RELATIONSHIP BETWEEN TRADING VOLUME AND STOCK RETURN VOLATILITY: EVIDENCE FROM NAIROBI SECURITIES EXCHANGE

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A RESEARCH PROJECT SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF THE DEGREE OF MASTER OF BUSINESS ADMINISTRATION , UNIVERSITY OF NAIROBI

2014

DECLARATION

I hereby declare that this research project is my original work and effort and that it has never been submitted for the award of a degree in any other university. Where other sources of information have been used, they have been acknowledged.

Signature………………………… Date……………..

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D61/79041/2012

This research project has been submitted for examination with my approval as University Supervisor.

Signature………………………… Date……………..

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DEDICATION

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

ACKNOWLEDGEMENTS

Many people have made valuable contributions to this research project. Without their support and encouragement, it would have been difficult for me to complete this research. I would like to take this opportunity to gratefully acknowledge those whose contributions have been instrumental in the successful completion of this research project.

First and foremost, I would like to express my sincere thanks to my supervisor, Ms. Winnie Nyamute. Her constant support, humble attitude, deep knowledge and professional advice throughout my MBA candidature have been invaluable to the completion of this project.

I also acknowledge Mr. Mirie Mwangi and Mr. Michael Chirchir for their immense support and encouragement that have enabled me to pursue and complete this challenging research. I would also like to thank Mr. Ronald Chogii for his invaluable suggestions, motivations and encouragement.

A special thank you goes to my family and friends for their abundant love, encouragement and wholehearted support. Finally, I dedicate this research project to my parents who have been a constant source of encouragement.

ABSTRACT

Trading volume and volatility are two key concepts in finance. The relationship between volume and volatility provides an insight into structure of financial markets, since the predicted price-volume relation depends on information flow, size of the market and short selling constraints. Therefore, the objective of this study is to examine the nature of relationship between trading volume and stock return volatility in the Nairobi Securities Exchange.

The research design was a correlational study and the population of study consisted of all the 20 companies forming the NSE 20-share index. Daily closing stock prices of all the companies comprising the NSE 20-share index and daily trade volume as a proxy for information arrival were used in the analysis for the period January 2008 to December 2013. Daily realized volatility was computed using standard deviation and realized volatility at different time horizons – weekly and monthly in this study, was calculated using simple averages. The study applied ordinary least squares regression and autoregression on the data. The study examined this relationship using the Heterogeneous Autoregressive Realized Volatility (HAR-RV) model of Corsi (2004) and extended this model as HARX-RV model following Aguilar and Ringgenberg (2011) by adding the trade volume as a proxy for the information arrival in the HAR-RV model.

The study found the F-statistic to be 39.4597 for the HAR-RV model which indicates that the model is statistically significant. Results from HAR-RV model show that volatility of stock returns is persistent in NSE and the persistence reduces when volume is added to the model. The F-statistic is 30.0461 for the HARX-RV model which indicates that the model is

statistically significant. But the coefficient of trading volume is not statistically significant, even though the persistence of the volatility estimates reduces in the HARX-RV model, implying that major variations of returns are explained by variables other than trading volume. It was concluded that there is a weak relation between trading volume and the stock return volatility of firms listed at the NSE. It is however recommended that a study of similar nature to be carried out on all the listed companies using a longer time period, to give a more varied and valid conclusion. This conclusion regarding the NSE is consistent with other studies conducted locally and within Africa (Gworo, 2012; Achieng, 2013; Mutalib, 2012), but inconsistent with the studies related to other emerging markets, specifically the Asian and Chinese market (Tripathy, 2011; Pathirawasam, 2011; Wang et. al, 2012) which found that volume represents the most predicted variable of increasing price volatility, and both volume and prices are integrated with each other.

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LIST OF ABBREVIATIONS

AFM	Association of Futures Markets
BSE	Bombay Stock Exchange
CSE	Colombo Stock Exchange
DAX	Deutscher Aktien Index
EM	Emerging Market
FM	Frontier Market
FTSE	Financial Times Stock Exchange
GDP	Gross Domestic Product
GEMS	Growth Enterprise Market Segment
GARCH	Generalized Autoregressive Conditional Heteroskedasticity
HAR-RV	Heterogeneous Autoregressive Realized Volatility
IBM	International Business Machines
IRF	Impulse Response Function
ISE	Istanbul Stock Exchange
KSE	Karachi Stock Exchange
MDM	Mixture of Distributions Model
MIMS	Main Investment Market Segment

MSCI	Morgan Stanley Capital International
NASI	Nairobi All Share Index
NSE	Nairobi Securities Exchange
NYSE	New York Stock Exchange
REITS	Real Estate Investment Trusts
RV	Realized Volatility
S&P 500	Standard and Poor's 500 Index
SENSEX	Sensitive Index
SIAM	Sequential Information Arrival Model
STT	Securities Trading Technology
TAQ	Trades and Quotes
US	United States
VAR	Vector Auto Regression
VECM	Vector Error Correction Model

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

In financial economics, the relation between trading volume and stock returns volatility has been the subject of extensive research in recent years. Its roots are generally credited to the work of Osborne (1959). In his seminal work, he modelled price changes according to a diffusion process that had a variance dependent on the quantity of transactions of that particular issue. With this, he began a long line of work that considered the possible relationship between returns volatility and the volume of trading.

Why do people trade and how do prices move? The trading volume and volatility are two key concepts in finance. Investors commonly use trading volume to predict price movements. The relationship between trading volume and stock returns provides "an insight into structure of financial markets" since the predicted price-volume relation depends on information flow, size of the market and short selling constraints (Karpoff, 1987). According to Hiemstra and Jones (1994) the correlation between stock prices and trading volume may explain movements of past stock prices in relation to movements in trading volume and/or vice versa. Therefore, this relationship has received much attention from both researchers and decision-makers.

1.1.1 Trading Volume

Volume is a measure of the quantity of shares that change owners for a given security. The amount of daily volume on a security can fluctuate on any given day depending on the amount of new information available about the company, whether options contracts are set to expire soon, whether the trading day is a full or half day, and many other possible factors. Trading volume is a factor that many have considered in the prediction of prices (Wang, 2002). Of the many different elements affecting trading volume, the one which correlates the most to the fundamental valuation of the security is the new information provided.

This information can be a press release or a regular earnings announcement provided by the company, or it can be a third party communication, such as a court ruling or a release by a regulatory agency pertaining to the company. Because of what can be inferred from abnormal trading volume, the analysis of trading volume and associated price changes corresponding to informational releases has been of much interest to researchers. There are many reasons why traders pay attention to trading volume. Theoretically, low volume means that the market is illiquid; this also implies high price fluctuation. On the other hand, high volume usually implies that the market is highly liquid, resulting in low price variability. This also reduces the price effect of large trades. In general, with an increase in volume, broker revenue will increase, and market makers have greater opportunity for profit as a result of higher turnover.

1.1.2 Stock Returns Volatility

Volatility is a statistical measure of the dispersion of returns for a given security or market index. In other words, volatility refers to the amount of uncertainty or risk about the size of changes in a security's value. Volatility exhibits three typical patterns in most financial time series, namely, clustering, asymmetry and persistence (Choi et. al, 2012). Many empirical studies have identified asymmetric volatility in particular, by which stock return volatility tends to rise more following a large fall in price than following a rise in price. Whereas it has turned out to be very difficult, if not impossible, to predict future asset returns from historical returns, it has infact been concluded in numerous studies that there is predictability in the volatility of asset returns.

Volatility adversely affects the functioning of the financial system and hence economic performance. Higher returns encourage the investors to invest and increase the capital inflow, whereas in volatile environments the returns are not certain and hard to predict affecting investments eventually. Risk is the major factor that determines the returns. Higher the risk, higher will be the return. Accurately modelling and forecasting volatility is important since volatility is an important variable in many areas of finance, like risk management, option pricing and also asset management: the volatility linked product market is growing rapidly. Over the last few years a large number of volatility products have been introduced, like variance options, variance corridors and volatility and variance swaps. It is because of these changes that researchers are interested in volatility forecasting.

1.1.3 Trading Volume and Stock Returns Volatility

A Wall Street adage says "It takes volume to make price move" (Karpoff, 1987). Researchers (such as Osborne) hypothesized long ago that volume would drive variability, and was subsequently supported by many empirical studies. These studies on volume-price relation suggest that there are positive relations between the absolute value of daily price changes and daily volume for both market indices and individual stocks (Ying, 1966; Westerfield, 1977; Rutledge, 1979). Return-volume relationships are of common interest as they may unearth dependencies that can form the basis of profitable trading strategies, and this has implications for market efficiency (Chen et. al, 2004). Market folklore claims that the relationship between volume and price movements depends on whether the market is in a bull or bear run. In a bull market, a relatively higher level of volume is associated with a given price change in comparison to a bear market. However, these claims are anecdotal and unsubstantiated.

Karpoff (1987) suggests the following four possible reasons for considering trading volume and its relationship to volatility. It provides insight into the structure of financial markets. The correlations which are found can provide information regarding rate of information flow in the marketplace, the extent that prices reflect public information, the market size, and the existence of short sales and other market constraints. The relationship between price and volume can be used to examine the usefulness of technical analysis. For example, Murphy (1985) and DeMark (1994) emphasized that both volume and price incorporate valuable information. A technical analyst gives less significance to a price increase with low trading volume than to a similar price increase with substantial volume.

Understanding the price-volume relationship in futures and other speculative markets is vital for one to determine why the distributions of rates of return appear kurtotic. One theory is that rates of return are characterized by a class of distributions with infinite variance, known as the stable Paretian hypothesis. Another theory is that the data comes from a mixture of distributions wherein each has different conditional variances, known as the mixture of distributions model. Research has shown that price data is generated by a stochastic process with changing variances which can be predicted or estimated by volume data. Also, price variability affects trading volume in futures contracts. This interaction determines whether speculation is a stabilizing or destabilizing factor on futures prices. The time to delivery of a futures contract affects the volume of trading, and possibly also the price.

Thus, to improve the understanding of the microstructure of stock market, the relationship between return, volume and volatility has received substantial attention in the market microstructure for a number of years. In addition, the return-volume relationship sheds light on the efficiency of stock markets.

1.1.4 Nairobi Securities Exchange

In 1954, the Nairobi Stock Exchange was constituted as a voluntary organization of stockbrokers registered under the Societies Act. In July 2011, the Nairobi Stock Exchange Limited changed its name to the Nairobi Securities Exchange (NSE) Limited. The change of name reflected the strategic plan of the Nairobi Securities Exchange to evolve into a full service securities exchange which supports trading, clearing and settlement of equities, debt, derivatives and other associated instruments. In September 2011 the Nairobi Securities Exchange converted from a company limited by guarantee to a company limited by shares and adopted a new Memorandum and Articles of Association reflecting the change.

As of June 2013, MSCI Barra classified Kenya as a frontier market (MSCI, 2013). Frontier Market is an economic term which was coined by International Finance Corporation's Farida Khambata in 1992. It is commonly used to describe a subset of emerging markets (EMs). Frontier markets (FMs) are investable but have lower market capitalization and liquidity than the more developed emerging markets. The frontier equity markets are typically pursued by investors seeking high, long term returns and low correlations with other markets. The implication of a country being labelled as frontier is that, over time, the market will become more liquid and exhibit similar risk and return characteristics as the larger, more liquid developed emerging markets.

The NSE is one of the most vibrant financial securities markets in Africa. NSE is reorganized into eleven independent market sectors including: Agricultural, Commercial and Services, Telecommunication and Technology, Manufacturing and Allied, Banking, Automobiles and Accessories, Insurance, Energy and Petroleum, Construction and Allied, Investment, and Growth Enterprise Market Segment. The main indices in the NSE are: the NSE 20-Share Index, Nairobi All Share Index (NASI) and FTSE NSE indices (NSE website). The NSE 20-Share index has been in use since 1964 and measures the performance of 20 blue chip companies with strong fundamentals and which have consistently returned positive financial results. The other index NASI was introduced as an alternative index. Its measure is an overall indicator of overall performance. The index incorporates all the traded shares of the day (NSE, 2013).

In 2012, Kenya achieved a real GDP growth rate of 4.3 %. The equity turnover of NSE rose 11.0% from 2011's Kshs. 156.1 Billion to Kshs. 173.6 Billion. Market capitalisation rose by 46.5 % to Kshs.1.27 trillion ($14.53 billion). The Exchange made a net profit of Kshs. 85.1 Million (though this reflected a slight 1.0% decrease from 2011's Kshs. 85.6 Million) off a total income level of Kshs. 384.9 Million, a 13.5% increase over the previous year's Kshs. 338 Million. The Exchange successfully established the Growth Enterprise Market Segment (GEMS) and the launch of a segment for Real Estate Investment Trusts (REITS) is imminent. The first inwards cross–listing occurred on December 14, 2012 with the entry of Umeme, the

Uganda power distributor, onto the Main Investment Market Segment (MIMS) of the Exchange. The Exchange has entered into a partnership with Securities Trading Technology (STT) of South Africa to develop a local Derivatives Market. To bolster this initiative, the NSE became an associate member of the Association of Futures Markets (AFM) in February, 2013 (NSE Annual Report and Financial Statement, 2012).

1.2 Research Problem

Emerging Markets are characterized by high risk and return, highly predictable and high volatility compared to the developed markets (Bekaert and Harvey, 1997). Volatility is one of the important aspects of financial market developments providing an important input for portfolio management, option pricing and market regulations (Poon and Granger, 2003). Return and volume are two major pillars around which the entire stock market revolves. While return can be interpreted as the evaluation of new information, volume is an indicator to which the investors disagree about this information. Moreover, it is observed from the prior literature (Karpoff, 1987; Mestel et al., 2005; Gallant et al., 1992; Suominen, 2001; Lee and Rui, 2002) that stock prices are noisy which can't convey all available information to market dynamics of stock prices and trading volume. Therefore, studying the joint dynamics of volume and volatility is essential to improve the understanding of the microstructure of stock markets (Mestel et al., 2003).

The interdependencies between stock return volatility and trading volume have been the subject of investigation by many researchers. The studies by Clark, 1973; Epps and Epps, 1976; Tauchen and Pitts, 1983; Harris 1986; Karpoff, 1987; Andersen, 1996; Lee and Rui, 2002; Alsubaie and Najand, 2009; Choi et al. 2012 give evidence of a strong relationship (contemporaneous as well as dynamic) between return and volatility. In contrast to these authors, there are also findings that are inconsistent (Najand and Yung 1991; Bessembinder and Seguin 1992, 1993; Darrat et al., 2003; Aggarwal and Mougoue, 2011). They do not report a contemporaneous correlation between return volatility and trading volume.

Gworo (2012) examined the price-volume movements in the NSE for the 14 companies continuously forming the NSE 20-share index between the periods January 2007 to December 2011. The study used Karl pearson's correlation coefficient model for the purpose of analysis to determine whether there exists a relationship between the variables and concluded that major variations of price were explained by other variables other than changes in traded volumes, implying a weak correlation between trading volume and share price volatility. Achieng (2013) carried out a similar study for all the 58 firms listed at the NSE by December 31, 2012 covering the period January 2008 to December 2012, using a regression model proposed by Lee and Rui (2002). The results indicated that major variations of stock prices and trading volume were explained by other factors as opposed to the relationship between the two variables. Kamuti (2013) examined the relationship for companies quoted under NSE- 20 share index for the period from January 2008 to June 2012. The study applied Unit root tests, GARCH techniques and causality tests on the data to determine the relationship between the variables. 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.

While a fair amount of empirical evidence on the volatility and volume relationship exists for developed countries, very few empirical studies have been reported from emerging markets and specifically from NSE. Given the mixed empirical results between price, returns and trading volume especially in emerging markets context, more empirical research from other emerging financial markets is needed to better understand the volume – volatility relationship. Moreover, most of the studies use the GARCH models to examine this relationship. This study aimed to examine this relationship for all the companies listed at the NSE, using the HAR-RV model of Corsi (2004) and extend this model as HARX-RV model following Aguilar and Ringgenberg (2011) by adding the trade volume as a proxy for the information arrival in the HAR-RV model. Therefore, the research question in this study was: Is there a relationship between trading volume and stock return volatility in the NSE?

1.3 Research Objective

The objective of this study was to determine the nature of relationship between trading volume and stock return volatility in the Nairobi Securities Exchange.

1.4 Value of the Study

The main purpose of this study is to impart inside knowledge of the relationship between volume and return volatility to traders / investors, researchers and policy makers.

Understanding the relationship between returns, volatility and trading volume in financial markets can help the investors and traders in Kenya in making investments decisions, as trading volume reflects information about market expectations, and its relationship with price can have important implications for trading, speculation, forecasting and hedging activities.

This study will provide additional insights and open new dimensions of research for future researchers as NSE is an important stock market. The researchers and scholars can use this study as a source of reference for further research or as a source of knowledge.

The study will be of importance to the financial managers and economic policy makers since identification of factors influencing pricing of stocks at emerging markets such as NSE is essential to the institution of public and private policies geared towards improving the stability and efficiency of stock markets.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

A detailed analysis of return volatility-volume dynamics is important to have knowledge of issues relating to market efficiency and information flow in the market. In literature review, past studies as well as theoretical frameworks on the relationship between stock return volatility and trading volume are reviewed with the objective of gaining a deeper understanding of the history, evolution, direction and gaps in earlier studies. The layout of this chapter is as follows. Section 2.2 discusses four models proposed to explain this relationship. Section 2.3 presents the empirical literature from the developed markets context as well as from the emerging markets context. Section 2.4 is a summary of the literature review, briefly discussing the research gaps especially emanating from the empirical literature review.

2.2 Theoretical Review

In terms of the theoretical background on the relationship between price changes and volume, there are various models proposed to explain this relationship, the “mixture of distributions” model (MDM) proposed by Clark (1973), Epps and Epps (1976), and Tauchen and Pitts (1983), the “sequential information arrival” model (SIAM) by Copeland (1976, 1977), Tauchen and Pitts (1983) and Smirlock and Starks (1985), the “asymmetric information” model proposed by Kyle (1985) and Admati and Pfleiderer (1988) and the “differences in opinion” model proposed by Varian (1985, 1989) and Harris and Raviv (1993) are the most popular models in the literature. All these models predict a positive relationship between price and trading volume.

2.2.1 Mixture of Distributions Model

The MDM was first introduced in the 1970s by Clark (1973) and further developed by Epps and Epps (1976), Tauchen and Pitts (1983), and Harris (1986). This model states that stock returns are generated by a mixture of distributions. Clark states that stock returns and trading volume are related due to the common dependence on a latent information flow variable. According to Clark, the more information arrives on the market within a given time interval, the more strongly stock prices tend to change. The author advises the use of volume data as a proxy for the stochastic (information) process. From the MDM it follows that there are strong positive contemporaneous but no causal linkages between trading volume and return volatility data. Under the assumptions of the MDM, innovations in the information process lead to momentum in stock return volatility. At the same time, return levels and volume data exhibit no common patterns.

In the MDM of Epps and Epps (1976), trading volume is used to measure disagreement as traders revise their reservation prices based on the arrival of new information into the market. The greater the degree of disagreement among traders, the larger the level of trading volume. Tauchen and Pitts (1983) developed a model in which average daily volume and the variance of daily price changes are positive functions of the daily flow of information, the extent to which traders disagree, and the number of traders. For a fixed number of traders, they derived the result that the covariance of squared daily price changes and daily volume is a positive function of the variance of the directing or mixing variable, and this relationship is expected to have a heteroskedastic disturbance term. Their model can be viewed as an amplification of Clark (1973).

2.2.2 Sequential Information Arrival Model

Copeland (1976) developed a simple model of the effects of the arrival of a single piece of information on price and volume. The key assumption of his model is that the information is received by one trader at a time, and each recipient trades on the basis of this information before it becomes known to anyone else. Thus, Copeland postulates a sequence of temporary market equilibria, ending when every trader is aware of the information. If the information increases the demand for long positions in the asset by some traders, and decreases the demand for a long position by others, the adjustment path will depend on the sequence in which optimists and pessimists receive the information. Hence, the dynamics of the market reaction are probabilistic, depending on the actual sequence in which optimists and pessimists receive the information.

Using computer simulations, Copeland showed there will be a positive correlation between price volatility, as measured by the absolute of price changes, and volume. He also demonstrated that volume is a positive function of the logarithm of the strength of the information, i.e. the size of the shift in a trader's demand curve. In addition, Copeland argued that, if the information is simultaneously received by all traders, there will be a negative correlation between volume and the absolute value of price changes. Thus, it is the sequential rather than the simultaneous arrival of information that leads to the prediction of a positive relationship between volume and volatility.

2.2.3 Asymmetric Information Model

Kyle (1985) developed a dynamic model of insider trading with sequential auctions, structured to resemble a sequential equilibrium to examine the informational content of prices, the liquidity characteristics of a speculative market, and the value of private information to an insider. There are three kinds of traders in the model: a single risk neutral insider, random noise traders and competitive risk neutral market makers. The insider makes positive profits by exploiting his monopoly power optimally in a dynamic context, while noise trading provides camouflage which conceals his trading from market makers. As the time interval between auctions goes to zero, a limiting model of continuous trading is obtained. In the equilibrium, prices follow Brownian motion, the depth of the market is constant over time, and all private information is incorporated into prices by the end of trading.

Similar conclusion was also attained in the study carried by Admati and Pfleiderer (1988), who found the concentrated-trading patterns arise endogenously as a result of the strategic behavior of liquidity traders and informed trader through intraday transaction data. In a word, the "asymmetric information" model says that informed investors submit trades based on their private information. When informed investors trade more, volatility increases because of the generation of private information.

2.2.4 Difference in Opinion Model

Compared to "asymmetric information" model, the "difference in opinion" model assumes that traders share common prior beliefs and receive common information but differ in the way in which they interpret this information and each trader believes absolutely in the validity of his interpretation. Harris and Raviv (1993) refer to this as the assumption that traders have differences of opinion, and assume that traders start with common prior beliefs about the returns to a particular asset. As information about the asset becomes available, each trader uses his own model of the relation between the news and the asset's returns to update his beliefs about return.

Harris and Raviv (1993) assume that there are two types of risk-neutral, speculative traders who they term responsive and unresponsive. The two types agree on whether a given piece of information is favourable or unfavourable, but they disagree on the extent to which the information is important. When they receive favourable (unfavourable) information, speculators in the responsive group greatly increase (decrease) their probability expectation of high returns. Speculators in the unresponsive group do not. Therefore, when the cumulative impact of the past information is favourable, the responsive speculators value the asset more highly and will own all of it. But when the cumulative impact of the past information is unfavourable, the unresponsive speculators value the asset more highly and will own all of it. Trading will occur when, and only when, cumulative information switches from favourable to unfavourable, or vice versa. Thus, the Harris and Raviv (1993) model predicts that volatility in the form of absolute price changes and volume are positively correlated because both are correlated with arrival of public information.

2.3 Determinants of Stock Return Volatility

Prior to 1981, much of the finance literature viewed the present value of dividends to be the principal determinant of the level of stock prices. However, Leroy and Porter (1981) and

Shiller (1981) found that, under the assumption of a constant discount factor, stock prices were too volatile to be consistent with movements in future dividends. This conclusion, known as the excess volatility hypothesis, argues that stock prices exhibit too much volatility to be justified by fundamental variables. While a number of papers challenged the statistical validity of the variance bounds tests of Leroy and Porter and Shiller, on the grounds that stock prices and dividends were non-stationary processes (Flavin, 1983; Kleidon, 1986; Marsh & Merton, 1986; Mankiw, Romer, & Shapiro, 1991), much of the subsequent literature, nonetheless, found that stock price movements could not be explained solely by dividend variability as suggested by the present value model with constant discounting (West, 1988a; Campbell & Shiller, 1987). High volatility on the emerging financial markets can be caused by many factors.

2.3.1 Gross Domestic Product

According to Fama (1990), Liua and Sinclairb (2008), Oskooe (2010), inter alia, economic growth influences the profitability of firms by affecting the expected earnings, dividends of shares and stock prices fluctuations. Furthermore, Schwert (1989, 1990) relates stock return volatility to the level of economic activity through financial and operating leverages. When stock prices fall relative to bond prices or when firms increase financial leverage by issuing debt to buy back their stocks, the volatility of firms' stock return increases. With an unexpected decline in economic activity, the profits of firms with large fixed costs falls more than the profits of firms that avoid large capital investment or long-term supply contracts.

Analysis from Schroders Economics team found that over the past sixty years there has tended to be a positive relationship between GDP growth and stock market returns during the recovery, expansion, and slowdown phases of the traditional business cycle. In the recovery and expansion phases of the business cycle, the stock market tends to perform well as rising GDP and earnings growth drives positive excess returns on equity. In the slowdown phase, inflation is still high and monetary policy remains tight, resulting in a difficult environment for corporations. Reduced earnings and stock valuations tend to result in negative excess returns for equities: declining GDP growth is therefore usually matched with poor equity performance. During the recession phase, there is often a de-coupling of GDP growth and stock market returns: GDP growth is falling, but the excess return on equity tends to be positive.

2.3.2 Inflation

Inflation - the rise in price of goods and services - reduces the purchasing power each unit of currency can buy. Rising inflation has an insidious effect: input prices are higher, consumers can purchase fewer goods, revenues and profits decline, and the economy slows for a time until a steady state is reached. Numerous studies have looked at the impact of inflation on stock returns. Unfortunately, these studies have produced conflicting results when several factors are taken into account - namely geography and time period. Most studies concluded that *expected* inflation can either positively or negatively impact stocks, depending on the ability to hedge and the government's monetary policy.

But *unexpected* inflation did show more conclusive findings, most notably being a strong positive correlation to stock returns during economic contractions, demonstrating that the timing of the economic cycle is particularly important for investors to gauge the impact on stock returns. This correlation is also thought to stem from the fact that unexpected inflation contains new information about future prices. Similarly, greater volatility of stock movements was correlated with higher inflation rates. The data has proven this in geographic regions where higher inflation is generally linked to emerging countries, and the volatility of stocks is greater in these regions than in developed markets. Since the 1930s, the research suggests that almost every country suffered the worst real returns during high inflation periods.

2.3.3 Industrial Production Growth

Market volatility moves with the business cycle (Schwert 1989). Previous studies have shown that the industrial production increases during economic expansion and decreases during a recession, and thus a change in industrial production would signal a change in economy. The productive capacity of an economy indeed rises during economic growth, which in turn contributes to the ability of firms to generate cash flows. That is why the industrial production would be expected to act beneficially on expected future cash flows, hence a positive relationship between real economy and stock prices exist. Furthermore, the volatility of stock returns increases during economic contractions and decreases during recoveries.

Fama (1981) indicated that the growth rate of industrial production had a strong contemporaneous relation with stock returns. Many studies show that large fractions (often more than 50%) of annual stock-return variances can be traced to forecasts of variables such as real GNP, industrial production, and investment that are important determinants of the cash flows to firms (Fama, 1990).

2.3.4 Irrationality of Agents

Finance theorists have argued that financial markets are intrinsically efficient (Fama 1965; Friedman 1953). This argument stems from the fact that rational traders possess perfect information and play the role of arbitrageurs when stock prices deviate from their fundamental values. Thus, in the long run, security prices stay in line with their fundamental values. This belief, however, contradicts the general market sentiments of irrational markets where many investors continuously behave irrationally. The noise trading approach (Shleifer and Summers 1990) explains the phenomenon by suggesting that rational traders may adopt practical yet irrational strategies to survive in a competitive environment faced with budget constraints and influences from the irrational traders.

Diversity and dynamics of beliefs are the root cause of price volatility and the key factor explaining risk premia. Agents may be "bulls" or "bears." A bull at date t expects the date t+1 rate of return on investments to be higher than normal, where "normal" is defined by the empirical distribution of past returns. Date t bears expect returns at t+1 to be lower than normal. Agents do not hold Rational Expectations (in short RE) since the environment is dynamically changing, non-stationary, and true probabilities are unknown to anyone. In such complex environment, agents use subjective models. Some consider these agents irrational, but one cannot require them to know what they cannot know: there is a wide gulf between an RE agent and irrational behavior.

2.3.5 Information

In modern financial markets, investors are simply flooded with a variety of information. On a daily basis, investors receive corporations' earnings reports, revisions of macro-economic indices, policymakers' statements, and political news. These pieces of information are processed by investors to update their projections of the economy's future growth rate, inflation rate, and interest rate. In turn, these changes in investors' expectations affect stock market prices.

In an incomplete information environment, random events are perceived differently by agents with heterogeneous beliefs. What appears as a negative surprise to an agent can be interpreted as a positive surprise by another agent. When investors have incomplete information, expected returns as measured by an econometrician deviate from those predicted by standard asset pricing models by including a term that is the product of the stock's idiosyncratic volatility and the investor's aggregated forecast errors (Hugonnier & Berrada, 2009). If investors are biased this term is non-zero on average and generates a relation between idiosyncratic volatility and expected stock returns.

2.4 Empirical Review

There are numerous empirical studies, which support the positive relationship between price (returns, volatility) and trading volume of a tradable asset (Crouch, 1970; Epps and Epps, 1976; Karpoff, 1986, 1987; Assogbavi et. al, 1995; Chen et. al, 2001). In a similar strand of literature, the asymmetric nature of volume response to return (volatility), i.e. the trading volume is higher when price moves up than on the downtick is sought to be explained (Epps, 1975; Karpoff, 1986, 1987; Assogbavi et. al, 1995). The asymmetric nature is explained through heterogeneous expectations and costs involved in short selling. Henry and McKenzie (2006) examined the relationship between volume and volatility allowing for the impact of short sales in Hong-Kong market and found that the asymmetric bidirectional relationship exists between volatility and volume.

2.4.1 Developed Market Context

Giot et. al (2010) decomposed realized volatility into two major components: a continuously varying component and a discontinuous jump component , to study the relationship between volume and realized volatility. The study sample consisted of the 100 largest stocks traded on the New York Stock Exchange (NYSE) as of January 1, 1995. The sample period covered a five year period from January 1, 1995 to September 30, 1999, which represented a total of 1199 trading days. Data for this study was retrieved from the Trades and Quotes (TAQ) database. They found that the number of trades is the dominant factor shaping the volume-volatility relation, whatever the volatility component considered and trade variables are positively related to the continuous component only. Trade variables are positively related to the continuous component only. The well-documented positive volume-volatility relation does not hold for jumps, indicating that poor trading volume leads to more erratic volatility changes.

Masset et. al (2010) analysed the lead-lag relationship of option implied volatility and index return in Germany based on Granger causality tests and impulse-response functions. The study dataset consisted of all transactions in DAX options and futures over the time period from 1995 to 2005. After analysing returns over 5-minute intervals, they found that the relationship was return-driven in the sense that index returns Granger cause volatility changed. This causal relationship is statistically and economically significant and can be clearly separated from the contemporaneous correlation. The largest part of the implied volatility response occurred immediately, but they also observed a smaller retarded reaction for up to one hour. A volatility feedback effect was not discernible and if it existed, the stock market appeared to correctly anticipate its importance for index returns.

Renault et. al (2011) provided a structural approach to identify instantaneous causality effects between durations and stock price volatility. By giving explicit moment conditions for observed returns over (random) duration intervals, they were able to identify an instantaneous causality effect. They found that instantaneous volatility forecasts for, e.g., IBM stock returns must be decreased by as much as 40% when not having seen the next quote change before its (conditionally) median time. Also, instantaneous volatilities were found to be much higher than indicated by standard volatility assessment procedures using tick-by-tick data. For IBM, a naive assessment of spot volatility based on observed returns between quote changes would only account for 60% of the actual volatility. For less liquidly traded stocks at NYSE this effect was even stronger. Also, instantaneous volatilities were found to be much higher than indicated by standard volatility assessment procedures. Finally, the documented causality effect had significant impact on statistical inference for tick-by-tick data.

Chen (2012) investigated whether the empirical linkages between stock returns and trading volume differ over the fluctuations of stock markets, i.e., whether the return–volume relation is asymmetric in bull and bear stock markets. Using monthly data for the S&P 500 price index and trading volume from February 1973 to October 2008, strong evidence of asymmetry in contemporaneous correlation was found. As for a dynamic (causal) relation, it was found that the stock return is capable of predicting trading volume in both bear and bull markets. However, the evidence for trade volume predicting returns was weaker.

Gebka (2012) investigated the dynamic relationship between index returns, return volatility, and trading volume for eight Asian markets and the US. They found cross-border spillovers in returns to be non-existent, spillovers in absolute returns between Asia and the US to be strong in both directions, and spillovers in volatility to run from Asia to the US. The study revealed that trading volume, especially on the Asian markets, depended on shocks in domestic and foreign returns as well as on volatility, especially those shocks originating in the US. However, only weak evidence was found for trading volume influencing other variables. In the light of the theoretical models, these results suggested sequential information arrivals, with investors being overconfident and applying positive feedback strategy. Furthermore, new information causes price volatility to rise due to differences in its interpretation among traders, but the subsequent market reaction takes the form of adjustment in price level, not volatility. Lastly, the intensity of cross-border spillovers seemed to have increased following the 1997 crisis, which the author interpreted as evidence of increased noisiness in prices and diversity in opinions about news originating abroad.

2.4.2 Emerging Market Context

Mutalib (2011) investigated the dynamics of relationship between trading volume and returns of Nigerian capital market. The study employed Granger causality tests to examine dynamic (causal) return- volume relation using daily stock data of 27 equities listed on the floor of Nigerian Stock Exchange for the period January 2009 to December 2010. The empirical results indicated, in general, a mild causal relation between stock returns and trading volumes for individual assets but on the overall, a weak evidence of a dynamic (causal) relation running from trading volume to market return was found. Based on the findings, the study recommended that other economic variables such as inflation rate, interest rate and firms' characteristics such as sectorial and industrial classification should be considered when forecasting short term returns of Nigerian capital market.

Tripathy (2011) conducted a study to investigate the dynamic relationship between stock return and trading volume of Indian stock market by using Bivariate Regression model, VECM Model, VAR, IRF and Johansen's Co integration test. The required time series data for the study was based on daily closing price of BSE SENSEX, actively traded 30 scripts and trading volume collected from Bombay Stock Exchange for a period of five years from January 2005 to January 2010. The study showed that there is a bi-directional causality between trading volume and stock return volatility. The study used variance decomposition technique to compare the degree of explanatory power of the trading volume over stock return and the evidence supported the influential role of the trading volume in the Indian stock market. Further Johansen's co integration analysis demonstrated that stock return is co integrated with the trading volume indicating long-run equilibrium relationship. The study concluded that stock price changes in any direction have information content for upcoming trading activities.

Attari et. al (2012) carried out a study to measure the relationship between trading volume and returns; and change in trading volume and returns of stocks in Pakistan. The study applied various techniques such as Unit root tests and GARCH on the data to determine the relationship between aforesaid variables. The sample of data used in the study comprised of weekly stock price index and trading volume of the Karachi Stock Exchange (KSE 100 index). The realization period covered was from January 2000 to April 2012 and data was collected from Bloomberg data base and business recorder data base. The GARCH results indicated a significant positive relationship between trading volume and returns, indicating that rising market goes with rising volume and vice versa. This finding depicts that information content of volume affects future stock return. In addition, the study found no causal relationship between change in volume and return. The explanation of this finding with regard to literature is that volume which is affected by market information, leads to price changes. And higher capital gains that depict positive price changes, lead to increase in volume, encouraging buying or long transactions of traders.

Pathirawasam (2011) conducted a study to examine the relationship between trading volume and stock returns. The sample of the study consisted of 266 stocks traded at the Colombo Stock Exchange (CSE) from February 2000 to December 2008. This sample included even delisted stocks in order to address the problem of survivorship bias. The study followed the conventional methodology used by Jagadeesh and Titman (Jagadeesh and Titman, 1993). The study revealed that stock returns are positively related to the contemporary change in trading volume. Further, it was found that past trading volume change is negatively related to stock returns. Investor misspecification about future earnings or illiquidity of low volume stocks can be the reason for the negative relationship between trading volume and stock returns. As the trading volume has predictive power on stock returns, investors can make trading volume based strategies to make profits and theoretically this provided evidence of weak form inefficiency of the CSE.

Wang et al. (2012) used heterogeneous autoregressive (HAR-RV) model with high-frequency data of Hu-Shen 300 index to investigate the volatility-volume relationship in the Chinese Stock Market via the volatility decomposition technique. The raw data in this study consisted of Hu-Shen 300 index (SZ399300) 1 minute high-frequency data ranging from April 2007 to December 2010. The data source was Hexun database. After eliminating trading days with missing data, the final dataset contained 947 days. The empirical analysis found that the continuous component of daily volatility is positively correlated with trading volume, the jump component revealed a significant and robust negative relation with volume. This result suggests that the jump component contains some “public information” while the continuous components are more likely driven by “private information”. Discussion of the intertemporal relationship supported the information-driven trading hypothesis. Lagged realized skewness only significantly affected the continuous component.

Celik (2013) tested the relationship between trading volume and return volatility within the scope of MDM and SIAM in Istanbul Stock Exchange (ISE) by using intraday ISE-30 index data and trading volume as a proxy for information arrival for the period between 04.02.2005 to 30.04.2010. The study used a 5-minute frequency to calculate the realized volatility and analysed two sub-samples considering the last global financial crisis. Firstly, they investigated the contemporaneous effect of information arrival on volatility by applying the HAR-RV model of Corsi(2004) and then extended this model as HARX-RV model following Aguilar and Ringgenberg (2011) by adding the trade volume as a proxy for the information arrival in HAR-RV model. HARX-RV model is denoted as in Equation [1]

$$RV_{t+1} = \beta_0 + \beta_D RV_t + \beta_W RV_{t-5,t} + \beta_M RV_{t-22,t} + \propto Vol_{t+1} + \varepsilon_{t+1} \qquad [1]$$

Where, RV_{t+1} is the realized volatility

RV_t is the daily realized volatility

RV_{t-5} is the weekly realized volatility

RV_{t-22} is the monthly realized volatility

Vol_{t+1} is the trade volume as a proxy for information arrival for day, t+1

The results indicated a positive relation between information arrival and volatility and supported that trading volume can be considered as a proxy for information arrival. The results show that findings differ across the two sub-samples. The findings support the MDM in pre-crisis period, however, the evidence was mixed in crisis period.

2.5 Summary of Literature Review

On the basis of the above-mentioned studies it can be stated that there are mixed empirical results between stock return volatility and volume especially in emerging markets context. Even though significant efforts have been made at the international level to evaluate volume and return volatility relationship, in Kenya this relationship has not been well investigated. Therefore, the current study aims to fill this gap and shed light on the informational efficiency of NSE. Also, previous literature mostly used GARCH models to examine the relation between volume and volatility. This paper differs from the previous literature in terms of using a volatility forecasting model- HARX-RV. This model is a simple autoregressive model for the Realized Volatility (RV) that takes into account volatilities realized over several horizons. The basic idea is that agents with different time horizons perceive, react and cause different types of volatility components. Thus, the study attempted to enhance the understanding of market asymmetry, market efficiency and information processing.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the research methodology that the researcher used to satisfy the research objectives stated in Chapter one of this study. It gives insight to the research design, target population, sample design, data collection and data analysis.

3.2 Research Design

The research study was studied through the use of a correlational research design. Correlational method is a statistical measure of a relationship between two or more variables that gives an indication of how one variable may predict another.

The main purpose of this research was to examine the nature of relationship between trading volume and stock return volatility in the Nairobi Securities Exchange. The study used realized volatility as a proxy for volatility and examined the relationship between volume and volatility using a volatility forecasting model- HARX-RV. The study extended the HAR-RV model of Corsi (2004) as HARX-RV model following Aguilar and Ringgenberg (2011) and Celik (2013) by adding the trade volume as a proxy for the information arrival in HAR-RV model.

3.3 Population

The target population in this study constituted all the companies listed on the NSE.

3.4 Sample

The dataset comprised of daily stock price index of all the active companies comprising the NSE 20-Share Index (Appendix A) and daily trade volume as a proxy for information arrival, for the period January 2008 to December 2013.

3.5 Data Collection

The study used secondary data obtained from NSE data-bank for the six year period starting January 2008 to December 2013. Quantitative data for NSE 20-Share index and trading volume was used to carry out the analysis.

3.6 Data Analysis

Econometrics model was used in the study to analyse the collected data. The data collected was used to develop a parsimonious component model to investigate the contemporaneous effect of information on volatility by applying the Heterogeneous Autoregressive Realized Volatility (HAR-RV) model as in Andersen et al. (2007) and Corsi (2009).

If we denote δ - period returns by, $r_{t,\delta}$ = p(t) – p(t - δ) the daily realized volatility will be computed as the summing corresponding 1/δ end of day squared returns as in Equation [2]:

$$RV_{t+1}(\delta) = \sqrt{\sum_{j=1}^{\delta-1} r_{t-j\delta}^2} \qquad [2]$$

Corsi's original HAR-RV (2004) was designed to capture the idea that investors with different time horizons would perceive, react to, and cause different types of volatility components. In other words, Corsi's model postulated that investor heterogeneity, in accordance with the Heterogeneous Market Hypothesis of Muller et al. (1997), leads to different volatility effects (short term, medium term and long term). HAR-RV model can be described as in Equation [3]:

$$RV_{t+1} = \beta_0 + \beta_D RV_t + \beta_W RV_{t-5,t} + \beta_M RV_{t-22,t} + \varepsilon_{t+1} \qquad [3]$$

$RV_t, RV_{t-5}\ and\ RV_{t-22}$ denote the daily, weekly and monthly realized volatility respectively.

The study extended the HAR-RV model of Corsi (2004) as HARX-RV model following Aguilar and Ringgenberg (2011) and Celik (2013), by adding the trade volume as a proxy for the information arrival in HAR-RV model. HARX-RV model is denoted as in Equation [4]:

$$RV_{t+1} = \beta_0 + \beta_D RV_t + \beta_W RV_{t-5,t} + \beta_M RV_{t-22,t} + \propto Vol_{t+1} + \varepsilon_{t+1} \qquad [4]$$

where Vol_{t+1} is the trade volume as a proxy for information arrival for day, t+1.

If information arrival affects the volatility, we would expect the coefficient of Vol_{t+1} , $\propto$ to be positive and statistically significant.

Jarque-Bera test statistics was used to find out whether the variables in the study follow normal probability distribution. JB test takes the form,

$$JB = n\left[\frac{S^2}{6} + \frac{K - 3^2}{24}\right]$$

Where, n = sample size

S = Skewness coefficient

K = Kurtosis coefficient

Skewness confers a measure of how symmetric the observations are about the mean, which is equal to a zero value in case of a normal distribution. A distribution can have positive skewness (if the mean is more than the median) or a negative skewness (when the mean is less than the median) while Kurtosis measures the thickness in the tails of a probability density function. For a normal distribution the kurtosis is equal to a value of 3.

CHAPTER FOUR

DATA ANALYSIS, RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the results and the interpretation of findings in 4.2, the empirical model in 4.3, while section 4.4 presents the discussion of the results.

4.2 Results and Interpretation of Findings

4.2.1 Descriptive Statistics

The study used secondary data obtained from Nairobi Securities Exchange (NSE). The data was analysed using Excel, which resulted in the following descriptive statistics relating to realized volatility of NSE 20-Share index and trade volume variables for the period January 2008 to December 2013, as presented in Table 1 below:

Table 1: Descriptive Statistics of Realized Volatility (RV) and Volume

	Volume	**RV**
Mean	16.6623	0.006
Median	16.6613	0.004
Maximum	19.8715	0.0695
Minimum	11.7845	0
Std Dev	0.7055	0.0068
Skewness	0.0448	3.3575
Kurtosis	1.7459	17.667
JB – Stat	189.25***	22227.21***

Source: Data obtained from NSE

Note: Volume is the logarithm of the trade volume variable. RV represents realized volatility. ***indicates the 5% significance level.

The descriptive statistics table above gives high average figure for volume and low average figures for realized volatility, however, these figures cannot give us more information about the distribution of the series.

The standard deviation figures are also high for volume, indicating that the data points are spread out over a large range of values, meaning that there is high level of variability in the data.

There is a wide gap between the maximum and minimum returns and volume, 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 both the skewness and Kurtosis are not equal to zero.

Skewness is more than zero meaning that bulk of the data is at the left and the right tail is longer. Kurtosis for volume is less than 3, meaning it is a platykurtic distribution, flatter than a normal distribution with a wider peak. The probability for extreme values is less than for a normal distribution, and the values are wider spread around the mean.

Whereas kurtosis for realized volatility is more than 3, meaning it is a leptokurtic distribution, sharper than a normal distribution, with values concentrated around the mean and thicker tails. This means high probability for extreme values. The distribution takes up a trend as graphically shown by appendices 2, meaning that it is not a normal distribution.

4.3 Empirical Model

4.3.1 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 as follows:

Table 2: Results of Stationarity Test on Returns

	Intercept	**Intercept and Trend**	**Constant with 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 NSE

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 1.61153 was lower than the critical value of 3.4952 at 5%, which means that the 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**	**Constant with 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 NSE

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.

4.3.2 Heterogeneous Autoregressive Realized Volatility Model

The heterogeneous autoregressive realized volatility (HAR-RV) model of Corsi (2004) considers volatilities realized over different time horizons. The realized volatility estimates are aggregated at different scales in order to have realized volatility measures of the integrated volatility over different periods: daily, weekly and monthly. Studying the interrelations of volatility measured over different time horizons, permits to reveal the dynamics of different market components. HAR-RV model can be described as in Equation [3]:

$$RV_{t+1} = \beta_0 + \beta_D RV_t + \beta_W RV_{t-5,t} + \beta_M RV_{t-22,t} + \varepsilon_{t+1} \qquad [3]$$

The results of model [3] that does not include volume variable are given in Table 4.

Table 4: Results of HAR-RV Model

	HAR – RV
$\boldsymbol{\beta_0}$	-0.0011
$\boldsymbol{\beta_1}$	0.1908
$\boldsymbol{\beta_2}$	0.3554
$\boldsymbol{\beta_3}$	-0.052
Adjusted $\boldsymbol{R^2}$	0.0713
F	39.4597
$\boldsymbol{\beta_1 + \beta_2 + \beta_3}$	0.4942

In Table 4 the sum of the parameter estimates ($\beta_1 + \beta_2 + \beta_3$) indicates the persistence. From the table above, RV_d and RV_w have a positive and statistically significant relationship with volatility ($\beta_1 = 0.1908; p = .000\ and\ \beta_2 = 0.3554; p = .000$), whereas, RV_m has a negative and statistically insignificant relationship with volatility ($\beta_3 = -0.052; p = .518 > .05$). The F – statistic is 39.4597 and p-value = .000, indicating that the model is statistically significant and the variables have a statistically significant relationship with volatility. Model summary is in Appendix D.

4.3.3 Heterogeneous Autoregressive Model with Volume

The study extended the HAR-RV model of Corsi (2004) as HARX-RV model following Aguilar and Ringgenberg (2011) and Celik (2013), by adding the trade volume as a proxy for the information arrival in HAR-RV model. HARX-RV model is denoted as in Equation [4]:

$$RV_{t+1} = \beta_0 + \beta_D RV_t + \beta_W RV_{t-5,t} + \beta_M RV_{t-22,t} + \propto Vol_{t+1} + \varepsilon_{t+1} \qquad [4]$$

The results of HARX-RV model that includes volume variable are given in Table 5.

Table 5: Result of HARX-RV Model

	HARX-RV
$\boldsymbol{\beta_0}$	-0.0084
$\boldsymbol{\beta_1}$	0.1926
$\boldsymbol{\beta_2}$	0.353
$\boldsymbol{\beta_3}$	-0.067
A	0.0004
Adjusted $\boldsymbol{R^2}$	0.0718
F	30.0461
$\boldsymbol{\beta_1 + \beta_2 + \beta_3}$	0.4786

If trading volume is considered as a proxy of the arrival of new information, we expect that $\alpha>0$. Similarly, if information arrival affects volatility, we expect that the coefficient of volume, α to be positive and statistically significant in HARX-RV model estimation. In addition, the sum of parameter estimates $(\beta_1 + \beta_2 + \beta_3)$ should be smaller when trading volume is included in model.

In this case, we can say that volatility persistence tends to decrease. α is positive (0.0004) supporting that trading volume can be considered as a proxy of the arrival of new information but is statistically insignificant, indicating that there is no relation between information arrival and volatility. Including trading volume into the model reduces the persistence of volatility terms in HARX-RV model. The F – statistic is 30.0461 and p-value = .000, indicating that the overall model is statistically significant and the variables have a statistically significant relationship with volatility. Model summary is in Appendix D.

4.4 Summary and Interpretation of Findings

From the empirical results, the standard deviation values for volume are high, indicating that the data points are spread out over a large range of values, meaning that there is high level of variability in the data NSE. There is a wide gap between the maximum and minimum returns and volume, which means that there is high variability of both price and volume change in NSE. 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 B.

The results of HAR-RV model show that the weekly realized volatility is the best estimate of volatility. The daily realized volatility is also positive and has a statistically significant relationship with volatility. But the monthly realized volatility is negative and statistically insignificant. The overall model has a F- statistic = 39.4597 and p-value = .000, indicating that the identified variables together have a statistically significant relationship with volatility. Similarly in the HARX-RV model, both daily and weekly realized volatility have positive coefficients, whereas monthly realized volatility is negative. The overall model including volume as a proxy for information arrival is statistically significant. From both the models it can be concluded that the weekly realized volatility is the best estimate for volatility forecast.

The HAR-RV and HARX-RV model results show that trading volume can be considered as a proxy of the arrival of new information, but it does not affect volatility. This means that changes in stock returns in the market are brought about by factors other than volume, such as the political environment, and investors' expectations of the market behaviour. 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 returns. Also, if the political environment is vulnerable, it could lead to a decline in stock returns. The results support the study by Olweny and Omondi (2011), which indicates that stock price volatility in NSE could also be brought about by macro-economic factors.

The result that there is no relationship between trading volume and stock return volatility in NSE 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. Also, the 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 return levels. Neither do changes in stock returns influence changes in stock volumes traded, nor do changes in stock volumes traded influence changes in returns of stocks in the market. Thus, it is very important for investors to understand stock market behaviours in terms of what factors directly influence return and volume levels, so as to make informed investment decisions.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents summary of findings, conclusions, and it also discussed limitations that may be in this study and areas that require further research.

5.2 Summary and Discussion of Results

Volatility measures variability, or dispersion about a central tendency. It is simply a measure of the degree of price movement in a stock, futures contract or any other market. The standard deviation was therefore calculated for the NSE 20-Share index over the period of study. Large values of standard deviation mean that stock returns fluctuate in a wide range from the mean. The stock returns of the index show low values of standard deviation implying that there is low stock return volatility during the period of study. The plot (Appendix C) for the returns shows volatility in the series during the first two years of the study and the returns started stabilizing following a uniform trend thereon, with a few outliers at times. These outliers could be due to factors such as impact from 2009 food crisis due to drought, which also caused electricity shortage that affected manufacturing sector. In 2010, the deterioration of security situations and floods could be the reasons. Inflation increase in 2011 and the fear of aftermath of the 2007 general elections slowed down the economy in early 2013 during elections.

This study intended to determine the nature of relationship between trading volume and stock return volatility in NSE using NSE 20-Share Index and daily trade volume as a proxy for information arrival. The trading volume coefficient in HARX-RV model is positive supporting that trading volume can be considered as a proxy of the arrival of new information but is statistically insignificant, indicating that there is no relation between information arrival and volatility. In addition to this, including trading volume into the model reduces the persistence of volatility terms in HARX-RV model. Thus, the findings suggest that there is a weak positive relation between volume and volatility.

5.3 Conclusions

Understanding the relationship between returns volatility and trading volume in financial markets is important for traders, researchers and policy makers. The distribution of returns has implications for various financial models and risk management practices. The contemporaneous relationship between returns and trading volume helps in understanding the market clearing process and frictions in the market. Also, ability of trading volume to forecast volatility helps agents like traders, with a very short-term investment horizon and portfolio managers that may have a medium-to-long-term investment horizon. In emerging markets generally and in Kenyan stock market context specifically, very few empirical studies have been reported on relationship between returns volatility and trading volume.

This study sought to determine the nature of relationship between trading volume and stock return volatility of firms listed in the Nairobi securities exchange. For this purpose we use daily NSE-20 Share index data and daily trade volume data as a proxy for information arrival running from 02.01.2008 to 30.12.2013. The study applied the HARX-RV model to test whether there is a contemporaneous relation between volume and volatility. The HARX-RV model extended the HAR-RV model of Corsi (2004) by adding the trade volume as a proxy for the information arrival in HAR-RV model As a result of HARX-RV model, we find that trading volume can be considered as a proxy for arrival of new information. But there is a statistically insignificant relation between information arrival and volatility. When trading volume is included, the persistence of volatility decreases, implying that there is a weak correlation between volume and volatility.

The study concludes that the number of shares traded is volatile. This implies that trading volume varies over time as shown by the high values of standard deviation of volume. It can also be concluded that changes in stock returns have a weak positive correlation with the number of shares traded. This indicates that major variations in share prices are explained by variables other than the traded volumes. This result raises a number of issues that could be addressed in future research regarding the specific variables that affect stock return volatility. This conclusion regarding the NSE is consistent with other studies conducted locally and within Africa (Gworo, 2012; Achieng, 2013; Mutalib, 2012), but inconsistent with the studies related to other emerging markets, specifically the Asian and Chinese market (Tripathy, 2011; Pathirawasam, 2011; Wang et. al, 2012) which found that volume represents the most predicted variable of increasing price volatility, and both volume and prices are integrated with each other. The reason for the negative relationship between trading volume and stock returns can be attributed to the fact that NSE is an emerging market, wherein investor misspecification about future earnings or illiquidity of low volume stocks can be the reasons. Based on the findings, the study recommends that other economic variables such as inflation rate, interest rate and firm's characteristics such as sectorial and industrial classification should be considered when forecasting returns.

5.4 Limitations of the Study

This study guides towards an analytical outcome. However, while conducting this study, following opportunity areas were identified, which can be termed as limitations-

First, only the NSE 20-share index is studied during the six year period. Although the index represents different sectors, a clearer picture would still be established if all listed companies are studied. This study generalized the findings from all the sectors and this raises the question of whether the findings could hold for each sector.

Secondly, we also experienced time limitations in that the time period in which the study was conducted was fairly short. Although, this did not compromise the quality of work produced. More time however, would have ensured a thorough analysis on the research project.

Another limitation was encountered in the model that we used to analyze the data collected. The model may have been limiting as it only utilized historical data. Past performance may not always predict future performance and ignores changes that may have been implemented in the present. The model was also highly quantitative thus not representative of the qualitative analysis of data.

Stock market in Kenya is influenced by a number of factors, the major being the general performance and the nature of the current economic situations in the country. The economic situation is reflected by the changes in the macroeconomic variables such as the level of the gross domestic product, interest rate levels, exchange rate, inflation, the amount of money supply in the economy and other factors beyond the scope of this study such as the employment/ unemployment rate and the activities of the government like general elections. Whereas, this study uses only number of shares traded, giving a partial analysis.

In addition, the study was conducted for a period of six years, from January 2008 to December 2013. Carrying out a similar study for a longer time horizon would not only enhance the study, but also vet the findings of this study.

5.5 Recommendations

5.5.1 Policy Recommendations

Though there is a weak correlation between the two variables as depicted by the estimation results, important policy implications arise out of the findings of the study. The Capital Markets Authority, NSE and other policy makers should be conscious of the effects of other macro-economic factors on stock returns. The aim should be to stimulate development of the financial markets to mobilize long term capital for the economic development. In setting relevant strategies, policy makers need to consider the effects of factors other than trading volume such that effective decisions can be made for long term financial market sustainability.

The study therefore recommends that there should be a deliberate policy framework aimed at creating a favourable market to provide stability wherein the macro-economic factors are not able to majorly impact. This would not only reinforce investors' confidence, but also attract more foreign investments into the equity market which will enhance market liquidity.

5.5.2 Suggestions for Further Research

The study can be extended in several ways. First, a study of a similar nature should be carried out for a more extended period, such as for 10 years. Carrying out a similar study for a longer time horizon would not only enhance the study, but also vet the findings of this study

Secondly, a research on the same topic should be conducted using all the firms listed on the NSE. This study generalized the findings from all the sectors and it raises the question of whether the findings could hold for each sector. A study should therefore be carried out to specifically find out the nature of the relationship for each sector and not a market as a whole as addressed in this study.

Thirdly, different variables can be used as a proxy for information arrival such as news arrival. As we know that the stock market in Kenya is influenced by a number of factors, the major being the general performance and the nature of the current economic situations in the country. The study can be extended using measures such as the level of the gross domestic product, interest rate levels, exchange rate and inflation.

The paper can be extended using high frequency based measures of volatility to find out whether there will be any significant variation. According to previous studies, the advantage of incorporating the high-frequency data is higher, potentially achievable information ratios compared to the use of daily closing prices and thus higher profit potential for investors.

This research used econometric models with Microsoft excel to do the analysis. A more advanced tool of analysis such as SPSS could be applied in similar study, to find out whether similar results will be obtained.

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APPENDIX A

List of Firms listed on NSE 20-Share Index

AGRICULTURAL

Rea Vipingo Plantations Ltd

Sasini Ltd

COMMERCIAL AND SERVICES

Express Kenya Ltd

Kenya Airways Ltd

Nation Media Group

TELECOMMUNICATION AND TECHNOLOGY

Safaricom Ltd

AUTOMOBILES AND ACCESSORIES

CMC Holdings Ltd

BANKING

Barclays Bank Ltd

Equity Bank Ltd

Kenya Commercial Bank Ltd

Standard Chartered Bank Ltd

MANUFACTURING AND ALLIED

British American Tobacco Kenya Ltd

East African Breweries Ltd

Mumias Sugar Co. Ltd

CONSTRUCTION AND ALLIED

Athi River Mining

Bamburi Cement Ltd

E.A. Cables Ltd

ENERGY AND PETROLEUM

KenGen Ltd

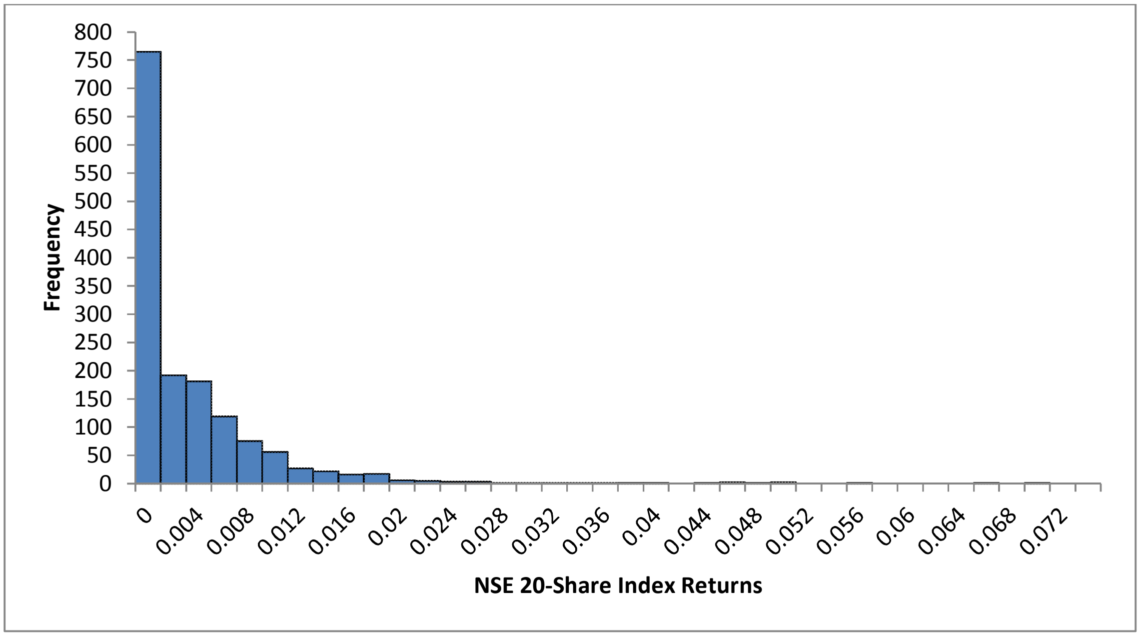
Kenya Power & Lighting Co Ltd

INVESTMENT

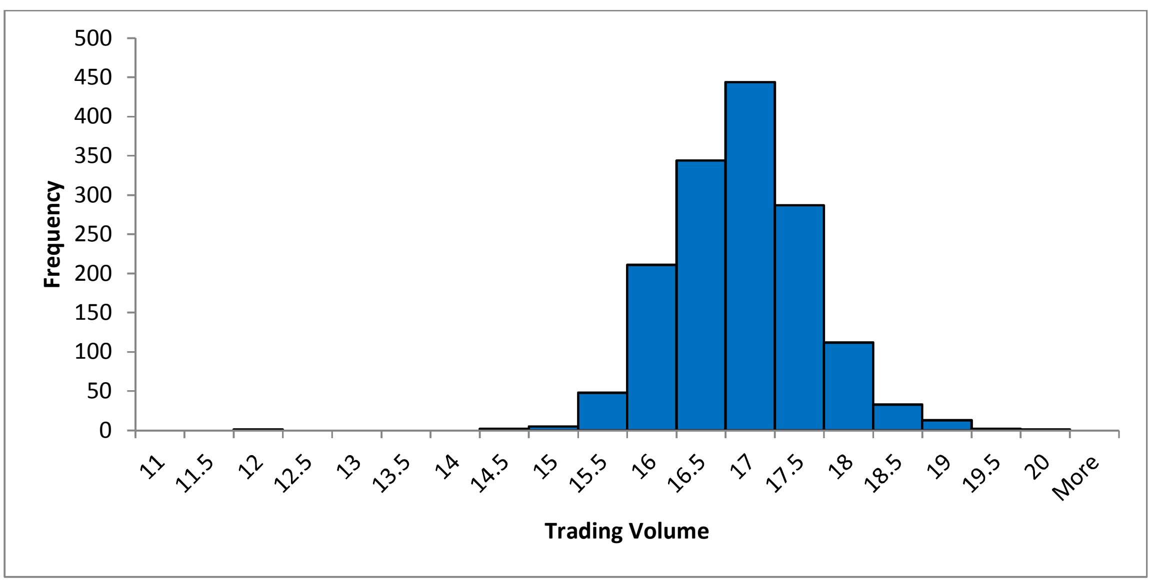
Centum Investment Co Ltd

APPENDIX B

Normality distribution of NSE 20-Share Index Returns

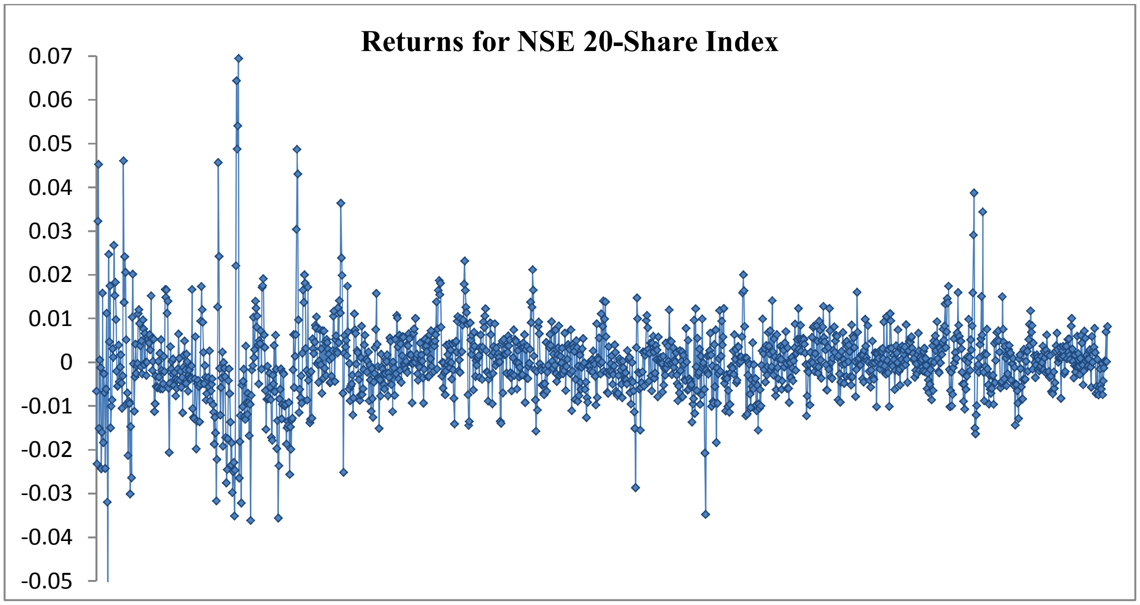


Normality distribution of Trading Volume



APPENDIX C

The plot is for returns of NSE 20-Share index for the period January 2008 to December 2013.



APPENDIX D

HAR-RV Regression analysis:

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.270539964
R Square	0.073191872
Adjusted R Square	0.071337019
Standard Error	0.008748462
Observations	1503

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	0.009060205	0.003020068	39.45966556	1.53034E-24
Residual	1499	0.114726836	7.65356E-05		
Total	1502	0.123787042			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-0.00114032	0.000304923	-3.739702406	0.000191175	-0.001738441	-0.0005422	-0.001738441	-0.0005422
X Variable 1	0.190794861	0.034619932	5.511127575	4.19119E-08	0.122886209	0.258703512	0.122886209	0.258703512
X Variable 2	0.355376331	0.043721183	8.128241388	9.02653E-16	0.26961514	0.441137522	0.26961514	0.441137522
X Variable 3	-0.051986924	0.080546161	-0.645430194	0.518747219	-0.20998207	0.106008221	-0.20998207	0.106008221

HARX-RV Regression using logarithmic volume:

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.272527358
R Square	0.074271161
Adjusted R Square	0.071799254
Standard Error	0.008746284
Observations	1503

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	0.009193807	0.002298452	30.04610903	4.46068E-24
Residual	1498	0.114593234	7.64975E-05		
Total	1502	0.123787042			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-0.008365828	0.005475951	-1.527739564	0.126788323	-0.019107174	0.002375519	-0.019107174	0.002375519
X Variable 1	0.192596216	0.034638145	5.560234762	3.18517E-08	0.124651802	0.260540629	0.124651802	0.260540629
X Variable 2	0.35300524	0.043747108	8.069224554	1.43727E-15	0.267193149	0.438817331	0.267193149	0.438817331
X Variable 3	-0.067048436	0.081328615	-0.824413847	0.409835696	-0.226578488	0.092481616	-0.226578488	0.092481616
X Variable 4	0.000432841	0.000327526	1.321547512	0.186520665	-0.000209617	0.001075298	-0.000209617	0.001075298