MODELING STOCK PRICE VOLATILITY DURING PRE AND POST FINANCIAL

CRISIS PERIOD IN KENYA

ENETH GAKII BUNDI

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DECLARATION

I declare that, this research project is my original work and has not been presented for a degree award in any university.

Signature……………………….   Date………………………..

This project has been submitted for examination with approval of University supervisor:

Signature…………………...   Date………………………..

Dr Philip Ngare

School of Mathematics

University of Nairobi

DEDICATION

I am dedicating this project to all my family members for their great support and unconditional love that they have given to me.

ACKNOWLEDGEMENT

I would like to thank the almighty God for giving me guidance; protection and good health to carry out this research .I also appreciate the great support by my family members, my supervisor Dr. Philip Ngareand my fellow classmates.

I am also grateful to the entire academic staff of the School of Mathematics for their encouragement and support.

Table of Contents

34LIST OF FIGURES

ABSTRACT

The trend of stock market prices in Kenya during the financial year 2007-2010 has been of major concern for stock market investors and the financial institutions. Investors as well as the financial institution use the stock returns volatility to measure risk however it becomes a challenge to make predictions on the stock price movement if the stock market environment is unstable.This study mainly concentrates on estimating the historical volatility using historical data from Nairobi stock exchange. An analysis of the trend of stock market prices during this period has revealed that unexpected event spikes the volatility of stock prices.

The volatility trend revealed in this study can be associated with the major shocks affecting the financial economy for instance the global financial crisis, domestic crisis (post-election violence). Injection of these shocks in the economy, increases uncertainty on the political and economic stability hence lowers investor's confidence.

CHAPTER ONE

1. INTRODUCTION

1.1. Background of the study

According to the Central bank annual report, the Kenyan economy was highly affected by the crises (both domestic and financial) that the economy faced in the FY 2007/2008 which lead to a fall in the economic growth from 7% to less than 2, the country¢s exchange rates depreciated and in response to the global financial crisis most central banks reacted by lowering the interest rates. Exchange rates and interest rates changes are the key driving forces that influence the changes in the stock prices. This therefore makes the analysis of the pre and post crises (both financial and domestic) stock price volatility of great importance.

Volatility refers to the amount of uncertainty or risk about the size of changes in a security's value.It¢s an inevitable market experience mirroring fundamentals, information and market expectations. Adjustments in equity prices echo changes in various aspects of the society such as economic, political and monetary aspects. Thus, corporate profitability, business strategy, product quality, political stability, interest rates among other factors should have a role to play in shaping the intensity of price fluctuations, as the market moves from one equilibrium to another. At the same time information about the changes in fundamentals should spark market activity changing the landscape of future prices (George, 2008). Stock volatility is associated with the business cycle, which is the recession, booms or recovery period. Stock volatility is higher during the recession and lower during the boom period of the economy.

Stock Market is a market or a facility by means of which :offers to sell, purchase or exchange securities are regularly made or accepted or information is regularly provided concerning the prices at which, or the consideration for which, particular persons or particular classes of

persons, propose, or may reasonably be expected to sell, purchase or exchange securities (NSE). In Kenya the main stock market is the Nairobi Stock Exchange which was established in 1954 and is regulated by the Capital Market Authority. It trades equities, preference shares, treasury bonds and corporate bonds and the main indices: NSE All Share Index and NSE 20 Share Index. There are different factors that affect the stock market which range from interest rates, exchange rates, inflation, Balance of payments, unemployment rates, GDP, monetary and fiscal policy used by the government and other factors such as the political stability in the economy, cultural practices as well as trade relationships that a country has developed (Jeff, 2011).The stock market is supposed to play an important role in the economy in the sense that it mobilizes domestic resources and to channel them to productive investments. However, to perform this role it must have significant relationship with the economy. Higher interest rate reduces the value of equity as indicated by the dividend discount model and consequently, makes fixed income securities more attractive as an alternative to holding stocks. As a result, this may reduce the propensity of investors to borrow and invest in stocks and also, raises the cost of doing business and hence affects profit margin. On the other hand, lower interest rates resulting from expansionary monetary policy also boost stock market.

A financial crisis is a situation whereby there is a fall in the value of the financial institutions, which is composed of both the financial and capital markets, or rather a scenario in which the value of assets falls. The Kenyan economy experienced a financial crisis in the FY 2008 which saw the economic growth in the country go down. According to the Central Bank of Kenya report, the economic growth rates fell from 7% which was the growth rate in 2007 to less than 2% in the 2008 (CBK, 2009). During this period the country was faced by both the global

financial crisis as well as domestic crisis which arose from the post election violence brought along by political instability.

Stock price volatility is an indicator that is used by option traders to find changes in trends in the stock markets. There are two main types of stock volatility namely: the historical stock price volatility and the implied stock price volatility that are used in the options markets. Stock price volatility tends to rise when there is new information in the markets thus as explained by the efficient market hypothesis the stock prices reflect the available information in the market.

Historical volatility, oftenly referred to as actual volatility and realized volatility is the measure of the stock price movements based on historical prices and is used to measure how active a stock price typically is over time. It measures the fluctuations in the share price specifically by taking the daily percentage price changes in a stock and calculating the average in a specified time period. It helps to determine the option's worth as well as give traders a clue to the type of strategy that can be best implemented to optimize profits in a given market (George, 2008).

Implied volatility it is a measure of an underlying assets' volatility as is reflected in an option's price. That is implied stock volatility is the level of volatility that will calculate a fair value that is equal to the current trading option price. In order to determine the implied volatility of a stock we consider the following: the expiration date, the stock current price, the strike price and the stock dividends paid by the stock and thus use an options pricing model for instance The Black-Scholes option pricing model. Implied volatility is said to be an indicator of the stock direction. Therefore if the market participants expect an underlying asset to exhibit high volatility going forward, option premiums (implied volatility) will be high. If the underlying asset is expected to show little volatility going forward, implied volatility will fall to reflect those expectations. Implied volatility is used to monitor market's opinion about the volatility of a particular stock.

Justified volatility can form a basis for efficient price discovery, while volatility dependence implies predictability, which is welcomed by traders and medium-term investors (Greg, 2010). The importance of volatility is widespread in the area of Financial Economics. Equilibrium prices, obtained from asset pricing models, are affected by changes in volatility; investment management lies upon the mean-variance theory, while derivative valuation hinges upon the reliable volatility forecasts.

The study is aimed at analyzing the pre-and post (financial and domestic) crisis stock price volatility by investigating the changes or the pattern followed by the stock prices before the crisis and after the crisis. The findings will then be used to make appropriate recommendation on the prediction of stock prices by the investors.

1.2. Objectives of the study

1. To analyze the pre and post financial crisis stock price changes.

2. To model the stock price volatility at NSE.

3. To evaluate the impact of the financial crisis on the stock price volatility.

4. Pricing volatility.

1.3. Significance of the Study

The findings of this study will provide the stock market investors with a better understanding of the stock price volatility in relation to the impact of unexpected events on stock prices and thus help them plan their trading strategies and approaches on investments in future.

To academicians and researchers the study is of great importance as it will provide the base from which more research studies can be done on stock price volatility. The study also provides more information which can be used by researchers and academicians in their literature review.

1.4. Statement of Problem

Investors are highly concerned with maximizing the profit margins thus their focus is mainly on the changes in stock price which in turn increase the risk involved in the investments. The stock market prices are highly affected by demand and supply forces in the market, political as well as investorø expectations, therefore, the market faces high levels of uncertainty due to the movements of price unexpectedly. Therefore by analyzing the stock price volatility by investigating the patterns involved the study aims at comparing the variations in the prices which can be used by investors to plan and manage their investments. It will also reveal a pattern through which the financial institutions can use to predict and upgrade their moves in order to maximize the stock returns as well as company profit.

The various agents in the financial economy face the problem of unexpected volatility. This study narrows down to investigate the effect of the domestic crisis on the stock prices by analyzing the stock movement before the crises, on and after the crises and comparing the results with the stock price movement in the U.S stock market. Since both U.S and the Kenyan economy both were affected by the Global Financial crisis then the difference observed in the stock price movements of the two economies will reveal the significance of domestic crisis on the stock prices. The analysis can thereby be used by the agents to predict the behavior of stock prices in case of economic shocks as well as crises.

CHAPTER TWO

2. LITERATURE REVIEW

Over the recent past years scholars, practitioners and various institution have diverted their attention on how to manage market risk.The distribution of stock returns is symmetrical since the stock prices follow a random walk hence one canestimate the probabilities of profits and losses associated with each amount. Thus the standard deviation of securities returns, which is referred to as historical volatility, can be used as a risk indicator (Marie et al, 2003).

2.1. Financial crisis and stock price volatility

The financial crisis stemming from the burst of the housing and credit bubble lead to a shutdown of the credit markets and spread around the globe, with the resultant massive destruction of equity and real estate wealth. The drastic crisis of investor confidence triggered massive selloffs in the stock markets around the world (Lemma, 2009). This study analyses the causes of global financial crises (by using data from several countries), the determinant of stock markets performance as well as the policies that can be implemented, by investigating the correlation in pre-crisis and the crisis period. In conclusion Lemmaøs results show that the stock performance is affected by the crisis.

In the capital market, by March 2009 the Nairobi Stock Exchange (NSE) 20-Share Index had fallen to a near seven-year low. It improved between March and June 2009, slumped in July-September of the same year and increased marginally by about 5% between end-September and December 2009 (0.8% in October, 4.1% in November and -0.1% in December 2009) as investors focused their portfolio on the bond market (Francis,2010). Over the past decade, foreign investors have increased their investments in the Nairobi Stock Exchange (NSE) attracted by high returns. As a consequence, the crisis has adversely affected the stock market, with foreign

sales exceeding foreign buys in many counters, as foreign investors diversify away from the market (Kibaara, **2008**).

2.2.   Modeling stock price volatility

The NSE 20-Share Index has therefore taken a hit since the mid-2008 on the back of the post-election violence and the crisis.The NSE 20-Share Index slumped by 35% in 2008, 25% since July 2008.13 By end-February 2009, the index had declined by 23.2% in the previous one month, by 26.8% in the previous three months and by 46% in the previous one year, offsetting the gains made in the previous three years (one of the largest offsets in sub-Saharan Africa). In March 2009, the index fell further to about 2000 points, near its seven-year low of 1983 points. The index then reversed its trend, picking up an upward trajectory, raising hopes that the market could be finally getting out of the woods, as the economy showed some signs of recovery. The NSE 20-Share Index improved between March and June 2009 by 17.5%, but slumped in July-September 2009, shaving its value by 8.8%. The index increased by about 5% between end-September and December 2009 (0.8% in October, 4.1% in November and -0.1% in December 2009).

 A study by Sergiy 2009, focused on modeling volatility in financial markets by comparing different models for conditional volatility estimation as well as examining the accuracy of several methods: historical volatility models for instance, Exponential Weighted Moving Average, the implied volatility, and autoregressive conditional Heteroskedasticity models (the GARCH family of models). He introduces a number of representations of the volatility skews and discusses their importance for the risk management of the options portfolio.

Equity volatility is time varying and tends to display patterns, thereby rendering the stock returnsø empirical distribution non-normal. Several historical time series models have been used,

among them being historical volatility models which lie on the premise that past standard deviation of returns can be estimated. Standard deviation in this case is defined as the variability of the distribution of stock or index prices. In financial theory it is assumed that the logarithms of the stock prices are normally distributed and not the prices themselves thus the computation of statistical volatility will use the lognormal distribution of stock returns rather than the simple standard deviation. For instance the random walk model, where the best forecast of today's volatility is yesterday's realized value.

Another approach is the Historical average which amounts to a long-term average of past standard deviations. Moving average method is also used though it does not include all past standard deviations but discards older information by deploying a rolling window of fixed length say 10 -40 trading days. Risk metrics model is another approach (JP Morgan, 1996) which uses an exponentially weighted moving average to forecast volatility and gives greater importance on the recent volatility estimates.

2.3. Pricing volatility

2.3.1. Volatility trading

This is where the volatility of the underlying asset rather than the price itself is traded thus this can be done using options. Option trading allows the investors to take both short and long position on volatility. A study of Peter Carr, 2002, towards a theory of volatility trading discusses different methods of trading volatility which includes taking static positions in options that is both long position and short position; delta-hedging an option position and buying or selling an over-the counter contract whose pay-off is the explicit function of volatility (Carr, 2002,. He concludes that while static positions in options do generate exposure to volatility, they also generate exposure to price. Similarly, a dynamic strategy in futures alone can yield a

volatility exposure, but always has a price exposure as well. By combining static positions in options with dynamic trading in futures, payoffs related to realized volatility can be achieved which have either no exposure to price, or which have an exposure contingent on certain price levels being achieved in specified time intervals.

As foreign exchange investors think that they can foretell the currency trends or bond traders believe that they know about the future path of interest rates, laying a bet on the expected level of volatility surfaces as another trading vehicle. Given the dynamic and changing nature of statistical volatility, the trader must take into account the occurrence of unusual events. A unique and unusual event can spike historical volatility for instance panics, financial crisis, earnings and other unexpected events such as post election violence was the case in Kenya in FY 2008. Although volatility is always in a state of change most stock or indexes can be assigned a normal or average value that is the traders can use the concept of reversion to the mean to assign a value (George, 2008).

CHAPTER THREE
3. METHODOLOGY

This chapter discusses the research design and methodology of the study; it highlights a full description of the research design, the research variables and provides a broad view of the description and selection of the population. The research data sources, data collection techniques and data analysis procedure have also been pointed out.

3.1. Research Design

A research design is a strategic plan used so as to achieve the objectives of the study as well as to provide solutions to the problem encountered in the area of the study. This study will use descriptive and quantitative survey design thus it will use an empirical approach where secondary data will be analyzed and conclusions made based on the results obtained. The research is designed to model volatility by computing both historical volatility and implied volatility. Historical volatility is calculated from the historical stock prices obtained from NSE. On the other hand, implied volatility is calculated using (call and put) options this is done by use of the Black-Scholes model. With known parameters, these are substituted in the model: the parameters include time to maturity, expiration date, the strike price and the current stock price (underlying asset).

3.2. Population and sample design

The variables used in this research are the daily stock price's highest and lowest value for the last 12 months, the weighted average price and both the NSE 20 share index and NSE All Share Index (NASI). In this case, the NSE share index used in the research is the NSE 20 share index which is a price weight index and measures the performance of 20 blue-chip companies with

strong fundamentals and that have consistently returned positive financial results. NASI was introduced in 2008 as an alternative share index; its measure is overall indicator of the market performance.

The sample data is based on the NSE stock price and index values for the financial year 2007 to 2010. The sample data used is presented as daily stock price as well as the NSE 20 share index and NASI share index for the time periods January 2007 to December 2010.

3.3. Data collection

The data used in this research is secondary data. The daily stock prices and the NSE 20 share index data is obtained from the Nairobi Stock Exchange.

3.4. Data analysis

Data analyses will involve the use both of descriptive and quantitative statistics, which in this case will include the use of graphs, histograms and bar charts. These will enable the study to establish the strength of relationships between the variables involved in this study.

3.5. Estimating historical volatility

To estimate the historical data empirically, this study observes the stock prices at fixed time intervals (daily, weekly and monthly) using the secondary data obtained from NSE (Hull, 2008).

Let**: n** be the number of observations.

S_t be the current stock price and S_{t-1} be the previous stock price: r_t: the continuous return

Therefore,

$$r_t = Ln\left[\frac{S_t}{S_{t-1}}\right]$$, which is the continuous return.

The natural logarithm is used to obtain an exact estimate of returns, since the dispersion of the stock prices conforms to a lognormal distribution rather than a normal distribution, which can be traced back to the effect of compounding.

Mean return is given by:

$$\overline{r_t} = (\sum_{t=1}^{n} r_t) / n$$

If r_t is normally distributed with a mean μ and a standard deviation σ, then the expected arithmetic mean is;

$$E(R_t) = e^{\mu + \frac{\sigma^2}{2}}$$

Standard deviation is obtained using the following equation:

$$\sigma_r = \sqrt{\left[\left(\sum_{t=1}^{n}\left(r_t - \overline{r_t}\right)^2\right) / n - 1\right]}$$

Volatility is expressed as a percent per year by annualizing the standard deviation.

There are two ways of annualizing the standard deviation: one approach in which the Standard deviation is annualized by multiplying the σ with the square root of the trading days. If the observations are daily then, **volatility = $\sigma \times \sqrt{}$ trading days per year**. If the observations are weekly or monthly then the volatility is obtained by multiplying the standard deviation with ç52 or ç12 respectively. The other method of annualizing standard deviation is by converting the standard deviation back into variance by obtaining its square, and then the variance is multiplied

by the number of trading days in a year and thereafter we obtain the square root of the value to get the standard deviation. This study uses the first approach described to obtain the annualized standard deviation.

Choosing an appropriate n can be challenging but generally more data lead to higher levels of accuracy, but volatility does change over time and data that is too old may not be relevant for predicting the future. Therefore, an often-used rule of thumb is to set n equal to the number of days to which the volatility is to be applied. For instance, if the volatility estimate is to be used to value a 2-year option, daily data for the last 2 years is used.

3.6. Estimating implied volatility

Implied volatility is the volatility which is implied by the option prices observed in the market. Thus, the volatility cannot be observed directly using the Black-Scholes pricing formulas.

Black Scholes assumptions:

1. The price of the underlying share follows a geometric Brownian motion. That is, the share price changes continuously through time according to the stochastic differential equation:

$$dS_t = S_t (\ dt +\ dZ_t)$$

Where: μ is the expected rate of return, σ is the volatility of the stock price and dZ has a normal distribution with: mean of $dZ = 0$;

Standard deviation of $dZ = \varsigma\ dt$

And the variance of $dZ = dt$

2. There are no risk-free arbitrage opportunities.

3. The risk-free rate of interest is constant, the same for all maturities and the same for borrowing or lending.

4. Unlimited short selling (that is, negative holdings) is allowed.

5. There are no taxes or transaction costs.

This is important since for continuously rebalancing some risk-free portfolios.

6. The underlying asset can be traded continuously and in infinitesimally small numbers of units.

Infinite divisibility of securities is necessary to ensure that perfect hedges can be achieved.

The Black-Scholes formulas for the prices at time 0 of a European call option on a non-dividend-paying stock and a European put option on a non-dividend-paying stock are as follows:

$$c = S_o N(d_1) - Ke^{-rT} N(d_2)$$

And

$$p = Ke^{-rT} N(-d_2) - S_o N(-d_1)$$

Where:

$$d_1 = \frac{Ln(S_o / K) + \left(r + \frac{\sigma^2}{2} \right) T}{\sigma \sqrt{T}}$$

And

$$d_2 = \frac{Ln\left(S_o / K\right) + \left(r - \frac{\sigma^2}{2}\right)T}{\sigma\sqrt{T}} = d_1 - \sigma\sqrt{T}$$

Where c and p are the European call and put price respectively, S_0 is the stock price at time zero, K is the strike price, r is the continuously compounded risk-free rate, is the stock price volatility and T is the time to maturity of an option.

The strike price and the time remaining to maturity are obtained from the terms of the option contract, while the risk-free rate of interest and the price of the underlying asset can be obtained from market quotations hence the implied volatility is the only unknown in the formula. Therefore, if the parameters in the Black-Scholes are known, then the implied volatility can be obtained by substituting the values in the formula until the solution to the formula is equal to the price at which the option is trading. However, this study focuses mainly on the historical volatility since options are not traded in Kenya.

The next chapter analyses data using both graphs and bar charts to investigate the trend of daily and weekly stock prices using data obtained from NSE.

CHAPTER FOUR

4.   DATA ANALYSIS AND DISCUSSIONS

4.1. A wide spread increase in the stock volatility.

Kenya's stock market volatility can be traced in the financial year 2008 and persisted throughout to financial year 2010 due to uncertainty in global markets that filtered in the local market. The share index reached a high level of 5,646 in the year 2007 and a value of 4,234 in 2010 as the stock market gained stability.

4.1.1.   Trend of weekly NSE 20 and NASI stock Share Index for the year 2007 to2010

NSE 20 and NASI are the two main stock market indices used by NSE. Both indices show a similar trend with NSE 20 reaching a high level of 6,161.46 and a low level of 2,375.01 whereas NASI 115.20 and 51.28 highest and lowest value respectively. However, NSE 20 reveals a higher rate of volatility than the NASI.
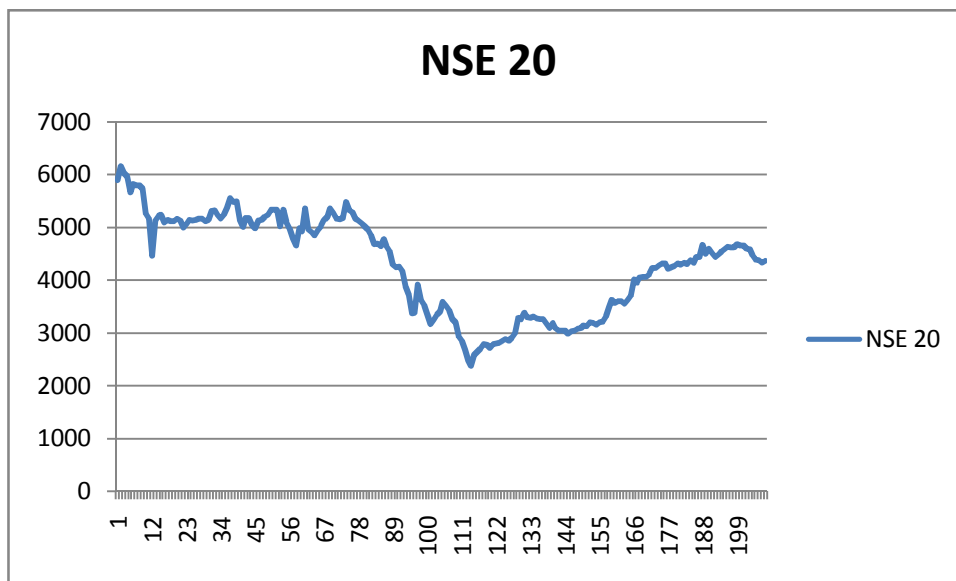
Figure 4.1.1
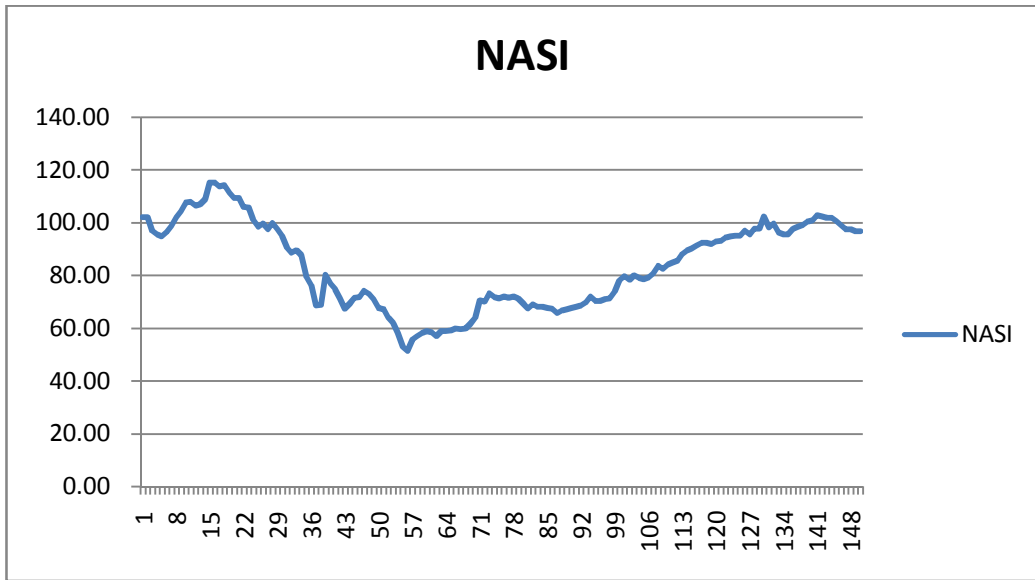
Figure 4.1.1.1

4.2. Annual Historical volatility for NSE 20 Share Index and NASI indices

The volatility of both the NSE 20 share index and the NASI decreases significantly from 2007 to 2010.
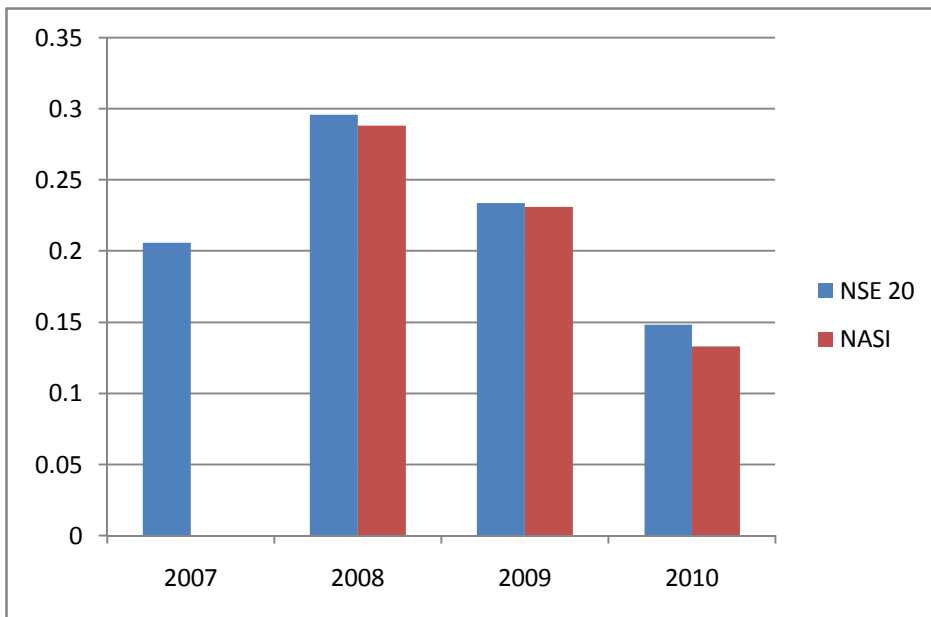
Figure 4.2

4.2.1. Historical volatility for each industry compared with that of the indices from 2007

The main stock market indices usually include the largest market capitalizations on the national stock exchange, but their composition varies greatly. The number of companies included, the volatility of the individual stocks tracked and the degree of diversification, as shown by the variations between the stocks tracked, can differ significantly. As revealed by the chart, the volatility of stock prices for different industries is more than the volatility of the overall index (NASI).
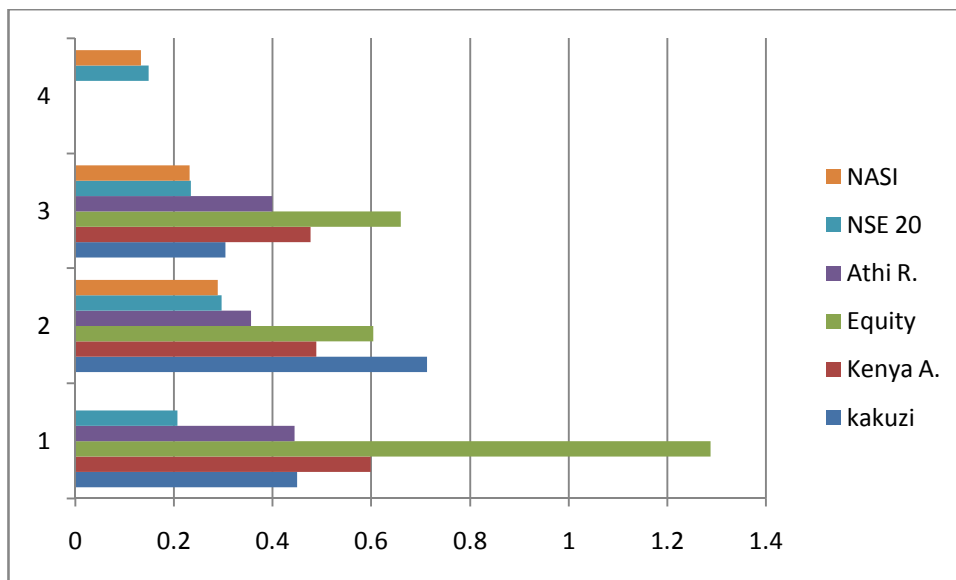
Figure 4.2.1

4.3. The trend of daily NSE 20 share index in the year 2007

The NSE 20 share index has had a high value of 6161.46 in the month of January and a low value of 4465.09 in the month of March. Thus the volatility of the index is higher in the first quota of the FY 2007 and low volatility is revealed in the following month consistently with volatility spike in the month of October.
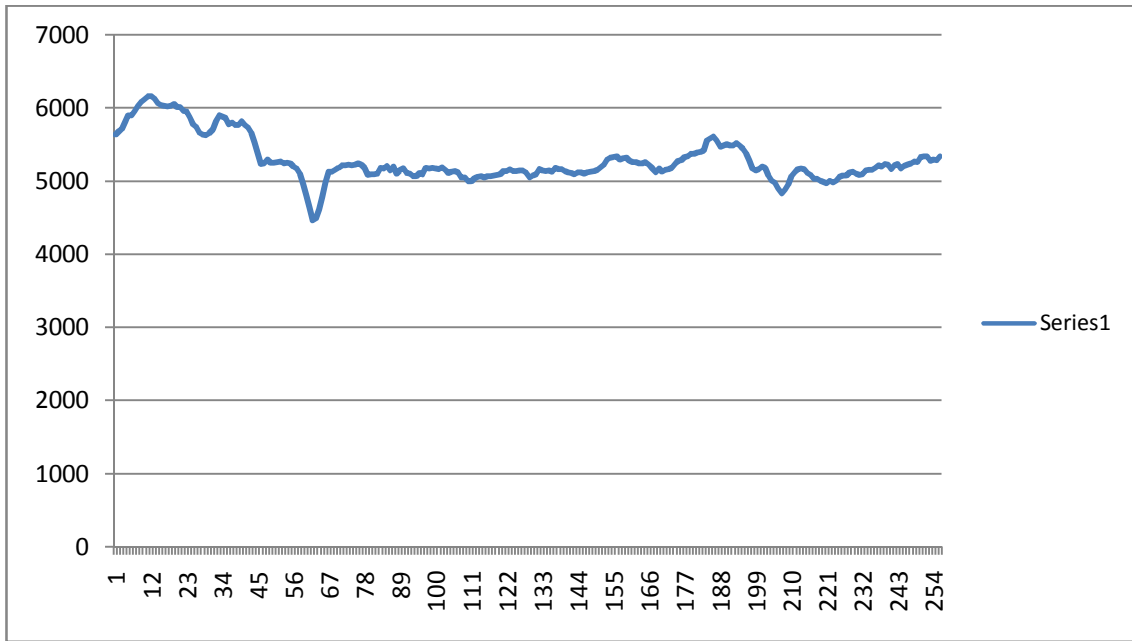
Figure 4.3

4.4. 6-Month historical volatility for NSE 20 share index and NASI
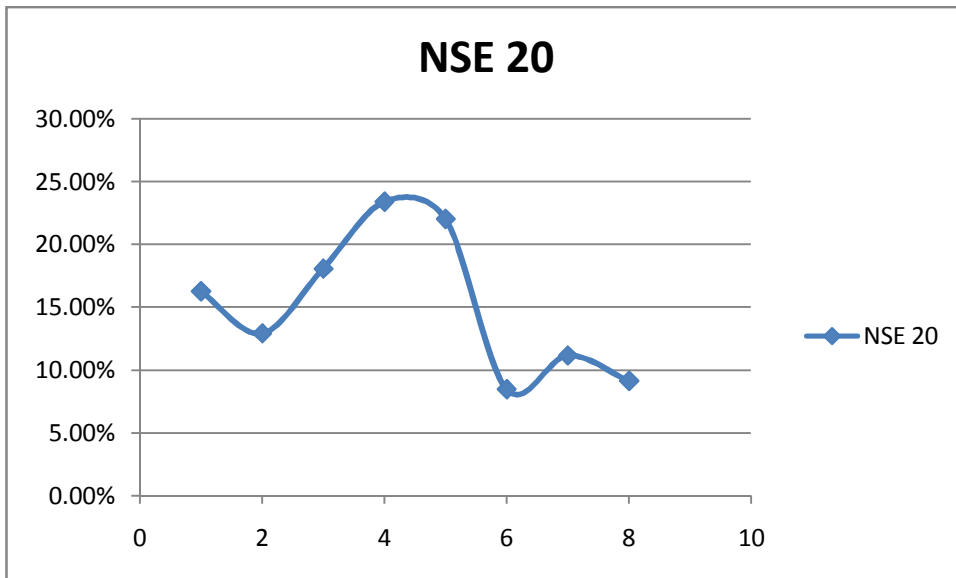
Figure 4.4
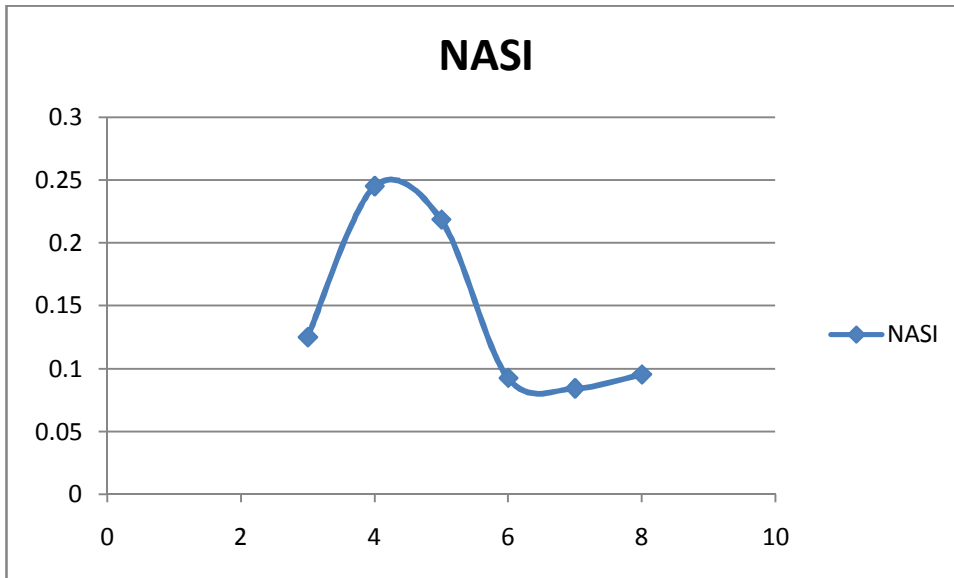
NASI

Figure 4.4.1.1

The above graphs are constructed from a 6-month annualized historical volatility of both the NSE and NASI. Both indices show a similar volatility trend that reveals increasing volatility that reaches a volatility peak in the financial year 2008 for both indices. In 2009 the volatility level decreases substantially and takes low levels in 2010.

4.4.1. 6-Month and annual historical volatility for NSE 20 share index

Annual volatility

Year	Index	Index
	NSE 20	**NASI**
2007	0.205768	
2008	0.295385	0.287973
2009	0.233604	0.23056
2010	0.14798	0.1328

6-month volatility

YEAR	NASI	NSE
2007		0.16261
2007		0.12916
2008	**0.125026**	0.180591
2008	**0.244992**	0.2337
2009	**0.218515**	0.220048
2009	**0.092584**	0.084903
2010	**0.084355**	0.111615
2010	**0.095412**	0.091429

The annual volatility for NSE 20 index is higher than that of the 6-month for the four years.
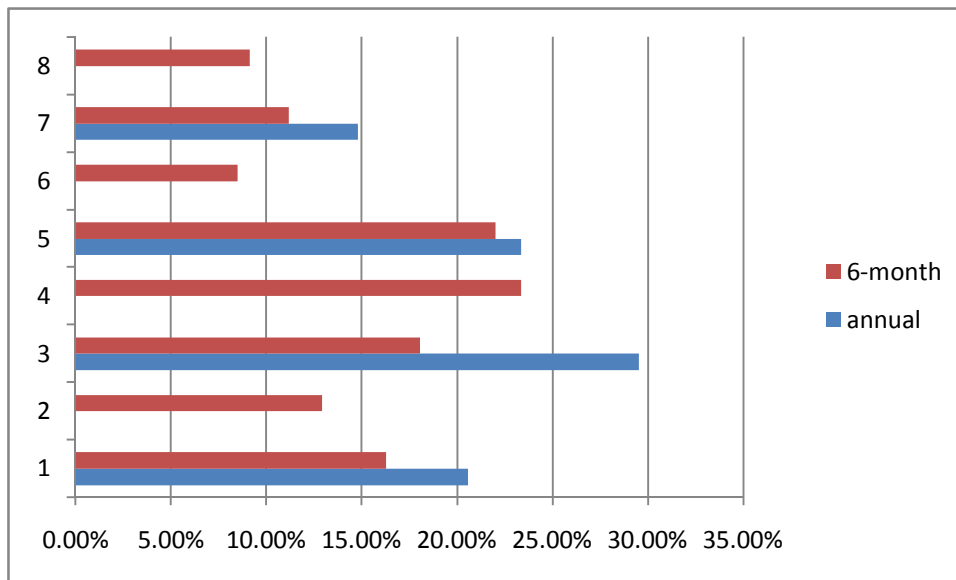
Figure 4.4.1

4.4.2. 6-Month and annual historical volatility for NASI

It reveals the same trend as that of the NSE 20 in that the annual volatility is higher than the 6-month volatility.
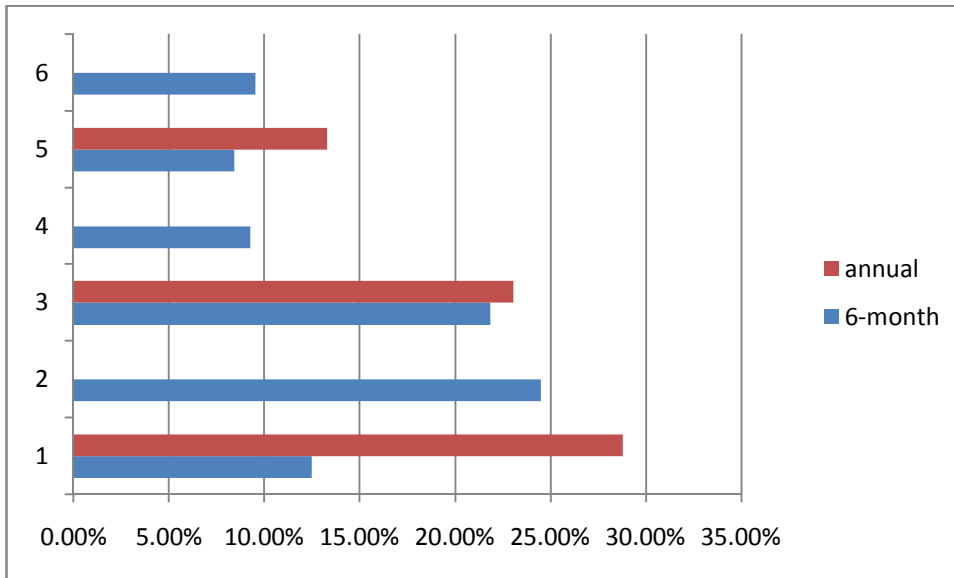
Figure 4.4.2

4.5. The trend of daily stock prices in the financial year 2007 (Unilever Tea Kenya Ltd)

The stock prices in the financial year 2007 trend reveal a high value of 91in the month of January and lowers to the value of 60 in December. This trend reveals the political impact on the stock prices and can be associated to low investor confidence due to uncertainties in the stock market considering the political environment.
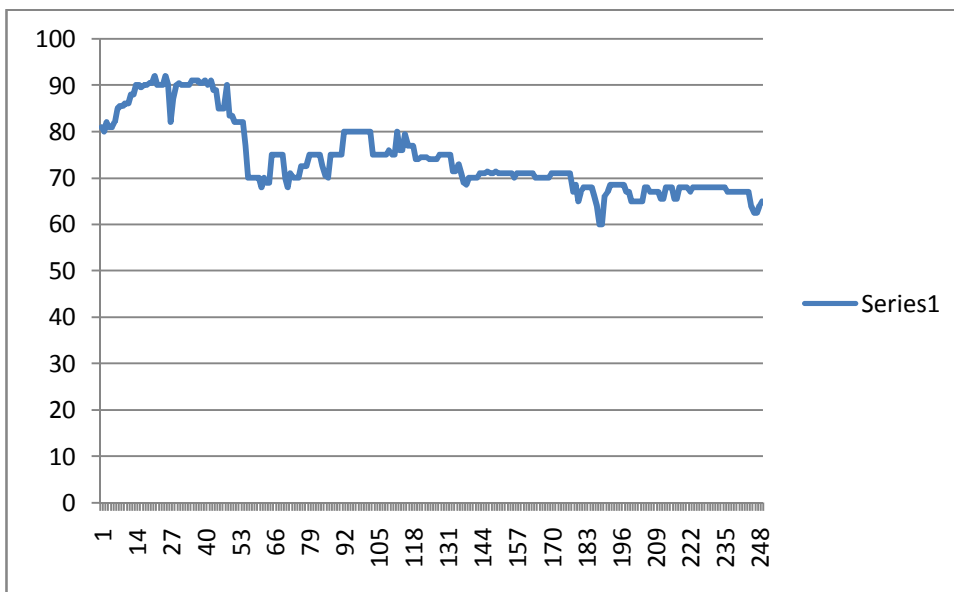
Figure 4.5

4.6. Monthly historical volatility for the stock prices

The monthly volatility for the stock prices portrayed in the figure below is calculated using an investment in the main market segment óUnilever Tea Kenya Ltd. It reveals the same trend as the NSE 20 share index with sharp volatility spikes in March.
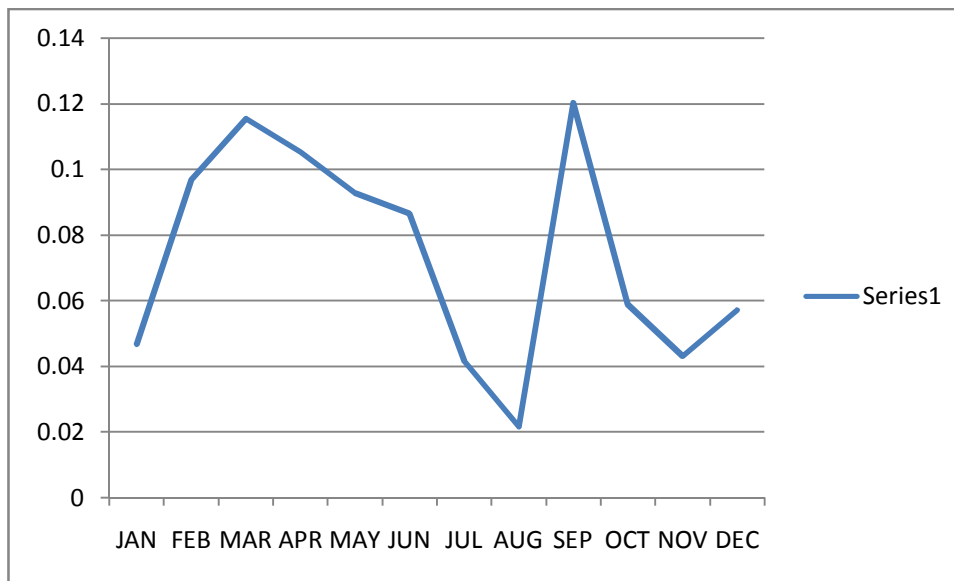
Figure 4.6

4.6.1. Monthly historical volatility for different industries in the Main investment segment

The industries in the Main Investment Market Segment as classified by NSE include: Agricultural, Commercial and Services, Finance and Investment and Industrial and allied. This study uses one investment from each industry in the segment as follows;

- Agricultural- Unilever Tea Kenya Ltd or Kakuzi Ltd

- Commercial and Services- Kenya Airways Ltd

- Finance and Investment- Equity Bank Ltd

- Industrial and allied- Athi River Mining

Historical volatility of stock prices from different industries also vary substantially as can be observed from both the graph and bar chart below. Volatility varies differently in various months with a high volatility from the industries observed in the month of March and April. Volatility from Finance and Investment industry is the highest in the month of April followed by Commercial and Services industry in March.
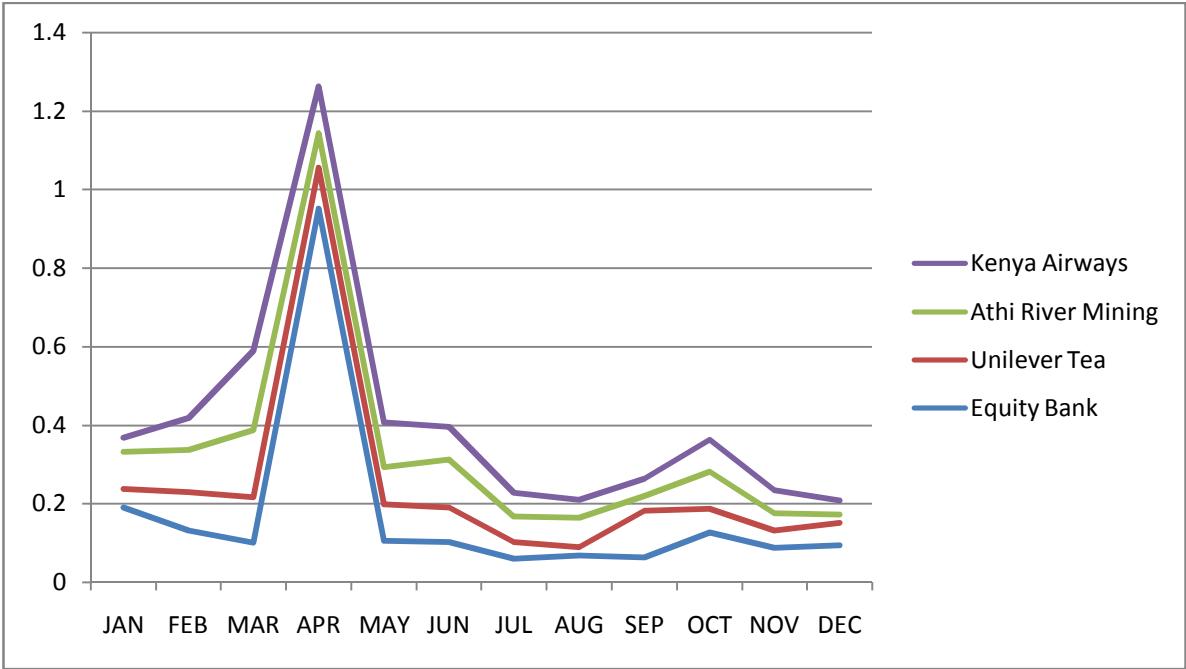
Figure 4.6.1
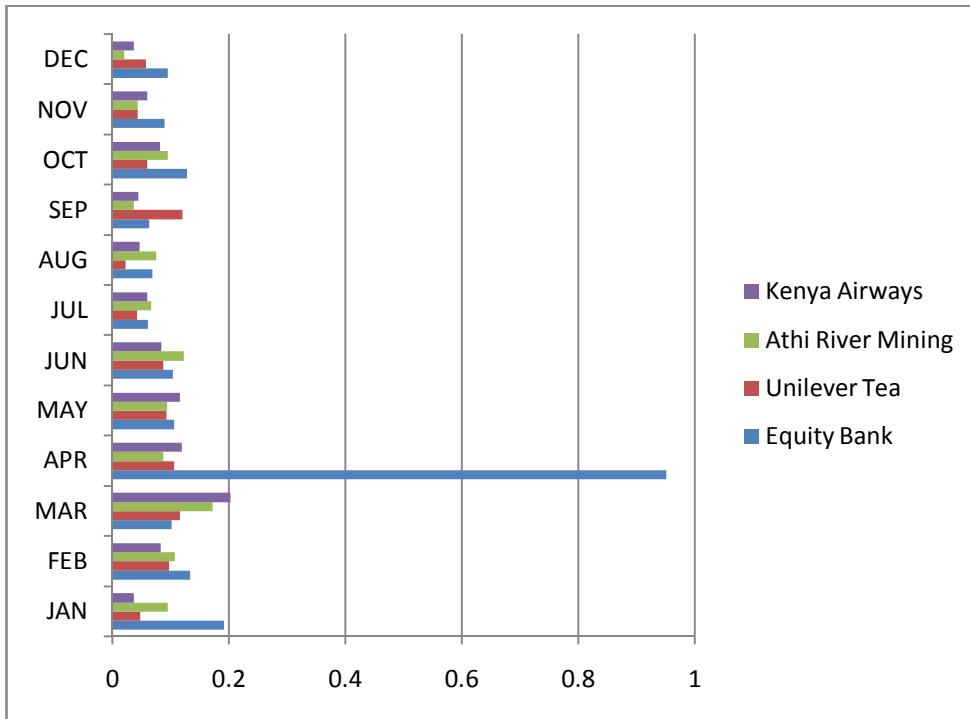
Figure 4.6.1.1

4.7. The trend of daily stock prices from different industries in the main segment in Financial Year 2007
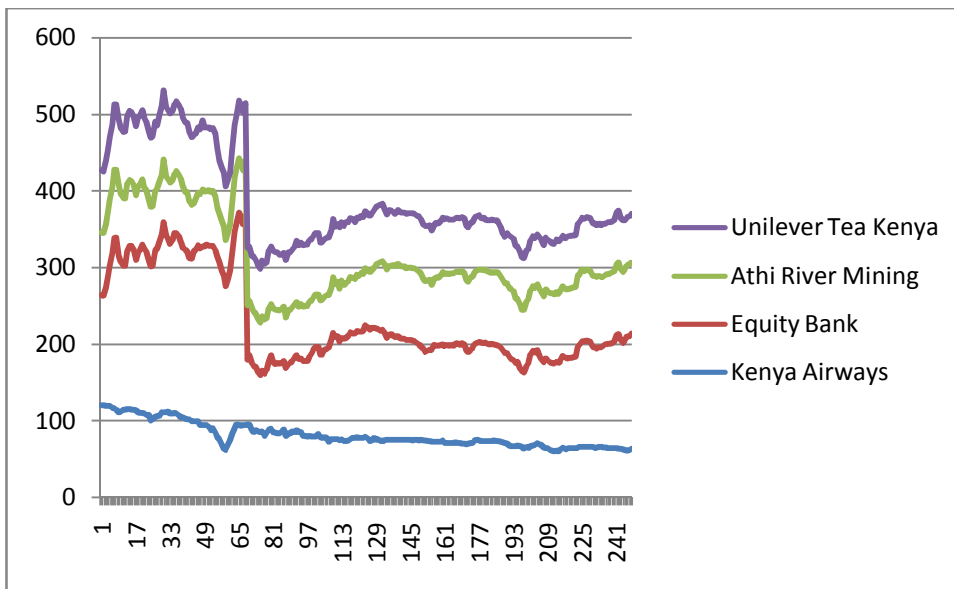
Figure 4.7

As observed in the figure above the changes in the stock prices vary with low changes in stock prices from Kenya Airways as compared to other investments.

4.8. The trend of weekly stock prices from different industries in the main segment in Financial Year 2007
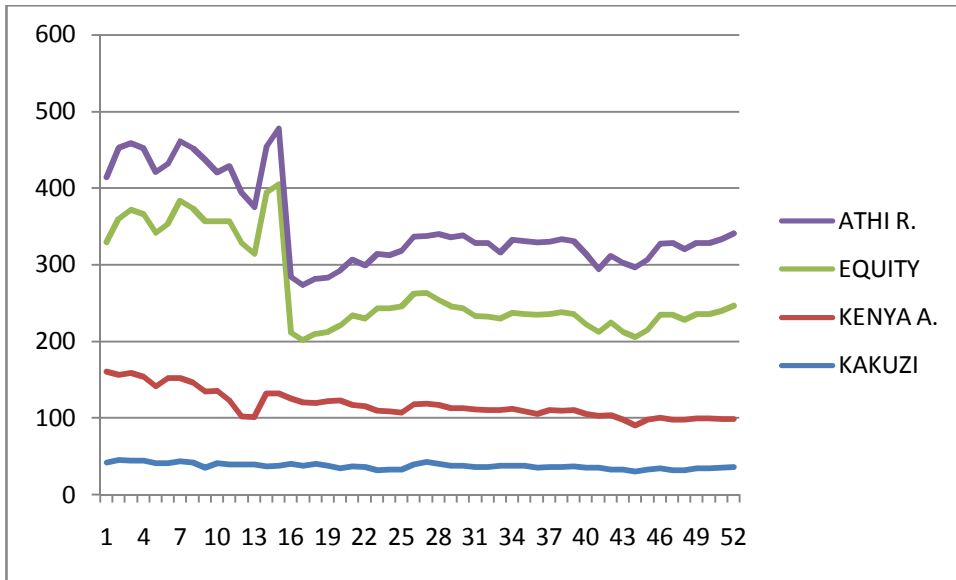
Figure 4.8

The above graph shows higher stock price changes for both Athi River and Equity Bank than that of Kakuzi Ltd and Kenya Airways.

4.8.1. The trend of weekly stock prices from different industries in the main segment in Financial Year 2008
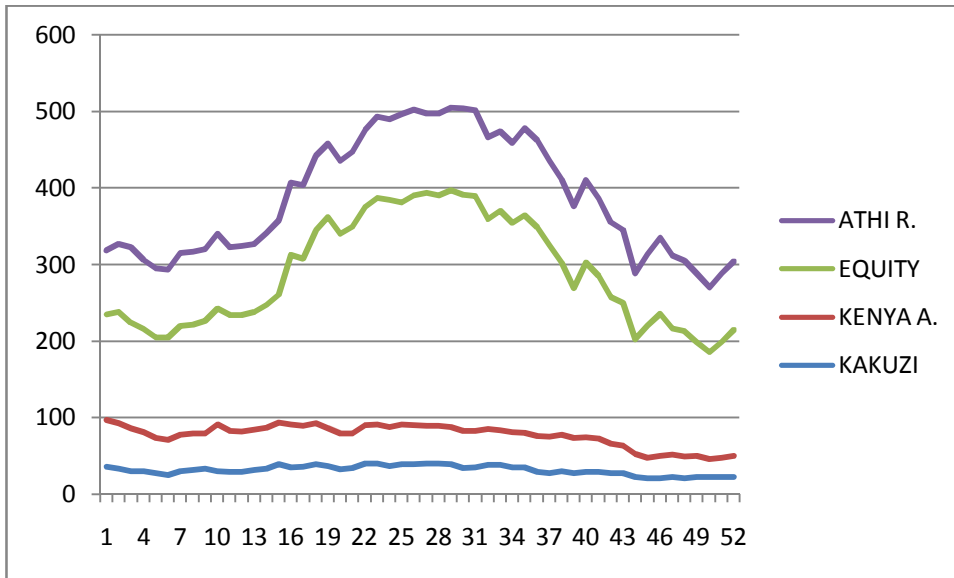
Figure 4.8.1

This shows high changes in the prices in 2008 with both Equity bank and Athi River mining forming ‑stock price plateausø while Kakuzi and Kenya Airways are characterized by low price changes.

4.8.2. The trend of weekly stock prices from different industries in the main segment in Financial Year 2009
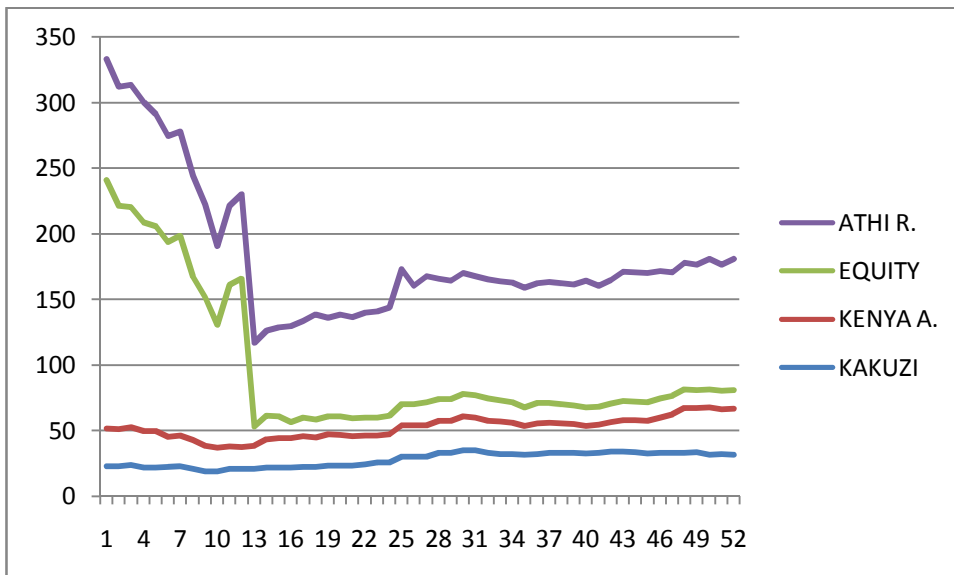
Figure 4.8.2

The trend portrayed reveals high volatility for both Equity and Athi River with rapid changes for the first half of the year which levels down in the rest of the year. Kakuzi and Kenya Airways maintain lower levels of changes similar to that of the financial year 2008.

4.9. Intraday volatility for different industries in 2007

Intraday volatility is measured the percentage change by calculating the difference between highest stock prices and lowest prices in a day. The observation from the daily stock prices reveals high level of intraday volatility as well as extreme low levels in the month of January. The trend reveals that though there is consistent volatility for Kenya Airways Ltd the volatility is maintained at the same range throughout the year unlike for the other investment where volatility range rises steadily after the first month.
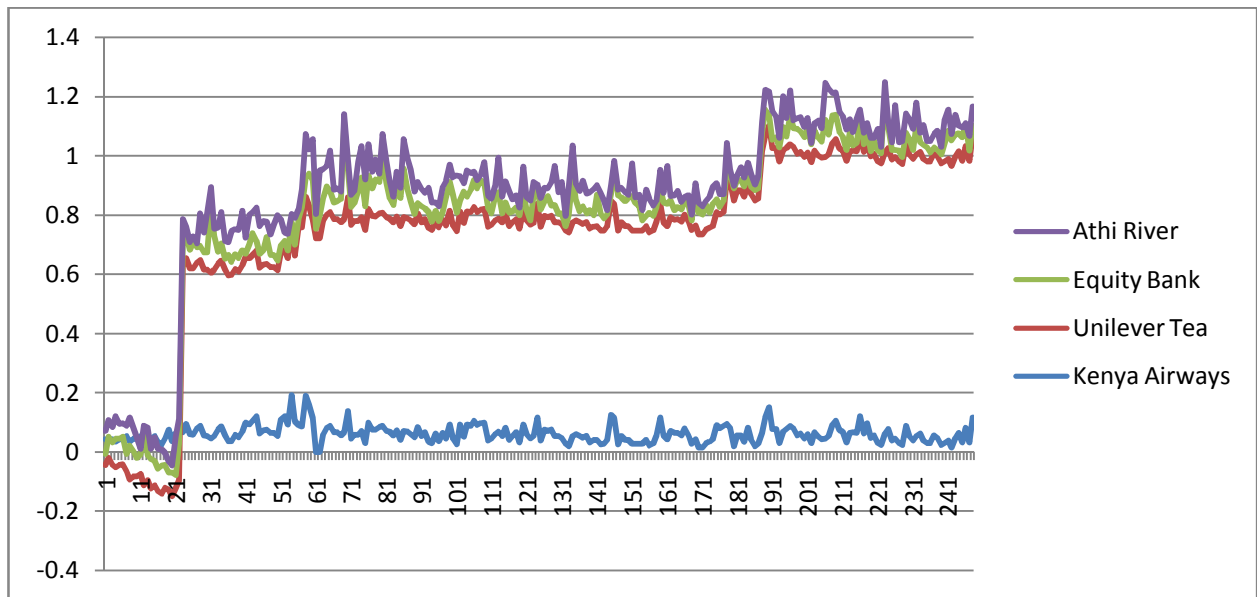
Figure 4.9

4.10. Annual Historical volatility for different industries from the main industries (represented by one investment from each industry)
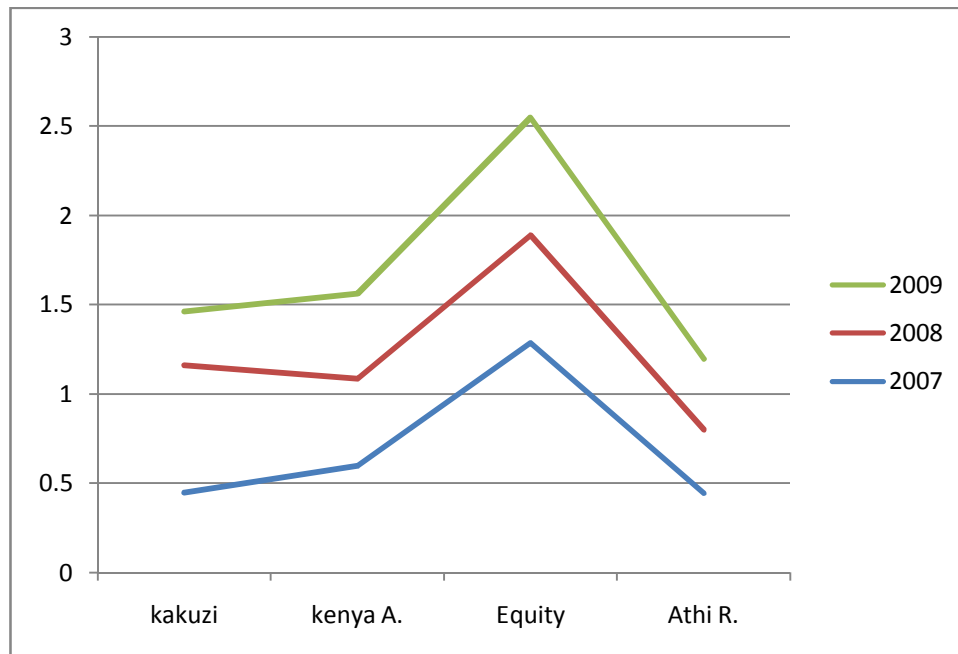
Figure 4.10

As revealed from the graph above, the Finance and Investment industry represented by Equity Bank Ltd portrays high volatility compared with the other industries. Though NPLs have been declining, the impact of the December 2007 post-election crisis reversed the gains in the first half of year 2008 (CBK, 2008, Report). This can be clearly shown from the bar chart below.
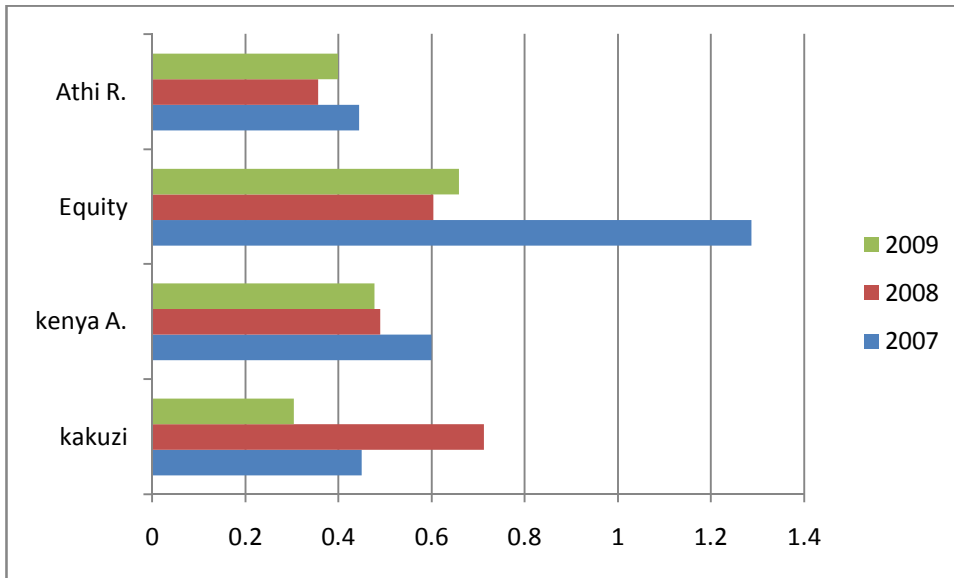
Figure 4.10.1

Comparing the Trend of weekly stock prices for different industries

Equity Bank Ltd
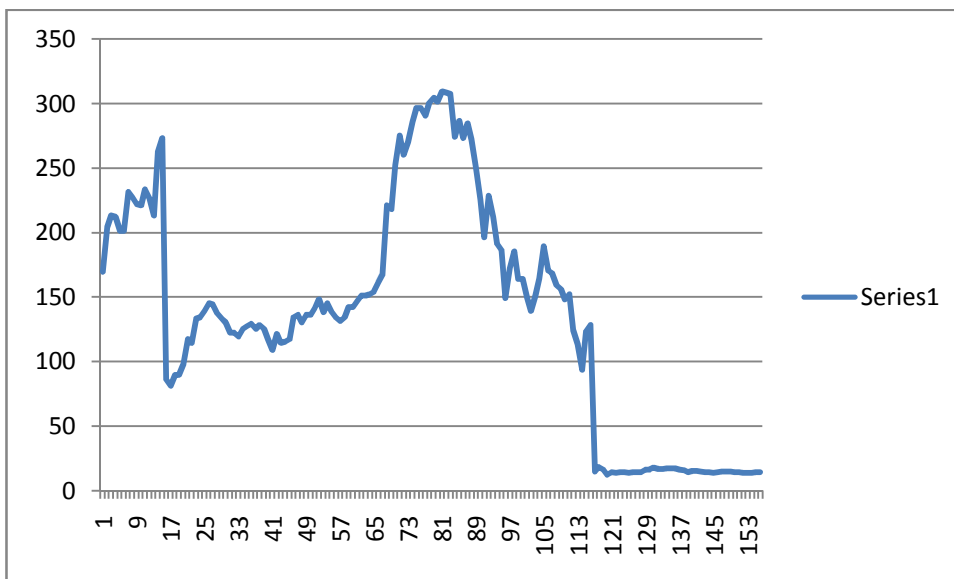
Figure 4.10.2
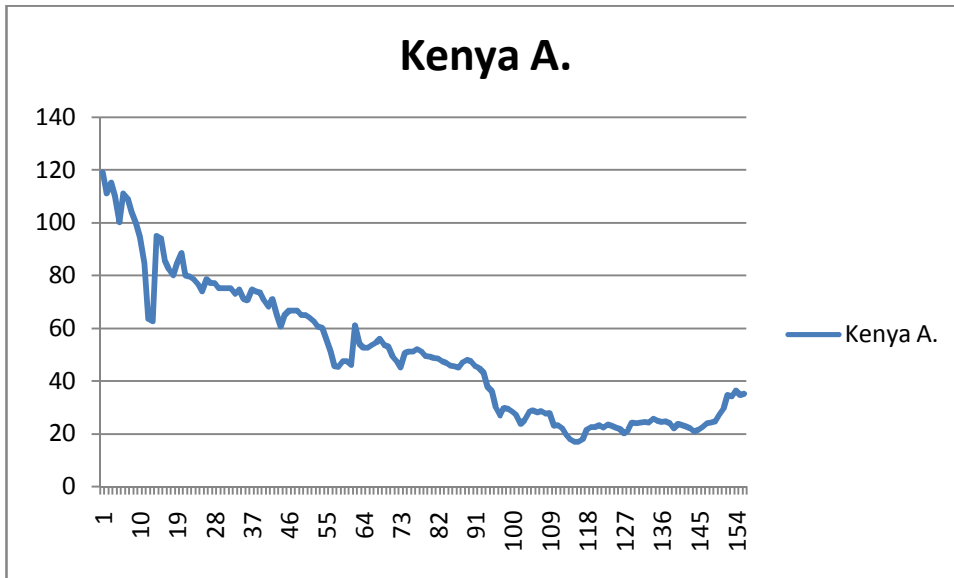
Figure 4.10.3
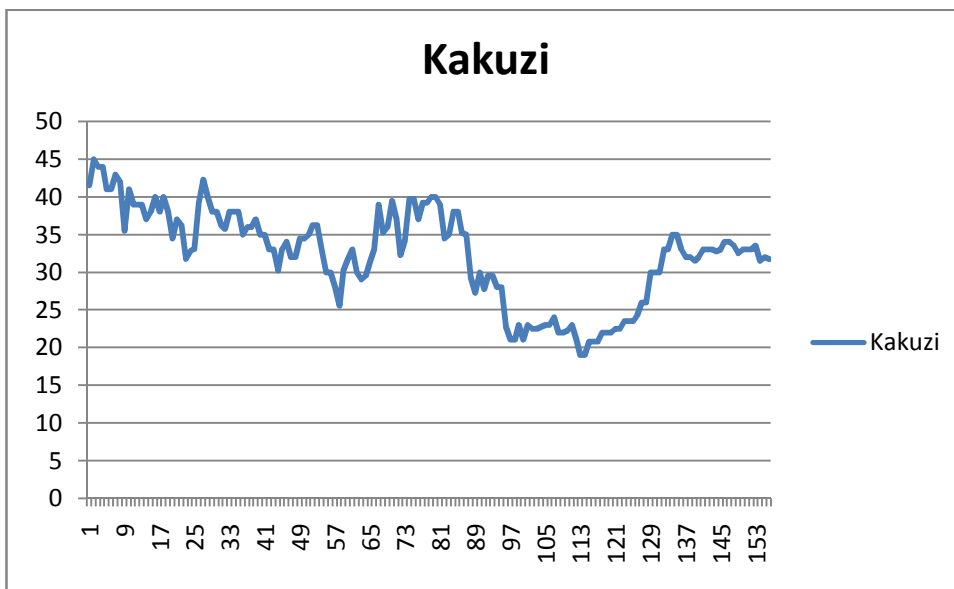
Figure 4.10.4

Figure 4.10.2, 3, 4 & 5reveal that different industries react differently to the occurrence of unexpected events. Though there is change in the movement of stock prices for all industries, the trends differ in each industry.
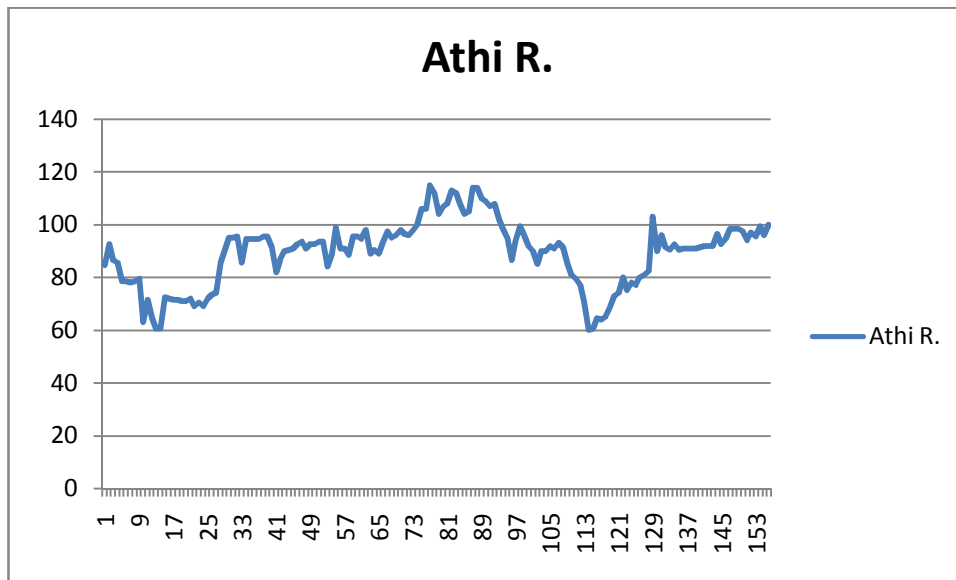
Figure 4.10.5

The trend of volatility as revealed by the data analysis in figure 4.10 and 4.10.shows volatility trend and frequency can be associated to current circumstances as well as development of management techniques in the stock market. That is volatility trend stems from the characteristic of the current period being analysed as well as the way the capital markets operate and how investors manage their assets. The price of financial assets is determined by discounting the expected future dividend and the price changes when new information arrives. This can be explained using the market efficiency hypothesis which states that the stock prices reflects all the available information both public and private. Thus new important information leads to an increase in volatility.

The increase in volatility during the period 2007 to 2009 stems from certain phenomenon which include the frequent shocks injected into the economy. These shocks include the Global Financial crisis and the Domestic crisis which hit the Kenyan economy during this period. The domestic crisis was the aftermath of the country's general election which resulted to post election violence which reduced the investor's confidence the rapid changes in the stock prices.

During this period the country's political, economic and social environment which forms a key drive for both financial and capital markets was unstable hence hindering efficient operations in both markets. Net foreign equity flow measures the value of outflows from the sale of shares by foreign shareholders against value of inflows from the purchase of shares by foreign shareholders. A high net outflow is a sign of foreign investors leaving the stock market as happened in 2008 when net foreign equity outflow was Kshs 8.3 billion. As at December 2010 net foreign equity annual inflow was Kshs 15 billion, implying more purchases than sales, leading to a recovery in stock prices (Kenya Financial Report).

In addition, this lead to an increase in uncertainty about the Macro economic outlook of the country thus investors can only use rational expectations and speculations to predict the best strategies to use in the stock markets. The macro economic outlook in Kenya during this period was as follows:

Inflation ended up higher during the last half of the fiscal year2007/2008 than similar period in the last year. In particular, the average annual overall inflation declined from 10.4 percent in the year to June 2007 to 9.8 percent in the year to December 2007, before rising to 18.5 percent in the year ending June 2008. Similar upward trends were observed for the 12-month overall inflation that increased from 13.6 percent in July 2007 to 29.3 percent in June 2008. The annual average underlying inflation was 7.6 percent in June 2008 which was above the 5 percent objective. The increase was mainly due to supply shocks emanating from adverse climatic conditions which affected food supplies, sharp increases in international crude oil prices and the effects of post-election crisis (CBK, Annual Report 2008).

Short term interest rates ended up higher in June, 2008 than in June 2007. The average interest rate on the 91-day Treasury bill increased from 6.53 percent in June 2007 to 7.73 percent in June

2008, while that for the 182-day Treasury bill rose from 7.19 percent in June 2007 to 8.84 percent in June 2008. The lending and deposit rates were also higher, averaging 13.1 percent and 4.18 percent, respectively in June 2007, and rising to an average of 14.1 percent and 4.48 percent, respectively in June 2008. The Central Bank Rate (CBR) was reviewed from 8.75 to 9 percent in June, 2008.

Kenya¢s balance of payments surplus resulted in a build-up of gross foreign assets of the banking system from US$ 3,767 million at the end of June 2007 to US$ 5,786 million at end of June 2008. Of this, gross official foreign exchange reserves held by the CBK amounted to US$ 3,445 million (equivalent to 4.5 months of imports) at the end of June 2008, compared with US$ 2,723 million (4.3 months of imports) at the end of June 2007.

The Kenya shilling had mixed performance against major world currencies in the 2007/2008 fiscal year. Against the US dollar, the shilling appreciated to an average of Kshs 63.8 per US dollar in June 2008 compared with Kshs 66.6 per US dollar in June 2007. Against the East African Community member states, the Kenya shilling gained by 0.7 percent against the Uganda shilling to exchange at Ush 25.1 per Kenya shilling in June 2008, but depreciated by 1.7 percent against the Tanzanian shilling to exchange at Tsh 18.6 per Kenya shilling in June 2008.

In times of high risk, any minor news may bring about a radical change in the investors¢ valuations. A very weak firm can suddenly be transformed from a company on the brink of bankruptcy into a viable one and vice-versa, which can lead to big swings in stock prices. On the other hand, a company with sound fundamentals would be subject to smaller shifts in investors¢ perceptions and, therefore, its share price would be less volatile.

CHAPTER FIVE

5. CONCLUSIONS AND RECOMMENDATIONS

It is observed that, there is evidence of higher volatility during the financial year 2008 compared to the other years considered in the study. This is revealed by the trend of stock prices as well as the indices (NASI and NSE). Therefore, volatility tends to depend on economic, political and the trading itself as can revealed by the analysis in the study where the indices reveal high volatility in 2008 compared to the other years. The Finance and investment industry represented by equity bank shows varying trends of volatility and portrays the highest average annual historical volatility compared to other industries. It has been noted that the stock price volatility for different industries exceed the volatility of the indices.

An analysis of the trend of volatility gives the investors an overview of how the stock prices tend to behave in case of unexpected event end thus can help them formulate better strategies on how to make the highest profit margin in case of the occurrence of a similar event which in our case is financial crisis as well as domestic crisispost election violence which tend to alter the stability of the economy.

REFERENCES

1. John, C. H. (2008) Prentice Hall, *Options Futures and Other derivatives* -Business & Economics

2. George, A. F., Tom, G.& Richard, M.C. (2003) John Wiley & Sons, *the volatility Course*- Business & Economics

3. Greg, N.G. (2010) CRC press, *Stock Market Volatility*- Business and economics

4. Lemma (2009)Financial crisis and Stock market

5. Chinhyung, D. C.&Edward W. F., Wiley, the Journal of Finance, Vol. 43, No. 2 (Jun., 1988), pp. 451-466

6. Sergiy, L. (2009) Volatility modeling in financial markets

7. Daron, A., Simon, J., James, R. & Yunyong, T. (2002) Institutional causes, macroeconomic symptoms:

8. Volatility, crises and growth

9. Colin, B. & Miguel, A. G. (2012) *Volatility Trading:*Trading Volatility, Correlation, Term Structure and Skew

10. Marie-Hélène, G., Sébastien, L. & Catherine, L. (2003) *Stock market volatility*: from empirical data to their interpretation

11. Peter, C. (2002) Towards a Theory of Volatility Trading

12. John, E. A.,(1995) *Journal of Banking and Finance*, Valuing futures and options on volatility

13. Colm, K. & Kevin, D. (2010) The causes of Stock Market volatility in Australia.

14. Mark, K. (1991) Financial Analysts Journal, Vol. 47, No. 4 (Jul. - Aug., 1991), pp. 22-25 What practitioners need to know about estimating volatility. Part 1

15. Zhou, Shifei and Hao, W., Kin K. L., Jerome Y. (2013) Routledge,*Volatility surface & term structure:* high profit options trading strategies

16. Kenya Financial sector Stability Report (2010)

17. Central Bank Annual Report 2008

18. Lemma, W. S. (2009) *Financial Crisis and Stock Markets*: Issues, Impact, and Policies

19. Kibaara, B. (2008) The impact of the global financial crisis on developing countries

APPENDICES

INTRADAY VOLATILITY

Kenya Airways	Unilever Tea	Equity Bank	Athi River
0.042735043	-0.085365854	0.035714286	0.076923077
0.042735043	-0.0625	0.071428571	0.056603774
0.043103448	-0.085365854	0.075342466	0.05
0.034188034	-0.085365854	0.096774194	0.075
0.043103448	-0.085365854	0.088235294	0.047619048
0.043859649	-0.085365854	0.091891892	0.046511628
0.054054054	-0.117647059	0.057142857	0.095238095
0.035714286	-0.127906977	0.114155251	0.093023256
0.045454545	-0.127906977	0.083743842	0.077777778
0.045454545	-0.127906977	0.063157895	0.068181818
0.054545455	-0.127906977	0.06741573	0.016949153
0.035714286	-0.147727273	0.176470588	0.022727273
0.053097345	-0.147727273	0.084210526	0.090909091
0.044642857	-0.166666667	0.097087379	0.034883721
0.054054054	-0.166666667	0.081730769	0.080745342
0.035714286	-0.166666667	0.075	0.066666667
0.026785714	-0.166666667	0.09375	0.054545455
0.04587156	-0.166666667	0.076923077	0.041666667
0.075471698	-0.20212766	0.057692308	0.035714286
0.036363636	-0.184782609	0.078703704	0.023529412
0.064814815	-0.184782609	0.041860465	0.130718954
0.076923077	-0.171270718	0.12195122	0.083333333
0.067961165	0.56	0.075	0.083870968
0.095477387	0.56	0.078947368	0.025641026
0.06	0.56	0.061538462	0.025641026
0.059405941	0.56	0.089108911	0.019480519
0.08	0.56	0.051401869	0.012820513
0.089108911	0.56	0.045454545	0.111111111
0.055555556	0.56	0.057268722	0.066666667
0.055045872	0.56	0.058333333	0.133333333
0.04587156	0.56	0.222222222	0.064935065
0.055045872	0.56	0.113636364	0.025641026
0.074766355	0.56	0.040909091	0.081081081
0.085714286	0.56	0.058558559	0.105263158
0.056603774	0.56	0.034782609	0.06
0.037037037	0.56	0.066666667	0.044585987

0.037735849	0.56	0.043478261	0.103896104
0.058252427	0.56	0.048888889	0.083333333
0.04950495	0.56	0.045454545	0.093333333
0.07	0.56	0.050228311	0.133333333
0.1	0.56	0.009174312	0.053333333
0.09375	0.56	0.047619048	0.1
0.105263158	0.56	0.073170732	0.071428571
0.120879121	0.56	0.032110092	0.111111111
0.0625	0.56	0.045454545	0.095238095
0.073684211	0.56	0.048034934	0.098484848
0.075268817	0.56	0.090909091	0.051470588
0.064516129	0.56	0.039130435	0.071428571
0.065217391	0.56	0.039130435	0.102941176
0.054347826	0.56	0.030434783	0.154411765
0.111111111	0.56	0.025751073	0.088235294
0.122093023	0.56	0.029411765	0.028571429
0.094117647	0.56	0.025531915	0.057142857
0.192771084	0.56	0.021459227	0.028571429
0.103896104	0.56	0.034782609	0.092307692
0.090277778	0.671428571	0.026086957	0.031746032
0.086956522	0.671428571	0.068181818	0.061538462
0.19047619	0.671428571	0.063348416	0.147540984
0.159663866	0.671428571	0.107843137	0.083333333
0.113821138	0.671428571	0.13	0.140350877
0	0.720588235	0.032110092	0.05
0	0.720588235	0.081081081	0.147540984
0.058479532	0.720588235	0.075	0.1
0.081521739	0.720588235	0.09375	0.069444444
0.088888889	0.720588235	0.071969697	0.136363636
0.066666667	0.720588235	0.055555556	0.042253521
0.066666667	0.720588235	0.058823529	0.042857143
0.055555556	0.720588235	0.075471698	0.027777778
0.066666667	0.720588235	0.324503311	0.028169014
0.139534884	0.720588235	0.088235294	0.035714286
0.046511628	0.720588235	0.058823529	0.042857143
0.05952381	0.720588235	0.058823529	0.042857143
0.058823529	0.720588235	0.102564103	0.099236641
0.072289157	0.720588235	0.133333333	0.106060606
0.029411765	0.720588235	0.078014184	0.090909091
0.1	0.720588235	0.111111111	0.106060606
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0.075	0.720588235	0.123287671	0.067164179
0.084337349	0.720588235	0.104938272	0.028571429

0.088235294	0.720588235	0.182926829	0.082706767
0.071428571	0.720588235	0.114942529	0.075757576
0.068322981	0.720588235	0.068181818	0.058823529
0.055555556	0.720588235	0.057142857	0.028571429
0.074074074	0.720588235	0.108433735	0.043478261
0.041420118	0.720588235	0.094117647	0.035714286
0.071428571	0.720588235	0.164705882	0.098484848
0.06875	0.720588235	0.095238095	0.106060606
0.061728395	0.720588235	0.063953488	0.106060606
0.049382716	0.720588235	0.033333333	0.075757576
0.085365854	0.720588235	0.032608696	0.073529412
0.054878049	0.720588235	0.053191489	0.058823529
0.06626506	0.720588235	0.03626943	0.052238806
0.035714286	0.720588235	0.053191489	0.082706767
0.02994012	0.720588235	0.026315789	0.065693431
0.0625	0.720588235	0.03125	0.028571429
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0.028571429	0.720588235	0.086206897	0.010810811
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0.088435374	0.720588235	0.04	0.21276596
0.095890411	0.828125	0.032	0.087912088
0.083333333	0.828125	0.031746032	0.010526316
0.020547945	0.828125	0.04	0.010526316
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0.056338028	0.828125	0.032258065	0.043478261
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0.082191781	0.828125	0.032258065	0.032608696
0.041666667	0.828125	0.024193548	0.042553191
0.020547945	0.828125	0.033057851	0.21276596
0.027777778	0.828125	0.033057851	0.043956044
0.065217391	0.95	0.060869565	0.038888889
0.117647059	0.95	0.086956522	0.068181818
0.151515152	0.95	0.034482759	0.079545455
0.076923077	0.95	0.026086957	0.098265896
0.076923077	0.95	0.035714286	0.068965517
0.03030303	0.95	0.046296296	0.034090909
0.069230769	0.95	0.076923077	0.104294479
0.076923077	0.95	0.037735849	0.0625
0.088	0.95	0.096446701	0.086956522
0.08	0.95	0.063157895	0.025
0.056	0.95	0.083333333	0.036585366
0.062992126	0.95	0.069306931	0.047619048
0.046153846	0.95	0.064814815	0.036144578
0.061538462	0.95	0.080357143	0.036585366
0.029411765	0.95	0.058333333	0.005882353
0.067164179	0.95	0.069565217	0.024096386
0.051094891	0.95	0.059322034	0.058823529
0.043478261	0.95	0.053571429	0.046511628
0.044776119	0.95	0.125	0.127272727
0.054263566	0.95	0.065420561	0.15625
0.09375	0.95	0.090909091	0.076023392

0.105691057	0.95	0.081081081	0.076023392
0.074380165	0.95	0.054545455	0.069767442
0.068965517	0.95	0.045045045	0.069767442
0.033333333	0.95	0.035087719	0.069767442
0.06557377	0.95	0.0625	0.045454545
0.066666667	0.95	0.01754386	0.045454545
0.06557377	0.95	0.026315789	0.082352941
0.12195122	0.95	0.060869565	0.022222222
0.063492063	0.95	0.025641026	0.039548023
0.098360656	0.95	0.034482759	0.028089888
0.047244094	0.95	0.017094017	0.045454545
0.055555556	0.95	0.043478261	0.010989011
0.03125	0.95	0.034482759	0.075144509
0.0234375	0.95	0.033898305	0.021978022
0.0625	0.95	0.192	0.043956044
0.076923077	0.95	0.06870229	0.021978022
0.038167939	0.95	0.02962963	0.027027027
0.046153846	0.95	0.022058824	0.152941176
0.03030303	0.95	0.037037037	0.027027027
0.022900763	0.95	0.022222222	0.054945055
0.088709677	0.95	0.037593985	0.066666667
0.053846154	0.95	0.0546875	0.06741573
0.038461538	0.95	0.03125	0.071823204
0.0546875	0.95	0.096	0.077777778
0.0625	0.95	0.031746032	0.032608696
0.03875969	0.95	0.046511628	0.068181818
0.030769231	0.95	0.046153846	0.021978022
0.031007752	0.95	0.030075188	0.038888889
0.055555556	0.95	0.022556391	0.044198895
0.046875	0.95	0.02238806	0.065934066
0.023076923	0.95	0.02962963	0.027322404
0.03125	0.95	0.059701493	0.077777778
0.0390625	0.95	0.094202899	0.072222222
0.015625	0.95	0.085714286	0.021505376
0.048	0.95	0.072992701	0.066666667
0.06557377	0.95	0.058823529	0.027027027
0.032258065	0.95	0.079710145	0.032608696
0.083333333	0.95	0.071428571	0.005347594
0.032786885	0.95	0.034482759	0.049723757
0.116666667	0.95	0.034013605	0.066666667

Monthly volatility for stock prices

Month	Equity Bank	Unilever Tea	Athi River Mining	Kenya Airways
JAN	0.191465931	0.046783038	0.094295568	0.036096014
FEB	0.132857668	0.096573617	0.106479104	0.082748946
MAR	0.100802327	0.115318061	0.170923252	0.201736929
APR	0.950801567	0.1053015	0.086921021	0.119053811
MAY	0.105963627	0.09280692	0.093862537	0.114867583
JUN	0.10344938	0.086533635	0.121797199	0.083232489
JUL	0.060684848	0.041537074	0.06554635	0.059590838
AUG	0.068010862	0.02170924	0.074253437	0.045749622
SEP	0.063177359	0.120227789	0.036126794	0.043612743
OCT	0.127863163	0.058845987	0.094096184	0.081554598
NOV	0.088925969	0.043062161	0.042886288	0.059006241
DEC	0.094678412	0.057123542	0.019924179	0.036713946

Volatility for different industries using weekly prices					
	kakuzi	Kenya A.	Equity	Athi R.	NSE 20	NASI
2007	0.448883	0.59847	1.286616	0.444313	0.205768	
2008	0.71202	0.488437	0.603383	0.355553	0.295385	0.287973
2009	0.30395	0.476821	0.658692	0.39843	0.233604	0.23056
					0.14798	0.1328

rt	mean-rt		INTRADAY
0.012423	-0.00064	6.88159E-07	-0.08537
-0.01242	-0.00064	5.59645E-07	-0.0625
0.024693	-0.00064	2.58801E-06	-0.08537
-0.01227	-0.00064	5.45278E-07	-0.08537
0.012423	-0.00064	6.8821E-07	-0.08537
0	-0.00064	1.65833E-09	-0.08537
0.035932	-0.00064	5.39357E-06	-0.11765
0.005865	-0.00064	1.70693E-07	-0.12791
0	-0.00064	1.65833E-09	-0.12791
0.005831	-0.00064	1.68914E-07	-0.12791
0	-0.00064	1.65833E-09	-0.12791
0.02299	-0.00064	2.25177E-06	-0.14773

0	-0.00064	1.65833E-09	-0.14773
0.022473	-0.00064	2.15432E-06	-0.16667
0	-0.00064	1.65833E-09	-0.16667
-0.00557	-0.00064	9.79917E-08	-0.16667
0.005571	-0.00064	1.55616E-07	-0.16667
0	-0.00064	1.65833E-09	-0.16667
0.00554	-0.00064	1.54076E-07	-0.20213
0	-0.00064	1.65833E-09	-0.18478
0.016438	-0.00064	1.17622E-06	-0.18478
-0.02198	-0.00064	1.83588E-06	-0.17127
0	-0.00064	1.65833E-09	0.56
0	-0.00064	1.65833E-09	0.56
0.021979	-0.00064	2.06322E-06	0.56
-0.02198	-0.00064	1.83588E-06	0.56
-0.09309	-0.00064	3.44627E-05	0.56
0.059189	-0.00064	1.44341E-05	0.56
0.033902	-0.00064	4.81145E-06	0.56
0.00554	-0.00064	1.54076E-07	0.56
-0.00554	-0.00064	9.67631E-08	0.56
0	-0.00064	1.65833E-09	0.56
0	-0.00064	1.65833E-09	0.56
0	-0.00064	1.65833E-09	0.56
0.01105	-0.00064	5.51155E-07	0.56
0	-0.00064	1.65833E-09	0.56
0	-0.00064	1.65833E-09	0.56
-0.00551	-0.00064	9.55698E-08	0.56
0	-0.00064	1.65833E-09	0.56
0.00551	-0.00064	1.52575E-07	0.56
-0.01105	-0.00064	4.36859E-07	0.56
0.01105	-0.00064	5.51155E-07	0.56
-0.02222	-0.00064	1.87758E-06	0.56
0	-0.00064	1.65833E-09	0.56
-0.04599	-0.00064	8.29053E-06	0.56
0	-0.00064	1.65833E-09	0.56
0	-0.00064	1.65833E-09	0.56
0.05716	-0.00064	1.34717E-05	0.56
-0.07496	-0.00064	2.22712E-05	0.56
0	-0.00064	1.65833E-09	0.56
-0.01813	-0.00064	1.23286E-06	0.56
0	-0.00064	1.65833E-09	0.56
0	-0.00064	1.65833E-09	0.56
0	-0.00064	1.65833E-09	0.56

-0.06291	-0.00064	1.56346E-05	0.56
-0.09531	-0.00064	3.61378E-05	0.671429
0	-0.00064	1.65833E-09	0.671429
0	-0.00064	1.65833E-09	0.671429
0	-0.00064	1.65833E-09	0.671429
0	-0.00064	1.65833E-09	0.671429
-0.02899	-0.00064	3.24052E-06	0.720588
0.028988	-0.00064	3.53979E-06	0.720588
-0.01439	-0.00064	7.62065E-07	0.720588
0	-0.00064	1.65833E-09	0.720588
0.083382	-0.00064	2.84671E-05	0.720588
0	-0.00064	1.65833E-09	0.720588
0	-0.00064	1.65833E-09	0.720588
0	-0.00064	1.65833E-09	0.720588
0	-0.00064	1.65833E-09	0.720588
-0.06899	-0.00064	1.88385E-05	0.720588
-0.02899	-0.00064	3.23996E-06	0.720588
0.043172	-0.00064	7.7404E-06	0.720588
-0.01418	-0.00064	7.39604E-07	0.720588
0	-0.00064	1.65833E-09	0.720588
0	-0.00064	1.65833E-09	0.720588
0.035091	-0.00064	5.14847E-06	0.720588
0	-0.00064	1.65833E-09	0.720588
0	-0.00064	1.65833E-09	0.720588
0.033902	-0.00064	4.81133E-06	0.720588
0	-0.00064	1.65833E-09	0.720588
0	-0.00064	1.65833E-09	0.720588
0	-0.00064	1.65833E-09	0.720588
0	-0.00064	1.65833E-09	0.720588
-0.0339	-0.00064	4.46066E-06	0.720588
-0.02797	-0.00064	3.01237E-06	0.720588
-0.00712	-0.00064	1.69116E-07	0.720588
0.068993	-0.00064	1.95521E-05	0.720588
0	-0.00064	1.65833E-09	0.720588
0	-0.00064	1.65833E-09	0.720588
0	-0.00064	1.65833E-09	0.720588
0	-0.00064	1.65833E-09	0.720588
0.064539	-0.00064	1.71307E-05	0.720588
0	-0.00064	1.65833E-09	0.720588
0	-0.00064	1.65833E-09	0.720588
0	-0.00064	1.65833E-09	0.720588
0	-0.00064	1.65833E-09	0.720588

0	-0.00064	1.65833E-09	0.720588
0	-0.00064	1.65833E-09	0.720588
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-0.06454	-0.00064	1.64631E-05	0.720588
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0.013245	-0.00064	7.77563E-07	0.720588
-0.01325	-0.00064	6.4056E-07	0.720588
0	-0.00064	1.65833E-09	0.720588
0.064539	-0.00064	1.71307E-05	0.720588
-0.05129	-0.00064	1.03453E-05	0.720588
0	-0.00064	1.65833E-09	0.720588
0.045024	-0.00064	8.40843E-06	0.720588
-0.03195	-0.00064	3.95296E-06	0.720588
0	-0.00064	1.65833E-09	0.720588
0	-0.00064	1.65833E-09	0.720588
-0.03974	-0.00064	6.16425E-06	0.720588
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0.006734	-0.00064	2.19337E-07	0.720588
0	-0.00064	1.65833E-09	0.720588
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-0.00673	-0.00064	1.49683E-07	0.720588
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0.013423	-0.00064	7.97601E-07	0.720588
0	-0.00064	1.65833E-09	0.720588
0	-0.00064	1.65833E-09	0.720588
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0.020762	-0.00064	1.84718E-06	0.720588
-0.02778	-0.00064	2.9697E-06	0.720588
-0.02857	-0.00064	3.14597E-06	0.720588
-0.00727	-0.00064	1.77324E-07	0.720588

0.021661	-0.00064	2.0057E-06	0.720588
0	-0.00064	1.65833E-09	0.720588
0	-0.00064	1.65833E-09	0.720588
0	-0.00064	1.65833E-09	0.720588
0.014185	-0.00064	8.86324E-07	0.720588
0	-0.00064	1.65833E-09	0.720588
0	-0.00064	1.65833E-09	0.720588
0.007018	-0.00064	2.36526E-07	0.720588
-0.00702	-0.00064	1.63939E-07	0.720588
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0.007018	-0.00064	2.36526E-07	0.720588
-0.00702	-0.00064	1.63939E-07	0.720588
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0	-0.00064	1.65833E-09	0.720588
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-0.01418	-0.00064	7.39604E-07	0.720588
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0	-0.00064	1.65833E-09	0.720588
0	-0.00064	1.65833E-09	0.720588
0.014185	-0.00064	8.86324E-07	0.720588
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0	-0.00064	1.65833E-09	0.720588
-0.05799	-0.00064	1.32603E-05	0.828125
0.022141	-0.00064	2.0929E-06	0.828125
-0.05245	-0.00064	1.08217E-05	0.828125

0.030305	-0.00064	3.86167E-06	0.828125
0.014815	-0.00064	9.63306E-07	0.828125
0	-0.00064	1.65833E-09	0.828125
0	-0.00064	1.65833E-09	0.828125
0	-0.00064	1.65833E-09	0.828125
-0.02985	-0.00064	3.44081E-06	0.828125
-0.03077	-0.00064	3.66064E-06	0.828125
-0.06454	-0.00064	1.64631E-05	0.95
0	-0.00064	1.65833E-09	0.95
0.09531	-0.00064	3.71237E-05	0.95
0.015038	-0.00064	9.91277E-07	0.95
0.022141	-0.00064	2.0929E-06	0.95
0	-0.00064	1.65833E-09	0.95
0	-0.00064	1.65833E-09	0.95
0	-0.00064	1.65833E-09	0.95
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-0.02214	-0.00064	1.86388E-06	0.95
0	-0.00064	1.65833E-09	0.95
-0.03031	-0.00064	3.54821E-06	0.95
0	-0.00064	1.65833E-09	0.95
0	-0.00064	1.65833E-09	0.95
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0	-0.00064	1.65833E-09	0.95
0.04512	-0.00064	8.4441E-06	0.95
0	-0.00064	1.65833E-09	0.95
-0.01482	-0.00064	8.10065E-07	0.95
0	-0.00064	1.65833E-09	0.95
0	-0.00064	1.65833E-09	0.95
0	-0.00064	1.65833E-09	0.95
-0.02264	-0.00064	1.95182E-06	0.95
0	-0.00064	1.65833E-09	0.95
0.037458	-0.00064	5.85292E-06	0.95
0	-0.00064	1.65833E-09	0.95
0	-0.00064	1.65833E-09	0.95
-0.03746	-0.00064	5.46547E-06	0.95
0	-0.00064	1.65833E-09	0.95
0.037458	-0.00064	5.85292E-06	0.95
0	-0.00064	1.65833E-09	0.95
0	-0.00064	1.65833E-09	0.95
0	-0.00064	1.65833E-09	0.95
-0.01482	-0.00064	8.10065E-07	0.95

0.014815	-0.00064	9.63306E-07	0.95
0	-0.00064	1.65833E-09	0.95
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0	-0.00064	1.65833E-09	0.95
0	-0.00064	1.65833E-09	0.95
0	-0.00064	1.65833E-09	0.95
0	-0.00064	1.65833E-09	0.95
0	-0.00064	1.65833E-09	0.95
0	-0.00064	1.65833E-09	0.95
0	-0.00064	1.65833E-09	0.95
0	-0.00064	1.65833E-09	0.95
0	-0.00064	1.65833E-09	0.95
0	-0.00064	1.65833E-09	0.95
-0.01482	-0.00064	8.10065E-07	0.95
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0	-0.00064	1.65833E-09	0.95
0	-0.00064	1.65833E-09	0.95
0	-0.00064	1.65833E-09	0.95
0	-0.00064	1.65833E-09	0.95
0	-0.00064	1.65833E-09	0.95
0	-0.00064	1.65833E-09	0.95
0	-0.00064	1.65833E-09	0.95
-0.04581	-0.00064	8.22649E-06	0.95
-0.02372	-0.00064	2.14704E-06	0.95
0	-0.00064	1.65833E-09	0.95
0.023717	-0.00064	2.39235E-06	0.95
0.015504	-0.00064	1.05112E-06	0.95