

**THE EFFECTS OF VOLATILITY RISK ON THE VOLUME OF
FUTURES CONTRACTS TRADING AT THE NAIROBI SECURITIES
EXCHANGE**

BY

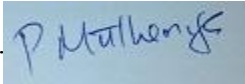
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**A RESEARCH PROJECT SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF
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DECLARATION

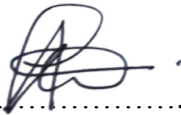
This research project is my original work and has not been submitted to any other University for academic award.

Sign.....  Date.....08/12/2020.....

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D63/5353/2017

This project has been submitted with my approval as the University supervisor.

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DEDICATION

I dedicate this project to my wife, Benedetta Mbithe.

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ABBREVIATIONS

ABSA	Amalgamated Banks of South Africa
ANOVA	Analysis of Variance
BAT	British American Tobacco
BP	Breusch-Pagan
CAPM	Capital Asset Pricing Model
CMA	Capital Market Authority
EABL	East African Breweries Limited
GARCH	Generalized AutoRegressive Conditional Heteroskedasticity
GDP	Gross Domestic Product
HAR-RV	Heterogeneous Autoregressive Realized Volatility
KCB	Kenya Commercial Bank
KENGEN	Kenya Electricity Generating Company
MDH	Mixture of Distributions Hypothesis
MPT	Modern Portfolio Theory
NEXT	Nairobi Securities Exchange Derivatives Market
NSE	Nairobi Securities Exchange
NSE	Nairobi Securities Exchange
OTC	Over The Counter

SET	Stock Exchange of Thailand
SIAH	Sequential Information Arrival Hypothesis
TFEX	Thailand Futures Exchange
TTM	Time to maturity
USIU	Unites States International University

ABSTRACT

The study sought to determine the effects of volatility risk on the volume of futures contracts traded at NSE. This study used a descriptive cross-sectional research design. The targeted population was the NSE Listed firms which trades in future contracts and the NSE25 Index Futures. The data used consisted of daily futures contract prices, the volume of daily futures contracts traded and the NSE25 Index Futures for the period 4th July 2019 to 4th July 2020. Secondary data obtained from NSE data-bank for the one-year period starting 4th July 2019 to 4th July 2020 was used for this study. Analysis was carried out using data for the NSE25 Index Futures, daily futures contracts prices and trading volume data. Descriptive statistics were used in summarizing the data. Information effects on Volatility was investigated by applying Heterogeneous Autoregressive Realized Volatility (HAR-RV) model. The study extended this model as HARX-RV model by adding the trade volume as a proxy for the information arrival in the HAR-RV model. The descriptive shows high mean and standard deviation values for volatility risk and low average figures for volume of trades. Results from HAR-RV model show that volatility of future contracts is persistent in the futures market at the NSE and the persistence reduces when volume is added to the model. The findings show a positive but insignificant effect of volatility risk on volume of trade. The study concludes that the number of future contracts traded is volatile. The researcher further concluded that changes in the volatility of futures contracts positively but insignificantly affect the volume of future contracts traded. The study recommends that investors understand future contract market behaviours so as to make informed investment decisions relating to their investment. The Capital Markets Authority, NSE and other policy makers should be conscious of the effects of other factors other than volatility on future contracts traded. The study recommends that similar study with a longer period and different variables.

CHAPTER ONE

INTRODUCTION

1.1 Background of Study

The Nairobi Securities Exchange (NSE) established Derivatives market in efforts minimize losses arising from sudden changes in asset prices at the stock market and to diversify its trading activities thus deepen capital markets. As a subsidiary of NSE, the derivatives market dubbed Nairobi Securities Exchange Derivatives Market (NEXT) was officially commissioned on 4th July 2019 and offers future contracts as a hedging tool to either gain or mitigate the risk of loss. NEXT is governed and regulated by the Capital Market Authority (CMA) under the Capital Market Act (Cap. 485A), the Capital Markets (Derivatives Market) regulations, 2016 and the NSE Derivatives Rules. Future contracts enables a trader to buy a certain amount of foreign currency today in the prevailing market rate and then later on have it deposited in the customer's account when required. Such a move is reached after having considered the exchange rate that will be expected at that given time. According to Geoffrey Odundo, the Chief Executive Officer at NSE asserted that 'derivatives trading would be of great help towards the growth of the trading activities which had remained flat in the years before its introduction'.

The derivative market is thought to be capable of enhancing the investors' portfolio performance by providing the traders with tools that are able to help manage risks associated with the financial transactions. This has been realized in the past few years of an increase in asset price volatility in international as well as in domestic markets.

The future contracts were, perhaps thought to be one of the most successful financial innovations of the 1980's by most the financial traders (Gorham & Singh, 2009). The first future contract was undertaken in April 1982 by the Chicago mercantile exchange S&P 500 futures. After that there were many others traders based in Osaka Stock Exchange, Hong Kong Index Futures, and the London International Financial Futures Exchange, just but to mention a few who took part in trading using future contracts. There has been far-reaching changes with the global financial markets due to the increased number of orders and consequently the increased volume of the quantities coming from traders from all over the world. Therefore, there has been a need to have in place adequate technology inform of high speed computers in order to enable the traders to handle the increasing volume or orders for financial assets.

Since within the developing and emerging financial markets there are no gadgets that are able to help in processing the increasing volume for financial assets, it has been found that such markets are susceptible to volatility compared to the already developed nations (Gorham, et al., 2009). Previous empirical studies which have focused on regulated derivatives trading have not conclusively supported a stabilizing impact for instance (Koch & Koch, 1993; Darrat & Rahman, 1995) studies did not confirm volatility impact resulting from S&P 500 futures trading, whereas still others, (Eva & Wagner , 2012) found a stabilizing impact on futures contracts trading on the mean level of conditional volatility of the underlying stock index, on their research of Volatility impact on Stock Index Futures Trading using GARCH to model stock market volatility (Olatundun, 2009) states that introduction of derivatives market in Sub-Saharan African Countries would assist the countries in hedging their assets against capital flow volatility thus minimizing overdependence on borrowing from credit banks and also enhance their risk management techniques with proper guidelines and regulations.

1.1.1 Volatility Risks

Volatility is how rapidly the price of an asset may change, Volatility risk is the risk which occurs as result of changes in price of an asset, thus it may be viewed as how rapidly the price of an asset may change. Volatility within the financial market sector impacts the returns earned by those who happen to have been involved in financial transactions such as those involving future contracts. The decision-making process undertaken by the investors is normally influenced by communication from NSE pertaining the volatility of the future contracts. Due to the uncertainties that are associated with the changes that takes place within the financial markets, the investors might not be placed in a better position to reach for informed decisions with regard to investments.

A major point of concern within the future contract market is the opaqueness over the counter (OTC) markets. Also, there is the concerns of the complexity of the different OTC derivatives instruments as well as the high degree of concentration. There lacks transparency with regard to the total risk exposures of the market participants which is as a result of underestimation of the counterparty risk and those that come from the unregulated non-bank market entities. This would lead to a negative impact with regard to the financial market stability. This effect would be significantly reduced by having an exchange-based derivative trading or a centralized counterparty as is a common for the classic kinds of derivatives such as options as well as others within the financial markets across the world. Future contracts return volatility is a significant concept in finance which can be used by financial analysts as well as other financial professionals in interpreting and understanding how the market appears to be performing during a particular time.

In the case that market indicates a higher volatility, such would be regarded to indicate the likelihood that the market is declining. While, in the case that there appears to be indication of a lower volatility, such would be taken to be indicating the possibility of a rising market. Such information needs to be availed to the investors so that they can be in a position to reach for sound business decisions. It assists the investors to align their investment portfolios with the anticipated returns.

There are various methods that can be used to evaluate volatility which can be either categorized as time variant or time invariant. However, one of the easiest methods of measuring volatility can be asserted to be the standard deviation. Standard deviation method is characterized as a time invariant method.

1.1.2 Volume of Futures Contracts Trading

Volume is reported for all futures contracts traded in a specified period. Volume of contracts is calculated by summing up all number of contracts bought and sold over a given period of time. This implies that when a future is traded either by being bought or sold, it counts towards volume of that contract. The rise or decline of volume in futures contract can be used by investors to make trading decisions.

Volume gives important information to traders such as identifying the times of day when a future contract is most liquid, this is key in making trading decisions as traders would prefer higher volumes time to trade since it means more traders are actively interested in buying and selling.

Volume also indicates the price levels at which traders are more or less interested in trading a future contract, traders can use this information to decide whether to buy or sell. Moreover volume can be important during the rollover as traders can decide when to switch to trading the front month futures contract as volume decrease in the expiring contract.

1.1.3 Volatility Risk And Volume Of Futures Contracts Trading

Previous empirical studies have tended to find a positive relationship between volatility and volume of derivatives traded in stock markets. Most of the research has greatly focused on the behaviour of volume of futures contract traded as volatility changes from one period to the next. (Karpoff, 1987) , found that there exists a positive relationship between volatility and trading volumes of both equity stock and futures contracts. Empirical researches of literature on volatility market activity, incorporates day-to-day changes in volumes of futures contracts traded when modelling volatility and has in most cases given a positive relationship, however looking at volatility against monthly volume changes gives a contrary opinion. However (Huson ,Ali & Annuar, 2005) found that there is persistence in volatility even after volume was included in their GARCH model contrary to the major believe of earlier studies which tend to suggest a positive correlation between volatility and volume of futures contracts.

Different markets have different dynamics and different macroeconomic factors that influence volatility-volume relationships, (Bhaumik, Karanasos & Kartsaklas, 2008) noted an inverse volatility – volume relationship in the Indian stock market. They note a decline in spot volatility when futures trading is introduced in the market, and consequently a drop in volume on introduction of option contracts., offering support to the view that derivatives trading introduction on the market leads to decrease in trading volumes of futures contracts as investors have a wide range of instruments to hedge their portfolios.

1.1.4 Futures Contracts Listed at Nairobi Securities Exchange

The Nairobi Securities Exchange (NSE) offers platform to investors both local and international to trade in equity and debt security instruments. It is the leading Securities Exchange in East Africa and has been in operations since 1954. The Nairobi Securities Exchange launched Nairobi Securities Exchange Derivatives Market (NEXT) in July 2019 to introduce Futures trading to the Kenyan Market. NEXT is regulated by the Capital Markets Authority (CMA), NEXT was established to expand the country's financial market to the international markets and as an alternative to risk averse investors who would want to trade to an already volatile stock market. NEXT offers the NSE 25 Index Futures and the Single Stock Futures. The body offers future contracts which are characterized by; Standardized Specifications, Trade on Exchange, Agreed Underlying Asset, Price and Date and Daily Valuation and settlement.

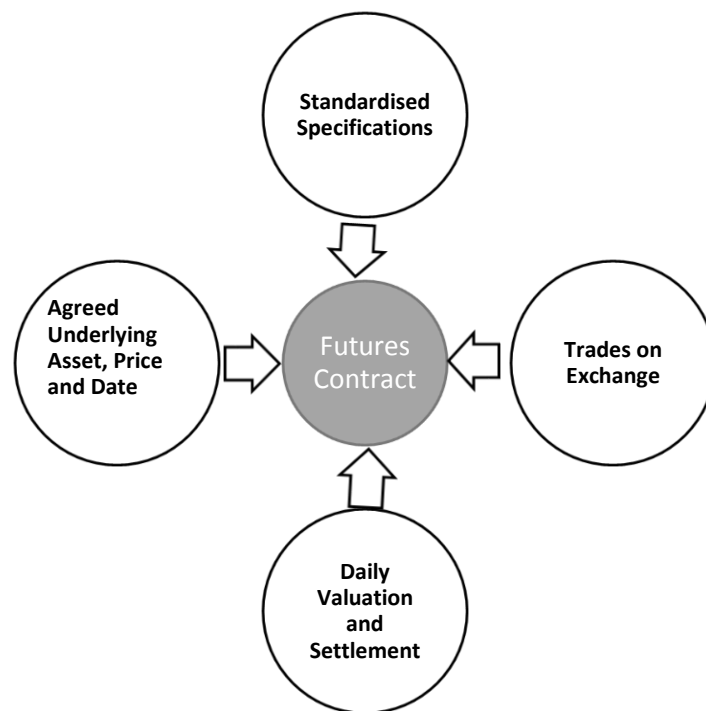


Figure 1.1: Future Contract

The available single stock futures that are listed in the NSE include; BAT Kenya, EABL, KENGEN, ABSA group, Equity, KCB and Safaricom.

Table 1.1: NSE 25 Index Futures

Underlying asset	NSE 25 Share Index
Size of the contract	Each index point is equal to Ksh. 100.00
Minimum price movement	A single index point which is equivalent to Ksh. 100.00
Months of contract	Contracted on quarterly basis
Settlement	Settled in Ksh. In case of cash transactions.
Settlement price	Spot plus cost of carry for illiquid contracts or VWAP for theoretical price or liquid contracts
Expiry dates	Third Thursday of each expiry month

Table 4.2: Single Stock Futures

Underlying asset	Qualifying stock share	
Size of contract	For the shares that are trading below Ksh. 100.00	
	1 = 1,000 underlying shares	
Minimum price movement	For share which are trading above Ksh. 100.00	
	1 = 100 underlying shares	
	Price Range	Tick Size
	Under Ksh. 100.00	0.01
	Greater or equal but less than Ksh.500.00	0.05
	Equal or greater than Ksh. 500.00	0.25
Contract months	Quarterly contracts	
Settlement	Cash is normally settled in Ksh.	
Settlement price	Spot plus cost of carry for illiquid contracts or VWAP for theoretical price or liquid contracts	
Expiry dates	Third Thursday of each expiry month	

1.2 Research Problem

Different research studies in different markets have given different opinions on the volume-volatility relationship and argued why such differing opinions hold. (Aris, 2017) found a positive relation existing between uncertain trading volumes and volatility in the Korean Index futures market given that investors had access to market information. Theoretical research studies have proved that proper dissemination of information leads to changes of prices and trading volume. Investors are motivated with increase of market information and this increases volatility (Harris & Ravi, 1993). According to Cytonn Report (2019), Openness on trading contracts has a huge impact on volatility of equities. Buyers will consider trading in companies whose prices are less volatile. In an efficient market, there is an assumption that the personal as well as the portfolio investors will not be in a position to utilize information which is linked to price that could be used to predict the price of the future contracts. Trading activity and the liquidity of the financial markets are important ingredients of the financial markets (Poon, 2005). The trading activity is normally indicated by the trading volume which in turn can be thought to be a representative of the market liquidity.

In general, most empirical studies carried out by different researchers in both emerging and in developed stock markets have found a positive correlation in volume – volatility relationship, in derivatives markets the same relationship has been confirmed and especially futures contracts market (Tanachote & Krikita, 2016) found a positive relationship in Asian Commodity futures exchange where they were researching on the volume- volatility effects. Whereas many findings point to a positive relationship, few of these studies have also had a negative or inverse relationship findings such as (Kawaller, 2001) which is rare and contradicts sharply with the widely held positive relationship perception.

(Edwards, 1988) and (brown-Hruska & kuserk, 1995) found a negative correlation on futures trading with the spot volatility on the S&P 500. Whereas (Dennis and Sim, 1999) stated that there existed insignificant effects on introduction of futures trading to the spot market volatility in the Australian Stock Market.

The Nairobi Securities Exchange Derivatives Market (NEXT) will see a shift of risk averse investors as they seek to hedge their portfolios and reduce risk of exposure. On the first trading day after NEXT was launched, single stock futures for Safaricom and EABL were traded with nil purchase of equity index futures contract mainly explained by the investors' preference of single stock futures to index futures contract. Openness on contracts traded and market information needed to be properly availed to investors in time to enable them make informed business decisions.

1.3 Research Objective

This study was carried to establish the effects of volatility risk on the volume of futures contracts traded at NSE.

1.4 Value of Study

Findings of this study will impact inside knowledge to financial investors which can be used in making wise investment decisions and protect their assets against volatile stock prices. Insights into how volume-volatility risk affect performance of future contracts will help investors choose onto which companies to invest in and allow them to make informed decisions on when to anticipate price changes and hedge their investments. Investors can well use this study to align their assets with associated expected returns.

The study will also help companies and financial Managers in managing of market risks resulting due to volatility risk, this will in-turn will be beneficial as both domestic and international investors will have confidence and invest in them and positively influence the performance of companies. This study will also assist pension funds and insurance companies to monitor volatility and downside risk of their equity holdings.

Government of Kenya will be in a position to understand the impact of volume-volatility relationship to the economic performance. Economic policy makers in government may use this study as a guide when formulating economic policies. This study may be used as a source of reference by Researchers and Scholars as they conduct their academic research or as source of knowledge.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Different research studies have given different concepts that affect the derivatives markets in Kenya. This chapter will entail theoretical review, some of the factors that are thought to influence future contract volatility and the empirical review of the research from local as well as international studies. In addition, the study will also present a summary of the empirical review as well as the study's conceptual framework.

2.2 Theoretical Review

2.2.1 Sequential Information Arrival Hypothesis

Copeland (1976), introduced the Sequential Information Arrival Hypothesis (SIAH) and assumed that trader's first utilized information received and then passed to each other gradually. Copeland suggested that changes in price and trading volume are caused by the change in demand curve of traders due to the information received and thus markets dynamics depended on how idealists and pessimists received information.

By simulating data, Copeland indicated existence of positive relationship between trading volume and price volatility. However, Copeland also showed existence of inverse correlation between volume and value of price changes if the information was simultaneously received to every trader. Thereby consecutive dissemination of information leads to positive relationship rather than simultaneous arrival of information.

2.2.2 Mixture of Distributions Hypothesis

Clarks (1973) introduced the Mixture of Distributions Hypothesis (MDH) and Epps & Epps (1976) enhanced its application further. The hypothesis stated that prices changes and trading volume are independently distributed over a series of information arrival. According to Clarks conditional volatility variance and volume traded are positive function of information arrival. The MDH implies existence of strong certain contemporaneous link between price volatility and volume. However, return levels and volume data does not show any usual patterns.

2.2.3 Asymmetric Information Theory

This theory suggests insider trading, this implies that sellers have important information of the products in the market that buyers may not possess thus they end up setting the prices of the goods sold in their favor. It argues that superior and inferior goods can be traded with prices at par as long as buyers have scanty information on the goods sold.

Admati and Pfleiderer (1988), stated that volatility increased when investors trade more because of the knowledge gap between sellers and buyers. Assuming that sellers traded based on their private information. Arkelof (1970), affirmed this by finding that buyers of motor vehicles were being exploited by sellers because of buyers' lack of knowledge in motor vehicles. Sellers private information made them sell low quality cars at the price of high-end vehicles.

2.2.4 Modern Portfolio Theory

The modern portfolio theory (MPT) assumes that the investors are risk averse, implying that in a case where there are two portfolios which are offering similar expected return, the investors will go for the one that has less risks involved (Francis & Kim, 2013).

However, an investor is free to take on increased risks if the compensation appears to them to be worth taking. This is to mean that, an investor might decide to indulge in a high risk transaction given that the expected returns are high. Therefore, for the investors who might be looking for greater anticipated returns, they must accept to take on transactions that are riskier (Francis, et al., 2013). In addition, following this theory it appears that there will be exact trade-off of each, consequently different investors will eventually result in evaluating the trade-off in a different way based on his or her individual risk aversion characteristics.

According to the MPT, volatility generates risks which are associated to the degree of the spread of returns about the average. Generally, volatility is experienced within a market whenever the prices or the interest rates fall or rise within the stock market. In this theory, the most commonly used measure of volatility of the securities is the standard deviation (Elton, 2009). The investors always look forward to earn a certain amount of return from the investments that they make. However, at times there might be deviation from the amount that the investors had anticipated to earn. Therefore, each of the securities that the investors takes there is a possibility that they might not earn the anticipated amount of return and this is what amounts to the risk that a certain individual investor is exposed to (Elton, 2009). The MPT theory is relevant to this study because it is based on the assumption that the investors within the market are risk averse and are always looking forward to optimizing their anticipated returns from the investments that they decide to take on which are pegged on a certain market risk level.

2.2.5 Prospect Theory

This is a theory that is used in decision making under conditions of risks. Decisions are normally based on judgments that are made by the investors found within the securities market. Judgments on the other hand refer to assessments about the external state of the market. The external markets or world normally is full on uncertainties due to the unforeseen outcomes or consequences that comes with certain decisions. This theory was designed to explain a certain pattern of choice (Kahnemann & Tversky, 1979). This theory is made up of two distinct parts of making decisions; the framing phase and the evaluation phase. The evaluation phase is the phase that appears to be relevant in this study since it involves the decision process of choosing from the available options. This is the same case with securities at the Nairobi Security Exchange derivatives market, where there are normally options presented to the investors in order to choose from. The decision made by the investors are normally influenced by two distinct process; one which is linked to subjective value and the second one is related to the perceptual possibility or likelihood.

According to Tversky and Kaheman (1979), framing is influenced by the manner in which the issue has been presented, the habits as well as the decision maker's expectancies. The reason why people engage in framing is to simplify the evaluation of the available choices. This can be related to what the investors at the NSE do – the investors are presented with various options pertaining future contracts and they simplify the evaluation by relying on their habits as well as their expectancies. The investors might, for instance, be presented with different scenarios indicating different levels of return and it is upon them to make decisions that are based on their habits as well as their expectancies.

2.3 Determinants of Futures Contract trading

This section will elaborate on the determinants which have an influence on volume of futures contract trading. There are various factors that have been found to influence the volume of futures contracts.

2.3.1 Volatility

Volatility is the core variable that is applied when pricing futures contracts, managing risk as well as calculating or determining the margin amount that is anticipated by the investors. If the investors happen to have known the correct volatility direction as maturity approaches, they get a chance to know the correct estimate of the settlement price. Previous research view present value dividends as key aspect of stock prices level. Nevertheless, recent research studies have found that variability of dividends may not solely explain volatility (West, 1988 & Shiller, 1987). There has been carried out several works that were meant to check volatility versus trading volume relationship. There has resulted considerable evidence pointing that there exists a positive correlation between the trading volume and futures price volatility.

Wiley and Daigler (1999), there are a likelihood that volatility-volume association is relying on the type of investor. Wiley and Daigler (1999), found out that trades carried out by clearing members as well as the floor traders mostly indicate an inverse association between volume and future price volatility and public drives the positive volume-volatility association. It should also be noted that informed trades lead to decrease in volatility, whereas uninformed trades leads to rise in volatility in futures contract prices (Fabozzi, 2008). This is important within the NSE derivative market, since it can make the investors to reach for sound decisions regarding the type and number of futures contracts that they can acquire and at what time.

2.3.2 Time to Maturity

As earlier cited, that, according to Samuelson, price changes of futures contracts prices should be expected to rise when the contract is almost expiring, as prices changes so do the volume of futures contracts, as the market activity become intense. It is the latter that is widely known as the “Samuelson hypothesis”. The reasoning behind the Samuelson hypothesis is that the sensitivity of the market towards news as the expiring date nears causes the volatility of the future contracts in question to increase (Samuelson, 1965). This is based on the assumption that the market becomes more sensitive to news about near-maturity compared to those whose maturity date is far. This hypothesis has been proved to hold in the TFEX where SET50 future contract price volatility as well as gold futures price volatility have appeared to rise once the expiry date approaches.

On the other hand, there are some other futures contracts which have shown the inverse maturity effect. For instance, the inverse maturity effect has been shown by crude oil futures that were traded in the TFEX. The volatility appears to decrease as the maturity date approaches. Therefore, it could be argued that volatility can depend on the type of future contracts that are in question.

2.3.3 Open Interest

Open interest differs greatly from the volume of trade. The expected in this case is that open interest is inversely associated with volatility since the availability of a large number of contracts represents increased market depth, therefore meaning improved liquidity.

2.3.4 Inflation

Inflation is upward movement of prices commodities and services; inflation reduces the purchasing power of a country's currency making it weaker against other currencies. Previous studies have had a mixed finding on how inflation affects stock returns volumes. Most of the researchers found expected inflation impacts stock returns either on the upward side or downward side depending on existing government's monetary policy's framework and the ability to hedge. Studies on the unexpected inflation however found a positive correlation to stock returns during certain economic periods such as economic contractions.

2.3.5 Information

Investors have access to unlimited market information in the recent due to advanced technological milestones. Investors can access daily stock market information at their own convenience. The availability of credible and ready information has enabled investors to update their projections and make informed investment decisions as they able to anticipate future changes in prices at the stock market.

Developing markets may have limited information on their stock market and this may give incomplete information environment to investors. Investors with inadequate market information may be biased in their predictions on stock performance thus increasing their risk of loss.

2.4 Review of Empirical Studies

Wiley and Daigler (1999), undertook a study that was meant to investigate the causes of volatility in futures contract prices. In their study, the two researchers found out that trades that were been conducted by the clearing members and the traders on the floor indicated an inverse relation on volume and future price volatility, also the same researchers stated that there was a positive association between volume and volatility with regard to the price movement of the future contracts was concerned. The above lead both Wiley and Daigler to reach at the conclusion that the relation between volume and volatility of the price of the futures contracts relied on the type of trader.

“Samuelson hypothesis”. The reasoning behind the Samuelson hypothesis is that the sensitivity of the market towards news as the expiring date nears causes the volatility of the future contracts in question to increase. In addition, the open interest and volume were studied by Saunders and Grammatikos (1986) and found existence of positive association of volatility - volume of futures contracts. However, there were others that were carried and indicated inverse relationship such as those carried out by Pati and Kumar (2007). On the other hand, there are some other futures contracts which have shown the inverse maturity effect. For instance, the inverse maturity effect has been shown by crude oil futures that were traded in the TFEX.

Following the findings by Samuelson, it can be asserted that volatility of futures contracts prices should be rises contract as futures contract is almost expiring. It is the latter that is widely known as the Time to maturity (TTM) and affects volatility of future contract prices across different derivative market such as the NSE. The association between time to maturity and volume has been carried out in various countries across the world using different underlying assets.

According to (Rutledge, 1976; Beaulieu, 1998 and Walls, 1999) there are some studies that have found an inverse association between volume-volatility while others have found out a positive relationship between volatility-volume with regard to future contract prices are considered. Wang et al. (2012) investigated the volatility –volume association at the Chinese Stock Market, the study’s findings were a positive correlation of daily volatility with trading volume, explaining the aspect of private information in skewing the prices changes of stocks. Matheka (2011), from the University of Nairobi in his research on the Impact of derivatives in the Nairobi Securities Exchange. The study stated that futures trading in general will significantly decrease the spot price volatility. Applying the GARCH Model, the study indicates a decrease in spot price volatility if derivatives were introduced into Kenyan Market, “Futures trading in general does not destabilize (unpredictable volatility and share price movements) the underlying security”. Matheka (2011)

Kinyua (2014), from the Unites States International University (USIU), in his research of Adopting Derivatives Market in Kenya found a decreasing Market volatility In the NSE on the introduction of Equity Derivatives. This was due to lack of investor information and existence of weak regulation framework on the rules governing derivatives markets in Kenya.

2.5 Conceptual Framework

Figure 2.2 shows the conceptual framework of the study illustrating the independent variable time to maturity (TTM) and volatility as well as open interest and the dependent variable volume of futures contracts trading within the NSE derivative market.

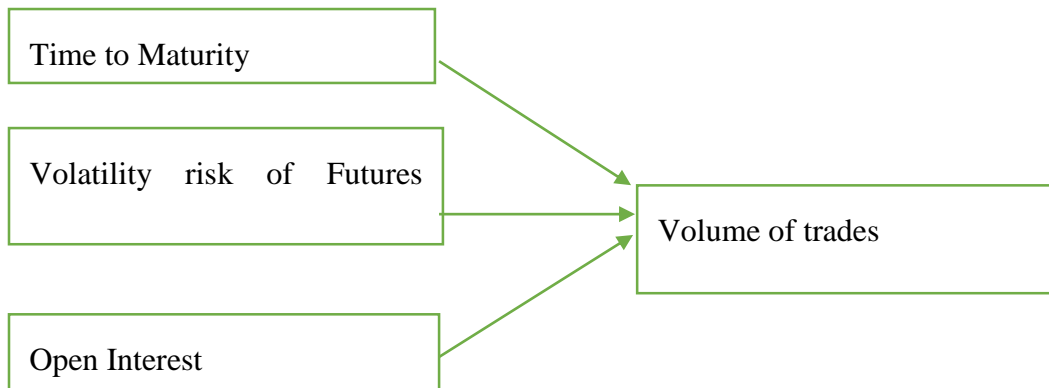


Figure 2.2: Conceptual Framework

2.6 Summary of Empirical Review

From the evidence collected above it is clear that the volume of trading of futures contract highly affected by various parameters such as open interest, volatility and time to maturity, just but to mention a few. Following the findings by Samuelson, it can be asserted that volume of futures contracts trading should be expected to rise when the contract is almost expiring as volatility is also increasing. It is the latter that is widely known as the “Samuelson hypothesis”. The reasoning behind the Samuelson hypothesis is that the sensitivity of the market towards news as the expiring date nears causes the volatility of the future contracts in question to increase. However, this is not the case for all kind of future contracts.

This hypothesis has been proved to hold in the TFEX where SET50 future contract price volatility as well as gold futures price volatility have appeared to rise once the expiry date approaches. On the other hand, there are some other futures contracts which have shown the inverse maturity effect. For instance, the inverse maturity effect has been shown by crude oil futures that were traded in the TFEX.

CHAPTER THREE:

RESEARCH METHODOLOGY

3.1 Introduction

The chapter looked at the selection, justification and presentation methods as well as the techniques which were employed in order to realize the objectives of the research study. This chapter takes care of the research methodology process right from the research design to methods used to analyze our data

3.2 Research Design

This refers to the various research methods and techniques that are researcher chooses in order to conceptualize a research topic to the relevant empirical research. This simply means that a research design takes into consideration the information which is required as well as the techniques which were employed by the researcher in order to collect and analyze the data that is linked to the research question. There are various kinds within which research design can be classified; descriptive and explanatory research. In this study, the researcher employed the use of descriptive cross-sectional research. Cross-sectional research entails collection of data or information pertaining a certain thing at a given point in time.

3.3 Population

The targeted population in this research study was the NSE Listed firms which traded in future contracts and the NSE₂₅ Index Futures between 4th July 2019 and 4th July 2020.

3.4 Sample

The data used consisted of daily futures contract prices, the volume of daily futures contracts traded and the NSE₂₅ Index Futures for the period 4th July 2019 to 4th July 2020.

3.5 Data Collection

Secondary data obtained from NSE data-bank for the one-year period starting 4th July 2019 to 4th July 2020 was used for this study. Analysis was carried out using data for the NSE₂₅ Index Futures, daily futures contracts prices and trading volume data.

3.6 Diagnostic Tests

Application of T-test and F-test to check any significant difference on descriptive statistics measures and hypothesis testing. We calculated 95% confidence interval to confirm the findings. ANOVA as well as linear regression statistics employed in the research study as they assume that the errors of the models that are employed to carry out the analysis are independent of one another and that there is no autocorrelation.

The study involved carrying out of the Breusch-Pagan (BP) in order to check for heteroscedasticity. According to the heteroscedasticity test considers a significance level of over 0.05 as an indicator that there is no heteroscedasticity issue has been found in the data that is obtained from the results of the ANOVA. The rule that is employed in interpreting heteroscedasticity is that if a clear pattern is shown, then there is a heteroscedasticity issue, whereas, if there is no a clear pattern then there is no heteroscedasticity issue in the data. The research study also employed graphical tests using the scatterplot in order to determine if heteroscedasticity was in the data or not.

We used Jarque-Bera test statistics to confirm the normality of the variables as below.

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

Where, t = Sample size

S = Skewness coefficient

K = Kurtosis coefficient

For a normal distribution Skewness is equivalent to zero, positive skewness if the mean is greater than the median and negative skewness when mean is lower than the median, while for a normal distribution Kurtosis is equivalent to 3.

3.7 Data Analysis

Before data analysis, data was cleaned. The data was then coded and entered into SPSS 25 for analysis. Descriptive statistical analysis was used in summarizing the data in order to make it easy to point on any given trends that had been reflected in the data collected. Descriptive statistics was calculated clearly indicating mean, standard deviation and skewness. Information effects on Volatility was investigated by applying Heterogeneous Autoregressive Realized Volatility (HAR-RV) model.

we denote x - period returns, $\gamma_{n,x} = y(n) - y(n-x)$ the daily realized volatility was computed as the summing corresponding 1/x end of day squared returns as in equation [2];

$$RV_{n+1}(x) = \sqrt{\sum_{j=1}^{x=1} \gamma_{n-jx}^2}$$

[2]

Corsi (2009) HAR –RV model captures the strong persistence observed in realized volatility. It is widely used because of its ability to provide excellent forecasting performance. The model has attracted numerous citations to estimate linear regressions.

$$RV_{n+1} = \beta_0 + \beta_D RV_n + \beta_W RV_{n-5, n} + \beta_M RV_{n-22, n} + \varepsilon_{n+1} \quad [3]$$

RV_n , $Rn_{n-5, n}$ and $\beta_M RV_{n-22}$, denote the volatilities for each day, each week and each month.

HAR-RV model of Corsi (2009) was extended by adding trading volume as proxy to HARX-RV model as below

$$RV_{n+1} = \beta_0 + \beta_D RV_n + \beta_W RV_{n-5, n} + \beta_M RV_{n-22, n} + \alpha Vol_{n+1} + \varepsilon_{n+1} \quad [4]$$

Vol_{n+1} is trading volume as a proxy for information arrival for day, n+1.

Vol_{t+1}, α would be positive and statistically significant if information arrival has an effect on the volatility.

CHAPTER FOUR

DATA ANALYSIS AND PRESENTATION OF FINDINGS

4.1 Introduction

This chapter presents findings from data analysis, which was guided by research objectives and the results presented in the tables below. Data analysis was done in the chapter. Tabular presentation was used in this study.

4.2 Descriptive Statistics

To derive the descriptive statistics, secondary data obtained from Nairobi Securities Exchange (NSE) was analyzed using Excel, results for realized volatility of NSE 20-Share index and trade volume variables for the period 4th July 2019 to 4th July 2020 were obtained as below. The descriptive statistics are based on the selected firms that traded future contracts within the period.

Table 4.3: Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Volatility Risk	6781	6.00	4404.00	710.5638	1301.88576
Volume Of Trades	6781	.00	48.00	.1520	1.18398
Valid N (listwise)	6781				

The descriptive statistics show that volatility risk had a mean of 710.56 with the volume of trades averaging at 0.1520. This shows high mean values for volatility risk and low average figures for volume of trades. The standard deviation figures are also high for volatility risk (1301.8), indicating that the data points are spread out over a large range of values compared to volume of trade (1.18398).

The variation between the maximum and minimum volatility risk and volume indicates existence of high variability of both volatility risk and volume trade in future contracts.

4.3 Diagnostic Tests

Table 4.4: Normality test

	Volatility Risk	Volume of Trades
Kurtosis	1.405370821	516.5312
Skewness	1.796220329	18.16525
JB-Stat	4204.4169**	75756299.0204**

Positive skewness for volatility indicates that the right tail is longer and most of the data is at the left. The normality test also shows Kurtosis for volatility less than 3 indicating a platykurtic distribution, meaning that there is fewer and less extreme outliers as compared to normal distribution. Whereas kurtosis for realized volume of trades is more than 3 and values concentrated around the mean, it clearly indicates existence of high probability for extreme volumes since the kurtosis of realized volume of trades is precise than the normal distribution.

The study used Jarque-Bera test statistics to confirm the normality of the data for the study variables where J-B is equal to 0 under the null hypothesis of normal distribution. Since the Kurtosis and skewness are both greater than zero it shows the data is not normally distributed.

```

----- Breusch-Pagan and Koenker test statistics and sig-values -----
              LM              Sig
BP           6281.341         .999

```

Figure 4.3: Breusch-Pagan Test of heteroskedasticity

From the findings shown by figure 4.2, the p-value is more than 0.05. Hence, we cannot reject the null hypothesis that there is constant variance in our data. Hence the data used in analysis has low levels of heteroscedasticity which is not a problem.

4.4 Empirical Model

4.4.1 Stationarity Test

To find out whether the data is stationary, Augmented Dickey Fuller (ADF) Unit Root test has been used. The ADF test includes testing with presence of intercept for this study.

Table 4.5: Volatility risk

	Intercept
ADF Test Statistic	-1.4072
1% critical value*	-2.567
5% critical value*	-1.941
10% critical value*	-1.616

When stationarity was tested for volatility risk, the t-statistics value of 1.4072 was below the critical value of 1.941 at 5%, this indicates Stationarity of the data series. At significance level of 5%, the time series of the variables were stationary, indicating that volatility risk would be temporary and its effects on the volume of trade would cease to exist over time.

Table 4.6: Volume of Trade

	Intercept
ADF Test Statistic	-1.4619
1% critical value*	-2.567
5% critical value*	-1.941
10% critical value*	-1.616

When stationarity was tested for volume of trade, the t-statistics value of 1.4619 was below the critical value of 1.941 at 5%, this indicates Stationarity of the data series. At significance level of 5%, the time series of the variables were stationary, indicating that shocks on futures traded would be temporary and its effects on the volume of trade would cease to exist over time.

4.4.2 Heterogeneous Autoregressive Realized Volatility Model

The heterogeneous autoregressive realized volatility (HAR-RV) model of Corsi (2009) checks realized volatilities for stocks at different time periods. The estimates of realized volatilities are measured at separate to bring about separate realized volatility measures of daily, weekly and monthly periods. This study of relationships in volatilities at different times helps to ascertain the dynamics of market compositions. HAR-RV model is presented as below:

$$RV_{n+1} = \beta_0 + \beta_D RV_n + \beta_W RV_{n-5, n} + \beta_M RV_{n-22, n} + \varepsilon_{n+1}$$

Table 4.7: Regression Model Summary^b Volatility Model

Model	R	R Square	Adjusted Square	R Std. Error of the Estimate	Durbin-Watson
1	.997 ^a	.995	.995	94.53855	2.001

a. Predictors: (Constant), Xvariable3, Xvariable1, Xvariable2

b. Dependent Variable: Y

From the model summary table, the R² was 0.995, an indication that time to maturity, volatility risk of futures contracts and Open Interest contributes to 99.4% change in the volume of trades in the futures market at NSE.

Table 4.8: ANOVA^b for Volatility Model

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.143E10	3	3.810E9	426325.384	.000 ^a
	Residual	6.057E7	6777	8937.537		
	Total	1.149E10	6780			

a. Predictors: (Constant), Xvariable3, Xvariable1, Xvariable2

b. Dependent Variable: Y

The calculated F-statistic (426325.384) was greater than the F-critical (2.606) indicating that the model fitted the data. The Anova tables shows a p-value of 0.000 indicating a statistically significant model with a statistically significant relationship between volatility risk and volume of trade variables.

Table 4.9: Regression Coefficients^a Volatility Model

Model		Unstandardized		Standardized	t	Sig.
		Coefficients				
		B	Std. Error	Beta		
1	(Constant)	-1.841	1.308		-1.407	.159
	Xvariable1	.956	.012	.956	78.746	.000
	Xvariable2	.010	.017	.010	.581	.561
	Xvariable3	.032	.012	-.032	2.610	.009

a. Dependent Variable: Y

From the table above, RVd and RVw showed positively statistically significant relation to volatility risk ($\beta_1=0.95607$, $p=0.000$; $\beta_2=0.00975$, $p=0.561$). RVm showed a negative and statistically insignificant relationship with volatility risk ($\beta_3=-0.0317$, $p=0.009$). The daily Realized Volatility has the highest coefficient meaning that it is the best data to use to determine the volatility of future contracts.

4.4.3 Heterogeneous Autoregressive Model with Volume

Trade volume was added as a proxy for arrival of information in the HAR-RV model to extend the HAR-RV model of CORSI (2009) to HARX-RV model, this follows Aguilar and Ringgenberg (2011) and Celik (2013). HARX-RV model is presented as below:

$$RV_{n+1} = \beta_0 + \beta_D RV_n + \beta_W RV_{n-5, n} + \beta_M RV_{n-22, n} + \alpha Vol_{n+1} + \epsilon_{n+1}$$

Table 4.10: Regression Model Summary with Volume

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.997 ^a	.995	.995	94.54385

a. Predictors: (Constant), volume of trades, Xvariable1, Xvariable3, Xvariable2

From the model summary table, the R^2 was 0.9947, an indication that time to maturity, volatility risk of futures contracts and open interest contributes to 99.4% change in the volume of trades among volume of futures contracts traded at NSE between 4th July and 4th July 2020.

Table 4.11: ANOVA^b Model with Volume

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.143E10	4	2.858E9	319708.215	.000 ^a
	Residual	6.057E7	6776	8938.540		
	Total	1.149E10	6780			

a. Predictors: (Constant), volume of trades, Xvariable1, Xvariable3, Xvariable2

b. Dependent Variable: Y

From the Anova table, the F calculated (319708.2) was greater than F-critical (2.606). This shows that the HARX-RV model fitted the data. The Anova table also shows a p-value of 0.000. This indicates that the HARX-RV model is statistically significant and the variables of volatility risk have a statistically significant relationship with the volume of trade.

Table 4.12: Regression Coefficients^a Model with Volume

Model		Unstandardized		Standardized	t	Sig.
		Coefficients		Coefficients		
		B	Std. Error	Beta		
1	(Constant)	-1.932	1.321		-1.462	.144
	Xvariable1	.956	.012	.956	78.740	.000
	Xvariable2	.010	.017	.010	.581	.561
	Xvariable3	.032	.012	-.032	2.608	.009
	Volume of trades	.475	.972	.000	.489	.625

a. Dependent Variable: Y

Considering traded volume as proxy of new information arrival, it is expected that the constant is more than zero ($\alpha > 0$). Likewise, it is expected that coefficient of traded volume, α to be positively statistically significant in the HAR-RV model estimation assuming that arrival of information affects volatility. Additionally, smaller sum of parameter estimates should be observed on inclusion of trading volume to the model.

From table 4.12, we have a positive α (0.47544) and a reducing volatility persistence, we can thus conclude that there is no significant relation between information arrival and volatility since extending the HAR-RV to HARX-RV model by adding volume reduces persistence of volatility.

4.5 Discussions

HAR-RV model results indicate that the best estimate of volatility is the weekly realized volatility, although daily realized volatility shows a positively statistically significant relationship with volatility. The monthly realized volatility however is negative and statistically insignificant.

Overall the model was significant, showing a statistically significant relationship between volatility and all identified variables. Likewise, for the HARX-RV model, the daily and weekly volatility had significant positive coefficients, in conjunction the monthly volatility was negative and insignificant. The overall model including volume is statistically significant. We can conclude that daily volatility is the best estimate for volatility forecast for volume trading in future contracts from the both models.

The regression modelling findings indicate trading volume can be considered as a proxy of new information arrival, however this does not mean it relates significantly to volatility risk. This indicates that changes in volume of future contracts trading in the NSE are driven about by factors other than volatility, such factors may include future expectations of markets by investors and political environment. If the investors expect future better performance of volume of trading in future contracts, they can increase their current demand for futures contracts stimulating a rise in trading volume. The result of insignificant volume volatility relationship at NSE indicates that volatility of futures contracts may have low impact on the influence to investors' decision making to purchase more securities in the stock market. Other factors such as available capital to invest are likely to have influence to investors. Thus, volatility risk in the market do not impact on the volume of future contracts traded at the NSE. Either changes in future contract volatility or changes in volumes traded influence changes in future contract volumes traded and changes in volatility risk in the market. Tanachote and Krikita (2016) found that a significant relationship existed between volatility and trade volumes in the futures market. This shows that this study finding differed with those of Tanachote and Krikita.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter gives a summarization of findings and conclusions, any limitations in this study and further areas of research are also discussed in this chapter.

5.2 Summary of Findings

Volatility measures the extend of price movement in futures contracts thus it is measure variability, or dispersion about a central tendency. Standard deviation calculation was done for NSE 20-Share index over the period of study (4th July 2019-4th July 2020). Large values of standard deviation and mean for volatility risk fluctuate in a wide range from the mean. Volatility of futures contracts show high values of standard deviation and mean implying that there is high futures volatility during the period of study. The volume of futures contracts shows low values of standard deviation and mean implying that there is low variation in the volume of future contracts traded during the period of study.

This research aimed to determine and explain the effects of volatility risk on the volume of futures contracts traded at NSE. For this purpose, daily NSE-20 Share index data and daily trade volume data as a proxy for information arrival as at 4th July 2019 to 4th July 2020 was used for the study. The application of HARX-RV model to test whether there is a contemporaneous relation between volatility risk and volume of trading in future contracts.

To add trade volume as proxy of new information arrival in HAR-RV model the HARX-RV model extended the HAR-RV model of Corsi (2009).

HARX-RV model application on this study assist find that trading volume can be considered as a proxy for arrival of new information. Although the relationship between volatility and information arrival is not statistically significant. On inclusion of trading volume, there is a decrease in volatility persistence, indicating a weak effect of volatility risk on volume of future contract trades.

5.3 Conclusions

The research culminates that the number of future contracts traded is volatile, indicating that trading volume varies over time as shown by the high standard deviation of volatility risk. The researcher further concluded that changes in the volatility of futures contracts positively but insignificantly affect the volume of future contracts traded. This shows that major changes in future contract prices are affected by other variables except traded volumes.

The reason for the insignificant effect of volatility and volume of future contracts at the NSE can be accredited to the fact that Kenya is a developing country and in such the NSE market is not fully developed but rather an emerging market, wherein limited investor knowledge on the derivatives market might be reason, this result raises a number of issues that could be addressed in future research regarding the specific variables that affect volume of trading of in the futures market.

5.4 Policy Recommendations

Availability of market information is fundamental as investors are able to understand market dynamics especially factors affecting market prices movements and volume traded, investors with market knowledge are able to make informed investment decisions. The study recommends that Nairobi Securities Exchange to arrange public workshops and educate investors on stock investments and also provide periodical briefs and journals to Investors.

The Capital Markets Authority, Nairobi Securities Exchange and all other policy makers including government treasury should be conscious of the effects of other factors other than volatility on future contracts traded. This should be aimed at stimulating development of financial markets in Kenya and to enable mobilization of adequate capital both long term and short term for economic growth and development. In introduction and assimilation of relevant strategies, policy makers must study and look deeply to all effects of other factors other than trading volume.

The study recommends that there should be policy framework which is agreeable to market participants aimed at fostering a conducive market environment to assist stabilize the market when the factors are not able to majorly impact. This would increase investors' confidence on the stock market and also encourage and attract foreign investors to invest into the equity market enhancing market liquidity

5.5 Limitations of the Study

The study was based on a one-year period from 4th July 2019 to 4th July 2020. This means that the findings may differ where the analysis is done based on a different period like 10 years. Hence the analysis was limited to the period of study.

The study was also limited by the authenticity of the data. Despite the data having been collected from NSE, it was difficult for the researcher to ascertain the authenticity of the data provided. The study was also limited to the variables of study. The study was based on volatility risk and volume of trades in futures contracts.

First, only the NSE₂₅ Index is studied in this research. Although the index represents different sectors, a clearer picture would still be established if all listed firms 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.

5.6 Recommendations for Future Studies

The study was based on a one-year period (4th July 2019 to 4th July 2020). The study recommends a similar research based on a longer period of time like 5 years. This would enable reader to compare and validate the findings on the effect of volatility risk on future contracts.

The study was based on the variables of volatility risk and volume of future contracts. Based on the findings, the study recommends that other factors that affect the volume of trading at the futures market. The study recommends a study based on all listed firms other than the firms under NSE₂₅ Index. This would enhance the generalizability of the findings.

The study was conducted on Nairobi Securities Exchange in Kenya, the study recommends a similar research done on sub-Saharan Africa markets since most of those markets are emerging markets. This would enable the reader to compare different markets based on the countries market composition.

REFERENCES

- Beaulieu, M. C. (1998). Time to maturity in the basis of stock market indices: Evidence from the S&P 500 and the MMI. *Journal of Empirical Finance*, 5(3), 177-195.
- Boonvorachote, T., & Lakmas, K. (2016). Price Volatility, Trading Volume, and Market depth in Asian Commodity Futures exchanges. *Kasetsart Journal of Social Sciences*, 37(1), 53-58
- Elton, E. J. (2009). *Modern portfolio theory and investment analysis*. New Delhi: Wiley India.
- Fabozzi, F. J. (2008). *Handbook of finance*. Hoboken, N.J: John Wiley & Sons.
- Francis, J. C., & Kim, D. (2013). *Modern portfolio theory: Foundations, analysis, and new developments + website*. Hoboken, N.J: Wiley.
- Galai, D., & Masulis, R. W. (1976). The Option Pricing Model and the Risk Factor of Stock. *Journal of Financial Economics*, 3(5), 53-81.
- Gorham, M., & Singh, N. (2009). *Electronic exchanges: The global transformation from pits to bits*. Burlington, MA: Elsevier.
- Grammatikos, T., & Saunders, A. (1986). Futures price variability: A test of maturity and volume effects. *Journal of Business*, 59(4), 319–330.
- Kahnemann, D. & Tversky, A. (1979). Prospect theory: AN analysis of decisions under risk. *Econometrica*, 47(3), 262-91.
- Matanovic, E. & Wagner, H. (2012). *Derivatives Trading and Financial Market Stability – Analysing the Volatility Impact of DAX Stock Index Futures Trading Using GARCH* (Masters in Economics). University of Hagen.

- Pati, P. & Kumar, K. (2007). Maturity and Volume Effects on the Volatility: Evidences from NSE Nifty Futures. *ICFAI Journal of Derivatives Markets*, 4(4), 44-63.
- Poon, S. H. (2005). *A practical guide to forecasting financial market volatility*. Hoboken, New Jersey: John Wiley & Sons.
- Rhoads, R. (2011). *Trading VIX Derivatives: Trading and Hedging Strategies Using VIX Futures, Options, and Exchange-traded Notes*. Hoboken, New Jersey: John Wiley & Sons.
- Rutledge, D. J. S. (1976). A note on the variability of futures prices. *Review of Economics and Statistics*, 58(4), 118-20.
- Samuelson, P. A. (1965). Proof that properly anticipated prices fluctuate randomly. *Industrial Management Review*, 6(5), 41-49.
- Walls, W. (1999). Volatility, volume and maturity in electricity futures. *Applied Financial Economics*, 9(3), 283-287.