression

in the ARCH model using the residuals.

3.14 Linear Regression Model

The linear regression model examined the effects of inflation on stock returns.

Inflation rate was included as independent variable and monthly market return as the

dependent variable to the constant linear regression model.

$$r_t = c + \rho\pi_t + \varepsilon_t \quad\text{...(1)}$$

Where: r_t is the index return in month t, c is the constant term, π_t is the logarithmic

difference of CPI for month t and ε_t is the error term in month t. The regression

models will be estimated using statistical package and hypothesis tested.

3.15 Generalized Autoregressive Conditional Heteroscedasticity Model

Since the distributions of series are stated as nonlinear, the research employed a step-

wise approach, where the standard linear GARCH (1,1) was first applied to capture

the stock returns volatility.

3.15.1 GARCH Model Estimation

Descriptive statistics for Nominal stock returns and inflation (mean, standard

deviation, skewness, Kurtosis, Min, Max and Jacque-Bera statistic) for the entire

36

sample was calculated. The coefficients for GARCH (1,1) volatility model for return series and their standard errors were estimated. Diagnostic test statistics, ARCH LM test and Ljung-Box test were carried out to check whether the standardized squared residuals are serially uncorrelated and homoskedastic. The basic GARCH(1,1) model estimated is given by:

$$r_t = c + \rho\pi_t + \varepsilon_t$$
$$\sigma_t^2 = \omega + \alpha\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 \qquad\qquad \text{.................................(2)}$$

Parameters: $\mu, \omega, \alpha(ARCH) and \beta(GARCH)$

The model captures the time varying volatility of stock market returns. The standard GARCH (1,1) model therefore does not capture the asymmetric effect of shocks on stock market volatility and hence the choice of EGARCH. Test done to check presence of asymmetry effects for NSE returns using an EGARCH model confirmed that the returs are asymmetric thus EGARCH (1, 1) model should be used rather than a GARCH (1, 1) model.

3.15.2 Extension to the basic GARCH Model

The EGARCH (1,1) model was estimated to capture the asymmetric effect of shocks on stock market volatility. The EGARCH specification equation for the conditional variance proposed by Nelson (1991) then takes another form as follows:

$$\log\left(\sigma_t^2\right) = \omega + \beta\log\left(\sigma_{t-1}^2\right) + \alpha\left(\left|\frac{\varepsilon_{t-1}}{\sigma_{t-1}}\right| - \sqrt{\frac{2}{\pi}}\right) + \gamma\frac{\varepsilon_{t-1}}{\sigma_{t-1}} \qquad \text{....................(3)}$$

The model that was estimated for nominal return series with inflation (lagged inflation term) to integrate the effect of inflation on the conditional stock exchange volatility is as follows:

37

$$r_t = c + \rho \pi_t + \varepsilon_t$$

$$\log\left(\sigma_t^2\right) = \omega + \beta \log\left(\sigma_{t-1}^2\right) + \alpha\left(\left|\frac{\varepsilon_{t-1}}{\sigma_{t-1}}\right| - \sqrt{\frac{2}{\pi}}\right) + \gamma \frac{\varepsilon_{t-1}}{\sigma_{t-1}} + \lambda \pi_{t-1} \quad \ldots(4)$$

Where π_{t-1} is previous period inflation level and $\mu, \omega, \alpha, \beta$ and λ are parameters estimated. The presence of term γ makes it possible for both positive and negative shocks to have different impact on the previous period inflation rate.

To incorporate the distributed effect of inflation on conditional volatility of stock exchange returns, coefficients for EGARCH (1,1) volatility model were estimated for nominal return series with change in inflation.

$$r_t = c + \rho \pi_t + \varepsilon_t$$

$$\log\left(\sigma_t^2\right) = \omega + \beta \log\left(\sigma_{t-1}^2\right) + \alpha\left(\left|\frac{\varepsilon_{t-1}}{\sigma_{t-1}}\right| - \sqrt{\frac{2}{\pi}}\right) + \gamma \frac{\varepsilon_{t-1}}{\sigma_{t-1}} + \lambda(\Delta\pi)_{t-1} \quad \ldots(5)$$

$$(\Delta\pi)_t = \frac{\pi_t - \pi_{t-1}}{\pi_{t-1}}$$

Where $\Delta\pi$ is change inflation and $\mu, \omega, \alpha, \beta$ and λ are parameters estimated. The model captured impact of change in inflation on conditional stock market volatility.

CHAPTER FOUR

DATA ANALYSIS AND PRESENTATION OF FINDINGS

4.1 Introduction

This chapter discusses and presents the analysis results and their interpretations. The analysis results presented include descriptive statistics, normality test, non-linearity test, unit root test, correlation test, test for presence of ARCH effects, linear regression model, GARCH model and EGARCH model.

4.2 Data Presentation

The findings of the study is as follows:

4.2.1 Descriptive Analyses

Table 4.1 reports the monthly Mean returns, Standard deviation, Skewness, Kurtosis, and Jacque Bera statistics for the entire sample. An examination of characteristics displayed in Table 4.1 shows that for the overall sample, the average monthly nominal returns are positive. This translates to average monthly returns (in natural log) of 0.47%.

Table 4.1: Summary Statistics for Nominal Stock Returns and Inflation

Statistics	Inflation	Nominal Stock Return
Sample Period	2000M8 - 2012M8	2000M8 - 2012M8
Mean	0.006506	0.004662
Median	0.005561	0.007283
Maximum	0.050623	0.159754
Minimum	-0.024512	-0.256647
Std. Dev.	0.010996	0.065457
Skewness	0.587760	-0.470651
Kurtosis	5.282561	4.756443
Jarque-Bera	39.82628	23.99231
Probability	0.000000	0.000006
Sum	0.943397	0.675955
Sum Sq. Dev.	0.017410	0.616988
Observations	145	145

Source: Survey Data (2012)

39

4.2.2 Normality test Results

The market show evidence of fat tails, since the Kurtosis exceeds 3, which is the normal value, and evidence of negative skewness, for securities market return and positive skewness for inflation. These imply left and right fat tails, respectively. The Jarque-Berra normality tests refute the null hypothesis of normality of returns series and inflation. The first hypothesis that stock returns and Inflation are normally distributed was rejected.

4.2.3 Non-linearity test results

Linear structural models are unable to explain a number of important features common to much financial data, including: (i) **Leptokurtosis** - the tendency for financial asset returns to have distributions that exhibit fat tails and excess peakedness at the mean. (ii) **Volatility clustering or volatility pooling** - the tendency for volatility in financial markets to appear in bunches. Thus large returns (of either sign) are expected to follow large returns, and small returns (of either sign) to follow small returns. A plausible explanation for this phenomenon is that the information arrivals which drive price changes occur in bunches rather than being evenly spaced over time. (iii) **Leverage effects** - the tendency for volatility to rise more following a large price fall than following a price rise of the same magnitude.

Campbell, Lo and MacKinlay (1997) broadly defined a non-linear data generating process as one where the current value of the series is related non-linearly to current and previous values of the error term $y_t = f(u_t, u_{t-1}, u_{t-2}, \ldots\ldots\ldots)$ where u_t is an iid error term and f is a non-linear function. According to Campbell, Lo and MacKinlay, a more workable and slightly more specific definition of a non-linear

model is given by the equation $y_t = g\left(u_{t-1}, u_{t-2}, \ldots\ldots\right) + u_t \sigma^2 \left(u_{t-1}, u_{t-2}, \ldots\ldots\right)$ where g is a function of past error terms only, and σ^2 can be interpreted as a variance term, since it is multiplied by the current value of the error. Campbell, Lo and MacKinlay (1997) usefully characterise models with non-linear $g(\bullet)$ as being non-linear in mean, while those with non-linear $\sigma(\bullet)^2$ are characterised as being non-linear in variance. Models can be linear in mean and variance (e.g. the CLRM, ARMA models) or linear in mean, but non-linear in variance (e.g. GARCH models). If the variance of the errors is not constant, this would be known as heteroscedasticity. Models could also be classified as non-linear in mean but linear in variance (e.g. bicorrelations models). Finally, models can be non-linear in both mean and variance (e.g. the hybrid threshold model with GARCH errors employed by Brooks, 2001).

The BDS test was applied to the series of estimated residuals to check whether the residuals are independent and identically distributed (*iid*). The results for the BDS test statistic concluded that there is non-linear dependence in stock market returns series, but that the dependence is best characterised by a GARCH-type process.

4.2.4 Unit Root Test (Stationarity Test)

Having recognized the non-normal distribution of the two variables, the question of stationarity of the two time series need to be evaluated. The simplest check for stationarity is to plot time series graph and observe the trends in mean, variance and autocorrelation. A time series is said to be stationary (do not contain a unit root) if its mean and variance are constant over time. Time series data are often assumed to be non-stationary and thus it is necessary to perform a pretest to ensure there is a stationary relationship between inflation and stock return volatility in order to avoid

41

the problem of spurious regression (Riman and Eyo (2008)). Spurious regression is cited in Patterson (2000), to exist where the test statistics show a significant relationship between variables in the regression model even though no such relationship exists between them. Therefore, in order to address the issue of non-stationarity and avoid the problem of spurious regression, quantitative analysis was employ. For the testing of unit roots, the Augmented Dickey-Fuller test (ADF) was used. If the null hypothesis (H0: $\alpha=0$) is rejected, this means that the time series data is stationary. The decision criteria involved comparing the computed test statistic with the MacKinnon critical values for the rejection of a hypothesis for a unit root. If the computed ADF statistic is less negative (i.e. lies to the right of the MacKinnon critical values) relative to the critical values, we do not reject the null hypothesis of non-stationarity in time series variables. The results are shown in Table 4.2 and Table 4.3.

Table 4.2: Results of ADF stationarity test of NSE Returns at level

Null Hypothesis: R_LOGNSE20SI has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.26370	0.0000
Test critical values:	1% level	-3.476143	
	5% level	-2.881541	
	10% level	-2.577514	

*MacKinnon (1996) one-sided p-values.

Source: Survey Data (2012)

Table 4.3: Results of ADFuller stationarity test of Inflation

Null Hypothesis: LOGCPI has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.871278	0.0000
Test critical values:	1% level	-3.476143	
	5% level	-2.881541	
	10% level	-2.577514	

*MacKinnon (1996) one-sided p-values.

Source: Survey Data (2012)

Comparing the obtained ADF statistics for the two variables with the critical values for rejection of hypothesis of existence of unit root, it becomes evident that the obtained statistics for NSE returns and Inflation, -10.26 and -7.87 respectively, fall behind the critical values at 1%, 5% and 10% significance level of -3.432777, -2.88 and -2.578 (i.e. critical value is greater than ADF statistic). Thus, giving probability values 0.00; thereby, leading to the rejection of the hypothesis of unit root for both the series. Hence, it can be concluded on the basis of ADF test statistics that market returns as well as inflation series are, both, found to be stationary at level form.

4.2.5 Correlation test results

Pearson's Correlation test was conducted between market returns and inflation. Correlation test can be seen as the first indication of existence of any interdependency between the time series. Table 4.4 shows the correlation coefficients between market returns and inflation. From the derived statistics, it was observed that the coefficient of correlation to be -0.06431, which is indicative of mild negative correlation between the two series. The test shows that when inflation rate increase by 1%, market return decreases by 6.43%. Rise in price levels over time triggers investors to lose

43

confidence in the market. Thus, we may state that the two series are weakly correlated as the coefficient of correlation depicts some interdependency between the two variables. The third hypothesis that correlation exists between the two variables was accepted.

Table 4.4: Correlation matrix

	Inflation	Market return
Inflation	1.000000	-0.064310
Market return	-0.064310	1.000000

Source: Survey Data (2012)

4.2.6 Test for the presence of ARCH effects

The Breusch-Godfrey Lagrange multiplier test for general, high-order, ARMA errors was tested. The null hypothesis of the test is that there is no serial correlation in the residuals up to the specified order.

Table 4.5: Results of Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	3.398090	Prob. F(1,142)	0.0674
Obs*R-squared	3.388787	Prob. Chi-Square(1)	0.0656

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Sample: 2000M08 2012M08
Included observations: 145
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000171	0.006257	0.027383	0.9782
LOGCPI	-0.026255	0.491152	-0.053456	0.9574
RESID(-1)	0.152939	0.082676	1.849870	0.0664

Source: Survey Data (2012)

The low probability values resulting from Breusch-Godfrey L M test as shown in Table 4.5 specify that the null hypothesis is rejected. This is indicative of the presence of serial correlation (ARCH effect) in the residuals of the estimated equation. The GARCH model can for that reason be employed.

4.2.7 Regression Model

The regression model represented by equation 1 was estimated to assess whether inflation is a significant explanatory variable for the stock market return in NSE.

Table 4.6: Regression model results

Dependent Variable: R_LOGNSE20SI
Method: Least Squares
Sample (adjusted): 2000M08 2012M08
Included observations: 145 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.007153	0.006331	1.129797	0.2605
LOGCPI	-0.382841	0.496786	-0.770634	0.4422
R-squared	0.004136	Mean dependent var		0.004662
Adjusted R-squared	-0.002828	S.D. dependent var		0.065457
S.E. of regression	0.065550	Akaike info criterion		-2.598320
Sum squared resid	0.614437	Schwarz criterion		-2.557262
Log likelihood	190.3782	Hannan-Quinn criter.		-2.581637
F-statistic	0.593877	Durbin-Watson stat		1.694275
Prob(F-statistic)	0.442195			

Source: Survey Data (2012)

From the results, the coefficient for inflation is high. This implies that inflation is good at explaining the stock returns. The result does support the third hypothesis that Inflation is a significant explanatory variable for the stock returns thus the third hypothesis is accepted. The relationship between stock returns and inflation is negative. This suggest that increase in inflation rate reduces the market return and vise versa. The OLS model estimation findings oppose the Fisher Hypothesis that the two variables are positively correlated in the sense that an increase in inflation leads to a

45

proportional change in nominal market returns consequently hedging against inflation. The R-squared statistic measuring the success of the regression in predicting the values of the dependent variable within the sample indicate that only 0.4% of what is happening in the stock market return can be explained by inflation variable.

A common finding in time series regressions is that the residuals are correlated with their own lagged values. This serial correlation violates the standard assumption of regression theory that disturbances are not correlated with other disturbances. The primary problems associated with serial correlation are: OLS is no longer efficient among linear estimators since prior residuals help to predict current residuals, Standard errors computed using the OLS formula are not correct, and are generally understated and finally if there are lagged dependent variables on the right-hand side, OLS estimates are biased and inconsistent. For better estimation of the time series data, the GARCH models is desirable.

4.2.8 Evidence of Time-varying Volatility

In attempt to find the appropriate model for stock return volatility, GARCH and EGARCH Models are estimated and compared. The basic GARCH (1.1) estimation results are given in Table 4.7, with nominal market return as the dependent variable. The coefficient of the last periods forecast variance, (the GARCH term, β) is significant since the probability is zero. This implies that stock return volatility this month is explained by approximately 75.6% of the previous month's return volatility. Moreover, coefficient of news about volatility from the previous period, measured as the lag of the squared residual from the mean equation, (the ARCH term, α) is low at 13% and insignificant. This indicates that new information arrival into the market has insignificant impact on predicting next month's stock market volatility.

46

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46

Table 4.7: Results of the GARCH model for Stock Market Return Series

Dependent Variable: R_LOGNSE20SI
Method: ML - ARCH (Marquardt) - Student's t distribution
Sample (adjusted): 2000M08 2012M08
Included observations: 145 after adjustments
Convergence achieved after 19 iterations
Presample variance: backcast (parameter = 0.7)
GARCH = ω+ α*RESID(-1)^2 + β *GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Mean Equation				
C	0.005977	0.006334	0.943565	0.3454
LOGCPI	-0.269442	0.464613	-0.579929	0.5620
Variance Equation				
ω	0.000506	0.000473	1.070654	0.2843
α	0.129824	0.101970	1.273165	0.2030
β	0.756297	0.177994	4.249000	0.0000

Source: Survey Data (2012)

The persistence parameter $\alpha+\beta$ = 1.046, which is > 1 show a very explosive volatility. The GARCH coefficient demonstrates the capability of past volatility to explain current volatility (Engle and Bollerslev, 1986) and because it is very high, the rate at which it diminishes is rather very slowly. The statistically significant GARCH coefficient implies that past variances exert significantly positive effect on stock market return volatility. On the basis of these results, it is evident that there is significant time varying volatility in stock market returns during the sample periods.

4.2.9 Exponential Generalised Conditional Heteroscedasticity Model

The GARCH (1,1) results imply that the model is a good fit for explaining volatility but there is one point that should be emphasized. Although most of the previous studies used such GARCH (1,1) model in explaining volatility, this model is not suitable if shocks to stock return volatility are not symmetric. Asymmetry mean that downward movements in the stock market are followed by higher volatilities than

47

upwards movements of the same magnitude. The standard GARCH (1,1) model therefore does not capture the asymmetric effect of shocks on stock market volatility and hence the choice of EGARCH. This allows assessment of the impact of positive and negative innovations on stock returns volatility. Market returns series was tested for asymmetry by estimating an EGARCH model. The impact is asymmetric if $\gamma \neq 0$. The estimation results for the EGARCH (1,1) model are as shown in Table 4.8.

Table 4.8: EGARCH (1,1) Volatility Coefficients for Stock Market Return Series

Dependent Variable: R_LOGNSE20SI
Method: ML - ARCH (Marquardt) - Student's t distribution
Sample (adjusted): 2000M08 2012M08
Included observations: 145 after adjustments
Convergence achieved after 26 iterations
Presample variance: backcast (parameter = 0.7)
LOG(GARCH)=ω+α*ABS(RESID(-1)/@SQRT(GARCH(-1)))+β*LOG(GARCH(-1))
$\qquad$ + γ *RESID(-1)/@SQRT(GARCH(-1))

	Coefficient	Std. Error	z-Statistic	Prob.
Mean Equation				
C	0.007853	0.005943	1.321353	0.1864
LOGCPI	-0.229508	0.437627	-0.524438	0.6000
Variance Equation				
ω	-7.949629	1.529838	-5.196386	0.0000
α	0.288393	0.175070	1.647298	0.0995
γ	-0.302194	0.125914	-2.400010	0.0164
β	-0.402674	0.273611	-1.471702	0.1411

Source: Survey Data (2012)

Since γ is different than zero, it is concluded that there is asymmetry and EGARCH (1,1) model should be used instead of a GARCH(1,1) model. It is discovered that negative returns increase future volatility by larger amount than positive returns of the same magnitude. As can be seen from results in Table 4.8, and in line with our expectation, bad news has larger impact on stock volatility than good news. This is a very important finding in the sense that it conforms with a number of empirical

48

findings in the area. Saryal (2007), for instance, made similar discovery for Canada where the stock market index (TSE 300) records larger volatility in response to bad news than good news. Contrary to the GARCH results, Volatility persistence (α) is higher at 29% and significant while the volatility magnitude (β) is high at negative 40% and significant.

4.2.10 Impact of Inflation on Conditional Stock Market Volatility

The impact of inflation on stock market returns volatility is investigated through the estimation of equation (4). The coefficient of inflation λ in EGARCH (1,1) measures the predictive power of previous inflation rate on stock market volatility.

Table 4.9: Results of the EGARCH(1,1) model on the effect of Inflation on Stock Market Return Volatility

Dependent Variable: R_LOGNSE20SI
Method: ML - ARCH (Marquardt) - Student's t distribution
Sample (adjusted): 2000M09 2012M08
Included observations: 144 after adjustments
Convergence achieved after 72 iterations
Presample variance: backcast (parameter = 0.7)
LOG(GARCH)=ω+α*ABS(RESID(-1)/@SQRT(GARCH(-1)))+β *LOG(GARCH(-1))
       + γ *RESID(-1)/@SQRT(GARCH(-1)) + λ*LOGCPI(-1)

	Coefficient	Std. Error	z-Statistic	Prob.
Mean Equation				
C	0.008210	0.005713	1.436992	0.1507
LOGCPI	-0.231573	0.412960	-0.560765	0.5750
Variance Equation				
ω	-8.390524	1.458186	-5.754083	0.0000
α	0.200278	0.162703	1.230940	0.2183
γ	-0.314462	0.129514	-2.428011	0.0152
β	-0.471756	0.259031	-1.821231	0.0686
λ	14.71794	13.91880	1.057415	0.2903

Source: Survey Data (2012)

As can be seen from Table 4.9, the coefficient is positive and insignificant implying that an increase in inflation rate in the previous period increases conditional market volatility this month. The inflation coefficient is high suggesting that the inflation rate itself has strong predictive power on conditional stock market volatility. From the Table 4.9, volatility magnitude is high and significant as represented by β. This may be attributable to the fact that inflation has relatively big negative impact on investment at the stock market. Volatility persistence as measured by α is low and insignificant which leads to the conclusion that information slightly impacts on the conditional stock market volatility.

Table 4.10: Results of the EGARCH(1,1) model on the effect of Inflation change on Stock Market Return Volatility

Dependent Variable: R_LOGNSE20SI
Method: ML - ARCH (Marquardt) - Normal distribution
Sample (adjusted): 2000M10 2012M08
Included observations: 143 after adjustments
Convergence achieved after 29 iterations
Presample variance: backcast (parameter = 0.7)
$LOG(GARCH)=\omega+\alpha*ABS(RESID(-1)/@SQRT(GARCH(-1)))+\beta*LOG(GARCH(-1))$
$\quad\quad + \gamma *RESID(-1)/@SQRT(GARCH(-1)) + \lambda*CHNGCPI(-1)$

	Coefficient	Std. Error	z-Statistic	Prob.
Mean Equation				
C	0.007593	0.006750	1.124980	0.2606
LOGCPI	-0.185106	0.434759	-0.425766	0.6703
Variance Equation				
ω	-8.023802	1.200726	-6.682460	0.0000
α	0.290473	0.131478	2.209292	0.0272
γ	-0.316974	0.093206	-3.400793	0.0007
β	-0.407923	0.217174	-1.878320	0.0603
λ	-0.005191	0.006126	-0.847404	0.3968

Source: Survey Data (2012)

However, when the impact of inflation variability as measured by the movement of inflation on conditional stock market volatility was investigated; the inflation coefficient was found to be low, negative and statistically insignificant as shown in Table 4.10. Negative coefficient indicates the presence of leverage effect. This implies that a decrease in change of inflation rate in the previous period increases conditional market volatility this month. This is also evidence that bad news has an impact on stock return volatility than good news. From the findings, it is confirmed that inflation rate itself has a bigger impact on stock market volatility than the change in inflation rate. The estimated GARCH coefficient (β) and ARCH coefficient (α) are both high and significant but in different directions.

4.3 Summary and Interpretation of Findings

Preliminary investigation into the nature of the data revealed that the market return data is characterized by average monthly return (in natural log) of 0.65% and a comparatively high standard deviation of monthly returns of 1.1%, one would expect high conditional stock market returns volatility. The Jarque Bera statistics confirmed that the distribution of inflation and stock market returns is non-normal. This posed questions on stationarity of the two series. The ADF test results showed stationarity at level forms for both the series. The coefficient of correlation between the two variables was found to be slightly negative while the Breusch-Godfrey Lagrange multiplier test for general, high-order, ARMA errors found presence of serial correlation (ARCH effect) in the residuals of the estimated equation.

Fama's 'proxy hypothesis' explains the apparent anomaly of the negative relationship between inflation and stock market returns as against economic theory suggestion that equities are a good hedge against inflation. The objective of the project was to

51

investigate impact of inflation on stock market return and volatility in the NSE. The findings of the study seem to suggest that stock market returns may not provide an effective hedge against inflation. This is explained by the weak negative relationship between inflation and stock market returns. This is against the Fisher (1930) hypothesis.

The study shown, the actual practice is in line to the expectation on negative correlation. Ideally, the rise in the general level of prices is anticipated to reduce the expected cash inflows from investments; hence investors who own some asset are exposed to potential reduction of the real value of the stock due to inflation. The tendency would be to shy away from stock investments has inflation surges.

In this study, a nonlinear GARCH and EGARCH models for monthly stock returns volatility and inflation were estimated. The EGARCH model indicated that the market return series was show evidence of asymmetric effect. Firstly, results showed evidence of time varying volatility in stock market returns and from the asymmetric model, results indicate that bad news has larger impact on stock volatility than good news in the NSE using change in inflation, whereas the opposite, was established for inflation itself. Secondly, results show that inflation is one of the underlying determinants stock market volatility. But, previous inflation change was found to have less impact compared to inflation rate itself on stock returns volatility. These results, therefore, would be useful to investors and other market operators in making good portfolio decisions and for stemming the adverse effect of inflation on stock market volatility.

The study just like reviewed empirical studies in the area done by Hamilton and Lin (1996), Engle (2004), Engle and Rangel (2005), Rizwan and Khan (2007), etc., established a strong predictive power of inflation on stock market volatility and returns.

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter focuses on the summary, conclusions, recommendations and suggestions for further study.

5.2 Summary

Data for the estimation of models was obtained from NSE and KNBS for stock market index and inflation rate respectively. First, raw values of data were converted to log normal forms and descriptive statistics were obtained. From the Jarque Bera statistics it was affirmed that the distribution is non-normal in case of both the variables. This posed questions on stationarity of the two series. Hence, the nest step was to check stationarity of the two series with ADF test and the results showed stationarity at level forms for both the series. Then, the coefficient of correlation between the two variables was computed and it was found to be slightly negative. The Breusch-Godfrey Lagrange multiplier test for general, high-order, ARMA errors found presence of serial correlation (ARCH effect) in the residuals of the estimated equation. This qualitative idea of the dynamics between the variables indicated that a quantitative model can be developed in order to capture the dynamics between the volatility of the two variables. Thus, GARCH (1,1) framework was used to first extract conditional variances thus capturing stock returns volatility. The EGARCH model captured the asymmetric effect of shocks on stock market volatility by allowing assessment of the impact of positive and negative innovations on stock returns volatility. The market return series was found to show evidence of asymmetric effect. Preliminary investigation into the nature of the data revealed that the market return data is characterized by a non normal distribution and an average monthly

return (in natural log) of 0.65%. With comparatively high standard deviation of monthly returns of 1.1%, one would expect high conditional stock market returns volatility.

The results show evidence of time varying volatility in stock market returns and from the asymmetric model; results indicate that bad news has larger impact on stock volatility than good news in the NSE. Understanding the impact inflation on the variability of stock exchange volatility can help the investors in the stock market and other market operators to make good portfolio decisions based on their knowledge of past of the economy and expectations about future as well as stemming the adverse effect of inflation on stock market volatility. The results of this study show that inflation is one of the underlying determinants of stock market volatility. This study established that inflation is negatively linked with the stock market return, the results contradict Fisher effect hypothesis. The inherent reason behind this might be that the increasing inflation rates in Kenya increases market risk and uncertainty leading to risk averse investors withdrawing from the stock market.

The impact of inflation lag measured by inflation coefficient is high positive and insignificant implying that an increase in inflation rate in the previous period increases conditional market volatility this month. However, the impact of change in inflation lag on stock exchange volatility is negative but insignificant as indicated by very low value of the coefficient. This means that fluctuations in inflation have minimal predictive power for the stock volatility. Thus it can be concluded that during times of high inflation, stock returns remain low and investment is channeled from the stock exchange into businesses ventures which are less affected by inflation. In long

run, higher inflation rates increases stock market volatility which in turn may lead to uncertainty in the minds of investors leading to dried investment in the stock market causing difficulties for businesses and firms to attract investment. Accordingly, inflation rates should be stable in order to restore the confidence of the investors in stock market. The research finally found out that the monetary and real sectors of the economy may not be independent of each other, as money may also matter in explaining the behaviour of inflationary process in Kenya. Thus policies geared at controlling inflation should take into account the role of monetary and real variables especially as these will go a long way in further deepening of the stock market.

5.3 Conclusions

The issue of whether inflation has effect on stock market return and volatility is still a debatable subject. What is clear is that the relationship may be significant or insignificant depending on the country, stock market, monetary policy of the country, the methodology used and the period of study among other factors. The findings from this study are consistent with other studies as discussed earlier and although stock return volatility is an important aspect in the expectations and decisions of investors in the stock market, the role played by the Nairobi stock exchange market cannot be overlooked. This therefore shows the vast potential that the Nairobi stock exchange may have towards fostering the country's economy should the Kenyan government promote a saving culture and consequently improve investments income of the general public through appropriate policies. The Capital Markets Authority as a regulator should strive to ensure that impediment to stock market growth such as legal and other regulatory barriers are addressed.

The findings from this study emphasize on the role of the stock exchange market in directing economic growth i.e. the Nairobi stock exchange has been found to be a leading indicator for economic growth. Therefore there is need to identify factors that have significant effect on stock market return. This will enable investors make rational decisions in order to maximize returns. The regulator will also ensure that measures are put in place to ensure fair play in the market. The findings as illustrated by figures in Appendix shows evidence of volatility clustering over time.

5.4 Policy Recommendations

Based on the findings of the study, the study presents recommendations pertinent to the policy makers, investors, financial market regulators and future researchers. The study recommends that the government through its policy makers should come up with measures and policies that will help control and stabilise inflation rate fluctuation thus creating investor confidence in the securities market. This will consequently lower the stock market volatility (market risk) thus restoring the confidence of the investors in stock market and increasing market investment activity. This will then have a significant impact on the performance of the Nairobi Securities Exchange hence foster economic growth.

Inflation should be maintained at low levels. A rise in the general level of prices reduces the expected cash inflow from an investment, as result investors who own some assets are exposed to potential reduction of the real value of the asset they hold due to inflation. To encourage investment and growth of the financial market, inflation should be kept at the minimum. This is explained by the negative correlation between inflation and market returns findings from the study.

NSE along with the government should take steps to increase the number of mutual fund to stabilize the market in the long run, which can be done by enforcing a level playing regulatory measure for public and private mutual funds. Government can also take pro-active role in building a stable market through tapping the growing interest of general people in the market by increasing supply of shares.

The regulator should ensure that all the market players comply with the policies and regulations in an effort to ensure efficiency and effectiveness of the stock market. The study recommends survey to be carried out from time to time on macro-economic factors affecting stock return. This can be facilitated by availing data for free to students and other researcher with interest in studying the stock market, factors affecting the market returns and market efficiency.

5.5 Limitations

Correlational methods commonly suggest that variables are linearly related to one another. Since the data is non linear as informed by nonlinearity test, the correrational method reduce the strength of the relationship. The outliers, observations that are quite a bit different from the remaining observations also reduce the strength of the relationship.

Correlations are bivariate in nature meaning that two variables from different data sets are compared at a time. However, this is not realistic because there are almost always multiple relationships and effects on something.

The extent to which the findings can be generalized beyond the sample period studied is unclear. The number of observations is too limited for broad generalization. Further

empirical evaluations, however, are needed to replicate the findings in larger sample including daily returns since the findings from the sample may not reflect the behavior of the entire population.

Although correlational study employed suggested that there is a relationship between inflation and stock market return, the findings cannot prove that inflation causes a change in stock market return. Thus casual conclusions cannot be made because alternative explanations for correlational findings cannot be ruled out. In other words, correlation does not equal causation. Other variables might play a role, including interest rate, exchange rate and money supply among others.

5.6 Suggestions for further Research

This study sought to investigate the impact of inflation on stock market return and volatility in the NSE. Volatility of returns in financial markets can be a major stumbling block for attracting investment in small and developing economies. The stock market being an important institution in any economy and for a country to experience growth, the stock market should be efficient. Future researcher may conduct further studies and identify other macro-economic factors that significantly affect stock returns. Therefore further study should focus on macro-economic factors such as: foreign exchange rate, interest rate, money supply, monetary policy, fiscal policy and industrial production.

Further studies on persistence of news on stock return will be useful to investors in making rational investment decisions and aid the regulator in policy formulation.

REFERENCES

Abu, H. (2005). Modelling and Forecasting on the Malaysian Inflation Rates: An Application of GARCH models.1-13.

Adrangi, B., Chatrath, A. & Sanvicente, A. Z. (2000). Inflation, Output and Stock Prices: Evidence from Brazil. *Working Paper*, 34.

Aga, M. & Kocaman, B. (2006). An Empirical Investigation of the Relationship between Inflation, P/E Ratios and Stock Price Behaviors Using a New Series Called Index-20 for Istanbul Stock Exchange. *International Research Journal of Finance and Economics*, Issue 6.

Appiah-Kusi, J. & Pescetto, G. (1998). Volatility and Volatility Spill-Overs in Emerging Markets. *CERF Discussion Paper Series*, 98-04.

Aroni, J. M. (2012). Factors influencing Stock Prices for Firms listed in the Nairobi Stock Exchange. *International Journal of Business and Social Science*, 2 (20);   November 2011.

Balduzzi, P. (1995). Stock Returns, Inflation and the 'Proxy Hypothesis': A New Look at the Data. *Economics Letters*, 48, 47-53.

Boucher, C. (2006). Stock-price inflation puzzle and the predictability of the stock Market returns. *Economic Letters*, 90, 205-212.

Brooks, C. (2008). Introductory Econometrics for Finance (2nd Edition). *Cambridge University Press*, New York.

Brooks, R. D., Davidson, S. & Faff, R. W. (1997). An Examination of the Effects of Major Political Change on Stock Market Volatility: The South African Experience. *Journal of International Financial Markets, Institutions & Money*,7, 255 - 275.

Caporale, T. & Jung, C. (1997). Inflation and Real Stock Prices. *Applied Financial Economics*, 7, 265-266.

Chinzara, Z. (2011). Macroeconomic Uncertainty and Conditional Stock Market

Volatility In South Africa. *South African Journal of Economics*, 79 (1).

Choudhry, T. (1999). Inflation and the rates of return on stocks: evidence from high inflation countries. *Journal of International Financial Markets, Institutions and Money*, 11, 75-96.

Cochran, S .J. & DeFina R. H. (1993). Inflation's Negative Effects on Real Stock Prices: New Evidence and a Test of the Proxy Hypothesis. *Applied Economics*, 25, 263-274.

Robert, C. D. (2006). Evolution of stock Pricing.

Davis, N. & Kutan, A. M. (2003). Inflation and Output as Predictors of Stock Returns and Volatility: International Evidence. *Applied Financial Economics*, 13, 693-700.

Dickey, D. A. & Fuller, W. A. (1979). Disribution of the estimators for autoregressive time series with a unit root. *Journal of American Statistical Association*, 74, 427-431.

Elyasiani, E., Perera, P. & Puri, T. N. (1998). Interdependence and Dynamic Lingkages between Stock Market in Sri Lanka and its trading partners. *Journal of Multinational Financial Management*, 8, 89-101.

Engle, R. F. & Rangel, J. G. (2005). The SPLINE GARCH model for unconditional volatility and its global macroeconomic causes, Mimeo. Presented at the *World Congress of the Econometric Society*, London.

Engle, R. F. (2004) .Risk and Volatility: Econometric Models and Financial Practice. *American Economic Review*, 94, 405-420.

Fama, E. F. (1965). Behaviour of Stock-Market Prices. *Journal of Business*, 38(1), 34-105.

Fama, E. F. (1981). Stock returns, real activity, inflation, and money. *American Economic Review*, 71, 545–65.

Fama, E. F. (1970). Efficient Capital Markets: A Review of Theory and Empirical

Work. *Journal of Finance*, 25, 383–417.

Fama, E. F. & Schwert. G. W. (1997). Asset return and inflation. *Journal of Financial Economics*, 5, 115-46.

Feldstein, M. (2004). Here are the facts. *The Wall Street Journal*, Feb 12.

Fisher, I. (1930). The Theory of Interest. *Macmillan*, New York.

Frimpong, J. M & Oteng-Abayie, E. F. (2006). Modelling and Forecasting Volatility of Returns on the Ghana Stock Exchange Using Garch Models. *American Journal of Applied Sciences*, 3 (10), 2042-2048.

Geske, R. & Roll, R. (1983). The Fiscal and Monetary Linkage between Stock Returns and Inflation. *Journal of Finance*, 38, 1-34.

Geyser, J. M & Lowies, G. A. (2001). The impact of inflation on stock prices in the SADC countries. *University of Pretoria, Working Paper*, 14.

Graham, F. C. (1996). Inflation, real stock returns and monetary policy. *Applied Financial Economies*, 6, 29-35.

Hamilton, J. D (1996). Stock Market Volatility and the Business Cycle. *Journal of Applied Econometrics*, 11, 573-593.

Hardouvelis, G. A. (1988). The predictive power of the term structure during recent monetary regimes. *Journal of Finance*, 43(2), 339-356.

Ioannides, D., Katrakilidies, C. & Lake, A. (2002). The relationship between Stock Market returns and Inflation: An Econometric Investigation using Greek data.

James, C., Koreisha, S. & Partch, M. (1985). A VARMA Analysis of the Causal Relations among Stock Returns, Real Output, and Nominal Interest Rates. *Journal of Finance*, 40, 1375-1384.

Jang, H. & Sul, W. (2002). The Asian Financial Crisis and the Co-Movement of the Asian Stock Markets. *Journal of Asian Economics*, 13, 94-104.

Johansen, S. (1988). Statistical Analysis of the Cointegration Vectors. *Journal of*

Economic Dynamics and Control, 12, 231-254.

Karolyi, G. A. (2001, February 2001). Why Stock Return Volatility Really Matters. *Preliminary and Incomplete version.*

Kaul, G. (1987). Stock Returns and Inflation: The Role of Monetary Sector, *Journal of Financial Economics*, 18, 253-276.

Kemboi, J. K. & Tarus, D. N (2012). Macroeconomic Determinants of Stock Market Development in Emerging Markets: Evidence from Kenya. *Research Journal of Finance and Accounting*, 3(5).

Lee, B. S. (1992). Causal Relations Among Stock Returns, Interest Rates, Real Activity and Inflation. *Journal of Finance*, 47, 1591-1603.

Madsen, J. B. (2004). Pitfalls in Estimates of the Relationship between Share Returns and Inflation. Finance Research Unit, *FRU Working Papers*, 2004/07.

Merika, G. A. & Anna, A. M. (2006). Stock prices response to real economic variables: the case of Germany, *Managerial Finance*, 32(5), 446-450.

Modigliani, F. & Cohn, R. A. (1979). Inflation, Rational Valuation and the Market. *Financial Analysts Journal*, 35, 24-44.

Moon, W. S. (2001). Currency Crisis and Stock Market Intergration: A comparison between East Eastern and European Experiences. *Journal of International and Area Studies*, 8, 41-56.

Müslümov, A., Aras, G. & Kurtuluş, B. (2004). Evolving Market Efficiency in Istanbul Stock Exchange. *Social Science Research Network*, SSRN-id 890077.

Ogum, G., Beer, F. & Nouyrigat, G. (2006). An Empirical Analysis of the Kenyan and the Nigerian daily returns using EGARCH Models. Retrieved from http://www.euromedia-marseille.com/ media/Nouyrigat_-_ISINI.PDF

Olweny, T. & Omondi, K. (2011, December, 2011). The Effect of Macro-economic factors on Stock Return Volatility in the Nairobi Stock Exchange, Kenya.

Economics and Finance Review, 1(10) , 34 – 48.

Pindyck, R. (1984). Risk, Inflation and the Stock Market. *American Economic*
Review, 74, 335-351.

Rapach, D. E. (2002). The longrun relationship between inflation and real stock
prices. *Journal of Macroeconomics*, 24, 331-351.

Rizwan, M. F. & Khan, S. U. (2007). Stock Return Volatility in Emerging Equity
Market (Kse): The Relative Effects of Country and Global Factors.
International Review of Business Research Papers, 3(2), 362 – 375.

Robert, B. & Vittorio, G. (1994). European Macroeconomics, *Macmillan*.

Saryal, F. S. (2007). Does inflation have an impact on Conditional Stock Market
Volatility? Evidence from Turkey and Canada. *International Research*
Journal of Finance and Economics, 11.

Schwert, G. W. (1989). Why does Stock Market Volatility Change Over Time?
Journal of Finance, 44, 1115-1153.

Spyrou, S. (2001). Stock returns and inflation: Evidence from an emerging market.
Applied Economics Letter, 447-450.

Taylor, B. (1996). World Stock Market Returns 1990-1995: Domestic Real Stock
Market Performance. *Global Financial Data*, 1-47.

Wei, C. (2007). Does the Stock Market React to Unexpected Inflation Differently
Across the Business Cycle? *George Washington University*, 19(24),
1947-1959.

http://www.knbs.or.ke

http://www.nse.co.ke.

APPENDICES

Appendix A: Companies Listed in NSE

Agricultural

Eaagads Ltd Ord 1.25 AIM

Kakuzi Ord.5.00

Kapchorua Tea Co. Ltd Ord 5.00 AIM

Limuru Tea Co. Ltd Ord 20.00 AIM

Rea Vipingo Plantations Ltd Ord 5.00

Sasini Ltd Ord 1.00

Williamson Tea K. Ltd Ord 5.00 AIM

Automobiles & Accessories

Car & General (K) Ltd Ord 5.00

CMC Holdings Ltd Ord 0.50

Marshalls (E.A.) Ltd Ord 5.00

Sameer Africa Ltd Ord 5.00

Commercial & Services

Express Ltd Ord 5.00 AIM

Hutchings Biemer Ltd Ord 5.00

Kenya Airways Ltd Ord 5.00

Longhorn Kenya Ltd Ord 1.00

Nation Media Group Ord. 2.50

Scangroup Ltd Ord 1.00

Standard Group Ltd Ord 5.00

TPS Eastern Africa (Serena) Ltd Ord 1.00

Uchumi Supermarket Ltd Ord 5.00

Banking

Barclays Bank Ltd Ord 0.50

CFC Stanbic Holdings Ltd ord.5.00

Diamond Trust Bank K. Ltd Ord 4.00

Equity Bank Ltd Ord 0.50

Housing Finance Co Ltd Ord 5.00

Kenya Commercial Bank Ltd Ord 1.00

National Bank of Kenya Ltd Ord 5.00

NIC Bank Ltd Ord 5.00

Standard Chartered Bank Ltd Ord 5.00

The Co-operative Bank of K. Ord 1.00

Construction & Allied

Athi River Mining Ord 5.00

Bamburi Cement Ltd Ord 5.00

Crown Berger Ltd Ord 5.00

E.A.Cables Ltd Ord 0.50

E.A.Portland Cement Ltd Ord 5.00

Insurance

British-American Investments Co

(Kenya) Ltd Ord 0.10

CFC Insurance Holdings Ltd ord.1.00

Jubilee Holdings Ltd Ord 5.00

Kenya Re-Insurance Corp. Ord 2.50

Pan Africa Insurance Holdings Ord 5.00

Energy & Petroleum

KenGen Ltd Ord. 2.50

KenolKobil Ltd Ord 0.05

Kenya Power Co Ltd Ord 2.50

Total Kenya Ltd Ord 5.00

Investment

Centum Investment Co Ltd Ord 0.50

City Trust Ltd Ord 5.00 AIM

Olympia Capital Holdings ltd Ord 5.00

Trans-Century Ltd Ord 0.50 AIM

Manufacturing & Allied	**Telecommunication & Technology**
A.Baumann & Co Ltd Ord 5.00 AIM	AccessKenya Group Ltd Ord. 1.00
B.O.C Kenya Ltd Ord 5.00	Safaricom Ltd Ord 0.05
British American Tobacco Ltd Ord 10.00	
Carbacid Investments Ltd Ord 5.00	
East African Breweries Ltd Ord 2.00	
Eveready East Africa Ltd Ord.1.00	
Kenya Orchards Ltd Ord 5.00 AIM	
Mumias Sugar Co. Ltd Ord 2.00	
Unga Group Ltd Ord 5.00	

Source: (www.nse.co.ke)

Appendix B: Companies Constituting NSE 20 Share Index

Mumias Sugar	CMC Holdings	Equity Bank
Express Kenya	Kenya Airways	Kenya Commercial Bank
Rea Vipingo	Safaricom	Standard Chartered Bank
Sasini Tea	Nation Media Group	Bamburi Cement
EA cables	Barclays Bank of Kenya	British American Tobacco
Athi River Mining	Kenya Power	Centum Investment Company
Kengen	East African Breweries	

Source: (www.nse.co.ke)

Appendix C: Plotted Graphs
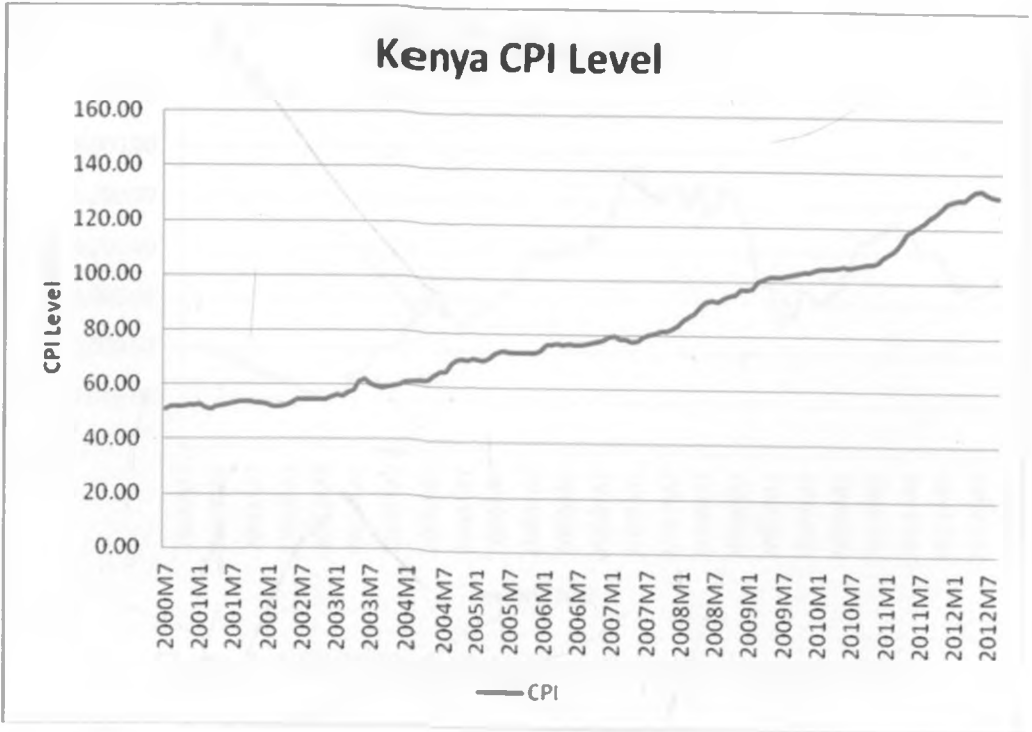
Figure 1: CPI trend from July 2000 to August 2012
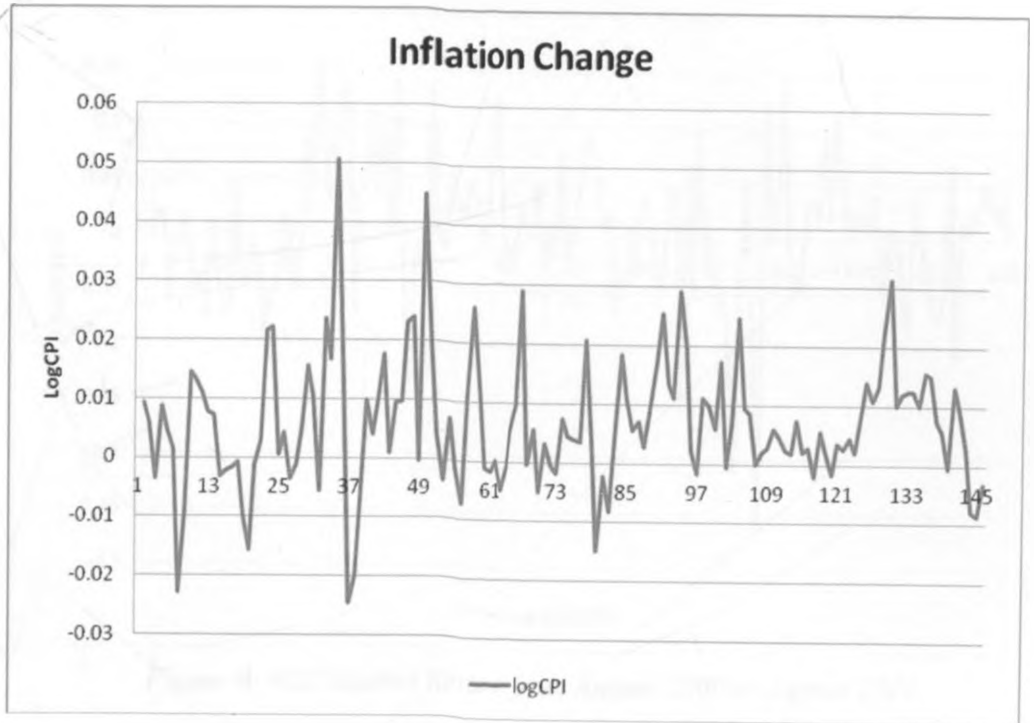
Figure 2: Estimated Inflation level from August 2000 to August 2012
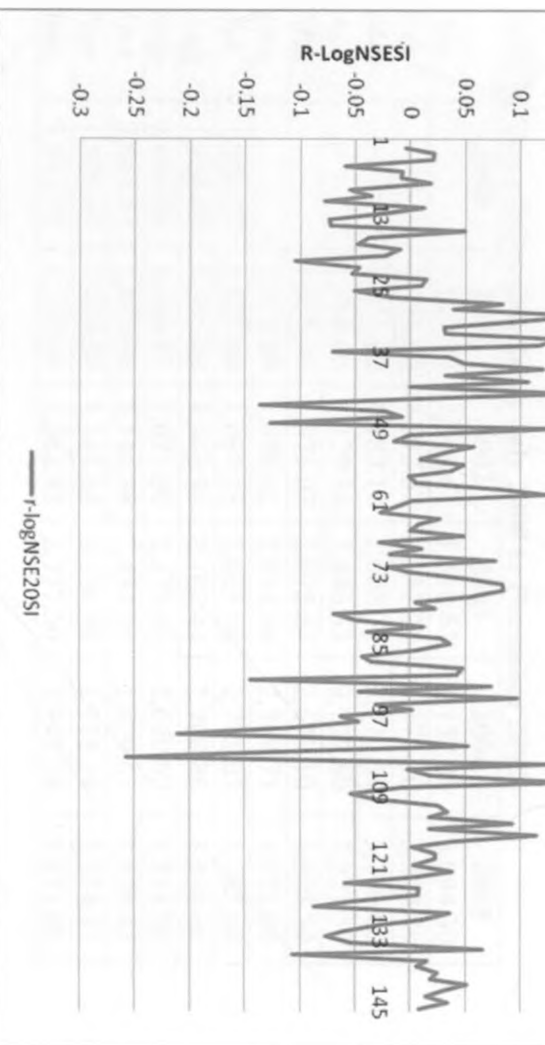
Figure 4: NSE Market Return from August 2000 to August 2012

68

NSE 20 Share Index

NSE20SI	
7,000.00	
6,000.00	
5,000.00	
4,000.00	
3,000.00	
2,000.00	
1,000.00	

2000M7
2001M1
2001M7
2002M1
2002M7
2003M1
2003M7
2004M1
2004M7
2005M1
2005M7
2006M1
2006M7
2007M1
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2009M7
2010M1
2010M7
2011M1
2011M7
2012M1
2012M7
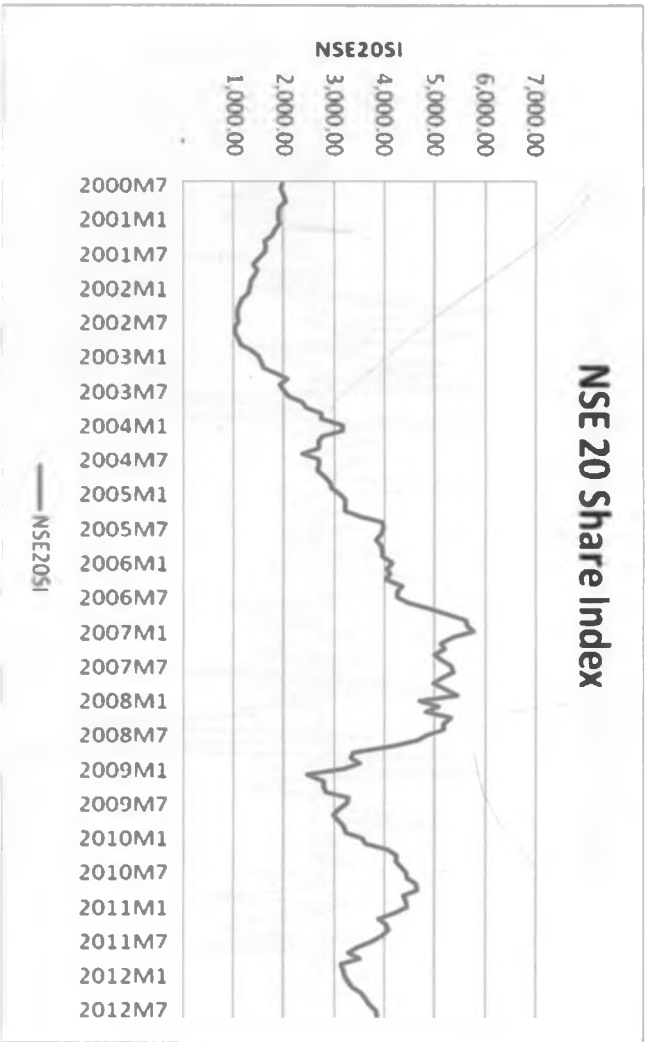
—— NSE20SI

Figure 3: NSE 20 Share Index from July 2000 to August 2012

Market Return

0.2

0.15
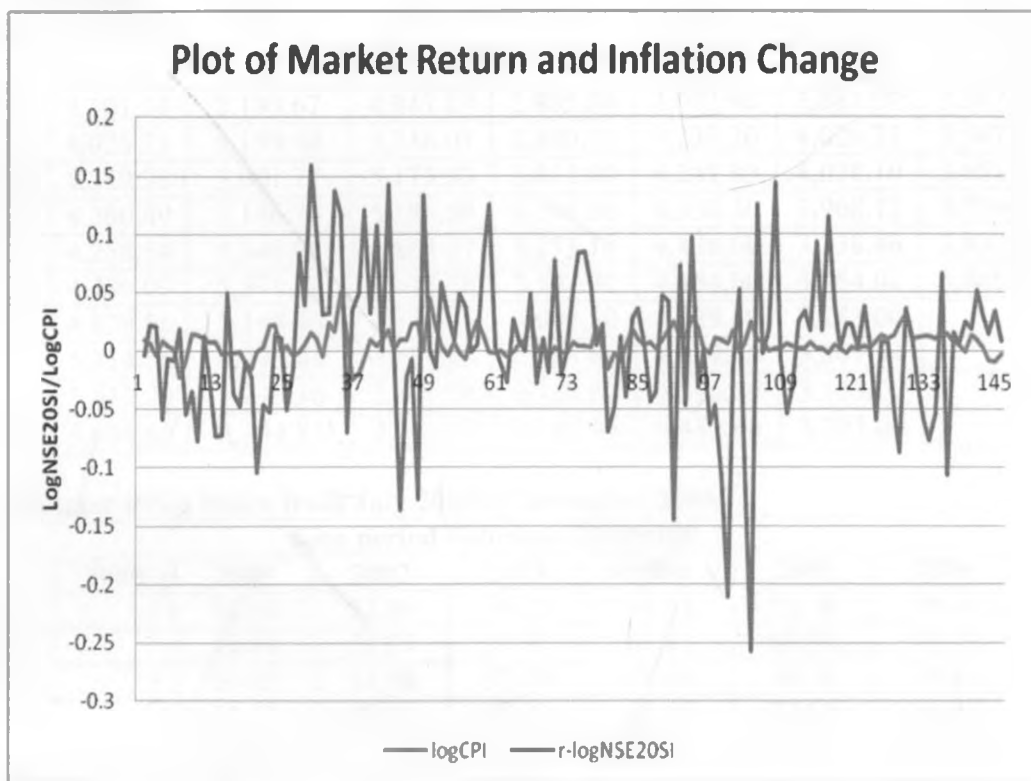
Figure 5: NSE Market Return and Inflation from August 2000 to August 2012

Appendix D: CPI and NSE 20 Share Index raw data

NSE 20 Share Index data from July 2000 to December 2005

	2000	2001	2002	2003	2004	2005
Jan		1,897.00	1,343.41	1,510.63	3,157.90	3,094.30
Feb		1,933.00	1,313.57	1,557.74	3,175.40	3,212.80
Mar		1,831.00	1,183.10	1,608.34	2,770.60	3,209.00
Apr		1,768.00	1,129.33	1,846.63	2,707.60	3,227.59
May		1,636.00	1,071.07	2,075.67	2,689.10	3,505.39
Jun		1,657.00	1,086.62	1,934.96	2,369.75	3,972.00
Jul	1,966.52	1,621.00	1,097.73	2,005.08	2,708.03	3,982.00
Aug	1,958.00	1,506.00	1,043.38	2,107.43	2,708.86	3,938.00
Sep	2,001.00	1,400.87	1,027.00	2,379.91	2,670.69	3,833.00
Oct	2,043.47	1,473.00	1,116.36	2,457.20	2,829.65	3,939.45
Nov	1,926.67	1,420.00	1,161.63	2,736.98	2,918.34	3,974.12
Dec	1,913.35	1,355.00	1,362.85	2,737.50	2,945.58	3,973.00

69

NSE 20 Share Index data from January 2006 to August 2012

	2006	2007	2008	2009	2010	2011	2012
Jan	4,171.80	5,774.24	4,712.71	3,198.90	3,565.30	4,465.00	3,224.00
Feb	4,056.63	5,387.28	5,072.41	2,474.80	3,629.40	4,240.00	3,304.00
Mar	4,101.64	5,133.67	4,843.17	2,805.00	4,072.90	3,887.00	3,367.00
Apr	4,025.21	5,199.44	5,336.03	2,800.10	4,233.20	4,029.23	3,547.00
May	4,349.75	5,001.77	5,175.83	2,852.60	4,241.80	4,078.10	3,651.00
Jun	4,260.49	5,146.73	5,185.56	3,294.60	4,339.30	3,968.12	3,704.00
Jul	4,258.54	5,340.08	4,868.27	3,273.10	4,438.60	3,738.46	3,832.00
Aug	4,486.07	5,371.72	4,648.78	3,102.70	4,454.60	3,464.02	3,866.00
Sep	4,879.86	5,146.46	4,180.40	3,005.50	4,629.80	3,283.06	
Oct	5,314.36	4,971.04	3,386.65	3,083.60	4,659.60	3,507.34	
Nov	5,615.20	5,215.36	3,341.00	3,189.60	4,395.20	3,155.00	
Dec	5,645.65	5,444.83	3,521.18	3,247.40	4,432.60	3,205.00	

Consumer Price Index from July 2000 to December 2006

Base period February 2009=100							
	2000	2001	2002	2003	2004	2005	2006
Jan		52.60	52.85	56.21	61.35	70.48	76.22
Feb		51.42	52.03	55.91	61.41	69.97	76.19
Mar		50.95	51.98	57.24	62.00	70.78	76.62
Apr		51.70	52.14	58.21	62.61	72.64	76.23
May		52.39	53.28	61.23	64.08	73.54	76.48
Jun		52.96	54.47	61.96	65.64	73.46	76.44
Jul	51.20	53.38	54.51	60.46	65.62	73.34	76.30
Aug	51.68	53.77	54.74	59.27	68.63	73.35	76.87
Sep	52.00	53.60	54.55	58.85	70.02	73.00	77.23
Oct	51.82	53.48	54.50	59.44	70.32	72.93	77.54
Nov	52.28	53.40	54.77	59.69	70.07	73.33	77.82
Dec	52.52	53.37	55.63	60.28	70.57	74.04	79.46

Consumer Price Index from January 2007 to August 2012

Base period February 2009=100						
	2007	2008	2009	2010	2011	2012
Jan	79.75	86.07	97.55	104.89	110.57	130.82
Feb	78.57	87.25	100.00	105.18	112.05	130.76
Mar	78.40	88.22	100.96	104.97	114.62	132.51
Apr	77.76	90.85	101.84	105.56	118.29	133.74
May	78.08	92.68	101.84	105.79	119.48	134.09
Jun	79.53	92.89	102.05	105.61	120.91	133.06
Jul	80.41	92.75	102.33	105.98	122.44	131.92
Aug	80.86	93.79	102.94	106.25	123.97	131.51
Sep	81.43	94.72	103.42	106.74	125.23	
Oct	81.66	95.29	103.68	106.97	127.20	
Nov	82.47	96.95	103.87	107.86	129.13	
Dec	83.91	96.89	104.66	109.38	130.09	