THE IMPACT OF DERIVATIVES IN THE NAIROBI STOCK EXCHANGE: IS CORPORATE KENYA READY?

BY

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DECLARATION

I declare that this is my original work and it has never been submitted to any other university for examination. The research thesis is as a result of my own work and acknowledgements have been made where I have used other peoples' ideas. I take full responsibility for the unintended typographic errors and or any short comings that may be found in this project.

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ABSTRACT

This article examines the impact of introduction of financial derivatives trading on the volatility of Nairobi Stock Exchange (a developing stock market). It examines the theme that the introduction of derivatives in the stock market in Kenya would reduce the volatility (risk) in the stock market. NSE 20 index has been used as a proxy of stock market return. ARCH/GARCH technique has been employed in the analysis. The conditional volatility of inter day market returns before and after the introduction of derivatives products are estimated with the (GARCH) model. The Finding suggests that derivatives trading have reduced the volatility and have a positive impact on the Kenyan economy.

LIST OF ABBREVIATIONS

AGRI: Agriculture Sector

AIMS: Alternative Investment Market Sector

AR (1): Autoregressive Model

ARCH: Autoregressive Conditional Heteroscedasticity

BAN: Banking and Insurance Sector

COMM: Commercial and Industry sector

ENER: Energy Sector

GARCH: Generalized Autoregressive Conditional Heteroscedasticity

GED: Generalized Error Distribution

INVES: Investment Sector

JB: Jarque-Bera

MINIG: Mining Sector

NSE: Nairobi Stock Exchange

OLS: Ordinary Least Squares

SAFEX: South Africa Futures Exchange

S&P: Standard and Poor

TELECOMM: Telecommunications and Information Sector

U.K.: United Kingdom

USA: United States of America

US: United States

1. CHAPTER ONE

INTRODUCTION

1.1 Background and Motivation of the Study

Kenya is a developing country and many a times we like staying afloat with the developed countries. In the process we like playing catch up with many of the developed countries. In the financial year 2011 to 2012, the Minister for Finance while reading the budget statement proposed that there will be a futures exchange. One of the measures was the establishment of a futures exchange to serve as a platform for trading futures contracts of multi-asset classes such as currency, mineral and energy derivatives. With this regard, the Minister further proposed to amend the Capital Markets Act to allow for the introduction of a regulated commodity futures market. One might wonder why have a futures exchange where as there is already an existing stock exchange. The answer is quite simple. A futures exchange is where derivatives are traded. However, it is possible to trade derivatives in the normal stock exchange, but it is better to trade them in the futures exchange. This is because investors will go to that particular exchange looking specifically for derivatives.

The purpose of this paper is not to look at the futures exchange but rather to look at the commodities that are going to be traded. We are going to analyze the characteristics of the commodities. These include: hedging, market risk measurement, profit and loss attribution, model risk assessment, optimal contract design and implied parameter estimation.

1.2 Objectives of the Study

The objective of this project is to determine the impact introduction of derivatives will have on volatility that is currently being experienced in the NSE. In order to achieve this objective the study will address the following:

- Evaluate of the South African (SAFEX) derivatives market before and after the introduction of derivatives.
- Examination of the NSE stock market which is already existing and yet is still volatile if it will be more stable after the introduction of derivatives and,
- Test whether other market factors may affect the volatility of each spot market separately.

1.3 Problem Statement

This project is based on three major investigation parts, each of which contributes to answering the main problem statement through investigation of subordinate research questions. The three major parts are: a theoretical investigation, an empirical model specification and an empirical test and results analysis. In the following we first present the main research question.

Secondly, we present the sub-questions and objectives associated with each investigation part. This is followed by hypotheses subsection, where the main problem statement is concretized into a number of hypotheses.

The focus area of this project is to investigate the impact derivative trading have and its relationship with the volatility of the underlying current markets. In the theoretical investigation we examine how derivatives bring information to the underlying markets and how this could have an impact of the volatility of the underlying markets. Furthermore, we present a thorough review of the existing research conducted within this area. Based on the results of other researchers we select an ARMA-GARCH volatility model that includes two explanatory variables for trading activity: volume and price, to use in our empirical application. The aim of this is to bring perspectives to the ongoing debate about the role of derivatives in capital markets. Thus, the main research question of this project is: *Will the introduction of derivatives reduce volatility in the capital markets?*

1.3.1 Theoretical Investigation

In the theoretical section we provide the theoretical framework and understanding of how derivatives trading might affect volatility of underlying assets. In the first part of the theoretical investigation we look at the unique properties of derivatives trading and how different agents in the derivative markets utilize derivatives for different purposes. We seek to answer the question: *How do different uses of derivatives affect derivatives trading?*

Secondly, we explore four theoretical perspectives on the relationship between information and volatility in the market. This provides views on how information is absorbed in the market, at which pace and by which market participants, which is the cornerstone in the market microstructure of financial markets. We therefore ask: *Which insights about the relationship between information, trading volume and volatility do various information hypotheses provide?* This will provide knowledge about what should be incorporated in the econometric model for the practical application. The third part reviews the models, methods and findings of previous research within this field. Based on this review and the preceding parts we seek to answer: *Based on existence research, which GARCH-type model will best ensure fulfillment of the problem statement?*

1.3.2 Empirical Model Specification

From the theoretical investigation we have found a preliminary GARCH-type model. We investigate the statistical properties of our data from NSE and specify a conditional volatility model for each asset's return series. We strive to answer: *How does the chosen GARCH-type model capture the characteristics of financial time series data?*

1.3.3 Empirical Test and Result Analysis

Based on our theoretical investigation and empirical model specification we have specified a GARCH - type model, which is used to test our hypotheses of the effect of derivatives trading on the underlying spot market volatility. The empirical testing and result analysis consists of a range of regressions as well as coefficient analyses based on the regression results. From this we will answer: *Will trading introduction of derivatives have a significant effect on the volatility of NSE20 Index?*

2. CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Options and derivatives provide a number of useful functions in the areas of risk management and investments. By definition, a derivative is a financial instrument or contract between two parties to be settled at a future date (Howells & Bain, 2002). The value of a derivative contract is 'derived' from an underlying asset, such as equity, a bond, the exchange rate, or even the weather. The key function of derivatives is to hedge the risk inherent in the underlying markets, in order to guard against changes in interest and exchange rates, fluctuations in commodity prices and so on (Hull, 2002). This is an extremely important function as it is much cheaper to purchase derivatives to hedge risk rather than run the risk of losing significant value in the underlying markets.

Derivatives trading in the stock market have been a subject of enthusiasm of research in the field of finance. Derivatives trading have two attributes on the basis of its effectiveness. So there have often been contrary views among the researchers of what may be the impact of derivatives trading. According to the nature of this instrument it is argued that this could enhance the market efficiency by establishing the market. There are many empirical findings for both their roles of derivatives trading.

Derivatives can also be useful for speculating. Employed as an alternative to purchasing the underlying asset, derivatives enable users to more effectively diversify their position and potentially earn greater returns. The presence of a derivatives market has also meant that investors can take advantage of any arbitrage opportunities present between the derivative and the underlying markets. The predominant users of derivatives contracts are corporates, banks, investment and insurance companies and other financial institutions. Currently in Kenya, there is no market and where such securities can be traded. The opportunity that is currently present is the rights.

By definition, rights are just additional shares provided to shareholders to raise capital. Over the last three years, Kenya has witnessed quite a number of rights issues. The first was Kenya commercial Bank Limited in 2006, when it sought to raise additional capital to fund its expansion in the East African region. The Standard Chartered Bank in offices also had a rights issue. They were seeking to raise capital to a tune of Kshs 2 Billion. This is because they were seeking to raise additional capital to fund the purchase of the Barclays Custodial services.

A common trend is emerging that whenever listed companies in the NSE are seeking to raise additional capital. This is the way to go. However, the modernity of this has already been perfected over the years in Kenya, there is no need to dwell on rights and rights issue.

The other form of derivatives is the forward contract. A forward contract is a contract made today for delivery of an asset at a pre-specified time in the future at a price agreed upon today. The buyer of a forward contract agrees to take delivery of an underlying asset at a future time, T at a price agreed upon today. The beauty of such a contract is that no money changes hands until time T. The seller agrees to deliver the underlying asset at a future time, T, at a price agreed upon today (Hull, 2002). This is a very beautiful contract since there is no money that changes hands. What happens if the buyer gets a better deal? Similarly, what happens if the buyer is no longer interested in the delivery of that asset? Business nowadays is not what it used to be ten years ago and also business today is not what it will be in the coming ten years. A lot of circumstances can change between $t = 0$ and $t = T$ where t denotes time.

In contrast to forwards, a futures contract is traded on an exchange. This means that futures contracts have the tendency to be more liquid, and must also be more standardized to suit the needs of a wider variety of users (Ross, Westerfield & Jaffe, 2005). This standardization in turn allows a secondary market to develop for futures contracts.

Hull (2002) explains that futures contracts require users to pay an initial margin and that the margin is subsequently adjusted day by day depending on whether the price of the contract rises or falls. If the value of the contract drops then the buyer of the futures contract must pay the futures exchange a sum equivalent to the value of the price change. This process is called mark-to-market, and it helps to reduce the risk of default from one of the parties by distributing any gains or losses relatively evenly over the contract's existence.

In his 1986 article economist Merton Miller claimed that financial futures were "the most significant financial innovation of the past 20 years" (p.463). He wrote that the truly remarkable thing about futures was their cash settlement ability. That is, futures can be deliverable or non-deliverable, which means that on the exercise date the parties can either trade the asset (deliverable) or settle in cash (non-deliverable). (Without the obligation to trade the underlying asset speculation is facilitated in a broader range of markets). However, it can also be an issue for buyers who require the underlying asset, especially if its physical market is illiquid.

Closely related to forwards and futures is the derivative swaps. Swaps involve two parties trading cash flows for a specified period of time (Hull, 2002). Swaps come in many forms, with the most common types being interest rate and currency swaps. An interest rate swap is where one party exchanges their floating interest rate payments for another party's fixed payments. Such an arrangement enables users to hedge against the interest rate depending on their circumstances. In comparison, currency swaps or foreign exchange swaps involve parties trading commitments to pay cash flows in one currency for another currency. Ross, Westerfield and Jaffe (2005) point out that "swaps, like forwards and futures, are essentially zero-sum transactions which is to say that in both cases, the market sets prices at a fair level and neither party has any substantial bargain or loss at the moment the deed is struck" (p.721). Many theories have been developed about the pros and cons of the impact of derivatives trading in the stock market. A common agreement has been found among the studies that the introduction of derivatives products, specially the equity index futures enables traders to transact large volumes at much lower transaction costs relative to the cash market.

A major theoretical argument for the benefit of derivatives trading is that it reduces the volatility of the stock market. The logic is that it reduces the asymmetric information among the investors and information reduces the speculation in the trading system. A variety of theoretical arguments have been advanced over the years to explain why speculative trading in general, or the existence of derivatives markets in particular, might affect the volatility of the underlying asset market.

The behavior of volatility in the equity market in India, for the pre and post derivatives period, has been examined using conditional variance for the period of 1999-2003 in (Nath, 2003). He modeled conditional volatility using different method such as GARCH (1.1). He has considered 20 stocks randomly from the Nifty and Junior Nifty basket as well as benchmark indices itself. As result, he observed that for most of the stocks, the volatility came down in the post-derivative trading period. All these methods suggest that the volatility of the market as measured by benchmark indices like S&P CNX Nifty and Nifty Junior have fallen in the post-derivatives period.

2.2 Literature Review

On the one hand, some researchers support the idea that when futures are traded this will lead to an increase in volatility that consequently will destabilize the underlying market. This suggests that it is desirable for the volatility to decrease and undesirable for the volatility to increase. According to Cox (1976) the main source of destabilization and yet increased volatility of the underlying cash markets is the existence of uninformed traders in the derivative market. Given that futures markets are considered to have a higher degree of leverage compared to cash markets. For instance, the transaction costs are generally small in futures markets. Moreover, the capital that is required for a cash transaction is much bigger than the capital committed for a futures transaction in the same asset. Consequently, future markers are mainly an entry for new information.

Another point worth mentioning is that futures and spot prices are combined by arbitrage; the transactions of the insurer's portfolio and risk arbitrageurs may result in a spill-over effect from futures volatility to the particular markets. Moreover, increased volatility may result from the uninformed traders which trade in both spot markets as well as derivative markets because they are searching for short-term gains, something that increases uncertainty and lowers the prices informational role. Additionally, the destabilisation gives rise to a greater need for stronger regulations in order to avoid unfavourable effects. An alternative way to see that is that future markets can be viewed as an additional way by which, all the data can be sent. As a result, the increased spot market volatility may result from the more occasional arrival as well as from the most immediate information processing.

Figlewski (1981) in his study, concerning how the futures trading affect the GNMA "pass through securities" (Government National Mortgage Association) wanted to see whether the price volatility of this market would change due to the futures trading, and what he found is that the monthly price volatility increased due to the futures markets. Moreover, he agreed with Cox's argument stating that if the futures traders are less informed than the people participating in the cash market, then this would result in an increase in the cash market volatility. Furthermore, Stein (1987) enriched Figlewski's point of view by stating that it's the derivatives that are traded in the commodities that destabilize the particular market by causing an increase in the volatility. Moreover, in his analysis he supports the idea that less informed traders are attracted by futures markets due to the high level of leverage; the way these traders behave lowers the information content of prices and raises the volatility of the spot market. As a result, according to Stein and Finglewski the destabilization of the spot market results from the involvement of uninformed investors in the derivatives markets. Almost the same idea was introduced by Cagan (1981).

Harris (1989) in his attempt to conduct a cross-sectional analysis of covariance for the sample period of 1975-1987, found out that after the derivatives were introduced there was a rise in volatility of the S&P500 index.
When Lee and Ohk (1992) wanted to examine how the introduction of the stock index futures would affect the volatilities of the Australian, Japanese, USA, UK and Hong Kong markets they discovered that after the introduction of the stock index futures the volatility of the stock market had risen significantly while making it more efficient; since volatility shocks contain information that are very rapidly absorbed and transmitted by the market. However, they excluded from their results the Australian and the Hong Kong stock markets. This is due to the fact that stock

markets around the world appear to have different features. Pok and Poshakwale (2004) distrust whether the conclusions driven by some researches, which are based on well-developed as well as highly liquid markets, can be actually implemented to the emerging markets, or not (Pok, et. al., 2004). As a result, they conducted a research based on the Malaysian stock market which has different structural features compared to a developed one (Pok W. et. al. 2004). Finally, Pok and Poshakwale (2004) in their study concerning the Korean stock market found that along with the rise in the volatility after the introduction of the derivatives they also noticed an improvement in the effectiveness of the stock market.

Last but not least, Antoniou and Holmes (1995) concerning the UK market stated that a rise in the volatility was due to the futures traded on the FTSE 100 index. However, this trade has contributed also to the improvement of the quality as well as to how fast the information is transmitted to the spot market.

All things considered, the main reasons for which there is detected a rise in the volatility of the spot markets are that an increase in the volatility of the futures markets may result from a high level of leverage as well as from the existence of less informed traders.

On the other hand, many analysts such as Powers (1970) support the idea that future markets raise the overall depth and informativeness of the market. Moreover, future markets are considered to be very important for price discovery as well as allowance for risk transfer while at the same time they may reduce spot market volatility. (Danthine 1978; Powers 1970; Schwartz and Laatsch 1991). It is believed that lucrative speculation from the well-informed traders have a tendency to stabilize the market while the less-informed traders will eventually be extinguished by the market in the short-run. Friedman (1953) states that speculation is actually destabilizing, which is similar to saying that speculators are in fact losing money, something that is unreasonable to happen at least in the long-run. Moreover, Chang et al. (1999) argues that even in the case that the empirical results suggest that spot portfolio volatility increases due to futures trading; this increase is relatively small compared to the shifts of volatility that occur from changes in other economic factors.

Moreover, Bessembinder and Seguin (1992) and Brown-Hruska and Kuserk (1995) analyse the relationship between the stock index futures market and the relative trading volumes in the stock market on one side and the S&P500 index of cash price volatility on the other side. The authors found out that active future markets are linked with decrease stock market volatility.
Antoniou et al. (1998) in a study that was driven by the largest markets in the world (Spain, Japan, Germany, UK, USA, Switzerland) came up with the result that the derivatives listing had had a negative effect on the level of volatility only in Switzerland and Germany. While in the rest countries it didn't affect the level of price volatility in the particular assets. The authors also suggested that the introduction of futures lowers the asymmetric reactions due to new information and that generally they affect the market in a positive way. Finally, they argue that there are markets, such as the Spanish stock market, that include exceptions.
Nevertheless, Pilar and Rafael (2002) in their study concerning the Spanish market disagreed with Antoniou et al. with the exclusion of the asymmetry issue. What they claimed was that the derivatives listing in the IBEX35 index had advantageous results as it had decreased the volatility of the particular market while simultaneously it had raised its liquidity, two things that encourage its efficiency.

Moreover, Schwarz and Laatsch (1991) support as well the idea that future markets are a significant mean of price discovery on the underlying spot markets. Furthermore, Stroll and Whaley (1988) argued that future markets encourage the efficiency of the market. Danthine

(1978) introduced a model which is implied to increase market depth and decrease the spot market volatility once the futures are traded.

Finally, some analysts claim that derivative markets do not affect the spot market volatility. For instance, Santoni (1987) discovered that the daily and weekly S&P500 index volatilities do not differ after futures listing. This idea was enhanced by Davis and White (1987) as well as by Edwards (1988). Particularly, Edwards in his analysis on the USA stock market volatility on pre- and post- futures introduction period over 16-years from 1972 to 1987 didn't find any evidence to endorse the hypothesis that the introduction of futures trading lead to an increase in the volatility of the spot market. However, he supported the idea that the increase in the prices of the stocks as well as the rise in several other macroeconomic factors, such as the intense fall of the dollar against other leading currencies, was the main factors that determined the volatility at that period.

Moreover, Aggarwal (1988) examined how futures listing affect the volatilities of S&P500 and DJIA indexes over 1981 to 1987 time period. Moreover, the OTC index was taken into consideration, which didn't have any active future market that could control it from irrelevant factors (Drimbetas, et al. 2007). What he discovered was that the volatility had increased in all of the markets, after the derivatives listing, separately of the derivatives trading existence, and derived the conclusion that volatility should be credited to several other external as well as internal factors, together with the bull market of 1985–1987, problems that are associated with the trade and budget deficit and ultimately the fall of the dollar (Drimbetas, et al., 2007). Furthermore, Darrat and Rahman (1995) in their analysis over the S&P500 index and DJIA jump volatility, over the 1982-1991 time period, they didn't find any correlation with the trade of derivatives. However, they drew the conclusion that the volatility and the structure of the OTC index are the components that consist of the factors of the volatility's stock price and also that this fact does not requires any additional adoption of stricter rules. Finally, Kan (1999) analysed the case of the Hong Kong market, over 1982-1992 time period, and he came up with common conclusions concerning the stock volatility of the HIS index.

All things considered, the conclusions driven by the literature differ in three ways. Firstly, they regard different countries and as a result economies that differ in structure as well as in the fundamentals of macroeconomics. Secondly, they concern different time periods and finally, they were applied different models each time that they were based on different assumptions.

All three arguments have a strong theoretical merit however; the effects of derivatives trading on volatility are in fact an empirical question. Even if the empirical research on this particular issue has created controversial results, it has mainly focused on large equity capitalisation markets. They are not many studies that analyze emerging and small equity markets. "*However, financial and technological innovation, deregulation and the globalisation of financial services make these markets very important for the financial stability of the global system, as a series of financial crises in the 1990s indicates*" (S.I. Spyrou 2005:184). Moreover, it is very important to know whether the empirical results that were received from the large markets can be applied to the small markets too. The conclusions differ according to the indexes and the testing methodologies that have been used. The way the model is specified as well as constructed of the activity variables is also very important. As a matter of fact, all The majority of the empirical studies have analysed the derivative index impact by comparing the unconditional variance of the returns of the pre- and post- futures introduction periods. Furthermore, they have used a GARCH type model, which enables the conditional variance to vary over time as a function of prior errors while the unconditional variance remains constant. (Engle, 1982; Bollerslev, 1986).

Another point worth mentioning is that some recent analysis has found out that volatility remains constant over time, implying that the GARCH model might be useful for prognosticating future volatility (French et al., 1987; Akgiray 1989; Bollerslev et al., 1992; Brailsford and Faff. 1996; Chu and Freund, 1996). When we want to examine the behaviour of volatility before and after futures introduction, it is important to isolate the influences that didn't occur from futures trading so that the impact of futures trading can be evaluated more promptly. This is usually accomplished by including a proxy variable for which there is no allied futures contract. If we isolate the 'market-wide' movements, then the impact of derivatives trading is seized if we introduce a dummy variable.

The majority of the empirical literature that study the behaviour of stock prices after option listing, suggest that when the options are introduced then the return volatility of the particular securities will be reduced, while at the same time the systematic risk will not be affected. The first studies by Trennepohl and Dukes (1979), Klemkosky and Maness (1980), Whiteside, Dukes and Dunne (1983) and Hayes and Tennenbaum (1979) find very few evidence that suggest a change in systematic risk as it was measured by the firms beta as well as in the total risk as it was measured by the returns of the variance. However, the conclusions of Trennepohl and Dukes (1979) and Whiteside, Dukes and Dunne (1983) suggest that the betas of the optioned securities decreased. Moreover, the results of Hayes and Tennenbaum (1979) suggest that when the options are introduced they have the ability to decrease the volatility of the underlying stocks. Likewise, some latest studies of Bansal, Pruitt and Wei (1989) indicate that the introduction of option tends to lower the total but not the systemic risk of the particular securities in the American markets.

Ma and Rao (1986) in their study, examined the characteristics that differentiate the stocks that undergo an increase in volatility, after the options were introduced, to the stocks that undergo a decrease in volatility. So they used multivariate linear discriminate analysis for these groups. The stocks that were characterized by increased risk, low returns, low trading volume and low growth were expected to be stabilized as soon as the options were traded. Finally, they drew the conclusion that option trading does not have a uniformity impact on the underlying securities. Another point worth mentioning is that empirical evidence is in favour of the idea that the more volatile stocks have the tendency to become more stable after the option listing while on the contrary, the more stable securities have the tendency to become more volatile. The main explanation for that is that usually the option listing attracts dissimilar kinds of traders concerning these two cases. Indeed it is a fact that there is a possibility for option listing to result in a raise in speculation with stable stocks which will lead in an increase in volatility, while the traders may hedge in options with stocks that are more volatile and as a result the returns are stabilized after the option listing.

Swart (1998) in a dissertation entitled 'the impact of share index futures trading on the volatility and liquidity of the underlying assets on the Johannesburg Stock Exchange, indicated significant positive relationships between futures trading activity and the volatility of underlying assets for the Gold index and the Industrial Index. Although no significant relationship was reported for the All Share Index, the author declares the results to support the hypothesis that index futures trading increases the volatility of the underlying assets. The author also maintains that the results of his research support the premise that the trading of index futures is associated with greater liquidity in the underlying.

As far as the UK Stock Exchange market is concerned, Antoniou and Holmes (1995) suggested that when the FTSE 100 index futures contract was introduced then this lead in an increase in volatility while it enhanced the quality and the pace of the information that were flowing in the spot market. Moreover, Butterworth (2000) in his study argues that the amount of information had increased after the introduction of the futures traded for the FTSE Mid 250 index, and Yo (2001) found that the introduction of futures trading wasn't followed by noteworthy changes in the particular markets. Furthermore, Bologna and Cavallo (2002) in their study over the Italian stock market found that the stock market volatility deceased after the introduction of the stock index futures trading. While at the same time Pilar and Rafael (2002) regarding the Spanish stock market, found that uncertainty diminished in the underlying markets while liquidity had risen. Ilueca and Lafuentre (2003) for the Spanish IBEX 35 index used a non-parametric approach as well as intra-day data, and they found that futures trading do no destabilize the spot market. Chiang and Wang (2002) in their study found out that when the TAIEX futures were traded then this affected significantly the spot price volatility while at the meantime the trading of Morgan Stanley Capital International (MSCI) Taiwan futures didn't. Furthermore, Yo (2001) didn't come up with noteworthy changes in the Hong Kong underlying market. Lee and Ohk (1992) studied the way the trading in stock index futures affect the stock return volatility in Australia, Japan, Hong Kong and the UK, and suggested that there was no considerable boost in Hong Kong and Australia, contrary to the other markets.

Moreover, the study concerning the effect of financial futures on the volatility of the underlying markets tends to concentrate on two financial instruments: *"the Government National Mortgage Association (GNMA) certificates in the US, and stock index futures (again, predominantly in the US)"* (A. Antoniou, P. Holmes 1995:121). Froewiss (1978) used regression analysis in order to test the variability of the GNMA 19. Prices compared to the prices of the bonds and he found out that after the introduction of derivatives there was no significant change. Moreover, he argued that the weekly spot price volatility remained the same in the post- futures introduction period.

However, Finglewski (1981) suggested that futures trading in the GNMA securities have resulted in a raise in monthly price volatility. Moreover, Simpson and Ireland (1982) used of a multivariate time series model and regression analysis in order to explain the changes that were observed in the daily and weekly prices due to futures.

In addition, Edwards (1988a,b) examined the stock market volatility in the pre- and post-futures introduction period and he found that the volatility for the S&P 500 index had decreased in the post-futures period. However, for the Value Line index he didn't find any significant difference. Moreover, Aggarwal (1998) argued that the post-futures period is considered to be more volatile for all markets and that stock index futures may not always be the primary reason for this particular boost in volatility. Santoni (1987) suggested that a rise in the trading volume of the S&P 500 futures contract is not necessary to result in an additional increase in the volatility of the underlying index while Smith (1989) claimed that the S&P 500 futures volume didn't affect the volatility of the returns of the index. Moreover, Becketti and Roberts (1990) didn't find almost any relation between the introduction or the activity level of S&P 500 stock index futures market and the stock market volatility. Bessembinder and Seguin (1992) argued that there was a positive relation between unanticipated S&P 500 futures trading and spot market volatility although there was a negative relation between spot market volatility and expected futures. Hruska and Kuserk (1995) presented for the S&P 500 that when the level of futures volume is higher compared to cash market trading, this could be related to lower spot market volatility. Bologna (1999) showed that once the stock index futures trading in the Italian stock exchange were introduced then this resulted in a decrease in volatility and that there is an inverse relation among the stock market conditional variance and the lagged futures volume. Finally, Altay-Salih and Kurtas (1998) analysed dissimilar indexes and they found that seventeen out of twenty-four had lower long run volatility in the post-futures period.

All things considered, despite the fact that many studies have been carried out in order to identify whether the futures markets stabilize or not the underlying cash markets, the results are yet not precise. That means that while the majority of the empirical results are not in agreement, on the contrary most of the recent studies tend to demonstrate similar results, with the implication of identical conclusions.

3. CHAPTER THREE

RESEARCH METHODOLOGIES AND STATISTICAL TECHNIQUES

3.1 Introduction

Various research methodologies are applied to establish statistically what effect or impact derivative trading will have in the economy of Kenya. The following graphical representation (table 3.1) outlines the approaches followed to determine the price effect, volume effect and volatility effect respectively.

Table 3.1

Price, Volume and volatility effect methodologies

Effect	Methodology	Section	Synopsis
Price	Event Study: Market model	3.2.1	A market model approach was used to generate company betas and calculate normal and subsequently abnormal returns (i.e actual minus normal)
	Event Study: Dummy variable regression	3.2.5	Similar to the market model approach but abnormal returns generated directly via a dummy variable regression (day zero only)
Volume	T- Test for change in mean	3.3.1	Pre and post period normalised (exponentially smoothed) average volumes calculated and the difference and the difference T- tested for significance
	Dummy regression with trend coefficient	3.3.2	Similar to the T- test but the dummy variable regression also includes a trend coefficient (time series variable) to account for the trending nature of volume
Volatility	F-test for difference in Variance	3.4.1	The volatility (standard deviation) of both periods (before and after the event) calculated and F-tested for significance
	GARCH methodology	3.4.2	GARCH(1,1) model used to determine the effect and persistence of information on the conditional volatility (structure), and detect a change in the inconditional volatility (level) of a company, pre to post futures.
	Change in systematic risk (beta): Dummy variable regression	3.4.3	The market-company relationship was inspected before and after initial futures trading. A dummy variable regression tests for an absolute shift in the constant term (alpha) and a change in the slope coefficient (beta).

Section 3.2 describes the event study methodology used to determine the price effect and section 3.3 introduces the methods used to detect a change in the average normalised trading volume of the underling following the introduction of futures trading. Measuring changes in volatility (conditional and unconditional) and systematic risk involves a pre to post introduction variance comparison, a generalised autoregressive conditional heteroskedasticy model, and a dummy variable regression model, all dealt with in section 3.4

3.2 Price Effect

The expected or predicated impact on the price/return of the underlying security according to the three major theoretical frameworks is as presented in table 3.2

Table 3.2

Predicted change in price according to conceptual frameworks

Complete Markets	Diminishing Short Sales Restrictions	Improved Information Environment
Positive – assuming a more efficient or complete market due to futures trading	Negative (lower) – futures allow short positions, thereby impounding negative information in the underling. Arbitrage between futures and spot markets could also lead to lower equilibrium prices	Either – positively related to future expectations

Source: Adapted from Clarke, Gannon & Vinning (2007:13)

An event study is conducted to determine the effect on the underlying with the introduction of future trading (i.e. the event). A market model and regression model are used, respectively to generate the abnormal returns required to analyse the impact. Sections 3.2.1 to 3.2.4 outline the concepts and principles of an event study. This is followed by a discussion of the market model approach to event studies (section 3.2.5); section 3.2.6 deals with the regression model which utilises a dummy variable, thereby isolating any abnormal returns caused by the event.

3.2.1 Event Study Methodology

The effect of a financial event on the value of a listed company in the NSE can be measured using financial market data in an event study (Campbell, Lo & MacKinlay, 1997). The effect of a firm specific event (e.g. introduction of a new derivative) should reflect as an abnormal or unexpected change (positive or negative) in the firm's share price.

Event study methodology encompasses the econometric techniques used to estimate and draw inferences from the impact of an event or multiple identical events in a particular period. Table 3.3 provides a summary of the process followed to determine the price effect on the other derivatives as well as the underlying asset.

Table 3.3

Outline of event study methodology

Event Definition	Define the event of interest and identify the period under investigation.
	The event window including the event date and the periods prior to and after the event is specified. A multiple-day period overlapping the specific date of interest may capture additional information on the price effect of an event.
Selection Criteria	Determine the security selection criteria for inclusion in the study.
	These criteria may include availability of data, market capitalisation, industry sector and/or distribution of event. A summary of the characteristics of the data sample is provided.
Normal and	Model the security price reaction.

abnormal returns	This generally involves an expectations model conditional upon the event. Any abnormal return is measured in order to appraise the event's impact on the share price The abnormal return is the actual ex post of the security minus the normal return of the security over the even window. The normal return is defined as the expected return not conditional on the event taking place. For each security *i* and event date τ we have: $AR_{i\tau} = R_{i\tau} - \mathrm{E}\left[R_{i\tau} \mid X_{\tau}\right]$ (3.1) Where $AR_{i\tau}$ = Abnormal return due to specific event $R_{i\tau}$ = Actual return during event period $\mathrm{E}\left[R_{i\tau}\right]$ = Normal (expected return in the absence of any event) X_{τ} = Conditional information for the normal return model
Estimation Procedure	Estimate the excess return The selected normal return model is used to estimate the model-parameters with a subset of data representing a defined estimation window. A normal or expected return for each security included in the study is derived from this specified pre-event period. The post-event period may be included to increase the model robustness. The actual event period is not included in the estimation period to prevent the event from influencing the normal return estimates. This step entails the calculations of residuals from the returns generated by the specified model.
Testing Procedure	Design the testing framework This step involves the formulation of the econometric design of the study. The null and alternative hypotheses are formulated and the technique for aggregating the abnormal returns of individual securities is determined.
Empirical Results	Organise and group the excess returns.

	Presentation of the basic empirical results and the diagnostics or analytical procedures. The residuals may be treated individually, but the aggregation across securities and inferences on the average effect are standard.
Interpretation and conclusions	Analyse the results.
	Insights on the apparent effect of the specified event on security prices. Concluding comments complete the study.

Source: Adapted from Bowman (1983) and Campbell et al (1997)

A viable and effective event study requires the isolation of the event to the greatest degree possible, independence of individual company returns, and the assumption of constant systematic risk as represented by the beta coefficient used to determine the 'normal' return. Wells (2004) recorded the following preferred features and requirements of an event study:

Feature: Extraneous factors diversified away and/or filtered out, leaving data that represent only the impact of the specified event on security returns.

Requirement: Samples are from different industries, each sample security has a different event day, and a large sample size.

Feature: Returns across the study sample are independent of one another.

Requirement: Study not focused on a specific industry.

Conversely, all the required features are potential problems are the event's impact may be confounded with other coincidental events, possibly resulting in any abnormal returns being incorrectly attributed to the studied event.

Feature: Constant beta[1] and the past is a perfect predictor of the future.

Problem: Empirical tests show that beta is not constant through time and that beta may change because the impact of a particular event may alter the co-movement between a security and the market. Shifting macroeconomic variables (e.g. interest rates, business cycles and trade balances) also change a security's beta.

3.2.2 Normal Return Models

The selection of a normal return model precedes any parameter estimation, calculation of abnormal returns (residuals) and statistical significance testing. The following section provides a brief overview of the alternative models used in event studies.

Models for measuring normal performance are, according to Campbell et all (1997 pg 153-154) loosely grouped into two categories, namely statistical and economic. Statistical models derive from statistical assumptions regarding security-return behaviour and are not dependent on any economic reasoning. Statistical models posit that asst returns are jointly multi-variately normal and independently and identically distributed through time. Economic models, on the other hand, rely on assumptions concerning investors' behaviour (economic restrictions) in addition to statistical assumptions allowing for a more precise measure of the normal return.

[1] Only Valid if beta is required by the normal return model selected for the event study. See section 3.2.3

Brown and Warner (1980) link up with the above, classifying three general benchmarks (i.e, models generating 'normal' returns) to determine the ex post[2] abnormal return on any given security. On the basis of their classification and that of Campbell et al (1997), the following combined structure is presented:

The mean-adjusted returns model assumes that the ex-ante[3] expected return, although it may differ across securities, is a constant and that the *ex post* predicted return equals this value. The abnormal return or the residual is equal to the difference between the observed or actual return and this predicted constant return. The mean daily return on each individual security over a predetermined estimation period is this used as the benchmark for the event period.

The market-adjusted returns model assumes that the ex ante expected returns are equal across securities, but not necessarily constant for a given security. Limited availability of data dictates the use of this model because a market-adjusted return substitutes for a pre-event estimation period providing the required normal parameters. This restricted market model's coefficients are pre-specified with α_i (intercept) constrained to be zero and β_i (slope coefficient) constrained to be one and an estimation period is therefore not required to obtain parameter estimates. This is similar to the mean-adjusted model, but instead the market's mean return is in effect used as the benchmark for the event period.

The market model is a risk-adjusted statistical model that relates the return of any given security to the return of the market portfolio. A one-factor OLS regression analysis generates the intercept or alpha (α), and slope or beta (β), thereby incorporating a risk adjustment component

[2] Ex-post (i.e. after the event) returns refer to actual returns

[3] Ex-post (i.e. after the event) returns refer to future or predicted returns

to the estimate of returns. Beta is the measure of an individual security's co-movement with the market's return and is, therefore, a measure of market risk.

Risk-adjusted economic models restrict the parameters of statistical models and provide more constrained normal return models. The Capital Asset Pricing Model (CAPM) is an equilibrium model which equates the expected return of an asset to its covariance with the market portfolio and the risk-free interest rate. CAPM provides for a single risk factor (market risk premium), while the Arbitrage Pricing Theory (APT) incorporates multiple risk factors. Mackinlay (1997) states that the most important factor. However, remains that the market factor and any additional factors add relatively little explanatory power. Statistical models provide any and all of the benefits from utilising a CAPM or APT model, and for event studies such models dominate.

3.2.3 Market Model

The concept of abnormal returns is the central element of event studies and the benchmark or model generating normal returns is consequently central to conducting an event study. All extensions or variations to the market model attempt to reduce the variance of the abnormal return by explaining more of the variation in the normal return. The lack of sensitivity to model choice can be attributed to the fact that the marginal explanatory power of additional factors proved to be small and these factors contributed little to the reduction in the variance of the abnormal return. Ultimately the benefit from using the market model will depend on the coefficient of determination (R^2) of the regression as this determines the extent to which the variance of the abnormal return was reduced (Campbell et al 1997). The chosen model for this study is the market model specified as follows:

For any security *i* the market model is:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \qquad (3.2)$$

$$E(\varepsilon_{it}) = 0$$

$$Var(\varepsilon_{it}) = \sigma^2_{it}$$

Where:

R_{it}	=	Period –t returns on security i (dependent variable)
R_{mt}	=	Period –t returns on the market portfolio m (independent variable)
ε_{it}	=	Error or disturbance term representing unsystematic risk
α_i	=	Intercept term (alpha – minimum return of security when market return is zero)
β_i	=	Slope coefficient (beta – systematic risk)
σ^2_{it}	=	Variance of the disturbance term

The parameters of the model (α_i, β_i and σ^2_{it}) are estimated by means of ordinary least squares (OLS) regression and used to calculate the residuals or abnormal returns.

3.2.4 Estimation of the Market Model

The relationship between a derivatives return and returns on the market is estimated by ordinary least squares (OLS) regression and this relationship is used to estimate expected returns, given returns on the market.

For the i^{th} firm in event time, the OLS estimators of the market model for an estimation window of observations are:

$$\hat{\beta} = \frac{\sum_{\tau=T_0+1}^{T_1} (R_{i\tau} - \hat{\mu}_i)(R_{m\tau} - \hat{\mu}_m)}{\sum_{\tau=T_0+1}^{T_1} (R_{m\tau} - \hat{\mu}_m)^2} = \frac{\text{cov}_{R_{i\tau}, R_{m\tau}}}{\text{var}_{R_{m\tau}}} \qquad (3.3)$$

$$\hat{\alpha}_i = \hat{\mu}_i - \hat{\beta}_i \hat{\mu}_m \qquad (3.4)$$

$$\hat{\sigma}^2_{\varepsilon_i} = \frac{1}{L_1 - 2} \sum_{\tau=T_0+1}^{T_1} \left(R_{i\tau} - \hat{\alpha}_i - \hat{\beta}_i R_{m\tau}\right)^2 = \frac{1}{L_1 - 2} \sum_{\tau=T_0+1}^{T_1} (\varepsilon_{i\tau})^2 \qquad (3.5)$$

Where:

$$\hat{\mu}_i = \frac{1}{L_1} \sum_{\tau=T_0+1}^{T_1} R_{i\tau}$$

$$\hat{\mu}_m = \frac{1}{L_1} \sum_{\tau=T_0+1}^{T_1} R_{m\tau}$$

$R_{i\tau}$ = Event-period – τ returns on security *i*

$R_{m\tau}$ = Event-period – τ returns on the market portfolio *m*

Source: Adapted MacKinlay(1997)

3.2.5 Abnormal returns modelled as regression coefficients

Another approach involves regression methods with abnormal returns being generated as coefficients of dummy variables corresponding to the event dates. The regression approach is computationally simpler than the market model approach since estimation of the benchmark model and the abnormal return (dummy variable coefficient) are done concurrently, while the appropriate statistical tests are performed directly in standard regression software packages McKencie, Thomsen & Dixon (2004).

$$R_{it} = \alpha_i + \beta_i R_{mt} + \delta D_F + \varepsilon_{it}$$

Where:

D_F = Dummy Variable

δ = Event Coefficient

The dummy variable has a value of one on an event day and a value of zero otherwise. The coefficient is interpreted as the abnormal return on the event day and the level of significance indicated by the relevant p-value generated as part of the regression output.

3.3 Volume Effect

The expected or predicted impact on the trading volume of the underlying security according to the three major theoretical frameworks is as presented in table 3.4:

Table 3.4

Predicted change in volume according to conceptual frameworks

Complete Markets	Diminishing Short Sales Restrictions	Improved Information Environment
Higher – assuming a more efficient or complete market due to futures trading	Unclear- short selling occurs in the futures market and not the underlying market. Faff and Hillier (2005) foresee an increase in trading volume	Unclear – similar to diminishing short sales theory. Informed traders trade on negative information (short sell in futures market).

Source: Adapted from Clarke, Gannon & Vinning (2007:13)

To determine whether the event caused a permanent change in volume the average normalised volume pre- and post-event is calculated and tested. An additional test is performed with a dummy variable with trend coefficient regression to determine whether the volume changed significantly even after accounting for the natural increase in trading volume over time.

3.3.1 Average normalised volume

Share trading volume is a highly volatile factor, according to Clarke et al (2007), often resulting in large variances, generally non-normal distributions and many outliers. An exponential smooth process is applied to the data to normalise the volume and the normalised volume figures are used in the analysis.

Single exponential smoothing formula:

$$S_t = \alpha Y_t + (1-\alpha) s_{t-1} = s_{t-1} + \alpha (Y_t - s_{t-1})$$

Where:

Y_t = Raw Data

S = Output of the exponential smoothing algorithm

α = Smoothing factor ($0 < \alpha \leq 1$)

Source: EViews (2007a:356) and NIST (2006)

3.3.2 Dummy variable regression

Trading volume generally tends to increase over time and a dummy variable regression considering this trend is used as this is not captured by a t-test for change in mean.

Equation used to estimate volume:

$$V_{it} = \alpha_i + \beta_i T_{it} + \delta D_F + \varepsilon_{it}$$

Where:

V_{it}	=	Normalised volume for security i at time t
α_i	=	Intercept
$\beta_i T_{it}$	=	Trend (day) coefficient and variable
δD_F	=	Dummy coefficient and variable

The dummy variable takes the value of zero for the pre-event period and one for the post-event period. The coefficient is interpreted as a change in trading volume after considering any underlying trend which may bias the results of the dummy variable. The level of significance is indicated by the relevant p-value of the statistical output.

3.4 Volatility Effect

The expected or predicted impact on the volatility of the underlying security according to the three major theoretical frameworks is as presented in table 3.5:

Table 3.5

Predicted change in volatility according to conceptual frameworks

Complete Markets	Diminishing Short Sales Restrictions	Improved Information Environment
Lower – assuming a more stabilized (efficient/complete) market due to futures trading	Lower – improved efficiency by reducing the asymmetric response to information. Arbitrage between shares and derivatives could lead to lower volatility	Lower- improved price discovery due to futures trading, leading to smaller fluctuations in price

Source: Adapted from Clarke, Gannon & Vinning (2007:13)

A ratio of pre-event variance to post-event variance is calculated as a preliminary test, with a GARCH model employed as the primary evaluation technique for changes in volatility due to the event. In addition, a pre-to-post beta comparison via a dummy variable regression is used to test for a change in systematic risk (beta) of a security following the event.

3.4.1 Variance

Variance (historical) is the measure of variability or statistical dispersion of security or portfolio returns, indicating the spread of historical values around the mean value. The variance is calculated as the mean of the sum of squares of the differences between the values and the mean of the sample. A larger variance denotes higher volatility and increased risk. As stated by Engle (2001), 'volatility is a response to news, which must be a surprise'. The timing of the news may be expected and this shows up as the predictable components of volatility, such as economic announcements or any corporate action. In order to determine a change in unconditional variance (volatility), a ratio of pre-futures variance to post-futures variance is calculated and an F-test applied.

The test statistic for tests concerning differences between variances of the two sample periods:

$$F = \frac{S_1^2}{S_2^2}$$

Where:

S_1^2	=	Variance for pre-event period ($df_1 = n_1 - 1$ numerator degrees of freedom)
S_2^2	=	Variance for post-event period ($df_2 = n_2 - 1$ denominator degrees of freedom)

The larger of the two ratios S_1^2 / S_2^2 and S_2^2 / S_1^2 is used as the actual test statistic and the value of the test statistic is therefore always greater than or equal to one. The rejection point for any formulation of the hypothesis is a single value in the right-hand of the relevant F-distribution A "not equal to" alternative hypothesis has the null hypothesis rejected at the α significance level[4] if the test statistic is greater than the upper $\alpha/2$ point of the F-distribution. A "greater than" or "less than" alternative hypothesis sees the null hypothesis rejected at the α significance level if the test statistic is greater than the upper α point of the F-distribution with the specified degrees of freedom (DeFusco et al 2004).

3.4.2 Generalised Autoregressive conditional heteroskedasticy (GARCH) model

The impact of a security-specific event on the level or degree of the security's price changes and the duration thereof is modelled as the conditional variance of the security. An increase or decrease in the post-event unconditional variance of the security is detected by the relative changes in parameter values specified by a GARCH model.

AR(1)-GARCH(1,1) model specification:

Conditional Mean equation

$$Y_t = a + bY_{t-1} + \varepsilon_t \qquad ;\varepsilon_t \sim N(0,h_t)$$

Conditional Variance equation

$$h_t = \omega + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1} \qquad ;\omega > 0, \alpha > 0, \beta \geq 0$$

Unconditional (constant) variance of the error term

[4] The level (α) of significance indicates the probability of a normally distributed variable changing by more than a specific number of standard deviations.

$$Var(\varepsilon_t) = \frac{\omega}{1-(\alpha+\beta)}$$

Specification of the log-likelihood function (LLF)

$$L = -\frac{T}{2}\log(2\pi) - \frac{1}{2}\sum_{t=1}^{T}\log(h_t) - \frac{1}{2}\sum_{t=1}^{T}\frac{(Y_t - a - bY_{t-1})^2}{h_t}$$

Y_t	=	Dependent Variable (return on an asset)
a	=	Constant
bY_t	=	Autoregressive coefficient and explanatory (lagged) variable
ε_t	=	Error term

And:

h_t	=	Conditional variance in period t
ω	=	Constant (long-term average)
$\alpha\varepsilon_{t-1}^2$	=	News coefficient and ARCH(1) term
βh_{t-1}	=	Persistence coefficient (old news) and GARCH(1) term

Source: Adapted from Brooks (2002)

If convergence is not achieved or implausible (i.e. parameter values are negative or too large) when parameter estimates are obtained with the default estimation settings, the estimation could be re done with different string values (programme assigns its own starting values using OLS regression for the mean equation), and/or by selecting a different error distribution to the Normal (Gaussian), increasing the maximum number of iterations or adjusting the convergence criterion. The parameters should be positive and should add up to a number less than one (required for a mean reverting variance process). A variety of views and procedures for inference and diagnostic checking are available to detect model failures according to Engle (2001)

4 CHAPTER FOUR

STATISTICAL ANALYSIS AND RESULTS

4.1 Introduction

The purpose of this chapter is to report the findings of various statistical procedures in order to determine the impact of derivatives in the NSE. Discernible changes – relative to a predetermined before-period – in price, volume and volatility of the underlying are evaluated for statistical significance and effect.

4.2 Price effect

An event study was conducted to determine the effect (if any) caused by the initial trading (introduction) of a single futures contract on the spot price of the underlying company. A market model[5] was used to regress the company returns on the returns of the market (Nairobi All Share Index - NASI), thereby determining the company's beta (slope coefficient – sensitivity to the return of the market) in order to establish the 'normal' daily returns of a company during the event period. The difference between this normal or anticipated returns (beta times the market return) and the actual return of the company represents the abnormal return on a specified day.

The selected model (market model), generating individual company betas, was not assessed in terms of 'goodness of fit' (R-squared) in each instance, but simple used to establish a normal return as determined by the market, to be compared with the actual return from the movement in individual share prices. The discrepancies between the relative and actual-company returns

[5] See chapter 3, section 3.2

during the event period are presented and attributed in the following table (4.1). Inferences regarding the statistical validity of each abnormal return and the conclusion reached on the impact of derivatives trading on the underlying share price follow the statistical output.

Table 4.1

Panel A shows the abnormal returns (AR) as calculated from a market model $R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it}$ for segments of listed companies on a specific day during the event period.

Panel B displays the abnormal return on the actual event day (day zero) obtained from a dummy variable regression $R = \alpha_i + \beta_i R_{mt} + \delta D_F + \varepsilon_{it}$

Day	Panel A: Event Study - Abnormal Returns											
	BAN		**AGRIC**		**ENERG**		**INVES**		**COMMA**		**AIMS**	
	AR	z-stat	AR	z-stat	AR	z-stat	AR	z-stat	AR	z-stat	AR	z-stat
-5	-0.68%	-0.45	-3.78%	[illegible]	-3.05%	-0.84	0.48%	0.21	4.68%	1.28	7.46%	1.48
-4	-1.30%	-0.85	1.51%	0.66	-2.19%	-0.60	-1.20%	-0.54	0.05%	0.01	2.24%	0.45
-3	0.42%	0.28	1.38%	0.61	-1.22%	-0.34	-0.49%	-0.22	3.99%	1.09	-5.51%	-1.10
-2	0.23%	0.15	0.93%	0.41	-1.05%	-0.29	-1.21%	-0.54	-7.29%	-2.00	2.40%	0.48
-1	4.01%	2.63	-1.15%	-0.51	-1.46%	-0.40	-0.15%	-0.07	6.95%	[illegible]	4.23%	0.84
0	-0.71%	-0.46	-0.07%	-0.03	-3.28%	-0.90	-0.66%	-0.30	-4.86%	-1.33	4.71%	0.94
1	0.84%	0.55	0.62%	0.27	-3.56%	-0.98	-0.18%	-0.08	0.90%	0.25	1.72%	0.34
2	0.01%	0.36	0.15%	0.06	1.00%	0.28	-0.36%	-0.16	-0.21%	-0.06	-6.33%	-1.26
3	0.40%	0.26	-0.93%	-0.41	0.64%	0.17	-0.84%	-0.38	-3.45%	-0.95	8.72%	[illegible]
4	-1.41%	-0.92	-0.53%	-0.23	-0.45%	-0.12	0.22%	0.10	-0.24%	-0.07	-1.96%	-0.39
5	-0.82%	-0.54	1.40%	0.62	-2.97%	-0.82	0.01%	0.00	-1.15%	-0.32	-11.63%	2.31
σ	1.52%		2.27%		3.64%		2.22%		3.64%		5.03%	
	Panel B: Dummy variable regression - Abnormal return on initial derivatives trading day (0)											
AR	-0.71%	-0.54	0.02%	-0.01	-2.89%	-0.91	-0.65%	-0.33	-4.85%	-1.53	4.68%	1.02
Σ	1.31%		2.06%		3.16%		1.95%		3.17%		4.58%	
Z-Value	1% Level of Significance				5% Level of Significance				[illegible]			

Table 4.1: Panel A depicts the abnormal returns for each segment of listed companies represented in the study (fifty eight) obtained from the event study methodology. Panel B exhibits the day-zero returns results from the dummy variable regression. In general, most daily

abnormal returns proved to be non-significant, not exceeding the 1.68 critical value cut-off for a 10%-level of significance (90% confidence level1). Derivative trading, according to this event study, had no effect (no significant abnormal returns during the event period) on the share prices of the selected market segments of the listed companies included in this study.

The following four companies showed a statistically significant abnormal return on a single day during the event period under investigation: Kenya Commercial Bank Limited, KENGEN Limited, Kenya Airways Limited and Safaricom Limited. With only one day showing a statistically significant deviation from the normal return, it can be concluded that the introduction of derivatives in the Futures Exchange will have a very little effect on the share prices of the remaining fifty eight listed companies.

Barclays Bank Limited and Standard Chartered Bank Limited each exhibited only two days of statistically significant abnormal returns, providing virtually no evidence that the trading of derivatives will influence their share price. Similarly, only three days of sufficiently sized abnormal returns regarded by Bamburi Limited (BAMB), Athi River Mining (ARM) and East Africa Breweries Limited (EABL) confirmed that derivative trading will have little effect on the returns of these companies.

British Africa Tobacco (BAT) was the only company to reveal some share-price impact caused by the initial derivatives trading. Showing abnormal returns on six days (including day zero), BAT mainly experienced abnormal share-price activity in the five-day period leading up to the availability of futures contracts on its equity shares.

Only two companies displayed statistically significant abnormal returns on trading-day zero (verified by the dummy variable regression – see panel B), namely BAT and EABL. The dummy variable regression isolating day-zero returns confirmed the results obtained by the market model in all instances except for Sasini Tea Limited.[6]

On an individual company-by-company basis it is clear that the introduction of derivative trading had little or no impact on the underlying companies' share prices. The event study in conjunction with the dummy variable regression presented no conclusive evidence to establish either a positive or a negative price effect due to derivatives trading.

However, as stated in chapter 3, section 3.2, in an event study the focus is on the mean and the cumulative mean of the dispersion of abnormal returns. The individual securities' abnormal returns are aggregated and averaged. These average abnormal returns per event day are summed across days to measure the average cumulative effect of the event on the sample securities for the whole event period or a variety of periods within the event window. Cumulating these periodic average residuals over a particular time interval (number of days in the event window) allows for meaningful inferences concerning the general impact of the event. If the initial trading of derivatives caused a price effect, significant abnormal returns on day zero and possible significant abnormal returns on day -1 and day +1 should be uncovered. Significance should be lower as one move further from the event date and for longer periods or periods not including the actual event.

[6] The event study indicated a 0.28% negative abnormal return on day zero (-0.06 critical value), while the dummy variable regression (DVR) showed a 0.05% above normal return. The fact that the DVR spanned the total 511 day period (beta estimation period) compared to 250 days (event study) could account for this inconsistency

4.3 Volume effect

The effect of derivatives trading on the NSE volume of the underlying market segments before and after the first futures market transaction is tested by comparing the average normalized trading volume Pre-derivatives trading. An additional test is performed with a dummy variable and trend coefficient (a time series variable that checks for a trend) regression to determine whether the volume significantly changed after accounting for the tendency of the volume to increase (trend) over time.

Figure 4.1

Normalised (smoothed) volume

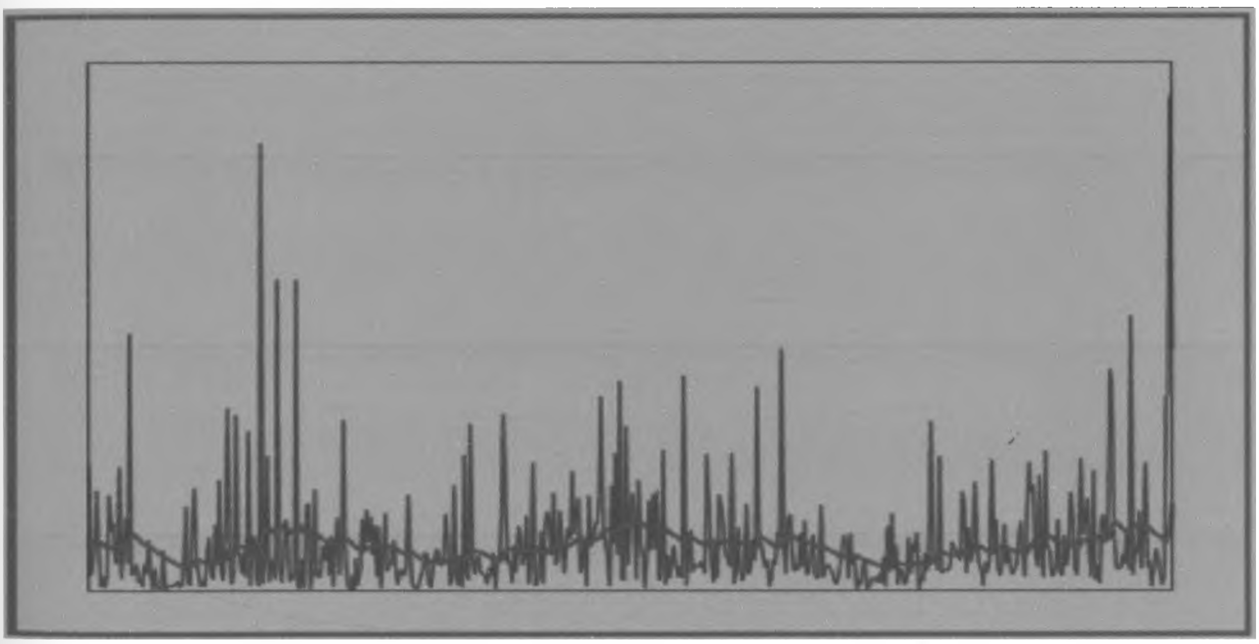


Figure 4.1 depicts the normalised daily trading volume (red) of Equity Bank Limited, used as an example, after an exponential smoothing process was performed on the actual data (blue). The forecasted value is a weighted average of the past values of the series where the weights decline exponentially with time (higher weight allocated to more recent data).

Panel A, in table 4.3 shows the output from the t-test for change in mean that is used to determine whether derivatives trading caused a permanent change in trading volume of the underlying. The average normalized volume in a specified number of days prior to derivative trading is compared with the average normalized volume in the period subsequent to the first derivative trade. The significance of the difference is determined by the size of the increase/decrease relative to the standard deviation of the underlying trading volume over the specified period[7].

[7] At 498 df the relevant t-values (two-sided) are 1,648 (10%), 1,965 (5%) and 2,586 (1%) respectively.

Table 4.3 Volume Results

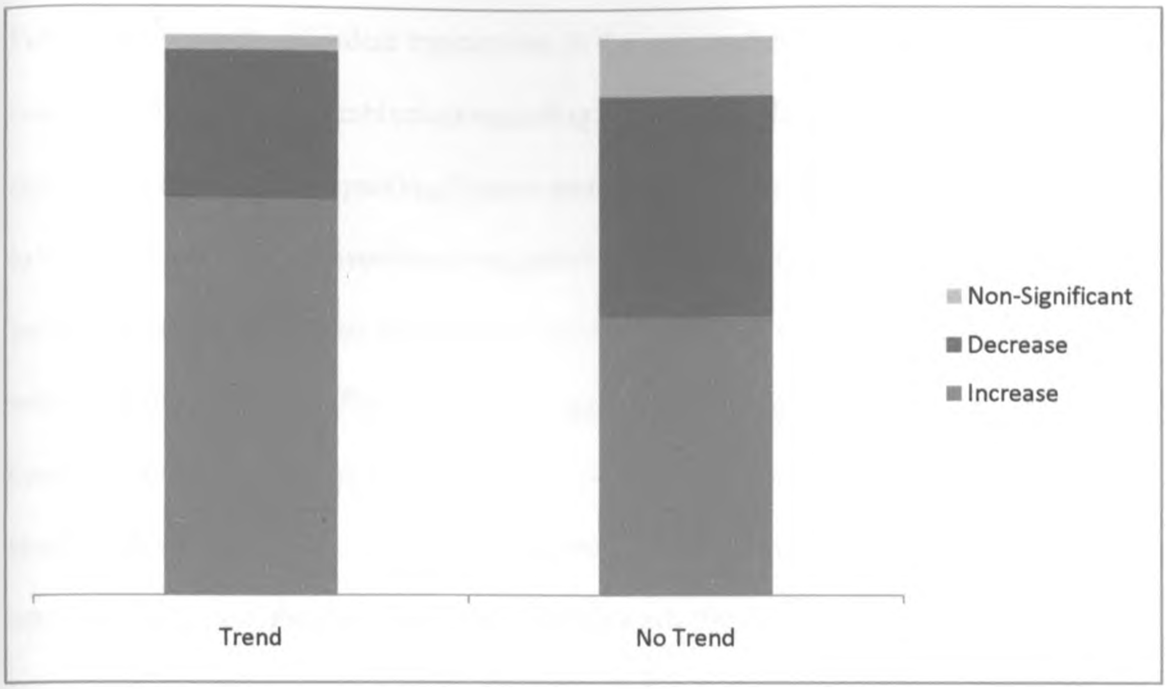
Panel A displays a simple t-test for change in mean between the pre- and post- derivative periods. Panel B shows the results from a dummy variable regression that checks for an underlying trend that may have resulted in the trading volume of a share naturally increasing (or decreasing) between the periods. The dummy tests for a structural break in the trend around the initial trading of single stock futures. The equation $V_{it} = \alpha_i + \beta_i T_{it} + \delta D_F + \varepsilon_{it}$ included a time series variable (T) that checked for a trend and a dummy variable to differentiate between the two periods.

NUMBER	MARKET SEGMENT	Panel A: Change in average volume			Panel B: Dummy variable regression			10%
								5%
		Change	σ	t-test	Constant	Trend	Change	1%
1	BANKING	9,675	3687.3	2.62	1582208.8	-7.04	11441.80	
					0.0000	0.7832	0.12290	p-value
2	AGRIC	-188084	32727.94	-5.75	763589.7	84.47	-209287.90	
					0.0000	0.7099	0.0015	p-value
3	ENERGY	15935	957.89	16.64	69614.9	-21.86	21420.91	
					0.0000	0.0009	0.0000	p-value
4	COMMER	185343	6133.14	30.22	327494.90	511.5	56956.11	
					0.0000	0.0000	0.0000	p-value
5	INVESTMNT	60170	7876.33	7.64	143858.9	112.73	31874.35	
					0.0000	0.0387	0.0435	p-value
6	AIMS	62988	9342.56	6.74	109958.7	-94.63	86738.92	
					0.0000	0.1439	0.0000	p-value
7	TELECOMM	3213	198.37	16.2	65698.96	15.40	-652.87	
					0.0000	0.0000	0.0586	p-value
8	MINING	118721	4970.29	23.89	171395.4	268.19	51405.31	
					0.0000	0.0000	0.0000	p-value

Trading volume generally tends to increase over time and a dummy variable regression considering this trending nature of volume is used, as this is not captured by a t-test for change in mean. The dummy variable regression is augmented with a trend (day) coefficient to isolate the size of the increase/decrease in trading volume witnessed after the introduction of derivatives in the market. In some instances the apparent increase or decrease was reversed as a result of the natural trend in trading volume. The dummy variable takes the value of zero for the pre-derivatives period and one for the post-derivatives period. The coefficient is interpreted as a change in trading volume after considering any underlying trend which may bias the results of the dummy variable.

Panel A tables the average change in normalized (smoothed) trading volume for each market segment subsequent to the initial trading of a futures contract. In each instance the relevant standard deviation and critical value are listed, showing highly significant changes, with the exception of Commercial and Services segment, in average normalized volume post-derivatives trading for all Market segments. In the majority of cases (7 of 8 significant results) the introduction of derivatives trading resulted in a highly significant increase in normalized trading volume.

Figure 4.2 **Changes in normalized trading volume**



In line with the dummy variable regression (with trend), the number of companies showing a significant increase in average normalized volume is nineteen (three non-significant increases). Fifteen companies exhibited a significant decrease in average normalised trading volume (one non-significant decrease). A small majority of companies (19 vs. 15), therefore, experienced a significant increase in trading volume following the onset of single stock futures trading. Figure 4.2 illustrates the result from the t-test (no-trend) compared to that of the dummy regression with trend coefficient. Accounting for the tendency of volume to increase (trend) over time, the results were thus altered in terms of statistical significance (number) and the direction of change[8].

This increase is predicted by the complete markets hypothesis, assuming a more complete market due to more investor participation. Market-makers have to cover/hedge their exposure in the

[8] Notable instances where the trend coefficient caused a change (reversal) in direction

Futures market with equivalent transactions in the spot market. The diminishing short-sales restrictions hypothesis is ambivalent regarding the volume effect of futures trading as short-selling occurs in the corresponding futures market and not the spot market. The improved information environment hypothesis suggests two opposing effects: attributing a reported increase to enhanced interest and analysis by market followers, and ascribing decreasing volumes to a shift in speculator activity to highly leveraged derivative products, substituting for trading in the underlying equity shares. This substitution theorem indirectly classifies single stock futures as speculative instruments, providing an incentive for speculators to shift their activities away from the underlying share and towards the derivative[9].

The observed changes in volume (increase or decrease) as highlighted by this study arguably depend on the dominating cause (increased investor participation or speculative activity) on a company by company basis. In general, this study concludes that increased investor participation via the market makers accounted for the change (increase) in normalized (smoothed) spot trading volume for a majority of the companies investigated.

[9] Substitution theorem as phrased by Clarke et al (2007).

4.4 Volatility effect

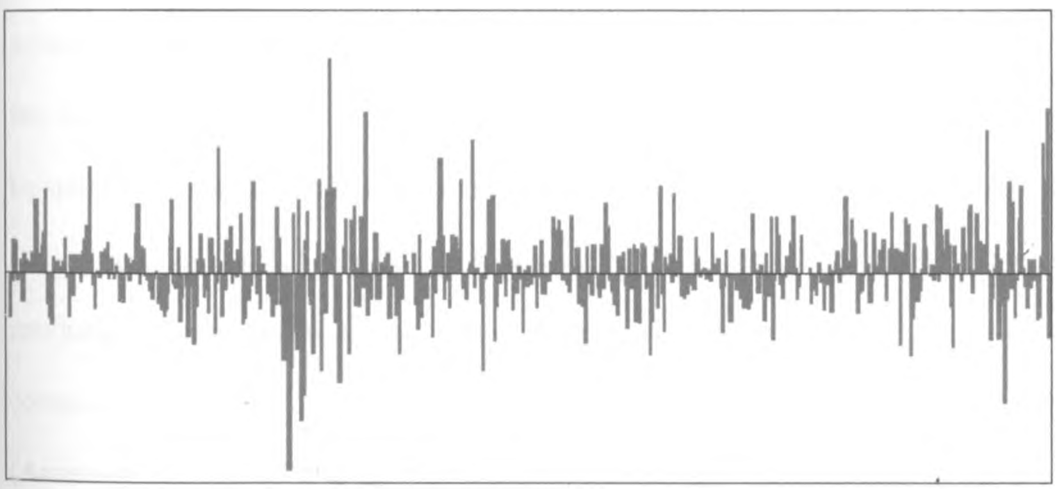
The volatility effect study comprises three different procedures. As a preliminary test, an F-test is performed on the ratio of pre-derivatives variance to post-derivative variance per company to reveal a change in the unconditional volatility of the spot price. A generalized Conditional Autoregressive Heteroskedasticy (GARCH) model is employed as the primary evaluation technique to detect any changes in the structure of volatility (conditional volatility) and the level of volatility (unconditional variance of the error term) due to the introduction of single stock futures. The third procedure involves a dummy variable regression to test for a change in the systematic risk (beta – slope coefficient) of each company and a shift in the constant term (alpha – minimum return when market return equals zero) after introducing Futures trading on the underlying.

4.4.1 ARCH-GARCH effects

The GARCH model, as stated in chapter 3, is mean reverting and conditionally heteroskedastic, with a constant unconditional variance. Any least squares deficiencies are corrected with the GARCH procedure and the required conditions satisfied. No additional tests were performed on the validity of the model. The conditional mean term was defined with the independent variable as the lagged value of the dependent variable (lognormal share return), that is an AR (1)-model. A large ARCH or GARCH term in the variance equation would indicate that the impact of a shock to the share price is likely to persist for several subsequent periods. A small ARCH or GARCH term implies a short-lived impact on the underlying. Correspondingly, an increase/decrease in the ARCH (1) coefficient suggests a faster/slower dissemination of news and apparent impact on the share price; while an increase in the GARCH (1) coefficient implies a prolonged effect of past news on the underlying. A summed ARCH and GARCH value represents the persistence of the shock-effect on the underlying price. An autoregressive (AR) root (ARCH plus GARCH) of less than one (unity) indicates a stationary and predictable volatility.

The results of CMC Holdings are used to illustrate the process followed in obtaining the required values and verifying the assertion that any least square deficiencies are corrected with the GARCH procedure. The inherent volatility clustering present in equity returns can be seen in figure 4.3 (CMC daily-returns), which exhibits significant levels of volatility persistence; large movements (magnitude of returns) are clustered with large movements, and small movements clustered with small movements.

Figure 4.3 Daily Returns – CMC Holdings Limited.



Annexure A (pages A-i and A-ii) shows the ARCH and GARCH coefficients obtained from running the GARCH model for the pre-derivatives (table A.1), post-derivatives (table A.2), and total period (table A.3) which included a dummy variable, respectively. Statistically significant (small p-values) small and decreasing ARCH values (pre to post) with large and increasing GARCH values (pre to post) were observed. The size of the AR root is indicative of a "high persistence to shocks" (i.e., volatility clustering) and therefore predictable volatility (function of past volatility). The direction of change after futures trading reveals a slower dissemination but longer lasting impact of information. This would suggest that the trading of futures contracts has attracted additional, relatively uninformed traders to both the futures and spot markets, leading in turn to a smaller immediate response to news and to news having a more persistent impact on the spot market. The dummy variable coefficient indicates a decrease (non-significant) in volatility post derivatives trading.

The Ljung-Box Q-statistics (Annexure A: table A.7, Correlogram of standardized residuals squared) provide evidence that the GARCH model adequately captured all of the persistence in the variance of returns, with no statistically significant Q-stats. The variance equation proves to be specified correctly, with no remaining ARCH detected. Similarly, the mean equation is tested for any remaining serial correlation (Annexure A: table A.5, Correlogram of standardized residuals) with the Q-stats all reported to be non-significant as expected. These results can be compared with the residual tests performed on the lagged lognormal returns regression (Annexure A). Table A.6 shows large and statistically significant Q-stats (small p-values) indicative of the residuals being serially correlated. Table A.4 reveals some linear dependence at lagged periods 23 and 24, corrected for in the GARCH model.

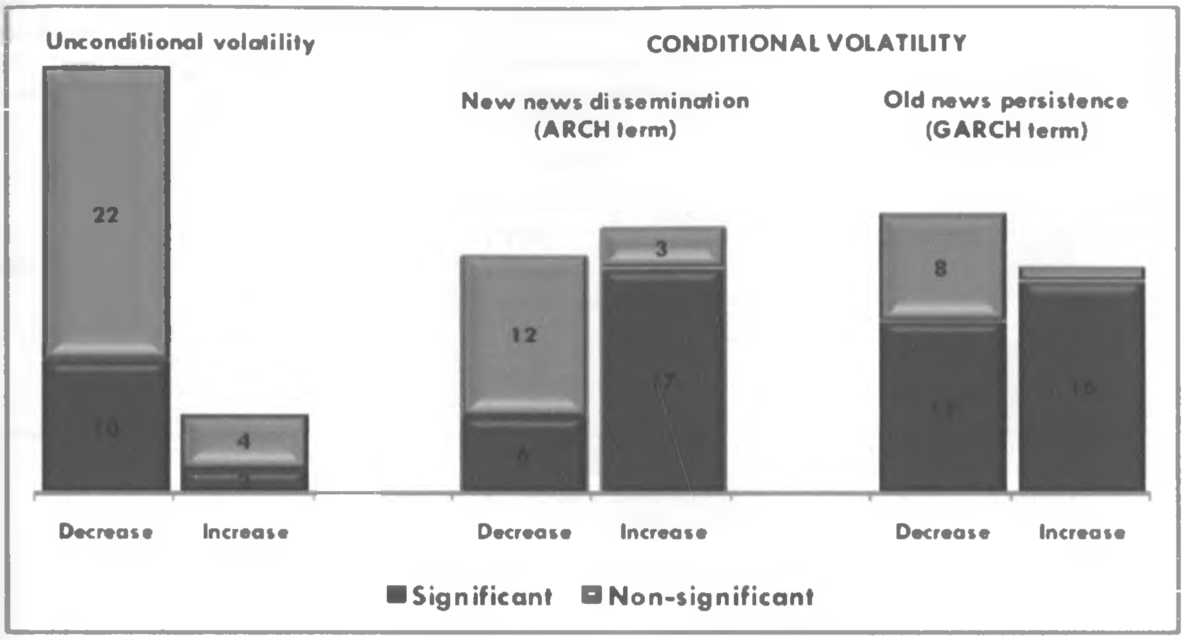
The ARCH LM test carried out on the variance equation exhibits no ARCH in the standardized residuals with both the F-statistic and the Obs*R-squared statistic, reported as non-significant (see Annexure A: table A.9) in contrast to the regression results before applying the GARCH concepts (table A.8) showing statistical significance and heteroskedasticy (i.e., non-constant variance of the error terms or residuals).

The Jarque-Bera (JB) statistic, testing the null of whether the standardized residuals are normally distributed, is significant (see Annexure A: figure A.2) and consequently the conditional normality assumption does not hold. The parameter estimates, however, are still consistent when the mean and variance equations are correctly specified. Violating the conditional normality assumption (i.e., a financial time series exhibiting fatter tails than the normal distribution), required the Heteroskedasticity Consistent Covariance option to be selected with the Normal (Gaussian) error distribution in order to calculate the Bollershev-Wooldridge robust standard errors. The Student's t-distribution and Generalized Error Distribution (GED), which also accounts for non-normality, allowed for the assumption of a more likely error distribution and the re-estimation of the model in some cases.

These diagnostics tests are important when GARCH model values are used to predict future volatility. Attempting to detect a change in the level (unconditional volatility) and structure (conditional volatility) of volatility from one period to another (e.g., pre- to post-futures) simply requires a comparison of the relative values and direction of change. For the purposes of this study, the conditions of $\omega > 0$, $\alpha > 0$, $\beta \geq 0$ and $(\alpha+\beta) < 1$ are necessary and sufficient to ensure a positive conditional variance and the existence of variance stationarity (i.e., a defined mean reverting level). All parameters must therefore be positive, with the sum of α and β expected to be less than but close to unity, with $\beta > \alpha$. Therefore, subject to these conditions, the

ARCH/GARCH results for the thirty-eight companies are presented and interpreted in table 4.4. These results are summarized in table 4.5 and presented graphically in figure 4.4 in an attempt to determine the general impact of derivatives trading on the level and structure of spot market volatility.

Figure 4.4 **Changes in Volatility, ARCH and GARCH**



A significant ARCH or GARCH term implies that the share returns exhibited a pattern of persistent volatility clustering, meaning that once there is a shock or jolt to the share price, the impact is more likely to persist for several subsequent periods. An insignificant ARCH or GARCH would indicate that the impact only lasted for one period.

Table 4.4 **ARCH and GARCH effects**

The table shows the results from an ARCH/GARCH variance regression for the total period, pre-Futures period and post-Futures period. The mean equation $Y_t = a + b Y_{t-1} + \varepsilon_t$ generated the residuals for the variance equation, estimated by regressing the lognormal share-returns on the one-period lagged returns of each share. The variance equation $h_t = \omega + \alpha \varepsilon_{t-1}^2 + \beta h_{t-1}$ produced the ARCH and GARCH terms for the pre- and post-period. A variance equation $h_t = \omega + \alpha \varepsilon_{t-1}^2 + \beta h_{t-1} + \delta D_F$ that includes a dummy variable produced the ARCH and GARCH terms as well as the coefficient δ which captures the change in the unconditional variance of the error terms pre to post derivative trading. The autoregressive root (α+β) governs the persistence of volatility shocks.

Market Segment, inferences and error distribution			**ARCH/GARCH effects**					10% / 5%
	Inferences	**ε**	**δ**	**ω**	**ARCH(α)**	**GARCH(β)**	**α + β**	**1%**
BAN	Negative δ- ns decrease in spot volatility. An increase in the ARCH and decrease in GARCH term post-Futures reveal a more immediate (ns) response to news and old news having a shorter-lasting (s) impact. The persistence (ARCH plus GARCH) of shocks dropped off post-Futures.	Normal (Gaussian)	-0.00001	0.00006	0.07607	0.69049	0.7666	
			0.5472	0.1943	0.1081	0.0002		*p-value*
			Pre-Futures	0.00005	0.06097	0.75175	0.8127	
				0.3634	0.2759	0.0006		*p-value*
			Post-Futures	0.00006	0.07062	0.64107	0.7117	
				0.3379	0.3618	[illegible]		*p-value*
AGRI	Model results not assessed due to post-Futures ARCH term and autoregressive root exceeding 1. The pre-Futures model does show a significant persistent old news effect on spot volatility. Model re--estimated with Student's t error distribution (OLS starting values).	Normal (Gaussian)	-0.00060	0.00131	0.55636	0.21281	0.7692	
			0.1664	0.0087	0.2827	0.3386		*p-value*
			Pre-Futures	0.00004	0.04418	0.94068	0.9849	
				0.3536	[illegible]	0.0000		*p-value*
			Post-Futures	0.00057	1.06346	0.13981	1.2033	
				0.0000	0.1849	0.3017		*p-value*
	Negative δ- ns decrease in spot volatility. Pre to post α and β values indicate an increased (s) rate of information flow with past news playing a smaller (s) role and a reduced persistence to shocks (α + β).	Student's t	-0.00001	0.00006	0.05183	0.92147	0.9733	
			0.6192	0.1111	0.0105	0.0000		*p-value*
			Pre-Futures	0.00004	0.05353	0.93093	0.9845	
				0.3715	0.1193	0.0000		*p-value*
			Post-Futures	0.00013	0.11798	0.80965	0.9276	
				0.0715	0.0604	0.0000		*p-value*
ENER	Negative δ- ns decrease in spot volatility. Pre to post α and β values indicate increased (ns) dissemination of information, but also a greater (s) contribution to	Normal (Gaussian)	-0.00001	0.00004	0.06630	0.77885	0.8452	
			0.4043	0.3545	0.0983	0.0001		*p-value*
			Pre-Futures	0.00005	0.06371	0.73571	0.7994	
				0.5166	0.2430	0.0296		*p-value*
			Post-	0.00002	0.07393	0.78136	0.8552	

	persistence by old news resulting in an increased persistence to shocks (α + β).		**Futures**	0.4175	0.2155	0.0002		*p-value*
			-	0.00007	0.04817	0.76085	0.8090	
INVES	Negative δ- ns decrease in spot volatility. Pre to post α and β values indicate increased (s) dissemination of information and a smaller (s) contribution to persistence by old news, leading overall to an increased persistence to shocks (α + β).	Normal(Gaussian)	0.00002					
			0.3372	0.2388	0.1212	0.0000		*p-value*
			Pre-Futures	0.00008	0.01072	0.75986	0.7706	
				0.8512	0.8236	0.5486		*p-value*
			Post-Futures	0.00005	0.09949	0.72699	0.8265	
				0.1960	0.0480	0.0000		*p-value*
COMM	Model results not assessed due to negative values and post-GARCH term exceeding 1. Model re-estimated with Generalized Error Distribution (GED) – 0.5OLS starting values.	Normal(Gaussian)	-0.00046	0.00070	0.12239	-0.09128	0.0311	
			0.1462	0.0433	0.2396	0.3956		*p-value*
			Post-Futures	0.00070	0.11325	-0.10198	0.0113	
				[redacted]	0.5482	0.6268		*p-value*
				0.000003	-0.04308	1.03571	0.9926	
			Pre-Futures	0.0005	[redacted]	0.0000		*p-value*
	Positive δ- ns increase in spot volatility. Pre to post αand βvalues indicate increased (s) dissemination of information and a smaller (s) contribution to persistence by old news, overall leading to a stagnant persistence to shocks (α+β).	GED	0.00003	0.00008	0.14889	0.60640	0.7553	
			0.3850	0.0334	0.1178	0.0001		*p-value*
			Post-Futures	0.00001	0.03597	0.89954	0.9355	
				0.0400	0.0110	0.0000		*p-value*
			Pre-Futures	0.00003	0.23549	0.69278	0.9282	
				0.2084	0.1246	0.0000		*p-value*
AIMS	Negative δ- ns decrease in spot volatility. Pre to post αand βvalues indicate increased (ns) dissemination of information, but also a greater (s) contribution to persistence by old news resulting in an increased persistence to shocks (α+β).	Normal(Gaussian)	-0.00007	0.00023	0.29973	0.26745	0.5671	
			0.3409	0.0455	0.0138	0.1954		*p-value*
			Pre-Futures	0.00028	0.22667	0.17859	0.4053	
				0.1291	[redacted]	0.6294		*p-value*
			Post-Futures	0.00013	0.30405	0.36472	0.6688	
				0.0170	0.0745	0.0890		*p-value*
			-0.00003	0.00017	0.20011	0.40035	0.6005	
	Re-estimated with GED	GED	-0.4745	0.0199	0.0288	0.0699		*p-value*

(OLS) to obtain α<β values. Similar inferences made. Negative δ- ns decrease in spot volatility. Increased (s) dissemination of information, but also a greater (s) contribution to persistence by old news resulting in an increased persistence to shocks (α+β).	Pre-Futures	0.00018	0.16670	0.46388	0.6306	
		0.2470	0.3322	0.2791		*p-value*
	Post-Futures	0.00010	0.21309	0.51674	0.7298	
		0.1438	[redacted]	0.0498		*p-value*
	-0.00005	0.00009	0.00599	0.82805	0.8340	
	0.4638	0.4550	0.7789	0.0002		*p-value*

Notes:-

- Default: Normal (Gaussian) error distribution with OLS starting values
- Alternative distributions: Student's t (optional fixed degrees of freedom) and GED (optional fixed parameter)
- Starting coefficients generated with Ordinary Least Squares (OLS); 0.8/0.5/0.3 x OLS; or set as zero
- ns = not statistically significant
- s = statistically significant

The preferred outcome of futures trading is a more efficient market, namely a faster dissemination of news by the underlying share price, a shorter-lived after-effect, and subsequently a less persistent shock-effect on the share price. This translates into a larger ARCH term, a smaller GARCH term and smaller AR root (ARCH plus GARCH). Eleven companies experienced this desired result (full benefit) attributed to futures trading (refer to table 4.5). The statistical output of nine companies confirmed that futures trading had the exact opposite consequence for the behavior of their share prices. A decreased ARCH and increased GARCH expose a more persistent shock-effect due to the longer-lasting influence of old news which, initially, was incorporated into the share price at a slower pace, since the start of derivatives trading in the NSE. Table 4.5 summarizes the market segments results post-futures with the majority (4 from 6) showing a statistically significant increase in the dissemination rate of news. Thirteen statistically significant instances of a reduced contribution to persistence by past news were also recorded among the fifty - seven (majority) companies exhibiting this tendency. Overall, more companies (5) showed a shortened period of excessive price movements following the incorporation of news, compared to those (4) showing an increased persistence to shocks (extended period of volatility). However, more statistically significant increases (3 from 5) in the long-term impact of old news were recorded.

Table 4.5 Summary of ARCH/GARCH model results

The table shows the per company change in spot volatility, change in the speed at which new information is incorporated in the share price (ARCH effect), and change in the influence of past news on the current share price (GARCH effect). A change in the autoregressive root (ARCH plus GARCH effect) represents a change in the persistence of shocks on the share price, determined jointly by the rate of dissemination and lingering impact of news.

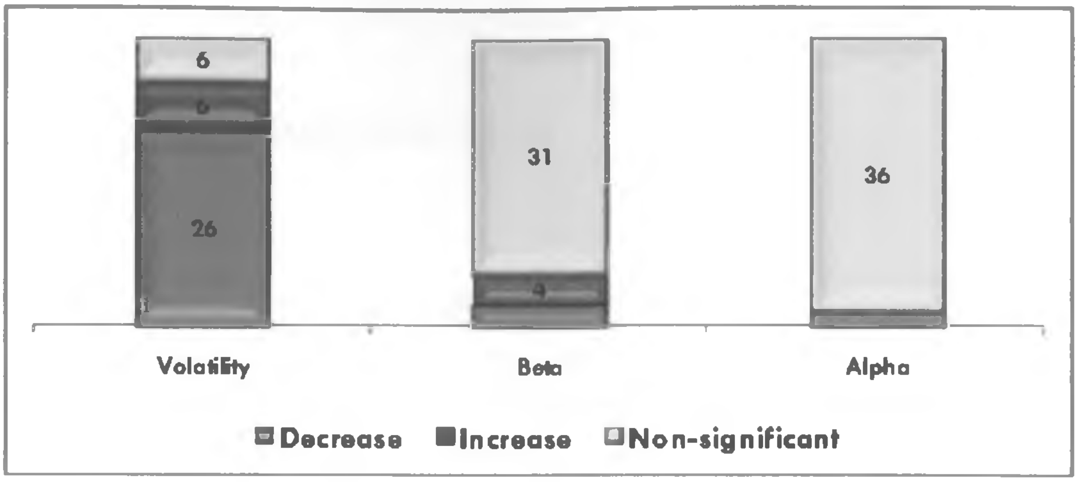
No	Code		ARCH	GARCH	AR Root
1	BAN	–	+	–	–
2	AGRIC	–	+	–	–
3	ENERG	–	+	+	+
4	INVEST	–	+	–	+
5	COMMER	+	+	–	–
6	AIMS	–	+	+	+
7	TELECOM	–	+	+	+
8	MINING	–	+	–	–

A futures-trading-effect of news being impounded in prices more rapidly, along with a decrease in persistence, conforms to a liquid underlying market (i.e., the individual share) with informed investors dominating. A less liquid share (lower trading volumes) could see the influx of more uninformed traders, less concerned with fundamentals, attracted by the newly available futures contract allowing for an additional or alternative access to the spot position. Market makers have to hedge themselves by buying the full long exposure and selling the short exposure in the spot market, thereby generating activity in the underlying share as a consequence of futures trading. A smaller immediate response to news having a more persistent impact on the spot market results from more uninformed traders entering the spot and futures markets. These results are in line with the complete markets hypothesis (more efficient market due to futures trading), diminishing short-sales restrictions hypothesis (reduced asymmetric response to information resulting from the ability to sell short), and the improved information environment hypothesis (improved price discovery through futures trading activity).

4.4.2 Changes in volatility, systematic risk and minimum return

Table 4.6: Panel A reports the outcomes of the F-test performed on the differences between variances. All but six companies displayed a significant difference in pre-derivatives and post-derivatives volatility. A large majority of the companies (40) experienced a significant decrease in volatility, while only six companies showed a significant increase in volatility. It is therefore concluded that Futures trading in general leads to a significant decrease in spot price volatility. These results tend to confirm those obtained by the GARCH model, concluding that futures trading in general does not destabilize (unpredictable volatility and share price movements) the underlying security. All three theoretical frameworks hold true, predicting a decrease in volatility after the introduction of derivatives trading. These results are presented graphically in figure 4.5.

Figure 4.5 Changes in volatility, beta and alpha



4.5 Summary

This section assembles the three components of this study, namely the price, volume and volatility effects, providing a per company breakdown of how first-time single stock futures trading impacted upon each. Table 4.7 shows the direction of change (increase or decrease) in the price level, trading volume, volatility level, volatility structure (dissemination rate of news and duration of impact as well as the level of persistence), and systematic risk for all thirty-eight companies.

Ideally, the introduction of futures trading should result in an increase in price, higher trading volume, lower volatility, reduced persistence to shocks (i.e., shortened volatile periods), and less systematic risk.

5 CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This section assembles the three components of this study, namely the price, volume and volatility effects, providing a per company breakdown of how first-time single stock futures trading impacted upon each. Table 5.1 shows the direction of change (increase or decrease) in the price level, trading volume, volatility level, volatility structure (dissemination rate of news and duration of impact as well as the level of persistence), and systematic risk for all fifty-eight companies.

Ideally, the introduction of futures trading should result in an increase in price, higher trading volume, lower volatility, reduced persistence to shocks (i.e., shortened volatile periods), and less systematic risk.

5.2 Conclusion on the price results

On an individual per company basis it is concluded that the introduction of derivatives or futures had little or no impact on the underlying share prices. The event study (market model plus dummy variable regression) presented no conclusive evidence to establish either a positive or a negative impact on the underlying prices. Table 5.1 shows that only three companies experienced a significant price effect on the first day (day zero) of futures/derivatives trading.

Table 5.1 Summary of all results

Table 5.1 Summary of all results	No NSE Code Industry Spot trading volume Year of introduction		1	2	3	4	5	6	7	8
			BAN	AGRIC	ENERG	INVEST	COMMER	AIMS	TELEC	MIN
Price effect	Event study	Market	–	–	+	–	–	–	–	–
		Dummy	–	+	+	–	–	–	–	–
Volume effect	Normalised volume	t-test	+	–	+	+	+	+	+	–
		Trend	+	–	+	+	+	+	–	–
Volatility effect	Level	F-test	–	+	–	–	–	–	–	–
		Dummy	–	–	–	–	+	–	–	–
	Structure	Dissemination	+	+	+	+	+	+	+	–
		Duration	–	–	+	–	–	+	+	–
		Persistence	–	–	+	+	–	+	+	–
	Beta	Shift	+	–	+	–	–	+	–	–
		Slope	+	+	+	–	+	–	+	–

The pattern of significant cumulative average abnormal returns implies that no clear evidence exists that derivatives trading in general has had any price effect (positive or negative) on the underlying. The diminishing significance exhibited for shorter periods closer to the event is in contrast to the conditions required to conclude a general price effect, namely significant abnormal returns on day zero and possible significant abnormal returns on day -1 and day +1. Significance should be lower as one move further from the event date and for longer periods or periods that do not include the actual event.

5.3 Conclusion on the volume results

The increase in trading volume experienced by the majority of the companies, even allowing for the natural increase in volume over time, is predicted by the complete markets hypothesis, assuming a more complete market as a result of more investor participation. The actions of market makers having to buy or sell the client's full long or short futures exposure in the spot market generate trading. It is reasonable to conclude that increased derivatives market activity leads to increased spot market activity. Thus, even speculators who may be moving from the spot to the futures market indirectly generate spot volumes.

5.4 Conclusion on the volatility results

The majority of the companies experienced a significant decrease in volatility, while only four segments of the listed companies in the NSE showed a significant increase in volatility. It is therefore concluded that derivative trading in general leads to a statistically significant decrease in spot price volatility. These results confirm those obtained with the GARCH model, indicating that derivative trading in general does lower spot market volatility, with all three theoretical frameworks holding true, predicting a decrease in volatility after the introduction of derivatives trading.

Derivative trading in general did not alter the relationship between company and market pre- to post-futures. Systematic risk remained largely unaffected, with only small changes in the majority of cases reported. No result regarding the general direction of change in systematic risk emerged from this study.

Overall, more companies showed a shortened period of excessive price movements following the incorporation of new news and accounting for the old news effect, compared to those showing an increased persistence to shocks (extended period of volatility). The results pointed to a statistically significant increase in the rate at which news is impounded in the share prices post futures. Although the majority of companies experienced a weakened influence of old news on share price movements, more statistically significant increases in the long-term impact of old news were recorded. It is therefore concluded that derivative trading allows the shock effect to dissipate more quickly, largely facilitated by the faster dissemination of news and also, to a lesser extent, by the constrained influence of old news on share prices, thereby providing for a more efficient market.

In closing, this study revealed the following about the impact of single stock futures trading on the underlying equity market:

No statistically significant changes in share prices which implies that is no price effect. Statistically significant increases in spot market trading volumes imply statistically significant reductions in the level of spot market volatility with evidence of changes in the structure of spot market volatility with evidence of an unaltered company-market relationship (alpha and beta) post futures.

ANNEX A

Table A.4 Correlogram of residuals (Pre-GARCH model)

Sample: 7 256

Included observations: 250

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
|	|	1	0.005	0.005	0.0058	0.939
|	|	2	-0.036	-0.036	0.3286	0.848
|	|	3	-0.022	-0.022	0.4565	0.928
|	|	4	-0.028	-0.029	0.6566	0.957
|	|	5	-0.031	-0.032	0.9042	0.970
|*	|*	6	0.143	0.142	6.2170	0.399
|	|	7	0.063	0.059	7.2344	0.405
|	|	8	-0.056	-0.050	8.0570	0.428
|*	|*	9	0.088	0.099	10.075	0.344
|*	|*	10	0.070	0.078	11.349	0.331
|	|	11	0.023	0.039	11.483	0.404
|	|	12	-0.041	-0.053	11.930	0.451
*|	*|	13	-0.100	-0.115	14.570	0.335
|	|*	14	0.059	0.083	15.484	0.346
|	|	15	-0.027	-0.052	15.675	0.404
|	|	16	-0.000	-0.043	15.675	0.476
|	|	17	0.002	-0.014	15.676	0.547
|*	|*	18	0.071	0.080	17.040	0.520
*|	|	19	-0.067	-0.041	18.277	0.504
|	*|	20	-0.038	-0.069	18.681	0.543
*|	*|	21	-0.074	-0.086	20.207	0.508
*|	*|	22	-0.160	-0.124	27.288	0.200
|*	|*	23	0.150	0.168	33.551	0.072
|	|	24	0.002	-0.047	33.552	0.093

Table A.5

Correlogram of standardized residuals (GARCH model)

Sample: 7 256

Included observations: 250

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
|	|	1	0.024	0.024	0.1508	0.698
|	|	2	-0.019	-0.019	0.2378	0.888
|	|	3	0.002	0.003	0.2384	0.971
|	|	4	-0.018	-0.018	0.3170	0.989
|	|	5	-0.046	-0.045	0.8574	0.973
|*	|*	6	0.111	0.113	4.0464	0.670
|	|	7	0.020	0.013	4.1504	0.762
|	|	8	-0.029	-0.027	4.3713	0.822
|*	|*	9	0.092	0.093	6.5634	0.682
|*	|*	10	0.074	0.071	8.0132	0.628
|	|	11	0.013	0.023	8.0552	0.708
*|	*|	12	-0.106	-0.119	11.020	0.527
|	|	13	-0.046	-0.045	11.581	0.562
|*	|*	14	0.070	0.091	12.878	0.536
|	|	15	-0.021	-0.040	12.995	0.603
|	|	16	0.024	0.002	13.150	0.662
|	|	17	0.003	-0.012	13.152	0.726
|	|	18	0.029	0.054	13.383	0.768
*|	*|	19	-0.075	-0.073	14.928	0.727
|	|	20	-0.007	-0.043	14.942	0.780
*|	*|	21	-0.079	-0.061	16.678	0.730
*|	*|	22	-0.114	-0.086	20.260	0.567
|*	|*	23	0.126	0.136	24.695	0.366
|	|	24	0.034	-0.008	25.022	0.405

Table A.6 Correlogram of residuals squared (Pre-GARCH model)

Date: 07/09/08 Time: 08:03
Sample: 7 256
Included observations: 250

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
|*	|*	1	0.108	0.108	2.9783	0.084
|*	|*	2	0.102	0.091	5.5977	0.061
|*	|*	3	0.087	0.069	7.5423	0.056
|*	|	4	0.087	0.065	9.4843	0.050
|*	|*	5	0.173	0.150	17.213	0.004
|*	|*	6	0.191	0.153	26.592	0.000
|	|	7	0.029	-0.033	26.806	0.000
|*	|	8	0.069	0.021	28.051	0.000
|	|	9	0.029	-0.018	28.270	0.001
|*	|	10	0.082	0.034	30.048	0.001
|	|	11	0.027	-0.040	30.239	0.001
|	|	12	0.048	0.010	30.852	0.002
|*	|*	13	0.085	0.070	32.752	0.002
|*	|*	14	0.148	0.126	38.589	0.000
|*	|	15	0.071	0.031	39.941	0.000
|*	|*	16	0.141	0.102	45.289	0.000
|	|	17	0.015	-0.028	45.351	0.000
|**	|*	18	0.223	0.181	58.857	0.000
|*	|	19	0.104	0.010	61.790	0.000
|**	|*	20	0.230	0.161	76.310	0.000
|	*|	21	-0.036	-0.149	76.666	0.000
|*	|	22	0.067	0.014	77.919	0.000
|	|	23	0.058	-0.026	78.856	0.000
|	*|	24	0.027	-0.074	79.063	0.000

Table A.7

Correlogram of standardized residuals squared (GARCH model)

Sample: 7 256

Included observations: 250

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
|	|	1	-0.028	-0.028	0.1970	0.657
|	|	2	0.000	-0.000	0.1970	0.906
|	|	3	0.001	0.001	0.1971	0.978
|	|	4	-0.025	-0.025	0.3606	0.986
|	|	5	0.050	0.049	1.0039	0.962
|*	|*	6	0.085	0.088	2.8628	0.826
*|	*|	7	-0.067	-0.063	4.0391	0.775
|	|	8	-0.032	-0.037	4.3079	0.828
*|	*|	9	-0.059	-0.059	5.2309	0.814
|	|	10	0.007	0.006	5.2454	0.874
|	|	11	-0.019	-0.031	5.3428	0.913
|	|	12	0.007	0.003	5.3557	0.945
*|	*|	13	-0.072	-0.061	6.7359	0.915
|	|	14	0.016	0.021	6.8051	0.942
|	|	15	-0.005	0.000	6.8110	0.963
|	|	16	0.063	0.058	7.8779	0.952
|	|	17	-0.004	-0.004	7.8829	0.969
|*	|*	18	0.071	0.074	9.2697	0.953
|	|	19	-0.003	0.009	9.2730	0.969
|*	|*	20	0.133	0.128	14.148	0.823
|	|	21	-0.039	-0.043	14.567	0.844
|	|	22	0.009	-0.004	14.591	0.879
|	|	23	0.016	0.017	14.663	0.906
|	|	24	0.003	0.001	14.666	0.930

Table A.8 Heteroskedasticity test (Pre-GARCH model) Heteroskedasticity Test: ARCH

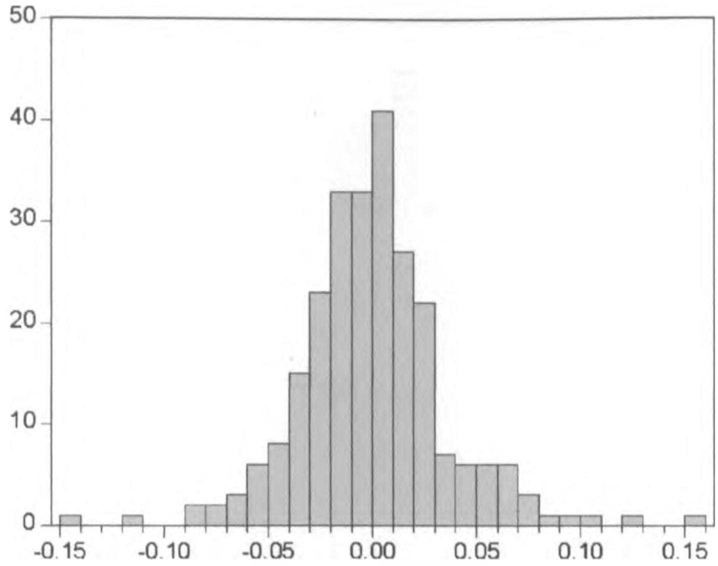
F-statistic 2.945848 Prob. F(1,247)	0.0874
Obs*R-squared 2.934701 Prob. Chi-Square(1)	0.0867
Test Equation:	
Dependent Variable: RESID^2	
Method: Least Squares	
Sample (adjusted): 8 256	
Included observations: 249 after adjustments	
Coefficient Std. Error t-Statistic	Prob.
C 0.001135 0.000196 5.780692	0.0000
RESID^2(-1) 0.108556 0.063248 1.716347	0.0874
R-squared 0.011786 Mean dependent var	0.001273
Adjusted R-squared 0.007785 S.D. dependent var	0.002837
S.E. of regression 0.002826 Akaike info criterion	-8.891783
Sum squared resid 0.001973 Schwarz criterion	-8.863530
Log likelihood 1109.027 Hannan-Quinn criter.	-8.880411
F-statistic 2.945848 Durbin-Watson stat	2.020013
Prob(F-statistic) 0.087352	

Table A.9
Heteroskedasticity test (GARCH model)
Heteroskedasticity Test: ARCH

F-statistic 0.192594 Prob. F(1,247)	0.6611
Obs*R-squared 0.194003 Prob. Chi-Square(1)	0.6596
Test Equation:	
Dependent Variable: WGT_RESID^2	
Method: Least Squares	
Date: 07/09/08 Time: 09:12	
Sample (adjusted): 8 256	
Included observations: 249 after adjustments	
White Heteroskedasticity-Consistent Standard Errors & Covariance	
Coefficient Std. Error t-Statistic	Prob.
C 1.025899 0.139387 7.360092	0.0000
WGT_RESID^2(-1) -0.027919 0.032924 -0.847964	0.3973
R-squared 0.000779 Mean dependent var	0.997997
Adjusted R-squared -0.003266 S.D. dependent var	1.943180
S.E. of regression 1.946351 Akaike info criterion	4.177789
Sum squared resid 935.7054 Schwarz criterion	4.206042
Log likelihood -518.1347 Hannan-Quinn criter.	4.189161
F-statistic 0.192594 Durbin-Watson stat	1.999229
Prob(F-statistic) 0.661150	

Figure A.1

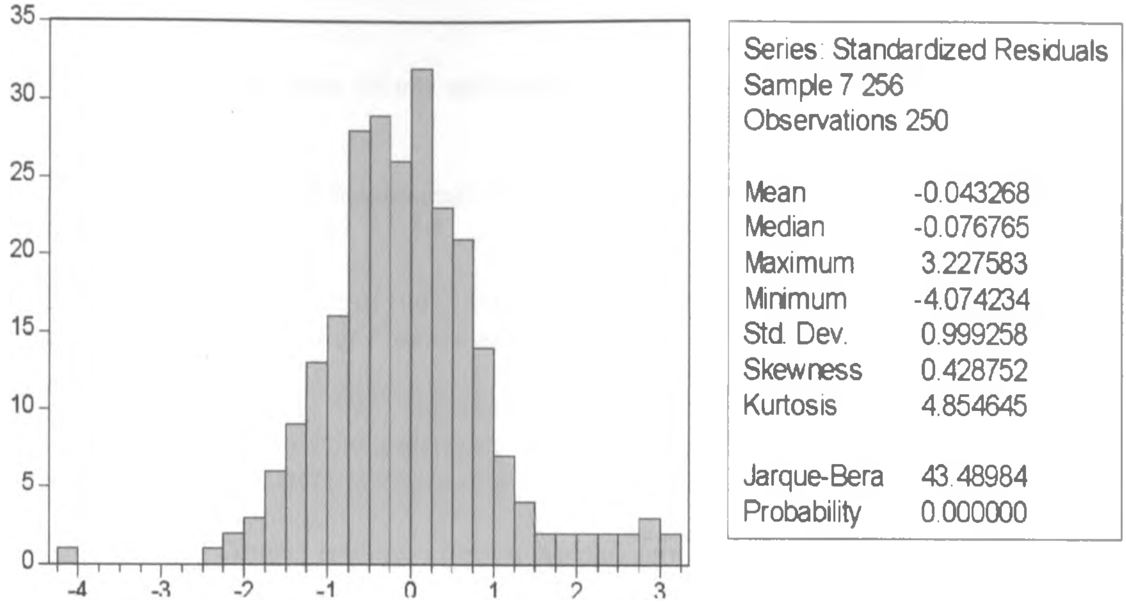
Histogram – Normality test (Pre-GARCH model)



Series: Residuals	
Sample 7 256	
Observations 250	
Mean	-8.74e-19
Median	-0.000425
Maximum	0.157232
Minimum	-0.148422
Std. Dev.	0.035688
Skewness	0.254442
Kurtosis	5.966254
Jarque-Bera	94.35029
Probability	0.000000

Figure A.2

Histogram – Normality test (GARCH model)



All the statistical presentations in Annexure A were generated by the R statistical software package.

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