THE DYNAMIC RELATIONSHIP BETWEEN STOCK PRICE VOLATILITY AND TRADING VOLUME AT THE NAIROBI SECURITIES EXCHANGE

BY

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DECLARATION

I hereby declare that this Project is my own work and effort and that it has not been submitted anywhere for any award. Where other sources of information have been used, they have been acknowledged.

Signature ……..Date: ……

Hellen Murugi Kamuti

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This Project has been submitted with my approval as the university supervisor.

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DEDICATION

I wish to dedicate this project to my family, who have continuously beared with my busy schedule through the entire program. Their support both financially and otherwise has been immeasurable.

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ABSTRACT

The study empirically examined the dynamic relationship between stock price volatility and trading volume in the context of Nairobi Securities Market. The study applied Unit root tests, GARCH techniques and causality tests on the data to determine the relationship between the variables.

Monthly prices and volume for companies quoted under NSE- 20 share index were used in the analysis for the period from January 2008 to June 2012. The study applied unit root test to establish the stationarity of the variables, so as to assist in deciding on the most appropriate analytical model to apply. GARCH model was used, since the data series exhibited heteroscedasticity, to find out long run volatility clustering on the variables. Granger causality test was used to determine the direction of relationship between price and volume.

The study found that there was a significant positive relationship between price and volume in the NSE, indicating that rising market goes with rising volume. Results from GARCH model show that volatility of stock returns is persistent in NSE. The research findings depicts that previous information content of stock prices influence volume of stock traded in the market and not vice versa. Thus, there is no presence of bi-directional granger causality between volume and prices. This means that changes in volume, which is affected by market information, does not lead to stock price changes in the market. The study results concluded that Price levels cause changes in stock volumes transacted in NSE.

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CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Stock return volatility has been a major concern in the financial sector around the world. This is because volatility in the stock market has significant effects on the stability of the economy and financial sector performance. According to Hongyu and Zhichao (2006), if volatility levels go behold a certain threshold, there is increase in the risk of investor losses leading to rise in concerns about the stability of the market as well as the wider economy.Stock return can be a direct indicator of the investors' interpretation of newly available information, while the volumes traded could be the implication of the level of trust that investors have on the information.

Changes in stock levels and returns has been studied adequately both in the developed and developing economies by many researchers. Bollerslev (1987) andEpps and Epps (1976) found aspects of stock volatility in the NYSE, which is a developed stock market.Zhao et al, (2011)concluded in their study that Chinese stock market is volatile, with correlation between volatility and trading volume been statistically significant. Similar results were observed by Attari et al., (2012) in their study of the Pakistan stock market.

Stock volume-return volatility has also been experienced in the emerging economies, as explained by researchers such as Okoli (2012), in the study of Nigeria Stock Exchange; she found that prices of market stock are influenced by microeconomic factors, such as foreign exchange changes.Volatility clustering, leptokurtosis and asymmetryassociated with stock returns on more advanced stock markets were observed by Frimpong and Oteng-Abayie (2006), in the study of Ghana Stock Exchange.

The Kenya stock market is small, but growing rapidly and thus, is also facing a lot of problems in terms of high volatility and great uncertainty. Stock behavior changes have been observed in various studies, such as by Omondi and Olweny (2011), as well as the study by Kiremu et al.,

(2013**)**. Thus, there is a great need to provide the participants of Nairobi Securities Exchange with more insight in regards to the relationship between stock volatility and trading volumes.

For most of the investors, financial decisions are exclusively based on expected returns and risk of investment opportunities. Thus, if the stock returns are expected to be high investors will be encouraged to invest, leading to an increase in volumes of stock traded and capital inflow in the economy.March (1994) argues that a decision-maker when making investment decision, it is assumed that they will choose the option that maximizes expected value, if the specific choice was to be made several times. The volume of stocks traded tends to be higher when stock prices are increasing than when prices are falling. Murphy (1985) and De Mark (1994) emphasized that both volume and price incorporate valuable information in stock market. Return-volume relationships are of common interest as they may unearth dependencies that can form the basis of profitable trading strategies, which gives the implications for market efficiency, (Chen et al., 2004).

Presence of any form of uncertainty in the market scares off investors due to probability of low levels of returns leading to reduced demand for investment. Risk is, thus, a major factor in determining the stock returns and consequently the volume traded. The emergence of informational efficient financial markets is an important tool of a country's economic performance, with a lot of implications on the stocks returns. However, Fama et al., (1995) efficient market hypothesis, does not hold in all cases, since past price or volume changes in a competitively traded stock market may not necessarily help in predicting future prices. Thus, various studies have questioned the efficient market hypothesis and have supported the notion that stock market excess returns can be predicted by publicly available information.

1.1.1 Theoretical Background

The purpose of conceptual framework is to help the reader quickly see the proposed relationship between variables in the study, Mugenda and Mugenda (2003). The conceptual framework of this study spells out the dynamic relationship between stock volatility and trading volume.

Investors' behavior is directly influenced by the level of risks that affects the market and the specific securities of interest. Black (1976) emphasized this fact and described it as leverage

effect, whereby a drop in the value of a stock normally increases the financial leverage, since the stocks become more risky causing an increase in volatility. Such a phenomenon is called asymmetric volatility.

1.1.2 Concept of Stock Volatility

The volatility of stock is a measure of uncertainty about the returns provided by the stock, and it is generally not observable. A market is said to be volatile if the past prices of stocks reflect in the future stock prices. Thus, to be able to input the estimates of the volatility of an underlying asset, we can only observe the stock return series. In financial market, volatility is often referred to as the standard deviation or variance ∂.

Schwert (1989) looked at the relationship between stock volatility and the volatility of real and nominal macroeconomic variables. Based on US data for several macroeconomic variables (namely inflation, industrial production, and money), he found weak evidence that macroeconomic volatility can be helpful in predicting stock return volatility. He, however, pointed a positive link between macroeconomic volatility and stock market volatility. Peters (1994) noted that stock prices and returns are cyclical, with imperfect predictability in the short run and unpredictable in the long run. They also exhibit nonlinear, and possibly chaotic, behavior related to time-varying positive feedback.There has not been extensive research on stock volatility in the Sub-Sahara African and Kenyan market in particular, possibly because the securities market is still developing. Some studies done in the African stock markets in this area include, Frimpong and Oteng-Abayie (2006) who applied GARCH models to the Ghana Stock Exchange. Brooks et al., (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. Ogumetal., (2006) applied the EGARCH model to the Kenyan and Nigerian Stock Market returns.

1.1.3 Concept of Trading Volumes

Trading volume and volume changes mainly reflect the available set of relevant information on the market. A change in investors' expectations leads to change in trading volume which therefore reflects the sum of investors' reactions to news.

Volumes of stocks traded may provide useful information about expected future returns. According to Blume et al., (1994) volume provides data on the quality or precision of information about past price movements. This helps traders by providing them with valuable information about security by observing both past price and volume information. Thus, traders who include volume measures in the technical analysis perform better in the market, than those who do not, (Chen et al.,2001).

1.1.4 Relationship between Stock Volatility and Trading Volumes

Andersen (1996) developed the general mixture of distribution hypothesis (GMDH) theory by providing a specific stochastic volatility process, which considered that the price volatility and trading volume are determined by unobservable information arrivals. Informed investors transacts whenever new information (both public and private) becomes available in the market. However, trading based on private information is difficult to identify, and hence trading volume can generally be examined in the context of publicly available information. Volatility is caused mainly by changes in volumes traded, practices and patterns, which in turn are driven by factors such as changes in macroeconomic policies, changes in investor tolerance of risk and increased levels of uncertainty. Blume et al., (1989) stated that Trading volume and volatility indicate potential importance as indicators of the current stock market activity on one hand and a potential source of information for the future behaviour of stock market on the other hand.

Woodruff and Senchack (1988) found a high level of volume measured by both number of stocks traded and number of transactions immediately following earnings announcements. Investors gain more confidence whenever they have readily available information, such as stock earnings, to assist them in analyzing the status of the market and thus, making investment decisions thereof. Kim and Verrecchia (1991) argued that different traders' reactions are caused by differing amounts of precisions of their private information, since investors' trading behavior is based on their held information and when it was gathered. Thus, in case an investor believes that out of the information in their possession stock market returns could improve, they could then increase the volumes of stock held.

Schwert (1990) argues that volume induces price changes because price changes are an important input into trading strategies. This is because most investors are risk-averse and presence of any unfavorable price changes in the market will put them off from taking up investment decisions. However, investors may portray 'herd', mentality when they exercise a similar characteristic by trading in the same direction leading either to an increase or decrease in the volumes of stock traded.

1.1.5Nairobi Securities Exchange

In Kenya, dealing in shares began in the 1920's when the country was under British colony. At that time, the market was not formally organized and rules and regulations to govern it did not exist. The NSE was formally organized in 1954 and was constituted as a voluntary association of stock brokers registered under the societies Act. Currently, there are sixty one (61) listed companies which are further categorized into ten groups namely; Agricultural, Commercial and Services, Telecommunication and Technology, Automobiles and Accessories, Banking, Insurance, Investment, Manufacturing and Allied, Construction and Allied and Energy and Petroleum,(NSE2013).

The Stock market in Kenya has been growing rapidly and has diversified to provide not only the primary role of providing an alternative source of capital for investment, but also many other functions. The NSE has recently adapted an automated trading system, to keep in pace with other major world stock exchanges, and this has greatly increased the volumes of stocks traded in the market. Currently the NSE is trading more than a 100 million shares each month, making it to play a great role in the economic growth of Kenya. This has been facilitated by enabling idle money and savings to become productive by bringing together the borrowers and lenders of money at a low cost. The market has helped in educating the public about the need to invest in the stock market as well as boosting the confidence of investors through the requirement of listed companies to have published financial reports.

1.2 Research Problem

Stock market volatility is one of the most important aspects of financial market developments, since it provides an important input for portfolio management, option pricing and

marketregulation, (Poon and Granger, 2003). In the Kenyan securities market, a lot of volatility has been experienced especially in the performance of initial public offerings (IPOs), such as Safaricom(2008), KenGen (2006) andAccess Kenya (2007) (IPOs), leading to both large positive or negative traded volumes and returns after the issue. Such occurrences create a lot of desire for an investor to gain better understanding about the behavior of stock market, since volatility beyond a certain threshold increases the risk of investor losses.Thus, for an investor who is risk averse, increased levels of volatility in the stock market could create confusion and fear of participating in activities of security market. On the other hand, increased volatility could act as an opportunity window for investors who are risk seekers. Risk seeker investors may interpret a present downturn in stock performance as an indicator of better performance in the future, leading them to increase volumes of stock traded.

Various studies have previously been done in the areas of Macro-economic factors on the stock return volatility on the NSE by Omondi and Olweny (2011), Owido et al., (2013) study on the efficiency of NSE, while Ogum et al., (2005), as well as Kiremu et al., (2013) studied volatility of NSE. However, these studies did not give the relationship that might exist between stock volatility and the volumes of stock traded in the NSE, whenever there are changes in trading patterns.

Investors, over and above understanding the macro-economic factors that affect the performance of securities, would also be interested in gaining more knowledge about the change in trading volume and returns of stocks inthe NSE. Understanding such an aspect in the securities market will be crucial for investors in making buy/ sell and hold decisions.Therefore, there is need to provide the investors with such insights and hence the need for the current study. To be able to provide the participants of the securities market with the necessary information, the study aims at answering such questions as whether there is a relationship between stock volatility and trading volumes in the NSE. The study also focuses on finding out whether stock volatility and volume move in the same direction or otherwise.

1.3 Objective of the Study

The objective of this study is to measure the dynamic relationship between Stock volatility and trading volume in the Nairobi Securities Exchange.

1.4 Value of the Study

Stock market performance in any economy can be used as an indicator of strength of the economic performance of the country. This study is, thus, important to the policy makers in managing the operations of stock market through proper policy formulation and implementation in regards to practices of the stock market. The policy makers' actions could improve the operations and performance of the market by adequately providing the necessary advice to the investors about the probable behavior of the stock market and the effects thereto, on the stock values. To the investors, this helps especially in boosting their confidence in the stock market and therefore increases the participation rates as well as the level of certainty of returns. It is, thus, critical for policy makers to manage the stock market volatility and ultimately enhance economic stability in order to improve the effectiveness of the asset allocation decisions, (Poon and Tong, 2010).

Many investors are risk averse, so they tend to shy away from securities that are less predictable. High volatility of stock return is attributable to high risk, this leads to high volatility in the market and thus, unfavorable market risk premium. By undertaking this study, it will assist many investors in understanding and predicting the stock market behavior, and thus, participate more.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter discusses the theoretical review in 2.2 and empirical review in 2.3, on the concept of volatility of stock and trading volume, while 2.4 gives a review of local research through literature review of theory and previous empirical research. The chapter is then concluded in 2.5, by discussing and summarizing empirical review of the previous studies.

2.2 Theoretical Literature

2.2.1 Mixed Distribution Hypothesis

The mixture of distribution hypothesis (MDH) developed by Clark (1973) and Epps and Epps (1976) gives an alternative volatility-volume nexus, in which the relation is critically dependent upon the rate of information flow into the market. The model assumes that the joint distribution of volume and volatility is bi-variate normal conditional upon the arrival of information. According to the hypothesis, all traders receive the new price signals simultaneously. This causes an immediate shift to new equilibrium without intermediate partial equilibrium. This is contrary to SIAH, which assumes that there are intermediate equilibria en route to the final equilibrium. However, under MDH, there should be no information content in past volatility data, that can be used to forecast volume since these variables contemporaneously change in response to new information arrival. Thus, both volatility and volume change contemporaneously in response to the arrival of new information. The MDH is used to measure the amount of disagreement among investors as they reassess their market standing based on the arrival of new information into the market. Under the MDH, trading volume increases as the level of disagreement among investor's increases. This suggests a positive causal relationship from trading volume to absolute returns.

This study focuses into finding out whether information flow affects stock volatility and volumes traded in the NSE. Investors in many cases access information at the same time, due to presence of equal participating conditions such as release of audited financial statements, that provide an in depth analysis of the company. Such occurrences could influence investors' behavior in the

NSE, leading to either positive or negative impact on volumes of stock traded and stock prices. This study will, thus, investigate whether there is MDH in NSE and its effects to the market.

2.2.2 Sequential Information Arrival Hypothesis

This model was developed by Copeland (1976) and later advanced by Jennings et al., (1981), and the model relates to the observed relationship of volume and volatility to private information. From the model, an individual trader receives a signal ahead of the market and trades on it, thereby creating volume and price volatility. As a result, volatility and volume move in the same direction. Traders, thus, change their trading positions as new information arrives to the market. Since not all traders receive the new information at exactly the same time, the response of each individual trader to this information represents an incomplete equilibrium. Thus, the final market equilibrium is established when all the traders have received the information and have made a trading decision based on the information. SIAH, thus, suggests that a lead-lag relationship between volume and volatility exists only in the presence of information. SIAH differs slightly with MDH as it proposes a positive causal relationship between volumes and returns in both directions, that is, each determines the other.

SIAH is experienced in NSE, in cases where some investors access information before others. In such instances, investors normally change their trading positions as new information arrives to the market leading to changes in stock volatility and stock volumes traded. This study will find out the effect on trading volumes and stock prices, as the investors receive new information at different times.

2.2.3 Efficient Market Hypothesis

Fama (1965) championed the efficient market hypothesis which suggested that at any point of time, prices will fully reflect all available information about individual stocks and the stock market as a whole. This is because when new information arrives, the news spread very quickly and is incorporated into the prices of securities immediately. Thus, according to the EMH, no market player has the advantage in forecasting stock price movements since no one has access to information that is not available to the entire market. Some investors tend to believe that they can select those stocks that will outperform the market through fundamental analysis, an analysis of

financial information such as company earnings, dividend payout, asset values and so forth, or through technical analysis; a study of past stock prices in an attempt to predict future prices According to Malkiel (2003), these analyses enable the investors to achieve returns greater than those that could be obtained by holding a randomly selected portfolio of individual stocks with comparable risk. However, under the EMH, investors engage themselves in a game of chance and not skill, at any time of them buying and selling securities. Therefore, it is, however, impossible to out-perform the market as prices normally incorporates and reflects all relevant information in the market. The EMH is not only concerned with the type and source of information, but also the quality and speed of which it is disseminated among inventors. This helps in questioning the type of information available and incorporated in stock prices. According to Fama (1970, 1991), EMH may exist in three levels:

2.2.3.1 Weak form of the EMH

The weak form reflects the situation where movements in stock prices follows a random path. Current stock price movements are independent of past price movements. This means that, all information contained in past trading volume, prices of stock, and the rates of return are already reflected in the current stock prices. Thus, the past data on stock and market are of no use in predicting future price changes. The random nature of stock price movements, on the other hand, means that any attempt to study past prices moving in order to detect mispriced stock and to gain above-average profits will fail. Thus one cannot gain from using information that everybody else in the market has known. Investors and analysts cannot practice technical analysis by drawing up charts of past stock prices and trading volume in order to predict future price movement since it cannot be used to predict and beat a market.

2.2.3.2 Semi-strong form of the EMH

The semi-strong form of the EMH states that the current stock prices not only reflect all past price movement but also all publicly available information (Fama, 1970). Examples of public information are data reported in a company's financial statements, earnings and dividend

announcements, announced merger plans, the financial situation of company's competitors, expectations regarding macroeconomic factors and so forth. This information will then be available at random intervals, and are quickly absorbed by the market. Therefore, investors who practice fundamental analysis by studying relevant reports and announcements with the attempt to make above-average returns on a consistent basis would be disappointed as the stock prices have already reflected such new public information.

2.2.3.3Strong-form of the EMH

The strong-form of the EMH is the strongest version of EMH, which states that current stock prices reflect all pertinent information, both public and private or inside information (Fama, 1970). The current stock price reflects all true or intrinsic value of the share and thus, the stock would be fairly priced in the stock market. Thus, there is no opportunity for investors to have exclusive access to information relevant to stock prices. The stronger-form of EMH states that even corporate insiders within a corporate a corporation would find it impossible systematically gain abnormal returns from inside information. Such information includes detailed information about the financial state and major strategies of the firm, alongside the tactical decisions the company makes that may not be available to shareholders. Under the EMH, investors engage in a game of chance and not skill, at any time of them buying and selling securities. Therefore, the stock volumes and prices will change from time to time, as investors respond to different information levels in the market. Thus, if the investors in NSE obtain information that seems to reflect expected market performance, they will transact in response to such news, leading to new market equilibrium. This will give either a positive or a negative relationship between stock volatility and volumes of stock traded in the market.

2.3 Empirical Literature

Epps and Epps (1976) useda two-parameter portfolio model to imply stochastic dependence between transaction volume and the change in the logarithm of security price from one

transaction to the next. He noted that the change in the logarithm of price is viewed as following a mixture of distribution hypothesis, with transaction volume as the mixing variable. The study explains that, new information affects the null prices of different traders in different ways. The complex pattern of excess demands created by the information leads to a new market price, which clears the excess demands and restores the equality between each individual's null price and market price. The study applied least square to model for each of 20 New York Stock Exchange (NYSE) common stocks. Sample periods were from one to four weeks, depending on how actively each security was traded. The research concludes that transaction volume (v) and the change in log price from one transaction to the next (y) are dependent random variables. Specifically, the variance of y conditional on v = v_k is a function of $v_k$the variance of the change in log price depends on volume.

Copeland (1976) assumed that traders receive new information in sequential random style. This causes the traders to change their trading positions as new news arrives to the market. However, not all traders tend to receive this new information at exactly the same time. Thus, the response of each individual trader to this information represents an incomplete equilibrium in the stock market. The final market equilibrium is established when all traders have received the information and have made a trading decision based on that information. Thus, the SIAH suggests that a lead-lag relationship between volume and volatility exists only in the presence of information.

Karpoff (1987) carried out a research on the relation between price changes and trading volume. In his research, he outlined four reasons why price-volume relationship is important, which includes provision of insight into the structure of financial markets, for event studies that use a combination of price and volume data, critical to the debate over the empirical distribution of speculative prices and lastly it has significant implications for research into futures markets. The research concludes that observations of simultaneous large volumes and large price changes (either positive or negative) can be traced to their common ties to information flows (as in the sequential information arrival model), or their common ties to a directing process that can be interpreted as the flow of information (as in the mixture of distributions hypothesis). There was

further evidence of no inter-temporal causality in any direction from volume to absolute price changes.

According to Bollerslev (1987).“A conditionally heteroskedastic time series model for speculative prices and rates of return, speculative price changes and rates of return series”, the study uses daily spot prices from the New York foreign exchange market on the U.S. dollar versus the British pound and the Deutschmark from March 1980 to January 1985, for a total of 1245 observations, excluding weekends and holidays. The study uses a simple time series model designed to capture dependencies of the variables and it is presented through the model as an extension of the Autoregressive Conditional Heteroskedastic (ARCH) and Generalized ARCH (GARCH) models. The study gives a conclusion that speculative price changes and rates of stock return series are approximately uncorrelated over time but characterized by tranquil and volatile periods. The standardized t-distribution fails to take account of this temporal dependence, and the ARCH or GARCH models with conditionally normal errors do not seem to fully capture the leptokurtosis.

Brailsford(1994) conducted a study on the empirical relationship between trading volume, returns and volatility. The study tests both the asymmetric model and the mixture of distributions hypothesis in relation to the Australian market. The stocks were selected on the basis of the top five ranked Australian stocks by market capitalisation. Daily prices, volume, dividend and capitalisation information were collected and a daily returns and standardized volume series were constructed. The resultant sample covers the period from 24 April 1989 to 31 December 1993, and contains 1,958 daily observations. The relationship between trading volume and conditional volatility of the aggregate market was modified to conditional variance equation of the GARCH model to include trading volume as an explanatory variable.The methodology involves testing the relationship between different measures of price change and trading volume. This was conducted using standard OLS regressions, while the second test examined the effect of trading volume on conditional volatility, by modification of the GARCH model. The study found evidence that supports an asymmetric model. The relationship between price change and volume, irrespective of the direction of the price change, was significant across three measures of daily trading volume for the aggregate market and was significant for individual stocks. Further,

evidence was found supporting the hypothesis that the volume-price change slope for negative returns is less steep than the slope for positive returns, thereby supporting the asymmetric relationship.

Mestal et al., (2003) carried out a study that investigated the empirical relationship between stock returns, return volatility and trading volume, using data from the Austrian stock market. The study used data set comprising daily market price and trading volume series for 31 companies listed on the Austrian stock market. The investigation covered the period between 06/2000 - 04/2003. The study used Vector Autoregressive (VAR) model to test for the contemporaneous as well as causal relation between trading volume, stock returns and return volatility, since it is sensitive to non-stationarities. To check the hypothesis whether the time series of stock returns and trading volume can be assumed to be stationary the study used augmented Dickey-Fuller (ADF) test. Their study results indicate that on average there is only a weak association in either direction between stock returns and trading volume on the Austrian stock market. They also found a strong support for the hypothesis of a positive relationship between return volatility and trading volume.

Brijesh and Priyanka (2009) examines the relationship between returns, volatility and trading volume for all the 50 stocks of S&P, a value-weighted stock index of National Stock Exchange, Mumbai India, derived from prices of 50 large capitalization stocks, for the period between January 2000 and December 2008. The study used VAR modeling to investigate the relationship between trading volume and return, while the relationship between volume and unconditional volatility and its asymmetric effect is investigated using OLS. Mixed distribution hypothesis (MDH) is tested using GARCH model in which contemporary volume is used as an explanatory variable in the GARCH specification. The study results give evidence of positive contemporaneous correlation between absolute price changes and trading volume in Indian stock markets. However, there are mixed result on asymmetric relationship between trading volume and returns. Most of the stocks show asymmetric behavior which is in line with the findings of Assogbavi et al., (1995) and Brailsford (1996). The results of impulse response analysis indicate that both returns and volume are mostly affected by their own lag and the volume is more autoregressive than returns i.e. any shock in either returns or volume does not affect the return

series beyond one lag. In case of unconditional volatility and trading volume, there is positive contemporaneous relationship between trading volume and unconditional volatility. The results of relation between trading volume and conditional volatility support strong contemporaneous relationship between trading volume and conditional volatility.

Attari et al., (2012) studied the dynamic relationship between stock volatility and trading volumeof stocks in Pakistan.They used a sample of listed companies on Karachi Stock Exchange (KSE) for the period from January 2000 to March 2012. The sample comprised weekly stock price index and trading volume of the KSE 100 index. The causal as well as contemporaneous relationship has been investigated by using GARCH and Granger causality tests. The study found a significant positive relationship between returns and volume, which means that rising markets goes with rising volumes and vice versa. The finding depicts that information content of volume affects future stock return. There was also the existence of bi-directional granger causality between volume and return, i.e. the volume had two way effects on the return of Pakistan stocks. However, there was no causal relationship between change in volume and return. As per the literature explanation, volume which is affected by market information, leads to price changes. The study concludes that higher capital gains that depict positive price changes, lead to increase in volume, encouraging buying of stocks.

Okoli (2012) studied the Return-Volatility Interactions in the Nigerian Stock Market. The study used yearly data for the period between 1980 – 2010, with the data consisting of Nigeria All-Share Index (ASI) and dataset being obtained from several issues of the Central Bank of Nigeria, Annual Report and the Fact book of the Nigeria Stock. The dataset gives the measure of stock market including; the two measures of money-the narrow money (M1) and broad money (M2), Interest Rate (INT), and Exchange Rate (EX-R), which represent monetary policy variables for the study. Industrial Production Index (IPI) which is used as a proxy for real output, and Federal Funds Rate (FFR) which reflects an international factor, are also used for the study. The study used GARCH (1,1) model and VAR model. The GARCH model shows that in the presence of the narrow money only the Exchange Rate (EX-R) affects the stock market prices in the conditional mean equation. The coefficient of the lagged conditional variance in the conditional variance equation is highly significant. In the presence of broad money, none of the predictors

affect the stock market prices in the Conditional Mean equation. The coefficients on both the lagged squared residual and lagged conditional variance terms in the conditional variance equation are highly statistically significant. The VAR model shows that there is a "bi-directional causality" between the narrow money and broad money.

Frimpong and Oteng-Abayie (2006) carried out a study onmodeling and forecasting volatility of returns on the Ghana Stock Exchange (GSE), using Garch Models. The purpose of the study was to model and quantify volatility of returns on the Ghanaian stock market with different types of GARCH models. The study used the basic random walk model, a symmetric GARCH (1,1) model and two asymmetric EGARCH (1,1) and TGARCH (1,1) to capture the main characteristics of financial time series such as fat-tails, volatility clustering and the leverage effect. The basic random walk (RW) model was included to test for the random walk (Efficient Market) hypothesis. The results of the study showed that the Databank Stock Index (DSI) exhibits stylized characteristics such as volatility clustering, leptokurtosis and asymmetric effects, which are associated with stock returns of the more advanced stock markets. Random walk hypothesis was also rejected for the GSE DSI returns. The GARCH models (a and b) suggested a high degree persistent in the conditional volatility of GSE stock returns. Thus GARCH (1,1) model is used since it is able to model and forecast the conditional volatility of the DSI better than the other competing models.

Olowe (2009) investigated the relation between stock returns and volatility in Nigeria using E-GARCH-in-mean model, in regards to the reforms in the banking and insurance sectors as well as the stock market crash and the global financial crisis. He found little evidence on the relationship between stock returns and risk as measured by their own volatility and showed that banking reforms and stock market crash negatively impacts on stock return while insurance reform and the global financial crisis have no impact on stock return.

2.4 Review of Local Research

Ogum et al., (2005) investigated the emerging market volatility using Nigeria and Kenya stock return series. From their study, the results of the exponential GARCH model indicated that asymmetric volatility found in U.S. and other develop markets was also present in Nigeria, butKenya showed evidence of significant and positive asymmetric volatility, meaning that positive shocks increase volatility more than negative shocks of equal magnitude.

Omondi and Olweny (2011) investigated the effects of Micro-economic factors on stock return volatility on the NSE. The study's focus was on the foreign exchange rate, interest and inflation rate fluctuations on the stock return volatility at the NSE. Monthly time series data for the period between January 2001 and December 2010 was used. The study applied (EGARCH) and (TGARCH) models. The results showed that stock returns are symmetric but leptokurtic and thus, not normally distributed. There was evidence of relatively low though significant impact of Foreign exchange rate on stock returns. Stock return volatility was also affected by Interest rate and Inflation rate. Leverage effect was also observed. This means that volatility rise more following a large price fall than following a price rise of the same magnitude.

Kiremu et al., (2013**)** conducted a study with the purpose to evaluate the market reaction to annual earnings announcements by companies listed at the NSE. Daily closing stock prices were analyzed to measure the impact of earnings announcements on stock prices. The study used secondary data from the NSE relating to annual earnings announcements, daily share prices, daily traded volumes and NSE 20 share index covering all the days in the event window for the period from 2006 to 2010. To calculate the daily abnormal returns, the market model was used. The abnormal return data was analyzed by Statistical Package for Social Sciences (SPSS). Data was analyzed by descriptive and inferential statistics and significance tested by T-test, with the level of significance being at 5%. The results of the study indicate that the average abnormal returns (AAR), Cumulative Average Abnormal Return (CAAR) and the trading activity ratio (TAR) within the event date were not significant. This means that information given by the annual earnings announcement is absorbed efficiently in the share prices, which eliminate chances of traders earning abnormal returns within the event date. This observation is consistent

with EMH, which states that upon the event occurrence; price reaction to new information must be instantaneous and unbiased, leaving no room for investors to earn abnormal returns.

Owidoet al., (2013) measured the efficiency of NSE using GARCH approach. The study used the daily NSE 20 share index of the Nairobi Securities Exchange for the period 2nd January 2006 to 18th November 2011. The study results show that the NSE is still not efficient in the weak form. The study confirms that due to volatility clustering, some time periods may be riskier than others and therefore it would not be accurate to generalize that Monday returns are generally lower. Instead stock return on a particular day depends on the previous activity and the notion of a weekly window is rejected. Since there is no randomness in the data whatever returns realized today will largely depend on the most recent activity in the market. Thus, volatility clustering exists in the market and that stock returns does not depend on the day of the week but rather the returns of the previous 3 days of the week, which means that the market is still not weak form efficient.

2.5 Summary

According to Epps and Epps (1976), market prices are affected in different ways by arrival of new information. This makes transaction volume and the change in log price from one transaction to the nextto be dependent random variables. Karpoff (1987) carried out more research of information flow and effects on the relation between price changes and trading volume. Copeland (1976) also supported the arrival of new information effects to the stock market prices. However, the study concluded that investors receive the information at different times leading to different responses. Thus, presence of information causes a lead-lag relationship between volume and volatility.

Brailsford (1994), in his research found that the relationship between price change and volume, irrespective or the direction of the change in price, was significant for the aggregate market and individual stocks. The results of impulse response analysis indicate that both returns and volume are mostly affected by their own lag and the volume is more autoregressive than returns. Attari et al., (2012) investigated causal as well as contemporaneous relationship using GARCH and Granger causality tests. Significant positive relationship between returns and volume was found,

indicating that rising market goes with rising volume and vice versa, which meant that information content of volume affects future stock return.

The aim of this paper is to find out if there is a dynamic relationship between stock volatility and Trading volumes in NSE, since over the recent past years, trading has changed greatly due to the introduction of Central Depository System (CDS), which has led to positive impact on the market (Otuke, 2006). The launching of live trading on the automated trading systems of the NSE in 2006 (NSE, 2006) has also had a lot of impact on the trading volumes. Thus, there has been a lot of research revolving around NSE market aspects, with both concurring as well as differing conclusions.

Owido et al., (2013) concluded that NSE is still not a weak form efficient, since stock return does not depend on the day of the week but a number of the previous days in the week. The study shows that there is no randomness in the data, since whatever returns realized today will largely depend on the most recent activity in the market. NSE has also been seen to be consistent with EMH, according to the study conducted by Kiremu et al., (2013**)**, price reaction occurs immediately upon receiving of unbiased new information leaving no room for investors to earn abnormal returns.

In the study of effect of Macro-economic factors on the stock return volatility on the NSE, Omondi and Olweny (2011) were able to observe Leverage effect. The study showed that volatility rise more following a large price fall than following a price rise of the same magnitude. These results were contradicted in the investigation of the emerging market volatility using Nigeria and Kenya stock return series byOgum et al., (2005). According to their study, Kenya stock market has evidenced by significant and positive asymmetric volatility, which suggests that positive shocks increase volatility more than negative shocks of equal magnitudes.Thus, previous researches in the NSE have ranged from effects of Macro-economic factor on the stock volatility, to efficiency of NSE, as well as volatility modeling. However, there has not been a study on the dynamic relationship between stock volatility and trading volumes in NSE. This is, thus, the motivation to conduct the investigation, as well as add to the existing knowledge and field of literature.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

This chapter discusses research design in 3.2 and population and sample in 3.3. Section 3.4 presents data and data collection instruments, while 3.5 give the models for data analysis.

3.2 Research Design

This is an empirical study in the quest to understand the relationship between stock volatility and trading volume at the NSE. The study entailed collection of observed data and modeling it using econometrics methods, using symmetric and asymmetric GARCH models. This is because the volatility that is observed in the stock market is a natural application for the autoregressive conditional heteroscedasticity (ARCH). The ARCH model introduced by Engle (1982) and Bollerslev's (1986) generalized ARCH (GARCH) model has been used in many studies such as (Schwert, 1990; Lamoureux and Lastrapes, 1990; and Kim and Kon , 1994). The GARCH specification allows the current conditional variance to be a function of past conditional variances, which enabled the achievement of this study's objectives.

3.3 Population and Sample

3.3.1 Population

The target population consisted of all the sixty (60) companies listed at the NSE as at June 2012, from which share price index was derived. This population gave a clear picture of the situation in the market, between the periods January 2008 to June 2012.

3.3.2 Sample

The sample of data used in this current study comprised monthly stock price index and trading volume of all the companies listed under NSE 20 share index.The realization period covered from January 2008 to June 2012 and data was obtained from NSE and CMA data bank.

3.4 Data and Data Collection Instruments

Secondary data from Nairobi Securities Exchange (NSE) data bank and data from Capital Market Authority (CMA) was applied for the study. Monthly average prices and traded stocks were captured from January 2008 to June 2012. As a way of collecting data, a schedule was drawn to give direction on the particulars of data relevant for the study.

3.5 Data Analysis

Econometrics model was used in the study to analyze the collected data so as to get accurate results. In specific GARCH model was used for analysis.

3.5.1 Conceptual Model

To examine the dynamic relationship between stock price volatility and trading volume, volatility was measured by the change in stock prices, while trading volume was measured by the number of stocks traded in the stock market. From the closing index price, the monthly rate of return (R_t) was calculated as:

$R_t = P_t - P_{t-1}$ (1)

Where $P_t$is the closing index price on month (t). The volume (V_t) can only take positive values. Therefore, besides the volume, an estimated change in the volume (ΔV_t) was also taken into account to cover both the positive and negative values (increases in volume as well as the decreases). Thus, change in volume was estimated:

$\Delta V_t = V_t - V_{t-1}$ (2)

3.5.2 Analytical Model

Generalized Autoregressive Conditional Hetroskedasticity (GARCH) model was used to investigate the relationship between trading volume and stock price volatility. Thus, theGARCH (p, q) model is given by;

$\sigma_t^2 = \propto_0 + \sum_{i=1}^{q} \propto_i \in_{t-i}^2 + \sum_{i=1}^{p} \beta_i \sigma_{t-i}^2$

To examine whether rising price leads to higher volume or vice versa,the following equation was tested:

$R_t = \propto_1 + \beta_1 R_{t-1} + b_1 V_t + \in_{t1}$ (3)

Where R_t stands for return, V_t is trading volume at time t. R_{t-1} is included in the equations to account for serial correlation in returns series.

3.5.3 Statistical Significance Test

The causal relationship between stock volatility and trading volume was tested using F-test, by applying the Granger Causality approach.

CHAPTER FOUR

DATA ANALYSIS, RESULTS AND DISCUSSION

4.1 Introduction

This chapter presentssummary statistics in 4.2 and empirical model in 4.3, while section 4.4 presents discussion of the results and 4.5 presents the summary.

4.2 Summary Statistics

The data used in the study was obtained from Capital Market Authority (CMA) annual financial report. The data was analyzed using Eview, a statistical analysis program which resulted into following descriptive statistics relating to price and volume as presented in the Table 1 below:

Table 1: Descriptive Statistics of Price and Volume in NSE-20: January 2008 - June 2012

	Volume	**Price**
Mean	450.9246	3848.719
Median	389.7650	3677.500
Maximum	2154.900	5336.000
Minimum	141.7700	2474.800
Std. Dev.	312.0419	722.6609
Skewness	3.287831	0.351229
Kurtosis	17.77621	2.144368
Jarque-Bera	588.5451	2.757496

Source: Data obtained from CMA annual financial statements.

The descriptive statistics table above gives high average figures for both price and volume, however, these figures cannot give us more information about the distribution of the series. The standard deviation figures are also high, meaning that there is high level of volatility in the market.There is a wide gap between the maximum and minimum returns, which means that there is high variability of both price and volume change in NSE. Under the null hypothesis of normal distribution, J-B should be 0. The J-B value shows a deviation from normal distribution. The data is also not normally distributed since boththe skewness and Kurtosisare not equal to zero and are

also more than 3. The distribution takes up a trend as graphically shown by appendices 2, meaning that it is not a normal distribution. This implies that the series distribution have fat tails, which is an indication of ARCH effect.

4.3 Empirical Model

4.3.1 Results of Stationarity Test

To find out whether the data is stationary Augmented Dickey Fuller (ADF) Unit Root test has been used. ADF unit root test is commonly applied to measure the existence of stationary.The ADF test includes testing with presence of Intercept, Intercept and Trend and constant with no trend and Intercept. The test results were shown as follows:

Table 2: Results of Stationarity Test on Price

Intercept Intercept	**and Trend**	**No Intercept and Trend**	
ADF Test Statistic	**-1.858216**	**-1.61153**	**-1.072149**
1% Critical Value*	-3.5572	-4.1383	-2.6064
5% Critical Value	-2.9167	-3.4952	-1.9468
10% Critical Value	-2.5958	-3.1762	-1.6190

*MacKinnon critical values for rejection of hypothesis of a unit root.

Source: Data obtained from CMA annual financial statements.

From Table 2 above, the 5% critical value is 2.9167. In test for stationarity with Intercept, the t-statistic is lower at 1.858216, meaning that the null hypothesis of non-stationarity was rejected in favour of stationarity of the series.When checking for stationarity with intercept and Trend, the t-statistics value of 1.611353 was lower than the critical value of 3.4952 at 5%, which means thatthe null hypothesis was rejected and concluded that the data series was stationary.When no Intercept and Trend is tested, the t-statistics value of 1.072149 was lower than the critical value of 1.9468 at 5%, which means that the data series was stationary.Thus, all the time series of the variables were stationary at 5% level of significance, meaning that various shocks would be temporary and their effects would be eliminated over time especially in the long term.

Table 3: Results of Stationarity Test on Volume

Intercept Intercept	**and Trend**	**No Intercept and Trend**	
ADF Test Statistic	**-4.312258**	**-4.257898**	**-1.746755**
1% Critical Value*	-3.5598	-4.1420	-2.6072
5% Critical Value-2.	9178	-3.4969	-1.9470
10% Critical Value	-2.5964	-3.1772	-1.6191

*MacKinnon critical values for rejection of hypothesis of a unit root.

Source: Data obtained from CMA annual financial statements.

From Table 3 above, at 5% critical value of 2.9167, in testing for stationarity with Intercept the t-statistic was higher at 4.312258, meaning that we do not reject the null hypothesis. When checking for stationarity with intercept and Trend, the t-statistics value of 4.257898 was higher than the critical value of 3.4969 at 5%, which means that we do not reject the null hypothesis.When no Intercept and Trend is tested, the t-statistics value of 1.746755 was lower than the critical value of 1.9470 at 5%, meaning that the data series was stationary.Thus, when no Intercept and Trend was used to test, the time series of the variables was stationary at 5% level of significance, which means that various shocks would be temporary and their effects would be eliminated over time especially in the long term. The physical Stationarity graph was as illustrated in the appendices 3.

4.3.2Cointegration Test

Johansen cointegration test was used to determine if there was a cointegrating vector among the variables. This was to help determine whether there is long term relationship between the variables. The long run coefficients was estimated as follows.

Table 4: Results of Johansen Test for Cointegration Vectors

Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
27.36222	15.41	20.04	None **
3.704425	3.76	6.65	At most 1

*(**) Denotes rejection of the hypothesis at 5%(1%) significance level.

To determine whether the variables are cointegrated, the 5% critical value of 3.76 was statistically significant, in comparison with the Likelihood Ratio results at 3.704425.Thus, the variables were not cointegrated.This means that there was no long run relationship between the variables.

4.3.3 ARCH and GARCH Models

Since the variables were not cointegrated, there was need to determine whether the series was characterized by ARCH effects, before estimating the GARCH model. Engle (1982) introduced the concept in which the variance depends on the size of the squared error term lagged one period. The results of ARCH test were as follows.

Table 5: Results of Heteroskedasticity Test - ARCH Test:

F-statistic	55.66774	Probability	0.000000
Obs*R-squared	27.65963	Probability	0.000000

Source: Data obtained from CMA annual financial statements.

From the results,the calculated chi-square value (F-statistic) was greater than the critical chi-square value,thus, the coefficients were statistically significant and so there was ARCH effect. This means that volatility news from the previous periods have explanatory power on the current volatility. Thus, we reject the null hypothesis of homoscedasticity.Therefore, the GARCH model was estimated in order to explain the conditional variance and volatility clustering.

Table 6: Results of GARCH Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Volume	0.846757	0.298922	2.832699	0.0066
C	3466.895	163.4261	21.21383	0.0000

Source: Data obtained from CMA annual financial statements.

From the GARCH Model results, the coefficient value of volume is statistically significant at 0.846757, meaning that volatility of stock returns is persistent in NSE. The coefficient of GARCH in the conditional variance equation of volume is greater than 0.1, thus a minor market shock leads to relatively large changes in future volatility.

Table 7: Results of Granger Causality Tests between Price and Volume

Null Hypothesis:	Observations	F-Statistics	Probability
Volume does notGranger Cause Price52	0.25615	0.77510	
Price does not Granger Cause Volume3.69204	0.03241		

Source: Data obtained from CMA annual financial statements.

The Granger causality test was used to verify the direction of causality among the variables. The results above give the two ways causality,so as to get the effect relationship between the variables. The results show that volume does not Granger cause price, while price Granger causes volume.

To be able to clearly understand the stock price volatility, the study examined the causality relationship when there are changes in both price and as well as volume through the following test.

Table 8: Results of Granger Causality Tests between Change in Price and Volume

Null Hypothesis:	Obs	F-Statistic	Probability
Volume does not Granger Cause Price Change	51	0.68895	0.50721
Price change does not Granger Cause Volume		0.14350	0.86671

The test results obtained in Table 8 show that volume does not Granger cause change in stock price in the NSE, and change in stock prices does not also Granger cause volume.

Table 9: Results of Granger Causality Tests between Price and Change in Volume

Null Hypothesis:	Obs	F-Statistic	Probability
Volume Change does not Granger Cause Price	51	1.00085	0.37543
Price does not Granger Cause Volume Change		0.54245	0.58499

Thetest results in Table 9 show that Change in volume does not Granger causes Price, while Price level does not Granger cause change in Volume.

Table 10: Results of Granger Causality Tests between Change in Price and Change in Volume

Null Hypothesis:	Obs	F-Statistic	Probability
Volume Change does not Granger Cause Price Change	51	0.62444	0.54004
Price Change does not Granger Cause Volume Change		0.46089	0.63360

The test results from Table 10 show that both change in price and volume do not Granger cause each other in the NSE market.

4.4 Discussion of the Results

The causality tests show that change in volume does not necessarily lead to changes in stock prices, but price levels may cause a change in stock volumes transacted in NSE. This means that changes in stock prices in the market are brought about by other factors other than volume, such as the investors' expectations of the market behavior. Thus, if the investors expect the stock market to perform better in the future, their current demand for securities could increase, triggering a rise in stock prices. Stock price volatility in NSE could also be brought about by macro-economic factors such as seen in the study by Olweny and Omondi, (2011).

The test resultsshow that changes in prices does not influence volumes of stock traded. This means that a price rise/fall may not influence the investor's decisions on whether to purchase some amount of securities in the market. Thus, investors are more likely to be influenced by other factors such as availability of funds to invest.

However, from the test results volume changes do not influence prices levels in the NSE market. This means that investor's response to the market is not influenced by their interpretation of volumes of stock traded in the market. Thus, large/small volumes traded in the market do not impact on the stock price levels.

When the relationship between changes in both prices and volume is sought, there seems to be none. This means that neither does changes in price influence changes in stock volumes traded, nor does changes in stock volumes traded influence changes in price levels of stocks in the market.Thus, it is very important for investors to understand stock market behaviors in terms of what factors directly influence price and volume levels, so as to make informed investment decisions.

4.5 Summary

From the empirical results, the standard deviation values are high, an indication of presence of volatility in NSE, which has further been characterized by presence of high variability of the variables. The data series is not normally distributed as shown by results of Kurtosis, skewness and J-B tests. This has been demonstrated by the series distribution taking up a trend as graphically shown by appendices 2.

The data series was tested for stationarity using ADF test.The test results showed that the variables are stationary at 5% level of significance. Due to presence of stationarity, presence of conditional variance and volatility clustering has been tested using ARCH and GARCH

models.Thus, presence of stationary means that various shocks would be temporary and their effects would be eliminated over time especially in the long term.

Correlation analysis was performed on the data series to find out whether the variables werecointegrated. However, from the test results, the variables were not cointegrated meaning that there is no long run relationship between the variables.

Granger causality tests were performed to determine the existence of relationship between the variables, as well as the direction of the present relationship. The results showed thatchange in volume did not lead to changes in stock prices, but price levels caused change in stock volumes transacted in NSE. This means that changes in stock prices in the market are brought about by other factors other than volume, such as the investors' expectations of the market behavior. Thus, to the investors the economic implication is such that previous news normally affects the present stock price volatility in the market and not necessarily the volumes of stock traded.

CHAPTER FIVE

SUMMARY AND CONCLUSION

5.1 Introduction

This chapter discusses the summary of the study in 5.2 and conclusion in 5.3, while section 5.4 presents limitations of the study and 5.5 gives the recommendations for further research.

5.2 Summary of the Study

The study empirically examined the dynamic relationship between stock price volatility and trading volume in the context of Nairobi Securities Market. The study applied Unit root tests, GARCH techniques and causality tests on the data to determine the relationship between the variables.

Monthly prices and volume for companies quoted under NSE- 20 share index were used in the analysis for the period from January 2008 to June 2012. The study applied unit root test to establish the stationarity of the variables, so as to assist in deciding on the most appropriate analytical model to apply. GARCH model was used, since the data series exhibited heteroscedasticity, to find out long run volatility clustering on the variables. Granger causality test was used to determine the direction of relationship between price and volume.

The study found that there is a significant positive relationship between price and volume in the NSE, indicating that rising market goes with rising volume. Results from GARCH model show that volatility of stock returns is persistent in NSE. The research findings depicts that previous information content of stock prices influence volumeof stock traded in the market. Thus, there is no presence of bi-directional granger causality between volume and prices. This means that changes in volume, which is affected by market information, does not lead to stock price changes in the market. However, the studyresults found that Price levels cause changes in stock volumes transacted in NSE.

5.3 Conclusion

From the analysis of data, the study has concluded that there is no bi-directional relationship between stock prices and volume in NSE. However, the results showed that stock prices influence volumes of stocks traded in NSE, but volume levels do not influence stock prices in the market.

5.4 Limitations of the Study

The study was faced with a number of limitations,such as the fact that the tool for analysis was also not easily accessible and it required adequate orientation for the researcher to be able to use it for analysis. This meant an input of more time for data analysis.There was also time constraint in undertaking research study and data analysis, thus, the study data was only limited to monthly averages of the variables.

5.5 Recommendations for Further Research

Further study may be done on the same topic researched in this paper, but for a more extended period and including all the companies listed in the NSE. A study could also be done using daily data of the studied variables instead of monthly averages, to find out whether there will be any significant variation. A more advanced tool of analysis could be applied in similar study, such as E-GARCH and M-GARCH, to find out whether similar results will be obtained.Research could also be carried out in regards to the extent ofNSE reaction to presence of new information.

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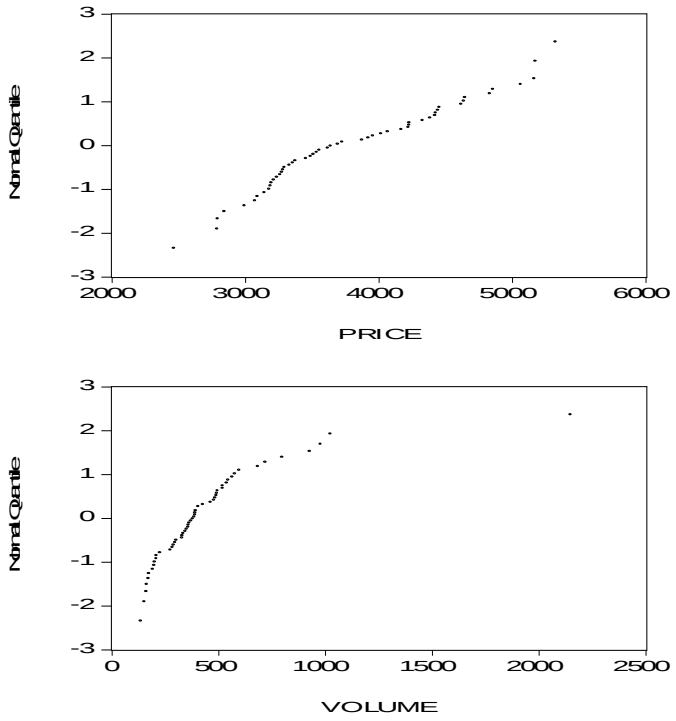
APPENDICES

1. The NSE 20-Share Index Companies.

1. Mumias Sugar
2. Express Kenya
3. Rea Vipingo
4. Sasini Tea
5. CMC Holdings
6. Kenya Airways
7. Safaricom Limited
8. Nation Media Group
9. Barclays Bank Kenya
10. Equity Bank
11. Kenya Commercial Bank
12. Standard Chartered Bank
13. Bamburi Cement
14. British American Tobacco
15. Kengen
16. Centum Investment Company
17. East Africa Brewaries
18. East Africa Cables
19. Kenya Power & Lighting Company Ltd
20. Athi River Mining

2. Normal Distribution Graph for Price



3. Stationality Graph