A TRANSITION IN INDIAN DERIVATIVE MARKETS – A CASE STUDY OF SINGLE STOCK FUTURES

DOCTOR OF PHILOSOPHY

In

ECONOMICS

By

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DEPARTMENT OF ECONOMICS
School of Social Sciences
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APRIL 2009

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DECLARATION

I hereby declare that the work embodied in this thesis entitled ***"A Transition in Indian Derivative Markets – A Case study of Single Stock Futures"*** carried out under the supervision of Dr. B. Nagarjuna is an original work of mine and has not been submitted for the award of any research degree or diploma of any university.

Place: Hyderabad **Signature of the Candidate**

Date: (PRADEEP KUMAR MAVULURI)

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Certificate

This is to certify that **Mr. Pradeep Kumar Mavuluri** has carried out the research embodied in the present thesis entitled ***"A Transition in Indian Derivative Markets – A Case study of Single Stock Futures"*** for the full period prescribed under Ph.D. ordinances of the University of Hyderabad.

This thesis represents an entirely an independent work and does not constitute part of any material submitted for any research degree or diploma here or elsewhere.

DR. B. NAGARJUNA
(Supervisor)

Head
Department of Economics

Dean
School of Social Sciences

To My Better Half…

ACKNOWLEDGEMENTS

I praise the God for blessing me with grace and showing mercy on me to complete the task.

I express my deep sense of gratitude and profound respect to Dr .B. Nagarjuna for his guidance, encouragement and co-operation throughout my research work.

I wish to acknowledge Prof. JVM Sarma, Head, Department of Economics and Late. Prof. Uma Shankar Patnaik, for their timely help in my research work as my doctoral committee members. Also I immensely acknowledge all the faculty members of the Department of Economics and also to the supporting staff of the Department of Economics and School of Social Sciences, for their kind co-operation and help.

I would like to extend my sincere gratitude to Dr Kiran Kumar, NISM, Mumbai, for his valuable suggestions and constant comments without which my dissertation would have not taken a proper shape.

I wish to acknowledge the services provided by the University of Hyderabad, IGML library, CC staff and members, also all members who involved directly or indirectly to complete this task. I would like to extend my thanks to all my seniors, juniors, classmates and well-wishers of all departments for their extended discussions and needful help throughout the research.

I would like to extend special thanks to Vijay, Praveen, Madhukar, Rajendra, Muniswamy, Dr. Busenna, Vachya and Dr.Giribabu.

Finally, I express my indebtedness to my parents and family members, for being ever inspiring, loving and supportive. And also I extend my thanks to all my relatives to encourage me for this work.

Pradeep Kumar Mavuluri.

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CHAPTER I

INTRODUCTION

i. INTRODUCTION:

The Indian capital market since early 1990s has undergone more than a decade of reforms on the road to improve transparency in the system, efficiency in information dissemination along with auditing disproportionate trade activities, the end purpose of all these reforms have been to en route the Indian market to such a level where it would fully integrate with the global developed exchanges. In the course country’s capital market saw a major makeover and structural change in the mechanism. Along with the establishment of Securities and Exchange Board of India (SEBI) for providing higher level accountability in the market, new institutions like National Stock Exchange of India Limited (NSE), National Securities Clearing Corporation Limited (NSCCL), National Securities Depository (NSDL) have been the transformation operatives that abetted ordering the system which also tendered surety to investing public voluminously. Likewise, with expedients of latest technology suitable these institutions acted as determinations along with yardstick for others to pursue. As a result several changes taken place in the operations of the secondary markets namely, automated online trading in exchanges, enabling trading terminals of the NSE and Bombay Stock Exchange (BSE) to be available across the country making geographical location of an exchange irrelevant. These micro level structural alterations fetched about depletion in trade expense that supported investors to fasten the contracts faster and cheaper than earlier.

Though the above mentioned changes that taken place during nineties resulted in the development of a resonant secondary market in the Indian stock exchanges, a consistent sequel of stock market crises which made the front pages of newspapers during the same time distorted the markets. For few years it is approximately appeared to be a parallel effort by SEBI on one side to seal all the loopholes while other side destined sequel of crises occurring often due to incidences of market manipulation in the secondary market. This procession of crises episodes as rightly pointed by Ajay Shah & Susan Thomas (2002) has displayed a shadow over the credibility of SEBI, as these crises highlight the costs to the economy of SEBI efforts from 1995 onwards in adopting a conservative position, i.e. perpetuating weekly settlement and Badla.

ii. INGRESS OF DERIVATIVES TRADING IN INDIA:

Though equity based derivatives markets are recent entrants in India, derivatives on commodities exist prior since independence on agricultural products viz. cotton, wheat, etc. and in precious metals like gold, sliver etc. Present study settling the attention on derivatives post independence period and during reform period (1991-2003) specific to equity based derivatives. In post independence period, the government revoked the ban on futures imposed after Second World War to curb hoarding and inflation with passage of Forward Contract (Regulation) Act (FCRA) in 1952. The forward and futures contracts were limited only for few commodity items under the FCRA, 1952. Later on, all futures trading were restricted by the government in 1966 to regulate the lobby groups controlling the prices of many framing and necessary commodities. After 1966, many exchanges had run out of business and it led to start of informal trade which imitated future kind product. Also there exists a currency forward market dominated by dollar-rupee contracts for one to twelve month periods. Summing all this, one can say that, equity based derivatives are unknown till 1990’s, and these may also be piercing from the stringent definition of FCRA, 1952 which did not include derivative products in the definition of securities & Sec.20 of the act purposely forbidden all trading in options from the initiation.

Thus, from early seventies till introduction of equity based derivatives instruments, Indian stock exchanges survived on unusual forward trading method that has undesirable characteristics--mixing of cash and futures trading. It became popular in later years by the name "*Badla*" which accompanied by "*long settlement cycles*". Existence of these kinds of products not only created several problems but also there were payment crises from time to time and frequent closure of the stock exchanges. But it was only after 1992 disaster struck (widely known as Harshad Mehta Scam) which shook the stock markets to its very foundations, government delegated powers to SEBI. Although SEBI positioned efforts in the reform period to regularize the markets (banned Badla trading in certain stocks on 13th December 1993, effective from March 1994) crises where occurring frequently (see Ajay Shah & Susan Thomas, 2002). Meanwhile Badla trading got re-introduced on BSE with certain restrictive checks and balances in January 1996.

Herein, one should recall that NSE, an transformation operative from right beginning of its inception were contradictory to Badla and keen on introduction of equity based derivatives requested the approval of same from SEBI on 14th Dec 1995. This also led to appointment of a committee chaired under L.C. Gupta on 18th Nov 1996 to examine the issue in detail to develop appropriate regulatory framework for derivatives trading. The committee submitted its report in March 1998, had recommended the introduction of stock index futures in the first place to be followed by other derivative products viz. index options and stock options (more fine points of the report are discussed in the later sections). Consequential to the recommendations of L.C. Gupta Committee (LCGC), on 16th December 1999, SEBI proposed second amendment to Securities Laws Act, 1995 that lifted prohibition of options trading. This amendment introduced a new section by name "Section 18-A" through which derivatives trading in exchanges are made legal. Let’s look at the passage of the section in the second amendment of Securities Laws Act that allows derivative trading in India.

Section.18.A.

Contracts in derivatives: Notwithstanding anything contained in any other law for the time being in force, contracts in derivatives shall be legal and valid if such contracts are -

(a) traded on a recognised exchange;

(b) settled on the clearing house of the recognised stock exchange in accordance with the rules and bye-laws of such stock exchange.

As a result of the above definition, all the contracts in derivatives which once prohibited and not legally permitted now through recognised exchanges having clearing house are legal and valid. This not only paved path for equity based derivatives but also for commodity derivatives which are currently traded now in India. However, commodity futures are permitted only in those commodities approved by Forward Markets Commission. There had, however, been a considerable debate on the question of whether derivatives based on equity stocks should be introduced in India or not, as these products are characterized as the tools of speculation. Along with the derivatives introduction debate, there was also a debate on stock futures introduction which will be discussed in the later section.

Finally, SEBI as step towards its efforts intended for global standards provided authorization for index futures on nation’s two benchmark indices in May, 2000. This resulted in commencement of ‘Sensex futures’ trading by BSE on June 9, 2000 and ‘Nifty futures’ trading on June 12, 2000 by NSE. This ingress was followed by ‘index options’ in June 2001 and ‘stock options’ in 2nd July 2001. Futures on individual stocks which are widely known as Single Stock Futures[1] (SSFs hereafter) were introduced on 9th November 2001. At this point it is important to mention that it was only after the SSFs introduction in India, re-introduction of SSFs took place in USA and some other developed markets. In the ingress, last but not least, 'interest rate derivatives' were launched on 24th June 2003 which failed to gather volumes and continue to have nil volumes. Despite the fact that there are five derivative products as mentioned above in the Indian markets, it is the volume of trading in SSFs segment that took drive very rapidly and exceeded trading volume of cash segment with in no time is current study of interest.

iii. DEBATE OVER DERIVATIVES INTRODUCTION:

As mentioned earlier there was a debate over these derivative products introduction in India. Debate on non-introduction of these derivatives can be classified into two arguments. One non-introduction argument was raised by strong broker associations which concerned their right and fear that these products will replace Badla. Since, Badla was a mix of the cash and the future settlements grown natively, it offered an evasion means through long settlements for large brokers tend to be active market players. Seeing its popularity, which served as a channel for employment of unaccounted assets of businessmen, speculators deployed their funds in a profitable way. Another argument of non-introduction comes from several stakeholders in the financial system viz. banks and financial institution which put forth the argument of speculative nature of these products which lead to instances of market crashes in the past which cannot be ignored are discussed in next chapter. Introduction argument was from the regulator i.e. SEBI, NSE, and other newly sophisticated financial institutions enthusiasm in view of fact that

[1] Through out this study 'stock futures', 'futures on individual stocks', 'individual stock futures' which are synonymous words are referred as 'Single Stock Futures (SSFs)'.

India must accommodate the internationally established and proficient type of derivatives trading as these instruments would enable the investors to hedge their risks against market fluctuations. Let’s move to LCGC report and where it stands in this debate.

SEBI that accepted the recommendations of LCGC report on May 11, 1998 broad meeting, released the contents of the report in June 1998. To sum up report in one sentence, it says that there should be phased introduction of derivatives trading in India beginning with ‘stock index futures’. However, in details report mentions that from its conducted market survey with various bodies concerned directly and indirectly with stocks trading viz. brokers, banks, financial institutions, mutual fund institutions, foreign institutional investors etc., it observed that there are limited products in the market for hedging and at hand need extensive derivatives products counting to equity, interest rate and currency derivatives products. Based on its study and observations, committee proposes the ‘stock index futures’ as the most preferred product followed by ‘stock index options’. And options on individual stocks were the third in the order of preference. Lets looks at the words from committee report on SSFs, “*Individual stock futures, was favored much less. It is pertinent to note that the U.S.A. does not permit individual stock futures. Only one or two countries in the world are known to have futures on individual stocks. Stock Index Futures are internationally the most popular forms of equity derivative.*” In addition, it also mentions that 3 month Futures as the most preferred product and in terms of the category of Options, American Options were preferred over European Options.

In accordance, while approving the recommendations of L.C. Gupta Committee and for an effective implementation of the same, SEBI setup a committee on “Risk

Containment Measures in the Indian Stock Index Futures" under the chairmanship of J. R. Verma in June, 1998. Later, amendments in Securities Act and introduction of index futures followed. But the concern relating to the economic desirability of these securities and their impact on the underlying markets has continued to presume importance, especially after transition in the direction of SSFs.

a. STOCK FUTURES INTRODUCTION:

In continuation with earlier debate on derivative introduction and as noted from L.C. Gupta committee report, SSFs were the least preferred and not popular form of equity derivatives. Before knowing what made this derivative product introduction, let's look at the words of R. H. Patil (2006), former Managing Director & CEO of NSE, Chairman of CCIL "*The original plan of bringing futures to the country in place of Badla was to introduce index futures, index options and stock options. The SEBI committee that went into the whole issue of equity based futures was not in favour of futures in individual stocks which are, however, currently being traded on the NSE. In fact, all over the world the widely accepted futures products are the index futures, index options and stock options. In most of the countries, wherever equity futures are traded the individual stock futures either do not find any place or even if they are grudgingly allowed, not much trade takes place in them. Most of the market players either do not find individual stock futures to be useful products or they consider them…and very rightly so…as highly risky products.*"

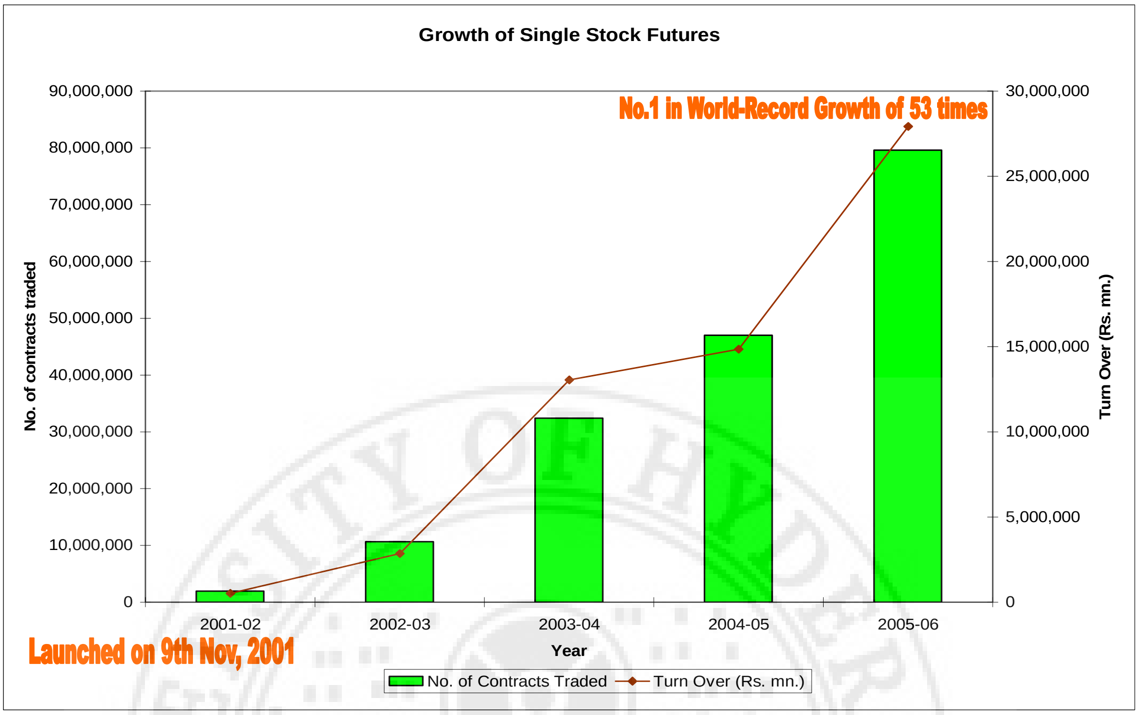
So, from the above, it is clear that even in the minds of regulator and NSE there was no thought of stock futures introduction which were widely critcised in the past for their speculative nature. This is true in fact as opposite to 'stock options' these 'stock futures' carry unlimited threat with them, i.e. stock option risk is restricted to the extent of the margin money paid for it, where it is not same with the case of stock futures. Since, the sum of margin is very minimal, chances of speculators becoming cartel and manipulating futures prices which in turn affect stock prices are very high. Then what made a transition in equity based derivative markets as a result SSFs are introduced? Though index futures were introduced on two benchmark indices in June 2000, Badla still existed at BSE, on one side an absolute efforts by the NSE to broaden the idea of futures, on other side BSE was neither intense on futures nor concerned in it, this is also one of the reasons for low volumes in BSE for derivatives from the beginning. It was only after March 2001 crash assisted by Badla, regulator went ahead for strong decision of banning Badla and introduction of compulsory rolling settlements. Contemporaneously in order to address the grievances of broker's community to provide a mechanism to hedge their risks, index options have been started on June 2001, followed by stock options in July 2001. With these the basic equity derivative products thought by regulator seems to be complete, but from market perspective, neither index options nor stock options are failure due to lack of volumes. Failure of options may be for several reasons but these made path easy for transition in equity based derivatives i.e. SSFs started on 9th Nov, 2001 but the apprehension involving their impact on the underlying markets has sustained to deduce importance on the economy. Again let's looks at the words of R.H. Patil (2006) about their introduction; "*Despite the obvious risks that individual stock futures pose to the safety and integrity of the capital market of the country, they have been introduced in a hurry in our country. In my opinion it was not a wise thing for us to have introduced individual stock futures. All those who had mourned the death of badla are very happy that a similar product is now available for them to play their games.*" With the above backdrop, objectives of the present study follow.

iv. OBJECTIVES OF THE STUDY:

From the above, one can articulate that Indian markets were disturbed by unsolicited feature, a mix of cash and futures trading--subsistence of the Badla scheme accompanied with process of long settlement cycles. Memorize till early 1990's the major stock exchange BSE has bookkeeping interval of fortnight plus settlement period of another 15 days. Also memorize the sequel of crises happened during the reform period. But subsequent to market crisis of March 2001, a series of reforms have been implemented which include the abolition of Badla, the taking up of rolling settlement followed by the introduction of SSFs. As a result, at this juncture one ought to look at the latest circumstances in support of an empirical assessment of this transition. That is, need to know what nature of influence these SSFs in fact exhibit on the financial markets is of interest to everybody, since rare investigations present for any economy. Wisdom of such empirical examination assumes importance in view of the fact that several economies retain successful markets in commodity futures, currency futures, index futures, and bond futures; SSFs are far behind compared to other derivative products. Certainly, a small number of countries posse SSFs that too have on few preferred or chosen stocks. However, to date such existence of SSFs trading is negligible due to volumes. Straight away contrast to all other, the present Indian situation is unusual due to spurt in the volumes. See figure 1 & 2 which exhibits present scenario of the growth of SSFs at NSE[2]. Currently the average daily trading volume of the SSFs in NSE is on an average more than twice the trading volume of the cash market. Also out of daily total trading volume of all the F&O products at NSE, SSFs alone accounts for more than 50 per cent. See figure 3 where these SSFs positioned themselves over a period of time.

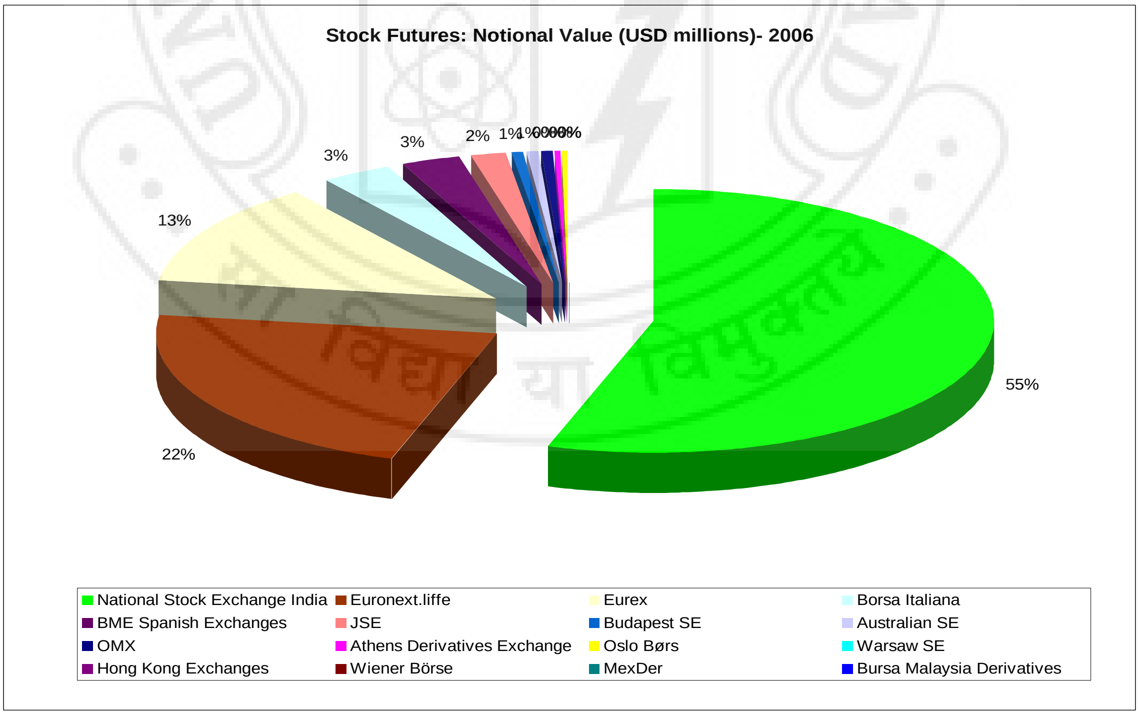
[2] From the commencement of equity based derivatives in India, out of total trading volumes in the futures and options for India, NSE accounts for 99 per cent of them. Refer various Indian Securities Market - A Review (ISMR) published yearly by NSE.

Figure 1: Growth of Single Stock Futures



Source: NSE Publication - Indian Securities Market - A Review 2007

Figure 2: Notional Value[3] of Stock Futures (USD Millions) across markets in the world



Source: NSE Publication - Indian Securities Market - A Review 2007

3 Notional value is the value of a derivative's underlying assets at the spot price. That is, the number of units of an asset underlying the contract, multiplied by the spot price of the asset. To compare across markets, it can used as a good measure.

With all the above point of views the following questions are central to the present analysis in order to explain the transition outcomes interconnected to market efficiency after the introduction of SSFs in Indian capital market:

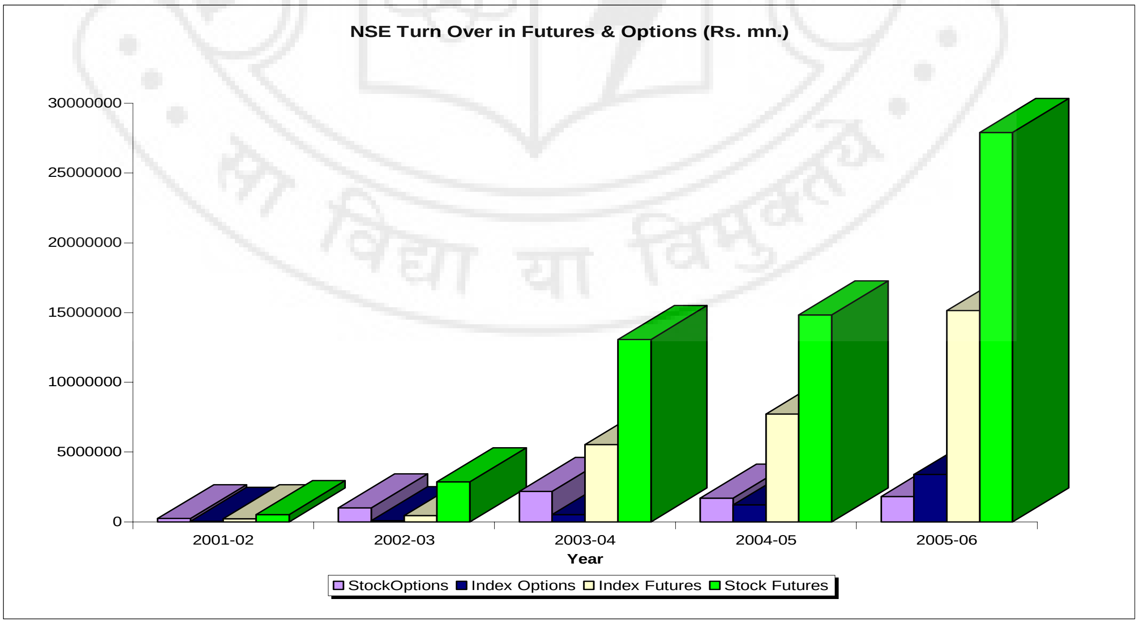
- Is there any conversion in the underlying spot volume after SSFs introduction? Since, the volume effect is not only important for investors but also for regulators, one need to find out what was the influence of SSFs introduction on spot volume. As stocks with high volumes are very liquid, volumes affect the liquidity of the stocks. And the following possibilities may arise which affect the liquidity in the market; because of low margins, in general SSFs give better hedging opportunities, here arises the odds of investors going only for the stocks where SSFs are available, this in turn decreases the liquidity in the market. Also because of low margins SSFs direct speculators to trade more which not only influence the spot prices but also hazardous i.e. as whole a shrink in market liquidity coursing inefficiency. Thus, first objective of the present study aims at liquidity after SSFs introduction i.e. whether the trading volume of the spot market decreased (shifted to futures grounding insecure ness to the market) or increased (building market towards effective track)?

- Is there any change in the underlying spot volatility after SSFs introduction? As observed from the words of R. H. Patil (2006), these SSFs carry high risk with them i.e. risk of high variability in prices (volatility) which are not hard with low margins. Consequently, what happened to the underlying market i.e. spot volatility is the present study’s second objective? Since, due to lower margins, it is anticipated that speculators with motive of increasing leverage positions will set off recurrent purchases at different prices rooting added explosive nature to the existing prices. However, an alternate opinion is that these instrument besides acting as tools for hedging, supply an extra course of information transmission which causes recurrent and rapid dispensation of information in the market which is synonymous to efficient market.

- Also study aims at cross checking whether the effects of futures introduction are same across the similar stocks i.e. to look at industry/sector specific after SSFs commencement.

This study resting on few aspects after transition in Indian derivative markets is an earlier attempt in Indian context holds several policy implications for regulators, researchers, policy makers, and investors. In addition, India market being an emerging market, where as rare existing research available is of developed markets, assessment and evaluation may throw more proficiency.

Figure 3: Stock Futures vs. other derivative products[4]



Source: NSE Publication - Indian Securities Market - A Review 2007

[4] Though there exist five equity based derivative products in futures and options segment of the NSE, the fifth one' interest rate derivative' is not included here because its volume are nil over the examined period except in its launch year 2003-04 .

v. STRUCTURE OF THE STUDY:

This study which examines defined objectives as above is structured in the following way. Next chapter 'Review of Literature' discusses the theoretical debate and summarizes the pertinent observed literature concerning equity based derivatives focusing on the relationship between spot markets. As large literature exists for the index futures compared to SSFs, an attempt has been made even to understand their effects to assess the relationship between spot market and SSFs. Chapter 3 'Liquidity of Single Stock Futures' exposes the methodology, data employed, results pertaining to the liquidity aspect of the SSFs introduction. Chapter 4 'Volatility of Single Stock Futures' presents the methodology, data employed used in this study along with the discussion of empirical results. Chapter 5 'Conclusions and Scope for Further Research' summarizes the empirical analysis, results and finally presents the concluding remarks with limitations of the study and further research prospects followed by references and appendices.

A Transition in Indian Derivative Markets – A Case Study of Single Stock Futures

Chapter II

Review of Literature

i. INTRODUCTION:

There has been no dearth for both theoretical and empirical literature on the effects of derivatives trading on the underlying markets in the financial literature. In addition, good number of diverse literature exists on the subject relating to the impact of index futures and stock options on the underlying stock market with respect to developed countries. However, studies pertaining to the impact of stock futures on underlying stocks are scarce and that too exists for few developed stock markets. This is because, though their introduction dates back to late 1980s in Sweden, due to not found favour in some of developed markets, they have been discontinued and were characterized as the tools of speculation. Nevertheless, in recent times, these stock futures have found acceptance not only in developed markets (in some developed markets they were re-introduced viz., USA) but also in several emerging stock markets. Due to this reality, much of the research exists does not address these stock futures, consequently no concrete research evidence is yet available. Therefore, most of the evidence whatever that available for the effects of derivative introduction in the financial literature is that of other derivative types[1] and that too examined in the context of developed nations.

This study contributes to the existing literature on two fronts despite the fact that only effects of stock index futures and single stock futures have been considered. See, Stewart Mayhew (2000), for a more comprehensive review of the other derivatives. First it extends the earlier work on the existing literature of index futures in association with the stock futures. Second, we document the same in the Indian context individually. However there are few studies which examined the effect of stock option-type of derivative in India they have been ignored, the reason is ever since their introduction

[1] Other derivatives include commodity futures and options along with stock index futures and options.

they have been unsuccessful in driving liquidity in the cash market as a result stock futures have been into existence (ISMR 2002). Accordingly, rest of the chapter has been organized as follows. Subsequent section reviews the effect of index futures. Followed by effect of single stock futures introduction and finally of the studies in the Indian context.

ii. STOCK INDEX FUTURES:

As discussed above there is an extensive amount of literature examining the impact of index futures introduction on the volatility of underlying indices. And coming to the results of these studies one can say that they are all indistinct, across both developed and emerging markets, having found significant increase in volatility of underlying indices in some markets and significant decrease in other. However all these studies provide their theoretical stand point why there has been decrease or increase in the volatility of the underlying indices. And this section tries to review the majority of studies for diverse stands they have to say about the index futures introduction and there after consequences with respect to different markets. The below are the findings of the varied studies.

In order to provide evidence whether since the inception of index futures trading on S&P 500 (one of the developed markets of the time) has destabilised the underlying market or not? Aggarwal (1988) and Edwards (1988a) attempted by employing the post and pre index futures commencement data and reported a decrease in volatility as measured by the variance of daily returns. In their view the low trading costs and leverage benefits of futures contracts though attracted uninformed speculators to the markets but found no significant increase in volatility of the underlying. A further investigation of Edwards (1988b) into the destabilisation effects of index futures concludes that the introduction of futures trading has not induced any change in the volatility in the long run. However, he observes that there is some evidence of futures-induced short-run volatility, particularly on futures contract expiration days, but this volatility does not appear to carry over to longer periods of time. At the same he does not directly attribute the decrease in volatility of underlying to futures trading and reports that volatility in the stock market decreased after futures trading began. As these studies are kinds of immediate or early studies on the introduction of index futures and not satisfied either with their empirical or empirical based reasons further investigation into them has been carried out in both developed and developing markets providing several unique theoretical stand points of their effect on the underlying.

One of such theoretical rise was that these futures pull more traders as they can enter with less cost; futures attract arbitrageurs whose activities may exaggerate price movements. In this line of reasoning, Ross (1989) puts forward that, under conditions of no arbitrage, variance of price change must be equal to the variance of information flow. This implies that the volatility of the asset price will increase as the rate of information flow increases. If this is not the case, plenty of arbitrage opportunities will be for the traders. Hence, as futures increase the flow of information, therefore, volatility of the spot price must change as the arbitrage opportunities will be absent. Thus, futures introduction leads to the increase in the volatility of price as a result of increased flow of information to the market. Based on Ross arguments mentioned above, Edwin et al (1989) observes increased volatility after the introduction of index futures by comparing daily return volatilities during the pre-index futures introduction and post-index futures introduction for S&P 500 between bull and bear markets. And their observation of a significant increase in the flow of information to the market occurred in post inception period found to be consistent with the inference of Ross arguments provide added significance for their evidence of increased volatility. However, in contrast, Fortune (1989) who studied the impact of index futures for the S&P 500 found no significant increase or decrease in the volatility due to the introduction of index futures. He points out these index instruments have not shown much uncertainty with their step in to the market. At the same time his study does not provides much insight into the reasons of any hypothetical arguments for his empirical verifications.

As the above studies studied the impact of index futures only on the underlying index, Harris (1989) examined the impact of index futures and options trading on S&P 500 stocks against a control sample of 500 matching stocks. He reported no significant difference in the volatility of stocks in the period 1975 through 1983 before the start of trade in index options and futures. However, after 1983, there is a statistically increase in the volatilities of stocks in the S&P 500 index. And he concludes that other factors could be responsible for this change as volatility turned out to be statistically insignificant. In similar lines, Laatsch (1991) had also performed a similar test for the introduction of futures on the Major Market Index (MMI) and finds no significant effect.

Coming to the non US studies of Index futures, Hodgson and Nicholas examined the Australian Index Futures in their paper published in 1991. Using data from the period 1981 to 1987 of daily and weekly returns centring on All Ordinaries Share Index Futures, investigated the volatility estimates of underlying index after introduction. Authors reported the significant pricing errors due to some non-simultaneity. Impending about their results there was not much significant observations compared to US studies. They found futures trading have not affected the volatility. However, they were pointing out several other occurrences like deregulation of stock exchanges, foreign bank ownership and mutual fund investment rules during 1984 and of floating Australian dollar in late 1983s might have significant effect hence unclear about their results.

Of course the studies on impact of index futures have not confined to measure of volatilities before and after, but have been examined even in the context of price interaction between cash and futures markets along with underlying volatility. In this context, Chan (1992) investigated the intraday patterns of volatility of Major Market Index futures and its underlying stocks. Along with examination of autocorrelation and cross correlation patterns of the intraday returns, Bivariate GARCH model had been used to estimate the volatility. The study predicts a strong inter-market dependence and predictability of the second market through the first market in both cash and futures market. Further study performed the price interaction between cash and futures markets under the classification of good news and bad news. Where author comes to a conclusion of good news makes cash market to lead futures market and bad news the other way.

Imminent to the evidence of the volatility and trading activity of index futures markets Bessembinder and Seguin first in 1992 published paper, come to a conclusion that return volatility bears an opposite relation ship with the trading activity for S&P 500 index futures. They considered volume and open interest for trading activity and provides evidence that as trading activity increases volatility decreases. And looking for further insights both the authors in their 1993 paper where they measured market activity by open interest propounded that underlying volatility of spot market is having indirect relationship with unexpected open interest. They reported that for the currency and agricultural contracts, spot volatility decreases when unexpected open interest increases. However, they articulate the direct relationship of unexpected volume with spot volatility. With their finding authors argue that open interest to be a good proxy for market depth as it reflects the current willingness of futures investors to risk their capital in futures contracts, which is an indicator of market depth. They also conclude that information flow proxy, trading volume has positive relationship with volatility as trading volume increases - volatility also increase.

Indeed in 1993, Jagadeesh and Subrahmanyam had examined the liquidity effects of the introduction of S&P 500 index futures. For this he had used bid-ask spread of individual component stocks of S&P 500 index futures, and reported that average spread has increased subsequent to the introduction of futures trading. However, when they repeated their test by controlling for factors like price, return variance, and volume of trade, they still find higher spreads during the post-futures period. On the whole Jagadeesh and Subrahmanyam suggested that introduction of index futures did not reduce spreads in the spot market, but there was weak evidence that spreads might have increased in the post futures period attributable to adverse-selection bid-ask spreads. Coming to another study on the price discovery i.e. price interaction between the cash market and futures market James (1993) confirm that futures market enhanced the efficiency of cash market as it opened better opportunities and predicts that in the long term the spot volatility may decrease.

Hong Choi and Subrahmanyam (1994) using the intra-day data of US Major Market Index futures for a year period before and after introduction of index futures and investigated both volatility and liquidity of the underlying cash market. They indicate that post index futures have an increase in the average intraday bid-ask spread but no significant change in the volatility. Finding on asymmetric information in the market resulted in an increase after the futures introduction. Where as volume undoubtedly increased and has shown a rise in the trading activity of the markets after the introduction of index futures.

Using the autoregressive fractionally integrated moving average (AFIMA) models along with variance ratios to the prices of intraday stock index futures, Fung et al. (1994) examined whether long memory exists in the data. Authors concluded that futures markets are not following random walk and no appearance of long term memory. Interestingly, the authors tested the impact of liquidity on the existence of long memory and found no evidence for it. The AFIMA model searches for a non-integer parameter, *d*, to difference the data to capture long memory. The existence of non-zero *d* is an indication of long memory and its departure from zero measures the strength of long memory. Long memory is also called fractal structure because of noninteger *d*. And their investigation of four daily currency futures price series, each series lasting from January 1982 through December 1991 with 2,527 observations. The estimates of *d* for three out of four series are significantly different from zero, hence, non random walk.

Turning attention towards the influence of macro-economic variables viz. inflation and term structure rates on the volatility Darrat and Rahman (1995) conducted their study on S&P index futures for a period of 1982 to 1991. Granger causality tests are applied to assess the impact on stock price volatility due to futures trading and other relevant macro-economic variables. They conclude that the futures trading have not shown any significant change in volatility as there were no signs of any sudden jumps in the prices. Coming to influence of macro variable term structure rates and OTC index proven to cause the significant changes for stock price, where as, risk premium and inflation turns out to be insignificant in causing the stock prices. However, Granger Causality tests are not fitted for stock prices since they follow non linearity where

Granger Causality is for a linear pattern, hence their study cannot assume much importance.

Antoniou and Holmes (1995) carried their investigation of index futures impact on underlying cash market volatility for FTSE-100 index of the U.K. and information flow. GARCH technique had been used to measure the volatility. Authors conclude that there was a significant increase in the underlying cash market volatility in the short runs and found no significant changes for a longer period. Authors attribute these as results of increased flow of information to the underlying cash market through the channel of futures trading. They further, conclude that the index futures have resulted in better and faster dissemination of information and apparently this is causing increase in volatility in the short run compared with the long run. Similarly, Kan Andy (1996) examined the impact of introducing stock index futures for Hang Seng Stock Exchange of Hong Kong, for their beta of underlying constituent stocks and found no significant effect of their introductions.

In the lines with Bessembinder and Seguin (1993) discussed in this chapter above, Ragunathan and Pecker (1997) investigated for the price volatility, trading activity and market depth for the Australian futures market and found the same that trading volume has positive relationship with volatility as trading volume increases - volatility also increase. Of course several other studies viz. Fung and Patterson (1999) whose focus was on volume and volatility of S&P index futures indeed looking for volatility changes after futures introduction also predict the same.

Whirling attention once again in explaining the volatility changes this time with the asymmetric information shocks in index futures from cash markets, Antoniou, Holmes and Priestley (1998) came to conclusion that the due to the introduction of index futures the asymmetric stock return volatility had been migrated to index futures from underlying markets. With their model, where traders having less information than the informed counterparts responding to good and bad news for the different markets examined viz., S&P 500, Nikkei225, FT-SF-100, IBEX 35, DAX 100, SWISS MI, they predict that index futures respond more to bad news leading to quicker falls in prices than to good news resulting in slow rise of prices. Hence, conclude though not strongly for all the markets examined, that asymmetric shock return volatility phenomenon migrated from stock market to index futures market after the introduction of index futures trading, reducing the underlying volatility to some extent.

Moving a step further, in examining the volatility of underlying with the index futures introduction using symmetric and asymmetric GARCH family techniques known for taking into account the persistence of volatility, Butterworth (2000) investigates for FTSE Mid 250 Index of LIFFE (UK) index over the period 12 October 1992 to 17 March 1995. Examination of existence of asymmetries in response to news had been symmetric for the index. Additionally, authors conclude that the introduction of the said index does not have any strong impact on underlying volatility measured by the standard deviation. But as it was evident that there has been more information flowing into cash market due to index futures onset they found an increase in persistence of volatility since this news was assimilating into price less rapidly than before the onset of trading.

Against all the above which has been examined for a single index or few indices of different markets, there has been a study done by the Huseyin Gulen and Stewart Mayhew (2000) for twenty five markets around the world before and after the introduction of stock index futures. Authors have examined the time series of excess returns over the world market index using various GARCH models to account for asynchronous trading, conditional heteroskedasticity in returns, and an asymmetric response to positive and negative news. Their results confirmed that expect in US and Japan, all other countries have experienced more or less decreased in volatility of the futures introduction. However, authors point out that in case of US and Japan where they found increased volatility due to futures introduction as being developed markets might resulted in a greater number of speculators with noisy information.

In the present discussion about the inception index futures impact on underlying markets last but not least, let see two European experiences, Italian and Spanish stock exchanges. Bologna and Cavallo (2002) employed GARCH class of models in order to examine the post index futures impact. In order to eliminate the impact of other market factors, authors tried other index returns on which there were no futures as proxy for market factors. Accordingly, authors estimated the changes in underlying volatility for the post inception of futures and found that underlying volatility had been declined. Additionally, they have noticed that in the post index future period, the importance of latest news has greater weight in comparison to past news in estimating the underlying spot volatility. And coming to Spanish experience, Pilar and Rafael (2002) investigated the effect of futures on Spanish stock market volatility and trading volume. Their findings also show a decrease in the volatility and increase in trading volume where authors have used GARCH family technique namely GJR model with a dummy variable in estimating the volatility.

The whole purpose of this review is to understand the possible outcomes and reasons provided for the impact of index futures. Hence after the whole review the following stand points on the introduction of index futures in various markets are seem to be clear that all the examined studies have mixed effects, i.e. some markets show decrease in volatility where others are opposite to them. Even for a single country there has been different conclusion for instance US. But the theoretical stand points on which empirical based conclusions were given are different. Where studies like Edwin et al (1989) based on Ross (1989) argument propounded increase in volatility since futures increase information flow hence larger spot price changes. In contrast studies by Harris (1989) and Brace and Hodgson (1991) found no effect of futures commencement and attributed other financial reforms occurrence at the same time of futures commencement or around might have influence over it. However, from trading activity perspective, Bessembinder and Seguin (1992, 1993) lead studies come to conclusion of an increase in volatility since trading activity increases. And coming to asymmetric information approach to cash and futures market studies by Antoniou et al (1995, 1998) and Butterworth (2000) conclude that futures induce greater short run volatilities than in long run. Further it has been noted that increase in volatility is a common phenomenon in different markets and index futures by themselves may not bear the sole responsibility. Adding to it they also make a point of enhancement in foreign ownership of equity along with expansion of other index-related instruments (i.e. other equity derivative instruments) and developments in index funds as likely justification of higher volatility in stock markets.

Therefore, whether inception of index futures increase or decrease the underlying volatility becomes still a debatable question. In addition, looking closing the listing of index futures around different markets does not seem to be an independent or exogenous event, as listing process involves many decisions made by regulators based on the recent or anticipated market conditions. Thus, index futures exclusively cannot provide any conclusion of their inception. Further, as this future index is based on component stocks of underlying index which cannot be directly traded against the component stocks which differ in their volatilities impact the index volatility indirectly, hence can be specific stock/stocks volatility against all together driving the whole index. And coming to difference of volatilities for different market i.e. developed versus developing markets, the above review does not support either empirically or theoretically what applies to developed is same for the developing markets, since both the markets have different characteristics which support these futures trading, hence one cannot come to a conclusion based on existing studies for different markets will apply same to the developing market like us. Hence, need to examine them in the context of specific market taking into considerations expansion of other index-related instruments i.e. other equity derivative instruments, so that accurate conclusions can brought.

iii. SINGLE STOCK FUTURES:

Day-by-day for market participants, regulators and academics alike, the volatility of financial markets has grown to be increasingly important. In addition, new innovative financial products to the market have enlarged the intricacy of the financial setting. And one such kind of innovation that has received recent attention in recent days is the market for stock based futures. And, this section reviews the studies comprise of the effects of single stock futures introduction.

Maurice and Michael (1997) investigated the introduction of single-stock futures on return, volatility and the microstructure of the underlying securities. And to examine this derivative type they took two theoretical standpoints one towards completion and stabilisation and other destabilisation of the market. Their study considers all the listed single stock futures in Sydney Futures exchange for the period before and after listing. The enquiry into the behaviour of volume after introduction resulted in increase of mean trading volume in the underlying market signifying stabilisation. However, their enquiry into the underlying volatility does not supported completion of market, as they find no significant change in the level of returns and an increase in underlying volatility. Hence, they concluded a week destabilisation effect of introduction.

Yet one can criticise this above mentioned study by Maurice and Michael (1997) for not considering recently available sophisticated statistical tools in order to explain underlying volatility changes and even for their study period considered. Even Lee and Tong (1998) examined the volatility effects of stock futures for Australian stock exchange and found no major evidence of changes in volatility of the stocks underlying the stock futures.

Steven and Sim (1999) also examined the volatility of the underlying shares in the cash market for the stock listed in Australian Stock Exchange. By employing daily prices of one year before and after listing stock futures with an asymmetric exponential ARCH model, their study finds evidence that stock futures had no significant effect on the underlying stocks volatility. Yet, they found for a few stocks there had been effect, even in these few stocks the results are varied as few have increased underlying volatility and others decreased. Overall, they evidence provide that the introduction of futures trading reflect imprecise effect on the underlying volatility.

And coming to evidence from Asian markets where Hong Kong Futures Exchange has introduced single stock futures in late 1995. However to the knowledge I have only two studies examined their impact? That too one examined by McKenzie and Brooks (2003) for informational efficiency of these derivative securities and concludes that it is not the arrival of news to the market which motivates derivative trading. And coming to the other study, Wang and Yau (2001) in their unpublished document investigated volume effects of stock futures trading in Hong Kong Futures Exchange. Their study finds no evidence of significant effect and they reason it for low trading volume on stock futures.

McKenzie, Brailsford and Faff (2001) have studied impact of single stock futures for existing stock futures of Sydney Futures Exchange for a period of Jan 1990 to June 1998. In order to verify conditional and unconditional volatility of deriving stocks they employed TGARCH method of estimation for a mean market model. Their study found evidence of a reduction in the underlying stocks' unconditional volatility. And also some evidence which is no consistent across all stocks for asymmetric response.

In case of USA where these stock futures have been re-introduced after a twenty year ban period, there are very few studies to throw light on the introduction effect of these stock futures. First study of re-introduced stock futures was on their margin requirements rather on their economic desirability by Dutt and Wein (2003) that examined the margin requirements on single stock futures imposed by US financial regulators and proposed a risk-based margin requirement rather than the current strategy based margin requirement. Second was by the Jones and Brooks (2005) looking into the reasons for why these derivative securities volumes have not yet gained sufficient interest by investors. By providing evidence from OneChicago Futures market he tries to find out answers for his self posed question and not addresses the volatility aspects of these stock futures introduction. Finally, Ang and Cheng (2005) tried to found out the effect of financial innovation using the listings of single stock futures. They provide empirical evidence from news event approach which draws explanation from fewer unexplained large stock returns for single stock futures in the post-listing period with a matched sample. Their results are in line with lower trading costs and higher leverage functions of these stock futures which provide more opportunities to the arbitragers than speculators. And conclude that there is a significant reduction in the uncertainty of underlying prices and predicted improvement in market efficiency after their introduction.

iv. INDIAN STUDIES:

Memorize as mentioned in the introduction chapter the equity based derivatives are unknown till 1990's, hence, studies pertaining to them emerged recently after their introduction. Let's look at the existing studies to understand their effects to assess the relationship between spot market and index futures followed by SSFS.

a) INDEX FUTURES:

In India index futures have started from June 9, 2000 on the Bombay Stock Exchange (BSE) with underlying index as BSE Sensitive Index known popularly as Sensex and from June 12, 2000 on the National Stock Exchange of India Ltd. (NSE) with underlying index as S&P CNX Nifty. Since the inception of these index futures the trading volumes have seen a steady increase, yet, NSE index futures have larger volumes always when compared to the BSE index futures. The total turnover of index futures of NSE during January 2006 was Rs.324063 Crore. As this index futures introduction in India has created lot of jargon before the introduction itself, researchers were keen on there outcome i.e. whether they increased or decreased the underlying volatility since their arrival.

Early studies in index futures after their inception in India, has been done by Thenmozi (2002) and Gupta and Kumar (2002). Thenmozi (2002) considering the data for the period 15th June 1998 to 26th July 2002, which provides 503 observations before introduction and 534 observation after math of total 1037 observations examined for the NSE S&P CNX Nifty Index futures and the underlying spot index i.e. S&P CNX Nifty. Accompanied with the volatility measure computed as the standard deviation of the daily returns, author has investigated the impact of introduction using a dummy variable regression technique with Nifty Junior index returns as a proxy to capture the market wide variability. And from the empirical findings of the study the author comes to a conclusion that there was a decreased volatility in the underlying market after the introduction of index futures. Additionally, author also examined lead lag relationship for the index futures and underlying using Stoll and Whaley (1990) and Chan (1992) simultaneous equation modelling, two stage least squares. And found that there is hardly any memory effect in futures market, but exhibited a faster transformation of information in futures market than cash market as there was hardly absence of any infrequent trading in futures market. Further, author concludes the futures market lead the cash market by one day and not found any significant signs of cash index leading futures index. However, this study being early one, firstly it has not taken into account the financial data problems such as heteroskedasticity, asymmetric nature etc. hence, fail to use the technique of GARCH family models. As a result their study suffers from the robustness of their empirical results. In addition daily data for lead lag suffer from the problem of dynamic time series properties; hence their finding of futures market leading the cash market by one day can not be accepted.

Next study by Gupta and Manish (2002) where again they have measured volatility by four different methods (close-close prices, open-to-open, Parkinson measure, Garman-Klass measure) based on daily prices (aggregated for monthly, bimonthly, quarterly, halfyearly etc.) for the both BSE and NSE indices with twin objectives of impact on spot index and relative volatility. They estimated the above mentioned various methods of volatility and employed to them F-test for significance. Their results provide evidence for the decline of the volatility for the both underlying stock indices. And it has accounted for the several changes in the market micro-structure, such as abolition of the traditional badla system, reduction of trading cycles etc. However, they found no significant evidence for concluding whether futures volatility is higher or lower in comparison to the underlying stock market volatility. Again this study does not account for financial data problem mentioned above and can be noted for even not taking into account for some measure for market variability as Thenmozi (2002).

Imminent to studies estimated with GARCH models for changes in volatility after inception of index futures and index options, Shenbagaraman (2003) using daily closing prices for the period 5th Oct 1995 to 31st Dec 2002 for the S&P CNX Nifty along with S&P 500 Index (US) and Nifty Junior for proxies of world market and local market variability. Estimations have been carried using day of the week dummy variables for Tuesday to Friday incorporated in the GARCH model applied. First the author examined for the whole period and concludes from evidence that there is no significant impact on underlying index volatility. However, when they estimated the model separately for the pre and post futures period and found that after future inception the persistence has disappeared meaning shock to volatility today has no effect on tomorrow and futures volatility. Authors attribute this evidence as increased market efficiency, since all information is incorporated into prices immediately. Additionally, authors predict that the result of efficiency might not solely because of futures introduction since inception of index futures and options accompanied by several regulatory decisions and stock exchange reforms. Hence, in contrast to developed markets, India being an emerging market has shown that commencement of index futures improved efficiency of information incorporation into prices faster but not envisage these result only due to the index futures due to several market reforms went on side by side during their inception in Indian markets.

Kiran and Chiranjit (2003) addresses whether and to what extent, the introduction of Index futures contracts trading have change the volatility structure of the underlying NSE Nifty Index. Using data for the period June 1999 and June 2001, one year before and after the introduction of Index futures, study first confirms using a CUSUM Plot that there is a shift around the time of inception. Then using classical F-Test for variances also indicated that the spot volatility has changed since the inception of Index futures. Next the GARCH family of techniques is employed to capture the time-varying nature of volatility and volatility clustering phenomena present in the data. The results obtained from the ARMA-GARCH model indicate that while the introduction of futures trading has made no change on the underlying mean level of the returns, it has significantly altered the structure of spot market volatility. Specifically, it is found that new information is assimilated into prices more rapidly than before since the onset of futures trading, leading to a decline in the persistence of volatility. These results for NSE Nifty are obtained even after accounting for world market movements, asymmetric effects and sub-period analysis, and contrasting the same with a control index, namely, NIFTY Junior. Thus it is concluded that such a change in the volatility structure appears to be the result of futures trading, expanding the routes over which information can be conveyed to the market.

Raju and Karande (2003) while addressing the price interaction between the Index futures and Spot Index also addressed the issue of volatility after the commencement of Index futures. Using daily closing values of Nifty Index futures from the period of June 2000 till October 2002 for price interaction and Jan 1998 to Oct 2002 for volatility effects employed the cointegration and GARCH family techniques for examining the price discovery process and volatility effects respectively. Based on the empirical findings they observed that the futures market compared to the spot market responds more quickly to deviations from equilibrium. And price interaction or lead lag relationship occurrence for the both market i.e. price discovery occurs in both the futures and the spot market, especially in the later half of the study period. Coming to the volatility effects of index futures introduction they conclude that there has been decline in volatility of the underlying markets, hence recommended introduction of futures on more indices and reduction in margins. Nonetheless the study lacks the empirical investigation of the asymmetries in the market.

Snehal and Saurabh (2003) examined the volatility effects on Indian spot market in line with Bologna and Cavallo (2002) GARCH Methodolgy using daily data of both BSE Sensex and S&P CNX Nifty having BSE-200 and Nifty Junior as proxy to capture market wide changes. They study predicts that there is change in the underlying market since year 2000 reflected by the reduction in volatility in all the examined indices. However, they concluded that as BSE have rare volumes in the derivative segment, the reduction of volatility can be attributed only to S&P CNX Nifty futures and same as vague for BSE. Here in the same line one can find same study by Golaka Nath (2003) found decline in the volatility after introduction of index futures on underlying index volatility, as it also verifies the Single Stock Futures impact on the respective stock underlying, it has been reviewed under Single Stock Futures.

b) SINGLE STOCK FUTURES:

Though, SSFs listing in India date back to late 2001 (November, 9 2001) with the 31 stocks and listing has been progressive for 128 stocks till January 2006, there had, however, been few studies to our knowledge. Sandeep et. al. (2003), made an early attempt on examining the impact of both stock options and futures for volatility and informational efficiency of underlying stocks for the November listing. Study has used one tailed f-test to pre and post variance as a measure of volatility for 250, 120 & 90 days raw daily returns along with excess daily returns to conclude on significant difference after their inception. They concluded that volatility has declined for different stocks and justifies the same for increasing number of stocks subsequently in Indian context also concluded that no significant change in the autocorrelation pattern for both pre and post series of stocks. However, study has not made any attempt on liquidity effects after inception of options and futures and ignores market wide factors as a whole along with the addressing several issues like ARCH effects of the return series which are common in nature for such studies. Another early study was done by Nath (2003) to provide the impact of stock futures commencement on Indian capital markets. Though this study uses the GARCH family technique in order to explain the volatility effects of stock futures listed – selected randomly that is justified on the basis at least 6 months after post SSFs, uses a vague comparison from the study's GARCH coefficients as measure of performance after inception of SSFs for only 13 stocks with 7 other as control stocks. Also, author was inconclusive of his results whether in post inception of futures volatility has decreased or increased by saying "volatility in the post derivatives has either remained more or less same or has increased marginally". However, even this study fails to look at the liquidity effects after SSFs inception.

From the existing both studies one can clearly find the gap of missing liquidity effects examination after inception of SSFs and addressing the issues pertaining to witnessed reforms which mentioned earlier in the chapter one that provides for a detailed examination of SSFs on both liquidity and volatility not only for the November listing which was chased by significant reforms causing market wide changes in capital market but also for other listings of SSFs for deeper perceptive of their speculative character.

v. SUMMARY OF FINDINGS:

Summarizing the above reviewed studies for index futures and stock futures done for both Indian and International markets will be a colossal task, hitherto, attempt had made to encapsulate major findings and problems reported by them on the centre of liquidity rooting from volatility that are significant from efficiency perspective, traders' perspective and of course undoubtedly to the academicians also. It has been observed that for International and Indian studies on index futures provided mixed results, which point out that this raises specifically when index futures not being an exogenous event, accompanied by several other internal policy matters, reforms and exchange related reorganizations. Though some studies conclude specific outcome of either increased or decreased volatility, one can observe from above that the pattern found not to be same across studies within the country and naturally differs from across the countries classified to be developed and new markets. Together, there is no firm evidence from the literature exists, which says that these products have been apparently optimistic and specific to developed markets.

Even, for India (being an emerging market), there was inconclusiveness whether the introduction of index futures have resulted in decrease or increase in volatility (see appendix A that summarizes all the Indian studies). And all most all studies more or less accept that in India inception of index futures has been accompanied with lot of reforms put forth by regulator, for securities trading both before and after giving permission for index futures, importantly it has to change the norms for stock exchanges to introduce these derivative securities. Further index futures accompanied other derivative instruments like index option in June 4, 2001 and stock options in July 2, 2001. Since, index options and stock options failed in creating volumes accompanied by market crisis in March 2001 made regulator to implement reforms like removal of badla system, adoption of rolling settlement and finally the introduction of SSFs. These stock futures which flourished in India with in no time and grown to be the largest in notional trading volumes in contradictory to other markets where commodity, index and currency futures thrive a lot have been discontinued in several stock exchanges for their characteristics which can be used for speculative purposes. See appendix of the chapter

Since, these SSFs existed in few that too for few stocks not bringing heavy contribution in contrast to the Indian case where there size is almost double to cash market segment, provides the need for empirical assessment in the given backdrop of market reforms aimed at global standards in the Indian capital markets. One can see such examination based on pragmatic evaluation could be a study that provides in abundance the consequences in advance for the other markets. Hence, this study enquires the nature of SSFs with in the framework of set objectives mentioned in chapter one (see appendix B for Indian study on SSFs and for authors remarks over it).

Appendix A: Summary of Indian Studies on Index Futures:

S. No	Author(s)	Underlying Index/Market	Data Period	Statistical Method-Employed.	Discussion of Results	Remarks
1	Thenmozi (2002)	Nifty	June 98-July 02	Simple regression with Dummy variable technique	Decreased Volatility in cash market after the introduction.	Being early study it has not taken into account the nature of financial data problems.
2	Gupta and Kumar (2002)	Nifty and BSE	June 98-June 02	Estimated various methods of volatility like standard deviation of returns and employed F-test for significance	No concrete evidence-reported decrease in volatility in some months	Techniques employed are traditional and does not take care of financial data problems. But observed for both indices.
3	Shenbagaraman (2003)	Nifty	Oct 95-Dec 02	GARCH family models	No increase in volatility after introduction – hence no destabilization.	Found significant change in volatility.
4	Kiran and Chiranjit (2003)	Nifty	June 99-June 01	GARCH family models along with the CUSUM change point analysis	Significant Change in underlying volatility and evidence of new information absorption rapidly after introduction of futures	Does not include liquidity effects analysis.
5	Raju and Karande (2003)	Nifty	Jan 98-Oct 02	GARCH family models	Decline in volatility of the underlying market after derivatives introduction.	Not enquired into the nature of efficiency aspects.
6	Snehal and Saurabh (2003)	Nifty and BSE	Jan 97-Mar 03	Followed GARCH method as suggested by Bologna and Cavallo (2002)	Attributed the decline in the spot market volatility as futures effect caused by Nifty alone.	Neither addressed efficiency aspects nor on underlying structural changes.

Appendix B: Indian Studies on SSFs:

S. No	Author(s)	Data Period	Statistical Method-Employed.	Discussion of Results	Remarks
1	Sandeep et. al. (2003)	250, 120 & 90 days raw daily and excesses returns of Pre and Post Inception	One tailed F-test for pre & post variance of stocks	Decline in volatility after SSFs inceptions, but not found any change in structure of return series.	Employed a technique that does not take care of financial data problems and not addressed the several aspects including changes in underlying structure of series.
2	Golaka Nath (2003)	Period considered for Stock Futures is 6 months of pre & post . And how the period has been chosen for each stock when there are so many listings.	GARCH family models	Author was inconclusive from the results.	Taken randomly i.e. selected 20 stocks out of which only 13 have SSFs and others being control stocks. No discussion of liquidity effects. And could not conclude anything on the effects their inception on volatility. Also a vague comparison between a group of stocks having SSFS and other stocks.

A Transition in Indian Derivative Markets – A Case Study of Single Stock Futures

Chapter III

Liquidity Effects Of Single Stock Futures

i. INTRODUCTION:

Liquidity is the ability to trade when you want to trade (Larry Harris, 2003). That is, competence to buy and sell large size quickly, at low cost and at the moment one wants to trade. Also, it is always advised to an investor to invest in liquid assets than illiquid ones because one can easily without much loss can get out of those investments in hitch times. Often, liquidity is regarded as a high level of trading activity. So, one can look at liquidity as quality of a market which in turn depends on the trading volumes (activity) or in other words as the efficiency and cost effectiveness with in a given markets. Hence, liquidity demonstrates an important characteristic of well functioning markets. In addition, due to instigation of several new financial products that bear relation with underlying products, the financial research is gaining enduring empirical attention towards liquidity which resembles market efficiency. Nonetheless, disregard of suppositions, from the beginning, trading volumes had been the key factor that can influence the overall liquidity in the market. With in the same framework empirical evidence in the literature validates trading activity as one of the large and instantaneous explanatory factor in elucidation of liquidity in the market.

However, the majority of the studies as pointed out earlier in the study ignored this vital aspect, moreover, in India it had been the case of stock options failure in building volumes, forced the regulator to introduce these SSFs. As well, one should not fail to recall that NSE stock futures with in no time after their introduction had occupied the first position both with in the country and outside with respect to notional trading of SSFs. Against the above milieu, it is important to analyze these volumes, which are far ahead of all other products in the derivative segment. SSFs in India had not been confined to one single event or no further introduction listings as in case of other markets. In this context one can say about their introduction in India as a gradual advancement, further, empirical verification of these stock futures provides us several advantages over and above index futures. Firstly, index futures are a market wide instrument. Secondly index futures though a tradable product, but their underlying asset is not a tradable one as it is a comprised one, where as underlying ones of single stock futures are directly available for trading. Finally, as we all know index futures introduction was a single event, and was followed by different market wide changes at the time of introduction as mentioned before. Hence, stock futures here provide an additional facilitation for examining the underlying affects scattered across many constituent's stocks and over a period of time so that other market wide changes have less effects.

The present chapter enquires into these volumes to analyze the liquidity raising the question, whether liquidity have been enhanced or worsened in the fundamental market after SSFs introduction? In order to explain the economic desirability with respect to huge trading activity that exists presently in SSFs, the present study investigates the same before and after their listing. An interrogation of whether underlying trading volume has undergone any significant changes in the framework of market stabilisation and destabilisation has been pursued. That is if market experiences an increase in the spot volumes after these SSFs have been introduced then one can say that there has been enhancement in liquidity. This shift is towards market stabilisation since risk adverse investors will use these instruments for hedging and invest more in underlying market. In contrast if there has been decrease in the spot volumes then one can conclude that they have been migrated or transferred to SSFs, which not only reduces the liquidity in the underlying market but also destabilizes the market as speculators broke into the market outbalancing price stability as these SSFs facilitate them with less margin requirement.

The rest of the chapter is organized as follows; next section outlines the data employed, descriptive statistics followed by econometric methodology applied in the context of present study. Subsequently reported the empirical results obtained, discussed the same and conclusions in conjunction with some remarks on practical implications of the findings are presented.

ii. DATA EMPLOYED:

The data employed in this study for liquidity aspects have been employed in the above backdrop for empirical assessment, thus, the current study in accordance with different listing of SSFs on NSE[1], first being on the 9th November 2001 for 31 stocks, employs the data till the listing that took place on 20th April, 2005. In total, SSFs during all these listings constitutes to 95 in number on NSE over a period of time. However, due to the non availability of data for the duration of observed period, nine stocks that have SSFs are excluded from the study. These SSFs are excluded from the analysis since either some of these were encompassing a simultaneous listing in both cash & derivatives segment (giving raise to underlying volumes observation of pre inception period of the SSFs difficult i.e. comparison is not viable) or been de-listed for not meeting the norms laid by the NSE that are customary on the prescribed criterion suggested by the SEBI for the commencement and prolongation on the stock exchanges. Selection and exclusion of stocks in futures and options segment at NSE are based on an eligibility criterion, in couple of words, the criteria enounces that the stocks median quarter sigma

[1] Recall from chapter one that adhere to commencement of equity based derivatives in India, out of total trading volumes in the futures and options for India, NSE accounts for 99 per cent of them.

order size over the last six months should be at least Rs. 0.10 million (Rs. 1 Lac)[2]. Detailed explanation of the eligibility criterion and about quarter sigma can be found in the appendix C.

Thus, total sample abbreviates to 86 SSFs that draw out of five different listing periods (see Table 1). Overall, the data employed in the present study provides a good sample as it takes into account more than 65% of market capitalization in cash segment and in case of SSFs 99% of trading in Indian stock markets i.e. with respect to both the stock exchanges (BSE &NSE) where this derivative instrument is traded. All the data employed in the present study has been obtained from NSE published daily "Bhavcopy" that are available at www.nseindia.com.

Table.1: SSFs –Sample Size

S. No	Listing Date	No. of Stocks Employed
1	09-11-2001	31
2	31-01-2003	12
3	29-08-2003	8
4	26-09-2003	4
5	20-04-2005	31
	Total	**86**

iii. METHODOLOGY:

Liquidity is not a directly evident one, so, several proxies have been proposed in the literature to measure liquidity. Studies in the literature had no concise proxy measure of liquidity since in financial literature there is no universal definition of liquidity. In addition, differences in operational systems of stock exchanges across the world added further for subsistence of prolix definitions in the literature. In the present study, in order to explore the liquidity effects of SSFs, for each underlying stock, it has been

[2] Refer to Circular No. NSE/F&O/0056/2004.

measured by employing commonly used proxy viz. trading volume. In specific the total traded value for each stock on daily basis has been obtained for six months before and after the listing date respectively. Descriptive statistics of data employed, are presented in tables 2 – 6 for each stock listing-wise respectively. For each listing (also occasionally referred as an event) presented the mean, standard deviation values of the empirical proxy for both pre and post listing periods along with the normality test statistic respectively. Therefore, for an examination of whether SSFs have an effect on liquidity, if so, increased or decreased after SSFs inception, the present study formulates the following hypotheses:

H_0: No difference between two means.

H_1: A true difference does exist between two means.

To test the above i.e. average total traded value for pre and post listing is equal to zero, *t*-test is not appropriate. Since it is evident from the normality test statistic values reported in the descriptive statistics for different listings, where not even a single underlying stock's total traded value is normal directs us to use a non-parametric test for empirical verification of the above. Subsequently, to determine if there is any significant change in the underlying trading volumes after the inception of SSFs current study employs Wilcoxon Rank Sum test.

Wilcoxon Rank Sum (WRS) test is a non-parametric analogue of two sample t-test. This test is based on the ranks of the data, and is used to compare means between two independent groups without the assumption of the normally distributed data. This non-parametric test provides a correct answer than the *t*-test when data is not normal (Siegel & Castellan, 1988). A two-sided WRS test statistic was used to compare the ranks for test of significance. If the two-tailed p-value is less than the significance levels, then there is a significant difference between the underlying trading volumes. Tables 7 – 11 presents the WRS test results event wise respectively[3]. Discussion of results, including comparisons of mean scores between pre and post listing for each stock engaged in the study in accordance different listings, observations and direction for further research follows.

iv. DISCUSSION OF RESULTS:

Tables 7 – 11, exhibits the empirical results of all the stocks employed in the current study their mean scores, change and significance. Comparisons of means are made between proxy of liquidity measure before and after SSFs inception of each stock. The columns of interest are third and fourth, change in the mean score and respective significance. Empirical evidence that each stock has undergone a significant change is assessed from each stock corresponding significance level exhibited in fourth column of the tables. If there is significant change then whether it is positive or negative can be obtained from column three and observations for the same will be drawn. Here one should remember and not to drew blank afterwards "*negative change indicates an improvement*" after SSFs inception.

An examination of table 7 which exhibits the results of first event indicates 7 out of 31 stocks have no significant change in the underlying volumes. However, in remaining 24 stocks 15 provide evidence for increase in underlying volumes against 9 stocks that provide evidence for decrease. Though there is an evidence of increase in

[3] Even empirical verification has done with total traded quantity as another measure of proxy for each stock respectively, as the evidence doesn't differed much from total trade value results have not been presented for brevity.

underlying volumes of 15 stocks from first listing, any observation of improving liquidity in the market and market moving towards stabilization cannot be agreed for the following reasons. Firstly, it is hard to say that such empirical evidence is free from effects ‘stock options’ which listed just four months in advance of SSFs inception. Secondly, since underlying stock is same for both ‘stock options’ and ‘SSFs’ effects may be dissipated and need to memorize that only ‘stock options’ are available stock level derivatives that might raised the underlying volumes in pre-listing period. Finally, the first list inception was accompanied by market wide changes as mentioned in the earlier chapters. With above it will unfair to agree any significant change in liquidity of the market from first list, hence, one need to examine other listings.

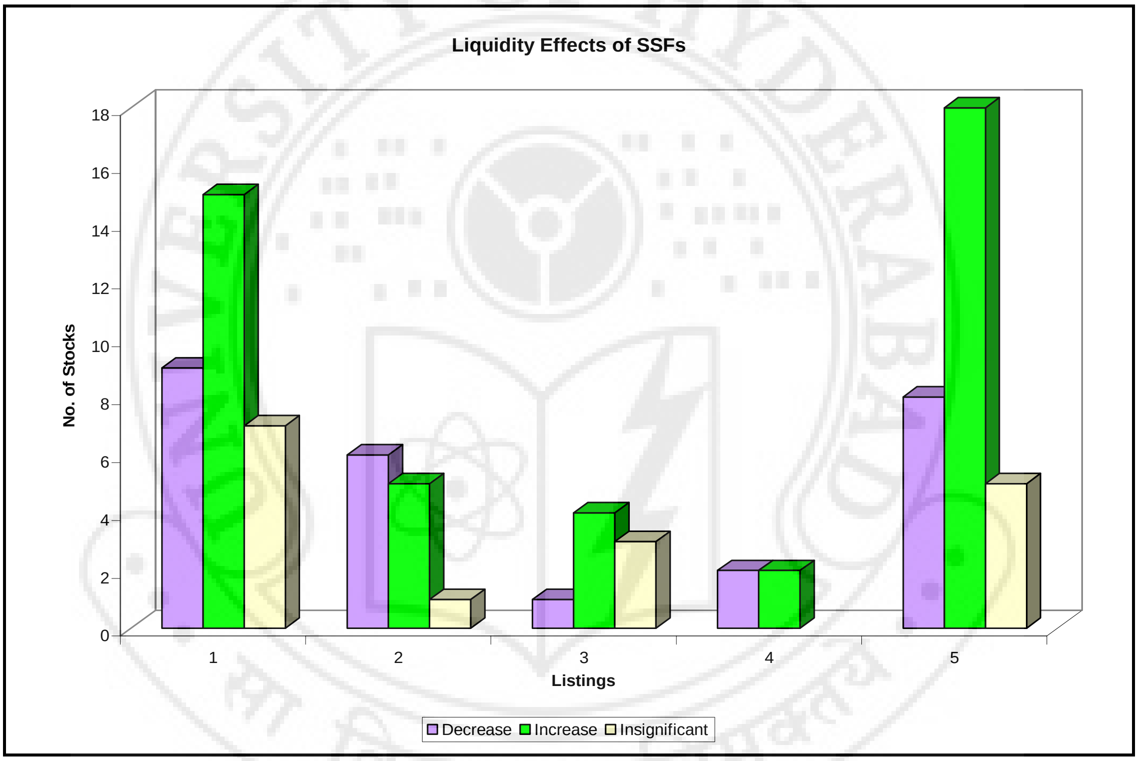
Table 8, exhibits the empirical results of second event took place on 31st Jan 2003 almost after a more than year gap provides slightly different results. Out of 12 stocks listed 11 stocks provide evidence of significant changes in the underlying volumes. Six and five of them are decreased and increased respectively. Since, the number of decreases is marginally higher compared to increases, reasoning will be weak. Decrease in underlying volumes renders the chances for migration to SSFs that not only reduces the liquidity in the underlying market but also destabilizes the market as discussed earlier in the chapter. Let’s move with this weak evidence to other listings whether they are providing same conclusions or distinct.

An examination of stocks listed on 29th August and 26th September 2003 are provided in the tables 9 and 10. From third event results, it is evident that out of 8 stocks listed 3 are insignificant putting up no evidence of changes in the underlying. However out of 5 significant stocks, 4 exhibit increases in liquidity against one decrease where all listed stock belong to banking industry. Coming to fourth event results, only 4 stocks got listed exhibiting all four to be significant where both increases and decreases are same. Observation from the above listings happened with in a month's time provide mixed judgements in terms of liquidity effects. While in the third event more number of stocks exhibit significant increase in the underlying volumes, fourth event provides equal number of increase against decrease. Again evidence is different compared to second, strong evidence of increase from the third and indifferent from fourth not providing a concrete observation on what had happened to liquidity in the market after these SSFs inception. Let's also look at last event employed in the study before summing up observations on the liquidity effects.

The 25th April 2005 listing was almost as huge as initial one that took place after a break; total 31 stocks have been employed in this list for studying liquidity effects and by this listing SSFs are no more new products as these are well received in Indian market reflected in their notional trading values as mentioned somewhere earlier. Yet, one cannot conclude with out analysing results, table 11 presents the liquidity results, out of 31 stocks 26 provide evidence of significant change in the underlying volume. Eighteen stocks exhibit increase in the volumes after SSFs inception against 8 decreases. Hence, more or less from above there is an evidence of support for improvement in the liquidity after these SSFs inception across different listings (see figure 4).

Coming to how these liquidity effects are across different kind or type of companies/industries/sectors, here are the observations; all banking sector listed roughly exhibit increase in underlying volumes after inception followed by petroleum and auto companies; where as pharmacy industry as a whole roughly present decrease in underlying volumes. Other sectors including IT, FMCG/CPG exhibited dissented results which varied across with different listings. Therefore, to conclude from above, it is evident that the liquidity effects measured by said proxy exhibited some support in second listing where liquidity experienced destabilisation in the market, thereafter, there has been tilt to towards the stabilisation that is increase of stocks spot volume but differed across kind or type of sectors. And this has been evident clearly from the third listing onwards to the end of sample analysis.

Figure 4: Liquidity Effects of SSFs over different listings.



Yet, the above empirical examination is a preliminary one that tries to address liquidity effects using a widely accepted proxy in the framework of market stabilisation and destabilisation. These are only pilot gestures towards the interrogation of whether market is moving towards efficiency. Beside from the above observations on liquidity aspects of SSFs one need to examine few other aspects viz. volatility behaviour before making out any conclusions from the above empirical evidence which will addressed in the next chapter. Adding up, the current study also executes verification for the practical findings of liquidity results presented which is described below.

Literature of empirical finance views rightly *measure of liquidity* as that which takes into account the execution of large orders without incurring a high transaction costs. Here, transaction costs referred are not the fixed costs typically incurred like brokerage, depository charges, etc. It refers to the costs attributable to lack of market liquidity i.e. cost for buyers and sellers who want to trade frequently and large trades. Lack of liquidity means trading activity (at higher trades) translates into a high cost for buyers and sellers, thus, efficient markets should have lower impact cost[4]. Hence, this chapter in order to verify its empirical findings compare the same with NSE monthly impact costs (see appendix C for more details on NSE impact cost), which are available for selected stocks only. The current study obtains the same and calculates averages for the required period i.e. in accordance with listing, before and after SSFs inception for the available stocks.

Compiled tables consisting of impact cost[5] are presented in appendix C Table 12. An examination of them reveals the same narrative as observed from the liquidity results presented. Majority of the stocks demonstrates decrease in the impact cost which is parallel to increases in the underlying spot volumes after the SSFs inception. Similarly stocks that exhibit increase more or less succeeds the same pattern. With the above observations and remarks the study moves to further research in order to investigate the volatility aspects of SSFs and their implications for the market in the following chapter.

[4] However, it also depends on market micro structure like trading systems they follow.
[5] NSE computes are for the portfolio of Rs. 50 lakh for each month for Nifty and Nifty Junior, hence, their impact costs are obtained for the available stock futures only and compilations from the same as reported.

Table No. 2: Descriptive Statistics for stocks listed on 9th Nov 2001

Stock Symbol	Total Traded Value (Rs. Mn.)					
	Pre Listing			Post Listing		
	Mean	Std. Dev.	Normality@	Mean	Std. Dev.	Normality@
ACC	254.3	197.8	0.796(<0.01)	245.3	171.9	0.872(<0.01)
BAJAJAUTO	30.6	34.1	0.741(<0.01)	32.8	31.4	0.769(<0.01)
BHEL	54.6	46.3	0.821(<0.01)	125.6	130.1	0.719(<0.01)
BPCL	21.3	22.4	0.767(<0.01)	199.7	239.2	0.772(<0.01)
BSES	20.0	32.8	0.544(<0.01)	20.3	27.5	0.581(<0.01)
CIPLA	114.9	100.1	0.834(<0.01)	59.9	51.8	0.745(<0.01)
DIGITALEQP	1616.5	745.6	0.946(<0.01)	1876.9	998.6	0.939(<0.01)
DRREDDY	359.6	283.1	0.892(<0.01)	270.3	282.0	0.695(<0.01)
GRASIM	47.9	53.1	0.664(<0.01)	44.8	36.4	0.841(<0.01)
GUJAMBCEM	23.6	31.7	0.634(<0.01)	32.9	29.4	0.759(<0.01)
HDFC	47.3	61.4	0.554(<0.01)	30.9	26.7	0.861(<0.01)
HINDALC0	28.8	27.0	0.777(<0.01)	19.5	20.2	0.746(<0.01)
HINDLEVER	226.3	190.1	0.723(<0.01)	182.3	110.6	0.868(<0.01)
HINDPETRO	20.9	17.5	0.837(<0.01)	260.4	319.8	0.772(<0.01)
ICICI	12.3	13.2	0.657(<0.01)	32.1	36.4	0.679(<0.01)
INFOSYSTCH	2000.5	736.2	0.979(<0.01)	2399.3	1044.6	0.967(<0.01)
ITC	386.4	371.7	0.745(<0.01)	251.8	200.1	0.801(<0.01)
L&T	325	242.2	0.813(<0.01)	282.6	344.1	0.531(<0.01)
MTNL	56.2	39.1	0.902(<0.01)	117.1	146.9	0.634(<0.01)
M&M	20.5	28.8	0.582(<0.01)	43.6	40.5	0.763(<0.01)
RANBAXY	648.1	668.9	0.824(<0.01)	362.4	258.5	0.841(<0.01)
RELIANCE	969.7	584.5	0.872(<0.01)	781.8	567.8	0.776(<0.01)
RELPETRO	95.2	68.6	0.815(<0.01)	181.4	114.5	0.916(<0.01)
SATYAMCOMP	1639.5	689.2	0.955(<0.01)	3924.2	1874	0.934(<0.01)
SBIN	94.8	95.2	0.723(<0.01)	200.4	329.0	0.509(<0.01)
STROPTICAL	139.3	77.6	0.960(<0.01)	107.5	72.7	0.873(<0.01)
TATAPOWER	31.1	33.6	0.710(<0.01)	29.1	22.2	0.819(<0.01)
TATATEA	25.2	28.5	0.684(<0.01)	24.7	31.6	0.528(<0.01)
TELCO	35.6	36.7	0.741(<0.01)	153.8	127.8	0.806(<0.01)
TISCO	123.6	122.3	0.781(<0.01)	83.5	65.6	0.804(<0.01)
VSNL	100.9	77.7	0.849(<0.01)	118.3	109.8	0.689(<0.01)

@Shapiro-Wilk test-statistic for Normality

Table No. 3: Descriptive Statistics for stocks listed on 31st Jan 2003

Stock Symbol	Total Traded Value (Rs. Mn.)					
	Pre Listing			Post Listing		
	Mean	Std. Dev.	Normality@	Mean	Std. Dev.	Normality@
BEL	61.7	54.9	0.806(<0.01)	56.2	47.2	0.823(<0.01)
HCLTECH	375.3	336.1	0.639(<0.01)	190.3	138.9	0.744(<0.01)
HEROHONDA	93.6	65.0	0.828(<0.01)	162.1	114.2	0.793(<0.01)
ICICIBANK	75.4	69.8	0.809(<0.01)	141.8	95.1	0.860(<0.01)
IPCL	71.2	163.9	0.340(<0.01)	73.9	67.6	0.798(<0.01)
MASTEK	1710.0	891.9	0.879(<0.01)	1121.7	769.7	0.908(<0.01)
NATIONALUM	51.6	48.7	0.787(<0.01)	55.0	70.6	0.682(<0.01)
NIIT	481.2	346.8	0.756(<0.01)	268.2	182.5	0.733(<0.01)
ONGC	64.8	57.5	0.806(<0.01)	149.7	195.9	0.702(<0.01)
POLARIS	966.6	579.5	0.908(<0.01)	287.6	181.2	0.893(<0.01)
SCI	58.5	61.2	0.741(<0.01)	65.7	42.6	0.863(<0.01)
WIPRO	1023.4	604.4	0.859(<0.01)	569.9	294.8	0.796(<0.01)

@Shapiro-Wilk test-statistic for Normality

Table No. 4: Descriptive Statistics for stocks listed on 29th Aug 2003

Stock Symbol	Total Traded Value (Rs. Mn.)					
	Pre Listing			Post Listing		
	Mean	Std. Dev.	Normality@	Mean	Std. Dev.	Normality@
ANDHRABANK	123	93.7	0.817(<0.01)	91.7	63.4	0.803(<0.01)
BANKBARODA	393.6	380.6	0.773(<0.01)	357.5	216.4	0.885(<0.01)
BANKINDIA	95.3	108.7	0.704(<0.01)	138.5	116.5	0.794(<0.01)
CANBK	687.8	470.7	0.814(<0.01)	606.6	352.8	0.869(<0.01)
HDFCBANK	45.4	48.4	0.604(<0.01)	113.6	76	0.849(<0.01)
ORIENTBANK	283.1	251.5	0.891(<0.01)	430.6	313.6	0.807(<0.01)
PNB	585.3	528.5	0.735(<0.01)	646.9	414.5	0.896(<0.01)
UNIONBANK	158	118.3	0.852(<0.01)	91.8	68.3	0.857(<0.01)

@Shapiro-Wilk test-statistic for Normality

Table No. 5: Descriptive Statistics for stocks listed on 26th Sept 2003

Stock Symbol	Total Traded Value (Rs. Mn.)					
	Pre Listing			Post Listing		
	Mean	Std. Dev.	Normality@	Mean	Std. Dev.	Normality@
ARVINDMILL	76.1	81.2	0.697(<0.01)	146.6	128.6	0.775(<0.01)
GAIL	179.8	159.0	0.872(<0.01)	876.8	773.2	0.828(<0.01)
IOC	184.6	196.5	0.832(<0.01)	395.9	266.9	0.851(<0.01)
SYNDIBANK	60.9	59.3	0.730(<0.01)	42.4	36.1	0.724(<0.01)

@Shapiro-Wilk test-statistic for Normality

Table No. 6: Descriptive Statistics for stocks listed on 20th April 2005

Stock Symbol	Total Traded Value (Rs. Mn.)					
	Pre Listing			Post Listing		
	Mean	Std. Dev.	Normality@	Mean	Std. Dev.	Normality@
ABB	33.1	41.6	0.512(<0.01)	50.5	43.7	0.810(<0.01)
ALBK	229.1	336.7	0.620(<0.01)	135.3	107.6	0.770(<0.01)
ASHOKLEY	78.8	52.5	0.884(<0.01)	117.7	101.8	0.708(<0.01)
BHARATFORG	45.3	47.8	0.673(<0.01)	127.4	104.3	0.852(<0.01)
BHARTI	580.8	497.4	0.785(<0.01)	345.7	250.3	0.854(<0.01)
CENTURYTEX	132.6	150.7	0.584(<0.01)	369.3	308.7	0.765(<0.01)
CHENNPETRO	91.9	153.3	0.471(<0.01)	50.2	54.9	0.667(<0.01)
COCHINREFN	45.8	42.3	0.709(<0.01)	28.9	22.9	0.738(<0.01)
COLGATE	19.0	15.4	0.785(<0.01)	54.0	45.5	0.720(<0.01)
DABUR	44.3	34.0	0.806(<0.01)	66.8	75.0	0.624(<0.01)
GESHIPPING	86.6	59.6	0.796(<0.01)	217.2	248.7	0.730(<0.01)
GLAXO	37.5	24.7	0.862(<0.01)	40.1	63.8	0.362(<0.01)
IDBI	216.9	197.7	0.732(<0.01)	394.2	335.7	0.853(<0.01)
INDHOTEL	22.7	20.1	0.733(<0.01)	64.9	50.3	0.882(<0.01)
IOB	99.0	102.6	0.655(<0.01)	90.1	75.3	0.760(<0.01)
JINDALSTEL	55.9	57.3	0.649(<0.01)	37.0	28.2	0.816(<0.01)
LICHSGFIN	42.6	45.3	0.723(<0.01)	46.9	41.3	0.807(<0.01)
MATRIXLABS	146.0	141.7	0.773(<0.01)	185.1	171.6	0.716(<0.01)
MRPL	78.1	85.6	0.627(<0.01)	69.5	85.1	0.636(<0.01)
NEYVELILIG	87.9	75.1	0.759(<0.01)	60.2	50.8	0.769(<0.01)
NICOLASPIR	61.8	43.5	0.807(<0.01)	49.2	40.2	0.749(<0.01)
PATNI	52.9	53.9	0.764(<0.01)	61.5	177.5	0.228(<0.01)
RELCAPITAL	137.0	183.5	0.636(<0.01)	2434.4	2595.6	0.811(<0.01)
SIEMENS	25.2	26.5	0.726(<0.01)	54.9	41.6	0.868(<0.01)
STER	20.1	20.0	0.697(<0.01)	31.1	31.1	0.783(<0.01)
SUNPHARMA	58.0	64.8	0.478(<0.01)	52.2	41.3	0.733(<0.01)
TATACHEM	78.7	68.7	0.771(<0.01)	135.7	141.0	0.666(<0.01)
UTIBANK	64.8	56.5	0.827(<0.01)	95.3	83.3	0.699(<0.01)
VIJAYABANK	131.0	109.9	0.775(<0.01)	69.7	48.8	0.794(<0.01)
VSNL	59.0	44.5	0.821(<0.01)	865.4	1078.3	0.776(<0.01)
WOCKPHARMA	30.8	43.2	0.453(<0.01)	75.6	96.4	0.736(<0.01)

@Shapiro-Wilk test-statistic for Normality

Table No. 7: Liquidity Results for stocks listed on 9th Nov 2001

Stock Symbol	Total Traded Value (Rs. Mn.)			
	Mean Score Pre-listing	Mean Score Post-listing	Change	p-value
ACC	127.5	124.5	3.0	>0.10
BAJAJAUTO	118.5	133.8	-15.4	<0.10
BHEL	97.7	155.5	-57.8	<0.01
BPCL	87.9	165.6	-77.7	<0.01
BSES	117.5	134.8	-17.3	<0.10
CIPLA	150.4	100.6	49.8	<0.01
DIGITALEQP	117.7	134.7	-17.0	<0.10
DRREDDY	139.9	111.6	28.3	<0.01
GRASIM	124.1	128.0	-3.8	>0.10
GUJAMBCEM	104.3	148.5	-44.2	<0.01
HDFC	138.4	113.1	25.2	<0.01
HINDALC0	142.2	109.1	33.1	<0.01
HINDLEVER	132.8	119.0	13.8	>0.10
HINDPETRO	85.4	168.3	-82.9	<0.01
ICICI	92.4	160.9	-68.5	<0.01
INFOSYSTCH	112.8	139.7	-26.9	<0.01
ITC	139.9	111.5	28.4	<0.01
L&T	141.1	110.3	30.8	<0.01
M&M	92.4	161.0	-68.6	<0.01
MTNL	108.3	144.4	-36.1	<0.01
RANBAXY	132.6	119.2	13.4	>0.10
RELIANCE	142.0	109.4	32.6	<0.01
RELPETRO	94.8	158.5	-63.7	<0.01
SATYAMCOMP	75.9	178.1	-102.2	<0.01
SBIN	109.3	143.4	-34.1	<0.01
STROPTICAL	142.3	109.1	33.2	<0.01
TATAPOWER	118.9	133.4	-14.5	>0.10
TATATEA	125.0	127.0	-2.0	>0.10
TELCO	76.7	177.3	-100.7	<0.01
TISCO	134.1	117.5	16.6	<0.10
VSNL	121.9	130.2	-8.3	>0.10

Table No. 8: Liquidity Results for stocks listed on 31st Jan 2003

Stock Symbol	Total Traded Value (Rs. Mn.)			
	Mean Score Pre-listing	Mean Score Post-listing	Change	p-value
BEL	128.0	123.0	5.0	>0.10
HCLTECH	157.7	93.3	64.4	<0.01
HEROHONDA	96.2	154.8	-58.6	<0.01
ICICIBANK	92.7	158.3	-65.5	<0.01
IPCL	107.9	143.1	-35.3	<0.01
MASTEK	151.3	99.7	51.7	<0.01
NATIONALUM	133.2	117.8	15.5	<0.10
NIIT	159.7	91.3	68.5	<0.01
ONGC	115.1	135.9	-20.8	<0.05
POLARIS	177.1	73.9	103.1	<0.01
SCI	109.3	141.7	-32.4	<0.01
WIPRO	162.2	88.8	73.4	<0.01

Table No. 9: Liquidity Results for stocks listed on 29th Aug 2003

Stock Symbol	Total Traded Value (Rs. Mn.)			
	Mean Score Pre-listing	Mean Score Post-listing	Change	p-value
ANDHRABANK	126.104	104.420	21.684	<0.01
BANKBARODA	112.286	121.429	-9.143	>0.10
BANKINDIA	98.224	137.850	-39.626	<0.01
CANBK	120.240	112.130	8.110	>0.10
HDFCBANK	78.704	160.654	-81.950	<0.01
ORIENTBANK	100.312	135.411	-35.099	<0.01
PNB	107.064	127.523	-20.459	<0.05
UNIONBANK	137.504	91.962	45.542	>0.10

Table No. 10: Liquidity Results for stocks listed on 26th Sept 2003

Stock Symbol	Total Traded Value (Rs. Mn.)			
	Mean Score Pre-listing	Mean Score Post-listing	Change	p-value
ARVINDMILL	92.640	76.039	16.601	<0.01
GAIL	76.039	167.566	-91.527	<0.01
IOC	88.210	152.867	-64.657	<0.01
SYNDIBANK	127.218	105.764	21.454	<0.05

Table No. 11: Liquidity Results for stocks listed on 20th April 2005

Stock Symbol	Total Traded Value (Rs. Mn.)			
	Mean Score Pre-listing	Mean Score Post-listing	Change	p-value
ABB	105.227	146.782	-41.555	<0.01
ALBK	124.747	128.170	-3.423	>0.10
ASHOKLEY	108.365	143.790	-35.425	<0.01
BHARATFORG	86.195	164.930	-78.735	<0.01
BHARTI	148.162	105.844	42.318	<0.01
CENTURYTEX	80.008	170.829	-90.821	<0.01
CHENNPETRO	141.479	112.217	29.262	<0.01
COCHINREFN	146.439	107.488	38.951	<0.01
COLGATE	79.642	171.178	-91.536	<0.01
DABUR	113.195	139.186	-25.991	<0.01
GESHIPPING	103.317	148.604	-45.287	<0.01
GLAXO	134.731	118.651	16.080	<0.10
IDBI	103.829	148.116	-44.287	<0.01
INDHOTEL	85.650	165.449	-79.799	<0.01
IOB	127.422	125.620	1.802	>0.10
JINDALSTEL	142.121	111.604	30.517	<0.01
LICHSGFIN	119.065	133.589	-14.524	>0.10
MATRIXLABS	114.008	138.410	-24.402	<0.01
MRPL	138.447	115.108	23.339	<0.01
NEYVELILIG	144.739	109.108	35.631	<0.01
NICOLASPIR	141.699	112.007	29.692	<0.01
PATNI	132.910	120.387	12.523	>0.10
RELCAPITAL	71.292	179.139	-107.847	<0.01
SIEMENS	90.691	160.643	-69.952	<0.01
STER	113.073	139.302	-26.229	<0.01
SUNPHARMA	130.650	122.542	8.108	>0.10
TATACHEM	104.130	147.829	-43.699	<0.01
UTIBANK	105.894	146.147	-40.253	<0.01
VIJAYABANK	154.455	99.844	54.611	<0.01
VSNL	86.609	164.534	-77.925	<0.01
WOCKPHARMA	111.804	140.511	-28.707	<0.01

Appendix C:

a) Impact Cost: NSE defines "Impact cost represents the cost of executing a transaction in a given stock, for a specific predefined order size, at any given point of time." And it is a practical and realistic measure of market liquidity; it is closer to the true cost of execution faced by a trader. In mathematical terms it is the percentage mark up observed while buying / selling the desired quantity of a stock with reference to its ideal price (best buy + best sell) / 2. However it is emphasised that: (a) impact cost is separately computed for buy and sell (b) impact cost may vary for different transaction sizes (c) impact cost is dynamic and depends on the outstanding orders (d) where a stock is not sufficiently liquid, a penal impact cost is applied.

Table 12: Impact Cost for the Stock Futures

Stock Symbol	NSE IMPACT COST for a portfolio size of Rs. 50 Lakh	
	Pre-listing	Post-listing
ABB	0.19	0.13
ACC	0.08	0.10*
ANDHRABANK	0.15	0.13
ASHOKLEY	0.23	0.15
BAJAJAUTO	0.21	0.60*
BANKBARODA	0.16	0.11
BANKINDIA	0.18	0.13
BHARATFORG	0.21	0.18
BHARTI	0.16	0.11
BHEL	0.13	0.15*
BSES	0.20	0.24*
CHENNPETRO	0.18	0.14
CIPLA	0.12	0.14*
COCHINREFN	0.18	0.13
COLGATE	0.18	0.13
DABUR	0.19	0.13
DIGITALEQP	0.07	0.18*
DRREDDY	0.10	0.09
GESHIPPING	0.17	0.12
GLAXO	0.18	0.14

GRASIM	0.11	0.13*
GUJAMBCEM	0.17	0.18*
HCLTECH	0.15	0.13
HDFC	0.15	0.14
HDFCBANK	0.15	0.12
HEROHONDA	0.19	0.10
HINDALCO	0.14	0.22*
HINDLEVER	0.16	0.14
HINDPETRO	0.18	0.22*
ICICI	0.33	0.25
ICICIBANK	0.46	0.11
IDBI	0.21	0.12
INFOSYSTCH	0.07	0.11*
IOB	0.28	0.13
IPCL	0.06	0.12*
ITC	0.08	0.12*
L&T	0.09	0.10*
LICHSGFIN	0.17	0.15
M&M	0.18	0.18
MTNL	0.14	0.20*
NICOLASPIR	0.20	0.15
NIIT	0.01	0.11*
ORIENTBANK	0.13	0.10
PATNI	0.21	0.17
PNB	0.13	0.10
RANBAXY	0.08	0.10*
RELIANCE	0.08	0.11*
RELPETRO	0.17	0.16
SATYAMCOMP	0.10	0.11*
SBIN	0.14	0.16*
SCI	0.07	0.14*
SIEMENS	0.23	0.15
SUNPHARMA	0.16	0.13
TATACHEM	0.13	0.10
TATAPOWER	0.19	0.19
TATATEA	0.11	0.15
TELCO	0.17	0.14
TISCO	0.09	0.15*
UTI	0.16	0.14
VIJAYABANK	0.18	0.13
VSNL	0.17	0.11
WIPRO	0.97	0.13

* Implies increase in impact cost post-listing.
Source: NSE.

b) Contract Specification for Single Stock Futures in NSE.

Underlying Asset	Individual Security (Individual Equity Stock).
Contract Size	Multiples of 100; at time of initiation, the value of the contract should not be less than INR 2 lakh.
Price steps	Re. 0.05
Price bands	Not applicable.
Trading cycle	The futures contracts will have a maximum of three month trading cycle--the near month (one), the next month (two) and the far month (three). New contract will be introduced on the next trading day following the expiry of near month contract.
Expiry day	The last Thursday of the expiry month or the previous trading day if the last Thursday is a trading holiday.
Settlement basis	Mark to market and final settlement will be cash settled on T+1 basis.
Settlement Price	Daily settlement price will be the closing price of the futures contracts for the trading day and the final settlement price shall be the closing price of the underlying security on the last trading day.

Source: NSE.

c) SSFs Selection Criterion in NSE:

1. The stock will be chosen from amongst the top 500 stocks in terms of average daily market capitalisation and average daily traded value in the previous six months on a rolling basis.

2. The stock's median quarter-sigma order size over the last six months will be not less than Rs. 0.10 million (Rs. 1 lakh). For this purpose, a stock's quarter-sigma order size shall mean the order size (in value terms) required to cause a change in the stock price equal to one-quarter of a standard deviation.

3. The market wide position limit in the stock shall not be less than Rs. 500 million (Rs. 50 crore). The market wide position limit (number of shares) shall be valued taking the closing prices of stocks in the underlying cash market on the date of expiry of contract in the month. The market wide position limit of open position (in terms of the number of underlying stock) on futures and option contracts on a particular underlying stock shall be lower of :

    - 30 times the average number of shares traded daily, during the previous calendar month, in the relevant underlying security in the underlying segment, (or)

    - 20% of the number of shares held by non-promoters in the relevant underlying security i.e. free-float holding.

4. If an existing security fails to meet the eligibility criteria for three months consecutively, then no fresh month contract shall be issued on that security.

Quarter Sigma Order Size: Quarter sigma size can be defined as the order size (value) required causing a change in the stock price equal to one-quarter of a standard deviation (calculated on the basis of Exponential Weighted Moving Average Method as recommended by J. R. Varma Committee for computation of value-at-risk for margin calculations). The Quarter Sigma order size is calculated by taking four order book snapshots in a day for a security for the last six months. Below are the detailed notes of the same.

1. The applicable VAR (Value at Risk) is calculated for each security based on the J. R. Varma Committee guidelines. (The formula suggested by J. R. Varma for computation of VAR for margin calculation is statistically known as 'Exponentially weighted moving average (EWMA)' method. In comparison to the traditional method, EWMA has the advantage of giving more weight to the recent price movements and less weight to the historical price movements.)

2. Such computed VAR is a value (like 0.03), which is also called standard deviation or Sigma. (The meaning of this figure is that the security has the probability to move 3% to the lower side or 3% to the upper side on the next trading day from the current closing price of the security).

3. Such arrived at standard deviation (one sigma), is multiplied by 0.25 to arrive at the quarter sigma. For example, if one sigma is 0.09, then quarter sigma is (0.09 * 0.25) = 0.0225.

4. From the order snapshots (taken four times a day from NSE's Capital Market Segment order book) the average of best buy price and best sell price is computed which is called the average price.

5. The quarter sigma is then multiplied with the average price to arrive at quarter sigma price. The following example explains the same :

Security	XYZ
Best Buy (in Rs.)	306.45
Best Sell (in Rs.)	306.90
Average Price	306.70
One Sigma	0.009
Quarter sigma	0.00225
Quarter sigma price (Rs.) (Average Price *Quarter sigma)	0.70

6. Based on the order snapshot, the value of the order (order size in Rs.), which will move the price of the security by quarter sigma price in buy and sell side is computed. The value of such order size is called Quarter Sigma order size. (Based on the above example, it will be required to compute the value of the order (Rs.) to move the stock price to Rs. 306.00 in the buy side and Rs. 307.40

on the sell side. That is Buy side = average price – quarter sigma price and Sell side = average price + quarter sigma price). Such an exercise is carried out for four order snapshots per day for all stocks for the previous six months period.

7. From the above determined quarter sigma order size (Rs.) for each order book snap shot for each security, the median of the order sizes (Rs.) for buy side and sell side separately, are computed for all the order snapshots taken together for the last six months.

8. The average of the median order sizes for buy and sell side are taken as the median quarter sigma order size for the security.

9. The securities whose median quarter sigma order size is equal to or greater than Rs. 0.1 million (Rs. 1 Lac) qualify for inclusion in the F&O segment.

Futures & Options contracts may be introduced on new securities which meet the above mentioned eligibility criteria, subject to approval by SEBI.

<u>Selection criteria for unlisted companies:</u>

For unlisted companies coming out with initial public offering, if the net public offer is Rs. 500 crs. or more, then the Exchange may consider introducing stock options and stock futures on such stocks at the time of its' listing in the cash market.

A Transition in Indian Derivative Markets – A Case Study of Single Stock Futures

Chapter IV

Volatility Aspects Of Single Stock Futures

i. INTRODUCTION:

Volatility is an important (constituted) measure of risk. In fact it is an indispensable part of life in the stock/investment markets as investors like to know in advance the amount of volatility, or risk, they are exposed to. Herein, one will be on wrong impression if thought it is investors' interest alone, emphatically, knowledge of it helps investors to make wise investment decision appropriately, besides it is also of equivalent interest to policy makers (includes regulators), market participants and academicians since it impacts are wide spread over socio-economic conditions of an economy--above of all on the financial organism. So, for smooth operation of financial system seasonable acquaintance of volatility is of large interest in the modern financial economy. In addition, due to introduction of several new financial products that bear relation with underlying markets in the financial system, examination of volatility has been the most frequent argument in empirical finance. Recall from chapter two that an overwhelming attention had been paid in addressing the volatility concerns of equity based derivatives particularly their commencement and carry-over on the several stock markets. Therefore the current study in order to continuity its scrutiny of what nature of influence newly commenced SSFs exhibit on Indian economy investigates their volatility aspects in this chapter.

Empirical finance literature has diversified views as mentioned earlier regarding the impacts of equity based derivatives entry across the stock markets. However, pros and cons views against these instruments are conceived with respect to market efficiency. In general, the term *efficiency* is used to describe the absorption of new information immediately and completely in the market i.e. if new information is reflected instantaneously then stocks are not systematically over or under valued--a characteristic of efficient markets. Pro-opinion is, these derivatives which are useful for hedging, bring in an extra itinerary in the market where information can be absorbed quickly and such a transition will be in course of market efficiency. Rapid assimilation of news in to prices, however, gives rise to an increase in volatility that put pro-opinions arguments conditional. That is, practically, the additional volatility should not be results of cheap alternate channel were speculators broke in causing price instability as viewed by contradictories. Thus, volatility behaviour reflected in terms of how news getting enwrapped in the market added less persistence of such news in the derivatives introduced markets was always of interest in the empirical finance.

In spite of several attempts made to address the above issue after derivatives unveiling across different stock markets, dissonance remains when it comes to the identification or outcomes of the additional sources of volatility. Herein one should remember that these derivatives by nature contain inherent risks due to their institutional and operational attributes which tend to be more volatile compared to underlying markets. Ignoring the established facts of these instruments against given backdrop of institutional arrangements[1] of the different markets putting forward an argument of a destabilizing factor due to an increase in volatility should be an ex-ante. Further, due to association of these derivatives with underlying market provides facilitation for volatility inter-transfers that calls for apropos investigation. Once again recall from chapter two that several studies have examined the volatility of the underlying stocks/indices before and after the introduction of equity based derivatives (though majority of them belong to index options & futures along with stock options) by employing different methodologies viz. comparison of variances, linear regression

[1] Market micro structure including trading methods adopted.

and complex Generalized Autoregressive Conditional Heteroscedasticity (GARCH) models with different rudimentary assumptions and parameters. The current study is an unique attempt in this direction since it address the market efficiency issue as mentioned earlier in a different environment i.e. emerging market context where unusual development in SSFS are originated against several other markets which retain their success in commodity, currency, index, and bond futures. Since, to date trading of SSFs in developed markets are negligible due to volumes, thus current study is of equal importance to the regulators, traders and theoreticians irrespective of markets.

Coming to the measurement of volatility, finance literature has accepted approach to use *stock returns* as proxy for volatility since it is not directly observed. Yet, the well accepted proxy measure suffers from the problem of not being constant over time i.e. time-varying. Current research which examines the volatility of SSFS employs sophisticated techniques to address this time-varying factor from a new information absorption perspective. Precisely, it investigates the issue of assimilation and persistence of new information after these SSFs inception. Further, it inspects the stocks with regard to their sector classification, to expose their respective sensitivity to different business practices. Together, study is an early attempt in the emerging markets like India that looks into SSFs introduction with diversified market efficiency elements viz. liquidity (addressed in chapter three) and informational aspects addressed through present chapter.

The rest of the chapter is organized as follows; next section outlines the data employed for volatility aspects, descriptive statistics followed by econometric methodology applied in the above mentioned background. Subsequently discussion on the empirical results obtained, conclusions in conjunction with some remarks on practical implications of the findings are presented.

ii. DATA EMPLOYED:

To examine the underlying volatility aspects of SSFs, study obtains daily closing price of each underlying stock for the same sample list of stocks that are used in chapter three and from same cited source. And then computed daily stock returns, as the difference in logs between closing prices i.e. $r_t = \log(p_t) - \log(p_{t-1})$ as a measure of proxy for volatility. Empirical finance literature commonly employs log-returns since these have the good property i.e. can be interpreted as continuously compounded returns--so that the frequency of compounding of the return does not matter and thus returns across assets can more easily be compared and above all these are unit free (Brooks 2002). Thus, daily log returns in percentages for each stock has been obtained for six months before and after SSFs inception except for first listing stocks that took place on 9th November 2001. For first listing stocks daily log returns in percentages have been calculated from six months before the 'stock options' listing date i.e. 2nd July 2001 to separate the effects of 'stock options' as pointed out from the observations of empirical results obtained from the earlier chapter viz. liquidity effects of SSFs, adding together ten months before and six months after the SSFs listing date. Tables 12.1 – 12.5 provides some descriptive statistics of log returns for each stock in accordance with listing dates. Mean, variance, skewness, excess kurtosis, normality and unit root tests statistics are reported for each stock employed. From the same when one look at the measures of skewness and kurtosis, it is clearly revealed that all return series are skewed and highly leptokurtic; this is strengthened by the highly significant Shapiro-

Wilk normality test statistic. Also for further empirical examination, it is imperative to ensure that the return series are stationary. Hence, all log returns are subjected to Augmented Dickey-Fuller (ADF) and Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) unit root tests with the null hypothesis of unit root is strongly rejected for the all series employed. In addition, in order to consider for market wide movements, daily S&P CNX Nifty Index (Nifty hereafter) closing prices were obtained for the same period and computed continuously compounded returns. Furthermore, all the return series plots for the corresponding examination period are presented in results where evidence in favour of time-varying volatility is detected in most of the cases. These summary statistics propel for need of employing GARCH type models that easily conciliate the observed time-varying phenomenon and persistent patterns in returns series.

iii. METHODOLOGY:

Current study aims at measuring the introduction effects of SSFs i.e. an examination of the volatility behaviour of the underlying stock before and after an *event*--here listing of SSFs on that stock. Also current study aims at the straightaway implication of the market efficiency hypothesis i.e. quick absorption of all new information arrival in the market. This study thus applies event study methodology framework to investigate the same. Event study is designed in the following way. The event date is the first trading day of the SSFs inception in the market. At this juncture, one need to take care of that no other major events (viz. splits, mergers or others that have direct effect) are close to the current event date. Otherwise confounding effect will spoil the estimates. Hence, for first listing stocks, since underlying stocks experienced ‘stock options’ listing just four months in advance of SSFs inception, in order to take in to account the dissipate effects of both, a reasonable length period was selected as explained in the earlier section *Data Employed*. For other listings respectively a reasonable length period of one year on either sides of the event date was selected for examination of volatility aspects of SSFs. Next, one has to consider for the market-wide movements that affect the underlying stocks. Hence, the current study employs the Nifty daily log returns as a control factor for market-wide movements.

Therefore, to examine underlying stocks volatility, study adopts GARCH framework for twin gains, firstly, these models explicitly address the time-varying nature of volatility, secondly, these models also facilitate an itinerary for examining whether underlying volatility has changed and how that may have changed after the SSFs introduction. Getting into econometrics terms, the preliminary estimation model is as follows:

$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t \tag{1}$$

where, R_t is the daily log returns of the listed stock, Mkt_t is the daily log returns of the Nifty. Next step towards the GARCH modeling is to take away any predictability colligated with lagged returns by fitting adequate number of auto-regressive (AR) and moving-average (MA) terms for equation (1) that can be re-written as follows:

$$\begin{aligned} R_t &= \phi_0 + \sum_{j=1}^{m} \phi_j R_{t-j} + \theta_1 Mkt_t + \varepsilon_t \\ \varepsilon_t / \sum_{k=1}^{n} \psi_k \varepsilon_{t-k} &\sim N(0,1) \end{aligned} \tag{2}$$

In the way indicated earlier, estimations done using above equation will be inappropriate when there is presence of Auto-regressive Conditional Heteroscedasticity (ARCH). Also, we have noted from the descriptive statistical measures like kurtosis and return series plots, leptokurtic tendencies, suggests the occurrence of volatility clustering phenomena in the data. So, for the identification of ARCH disturbances in estimated residuals, this study employs Lagrange Multiplier (LM) test proposed by Engle (1982) which has null hypothesis as 'there is no ARCH'. Also, study employs another test namely portmanteau Q-test[2] with the same null hypothesis for robustness.

Thus, if residuals obtained from above estimated equation exhibit presence of ARCH, then to model the time-varying variance and to verify proposed examination between volatility and information, the conditional variance for the above equation which represents conditional mean equation for each return series in the GARCH framework modeling is expressed using Bollerslev (1986) widely conversant with in the literature as standard GARCH (p, q) model:

$$\begin{aligned} &\varepsilon_t / \Omega_{t-1} \sim N(0, h_t) \\ &h_t = \alpha_0 + \sum_{j=1}^{p} \beta_j h_{t-j} + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 \end{aligned} \tag{3}$$

Equation (3) contains same error term as defined in equations (2) which has mean zero and time-varying variance of h_t defined as the conditional variance of the return series based on the information set Ω_t till time t. α_i's are coefficients related to the lagged squared error term that measures the impact of recent news on volatility and β_j's are the coefficients associated with the past variance term and measures the impact of less

[2] Portmanteau Q-test is used for testing serial-correlation of the squared residual series and functional for examining GARCH effects.

recent news on the volatility. There exist two sufficient conditions for the equation (3). Firstly, from non-negativity property of variances, the constant (α_0), coefficients (α_i's and β_j's) should be positive all i, j respectively. Secondly, conditional variance should not explode; thus, to provide non-explosiveness, the sum of the coefficients (α_i's and β_j's) excluding the constant (α_0) should be less than 1 as defined below:

$$\sum_{j=1}^{p} \beta_j h_{t-j} + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 < 1 \qquad (4)$$

The above conditional mean and variance parameters are estimated using the maximum likelihood method (ML). But it was pointed out that ML estimated standardized residuals tend to not follow normal distribution assumption, thus, with the objective of improving robustness of the model we use Bollerslev and Wooldrige (1992) suggested adjustment in the covariance matrix that validates the inference statistic by employing quasi-maximum likelihood method (QML). Succeeding, in order to verify the objective of current research, GARCH (1, 1) or ARCH (q)[3] models are employed with following specifications. Firstly, to observe the differentiations for the periods before and after the SSFs introduction, an exogenous (additive) dummy variable is used to represent the time of SSFs inception in the conditional variance. Further, as we need to dissipate effects of 'stock options' for first listing stocks, it takes the following form:

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \gamma_{d1} FD_t + \gamma_{d2} OD_t \qquad (5)$$

[3] The current study would also verify by employing different GARCH orders, but not did for two reasons. First, as observed from the literature examined GARCH (1, 1), turns out to be most sufficient and commonly employed GARCH order for the conditional variances in general followed by ARCH (q) models. Second, study executes a set of robustness statistics on GARCH (1, 1) that provides enough evidence in support of the employed GARCH or ARCH order.

where, FD_t takes on value of one after SSFs introduction, zero otherwise. Similarly, OD_t takes on value of one after 'stock options' introduction, zero otherwise. Equation (5) is used for estimating only the *first* listing stocks in order to separate the 'stock options' effect. That is if from the estimated results of the equation (5), FD_t comes out to be significant then one can demonstrate that altered underlying volatility is due to the SSFs inception disregarding 'stock options' introduction. Once, found evidence of underlying volatility is due to SSFs from equation (5) or presence of ARCH after estimating equation (2) for following listings, then next step is to model for implication of market hypothesis. Thus, secondly, besides an additive dummy variable in the variance equation, two multiplicative dummy variables were incorporated; first multiplicative dummy is employed with the lag of squared residual term, the second one is used with the lagged conditional variance.

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \alpha_{0,d} D_t + \alpha_{1,d} D_t * \varepsilon_{t-1}^2 + \beta_{1,d} D_t * h_{t-1} \qquad (6)$$

where, D_t takes on value of one after SSFs introduction, zero otherwise. The above variance equation allows us to observe simultaneously the behaviour of persistence and impulse volatility of SSFs, respectively, before and after their introduction. The multiplicative dummies employed enable us to find the amount and significance of a potential change through the parameters viz. $\alpha_{1,d}$, $\beta_{1,d}$ of our variance equation due to SSFs inception. That is, following the onset of SSFs, a positive (negative) significant value of $\alpha_{1,d}$ would suggest that news absorption is more (less) rapid, at the same time a negative (positive) significant value of $\beta_{1,d}$ implies that "less recent news" have less (larger) impact on today's volatility. Further, if $\alpha_{0,d}$ is positive (negative) then altered volatility exhibits an increase (decrease) after SSFs inception. Similarly, some times all return series may not follow order of GARCH (1, 1) hence ARCH (q) order of the above time-varying variance takes the following form:

$$h_t = \alpha_0 + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 + \alpha_{0,d} D_t + \sum_{i=1}^{q} \alpha_{i,d} D_t * \varepsilon_{t-i}^2 \tag{7}$$

Herein there is a need to memorize one of the primary restrictions of GARCH models that is they enforce a symmetric response of volatility to positive and negative shocks. This arises since the conditional variance is a function of the magnitudes of the lagged residuals and not their signs, in other words, by squaring the lagged error, the sign is lost. Since, such asymmetries are typically attributed to leverage effects, one need to verify of such existence in the employed GARCH framework. For this the current research employs sign bias, negative size, positive size and joint bias tests given by Engle and Ng (1993) as asymmetric test statistics.

Next, about the estimation of models which do not have the presence of ARCH? As noted from descriptive statistical measures, some return series do not exhibit much excess kurtosis, for those we have done estimations using following model:

$$\begin{aligned} R_t &= \phi_0 + \sum_{j=1}^{m} \phi_j R_{t-j} + \theta_1 Mkt_t + \gamma D_t + \varepsilon_t \\ \varepsilon_t / \sum_{k=1}^{n} \psi_k \varepsilon_{t-k} &\sim N(0,1) \end{aligned} \tag{8}$$

where, D_t takes on value of one after SSFs introduction, zero otherwise. However, for specific reasons mentioned earlier, first listing stocks that do not have ARCH effect are estimated using following model:

$$\begin{aligned} R_t &= \phi_0 + \sum_{j=1}^{m} \phi_j R_{t-j} + \theta_1 Mkt_t + \gamma_{d1} FD_t + \gamma_{d2} OD_t + \varepsilon_t \\ \varepsilon_t / \sum_{k=1}^{n} \psi_k \varepsilon_{t-k} &\sim N(0,1) \end{aligned} \tag{9}$$

Adjacent to this section, the discussion of empirical results for different listings--with focus on ‘stock options’ effects, observations and direction for further research follows.

iv. DISCUSSION OF RESULTS:

Similar to chapter three, discussion on empirical results of volatility aspects of SSFs are done in accordance to various listings. Adopting the framework outlined, as a first step towards GARCH modeling, the conditional mean equation for each stock log-returns series is estimated with appropriate lag structure. Study uses the Godfrey’s general Lagrange multiplier test against ARMA errors that tests joint significance of residual serial-correlation along with the residual Auto-Correlation Function (ACF) and Partial Auto-Correlation Function (PACF) plots[4] to confirm that specified AR or MA terms are adequate. Results of estimated conditional mean equation are presented in the reported tables for each stock with suffix *a* where coefficients of constant, fitted AR or MA terms, nifty, measure of overall significance of the estimated regression (F-stat) and Godfrey test statistic of residuals up to lag k are provided respectively. Thus, after affirmation of predictability associated with lagged returns captured appropriately, diagnostics for the presence of ARCH viz. Q and LM are exercised and reported subsequently in the same table. If there is an evidence of ARCH effect, succeeding estimations are done employing one of the GARCH specifications as mentioned in the earlier section. Tables with suffix *b* comprise the estimated GARCH results.

To be elaborate, let us examine empirical results of stocks by the piece. First of all, Associated Cement Company Ltd. (ACC) alphabetically first in the listed SSFs;

[4] ACF and PACF plots are not reported for brevity.

table 13a provides the conditional mean equation regression results where ACC log-returns follow AR (1), nifty (market-wide movements control factor) exhibit significance, Godfrey test statistic value for residual serial correlation up to lag 4 is low and its insignificance confirms that lag fitted is appropriate and F-stat provides overall significance of the estimated regression. At the same time portmanteau Q-test statistic for squared-residuals serial-correlation up to lag 4 and LM test statistic up to lag 4[5] exhibit a strong presence of ARCH in the estimated results. So, the above evidence suggests that examination of volatility needs GARCH framework modeling. Table 13b presents the estimated GARCH framework results for the stock ACC. One can observe proprieties viz. positive signs of main GARCH parameters and also the stableness of estimated GARCH model as the sum of '$\alpha_1+\beta_1$' is less than one confirmed by the Likelihood Ratio test statistic[6]. In addition, two compulsory checks one needs to examine are executed and reported subsequently in the same table; firstly, non-existence of any serial correlation in the residuals after GARCH estimation evident through Godfrey test statistic and secondly, whether specified GARCH framework captures the time-varying volatility appropriately i.e. there must not remain any ARCH effect in the residuals series evident through Q and LM test statistics. All these diagnostics reported suggest that the estimated model AR (1)-GARCH (1, 1) for ACC is befitting. The model diagnostic graph, namely the standardized residual plot, is displayed in figures followed immediately of results.

Now coming to the coefficients of interest, dummy variables 'γ_{d1}' and 'γ_{d2}' for SSFs and 'stock options' inception are highly insignificant, hence, we can reject the hypothesis that neither of them trading has an impact on underlying spot market in case

[5] From the probabilities of Akaike Information Criterion (AIC) true lag length of 4 was chosen for consistency across all listings.
[6] Likelihood Ratio test performs test of non-linear hypothesis on the model parameters.

of ACC. Next, to examine for existences of asymmetries in the estimated GARCH model current study executes the sign bias, negative size, positive size and joint bias tests given by Engle and Ng (1993) as asymmetric test statistics and their results are reported subsequently in the same table which suggests the absence of such coexistence. Similarly, results for remaining listed stocks are presented event-wise respectively. Summarizing the first listing stocks only six stocks namely DRREDDY, HDFC, HINDPETRO, ITC, L&T and TATAPOWER exhibit the significant impact on underlying spot markets after the SSFs inception. Hence, to examine the same for implications of market efficiency these stocks have been re-estimated using equation (6) or (7) and results are presented in tables with suffix c. Let's examine the coefficients of interest '$\alpha_{1,d}$ and $\beta_{1,d}$', there is a substantial decrease in news incorporation coefficient '$\alpha_{1,d}$' which is negative and significant for stocks DRREDDY, ITC and TATAPOWER. On the other hand HDFC exhibits an increase in the same coefficient i.e. positive, significant and demonstrate the ability to quickly incorporate new information. Coming to L&T it neither exhibits positive sign for news incorporation coefficient nor it is significant and HINDPETRO though exhibits significance for SSFs introduction absence of ARCH cannot showcase the implying informational related aspects (stocks with absence of ARCH have only one table with no suffices). Pertaining to persistence coefficient '$\beta_{1,d}$' evidence from L&T and TATAPOWER where both possess expected sign i.e. negative but there statistically insignificance cannot imply that the volatility shocks are less persistent after SSFs inception. In contrast only three stocks viz. BAJAJAUTO, BPCL and RANBAXY exhibit 'stock options' commencement impact on underlying and all the remaining stocks associated with the first event exhibit implication for hypothesis that either of the listing impact on trading of underlying spot market are rejected.

Herein, before moving to analyze other listed stocks for volatility aspects, one need to memorize few observed facts at this juncture; firstly, one can clearly observe that there is very minimal evidence of 'stock options' listing impact on underlying stocks from the assessment of first listed stocks, this empirical evidence add strengths to the observed fact that there was no much trading activity in the underlying stocks after options inception as mentioned several times in the earlier. Secondly, this establishes an itinerary that examination of introduction of 'stock options' impact on underlying stocks either for first listed or succeeding lists may not provide sound results where low volumes sustained. Finally, even there was not enough evidence to support absolute SSFs introduction impact, reminds one not to forget the structural changes that underwent before and after SSFs inception which have been neutralized to the adequate magnitude in the current study through appropriate market wide instruments and empirical examination period. With the above manifestation the current study moves forward for examining volatility aspects of other listings that have simultaneously both stock futures and options with their inception, however SSFs volumes are far way from not even comparable with options standing at number one position in notional trading world-wide and twice the trading volume of the cash market is of interest towards implications of market efficiency.

Second listing was almost after a more than year gap that took place on 31st Jan 2003 has 12 stocks. Interestingly, six stocks out of twelve exhibit significant change in underlying volatility after SSFs inception. For elucidation purpose let's analyze the stocks that have ARCH presence and undergone estimation through GARCH framework modeling first. Only five stocks out of twelve exhibits the presence of ARCH, however, NATIONALUM and ONGC do not showcase the SSF introduction impact. Coming to others and coefficients of interest '$\alpha_{1,d}$ and $\beta_{1,d}$', all the three stocks HEROHONDA, ICICIBANK and NIIT exhibit a decrease in the persistence coefficient $\beta_{1,d}$ which is negative, meaning that the volatility shocks become less persistent, where as news incorporation coefficient $\alpha_{1,d}$ is negative for all the three though only significant for ICICIBANK entailing no direction towards the ability to rapidly incorporate new information after SSFs debut. An eliciting notice in these results is that HEROHONDA exhibited the need for Integrated GARCH which has been re-estimated for the representation of the same. On the other hand seven stocks exhibit no ARCH effect and interestingly three of them viz. BEL, MASTEK and WIPRO provide evidence of change in the underlying volatility after SSFs launch. So, we cannot demonstrate aspects pertaining to volatility and information flow with these stocks. Thus, from the empirical evidence relating to second list stocks, we found that commencement of SSFs has altered underlying volatility virtually but not imparted a strong course towards market efficiency aspects; nonetheless this will be early conclusion without diagnosing other listings.

Moving ahead with assessment of stocks listed on 29th August and 26th September 2003 that has eight and four respective records where all the eight belong to banking industry and four represent distinct. Of examining third event results, it is evident that majority of them are undistinguished as manifestation towards SSFs influence is lacking in the single industry. Only two stocks are significant and conveying the consequence that is similar to observations from second listing. The persistence ccoefficient $\beta_{1,d}$ is negative and significant for both PNB and UNIONBANK, also news assimilation coefficient $\alpha_{1,d}$ is negative signifying no aptitude to quickly incorporate new information. UNIONBANK provided the evidence of asymmetries in the estimated volatility model; hence model has been re-estimated using GJR-GARCH framework (following Brooks 2002) and results of the same are presented subsequently. Coming to fourth event results we found evidence of equal number of both altered and unaltered effects from SSFs origin and results are not different from second and third listing stocks.

The 25th April 2005 listing was almost as huge as initial one that took place after a break; total 31 stocks have been employed in this list for studying volatility aspects. Again for elucidation purpose first let's examine GARCH framework estimated results. Total twelve stocks that exhibit ARCH effects provide mixed results with respect to implications of market hypotheses; coefficients of interest $\alpha_{1,d}$ for news assimilation is significant and positive only for two stocks namely CHENNPETRO, IDBI where as it is positive for STER but insignificant. Left nine stocks provide evidence of substantial decrease in news incorporation i.e. negative with only disagreement in their significance. Appertaining coefficient $\beta_{1,d}$ that provide evidence for decrease in the persistence exhibiting negative sign for more cases than positive, implying volatility shocks have become less persistent, however, again they differ in their significance. On the other hand leftover stocks that have no presence of ARCH effects provide no evidence of change in the underlying volatility after SSFs launch. So, we cannot demonstrate aspects pertaining to volatility and information flow with these stocks. Thus, from the empirical evidence relating to fifth and final in employed listings, we found that introduction of SSFs have minimal evidence to prove that there is a strong course towards market efficiency aspects.

Coming to how these volatility aspects are across different kind or type of companies/industries/sectors, here are the observations; all banking sector listed though exhibited more or less an increase in underlying liquidity as observed from earlier chapter failed altogether (omit IDBI) in providing evidence for increase in new information assimilation with only exception that some the stocks exhibited decrease in the persistence of shocks. Similarly all the petroleum (omit CHENNPETRO) and auto stocks. Interestingly all the pharmacy stocks neither provided any evidence of increase in underlying liquidity nor for implications of market efficiency, this can be for several reasons one of being established in the market is that they exhibit significance trading activity only during the financial results or other major announcements. Other sectors viz. IT and FMCG/CPG though exhibit results that are dissent among the industry across different listings altogether provide no evidence for any strong implications towards market efficiency.

Therefore, to conclude from the above empirical examination whether the SSFs introduction resulted for a time-varying structural change in the assimilation of news and persistence to volatility shocks, it is apparent that the volatility aspects studied by said proxy provides the considerable support towards the decrease in persistence of volatility shocks meaning investors impound more importance to recent news leading to a fall in the tenacity of information. This sign of less persistence is one of the characteristics that move market towards course of efficiency, however, observed decrease in the assimilation of news coefficient suggests that new information is not absorbed into prices more rapidly after post SSFs exhibit again lack of another important characteristics towards increase in market efficiency. Interestingly, a large evidence of less persistence in underlying spot volatilities strengthens that these SSFs brought about a significant change in the market which is an unexpected credit. In order to tone up the underlying structural changes observed due to SSFs intervention, the study employs a technique CUSUM (see appendix D) that detects elusive changes in order to complementary the results obtained. CUSUM plots for each log-returns employed in the study are displayed in the results that go hand in hand. In the plots one can notice that for first event stocks there are two vertical lines both for log-returns series and CUSUM, these represent ‘stock options’ and SSFs listing date respectively. Whereas for other listings only one vertical line exists that represents the SSFs listing date. Also one can notice that two stocks viz. ICICIBANK and VSNL have results twice; this is because ICICIBANK got de-listed after its merger with parent company ICICI in May 2002 and again made re-introduction in the second listing. Coming to VSNL it has been removed in June 2003 since stock failed to meet the SEBI eligibility criteria for trading as discussed earlier in the chapter three and again made eligibility to re-introduction in fifth listing. With this eventual discussion the current chapter concludes, however, summarization of the study including observations and remarks for the same has been documented in the succeeding chapter.

Table No. 12.1: Descriptive Statistics of Log-Returns for stocks listed on 9th Nov 2001

Stock Symbol	Mean	Variance	Skewness	Kurtosis*	Normality@	ADF#	PP+
ACC	0.004	10.80	-0.331	4.683	0.936 (<0.01)	-8.94 (<0.01)	-18.33 (<0.01)
BAJAJAUTO	0.226	5.907	0.548	1.696	0.965 (<0.01)	-7.52 (<0.01)	-16.24 (<0.01)
BHEL	0.029	11.90	0.039	2.210	0.964 (<0.01)	-8.35 (<0.01)	-19.09 (<0.01)
BPCL	0.273	12.92	0.209	1.796	0.973 (<0.01)	-8.64 (<0.01)	-17.08 (<0.01)
BSES	0.030	5.199	-0.088	2.071	0.965 (<0.01)	-7.99 (<0.01)	-18.88 (<0.01)
CIPLA	0.007	4.722	-0.116	2.738	0.958 (<0.01)	-9.05 (<0.01)	-17.58 (<0.01)
DIGITALEQP	0.144	24.26	-0.190	1.652	0.970 (<0.01)	-7.13 (<0.01)	-16.31 (<0.01)
DRREDDY	-0.073	20.80	-10.48	159.1	0.449 (<0.01)	-8.36 (<0.01)	-17.65 (<0.01)
GRASIM	0.035	6.954	-0.218	3.414	0.963 (<0.01)	-9.32 (<0.01)	-18.65 (<0.01)
GUJAMBCEM	0.075	6.463	0.185	1.308	0.978 (<0.01)	-7.85 (<0.01)	-16.95 (<0.01)
HDFC	0.052	4.695	0.466	4.040	0.927 (<0.01)	-10.73 (<0.01)	-20.26 (<0.01)
HINDALC0	-0.003	4.461	-0.189	1.120	0.983 (<0.01)	-7.57 (<0.01)	-18.09 (<0.01)
HINDLEVER	0.019	4.304	0.647	3.782	0.952 (<0.01)	-9.78 (<0.01)	-18.44 (<0.01)
HINDPETRO	0.229	9.577	0.653	1.752	0.973 (<0.01)	-8.36 (<0.01)	-15.72 (<0.01)
ICICI	-0.119	10.73	0.487	2.674	0.943 (<0.01)	-8.54 (<0.01)	-16.90 (<0.01)
INFOSYSTCH	-0.112	17.40	-0.210	2.017	0.969 (<0.01)	-8.56 (<0.01)	-16.44 (<0.01)
ITC	-0.097	5.034	-0.553	3.881	0.945 (<0.01)	-9.03 (<0.01)	-19.69 (<0.01)
L&T	-0.025	7.525	0.117	1.685	0.977 (<0.01)	-7.67 (<0.01)	-16.93 (<0.01)
MTNL	-0.053	8.814	-0.061	3.073	0.958 (<0.01)	-9.35 (<0.01)	-16.50 (<0.01)
M&M	-0.100	10.11	0.011	1.520	0.980 (<0.01)	-7.69 (<0.01)	-15.46 (<0.01)
RANBAXY	0.080	6.383	0.182	3.189	0.963 (<0.01)	-9.06 (<0.01)	-16.56 (<0.01)
RELIANCE	-0.048	6.505	0.100	4.865	0.913 (<0.01)	-7.95 (<0.01)	-17.75 (<0.01)
RELPETRO	-0.235	7.352	-0.250	3.081	0.958 (<0.01)	-7.68 (<0.01)	-17.29 (<0.01)
SATYAMCOMP	-0.056	25.58	0.058	1.110	0.979 (<0.01)	-8.34 (<0.01)	-17.35 (<0.01)
SBIN	0.052	6.766	-0.040	2.522	0.963 (<0.01)	-8.22 (<0.01)	-17.05 (<0.01)
STROPTICAL	-0.537	22.91	-0.529	2.423	0.968 (<0.01)	-7.08	-15.81

						(<0.01)	(<0.01)
TATAPOWER	0.067	12.26	-0.121	4.282	0.927 (<0.01)	-7.43 (<0.01)	-16.13 (<0.01)
TATATEA	-0.079	9.068	0.294	3.264	0.945 (<0.01)	-8.09 (<0.01)	-15.62 (<0.01)
TELCO	0.134	12.03	-0.248	1.480	0.987 (<0.01)	-8.31 (<0.01)	-16.51 (<0.01)
TISCO	-0.029	8.695	-0.405	3.768	0.965 (<0.01)	-7.87 (<0.01)	-17.81 (<0.01)
VSNL	-0.141	16.64	-4.807	50.54	0.688 (<0.01)	-8.52 (<0.01)	-17.48 (<0.01)

*Excess Kurtosis
@Shapiro-Wilk test-statistic for Normality.
#Augment Dickey-Fuller Unit Root test-statistic (trend level) at lag4.
+Phillips-Perron Unit Root test-statistic (trend level) at lag4.

Table No. 12.2: Descriptive Statistics of Log-Returns for stocks listed on 31st Jan 2003

Stock Symbol	Mean	Variance	Skewness	Kurtosis*	Normality@	ADF#	PP+
BEL	0.254	6.801	0.592	2.117	0.969 (<0.01)	-7.71 (<0.01)	-16.18 (<0.01)
HCLTECH	-0.055	11.04	-1.417	7.622	0.912 (<0.01)	-8.36 (<0.01)	-14.98 (<0.01)
HEROHONDA	0.000	6.455	-0.169	0.835	0.989 (<0.05)	-7.48 (<0.01)	-14.54 (<0.01)
ICICIBANK	0.050	4.196	0.104	1.367	0.982 (<0.01)	-7.42 (<0.01)	-15.30 (<0.01)
IPCL	-0.109	10.56	-5.611	62.48	0.670 (<0.01)	-5.49 (<0.01)	-14.35 (<0.01)
MASTEK	-0.219	34.43	-7.254	75.79	0.498 (<0.01)	-7.62 (<0.01)	-16.71 (<0.01)
NATIONALUM	0.000	8.955	0.109	4.498	0.932 (<0.01)	-7.35 (<0.01)	-14.51 (<0.01)
NIIT	-0.033	11.77	0.123	2.399	0.974 (<0.01)	-7.52 (<0.01)	14.89 (<0.01)
ONGC	0.115	3.184	-0.145	3.308	0.935 (<0.01)	-6.41 (<0.01)	-14.53 (<0.01)
POLARIS	-0.215	14.27	0.037	4.649	0.927 (<0.01)	-7.42 (<0.01)	-15.24 (<0.01)
SCI	-0.052	9.808	-0.323	4.309	0.947 (<0.01)	-6.31 (<0.01)	-16.58 (<0.01)
WIPRO	-0.073	9.023	-0.645	11.93	0.875 (<0.01)	-7.13 (<0.01)	-16.63 (<0.01)

*Excess Kurtosis
@Shapiro-Wilk test-statistic for Normality.
#Augment Dickey-Fuller Unit Root test-statistic (trend level) at lag4.
+Phillips-Perron Unit Root test-statistic (trend level) at lag4.

Table No. 12.3: Descriptive Statistics of Log-Returns for stocks listed on 29th Aug 2003

Stock Symbol	Mean	Variance	Skewness	Kurtosis*	Normality@	ADF#	PP+
ANDHRABANK	0.202	10.06	-0.001	2.843	0.965 (<0.01)	-7.51 (<0.01)	-14.56 (<0.01)
BANKBARODA	0.429	13.29	0.129	0.592	0.992 (>0.10)	-7.45 (<0.01)	-15.47 (<0.01)
BANKINDIA	0.216	10.24	-0.182	1.735	0.979 (<0.01)	-7.61 (<0.01)	-14.87 (<0.01)
CANBK	0.290	13.97	-0.374	2.993	0.961 (<0.01)	-8.36 (<0.01)	-16.21 (<0.01)
HDFCBANK	0.161	3.606	0.536	2.416	0.973 (<0.01)	-7.62 (<0.01)	-16.99 (<0.01)
ORIENTBANK	0.631	13.92	0.189	0.444	0.994 (>0.10)	-7.85 (<0.01)	-14.64 (<0.01)
PNB	0.426	17.61	-0.233	3.333	0.967 (<0.01)	-8.49 (<0.01)	-16.47 (<0.01)
UNIONBANK	0.275	9.236	-0.139	1.108	0.989 (<0.01)	-8.38 (<0.01)	-14.22 (<0.01)

*Excess Kurtosis
@Shapiro-Wilk test-statistic for Normality.
#Augment Dickey-Fuller Unit Root test-statistic (trend level) at lag4.
+Phillips-Perron Unit Root test-statistic (trend level) at lag4.

Table No. 12.4: Descriptive Statistics of Log-Returns for stocks listed on 26th Sept 2003

Stock Symbol	Mean	Variance	Skewness	Kurtosis*	Normality@	ADF#	PP+
ARVINDMILL	0.334	13.11	0.018	2.585	0.971 (<0.01)	-7.33 (<0.01)	-14.31 (<0.01)
GAIL	0.401	9.550	0.074	1.680	0.975 (<0.01)	-6.65 (<0.01)	-14.17 (<0.01)
IOC	0.270	15.57	-5.600	63.94	0.671 (<0.01)	-7.60 (<0.01)	-14.26 (<0.01)
SYNDIBANK	0.348	10.22	-0.143	1.197	0.985 (<0.01)	-7.24 (<0.01)	-14.32 (<0.01)

*Excess Kurtosis
@Shapiro-Wilk test-statistic for Normality.
#Augment Dickey-Fuller Unit Root test-statistic (trend level) at lag4.
+Phillips-Perron Unit Root test-statistic (trend level) at lag4.

Table No. 12.5: Descriptive Statistics of Log-Returns for stocks listed on 20th April 2005

Stock Symbol	Mean	Variance	Skewness	Kurtosis*	Normality@	ADF#	PP+
ABB	0.296	3.140	0.396	1.797	0.974 (<0.01)	-5.70 (<0.01)	-13.14 (<0.01)
ALBK	0.205	6.755	0.303	2.310	0.960 (<0.01)	-7.61 (<0.01)	-14.19 (<0.01)
ASHOKLEY	0.136	4.825	0.468	1.419	0.970 (<0.01)	-6.53 (<0.01)	-15.26 (<0.01)
BHARATFORG	-0.384	100.5	-14.93	231.9	0.142 (<0.01)	-7.15 (<0.01)	-15.42 (<0.01)
BHARTI	0.296	4.620	0.011	1.143	0.979 (<0.01)	-7.25 (<0.01)	-13.26 (<0.01)
CENTURYTEX	0.242	6.718	0.443	1.116	0.984 (<0.01)	-6.82 (<0.01)	-15.05 (<0.01)
CHENNPETRO	0.050	6.066	0.600	2.784	0.958 (<0.01)	-7.40 (<0.01)	-15.73 (<0.01)
COCHINREFN	-0.081	4.235	-1.576	16.20	0.870 (<0.01)	-6.85 (<0.01)	-14.67 (<0.01)
COLGATE	0.200	2.896	0.248	0.001	0.985 (<0.01)	-7.81 (<0.01)	-16.11 (<0.01)
DABUR	0.325	5.250	0.483	1.448	0.973 (<0.01)	-7.84 (<0.01)	-17.82 (<0.01)
GESHIPPING	0.065	4.973	0.620	0.834	0.972 (<0.01)	-6.72 (<0.01)	-15.40 (<0.01)
GLAXO	0.108	2.134	0.289	1.383	0.982 (<0.01)	-6.49 (<0.01)	-14.76 (<0.01)
IDBI	0.056	8.051	0.225	0.707	0.988 (<0.05)	-5.97 (<0.01)	-16.17 (<0.01)
INDHOTEL	0.183	2.573	0.227	0.839	0.990 (<0.10)	-6.78 (<0.01)	-15.28 (<0.01)
IOB	0.244	7.680	0.221	0.439	0.988 (<0.05)	-7.52 (<0.01)	-15.84 (<0.01)
JINDALSTEL	0.239	4.441	0.607	1.587	0.976 (<0.01)	-6.21 (<0.01)	-13.91 (<0.01)
LICHSGFIN	0.127	5.459	0.465	2.136	0.965 (<0.01)	-7.18 (<0.01)	-14.92 (<0.01)
MATRIXLABS	-0.954	222.9	-14.923	231.7	0.139 (<0.01)	-6.78 (<0.01)	-15.39 (<0.01)
MRPL	0.018	5.003	0.899	2.825	0.935 (<0.01)	-7.03 (<0.01)	-14.94 (<0.01)
NEYVELILIG	0.028	4.694	0.158	1.732	0.973 (<0.01)	-6.81 (<0.01)	-15.44 (<0.01)
NICOLASPIR	-0.555	102.2	-14.53	223.8	0.172 (<0.01)	-7.05 (<0.01)	-16.74 (<0.01)
PATNI	0.091	3.665	0.309	0.981	0.978 (<0.01)	-8.00 (<0.01)	-14.82 (<0.01)
RELCAPITAL	0.376	10.92	1.146	10.22	0.874 (<0.01)	-5.94 (<0.01)	-16.10 (<0.01)
SIEMENS	0.282	3.029	0.644	1.258	0.960 (<0.01)	-6.61 (<0.01)	-14.74 (<0.01)
STER	0.086	5.630	-0.115	1.897	0.972 (<0.01)	-6.16 (<0.01)	-14.86 (<0.01)

SUNPHARMA	0.148	3.145	0.478	1.353	0.974 (<0.01)	-7.19 (<0.01)	-15.32 (<0.01)
TATACHEM	0.138	3.571	0.651	1.391	0.966 (<0.01)	-6.57 (<0.01)	-16.53 (<0.01)
UTIBANK	0.177	6.234	0.492	0.898	0.974 (<0.01)	-7.54 (<0.01)	-17.45 (<0.01)
VIJAYABANK	0.032	6.751	0.457	1.520	0.978 (<0.01)	-7.59 (<0.01)	-15.63 (<0.01)
VSNL	0.230	7.915	0.968	5.073	0.930 (<0.01)	-6.28 (<0.01)	-13.83 (<0.01)
WOCKPHARMA	0.086	4.391	0.275	2.666	0.957 (<0.01)	-6.04 (<0.01)	-13.80 (<0.01)

*Excess Kurtosis
@Shapiro-Wilk test-statistic for Normality.
#Augment Dickey-Fuller Unit Root test-statistic (trend level) at lag4.
+Phillips-Perron Unit Root test-statistic (trend level) at lag4.

Stock Symbol – ACC (Associated Cement Company Ltd.)

Table No. 13a: Regression Results-Evidence of ARCH Effects. R_t takes stock symbol ACC, Mkt_t takes Nifty.

$$R_t = \phi_0 + \phi_1 R_{t-1} + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	0.048 (>0.10)
ϕ_1	-0.147 (<0.01)
θ_1	1.248 (<0.01)
F-stat	91.24 (<0.01)
G (4) test-statistic	4.162 (>0.10)
Q (4) test-statistic	31.26 (<0.01)
LM (4) test-static	25.20 (<0.01)

Table No. 13b:

Results of AR(1) - GARCH (1, 1) model for ACC using robust standard errors, R_t, Mkt_t are same as defined above, FD_t takes on value of zero before SSFs introduction and a value of one afterwards and OD_t takes on value of zero before 'stock options' introduction and a value of one afterwards.

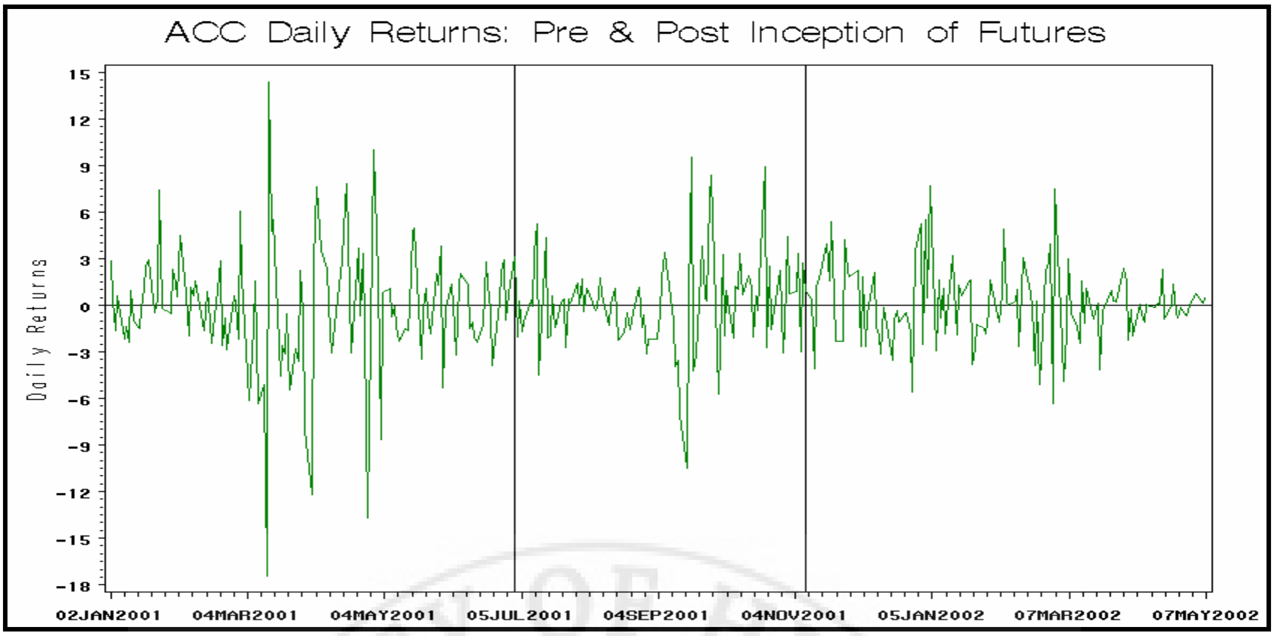
$$R_t = \phi_0 + \phi_1 R_{t-1} + \theta_1 Mkt_t + \varepsilon_t$$

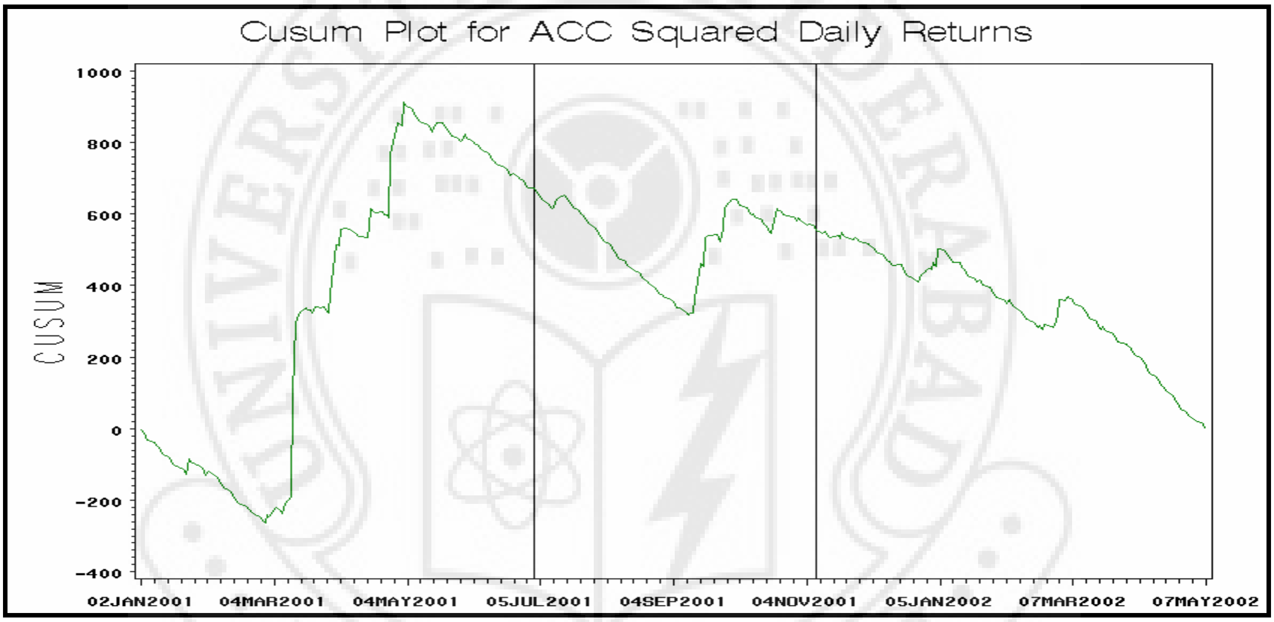
$$\varepsilon_t \sim N(0, h_t)$$

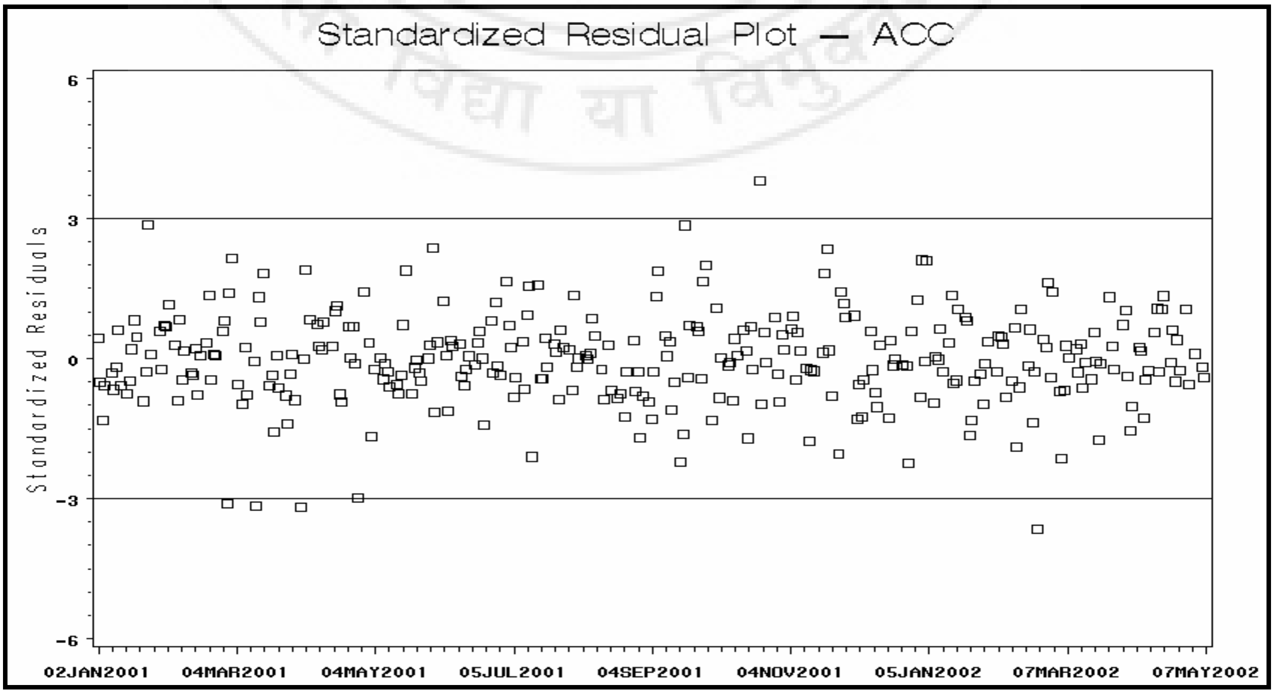
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \gamma_{d1} FD_t + \gamma_{d2} OD_t$$

Parameter	Estimate	p-value
ϕ_0	0.041	>0.10
ϕ_1	-0.143	<0.01
θ_1	1.160	<0.01
α_0	0.525	>0.10
α_1	0.103	<0.01
β_1	0.846	<0.01
γ_{d1}	-0.054	>0.10
γ_{d2}	-0.229	>0.10
Diagnostics		
G (4) test-statistic	2.840	>0.10
Q (4) test-statistic	1.872	>0.10
LM (4) test-static	1.972	>0.10
Sign Bias	0.345	>0.10
Negative Size Bias	-0.022	>0.10
Positive Size Bias	-0.065	>0.10
Joint Bias	4.979	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 + \beta_1 = 1$	3.730	<0.05

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


ACC Daily Returns: Pre & Post Inception of Futures
Daily Returns
15
12
9
6
3
0
-3
-6
-9
-12
-15
-18
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Cusum Plot for ACC Squared Daily Returns
CUSUM
1000
800
600
400
200
0
-200
-400
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Standardized Residual Plot — ACC
Standardized Residuals
6
3
0
-3
-6
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002

Stock Symbol – BAJAJAUTO (Bajaj Auto Ltd.)

Table No. 14a: Regression Results-Evidence of ARCH Effects. R_t takes stock symbol BAJAJAUTO, Mkt_t takes Nifty.

$$R_t = \phi_0 + \phi_1 R_{t-5} + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	0.239 (<0.10)
ϕ_1	0.114 (<0.05)
θ_1	0.408 (<0.01)
F-stat	16.21 (<0.01)
G (4) test-statistic	7.020 (>0.10)
Q (4) test-statistic	20.48 (<0.01)
LM (4) test-static	17.20 (<0.01)

Table No. 14b:

Results of AR(5) - GARCH (1, 1) model for BAJAJAUTO using robust standard errors, R_t, Mkt_t are same as defined above, FD_t takes on value of zero before SSFs introduction and a value of one afterwards and OD_t takes on value of zero before 'stock options' introduction and a value of one afterwards.

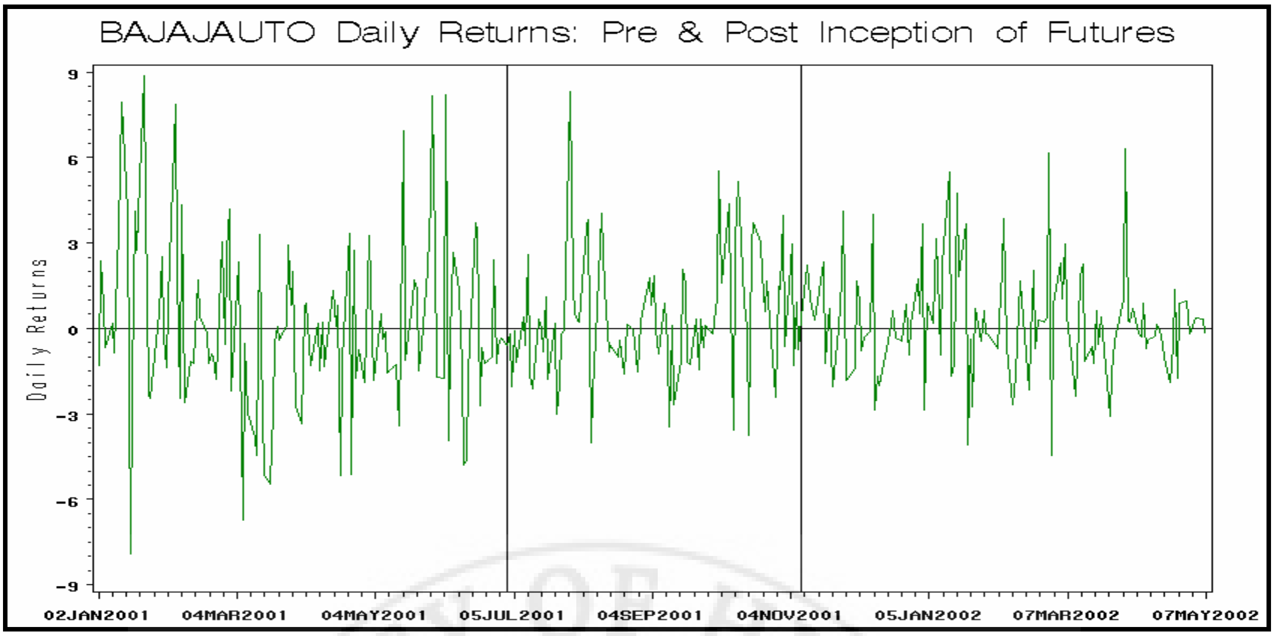
$$R_t = \phi_0 + \phi_1 R_{t-5} + \theta_1 Mkt_t + \varepsilon_t$$

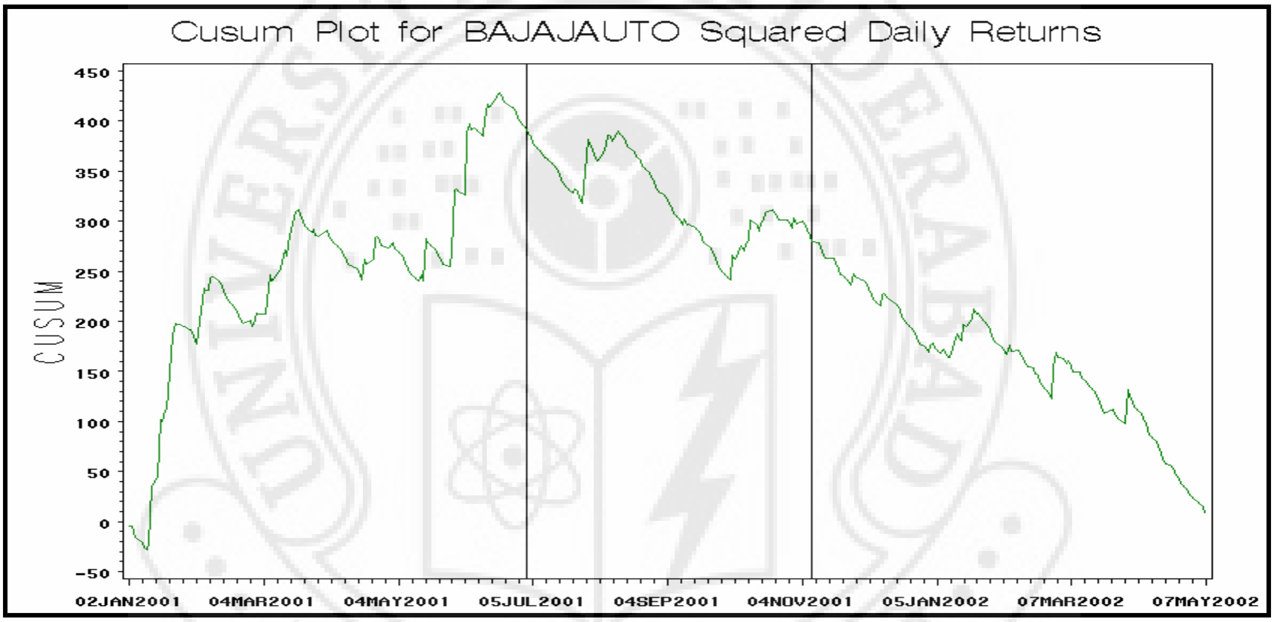
$$\varepsilon_t \sim N(0, h_t)$$

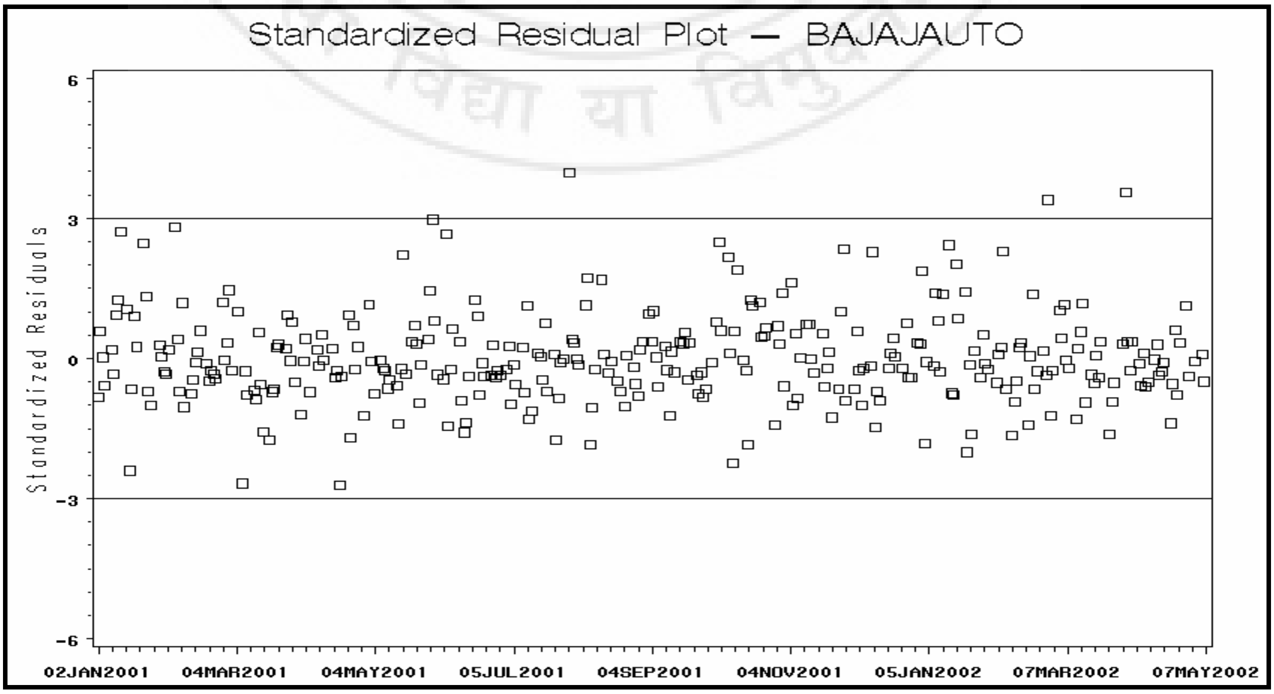
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \gamma_{d1} FD_t + \gamma_{d2} OD_t$$

Parameter	Estimate	p-value
ϕ_0	0.228	<0.10
ϕ_1	0.130	<0.05
θ_1	0.400	<0.01
α_0	2.612	<0.05
α_1	0.091	<0.10
β_1	0.592	<0.01
γ_{d1}	-0.318	>0.10
γ_{d2}	-1.258	<0.10
Diagnostics		
G (4) test-statistic	5.846	>0.10
Q (4) test-statistic	1.690	>0.10
LM (4) test-static	1.732	>0.10
Sign Bias	-0.479	<0.05
Negative Size Bias	0.513	<0.05
Positive Size Bias	0.251	>0.10
Joint Bias	7.298	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 + \beta_1 = 1$	21.53	<0.01

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


BAJAJAUTO Daily Returns: Pre & Post Inception of Futures
Daily Returns
9
6
3
0
-3
-6
-9
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Cusum Plot for BAJAJAUTO Squared Daily Returns
CUSUM
450
400
350
300
250
200
150
100
50
0
-50
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Standardized Residual Plot — BAJAJAUTO
Standardized Residuals
6
3
0
-3
-6
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002

Stock Symbol – BHEL (Bharat Heavy Electricals Ltd.)

Table No. 15a: Regression Results-Evidence of ARCH Effects. R_t takes stock symbol BHEL, Mkt_t takes Nifty.

$$R_t = \phi_0 + \phi_1 R_{t-2} + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	0.067 (>0.10)
ϕ_1	-0.095 (<0.10)
θ_1	1.044 (<0.01)
F-stat	45.51 (<0.01)
G (4) test-statistic	5.497 (>0.10)
Q (4) test-statistic	22.46 (<0.01)
LM (4) test-static	19.84 (<0.01)

Table No. 15b:

Results of AR(2) - GARCH (1, 1) model for BHEL using robust standard errors, R_t, Mkt_t are same as defined above, FD_t takes on value of zero before SSFs introduction and a value of one afterwards and OD_t takes on value of zero before 'stock options' introduction and a value of one afterwards.

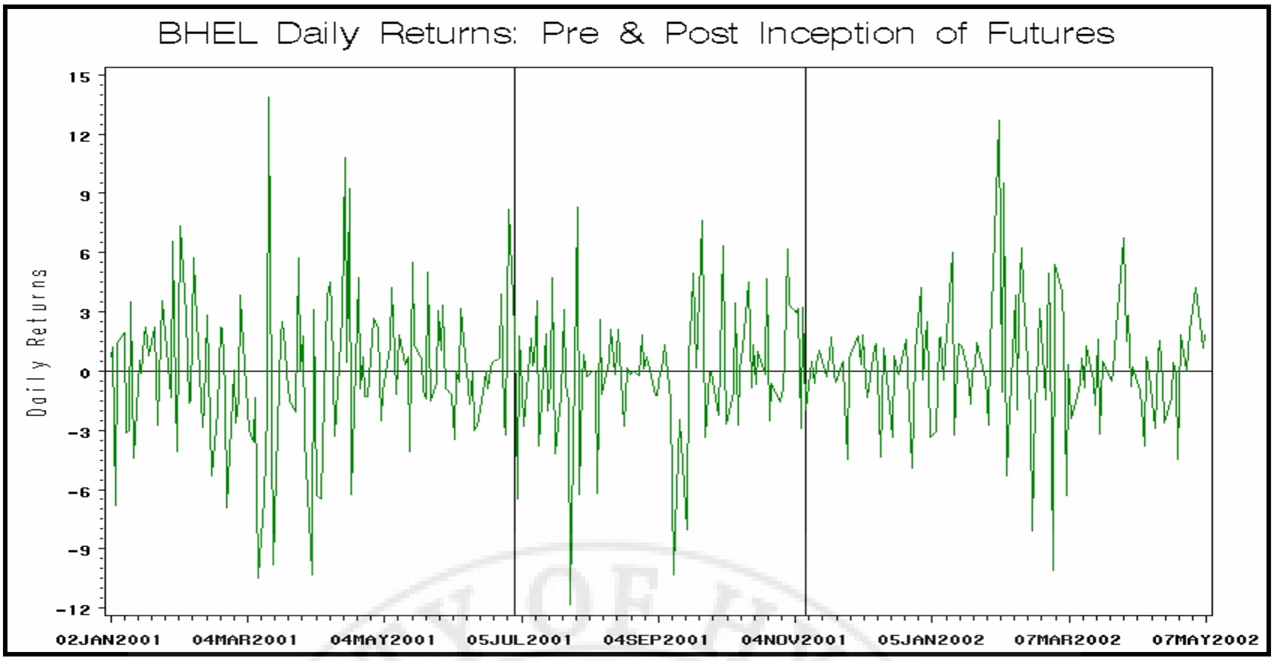
$$R_t = \phi_0 + \phi_1 R_{t-2} + \theta_1 Mkt_t + \varepsilon_t$$

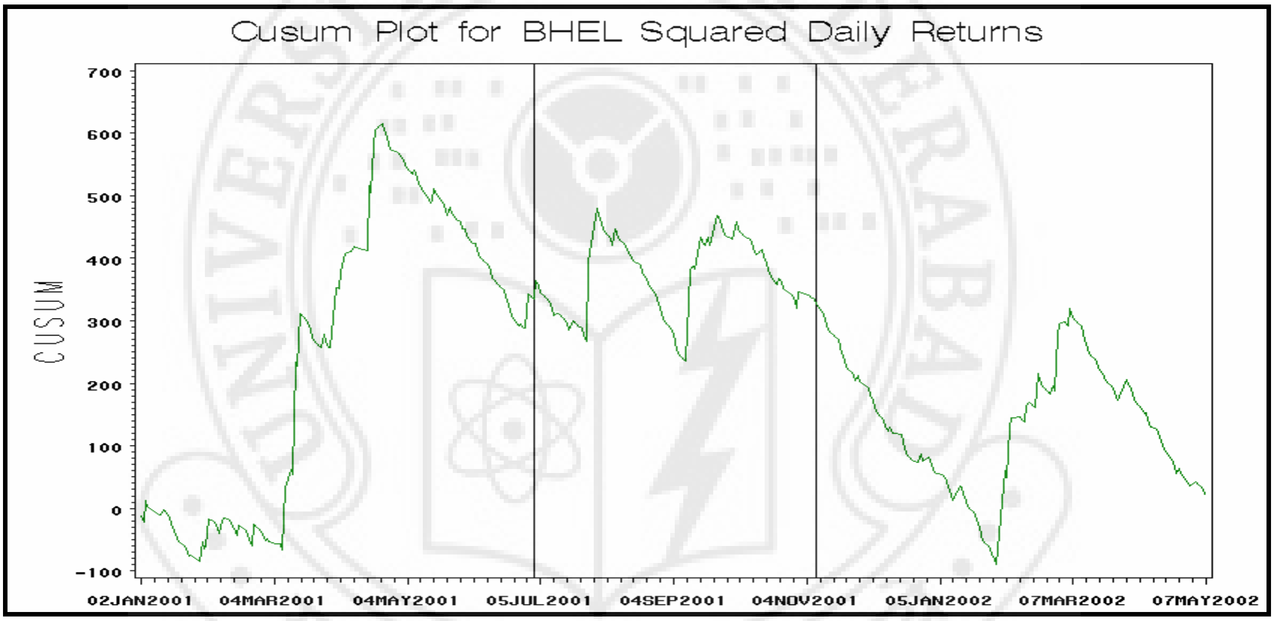
$$\varepsilon_t \sim N(0, h_t)$$

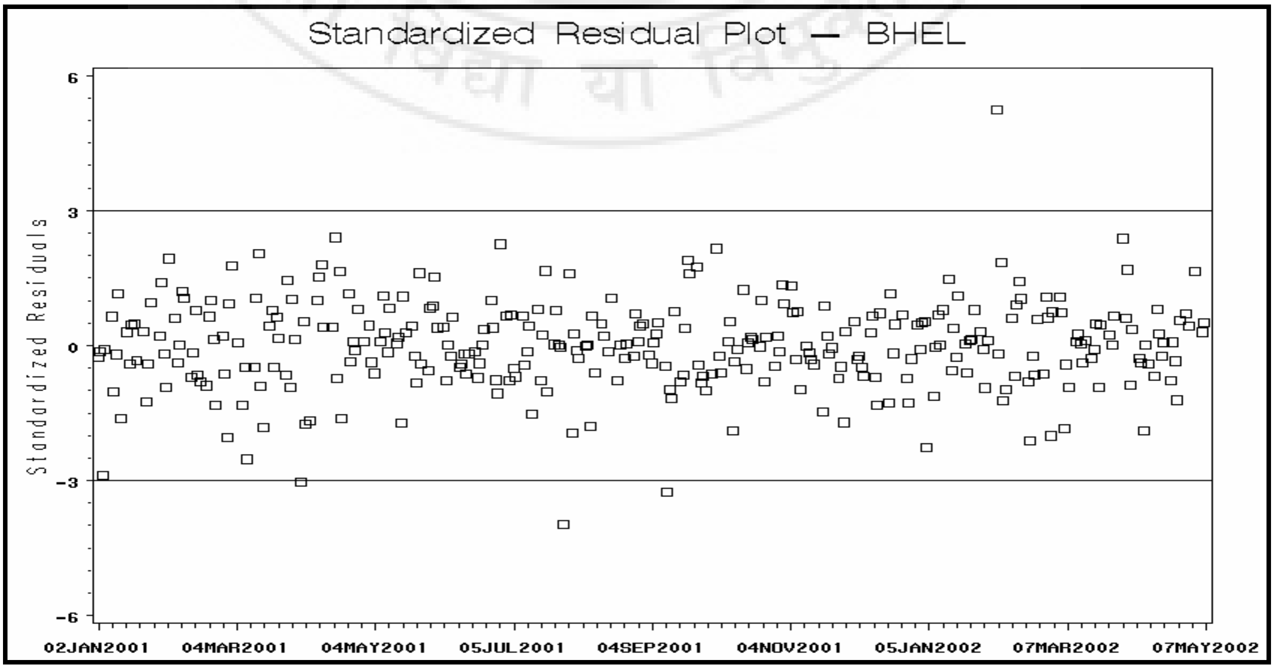
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \gamma_{d1} FD_t + \gamma_{d2} OD_t$$

Parameter	Estimate	p-value
ϕ_0	0.043	>0.10
ϕ_1	-0.131	<0.05
θ_1	1.056	<0.01
α_0	1.941	<0.10
α_1	0.086	<0.05
β_1	0.707	<0.01
γ_{d1}	-0.584	>0.10
γ_{d2}	-0.203	>0.10
Diagnostics		
G (4) test-statistic	4.282	>0.10
Q (4) test-statistic	3.455	>0.10
LM (4) test-static	3.636	>0.10
Sign Bias	-0.085	>0.10
Negative Size Bias	0.153	>0.10
Positive Size Bias	-0.078	>0.10
Joint Bias	1.193	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 + \beta_1 = 1$	21.83	<0.01

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


BHEL Daily Returns: Pre & Post Inception of Futures
Daily Returns
15
12
9
6
3
0
-3
-6
-9
-12
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Cusum Plot for BHEL Squared Daily Returns
CUSUM
700
600
500
400
300
200
100
0
-100
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Standardized Residual Plot — BHEL
Standardized Residuals
6
3
0
-3
-6
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002

Stock Symbol – BPCL (Bharat Petroleum Corporation Ltd.)

Table No. 16a: Regression Results-Evidence of ARCH Effects. R_t takes stock symbol BPCL, Mkt_t takes Nifty.

$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	0.299 (>0.10)
θ_1	0.751 (<0.01)
F-stat	37.61 (<0.01)
G (4) test-statistic	6.517 (>0.10)
Q (4) test-statistic	7.988 (<0.10)
LM (4) test-static	7.240 (>0.10)

Table No. 16b:
Results of ARCH (1) model for BPCL using robust standard errors, R_t, Mkt_t are same as defined above, FD_t takes on value of zero before SSFs introduction and a value of one afterwards and OD_t takes on value of zero before 'stock options' introduction and a value of one afterwards.

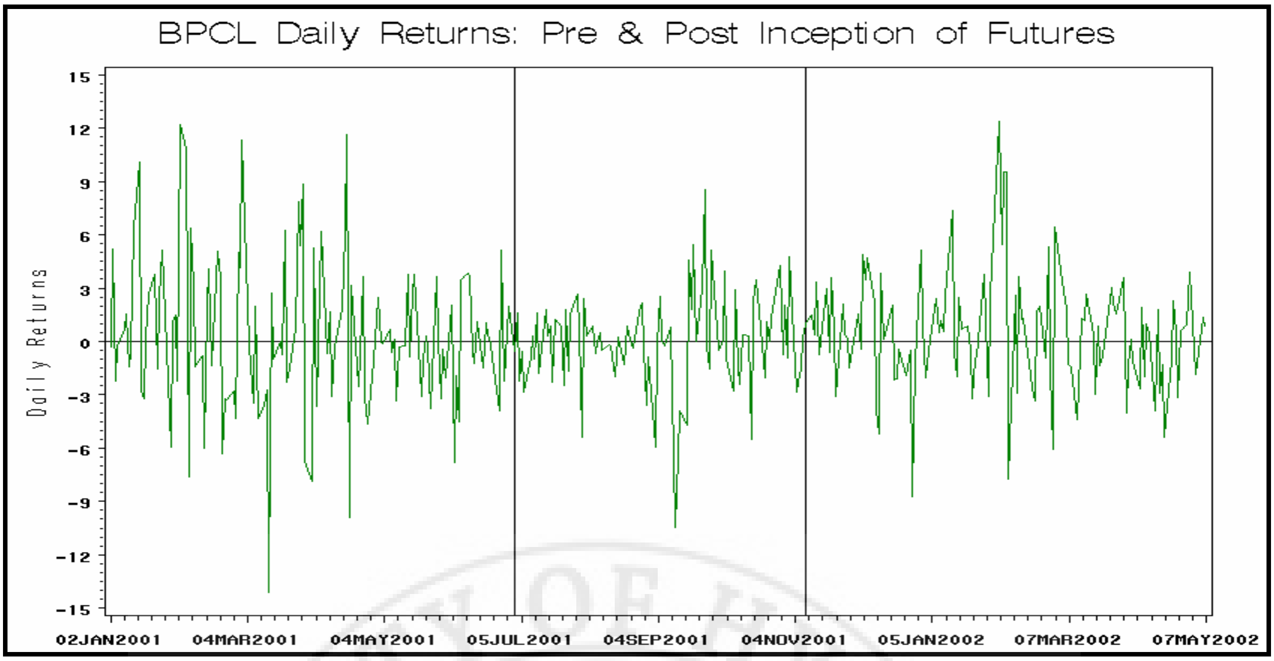
$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

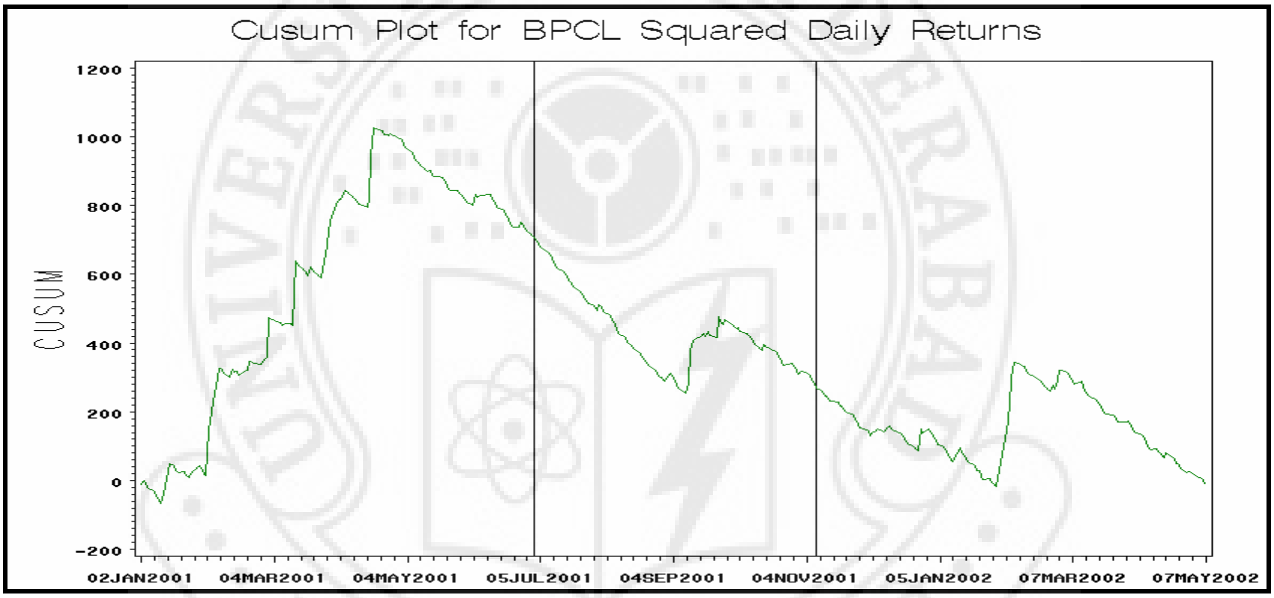
$$\varepsilon_t \sim N(0, h_t)$$

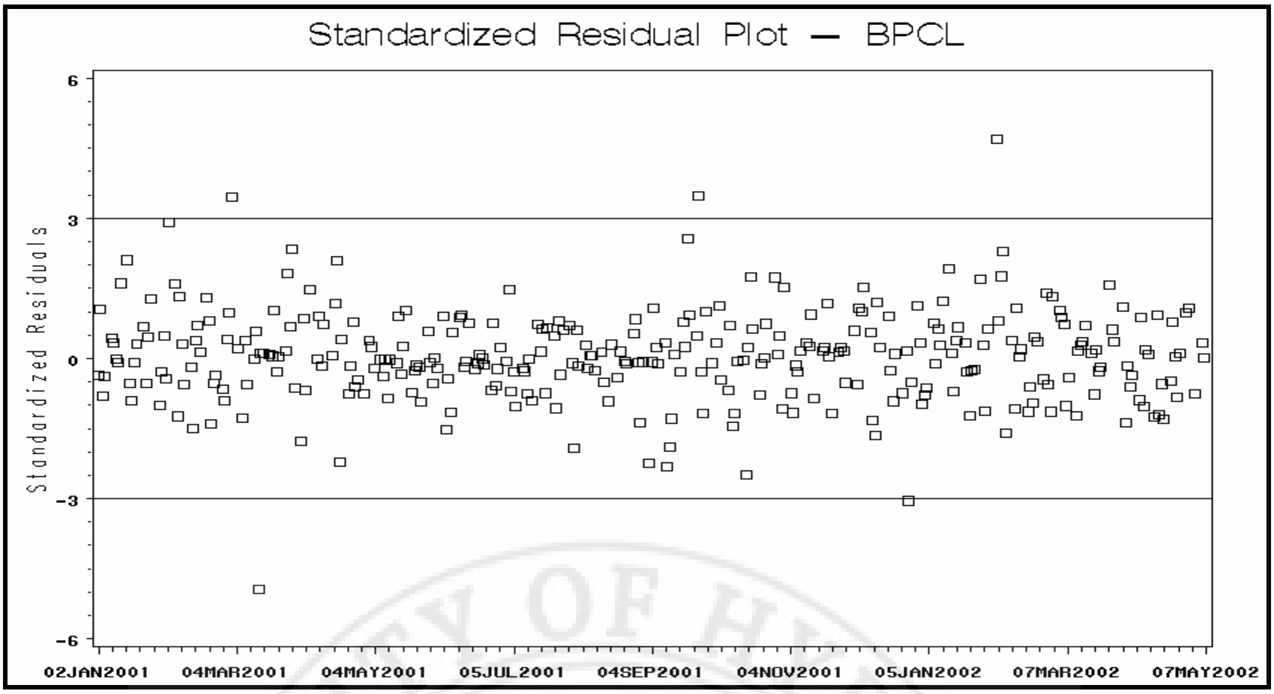
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \gamma_{d1} FD_t + \gamma_{d2} OD_t$$

Parameter	Estimate	p-value
ϕ_0	0.094	>0.10
θ_1	0.781	<0.01
α_0	13.19	<0.01
α_1	0.248	<0.05
γ_{d1}	0.107	>0.10
γ_{d2}	-7.027	<0.01
Diagnostics		
G (4) test-statistic	4.512	>0.10
Q (4) test-statistic	0.904	>0.10
LM (4) test-static	0.925	>0.10
Sign Bias	-0.053	<0.05
Negative Size Bias	0.397	<0.05
Positive Size Bias	0.282	>0.10
Joint Bias	4.911	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 = 1$	16.94	<0.01

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


BPCL Daily Returns: Pre & Post Inception of Futures
Daily Returns
15
12
9
6
3
0
-3
-6
-9
-12
-15
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Cusum Plot for BPCL Squared Daily Returns
CUSUM
1200
1000
800
600
400
200
0
-200
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002



Standardized Residual Plot — BPCL
Standardized Residuals
6
3
0
-3
-6
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002

Stock Symbol – BSES (Reliance Energy Ltd., Now Reliance Infrastructure Ltd.)

Table No. 17a: Regression Results-Evidence of ARCH Effects. R_t takes stock symbol BSES, Mkt_t takes Nifty.

$$R_t = \phi_0 + \phi_1 R_{t-2} + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	0.053 (>0.10)
ϕ_1	-0.095 (<0.10)
θ_1	0.643 (<0.01)
F-stat	38.23 (<0.01)
G (4) test-statistic	5.280 (>0.10)
Q (4) test-statistic	20.18 (<0.10)
LM (4) test-static	21.74 (>0.10)

Table No. 17b:

Results of AR(2)-ARCH (1) model for BSES using robust standard errors, R_t, Mkt_t are same as defined above, FD_t takes on value of zero before SSFs introduction and a value of one afterwards and OD_t takes on value of zero before 'stock options' introduction and a value of one afterwards.

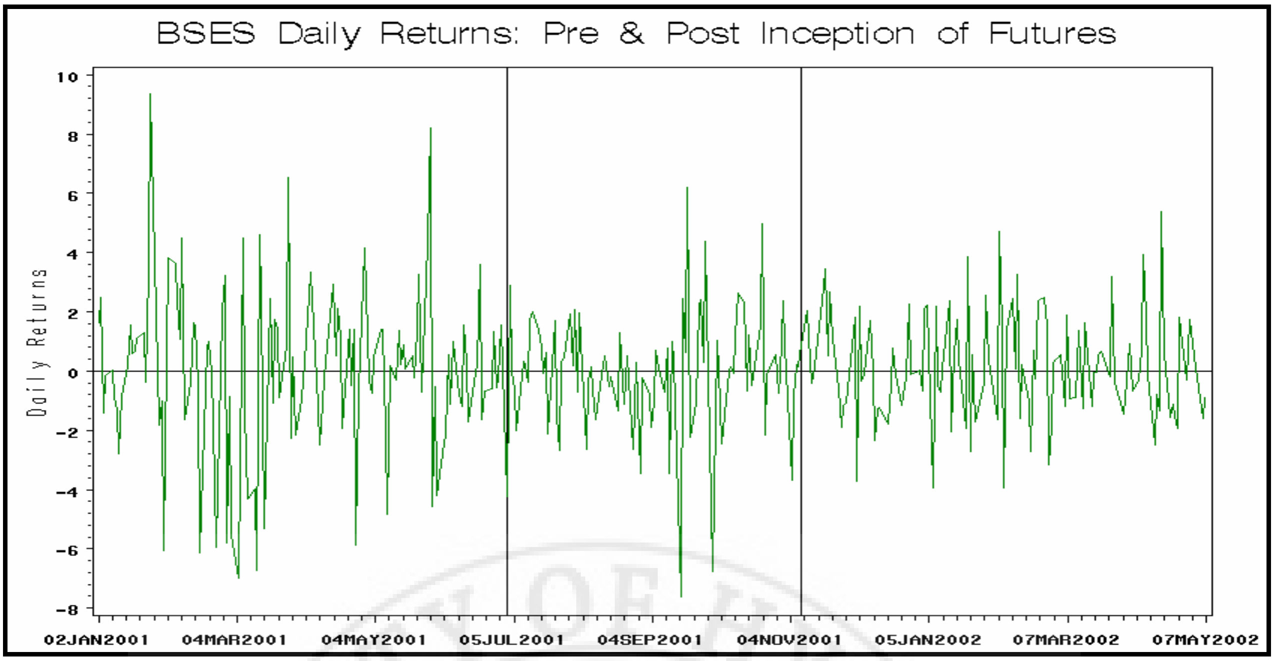
$$R_t = \phi_0 + \phi_1 R_{t-2} + \theta_1 Mkt_t + \varepsilon_t$$

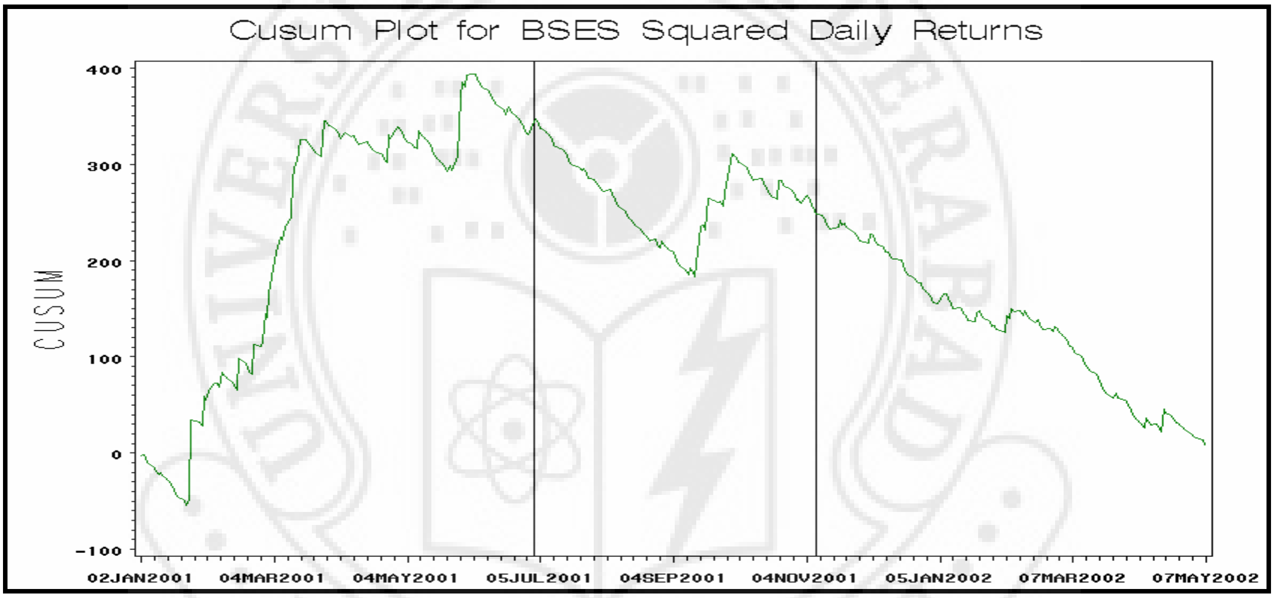
$$\varepsilon_t \sim N(0, h_t)$$

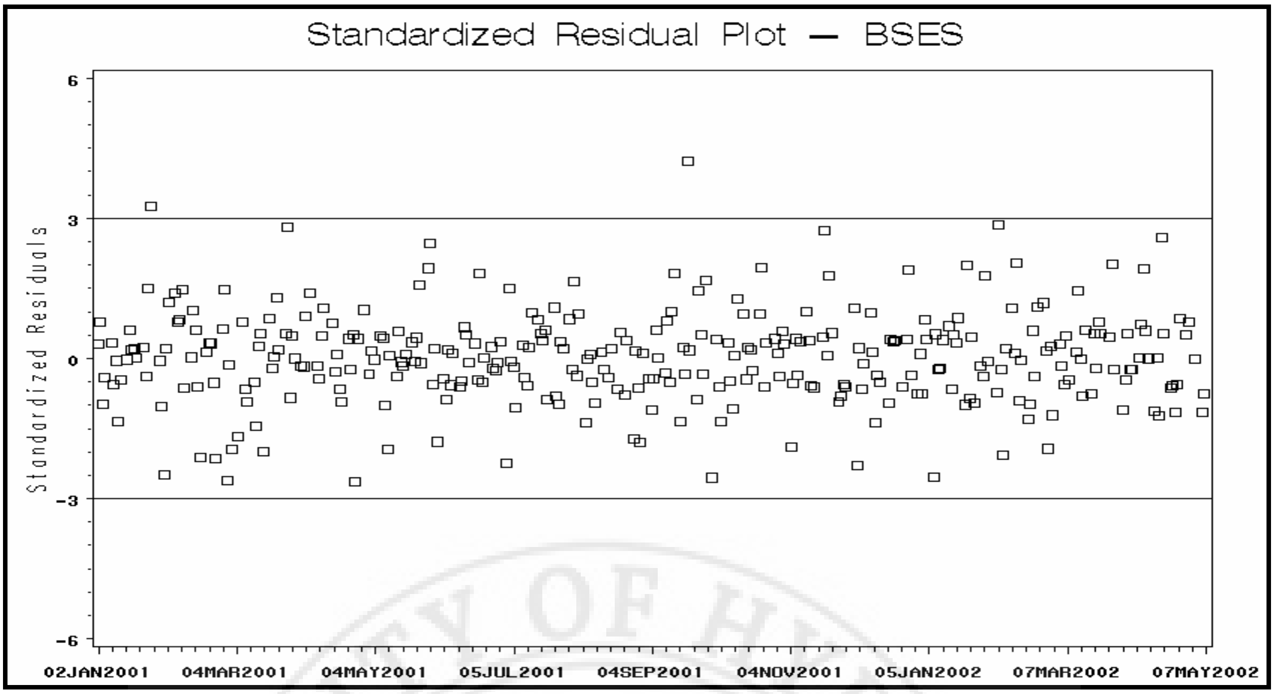
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \gamma_{d1} FD_t + \gamma_{d2} OD_t$$

Parameter	Estimate	p-value
ϕ_0	0.006	>0.10
ϕ_1	-0.085	<0.10
θ_1	0.626	<0.01
α_0	3.025	<0.01
α_1	0.416	<0.01
γ_{d1}	-0.360	>0.10
γ_{d2}	-0.710	>0.10
Diagnostics		
G (4) test-statistic	2.597	>0.10
Q (4) test-statistic	7.197	>0.10
LM (4) test-static	6.574	>0.10
Sign Bias	-0.165	<0.05
Negative Size Bias	0.263	<0.05
Positive Size Bias	0.085	>0.10
Joint Bias	2.012	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 = 1$	12.62	<0.01

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


BSES Daily Returns: Pre & Post Inception of Futures
Daily Returns
10
8
6
4
2
0
-2
-4
-6
-8
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Cusum Plot for BSES Squared Daily Returns
CUSUM
400
300
200
100
0
-100
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Standardized Residual Plot — BSES
Standardized Residuals
6
3
0
-3
-6
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002

Stock Symbol – CIPLA (Cipla Ltd.)

Table No. 18a: Regression Results-Evidence of ARCH Effects. R_t takes stock symbol CIPLA, Mkt_t takes Nifty.

$$R_t = \phi_0 + \phi_1 R_{t-4} + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	0.030 (>0.10)
ϕ_1	-0.093 (<0.10)
θ_1	0.620 (<0.01)
F-stat	39.90 (<0.01)
G (4) test-statistic	2.868 (>0.10)
Q (4) test-statistic	24.42 (<0.01)
LM (4) test-static	23.48 (<0.01)

Table No. 18b:
Results of AR(4) - GARCH (1, 1) model for CIPLA using robust standard errors, R_t, Mkt_t are same as defined above, FD_t takes on value of zero before SSFs introduction and a value of one afterwards and OD_t takes on value of zero before 'stock options' introduction and a value of one afterwards.

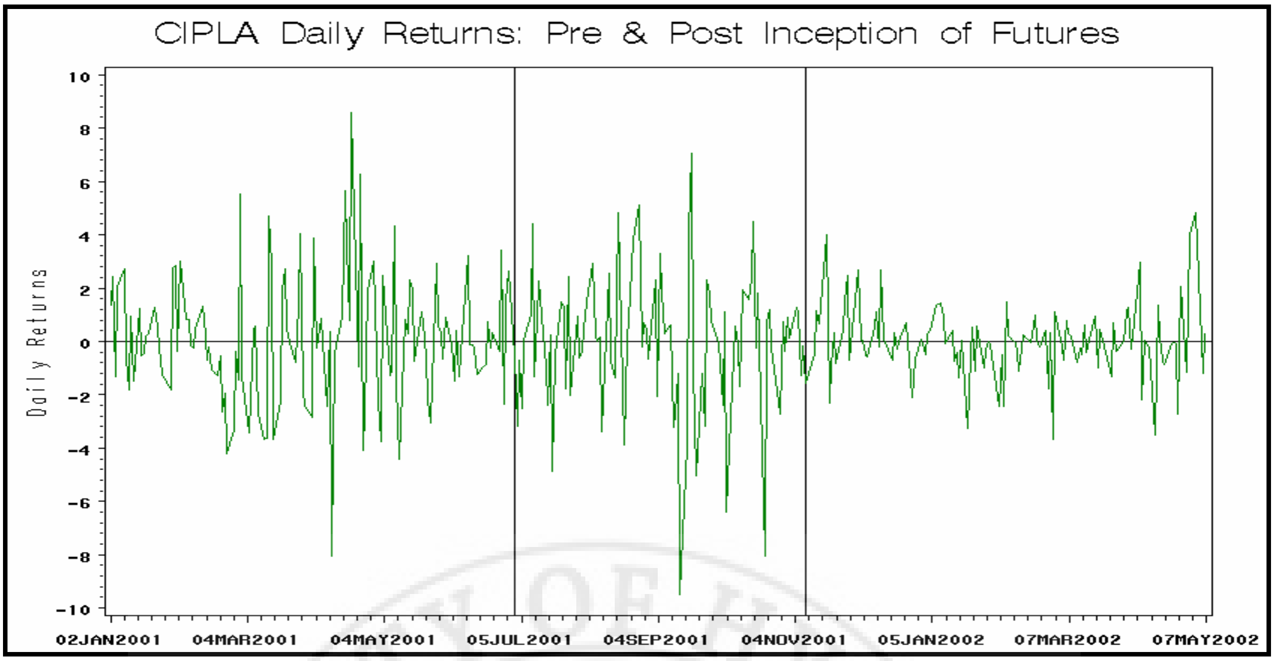
$$R_t = \phi_0 + \phi_1 R_{t-4} + \theta_1 Mkt_t + \varepsilon_t$$

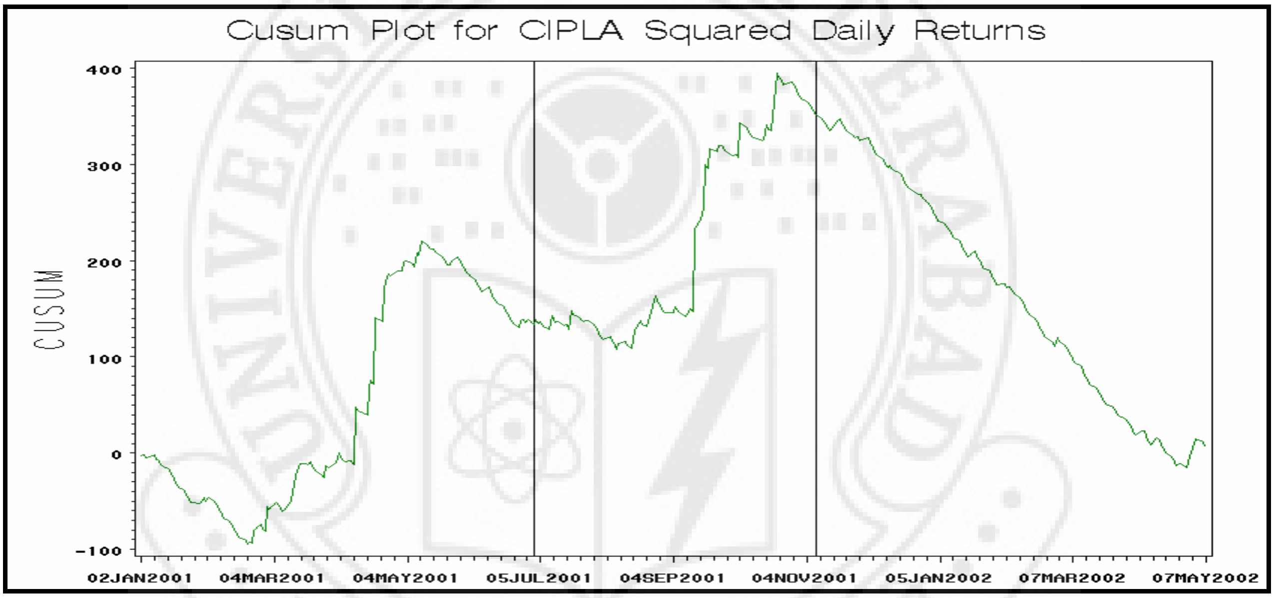
$$\varepsilon_t \sim N(0, h_t)$$

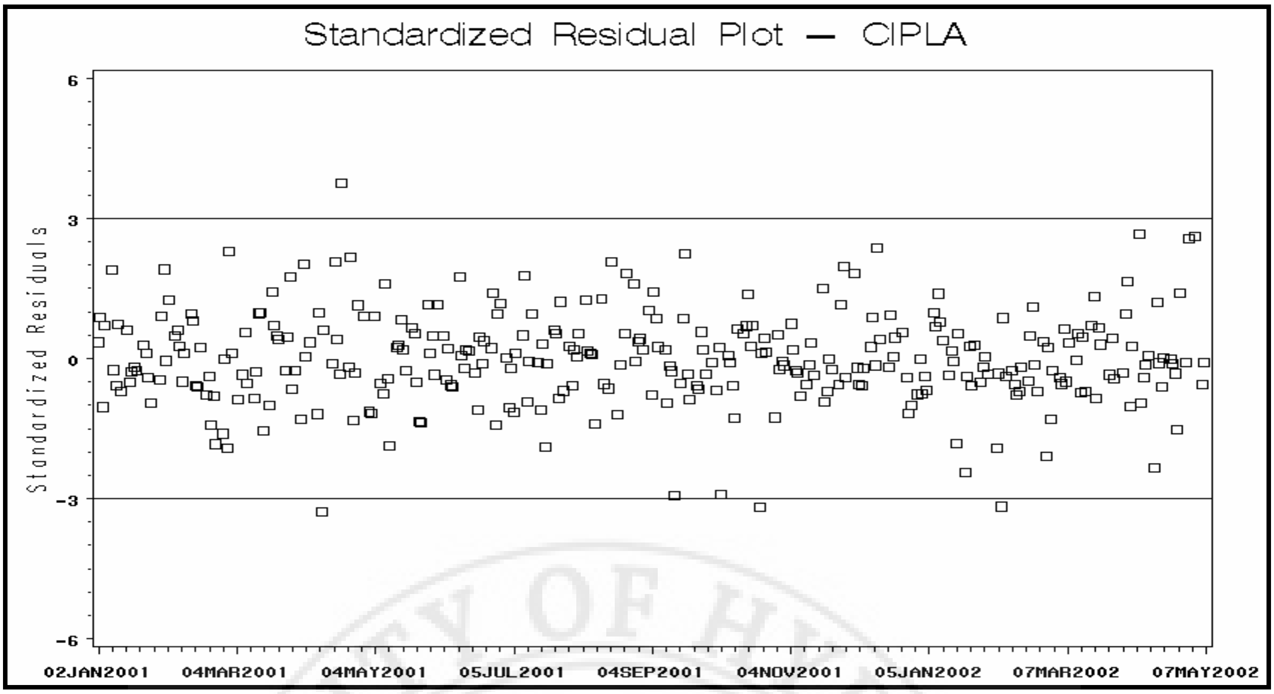
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \gamma_{d1} FD_t + \gamma_{d2} OD_t$$

Parameter	Estimate	p-value
ϕ_0	-0.002	>0.10
ϕ_1	-0.131	<0.05
θ_1	0.496	<0.01
α_0	0.418	<0.10
α_1	0.088	<0.05
β_1	0.794	<0.01
γ_{d1}	-0.564	>0.10
γ_{d2}	-0.378	>0.10
Diagnostics		
G (4) test-statistic	1.733	>0.10
Q (4) test-statistic	5.321	>0.10
LM (4) test-static	4.922	>0.10
Sign Bias	0.005	>0.10
Negative Size Bias	0.171	>0.10
Positive Size Bias	-0.007	>0.10
Joint Bias	1.671	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 + \beta_1 = 1$	8.510	<0.01

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


CIPLA Daily Returns: Pre & Post Inception of Futures
Daily Returns
10
8
6
4
2
0
-2
-4
-6
-8
-10
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Cusum Plot for CIPLA Squared Daily Returns
CUSUM
400
300
200
100
0
-100
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002



Standardized Residual Plot — CIPLA
Standardized Residuals
6
3
0
-3
-6
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002

Stock Symbol – DIGITALEQP (Digital Equipment India Ltd.)

Table No. 19:

Regression Results for DIGITALEQP using robust standard errors, R_t takes stock symbol DIGITALEQP, Mkt_t takes Nifty, FD_t takes on value of zero before SSFs introduction and a value of one afterwards and OD_t takes on value of zero before 'stock options' introduction and a value of one afterwards.

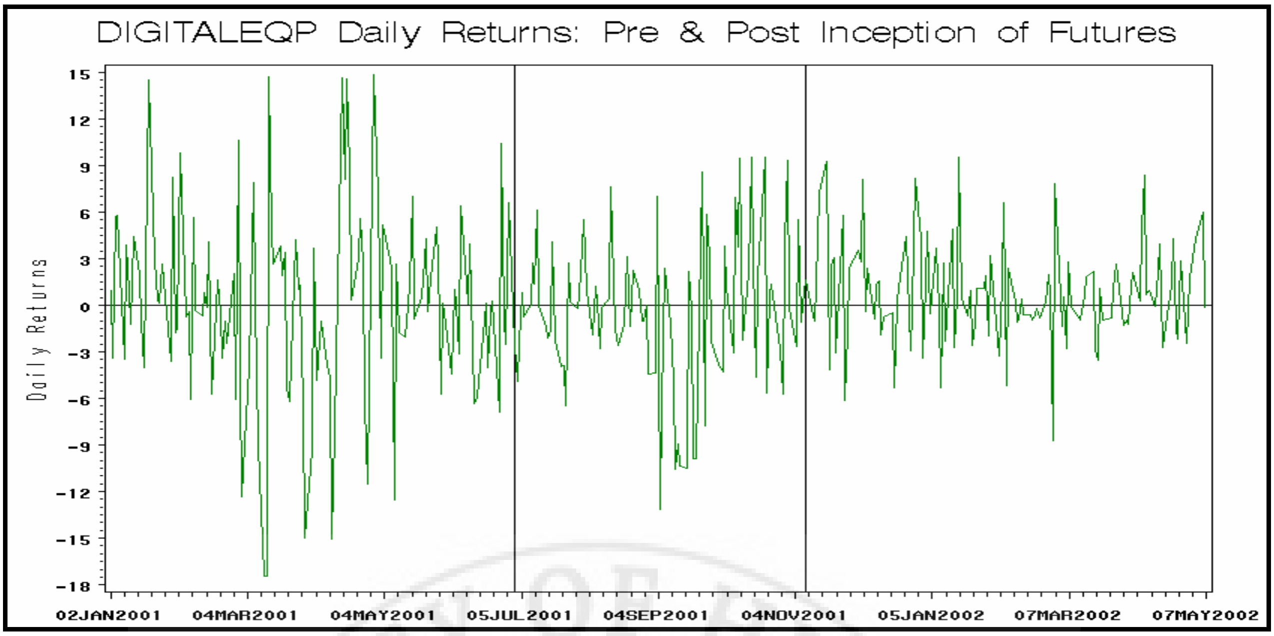
$$R_t = \phi_0 + \phi_1 R_{t-2} + \theta_1 Mkt_t + \gamma_{d1} FD_t + \gamma_{d2} OD_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0,1)$$

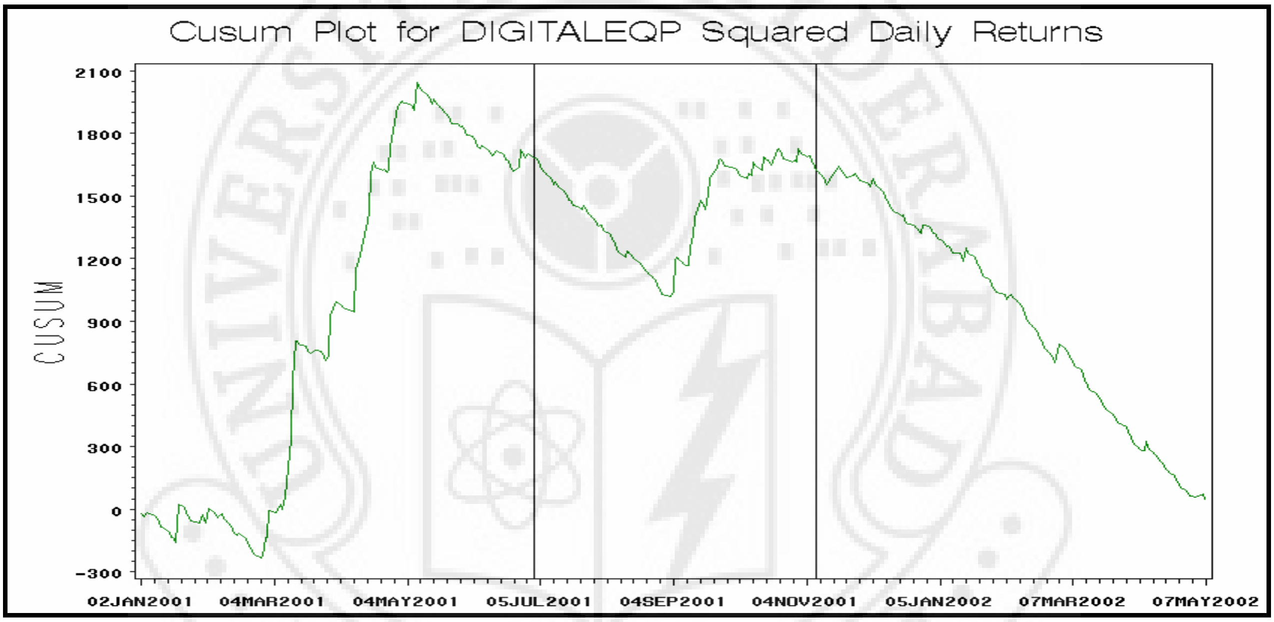
Parameter	Estimate
ϕ_0	0.307 (>0.10)
ϕ_1	-0.091 (<0.10)
θ_1	2.436 (<0.01)
γ_{d1}	0.651 (>0.10)
γ_{d2}	-0.488 (>0.10)
F-stat	111.2 (<0.01)
G (4) test-statistic	1.444 (>0.10)
Q (4) test-statistic	3.293 (>0.10)
LM (4) test-static	3.321 (>0.10)

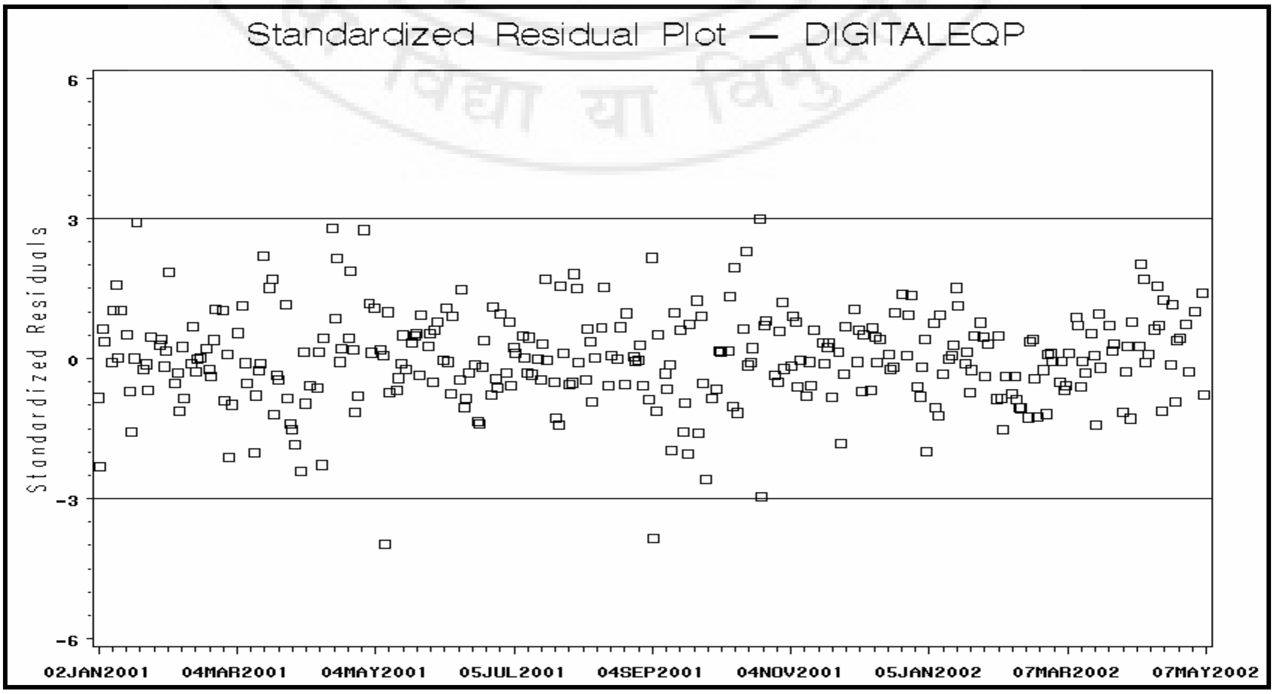
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


DIGITALEQP Daily Returns: Pre & Post Inception of Futures
Daily Returns
15
12
9
6
3
0
-3
-6
-9
-12
-15
-18
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Cusum Plot for DIGITALEQP Squared Daily Returns
CUSUM
2100
1800
1500
1200
900
600
300
0
-300
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Standardized Residual Plot — DIGITALEQP
Standardized Residuals
6
3
0
-3
-6
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002

Stock Symbol – DRREDDY (Dr. Reddy's Laboratories Ltd.)

Table No. 20a: Regression Results-Evidence of ARCH Effects. R_t takes stock symbol DRREDDY, Mkt_t takes Nifty and SD_t is stock split dummy takes the value of one for date 15th Oct 2001 on which DRREDDY has gone for stock split of 5 for 1.

$$R_t = \phi_0 + \theta_1 Mkt_t + \eta SD_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	0.152 (>0.10)
θ_1	0.491 (<0.01)
η	-69.57 (<0.01)
F-stat	423.0 (<0.01)
G (4) test-statistic	2.877 (>0.10)
Q (4) test-statistic	11.04 (<0.01)
LM (4) test-static	10.94 (<0.01)

Table No. 20b:
Results of ARCH (1) model for DRREDDY using robust standard errors, R_t, Mkt_t are same as defined above, SD_t is stock split dummy takes the value of one for date 15th Oct 2001 on which DRREDDY has gone for stock split of 5 for 1, FD_t takes on value of zero before SSFs introduction and a value of one afterwards and OD_t takes on value of zero before 'stock options' introduction and a value of one afterwards.

$$R_t = \phi_0 + \theta_1 Mkt_t + \eta SD_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0, h_t)$$

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \gamma_{d1} FD_t + \gamma_{d2} OD_t$$

Parameter	Estimate	p-value
ϕ_0	-0.056	>0.10
θ_1	0.321	<0.01
η	-69.31	<0.01
α_0	3.944	<0.01
α_1	0.662	<0.01
$\alpha_{0,d}$	-3.961	<0.01
$\alpha_{1,d}$	1.839	>0.10
Diagnostics		
G (4) test-statistic	2.258	>0.10
Q (4) test-statistic	6.361	>0.10
LM (4) test-static	5.901	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 = 1$	2.260	>0.10

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.

As the dummy of future introduction is highly significant, GARCH model has been estimated.

Table No. 20c:

Results of ARCH (1) model for DRREDDY using robust standard errors, R_t, Mkt_t are same as defined above, SD_t is stock split dummy takes the value of one for date 15th Oct 2001 on which DRREDDY has gone for stock split of 5 for 1, and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

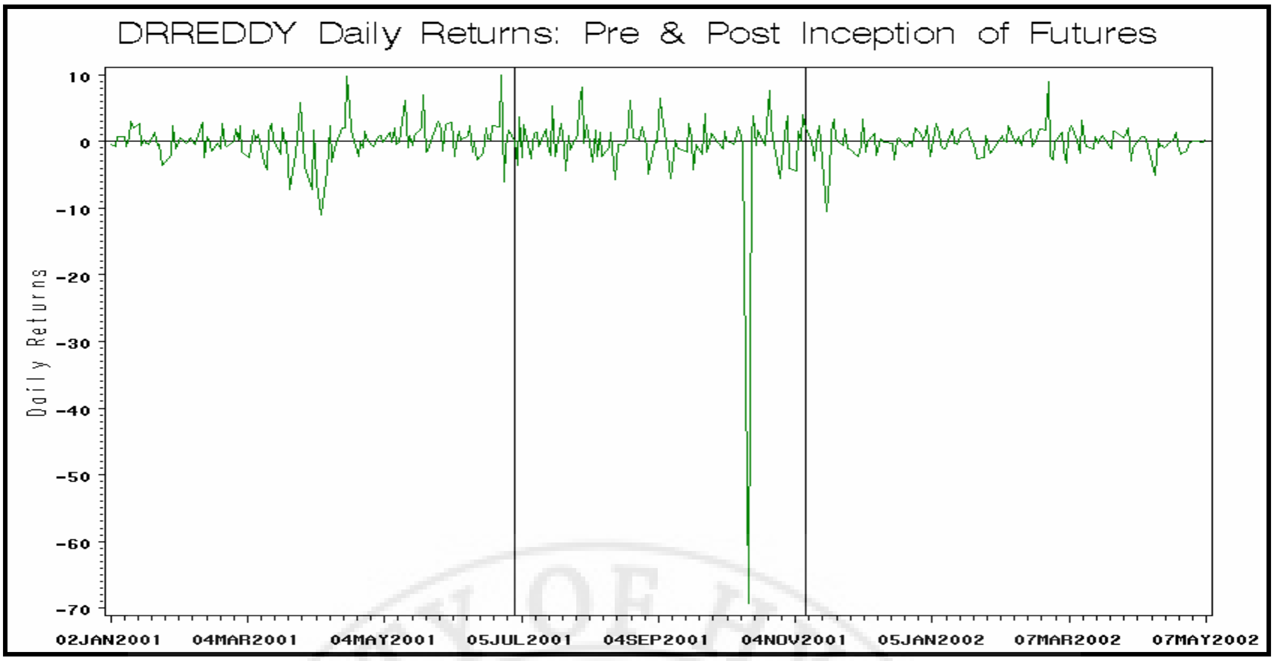
$$R_t = \phi_0 + \theta_1 Mkt_t + \eta SD_t + \varepsilon_t$$

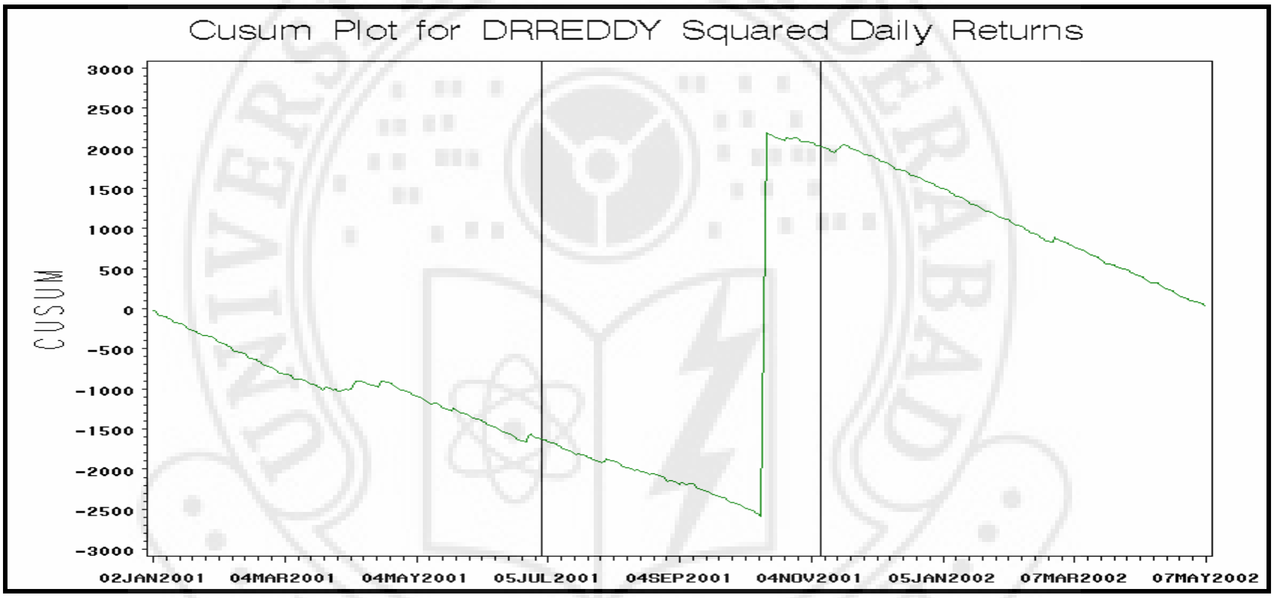
$$\varepsilon_t \sim N(0, h_t)$$

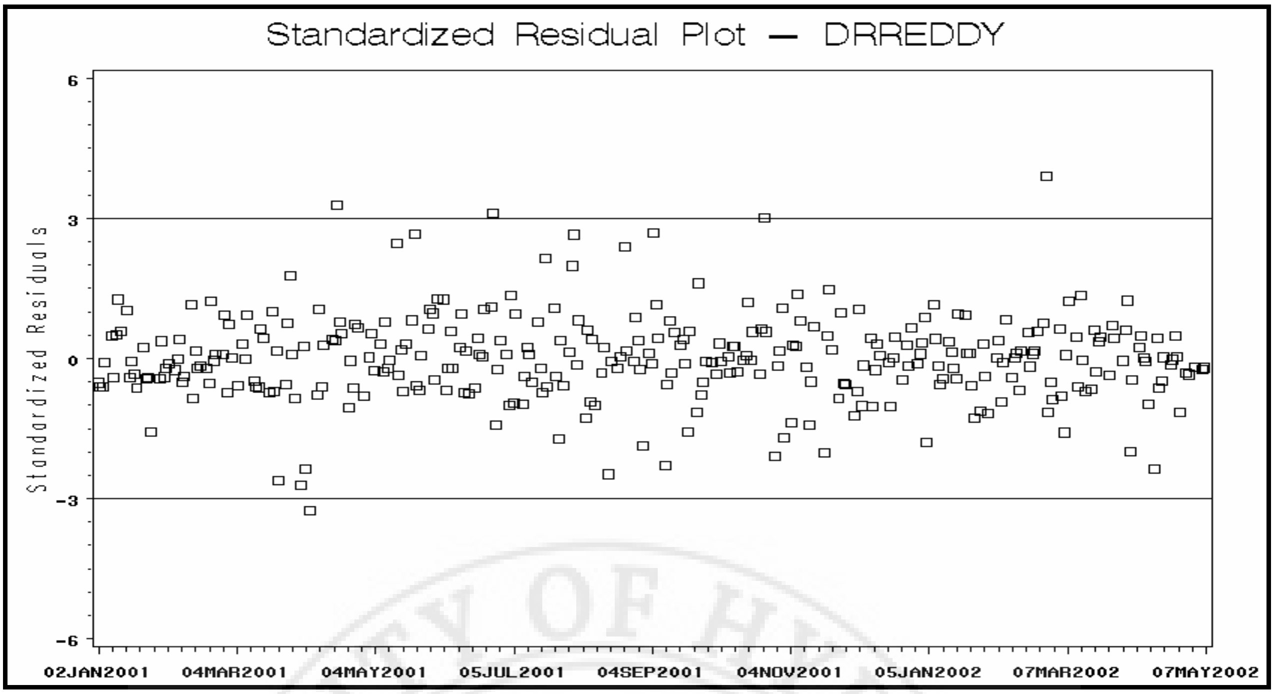
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_{0,d} D_t + \alpha_{1,d} D_t * \varepsilon_{t-1}^2$$

Parameter	**Estimate**	**p-value**
ϕ_0	0.168	>0.10
θ_1	0.469	<0.01
η	-69.52	<0.01
α_0	5.432	<0.01
α_1	0.174	<0.05
$\alpha_{0,d}$	-1.776	<0.05
$\alpha_{1,d}$	-0.158	<0.10
Diagnostics		
G (4) test-statistic	2.397	>0.10
Q (4) test-statistic	4.037	>0.10
LM (4) test-static	4.078	>0.10
Sign Bias	-0.630	<0.05
Negative Size Bias	0.019	>0.10
Positive Size Bias	0.359	>0.10
Joint Bias	5.593	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 = 1$	12.36	<0.01

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


DRREDDY Daily Returns: Pre & Post Inception of Futures
Daily Returns
10
0
-10
-20
-30
-40
-50
-60
-70
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Cusum Plot for DRREDDY Squared Daily Returns
CUSUM
3000
2500
2000
1500
1000
500
0
-500
-1000
-1500
-2000
-2500
-3000
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Standardized Residual Plot — DRREDDY
Standardized Residuals
6
3
0
-3
-6
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002

Stock Symbol – GRASIM (Grasim Industries Ltd.)

Table No. 21:

Regression Results for GRASIM using robust standard errors, R_t takes stock symbol GRASIM, Mkt_t takes Nifty, FD_t takes on value of zero before SSFs introduction and a value of one afterwards and OD_t takes on value of zero before 'stock options' introduction and a value of one afterwards.

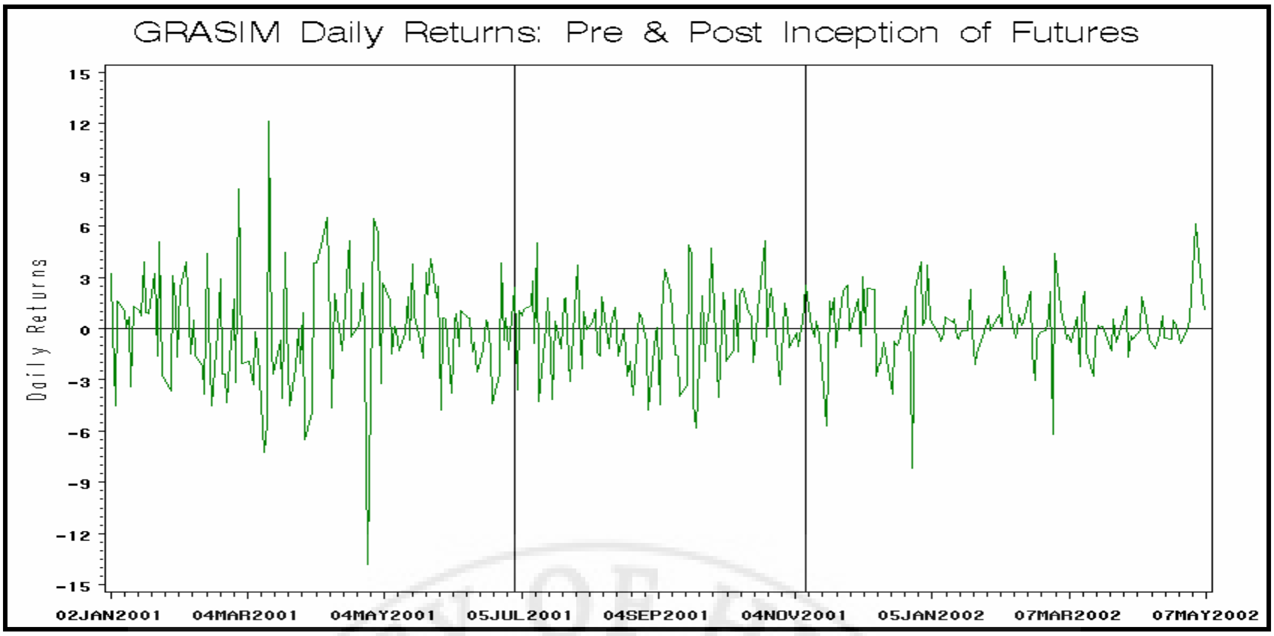
$$R_t = \phi_0 + \theta_1 Mkt_t + \gamma_{d1} FD_t + \gamma_{d2} OD_t + \varepsilon_t$$
$$\varepsilon_t / \varepsilon_{t-1} \sim N(0,1)$$

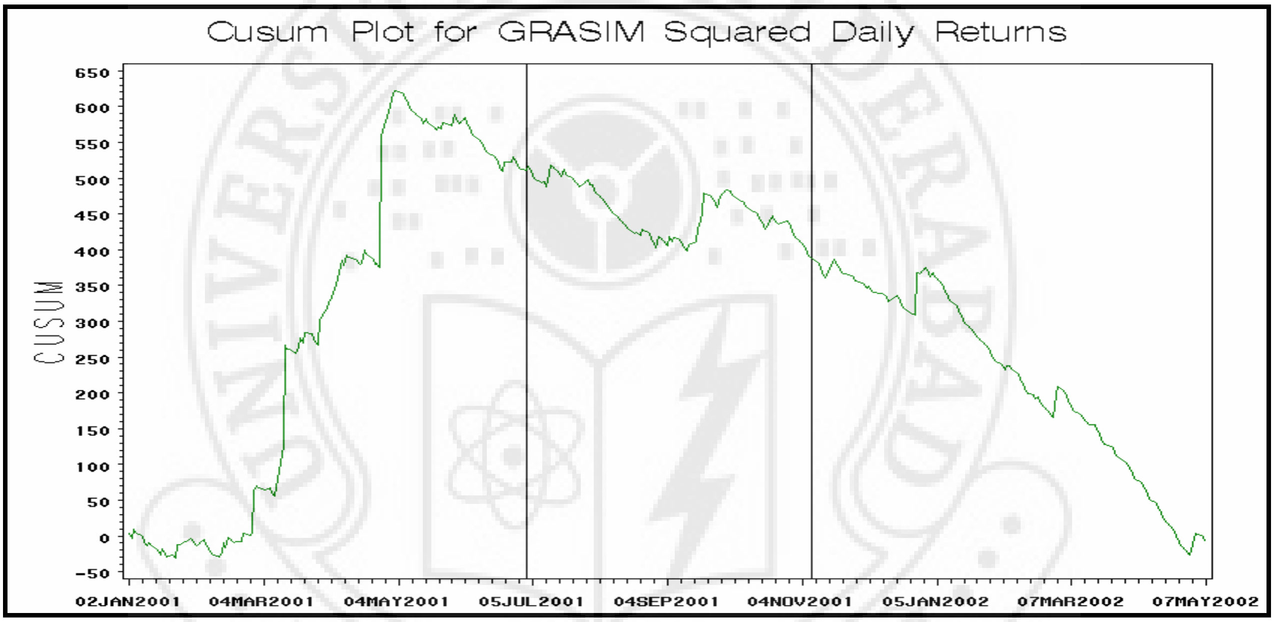
Parameter	Estimate
ϕ_0	0.122 (>0.10)
θ_1	0.979 (<0.01)
γ_{d1}	0.016 (>0.10)
γ_{d2}	-0.093 (>0.10)
ε_{t-1}	0.091 (<0.10)
F-stat	40.19 (<0.01)
G (4) test-statistic	3.689 (>0.10)
Q (4) test-statistic	3.828 (>0.10)
LM (4) test-static	3.329 (>0.10)

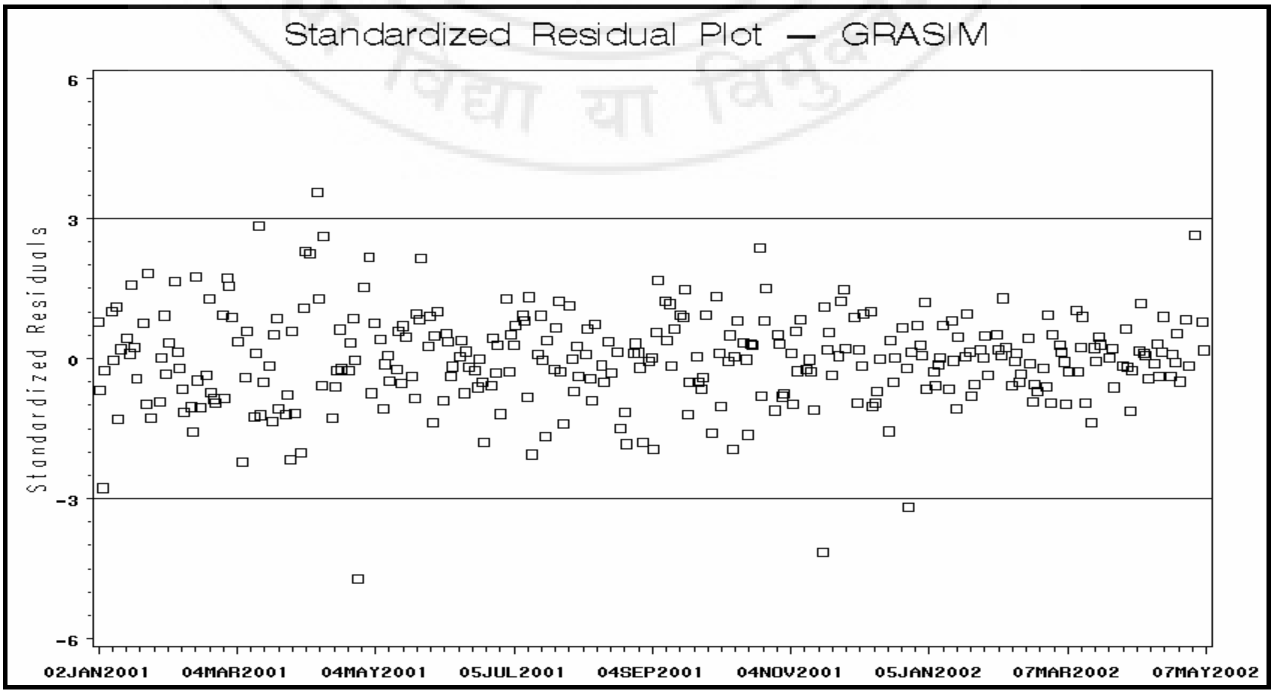
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


GRASIM Daily Returns: Pre & Post Inception of Futures
Daily Returns
15
12
9
6
3
0
-3
-6
-9
-12
-15
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Cusum Plot for GRASIM Squared Daily Returns
CUSUM
650
600
550
500
450
400
350
300
250
200
150
100
50
0
-50
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Standardized Residual Plot — GRASIM
Standardized Residuals
6
3
0
-3
-6
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002

Stock Symbol – GUJAMBCEM (Gujarat Ambuja Cements Ltd.)

Table No. 22a: Regression Results-Evidence of ARCH Effects. R_t takes stock symbol GUJAMBCEM, Mkt_t takes Nifty.

$$R_t = \phi_0 + \phi_1 R_{t-2} + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	0.102 (>0.10)
ϕ_1	-0.150 (<0.01)
θ_1	0.791 (<0.01)
F-stat	58.53 (<0.01)
G (4) test-statistic	1.495 (>0.10)
Q (4) test-statistic	10.66 (<0.01)
LM (4) test-static	9.522 (<0.01)

Table No. 22b:

Results of AR(1) - GARCH (1, 1) model for GUJAMBCEM using robust standard errors, R_t, Mkt_t are same as defined above, FD_t takes on value of zero before SSFs introduction and a value of one afterwards and OD_t takes on value of zero before 'stock options' introduction and a value of one afterwards.

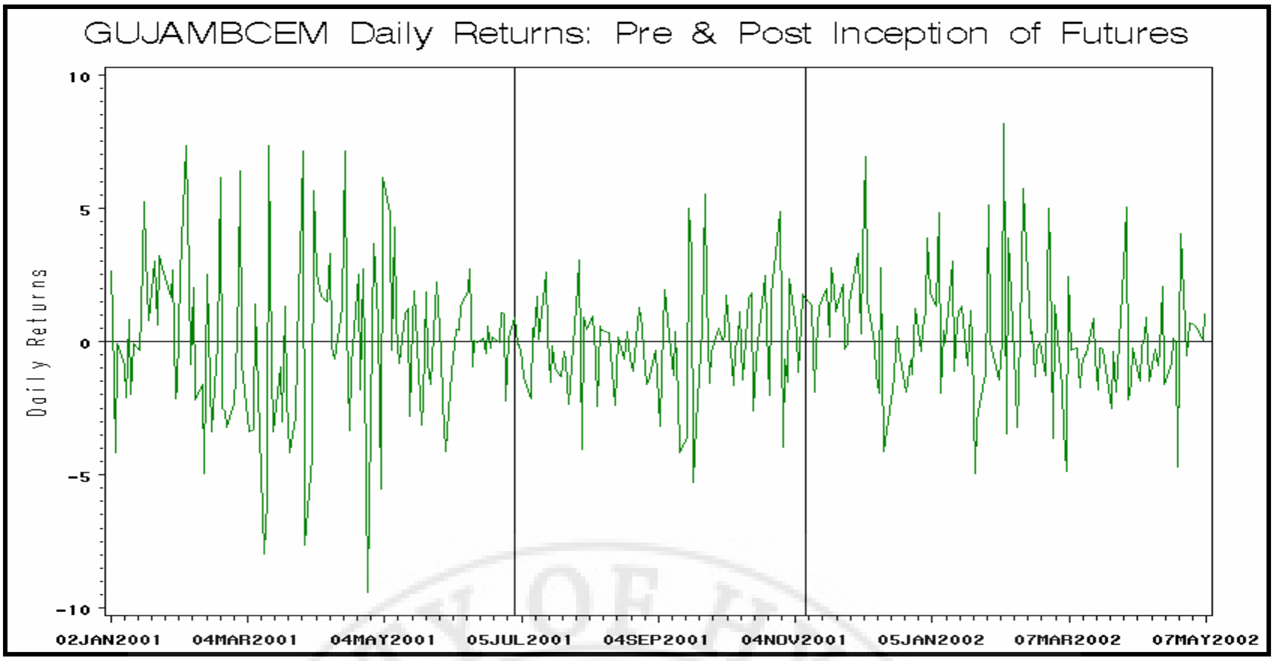
$$R_t = \phi_0 + \phi_1 R_{t-2} + \theta_1 Mkt_t + \varepsilon_t$$

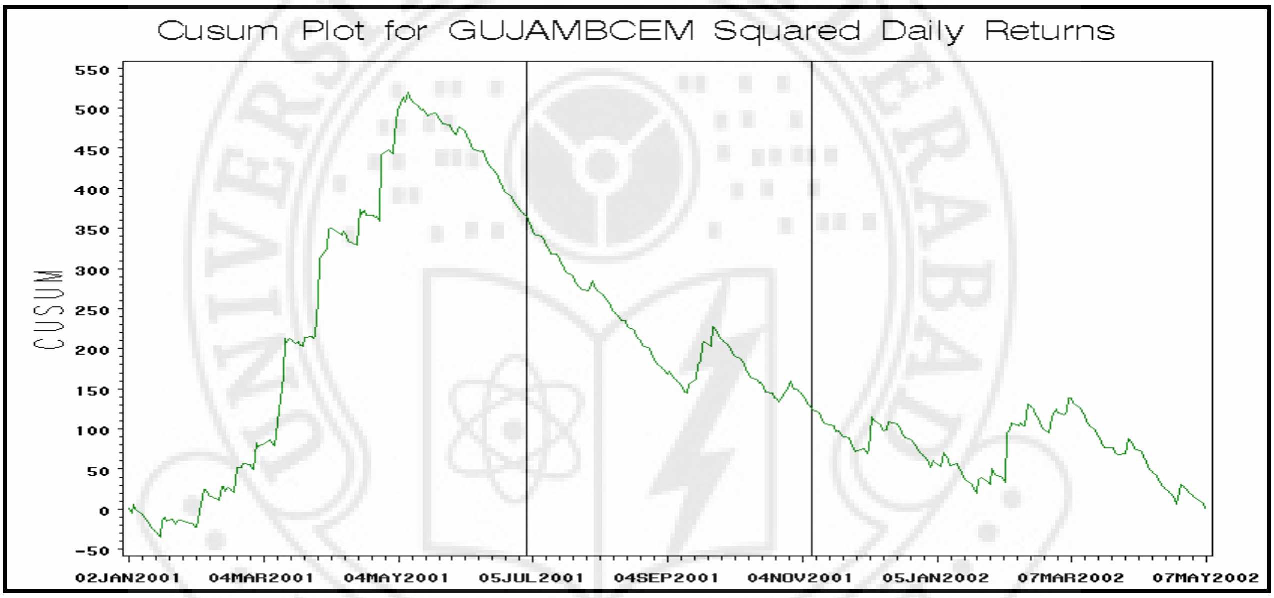
$$\varepsilon_t \sim N(0, h_t)$$

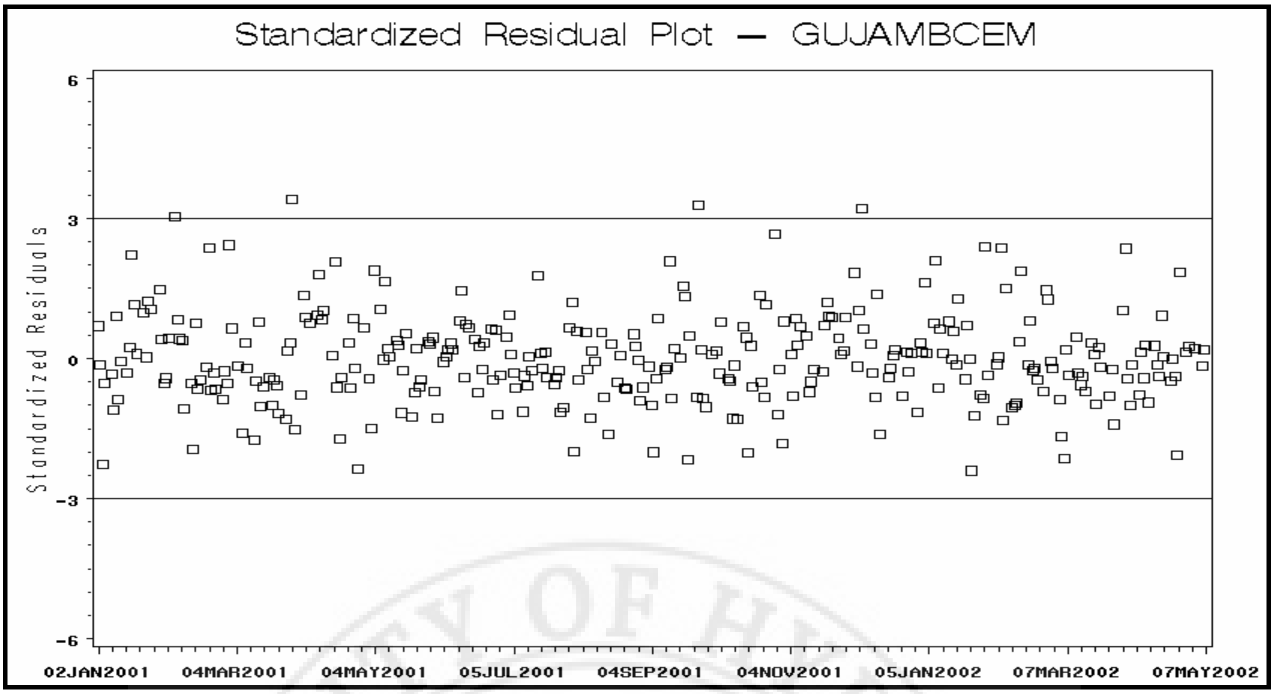
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \gamma_{d1} FD_t + \gamma_{d2} OD_t$$

Parameter	Estimate	p-value
ϕ_0	0.066	>0.10
ϕ_1	-0.173	<0.01
θ_1	0.737	<0.01
α_0	0.387	>0.10
α_1	0.060	<0.05
β_1	0.873	<0.01
γ_{d1}	0.101	>0.10
γ_{d2}	-0.176	>0.10
Diagnostics		
G (4) test-statistic	0.712	>0.10
Q (4) test-statistic	5.935	>0.10
LM (4) test-static	5.244	>0.10
Sign Bias	-0.005	>0.10
Negative Size Bias	0.124	>0.10
Positive Size Bias	0.011	>0.10
Joint Bias	0.886	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 + \beta_1 = 1$	2.980	<0.10

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


GUJAMBCEM Daily Returns: Pre & Post Inception of Futures
Daily Returns
10
5
0
-5
-10
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Cusum Plot for GUJAMBCEM Squared Daily Returns
CUSUM
550
500
450
400
350
300
250
200
150
100
50
0
-50
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Standardized Residual Plot — GUJAMBCEM
Standardized Residuals
6
3
0
-3
-6
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002

Stock Symbol – HDFC (Housing Development Finance Corporation Ltd.)

Table No. 23a: Regression Results-Evidence of ARCH Effects. R_t takes stock symbol HDFC, Mkt_t takes Nifty.

$$R_t = \phi_0 + \phi_1 R_{t-3} + \phi_2 R_{t-4} + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t / \varepsilon_{t-1} \sim N(0,1)$$

Parameter	Estimate
ϕ_0	0.065 (>0.10)
ϕ_1	-0.255 (<0.01)
ϕ_2	-0.088 (>0.10)
θ_1	0.343 (<0.01)
ε_{t-1}	0.124 (<0.05)
F-stat	11.46 (<0.01)
G (4) test-statistic	0.290 (>0.10)
Q (4) test-statistic	18.07 (<0.01)
LM (4) test-static	16.38 (<0.01)

Table No. 23b:

Results of ARCH (1) model for HDFC using robust standard errors, R_t, Mkt_t are same as defined above, FD_t takes on value of zero before SSFs introduction and a value of one afterwards and OD_t takes on value of zero before 'stock options' introduction and a value of one afterwards.

$$R_t = \phi_0 + \phi_1 R_{t-3} + \phi_2 R_{t-4} + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t / \varepsilon_{t-1} \sim N(0, h_t)$$

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \gamma_{d1} FD_t + \gamma_{d2} OD_t$$

Parameter	Estimate	p-value
ϕ_0	-0.014	>0.10
ϕ_1	-0.159	<0.01
ϕ_2	-0.093	<0.10
θ_1	0.295	<0.01
ε_{t-1}	0.144	<0.05
α_0	3.166	<0.01
α_1	0.502	<0.01
$\alpha_{0,d}$	-2.982	<0.01
$\alpha_{1,d}$	0.923	>0.10
Diagnostics		
G (4) test-statistic	3.039	>0.10
Q (4) test-statistic	1.245	>0.10
LM (4) test-static	1.103	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 = 1$	5.670	<0.05

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.

As the dummy of future introduction is highly significant GARCH model has been estimated.

Table No. 23c:

Results of ARCH (1) model for HDFC using robust standard errors, R_t, Mkt_t are same as defined above, and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

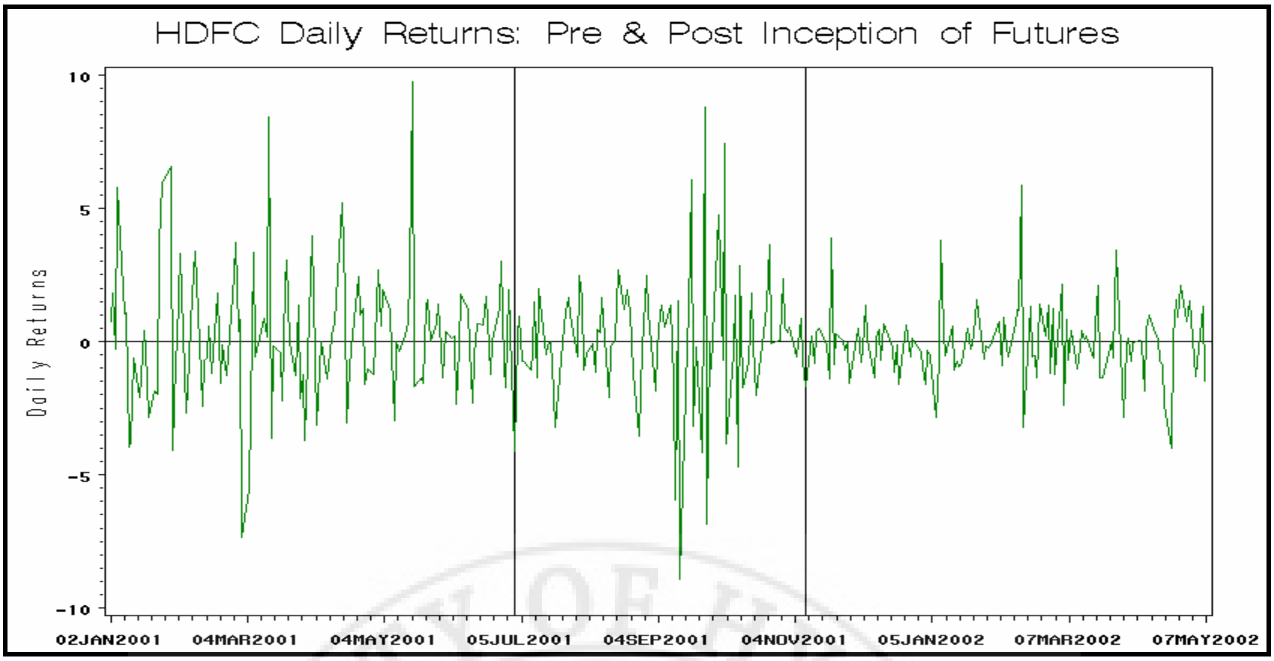
$$R_t = \phi_0 + \phi_1 R_{t-3} + \phi_2 R_{t-4} + \theta_1 Mkt_t + \varepsilon_t$$

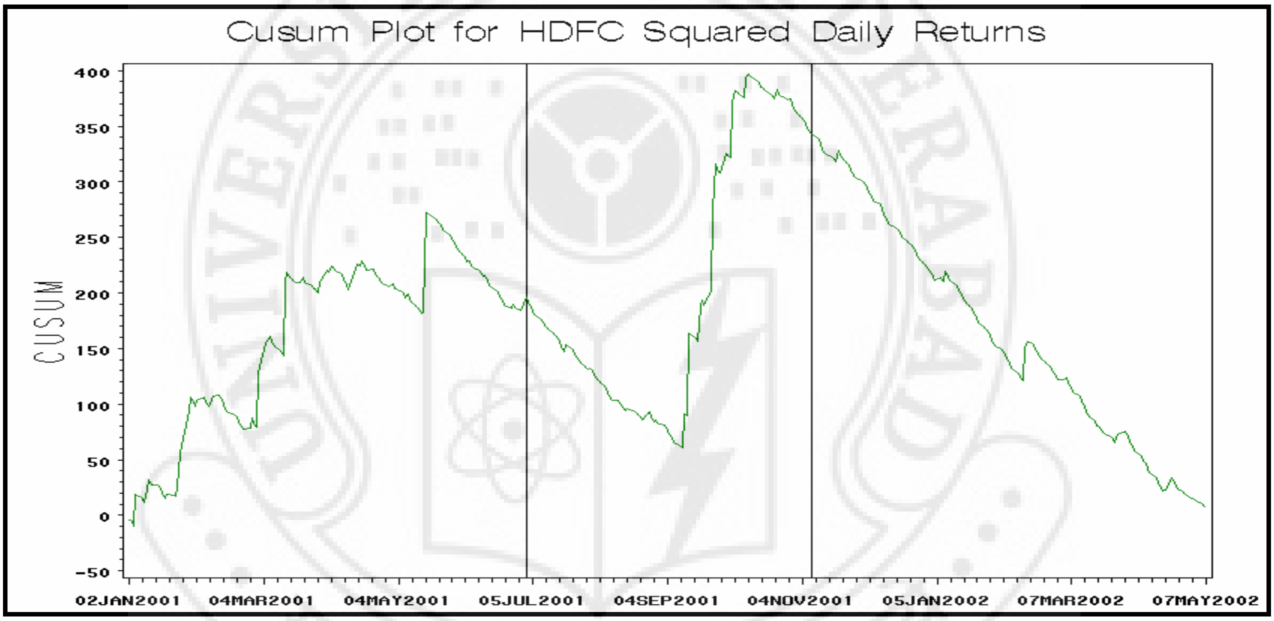
$$\varepsilon_t / \varepsilon_{t-1} \sim N(0, h_t)$$

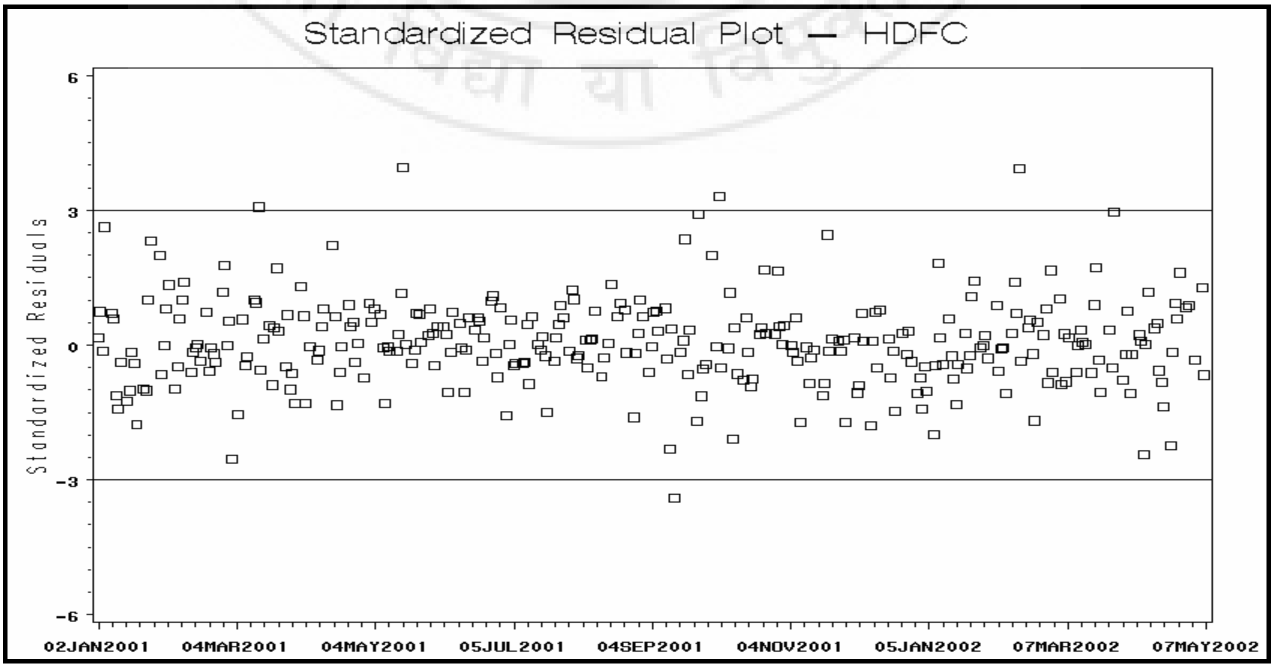
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_{0,d} D_t + \alpha_{1,d} D_t * \varepsilon_{t-1}^2$$

Parameter	**Estimate**	**p-value**
ϕ_0	-0.036	>0.10
ϕ_1	-0.139	<0.01
ϕ_2	-0.059	>0.10
θ_1	0.250	<0.01
ε_{t-1}	0.169	<0.01
α_0	4.138	<0.01
α_1	0.297	<0.05
$\alpha_{0,d}$	-3.414	<0.01
$\alpha_{1,d}$	0.753	<0.01
Diagnostics		
G (4) test-statistic	5.168	>0.10
Q (4) test-statistic	1.686	>0.10
LM (4) test-static	1.489	>0.10
Sign Bias	-0.223	<0.05
Negative Size Bias	0.200	>0.10
Positive Size Bias	0.041	>0.10
Joint Bias	1.432	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 = 1$	10.06	<0.01

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


HDFC Daily Returns: Pre & Post Inception of Futures
10
5
0
-5
-10
Daily Returns
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Cusum Plot for HDFC Squared Daily Returns
400
350
300
250
200
150
100
50
0
-50
CUSUM
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Standardized Residual Plot — HDFC
6
3
0
-3
-6
Standardized Residuals
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002

Stock Symbol – HINDALC0 (Hindalco Industries Ltd.)

Table No. 24a: Regression Results-Evidence of ARCH Effects. R_t takes stock symbol HINDALC0, Mkt_t takes Nifty.

$$R_t = \phi_0 + \phi_1 R_{t-3} + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	0.053 (>0.10)
ϕ_1	-0.095 (<0.10)
θ_1	0.643 (<0.01)
F-stat	38.23 (<0.01)
G (4) test-statistic	5.280 (>0.10)
Q (4) test-statistic	20.18 (<0.10)
LM (4) test-static	21.74 (>0.10)

Table No. 24b:

Results of AR(3)-ARCH (1) model for HINDALC0 using robust standard errors, R_t, Mkt_t are same as defined above, FD_t takes on value of zero before SSFs introduction and a value of one afterwards and OD_t takes on value of zero before 'stock options' introduction and a value of one afterwards.

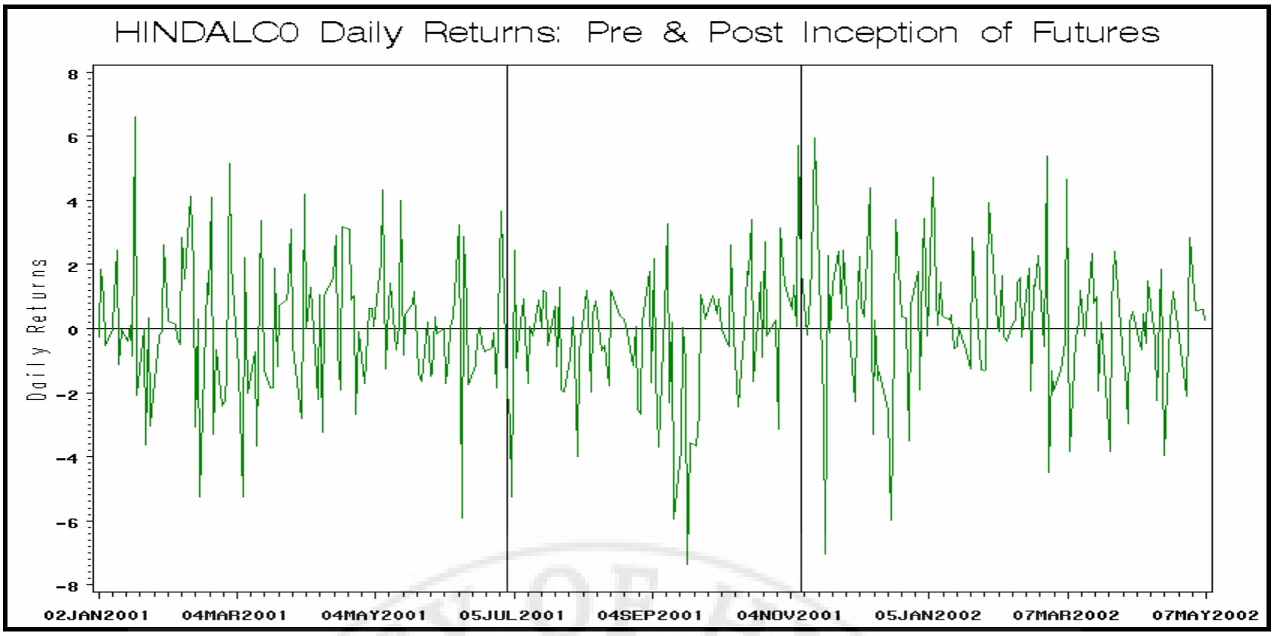
$$R_t = \phi_0 + \phi_1 R_{t-3} + \theta_1 Mkt_t + \varepsilon_t$$

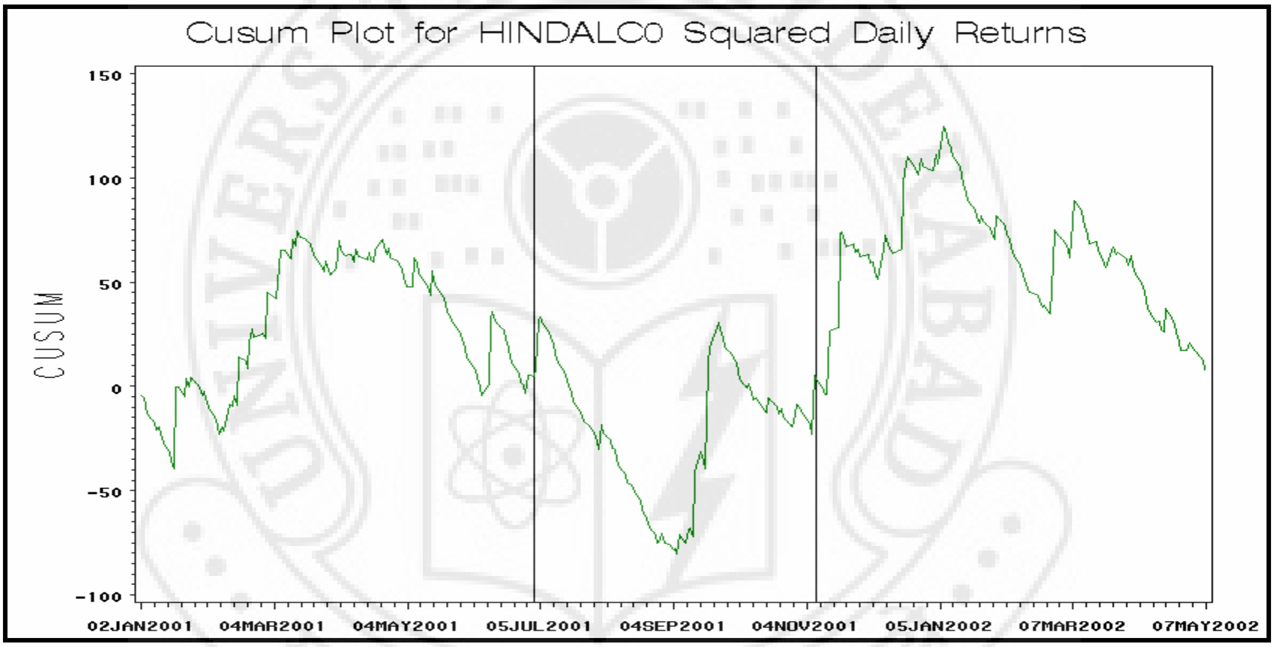
$$\varepsilon_t \sim N(0, h_t)$$

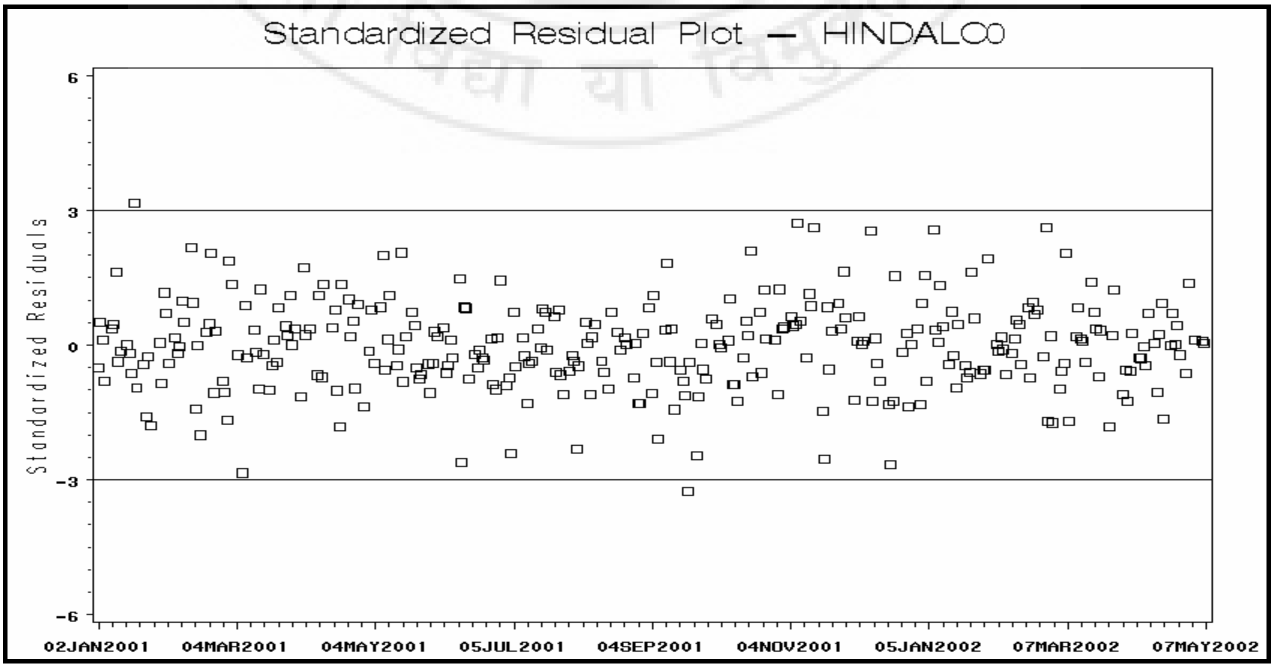
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \gamma_{d1} FD_t + \gamma_{d2} OD_t$$

Parameter	Estimate	p-value
ϕ_0	0.006	>0.10
ϕ_1	-0.085	<0.10
θ_1	0.626	<0.01
α_0	3.025	<0.01
α_1	0.416	<0.01
γ_{d1}	-0.360	>0.10
γ_{d2}	-0.710	>0.10
Diagnostics		
G (4) test-statistic	2.597	>0.10
Q (4) test-statistic	7.197	>0.10
LM (4) test-static	6.574	>0.10
Sign Bias	-0.165	<0.05
Negative Size Bias	0.263	<0.05
Positive Size Bias	0.085	>0.10
Joint Bias	2.012	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 = 1$	12.62	<0.01

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


HINDALCO Daily Returns: Pre & Post Inception of Futures
Daily Returns
8
6
4
2
0
-2
-4
-6
-8
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Cusum Plot for HINDALCO Squared Daily Returns
CUSUM
150
100
50
0
-50
-100
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Standardized Residual Plot — HINDALCO
Standardized Residuals
6
3
0
-3
-6
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002

Stock Symbol – HINDLEVER (Hindustan Unilever Ltd.)

Table No. 25:

Regression Results for HINDLEVER using robust standard errors, R_t takes stock symbol HINDLEVER, Mkt_t takes Nifty, FD_t takes on value of zero before SSFs introduction and a value of one afterwards and OD_t takes on value of zero before 'stock options' introduction and a value of one afterwards.

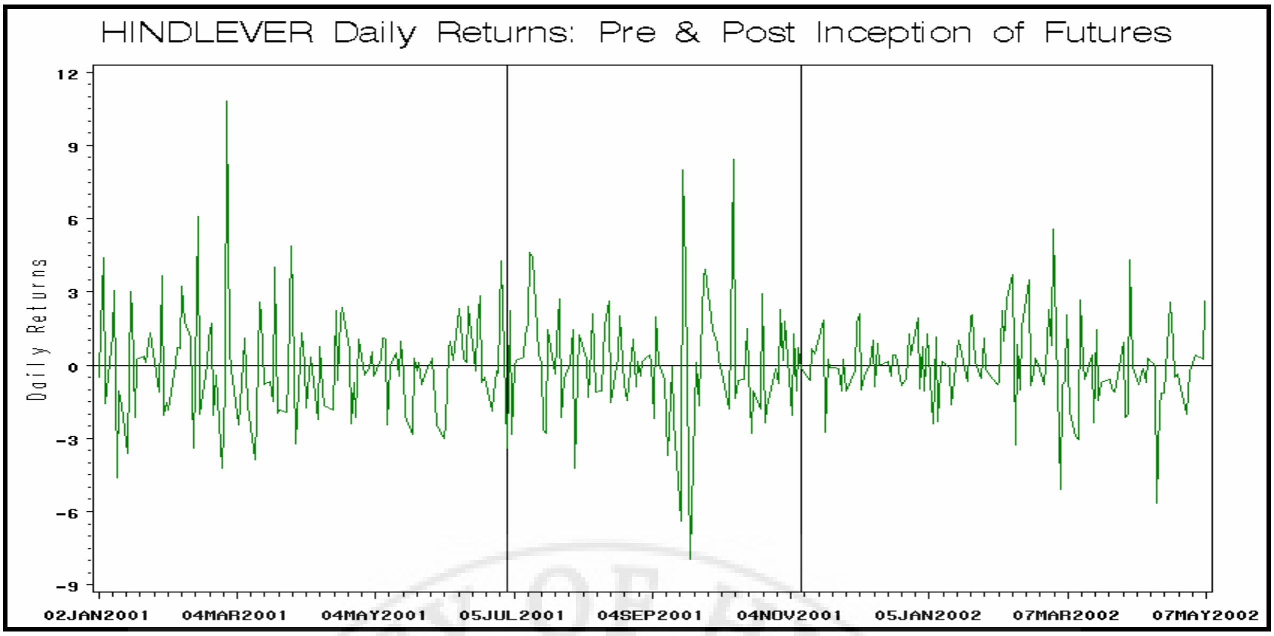
$$R_t = \phi_0 + \theta_1 Mkt_t + \gamma_{d1} FD_t + \gamma_{d2} OD_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0,1)$$

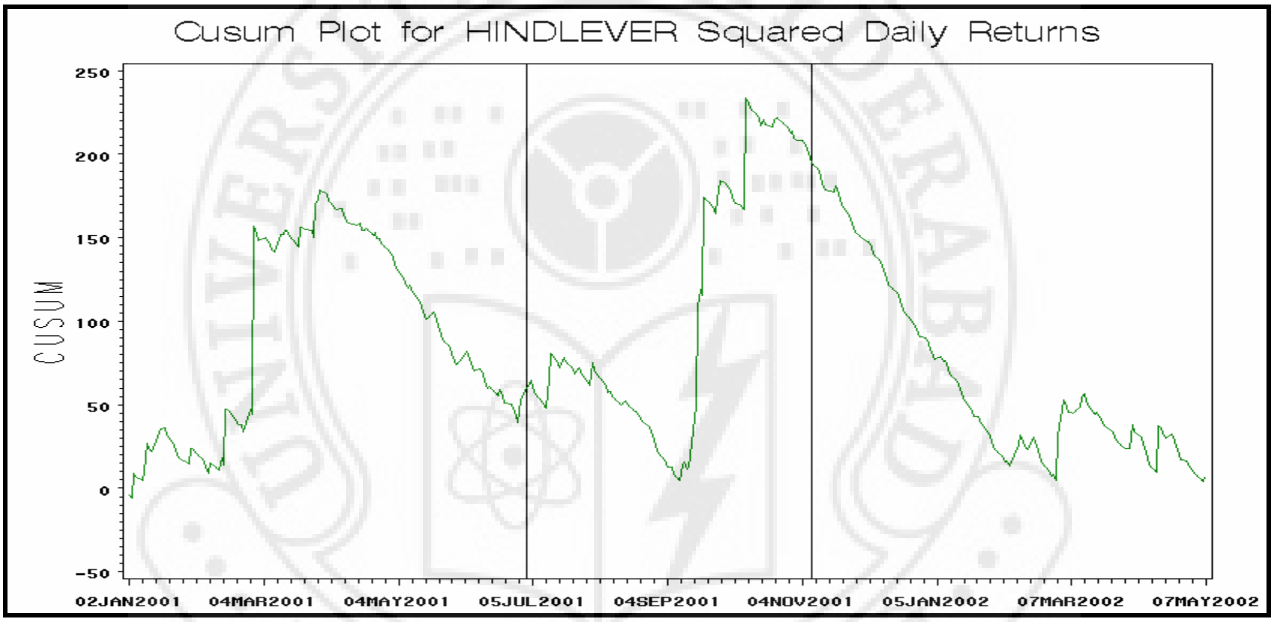
Parameter	Estimate
ϕ_0	0.098 (>0.10)
θ_1	0.757 (<0.01)
γ_{d1}	-0.229 (>0.10)
γ_{d2}	0.048 (>0.10)
F-stat	49.24 (<0.01)
G (4) test-statistic	4.521 (>0.10)
Q (4) test-statistic	5.519 (>0.10)
LM (4) test-static	5.392 (>0.10)

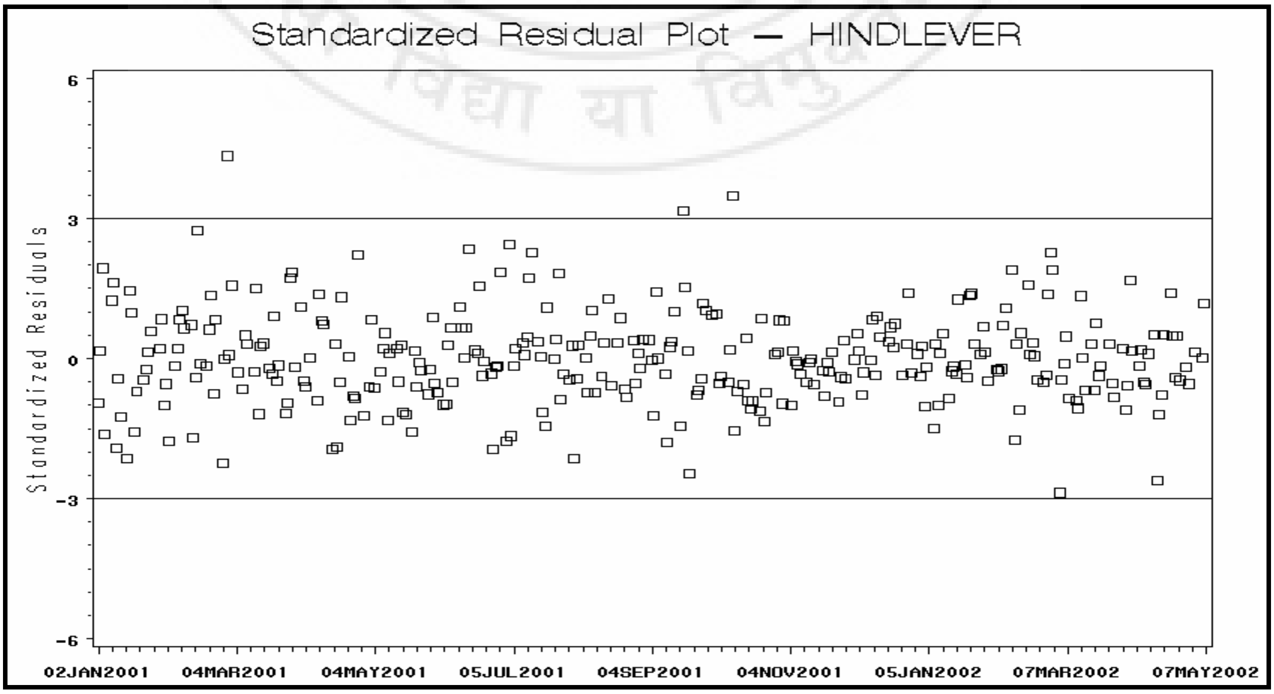
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


HINDLEVER Daily Returns: Pre & Post Inception of Futures
Daily Returns
12
9
6
3
0
-3
-6
-9
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Cusum Plot for HINDLEVER Squared Daily Returns
CUSUM
250
200
150
100
50
0
-50
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Standardized Residual Plot — HINDLEVER
Standardized Residuals
6
3
0
-3
-6
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002

Stock Symbol – HINDPETRO (Hindustan Petroleum Corporation Ltd.)

Table No. 26:

Regression Results for HINDPETRO using robust standard errors, R_t takes stock symbol HINDPETRO, Mkt_t takes Nifty, FD_t takes on value of zero before SSFs introduction and a value of one afterwards and OD_t takes on value of zero before 'stock options' introduction and a value of one afterwards.

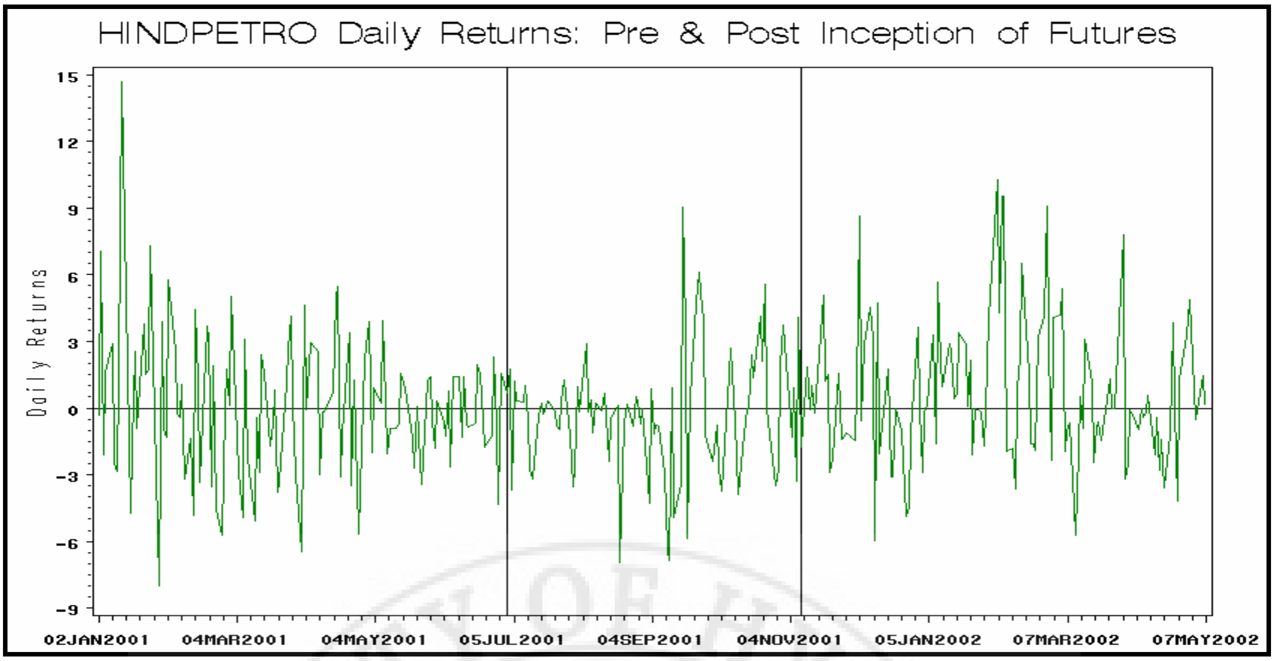
$$R_t = \phi_0 + \phi_1 R_{t-4} + \theta_1 Mkt_t + \gamma_{d1} FD_t + \gamma_{d2} OD_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0,1)$$

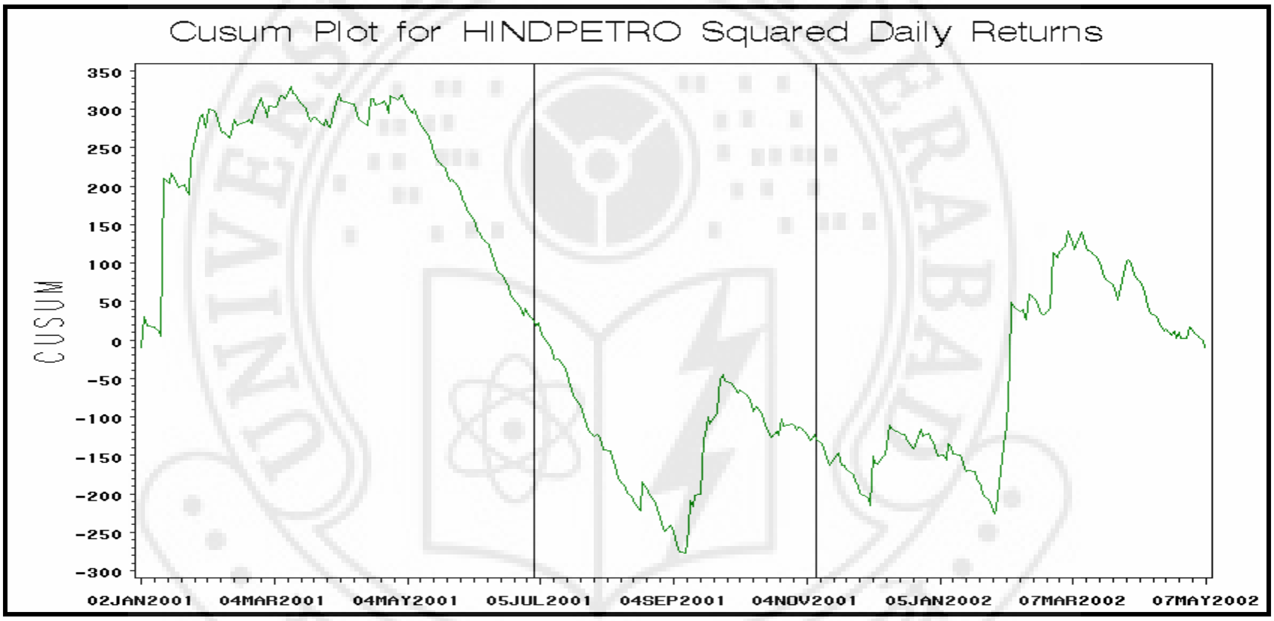
Parameter	Estimate
ϕ_0	0.176 (>0.10)
ϕ_1	-0.091 (<0.10)
θ_1	0.756 (<0.01)
γ_{d1}	0.706 (<0.05)
γ_{d2}	-0.278 (>0.10)
F-stat	15.49 (<0.01)
G (4) test-statistic	4.310 (>0.10)
Q (4) test-statistic	3.939 (>0.10)
LM (4) test-static	3.288 (>0.10)

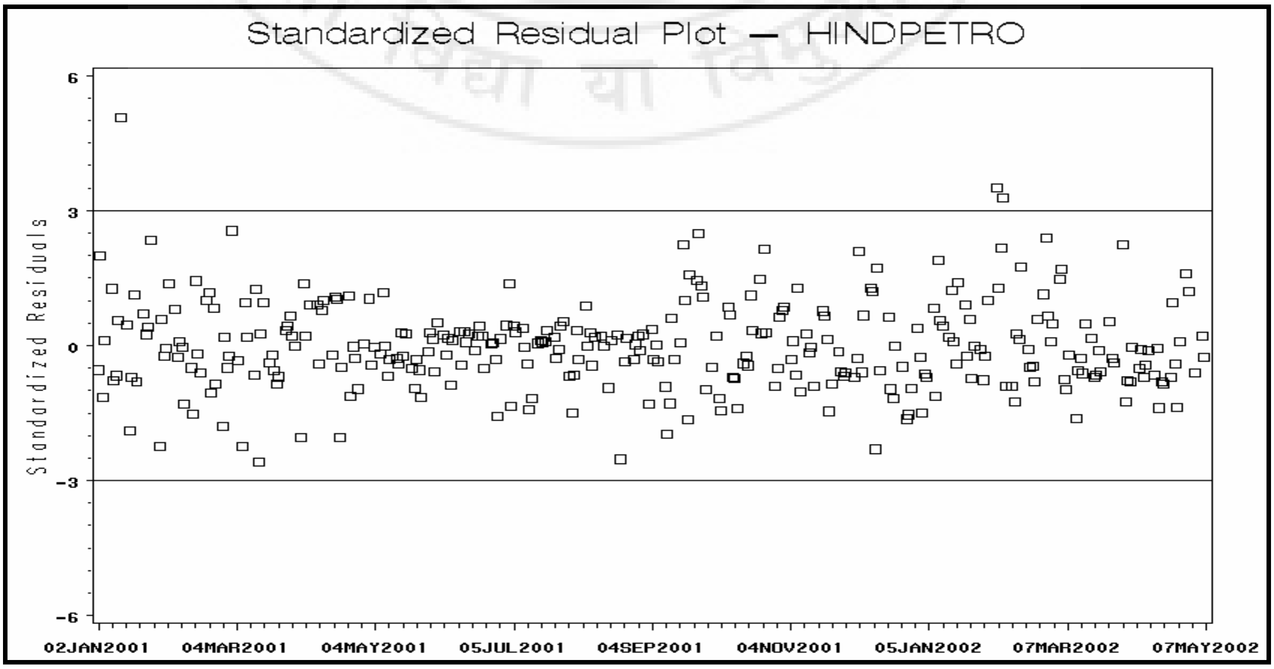
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


HINDPETRO Daily Returns: Pre & Post Inception of Futures
Daily Returns
15
12
9
6
3
0
-3
-6
-9
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Cusum Plot for HINDPETRO Squared Daily Returns
CUSUM
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Standardized Residual Plot — HINDPETRO
Standardized Residuals
6
3
0
-3
-6
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002

Stock Symbol – ICICI (ICICI Ltd.)

Table No. 27a: Regression Results-Evidence of ARCH Effects. R_t takes stock symbol ICICI, Mkt_t takes Nifty.

$$R_t = \phi_0 + \phi_1 R_{t-3} + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	-0.090 (>0.10)
ϕ_1	-0.122 (<0.05)
θ_1	0.857 (<0.01)
F-stat	33.08 (<0.01)
G (4) test-statistic	3.823 (>0.10)
Q (4) test-statistic	18.27 (<0.01)
LM (4) test-static	15.13 (<0.01)

Table No. 27b:

Results of AR(3) - GARCH (1, 1) model for ICICI using robust standard errors, R_t, Mkt_t are same as defined above, FD_t takes on value of zero before SSFs introduction and a value of one afterwards and OD_t takes on value of zero before 'stock options' introduction and a value of one afterwards.

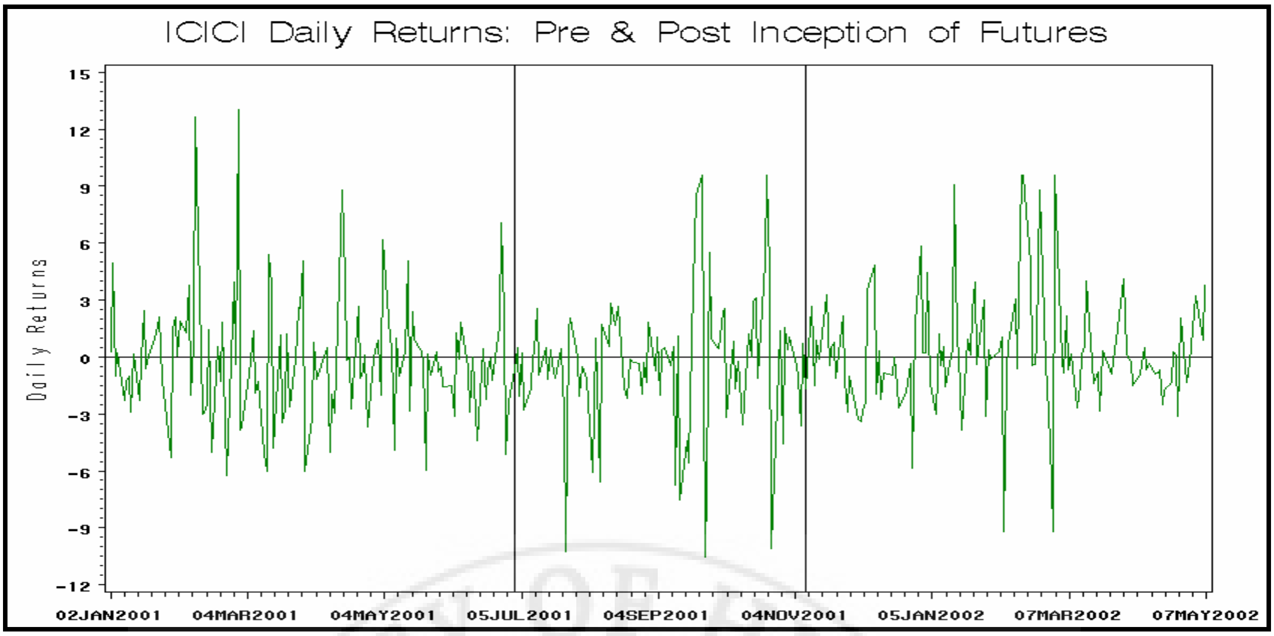
$$R_t = \phi_0 + \phi_1 R_{t-3} + \theta_1 Mkt_t + \varepsilon_t$$

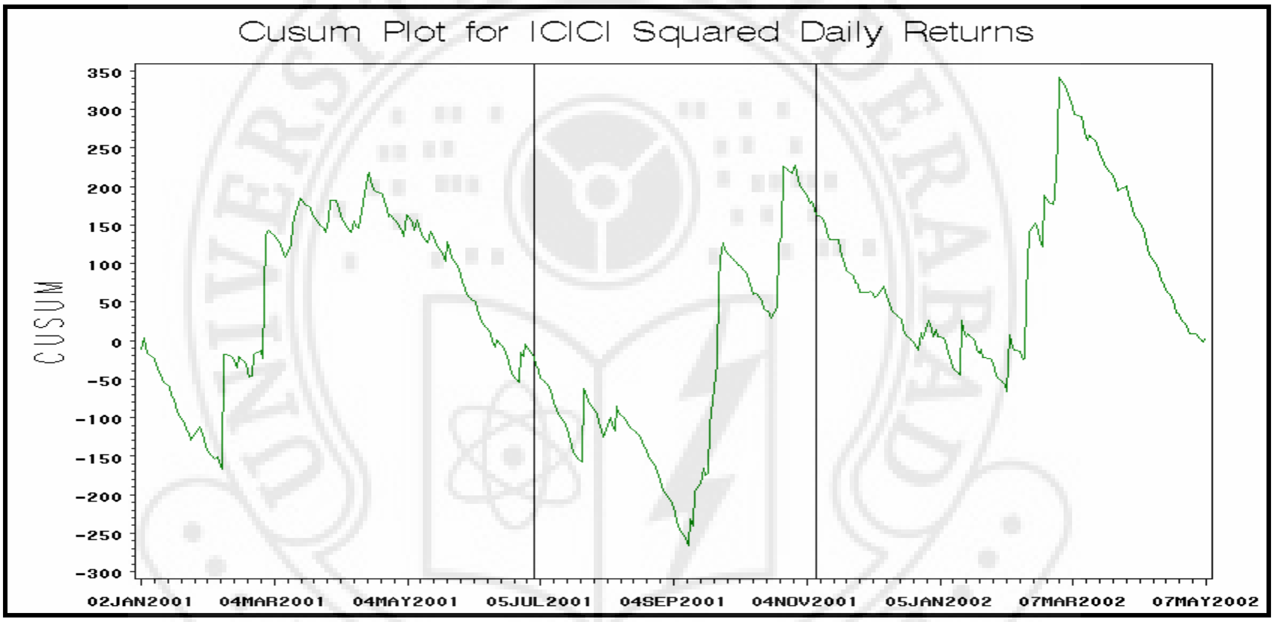
$$\varepsilon_t \sim N(0, h_t)$$

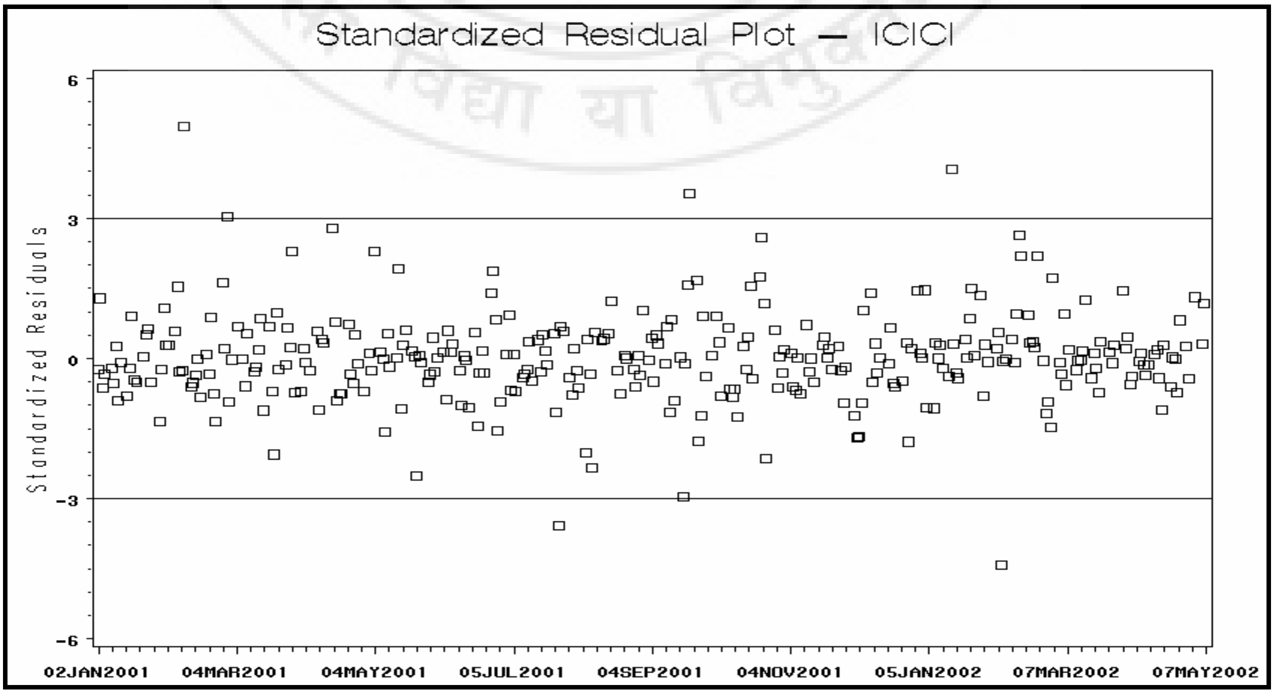
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \gamma_{d1} FD_t + \gamma_{d2} OD_t$$

Parameter	Estimate	p-value
ϕ_0	-0.190	>0.10
ϕ_1	-0.088	>0.10
θ_1	0.865	<0.01
α_0	0.884	<0.05
α_1	0.078	<0.05
β_1	0.802	<0.01
γ_{d1}	-0.046	>0.10
γ_{d2}	-0.154	>0.10
Diagnostics		
G (4) test-statistic	2.282	>0.10
Q (4) test-statistic	2.060	>0.10
LM (4) test-static	2.014	>0.10
Sign Bias	-0.180	>0.10
Negative Size Bias	0.163	>0.10
Positive Size Bias	0.204	>0.10
Joint Bias	1.057	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 + \beta_1 = 1$	14.87	<0.01

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


ICICI Daily Returns: Pre & Post Inception of Futures
Daily Returns
15
12
9
6
3
0
-3
-6
-9
-12
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Cusum Plot for ICICI Squared Daily Returns
CUSUM
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Standardized Residual Plot — ICICI
Standardized Residuals
6
3
0
-3
-6
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002

Stock Symbol – INFOSYSTCH (Infosys Technolgies Ltd.)

Table No. 28a: Regression Results-Evidence of ARCH Effects. R_t takes stock symbol INFOSYSTCH, Mkt_t takes Nifty.

$$R_t = \phi_0 + \phi_1 R_{t-2} + \phi_2 R_{t-3} + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	-0.039 (>0.10)
ϕ_1	-0.109 (<0.05)
ϕ_2	-0.118 (<0.05)
θ_1	1.992 (<0.01)
F-stat	131.8 (<0.01)
G (4) test-statistic	3.600 (>0.10)
Q (4) test-statistic	9.662 (<0.05)
LM (4) test-static	8.290 (<0.10)

Table No. 28b:

Results of AR(2,3) - GARCH (1, 1) model for INFOSYSTCH using robust standard errors, R_t, Mkt_t are same as defined above, FD_t takes on value of zero before SSFs introduction and a value of one afterwards and OD_t takes on value of zero before 'stock options' introduction and a value of one afterwards.

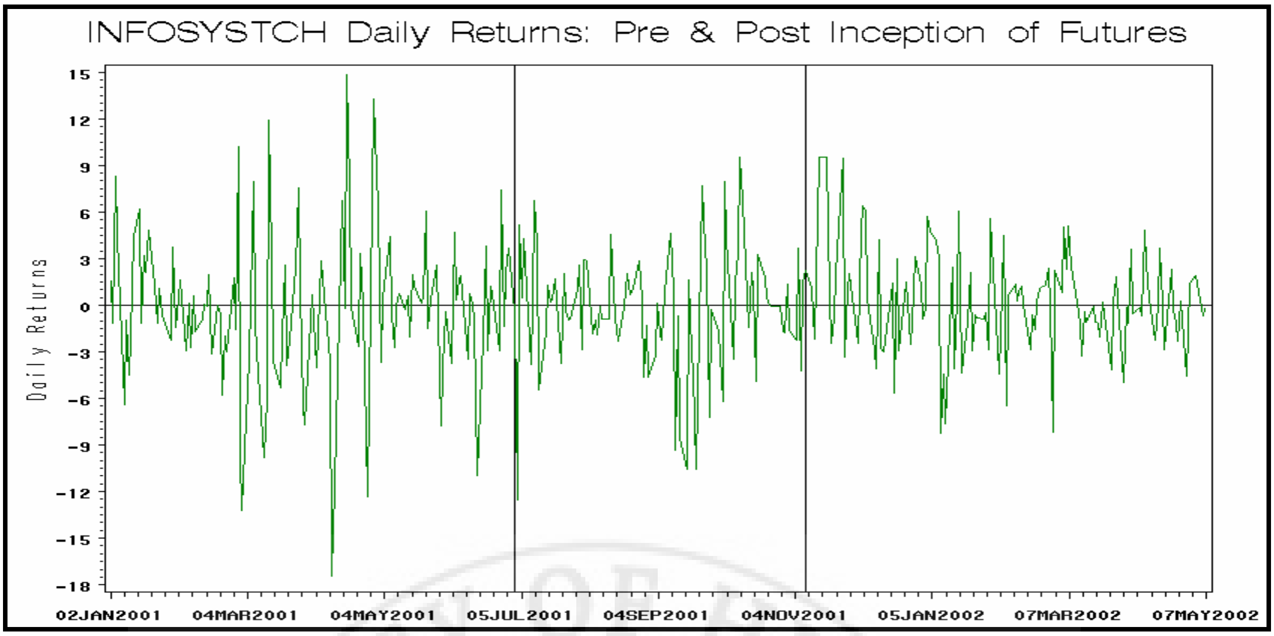
$$R_t = \phi_0 + \phi_1 R_{t-2} + \phi_2 R_{t-3} + \theta_1 Mkt_t + \varepsilon_t$$

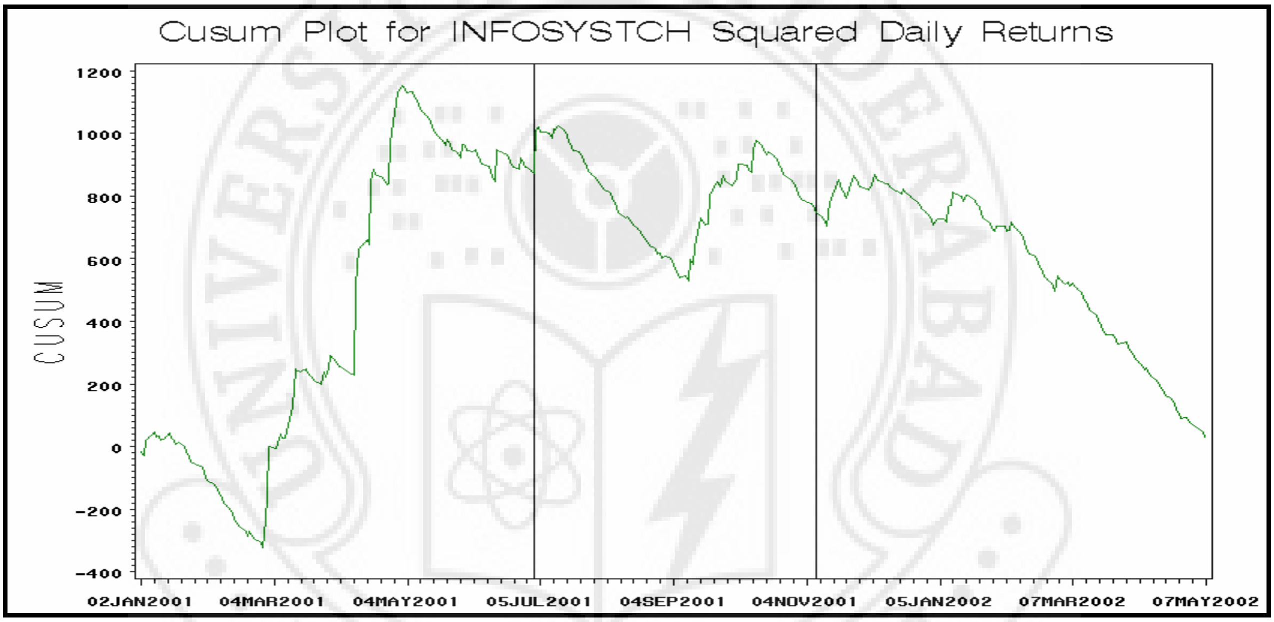
$$\varepsilon_t \sim N(0, h_t)$$

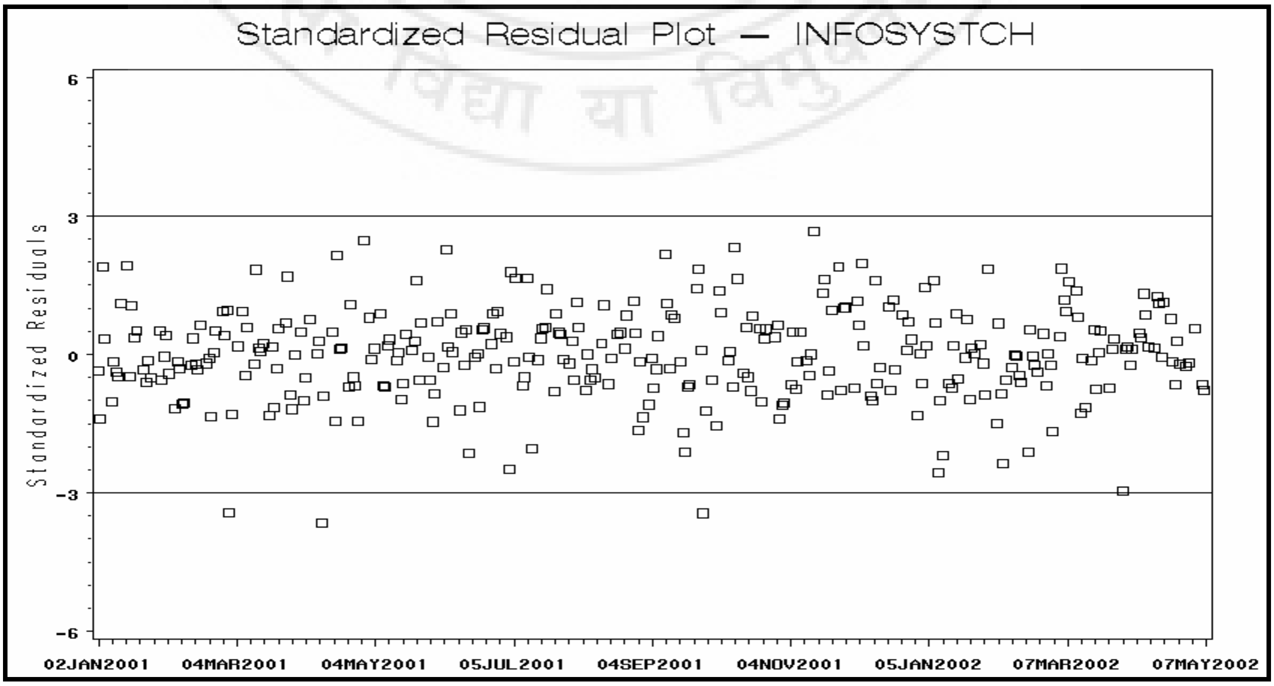
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \gamma_{d1} FD_t + \gamma_{d2} OD_t$$

Parameter	Estimate	p-value
ϕ_0	-0.057	>0.10
ϕ_1	-0.116	<0.01
ϕ_2	-0.085	>0.10
θ_1	1.900	<0.01
α_0	1.658	<0.05
α_1	0.085	<0.05
β_1	0.763	<0.01
γ_{d1}	0.068	>0.10
γ_{d2}	0.743	>0.10
Diagnostics		
G (4) test-statistic	4.614	>0.10
Q (4) test-statistic	0.815	>0.10
LM (4) test-static	0.719	>0.10
Sign Bias	-0.215	>0.10
Negative Size Bias	0.003	>0.10
Positive Size Bias	-0.034	>0.10
Joint Bias	3.683	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 + \beta_1 = 1$	3.910	<0.05

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


INFOSYSTCH Daily Returns: Pre & Post Inception of Futures
Daily Returns
02JAN2001 04MAR2001 04MAY2001 05JUL2001 04SEP2001 04NOV2001 05JAN2002 07MAR2002 07MAY2002


Cusum Plot for INFOSYSTCH Squared Daily Returns
CUSUM
02JAN2001 04MAR2001 04MAY2001 05JUL2001 04SEP2001 04NOV2001 05JAN2002 07MAR2002 07MAY2002


Standardized Residual Plot — INFOSYSTCH
Standardized Residuals
02JAN2001 04MAR2001 04MAY2001 05JUL2001 04SEP2001 04NOV2001 05JAN2002 07MAR2002 07MAY2002

Stock Symbol – ITC (Indian Tobacco Company Ltd.)

Table No. 29a: Regression Results-Evidence of ARCH Effects. R_t takes stock symbol ITC, Mkt_t takes Nifty.

$$R_t = \phi_0 + \phi_1 R_{t-3} + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	-0.075 (>0.10)
ϕ_1	-0.101 (<0.10)
θ_1	0.608 (<0.01)
F-stat	37.88 (<0.01)
G (4) test-statistic	5.907 (>0.10)
Q (4) test-statistic	9.445 (<0.05)
LM (4) test-static	10.16 (<0.05)

Table No. 29b:

Results of AR(3) - ARCH (1) model for ITC using robust standard errors, R_t, Mkt_t are same as defined above, FD_t takes on value of zero before SSFs introduction and a value of one afterwards and OD_t takes on value of zero before 'stock options' introduction and a value of one afterwards.

$$R_t = \phi_0 + \phi_1 R_{t-3} + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0, h_t)$$

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \gamma_{d1} FD_t + \gamma_{d2} OD_t$$

Parameter	Estimate	p-value
ϕ_0	-0.064	>0.10
ϕ_1	-0.139	<0.01
θ_1	0.584	<0.01
α_0	3.422	<0.01
α_1	0.297	<0.01
$\alpha_{0,d}$	-1.996	<0.01
$\alpha_{1,d}$	0.322	>0.10
Diagnostics		
G (4) test-statistic	3.297	>0.10
Q (4) test-statistic	2.551	>0.10
LM (4) test-static	2.671	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 = 1$	10.07	<0.01

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.

As the dummy of future introduction is highly significant GARCH model has been estimated.

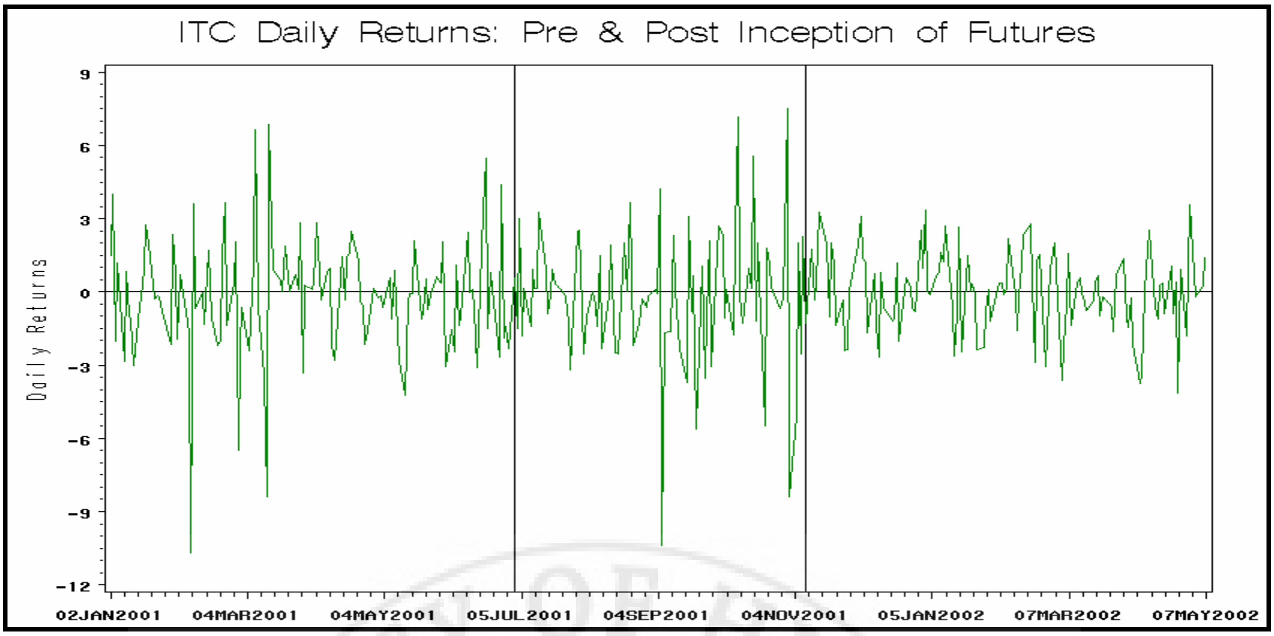
Table No. 29c:

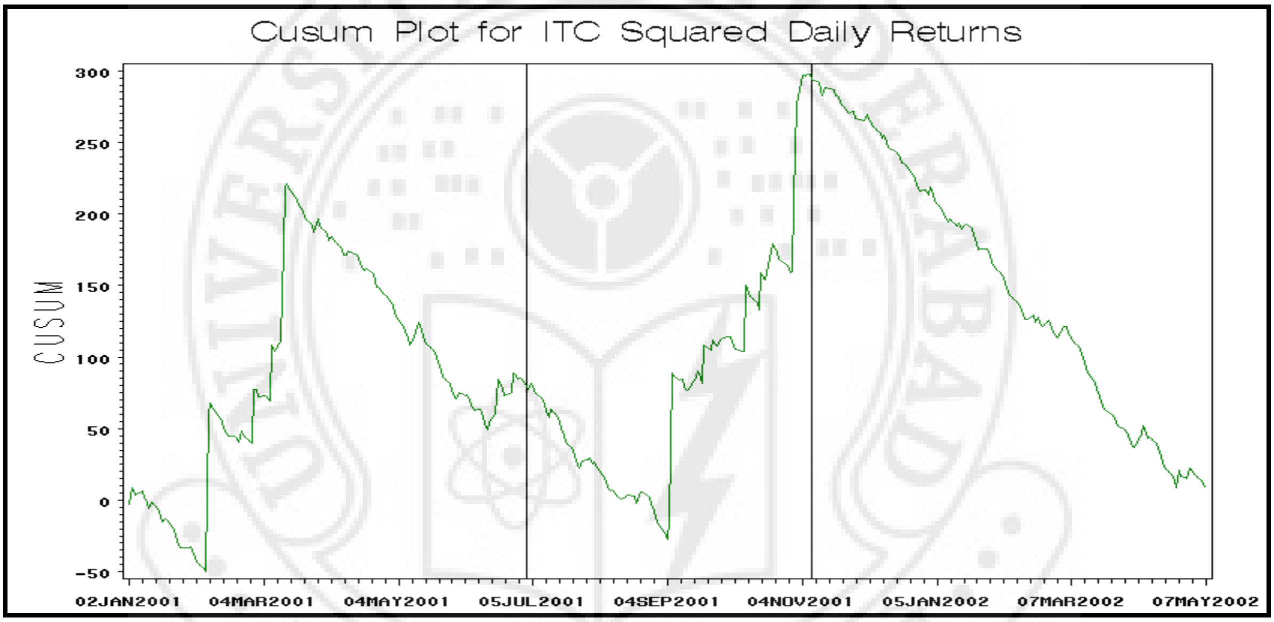
Results of AR(3) - ARCH (1) model for ITC using robust standard errors, R_t, Mkt_t are same as defined above, and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

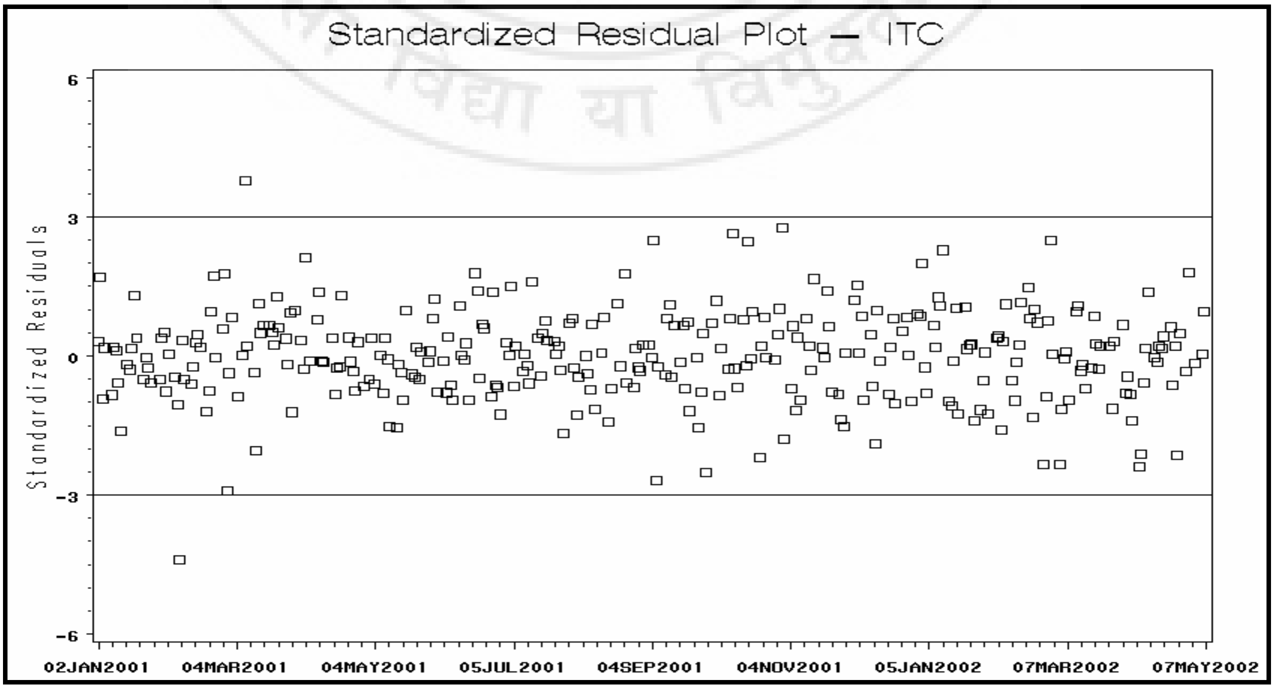
$$R_t = \phi_0 + \phi_1 R_{t-3} + \theta_1 Mkt_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0, h_t)$$
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_{0,d} D_t + \alpha_{1,d} D_t * \varepsilon_{t-1}^2$$

Parameter	Estimate	p-value
ϕ_0	-0.053	>0.10
ϕ_1	-0.140	<0.01
θ_1	0.575	<0.01
α_0	3.186	<0.01
α_1	0.484	<0.01
$\alpha_{0,d}$	-0.495	<0.01
$\alpha_{1,d}$	-1.123	<0.05
Diagnostics		
G (4) test-statistic	1.617	>0.10
Q (4) test-statistic	3.639	>0.10
LM (4) test-static	3.864	>0.10
Sign Bias	-0.176	>0.10
Negative Size Bias	0.093	>0.10
Positive Size Bias	0.155	>0.10
Joint Bias	0.920	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 = 1$	6.130	<0.01

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


ITC Daily Returns: Pre & Post Inception of Futures
Daily Returns
9
6
3
0
-3
-6
-9
-12
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Cusum Plot for ITC Squared Daily Returns
CUSUM
300
250
200
150
100
50
0
-50
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Standardized Residual Plot — ITC
Standardized Residuals
6
3
0
-3
-6
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002

Stock Symbol – L&T (Larsen & Toubro Ltd.)

Table No. 30a: Regression Results-Evidence of ARCH Effects. R_t takes stock symbol L&T, Mkt_t takes Nifty.

$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	0.014 (>0.10)
θ_1	1.084 (<0.01)
F-stat	188.0 (<0.01)
G (4) test-statistic	7.387 (>0.10)
Q (4) test-statistic	16.74 (<0.01)
LM (4) test-static	13.01 (<0.01)

Table No. 30b:

Results of GARCH (1, 1) model for L&T using robust standard errors, R_t, Mkt_t are same as defined above, FD_t takes on value of zero before SSFs introduction and a value of one afterwards and OD_t takes on value of zero before 'stock options' introduction and a value of one afterwards.

$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0, h_t)$$

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \gamma_{d1} FD_t + \gamma_{d2} OD_t$$

Parameter	Estimate	p-value
ϕ_0	-0.042	>0.10
θ_1	1.066	<0.01
α_0	1.194	<0.01
α_1	0.154	<0.05
β_1	0.623	<0.01
$\alpha_{0,d}$	-0.702	<0.05
$\alpha_{1,d}$	-0.073	>0.10
Diagnostics		
G (4) test-statistic	6.724	>0.10
Q (4) test-statistic	3.486	>0.10
LM (4) test-static	3.405	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 + \beta_1 = 1$	5.930	<0.01

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.

As the dummy of future introduction is highly significant GARCH model has been estimated.

Table No. XXc:

Results of GARCH (1, 1) model for L&T using robust standard errors, R_t, Mkt_t are same as defined above, and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

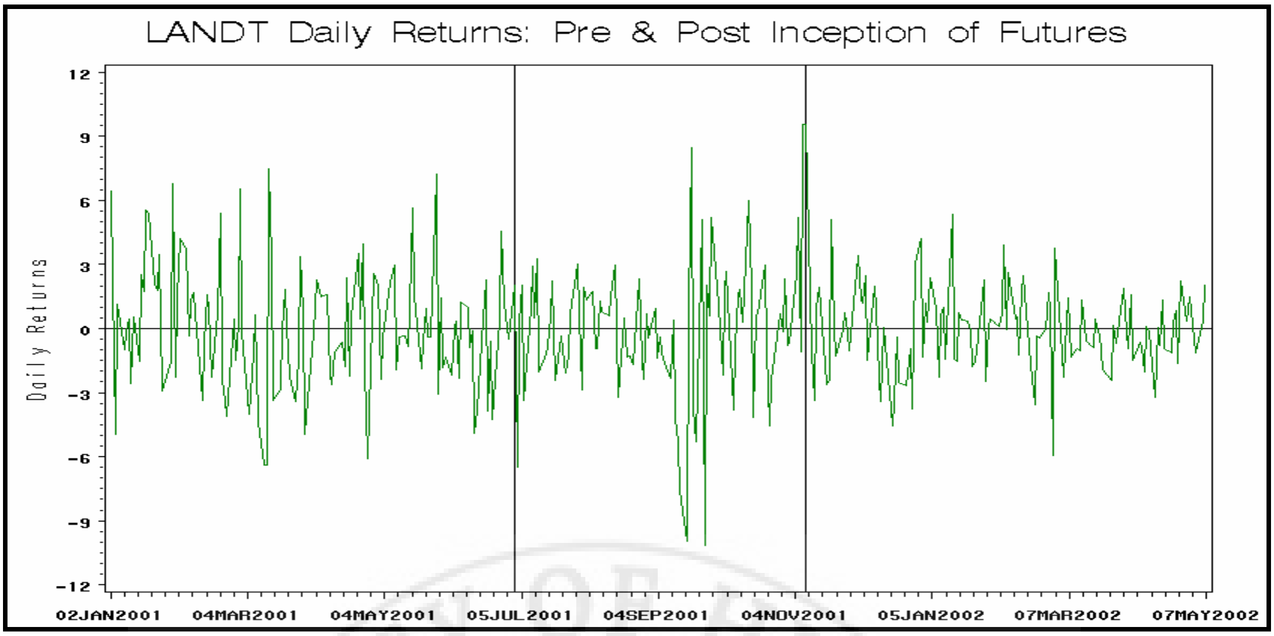
$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

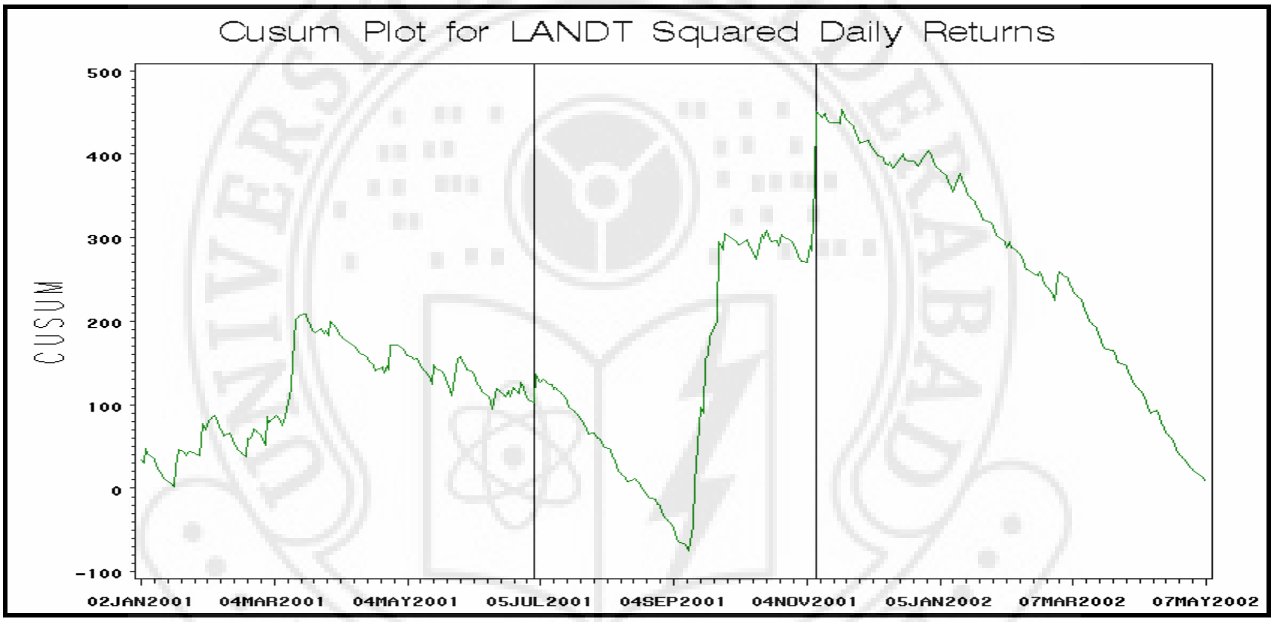
$$\varepsilon_t \sim N(0, h_t)$$

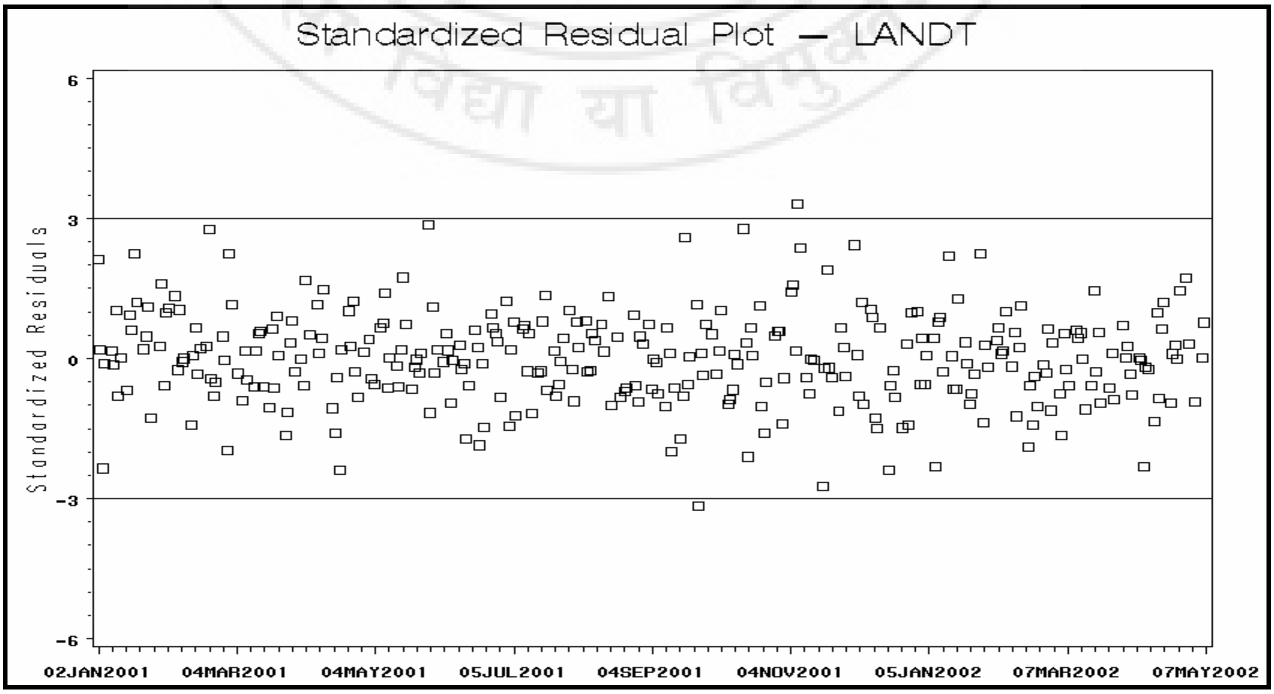
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \alpha_{0,d} D_t + \alpha_{1,d} D_t * \varepsilon_{t-1}^2 + \beta_{1,d} D_t * h_{t-1}$$

Parameter	Estimate	p-value
ϕ_0	-0.043	>0.10
θ_1	1.065	<0.01
α_0	1.191	>0.10
α_1	0.153	<0.05
β_1	0.612	<0.01
$\alpha_{0,d}$	-0.602	>0.10
$\alpha_{1,d}$	-0.038	>0.10
$\beta_{1,d}$	-0.013	>0.10
Diagnostics		
G (4) test-statistic	6.454	>0.10
Q (4) test-statistic	3.079	>0.10
LM (4) test-static	2.899	>0.10
Sign Bias	-0.148	>0.10
Negative Size Bias	0.350	>0.10
Positive Size Bias	-0.000	>0.10
Joint Bias	6.036	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 + \beta_1 = 1$	4.160	<0.05

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


LANDT Daily Returns: Pre & Post Inception of Futures
Daily Returns
12
9
6
3
0
-3
-6
-9
-12
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Cusum Plot for LANDT Squared Daily Returns
CUSUM
500
400
300
200
100
0
-100
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Standardized Residual Plot — LANDT
Standardized Residuals
6
3
0
-3
-6
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002

Stock Symbol – MTNL (Mahanagar Telephone Nigam Ltd.)

Table No. 31a: Regression Results-Evidence of ARCH Effects. R_t takes stock symbol MTNL, Mkt_t takes Nifty.

$$R_t = \phi_0 + \phi_1 R_{t-2} + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	-0.019 (>0.10)
ϕ_1	-0.159 (<0.01)
θ_1	1.001 (<0.01)
F-stat	62.24 (<0.01)
G (4) test-statistic	6.992 (>0.10)
Q (4) test-statistic	26.70 (<0.01)
LM (4) test-static	21.61 (<0.01)

Table No. 31b:

Results of AR(2) - GARCH (1, 1) model for MTNL using robust standard errors, R_t, Mkt_t are same as defined above, FD_t takes on value of zero before SSFs introduction and a value of one afterwards and OD_t takes on value of zero before 'stock options' introduction and a value of one afterwards.

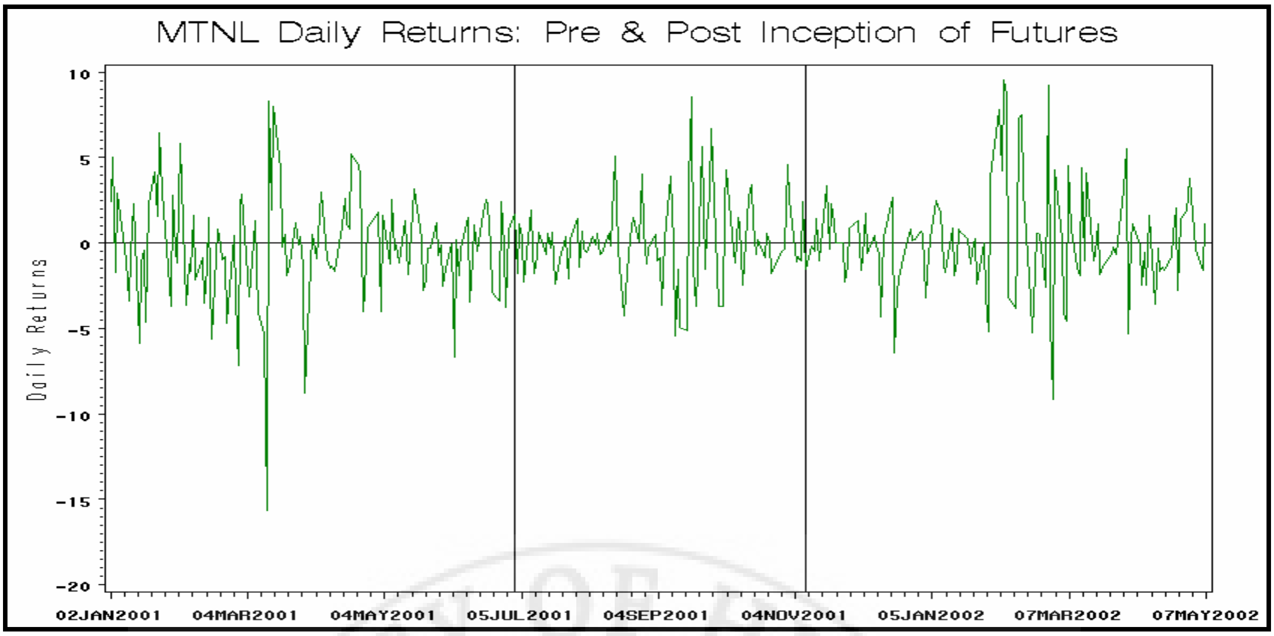
$$R_t = \phi_0 + \phi_1 R_{t-2} + \theta_1 Mkt_t + \varepsilon_t$$

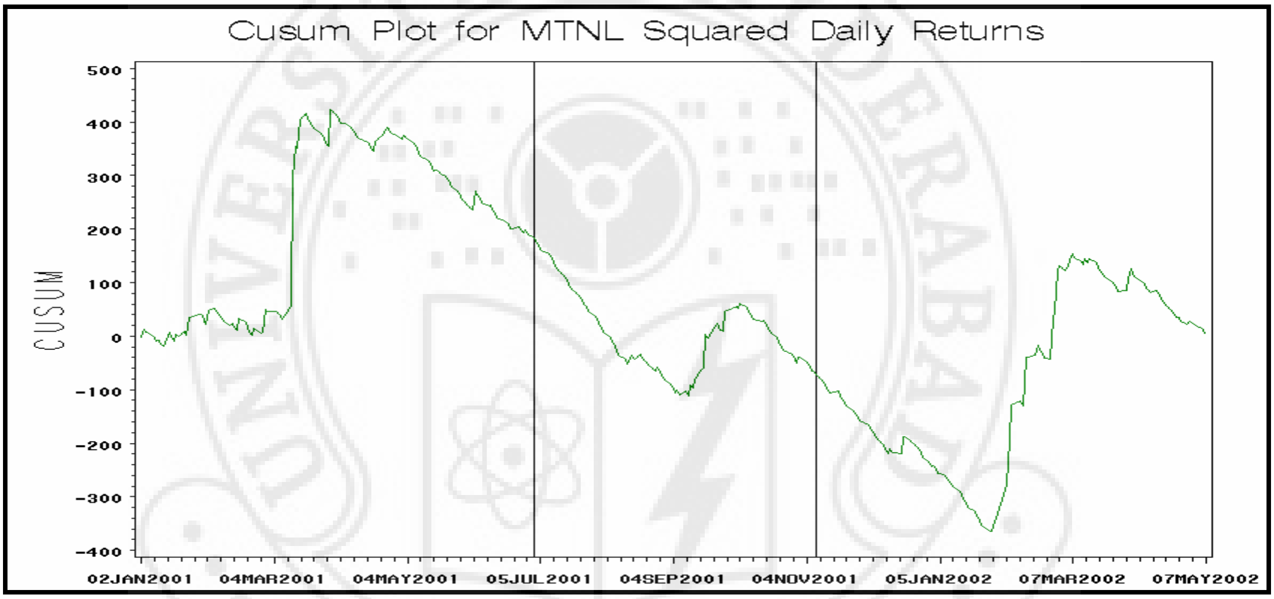
$$\varepsilon_t \sim N(0, h_t)$$

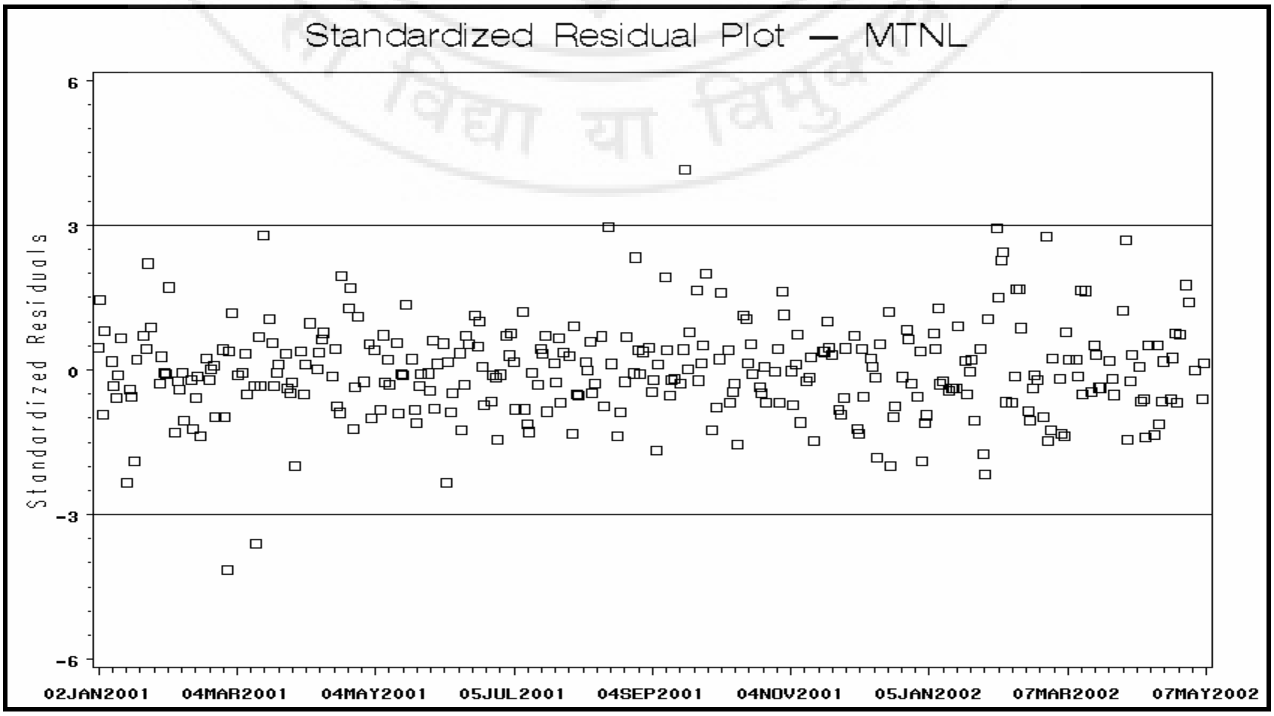
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \gamma_{d1} FD_t + \gamma_{d2} OD_t$$

Parameter	Estimate	p-value
ϕ_0	-0.044	>0.10
ϕ_1	-0.159	<0.01
θ_1	0.880	<0.01
α_0	1.117	<0.05
α_1	0.094	<0.01
β_1	0.776	<0.01
γ_{d1}	0.145	>0.10
γ_{d2}	-0.577	>0.10
Diagnostics		
G (4) test-statistic	3.323	>0.10
Q (4) test-statistic	3.750	>0.10
LM (4) test-static	3.737	>0.10
Sign Bias	-0.173	>0.10
Negative Size Bias	0.130	>0.10
Positive Size Bias	0.233	>0.10
Joint Bias	1.841	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 + \beta_1 = 1$	11.83	<0.01

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


MTNL Daily Returns: Pre & Post Inception of Futures
Daily Returns
10
5
0
-5
-10
-15
-20
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Cusum Plot for MTNL Squared Daily Returns
CUSUM
500
400
300
200
100
0
-100
-200
-300
-400
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Standardized Residual Plot — MTNL
Standardized Residuals
6
3
0
-3
-6
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002

Stock Symbol – M&M (Mahindra & Mahindra Ltd.)

Table No. 32a: Regression Results-Evidence of ARCH Effects. R_t takes stock symbol M&M, Mkt_t takes Nifty.

$$R_t = \phi_0 + \phi_1 R_{t-4} + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	**Estimate**
ϕ_0	-0.057 (>0.10)
ϕ_1	-0.114 (<0.05)
θ_1	1.137 (<0.01)
F-stat	69.42 (<0.01)
G (4) test-statistic	4.557 (>0.10)
Q (4) test-statistic	18.12 (<0.01)
LM (4) test-static	14.65 (<0.01)

Table No. 32b:

Results of AR(4) - GARCH (1, 1) model for M&M using robust standard errors, R_t, Mkt_t are same as defined above, FD_t takes on value of zero before SSFs introduction and a value of one afterwards and OD_t takes on value of zero before 'stock options' introduction and a value of one afterwards.

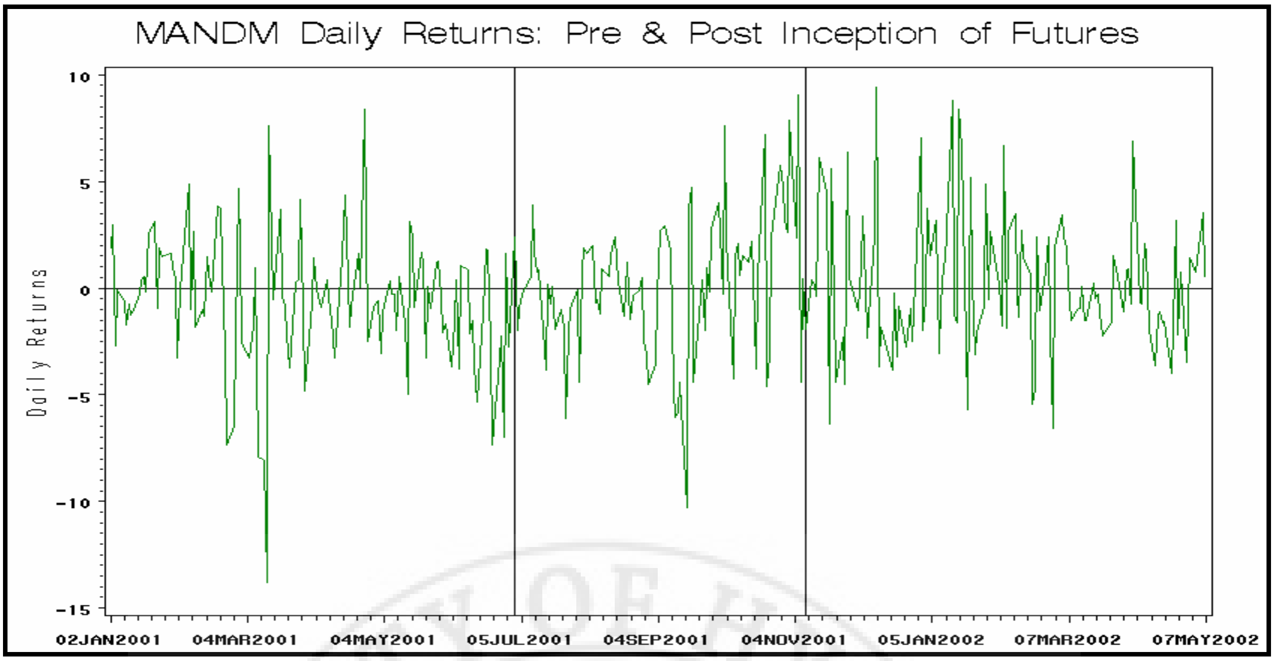
$$R_t = \phi_0 + \phi_1 R_{t-4} + \theta_1 Mkt_t + \varepsilon_t$$

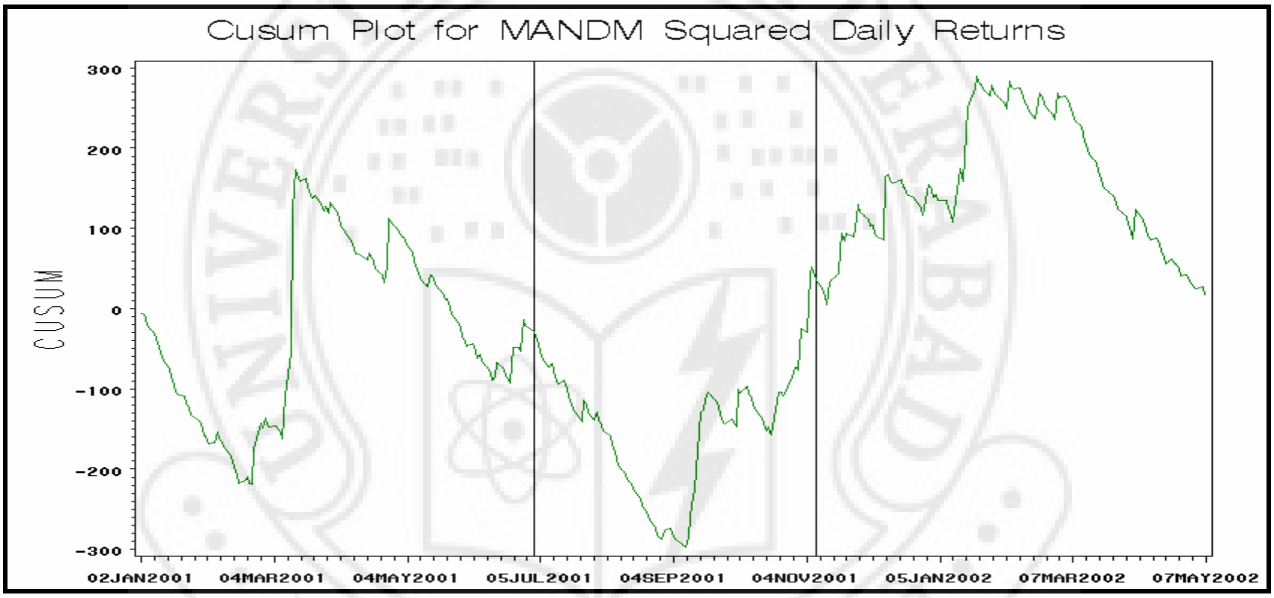
$$\varepsilon_t \sim N(0, h_t)$$

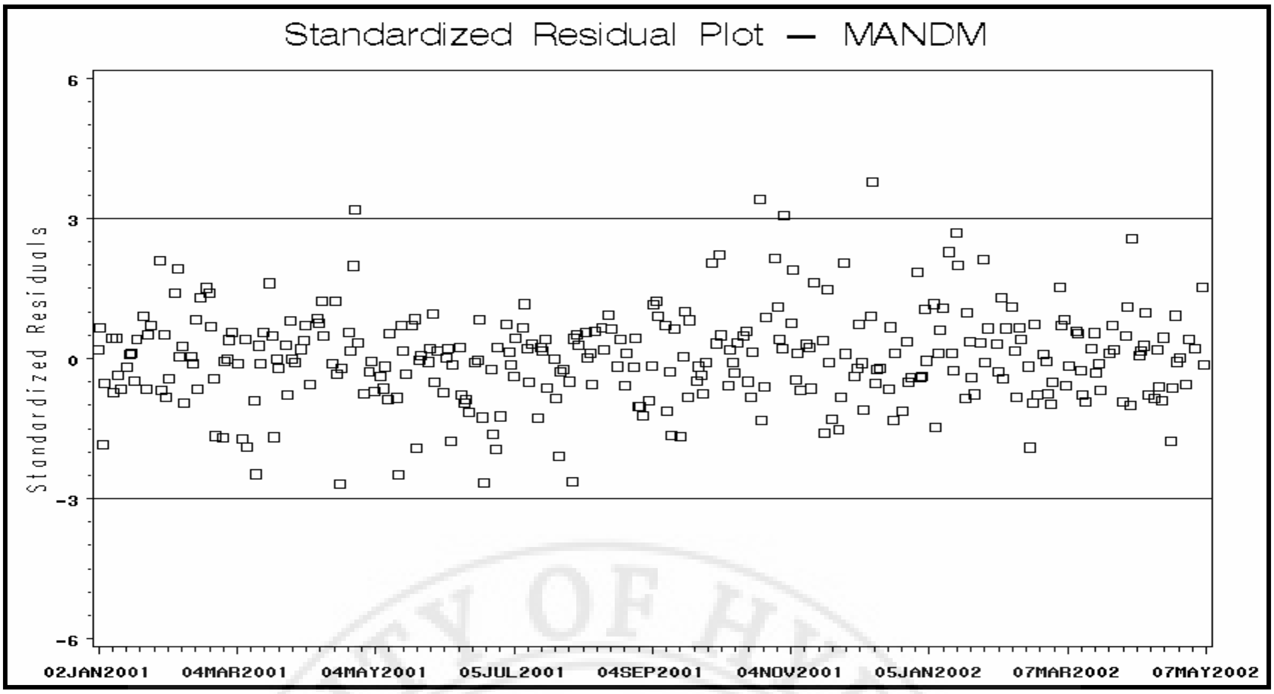
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \gamma_{d1} FD_t + \gamma_{d2} OD_t$$

Parameter	**Estimate**	**p-value**
ϕ_0	-0.160	>0.10
ϕ_1	-0.134	<0.01
θ_1	1.101	<0.01
α_0	2.009	<0.05
α_1	0.325	<0.01
β_1	0.366	<0.05
γ_{d1}	0.045	>0.10
γ_{d2}	0.732	>0.10
Diagnostics		
G (4) test-statistic	5.287	>0.10
Q (4) test-statistic	2.725	>0.10
LM (4) test-static	2.580	>0.10
Sign Bias	-0.138	>0.10
Negative Size Bias	0.146	>0.10
Positive Size Bias	0.118	>0.10
Joint Bias	0.886	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 + \beta_1 = 1$	7.180	<0.01

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


MANDM Daily Returns: Pre & Post Inception of Futures
Daily Returns
10
5
0
-5
-10
-15
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Cusum Plot for MANDM Squared Daily Returns
CUSUM
300
200
100
0
-100
-200
-300
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002



Standardized Residual Plot — MANDM
Standardized Residuals
6
3
0
-3
-6
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002

Stock Symbol – Ranbaxy (Ranbaxy Laboratories Ltd.)

Table No. 33:

Regression Results for RANBAXY using robust standard errors, R_t takes stock symbol RANBAXY, Mkt_t takes Nifty, FD_t takes on value of zero before SSFs introduction and a value of one afterwards and OD_t takes on value of zero before 'stock options' introduction and a value of one afterwards.

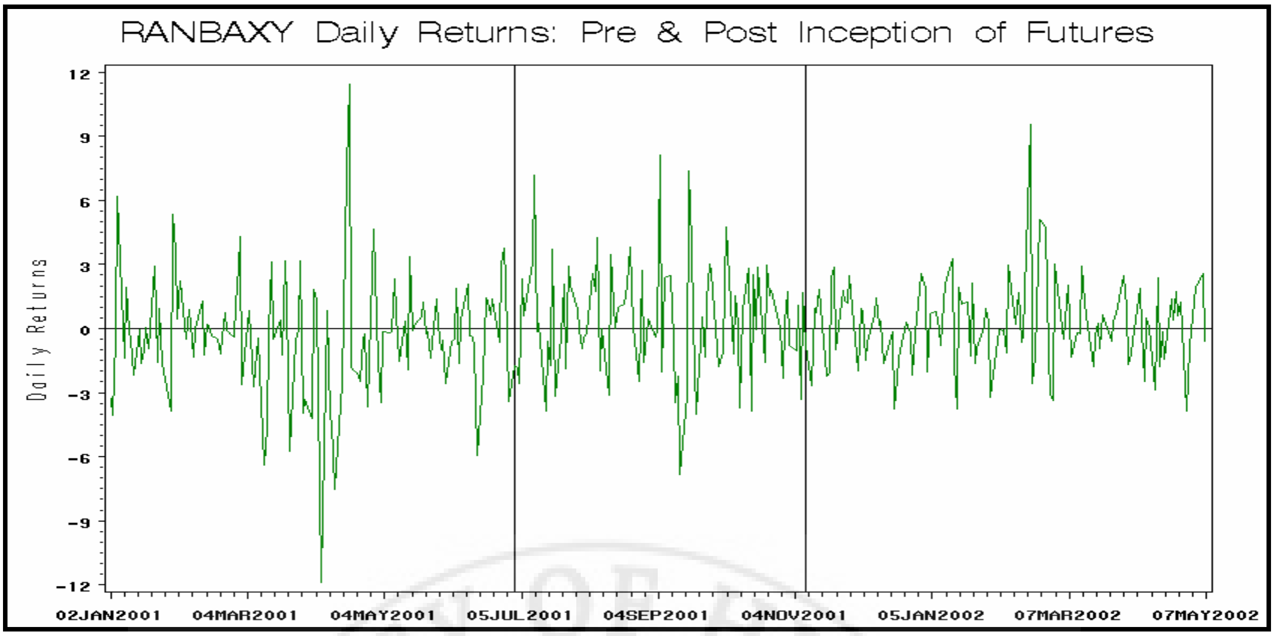
$$R_t = \phi_0 + \phi_1 R_{t-3} + \theta_1 Mkt_t + \gamma_{d1} FD_t + \gamma_{d2} OD_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0,1)$$

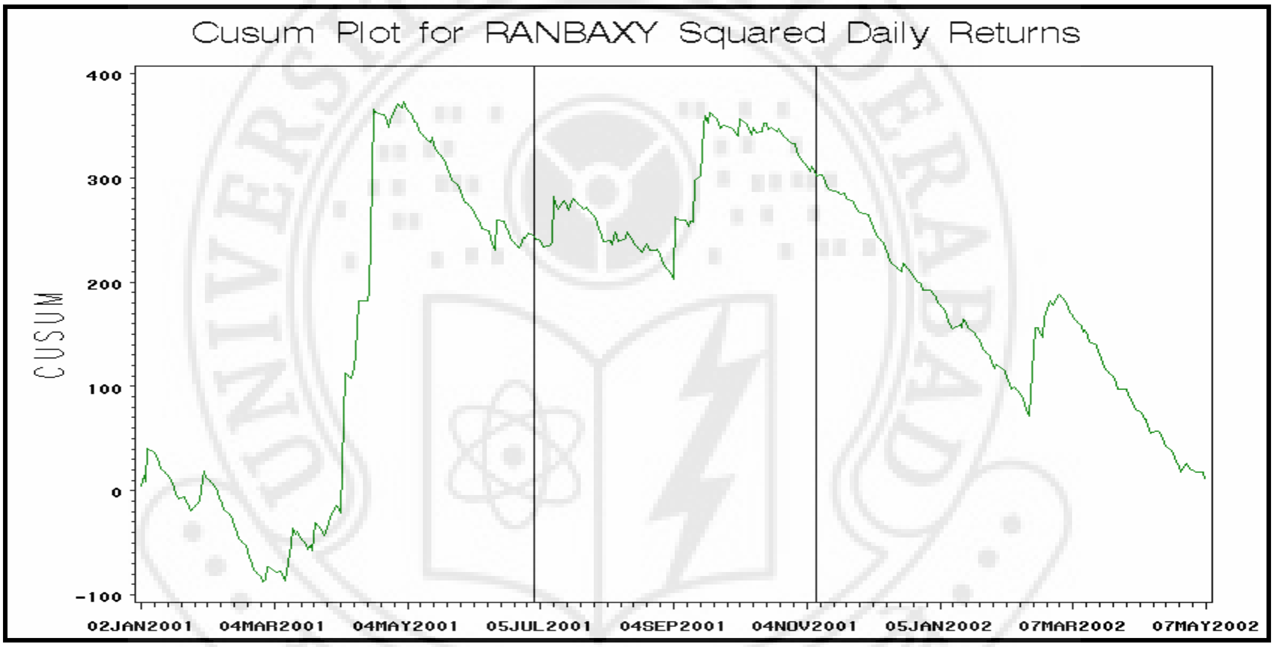
Parameter	Estimate
ϕ_0	-0.187 (>0.10)
ϕ_1	-0.114 (<0.05)
θ_1	0.789 (<0.01)
γ_{d1}	-0.403 (>0.10)
γ_{d2}	0.706 (<0.01)
F-stat	28.49 (<0.01)
G (4) test-statistic	2.136 (>0.10)
Q (4) test-statistic	2.999 (>0.10)
LM (4) test-static	2.602 (>0.10)

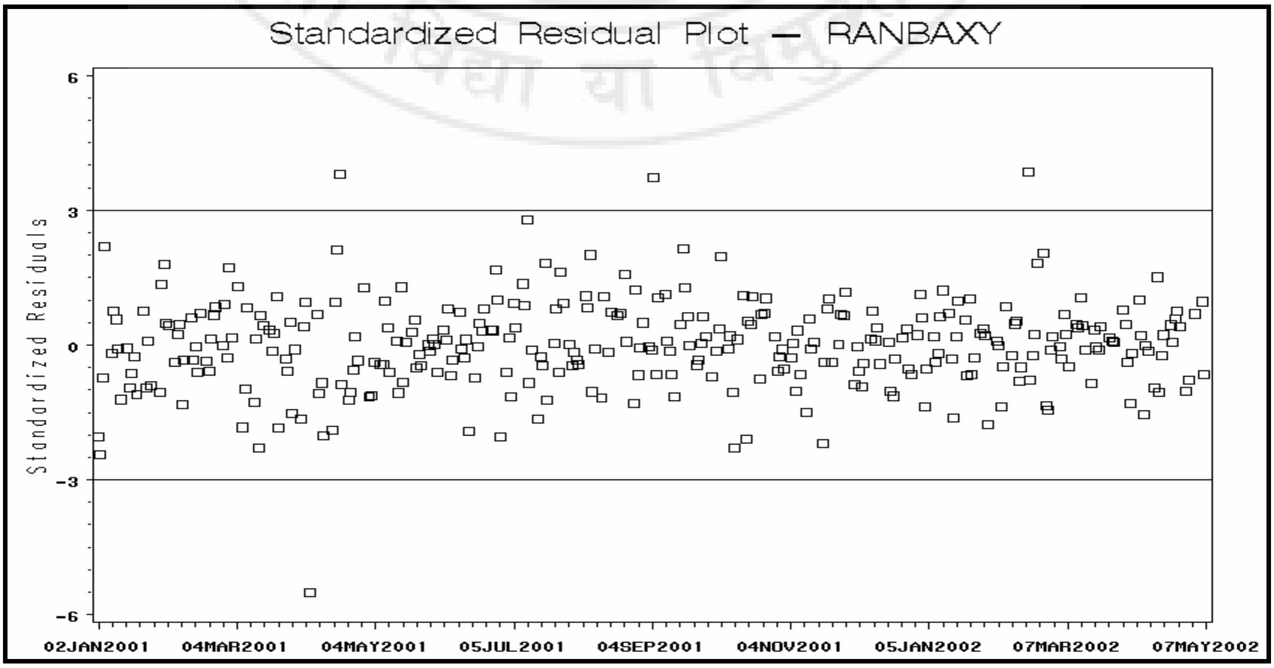
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


RANBAXY Daily Returns: Pre & Post Inception of Futures
Daily Returns
12
9
6
3
0
-3
-6
-9
-12
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Cusum Plot for RANBAXY Squared Daily Returns
CUSUM
400
300
200
100
0
-100
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Standardized Residual Plot — RANBAXY
Standardized Residuals
6
3
0
-3
-6
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002

Stock Symbol – Reliance (Reliance Industires Ltd.)

Table No. 34a: Regression Results-Evidence of ARCH Effects. R_t takes stock symbol RELIANCE, Mkt_t takes Nifty.

$$R_t = \phi_0 + \phi_1 R_{t-4} + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	-0.008 (>0.10)
ϕ_1	-0.132 (<0.01)
θ_1	1.073 (<0.01)
F-stat	127.0 (<0.01)
G (4) test-statistic	2.757 (>0.10)
Q (4) test-statistic	66.66 (<0.01)
LM (4) test-static	43.71 (<0.01)

Table No. 34b:

Results of AR(4) - GARCH (1, 1) model for RELIANCE using robust standard errors, R_t, Mkt_t are same as defined above, FD_t takes on value of zero before SSFs introduction and a value of one afterwards and OD_t takes on value of zero before 'stock options' introduction and a value of one afterwards.

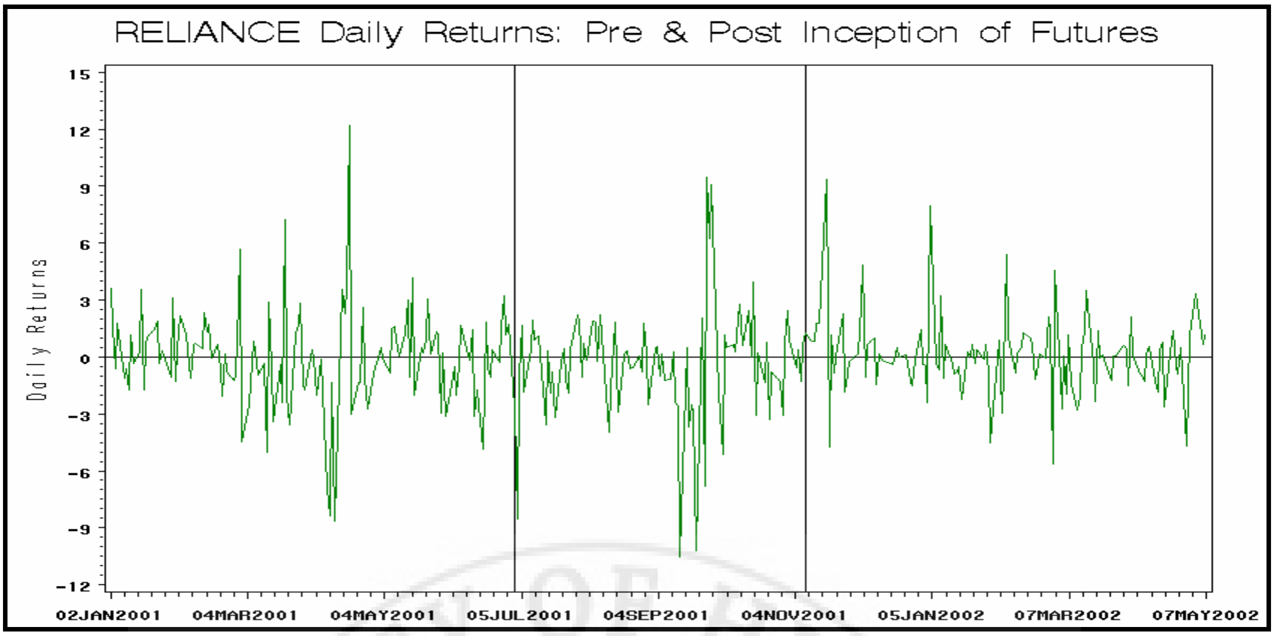
$$R_t = \phi_0 + \phi_1 R_{t-4} + \theta_1 Mkt_t + \varepsilon_t$$

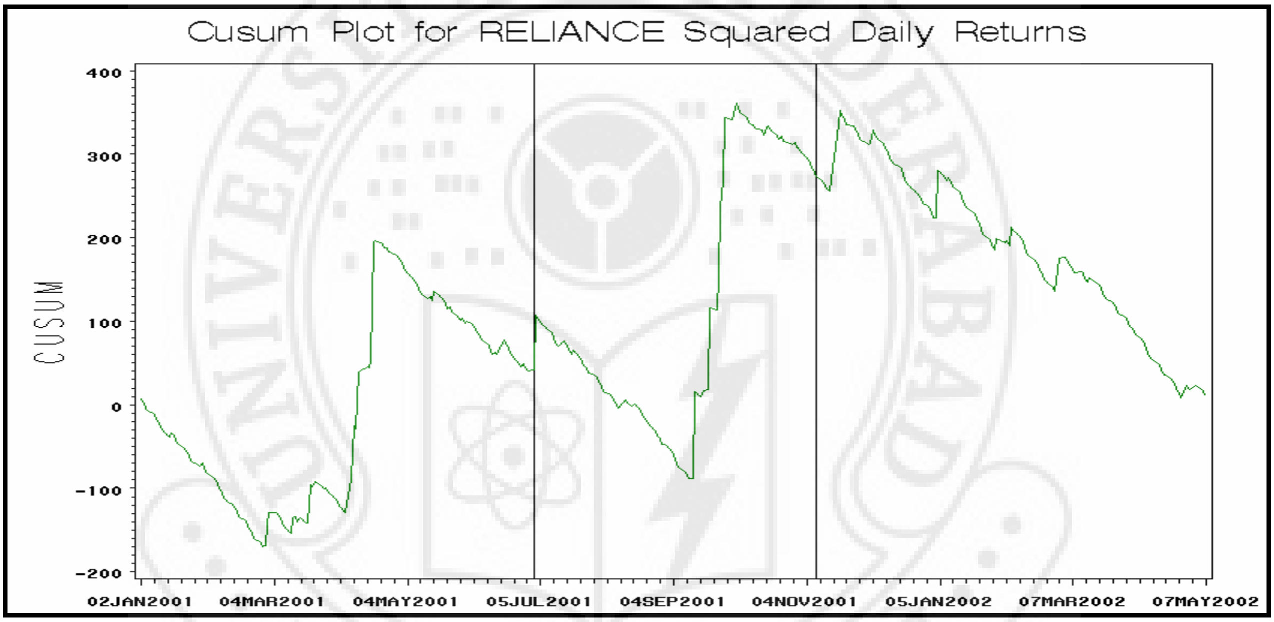
$$\varepsilon_t \sim N(0, h_t)$$

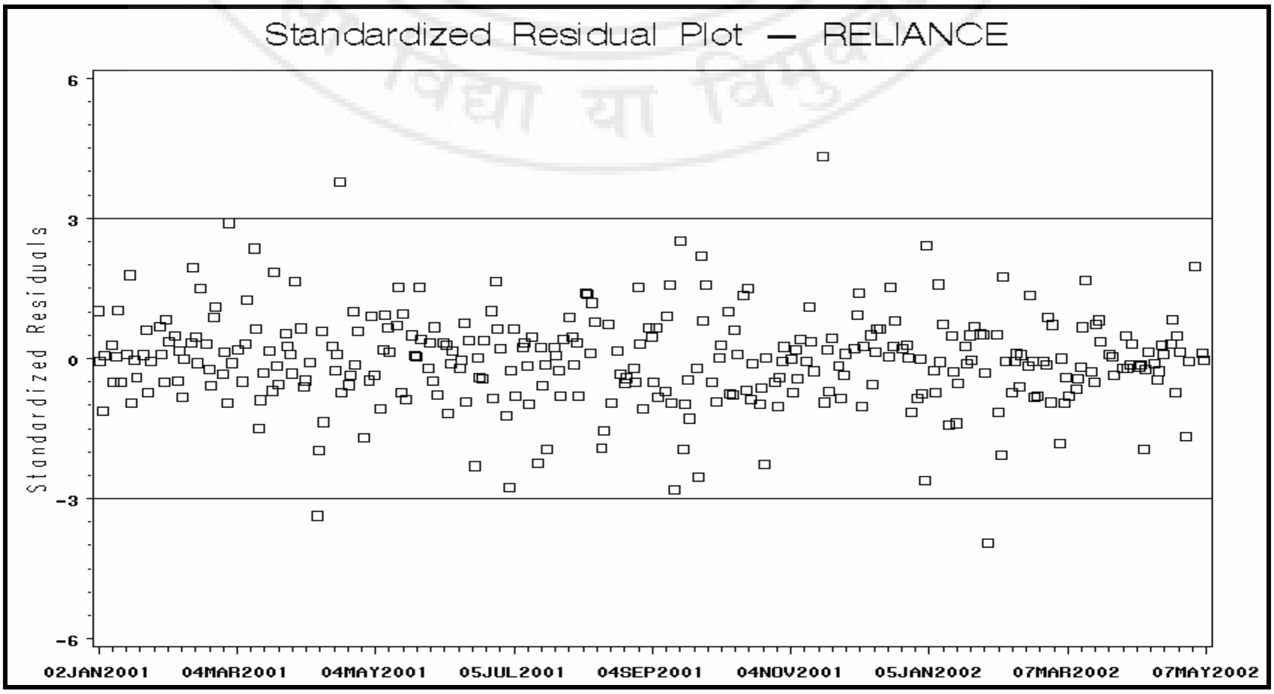
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \gamma_{d1} FD_t + \gamma_{d2} OD_t$$

Parameter	Estimate	p-value
ϕ_0	0.045	>0.10
ϕ_1	-0.099	<0.10
θ_1	1.103	<0.01
α_0	1.006	<0.01
α_1	0.202	<0.01
β_1	0.577	<0.01
γ_{d1}	0.098	>0.10
γ_{d2}	-0.427	>0.10
Diagnostics		
G (4) test-statistic	3.073	>0.10
Q (4) test-statistic	0.932	>0.10
LM (4) test-static	0.976	>0.10
Sign Bias	0.368	>0.10
Negative Size Bias	-0.301	>0.10
Positive Size Bias	-0.241	>0.10
Joint Bias	3.376	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 + \beta_1 = 1$	12.53	<0.01

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


RELIANCE Daily Returns: Pre & Post Inception of Futures
Daily Returns
15
12
9
6
3
0
-3
-6
-9
-12
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Cusum Plot for RELIANCE Squared Daily Returns
CUSUM
400
300
200
100
0
-100
-200
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Standardized Residual Plot — RELIANCE
Standardized Residuals
6
3
0
-3
-6
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002

Stock Symbol – RELPETRO (Reliance Petroleum Ltd.)

Table No. 35a: Regression Results-Evidence of ARCH Effects. R_t takes stock symbol RELPETRO, Mkt_t takes Nifty.

$$R_t = \phi_0 + \phi_1 R_{t-4} + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	-0.188 (<0.05)
ϕ_1	-0.149 (<0.01)
θ_1	1.264 (<0.01)
F-stat	172.7 (<0.01)
G (4) test-statistic	4.441 (>0.10)
Q (4) test-statistic	10.99 (<0.05)
LM (4) test-static	11.07 (<0.05)

Table No. 35b:
Results of AR(4)-ARCH (1) model for RELPETRO using robust standard errors, R_t, Mkt_t are same as defined above, FD_t takes on value of zero before SSFs introduction and a value of one afterwards and OD_t takes on value of zero before 'stock options' introduction and a value of one afterwards.

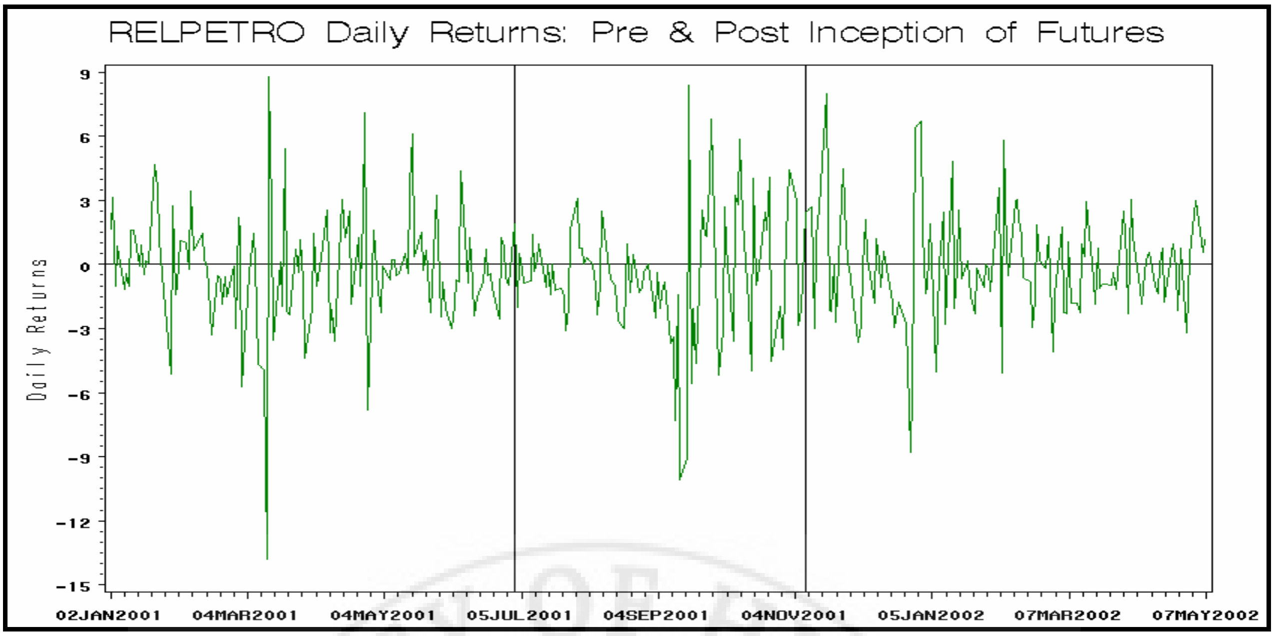
$$R_t = \phi_0 + \phi_1 R_{t-4} + \theta_1 Mkt_t + \varepsilon_t$$

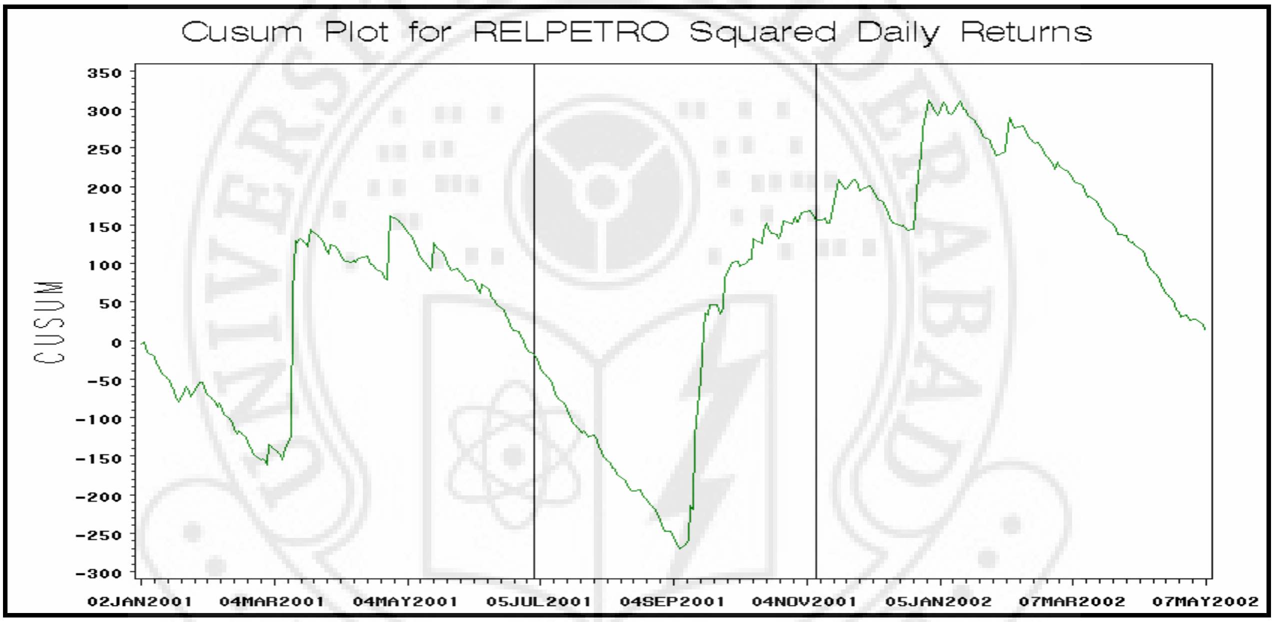
$$\varepsilon_t \sim N(0, h_t)$$

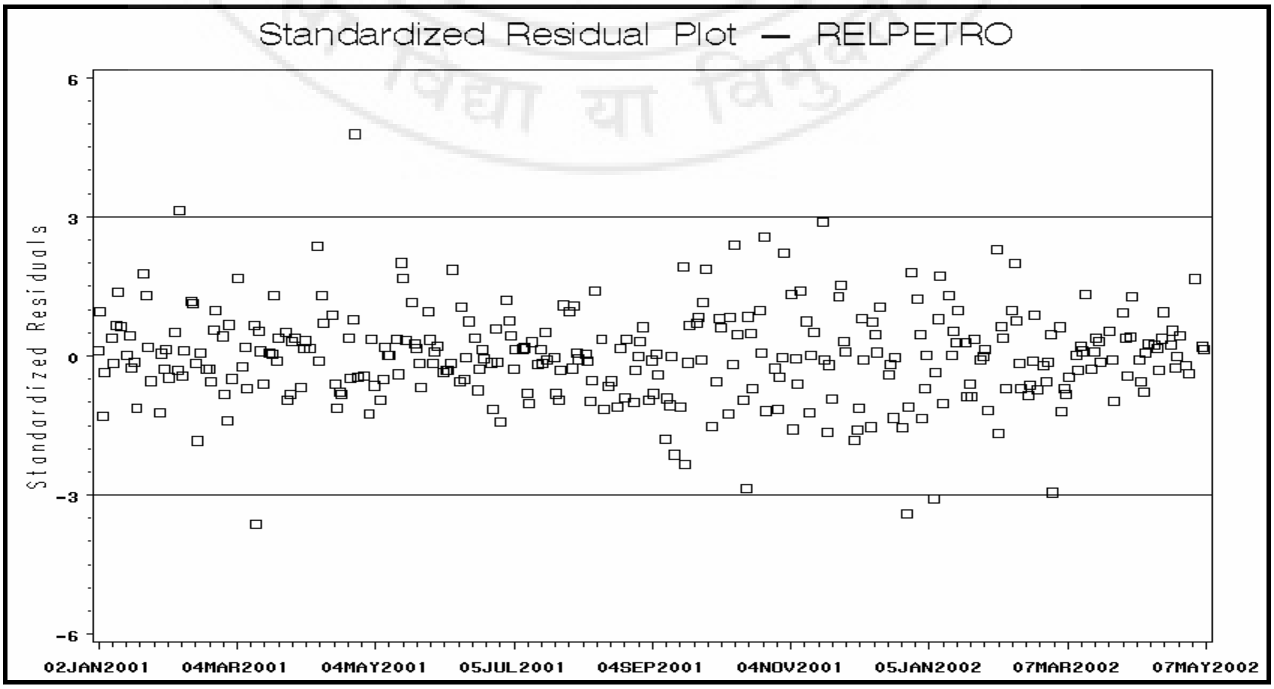
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \gamma_{d1} FD_t + \gamma_{d2} OD_t$$

Parameter	Estimate	p-value
ϕ_0	-0.190	<0.05
ϕ_1	-0.138	<0.01
θ_1	1.181	<0.01
α_0	2.502	<0.01
α_1	0.262	<0.01
γ_{d1}	-0.629	>0.10
γ_{d2}	0.681	>0.10
Diagnostics		
G (4) test-statistic	2.943	>0.10
Q (4) test-statistic	2.606	>0.10
LM (4) test-static	2.456	>0.10
Sign Bias	-0.049	<0.05
Negative Size Bias	0.059	<0.05
Positive Size Bias	0.048	>0.10
Joint Bias	0.136	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 = 1$	23.66	<0.01

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


RELPETRO Daily Returns: Pre & Post Inception of Futures
Daily Returns
9
6
3
0
-3
-6
-9
-12
-15
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Cusum Plot for RELPETRO Squared Daily Returns
CUSUM
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Standardized Residual Plot — RELPETRO
Standardized Residuals
6
3
0
-3
-6
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002

Stock Symbol – SATYAMCOMP (Satyam Computer Services Ltd.)

Table No. 36a: Regression Results-Evidence of ARCH Effects. R_t takes stock symbol SATYAMCOMP, Mkt_t takes Nifty.

$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	0.031 (>0.10)
θ_1	2.440 (<0.01)
F-stat	392.0 (<0.01)
G (4) test-statistic	5.913 (>0.10)
Q (4) test-statistic	26.86 (<0.01)
LM (4) test-static	18.72 (<0.01)

Table No. 36b:

Results of GARCH (1, 1) model for SATYAMCOMP using robust standard errors, R_t, Mkt_t are same as defined above, FD_t takes on value of zero before SSFs introduction and a value of one afterwards and OD_t takes on value of zero before 'stock options' introduction and a value of one afterwards.

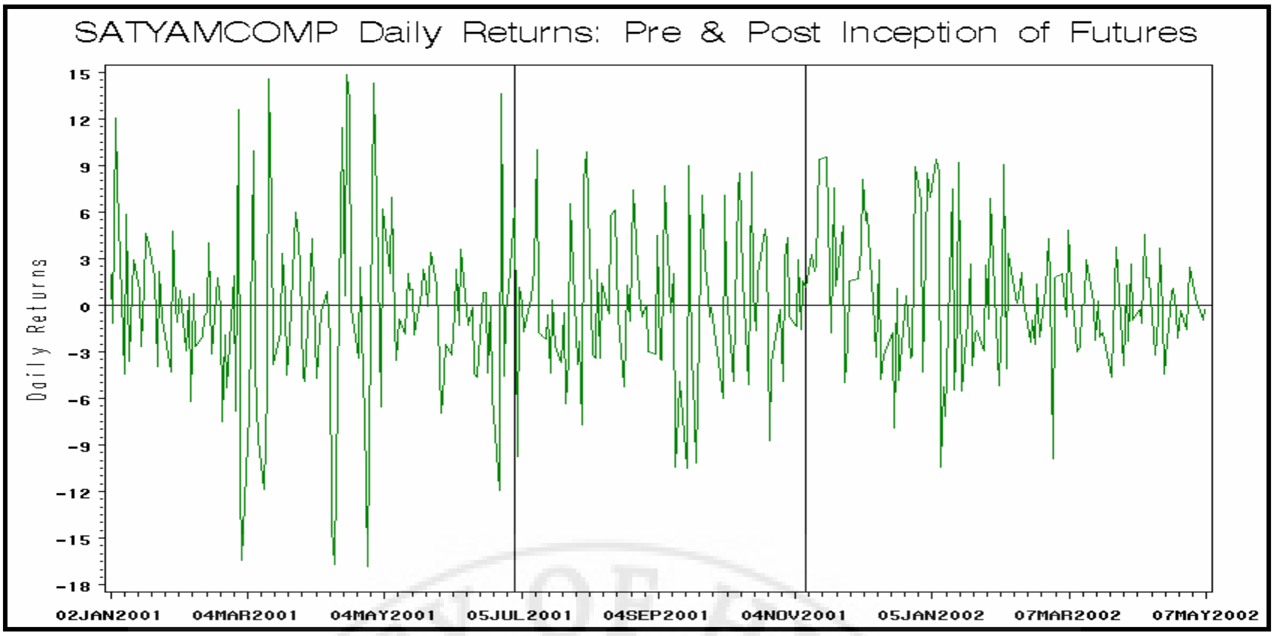
$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

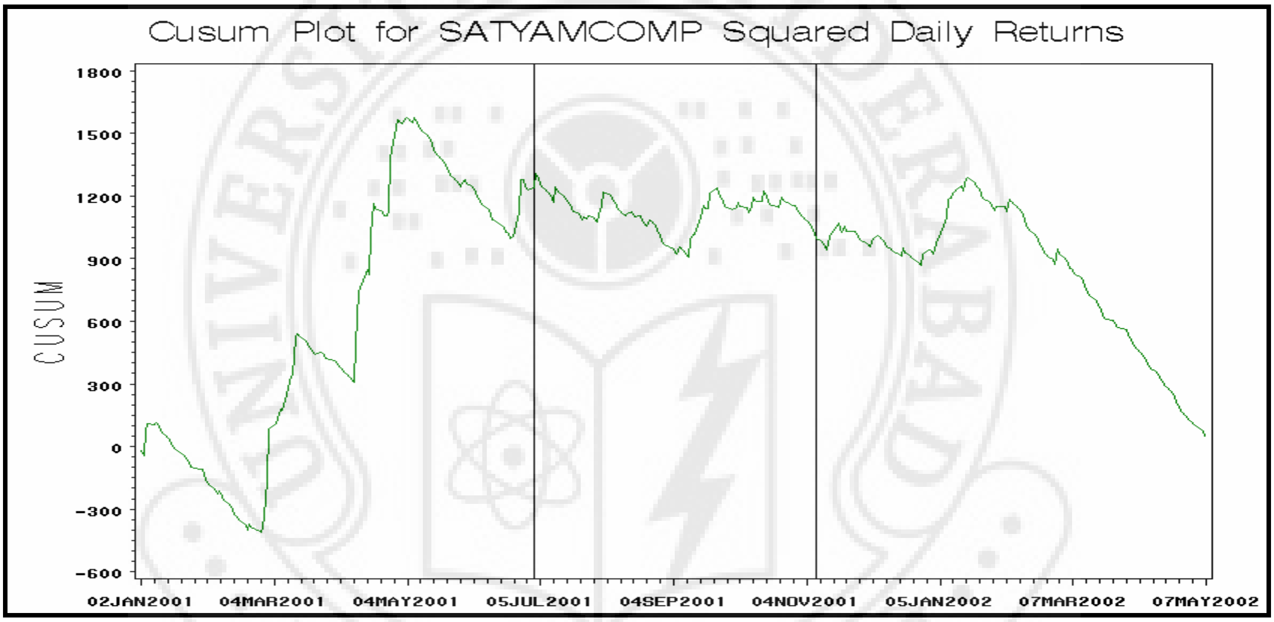
$$\varepsilon_t \sim N(0, h_t)$$

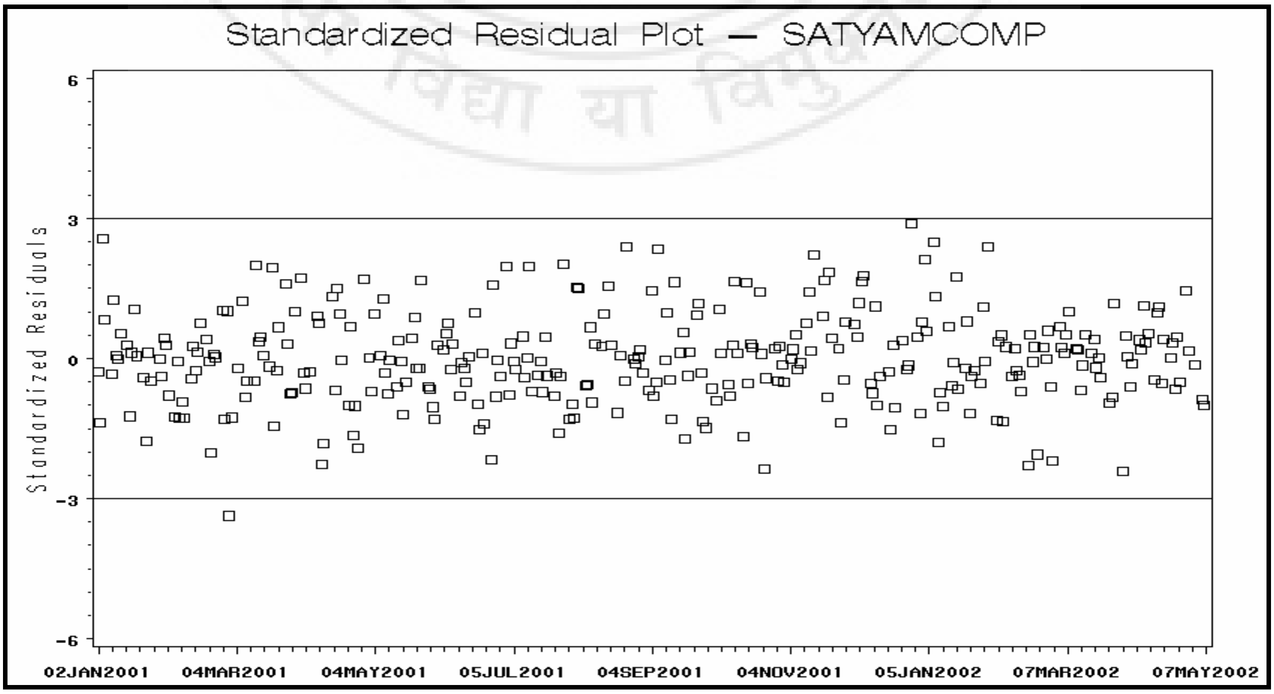
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \gamma_{d1} FD_t + \gamma_{d2} OD_t$$

Parameter	Estimate	p-value
ϕ_0	0.043	>0.10
θ_1	2.110	<0.01
α_0	2.444	<0.05
α_1	0.214	<0.01
β_1	0.613	<0.01
γ_{d1}	-1.442	>0.10
γ_{d2}	0.286	>0.10
Diagnostics		
G (4) test-statistic	1.126	>0.10
Q (4) test-statistic	1.310	>0.10
LM (4) test-static	1.081	>0.10
Sign Bias	0.121	>0.10
Negative Size Bias	-0.057	>0.10
Positive Size Bias	-0.068	>0.10
Joint Bias	0.545	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 + \beta_1 = 1$	6.990	<0.01

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


SATYAMCOMP Daily Returns: Pre & Post Inception of Futures
Daily Returns
15
12
9
6
3
0
-3
-6
-9
-12
-15
-18
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Cusum Plot for SATYAMCOMP Squared Daily Returns
CUSUM
1800
1500
1200
900
600
300
0
-300
-600
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Standardized Residual Plot — SATYAMCOMP
Standardized Residuals
6
3
0
-3
-6
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002

Stock Symbol – SBIN (State Bank of India Ltd.)

Table No. 37a: Regression Results-Evidence of ARCH Effects. R_t takes stock symbol SBIN, Mkt_t takes Nifty.

$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	0.085 (>0.10)
θ_1	0.955 (<0.01)
F-stat	152.0 (<0.01)
G (4) test-statistic	1.190 (>0.10)
Q (4) test-statistic	8.488 (<0.10)
LM (4) test-static	6.156 (>0.10)

Table No. 37b:

Results of GARCH (1, 1) model for SBIN using robust standard errors, R_t, Mkt_t are same as defined above, FD_t takes on value of zero before SSFs introduction and a value of one afterwards and OD_t takes on value of zero before 'stock options' introduction and a value of one afterwards.

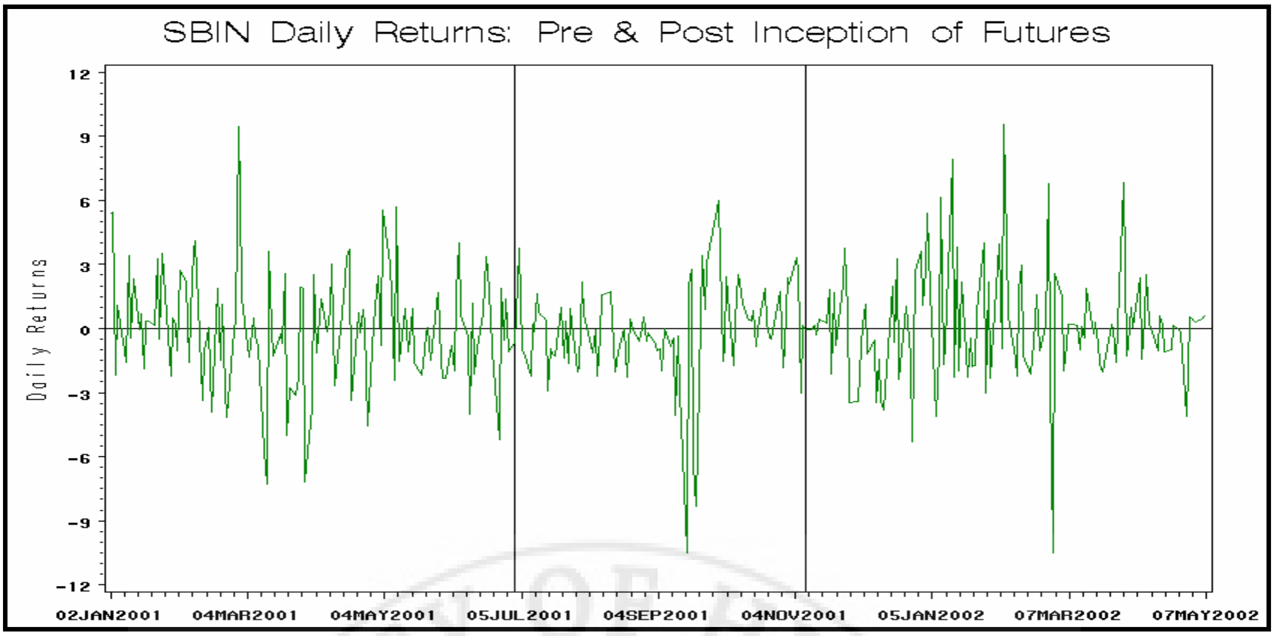
$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

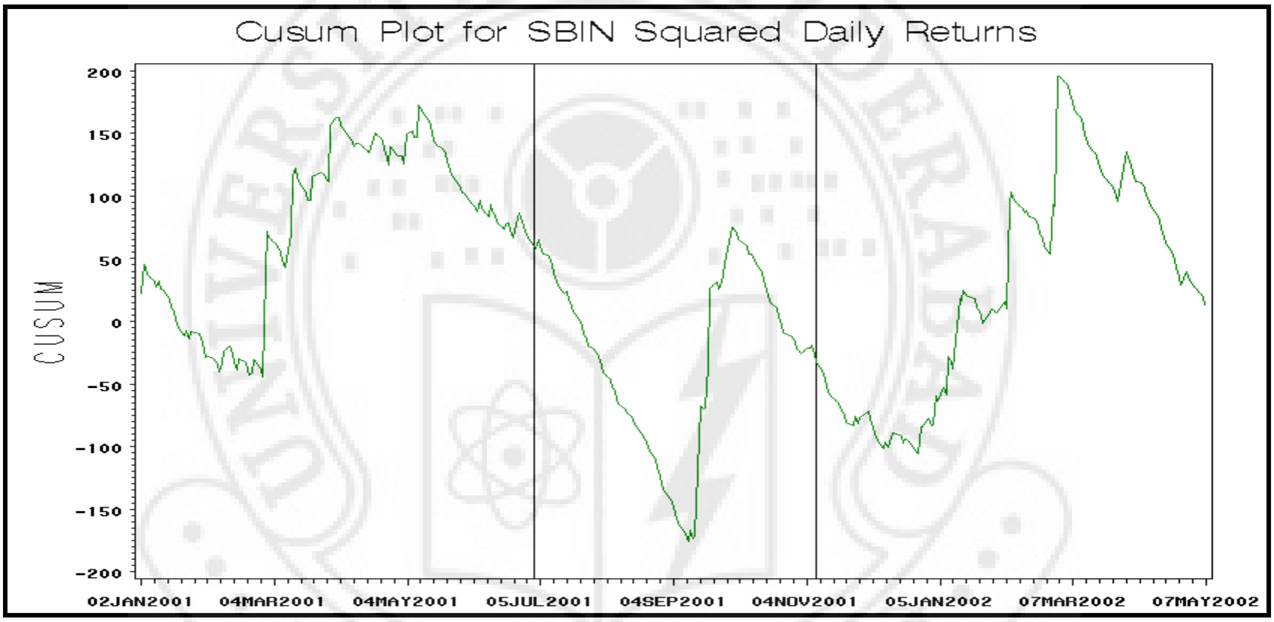
$$\varepsilon_t \sim N(0, h_t)$$

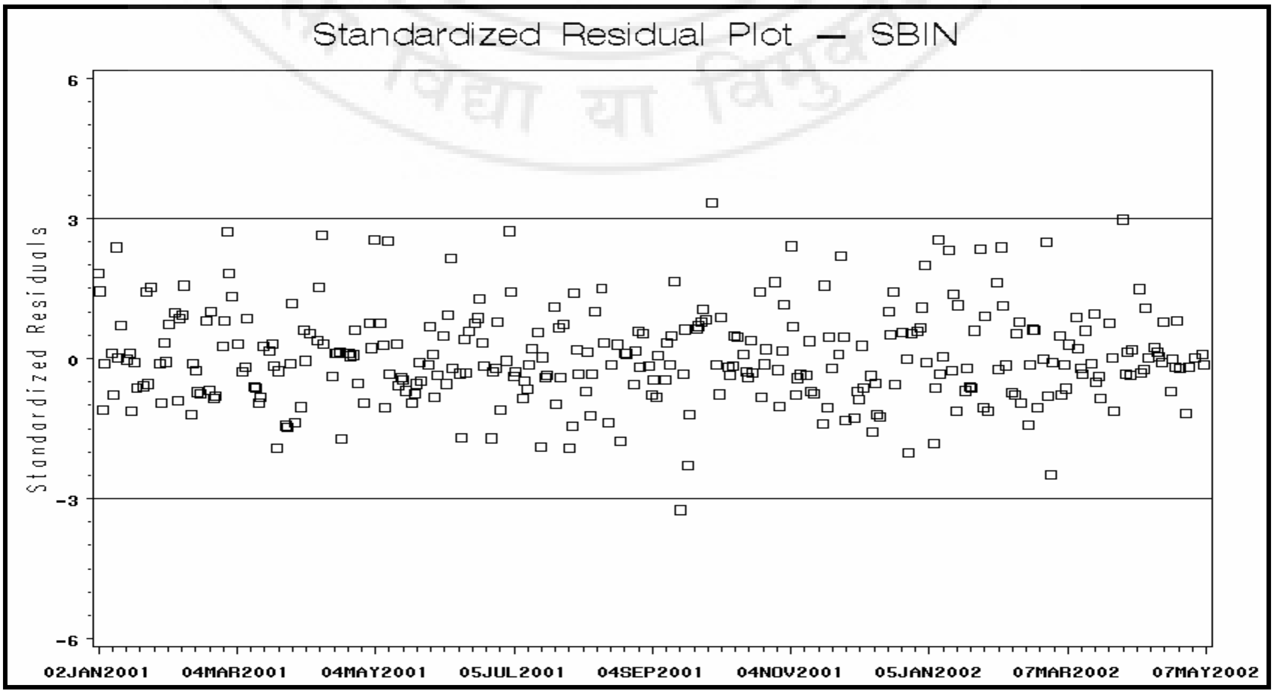
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \gamma_{d1} FD_t + \gamma_{d2} OD_t$$

Parameter	Estimate	p-value
ϕ_0	-0.019	>0.10
θ_1	0.938	<0.01
α_0	1.294	<0.05
α_1	0.211	<0.01
β_1	0.564	<0.01
γ_{d1}	0.512	>0.10
γ_{d2}	-0.575	>0.10
Diagnostics		
G (4) test-statistic	1.506	>0.10
Q (4) test-statistic	0.505	>0.10
LM (4) test-static	0.624	>0.10
Sign Bias	-0.274	>0.10
Negative Size Bias	0.221	>0.10
Positive Size Bias	0.143	>0.10
Joint Bias	2.354	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 + \beta_1 = 1$	7.070	<0.01

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


SBIN Daily Returns: Pre & Post Inception of Futures
Daily Returns
12
9
6
3
0
-3
-6
-9
-12
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Cusum Plot for SBIN Squared Daily Returns
CUSUM
200
150
100
50
0
-50
-100
-150
-200
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Standardized Residual Plot — SBIN
Standardized Residuals
6
3
0
-3
-6
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002

Stock Symbol – STROPTICAL (Sterlite Optical Technologies Ltd.)

Table No. 38a: Regression Results-Evidence of ARCH Effects. R_t takes stock symbol STROPTICAL, Mkt_t takes Nifty and ED_t is dummy which takes the value of one for date 15th Oct 2001.

$$R_t = \phi_0 + \phi_1 R_{t-5} + \theta_1 Mkt_t + \kappa ED_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	-0.399 (<0.10)
ϕ_1	0.167 (<0.01)
θ_1	1.770 (<0.01)
κ	-26.63 (<0.01)
F-stat	74.78 (<0.01)
G (4) test-statistic	7.059 (>0.10)
Q (4) test-statistic	58.15 (<0.01)
LM (4) test-static	36.66 (<0.01)

Table No. 38b:

Results of AR(5)-GARCH (1, 1) model for STROPTICAL using robust standard errors, R_t, Mkt_t are same as defined above, FD_t takes on value of zero before SSFs introduction and a value of one afterwards and OD_t takes on value of zero before 'stock options' introduction and a value of one afterwards.

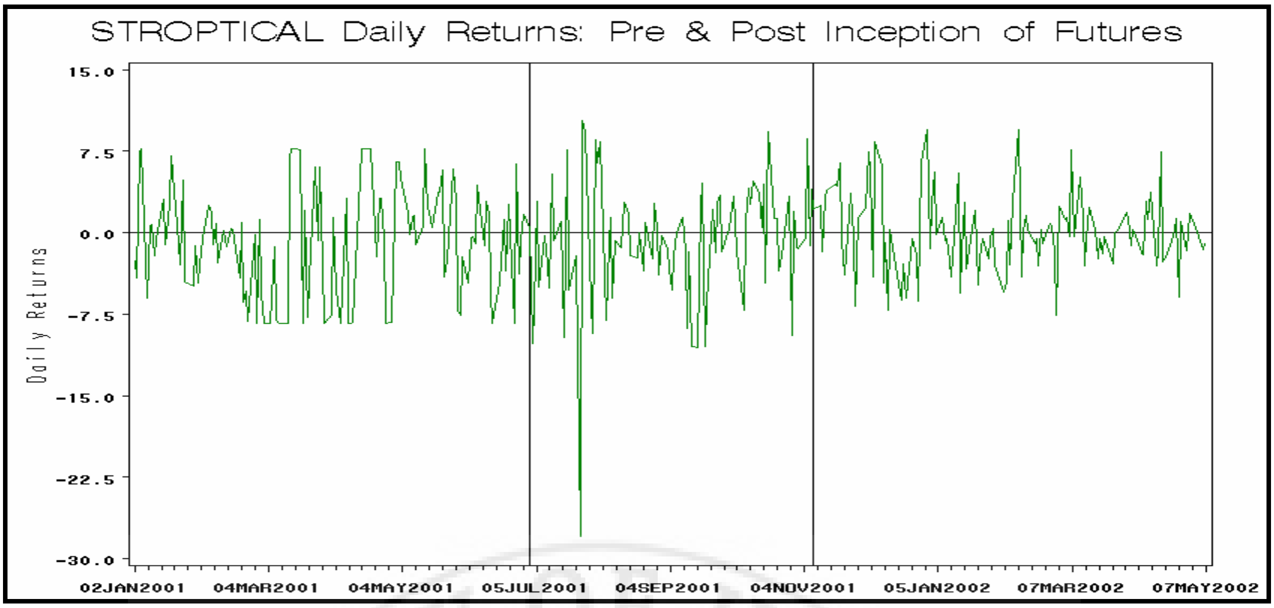
$$R_t = \phi_0 + \phi_1 R_{t-5} + \theta_1 Mkt_t + \kappa ED_t + \varepsilon_t$$

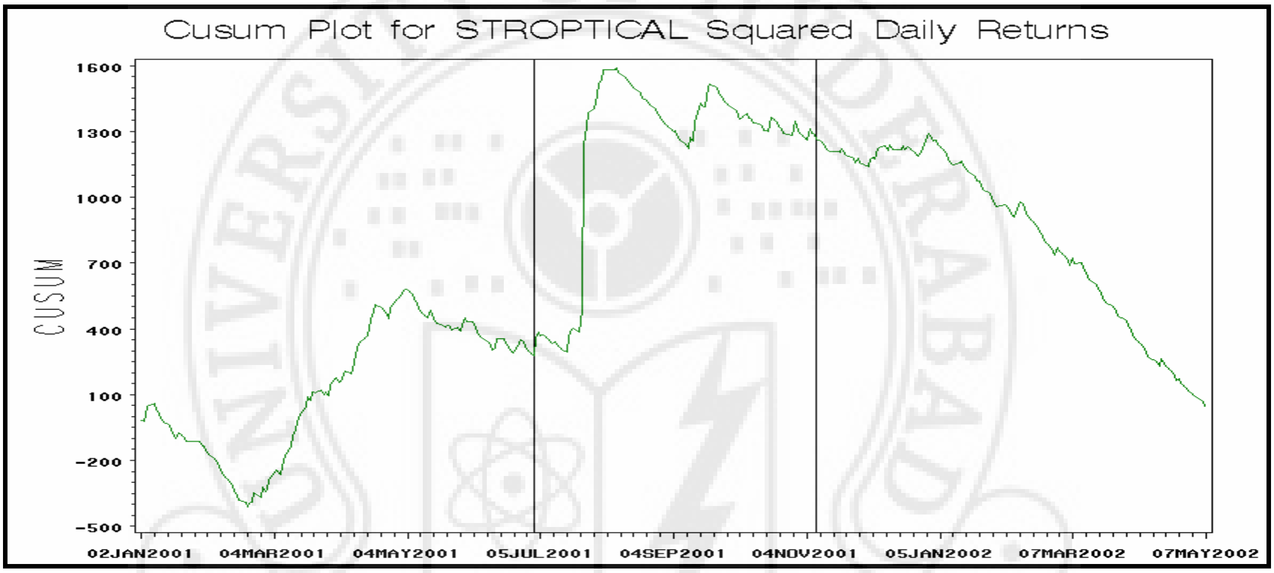
$$\varepsilon_t \sim N(0, h_t)$$

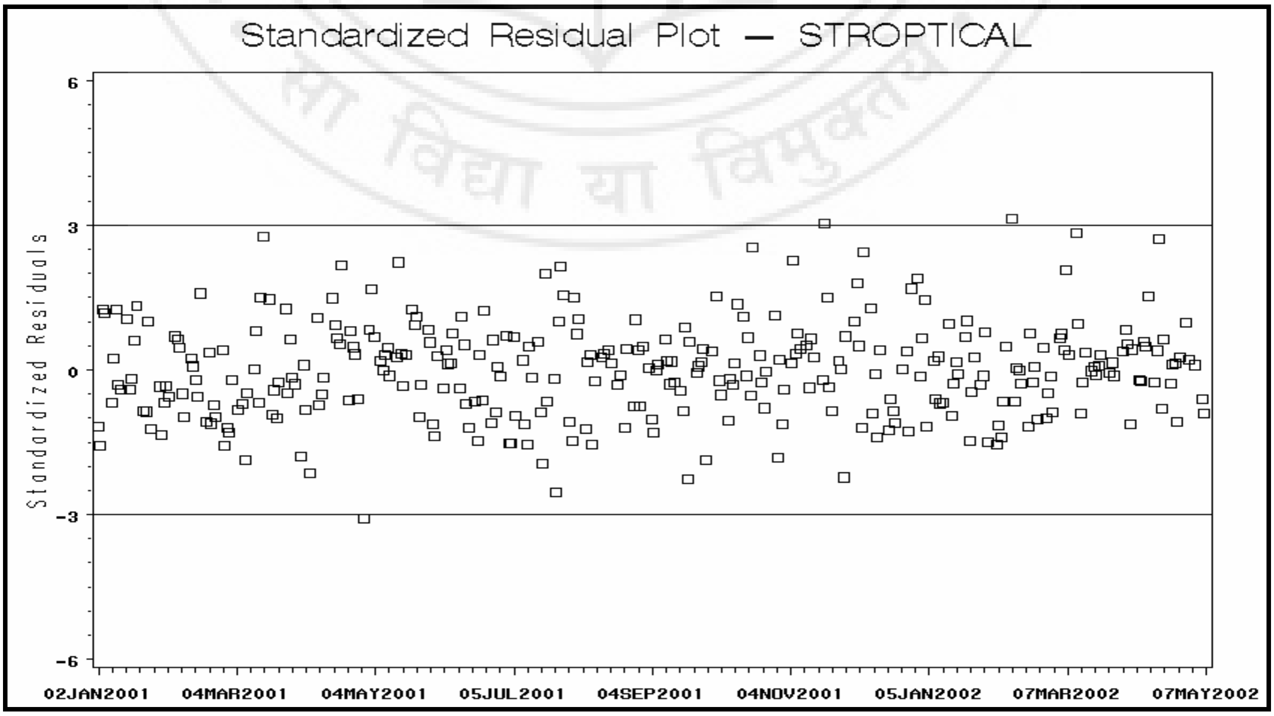
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \gamma_{d1} FD_t + \gamma_{d2} OD_t$$

Parameter	Estimate	p-value
ϕ_0	-0.418	<0.05
ϕ_1	-0.097	<0.10
θ_1	1.702	<0.01
κ	-31.19	<0.01
α_0	3.856	<0.01
α_1	0.165	<0.05
β_1	0.607	<0.01
γ_{d1}	-1.516	>0.10
γ_{d2}	0.404	>0.10
Diagnostics		
G (4) test-statistic	2.672	>0.10
Q (4) test-statistic	1.223	>0.10
LM (4) test-static	1.335	>0.10
Sign Bias	-0.171	>0.10
Negative Size Bias	0.093	>0.10
Positive Size Bias	0.119	>0.10
Joint Bias	1.091	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 + \beta_1 = 1$	10.46	<0.01

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


STROPTICAL Daily Returns: Pre & Post Inception of Futures
Daily Returns
15.0
7.5
0.0
-7.5
-15.0
-22.5
-30.0
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Cusum Plot for STROPTICAL Squared Daily Returns
CUSUM
1600
1300
1000
700
400
100
-200
-500
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Standardized Residual Plot — STROPTICAL
Standardized Residuals
6
3
0
-3
-6
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002

Stock Symbol – TATAPOWER (Tata Power Company Ltd.)

Table No. 39a: Regression Results-Evidence of ARCH Effects. R_t takes stock symbol TATAPOWER, Mkt_t takes Nifty.

$$R_t = \phi_0 + \phi_1 R_{t-2} + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	0.107 (>0.10)
ϕ_1	-0.139 (<0.01)
θ_1	1.171 (<0.01)
F-stat	65.84 (<0.01)
G (4) test-statistic	4.345 (>0.10)
Q (4) test-statistic	41.74 (<0.01)
LM (4) test-static	28.61 (<0.01)

Table No. 39b:
Results of AR(2)-GARCH (1, 1) model for TATAPOWER using robust standard errors, R_t, Mkt_t are same as defined above, FD_t takes on value of zero before SSFs introduction and a value of one afterwards and OD_t takes on value of zero before 'stock options' introduction and a value of one afterwards.

$$R_t = \phi_0 + \phi_1 R_{t-2} + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0, h_t)$$

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \gamma_{d1} FD_t + \gamma_{d2} OD_t$$

Parameter	Estimate	p-value
ϕ_0	0.013	>0.10
ϕ_1	0.113	<0.05
θ_1	1.040	<0.01
α_0	5.383	<0.05
α_1	0.099	<0.10
β_1	0.455	<0.05
$\alpha_{0,d}$	-2.122	<0.10
$\alpha_{1,d}$	-1.427	>0.10
Diagnostics		
G (4) test-statistic	2.425	>0.10
Q (4) test-statistic	0.487	>0.10
LM (4) test-static	0.458	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 + \beta_1 = 1$	4.910	<0.05

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.

As the dummy of future introduction is highly significant GARCH model has been estimated.

Table No. 39c:

Results of AR(2)-GARCH (1, 1) model for TATAPOWER using robust standard errors, R_t, Mkt_t are same as defined above, and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

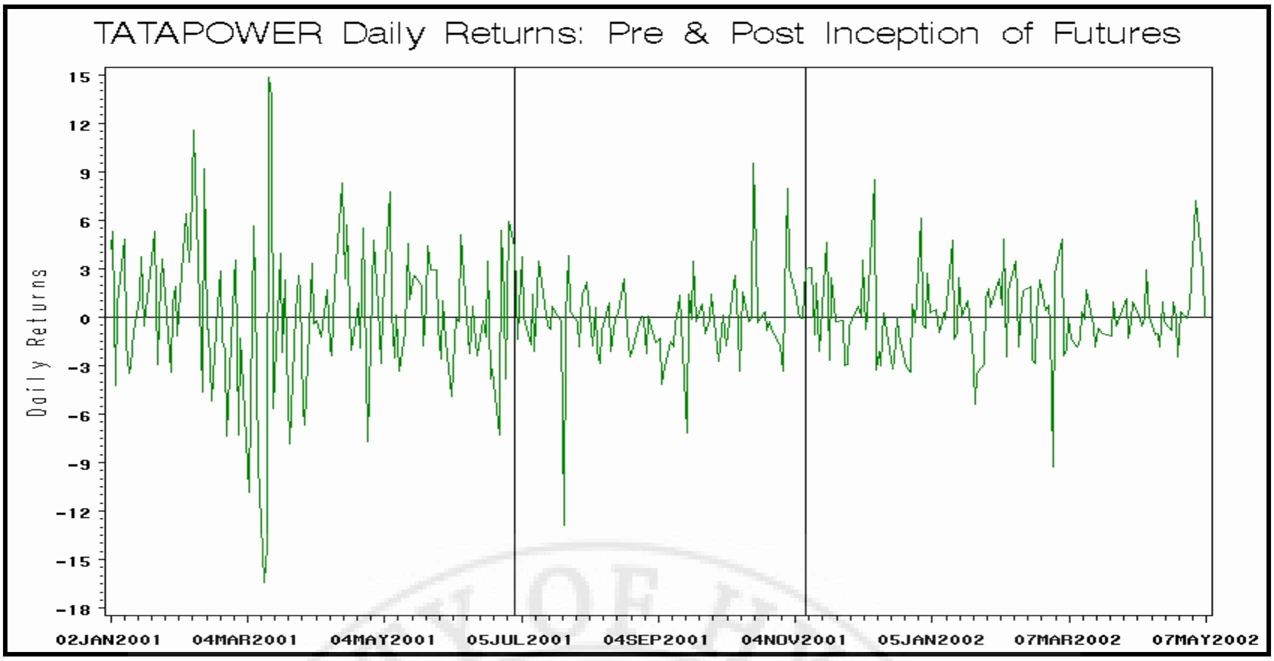
$$R_t = \phi_0 + \phi_1 R_{t-2} + \theta_1 Mkt_t + \varepsilon_t$$

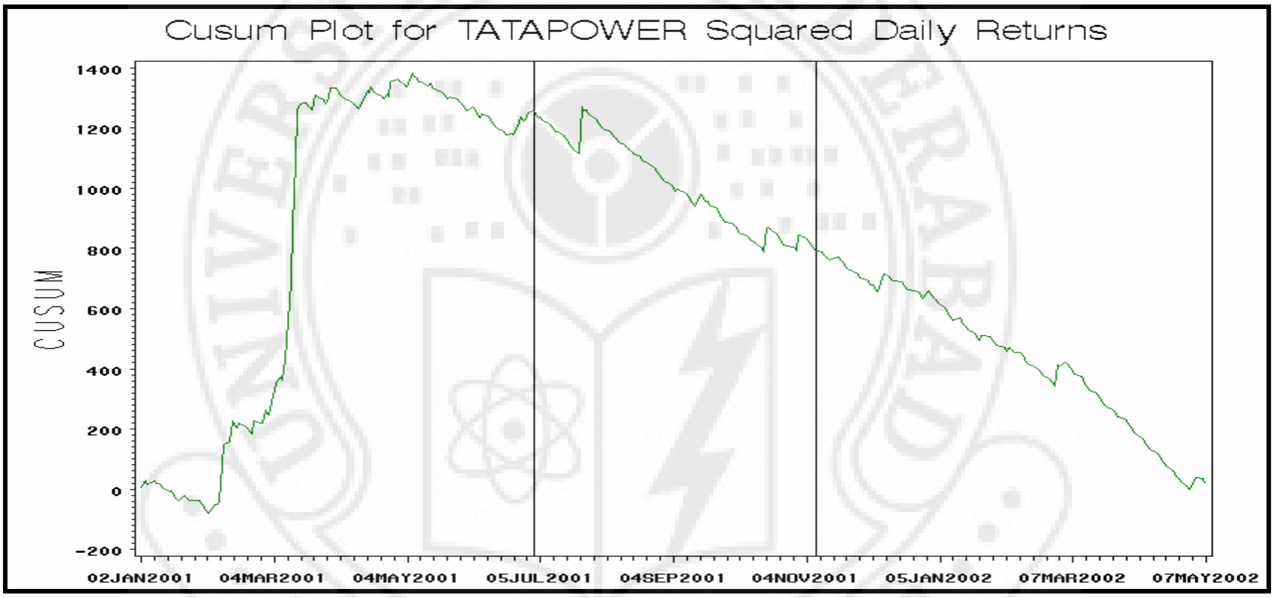
$$\varepsilon_t \sim N(0, h_t)$$

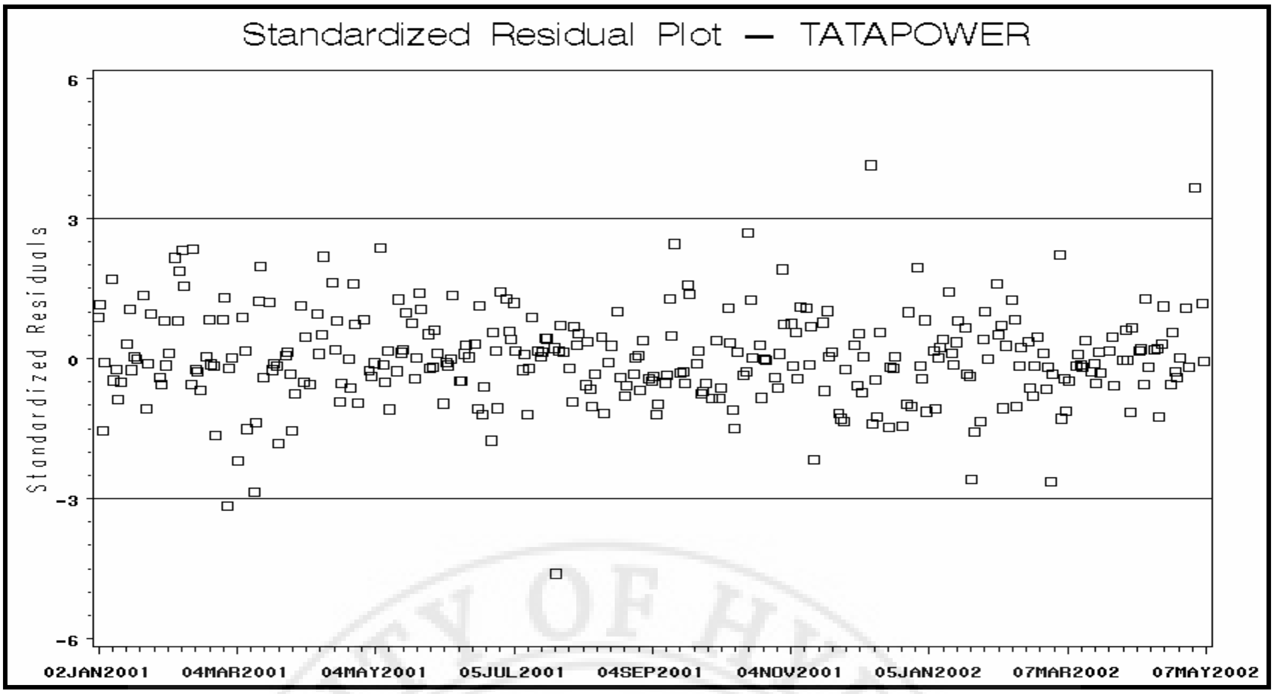
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \alpha_{0,d} D_t + \alpha_{1,d} D_t * \varepsilon_{t-1}^2 + \beta_{1,d} D_t * h_{t-1}$$

Parameter	Estimate	p-value
ϕ_0	-0.014	>0.10
ϕ_1	-0.117	<0.05
θ_1	1.059	<0.01
α_0	3.868	<0.05
α_1	0.183	<0.05
β_1	0.476	<0.05
$\alpha_{0,d}$	-1.115	>0.10
$\alpha_{1,d}$	-0.182	<0.05
$\beta_{1,d}$	-0.213	>0.10
Diagnostics		
G (4) test-statistic	1.807	>0.10
Q (4) test-statistic	0.478	>0.10
LM (4) test-static	0.446	>0.10
Sign Bias	-0.173	>0.10
Negative Size Bias	0.187	>0.10
Positive Size Bias	0.016	>0.10
Joint Bias	1.125	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 + \beta_1 = 1$	5.140	<0.05

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


TATAPOWER Daily Returns: Pre & Post Inception of Futures
Daily Returns
15
12
9
6
3
0
-3
-6
-9
-12
-15
-18
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Cusum Plot for TATAPOWER Squared Daily Returns
CUSUM
1400
1200
1000
800
600
400
200
0
-200
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Standardized Residual Plot — TATAPOWER
Standardized Residuals
6
3
0
-3
-6
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002

Stock Symbol – TATATEA (Tata Tea Ltd.)

Table No. 40:

Regression Results for TATATEA using robust standard errors, R_t takes stock symbol TATATEA, Mkt_t takes Nifty, FD_t takes on value of zero before SSFs introduction and a value of one afterwards and OD_t takes on value of zero before 'stock options' introduction and a value of one afterwards.

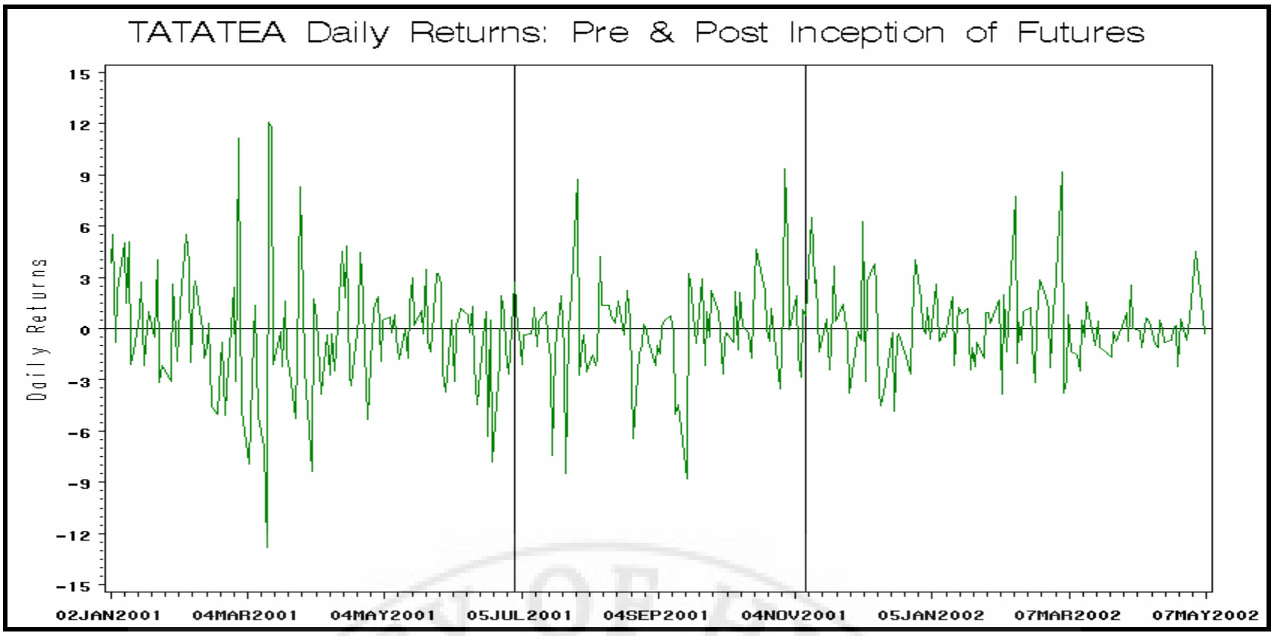
$$R_t = \phi_0 + \phi_1 R_{t-3} + \phi_2 R_{t-6} + \theta_1 Mkt_t + \gamma_{d1} FD_t + \gamma_{d2} OD_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0,1)$$

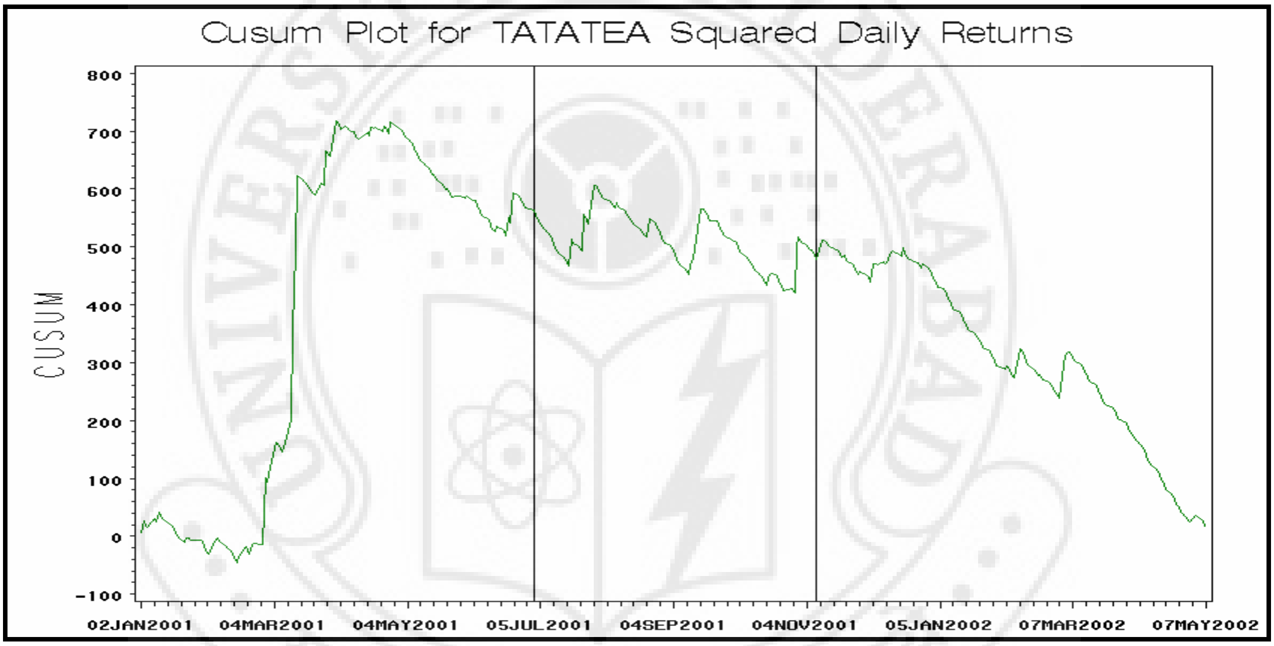
Parameter	Estimate
ϕ_0	-0.060 (>0.10)
ϕ_1	-0.146 (<0.01)
ϕ_2	-0.124 (<0.01)
θ_1	1.057 (<0.01)
γ_{d1}	0.048 (>0.10)
γ_{d2}	0.003 (>0.10)
F-stat	53.36 (<0.01)
G (4) test-statistic	3.256 (>0.10)
Q (4) test-statistic	7.605 (>0.10)
LM (4) test-static	7.111 (>0.10)

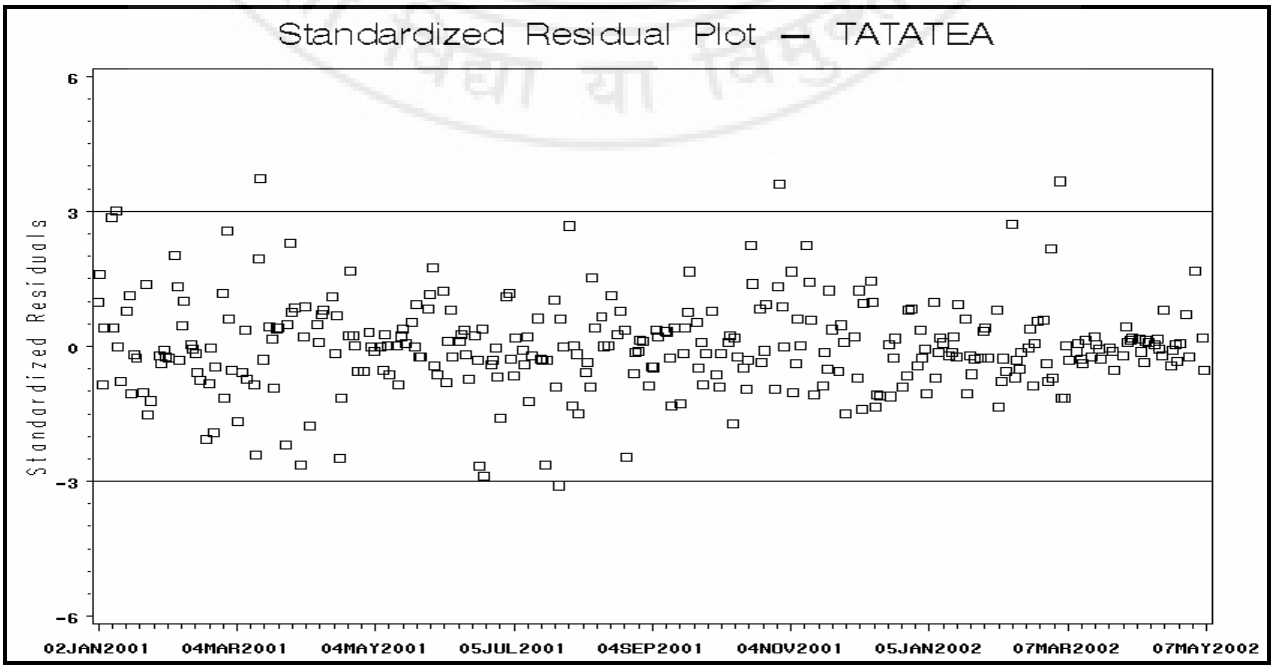
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


TATATEA Daily Returns: Pre & Post Inception of Futures
Daily Returns
15
12
9
6
3
0
-3
-6
-9
-12
-15
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Cusum Plot for TATATEA Squared Daily Returns
CUSUM
800
700
600
500
400
300
200
100
0
-100
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Standardized Residual Plot — TATATEA
Standardized Residuals
6
3
0
-3
-6
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002

Stock Symbol – TELCO (Now Tata Motors Ltd.)

Table No. 41:

Regression Results for TELCO using robust standard errors, R_t takes stock symbol TELCO, Mkt_t takes Nifty, FD_t takes on value of zero before SSFs introduction and a value of one afterwards and OD_t takes on value of zero before 'stock options' introduction and a value of one afterwards.

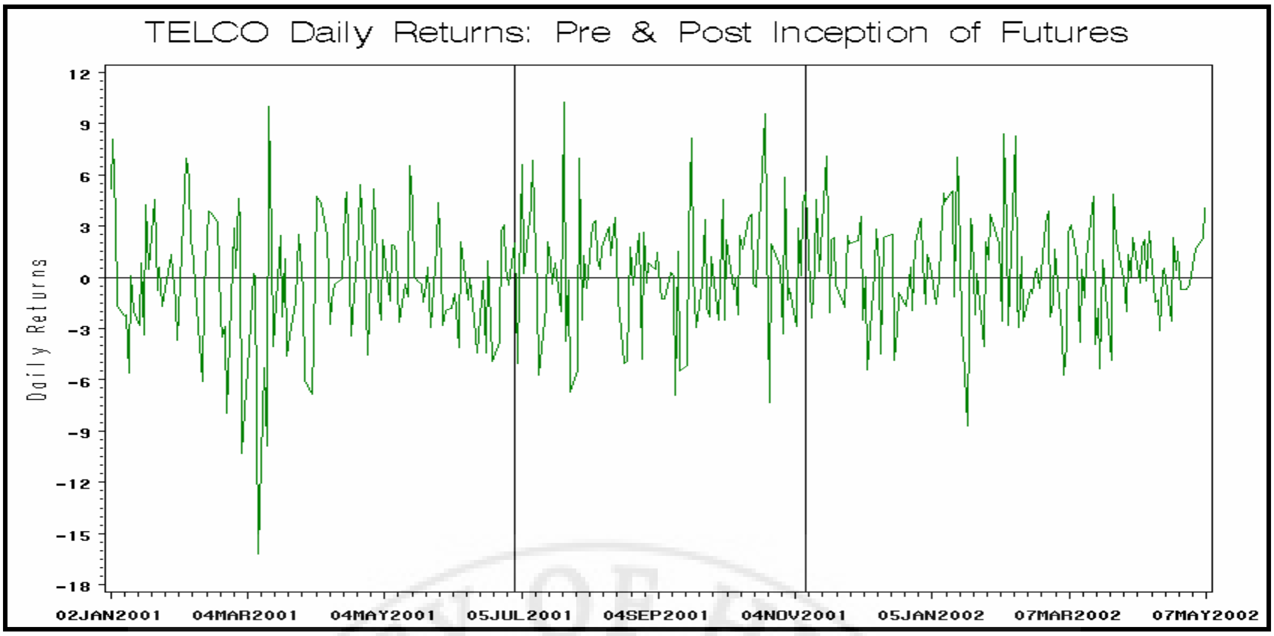
$$R_t = \phi_0 + \phi_1 R_{t-3} + \theta_1 Mkt_t + \gamma_{d1} FD_t + \gamma_{d2} OD_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0,1)$$

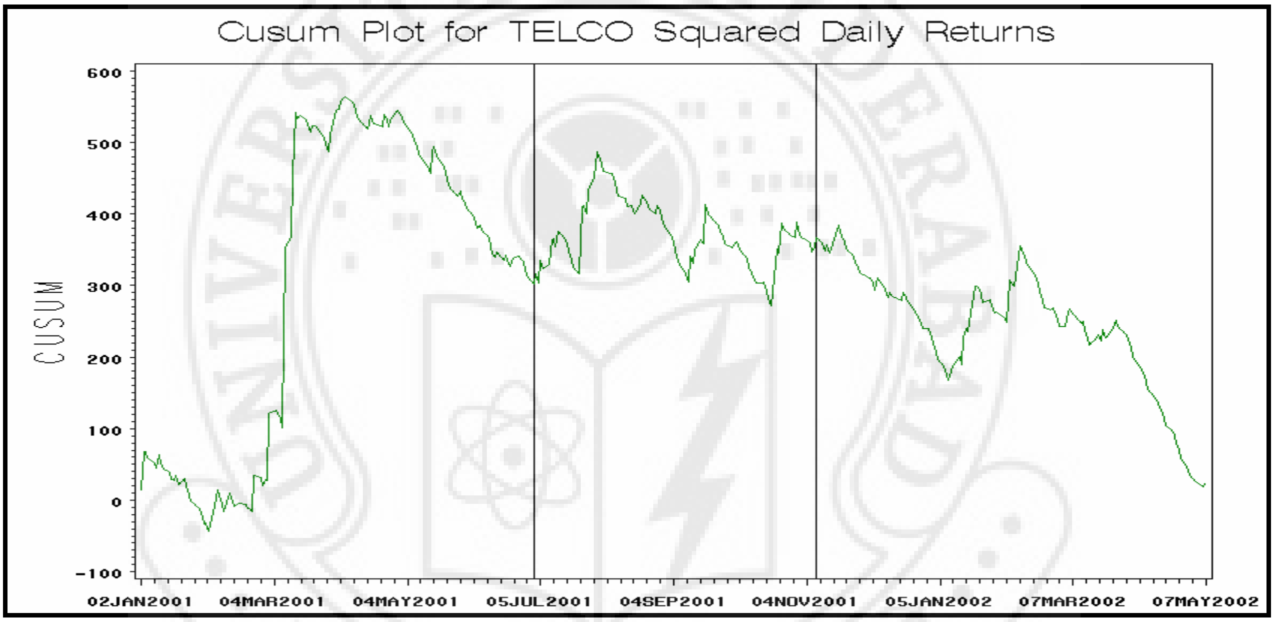
Parameter	**Estimate**
ϕ_0	-0.192 (>0.10)
ϕ_1	-0.123 (<0.05)
θ_1	1.071 (<0.01)
γ_{d1}	-0.210 (>0.10)
γ_{d2}	0.762 (>0.10)
F-stat	26.59 (<0.01)
G (4) test-statistic	2.805 (>0.10)
Q (4) test-statistic	2.805 (>0.10)
LM (4) test-static	2.454 (>0.10)

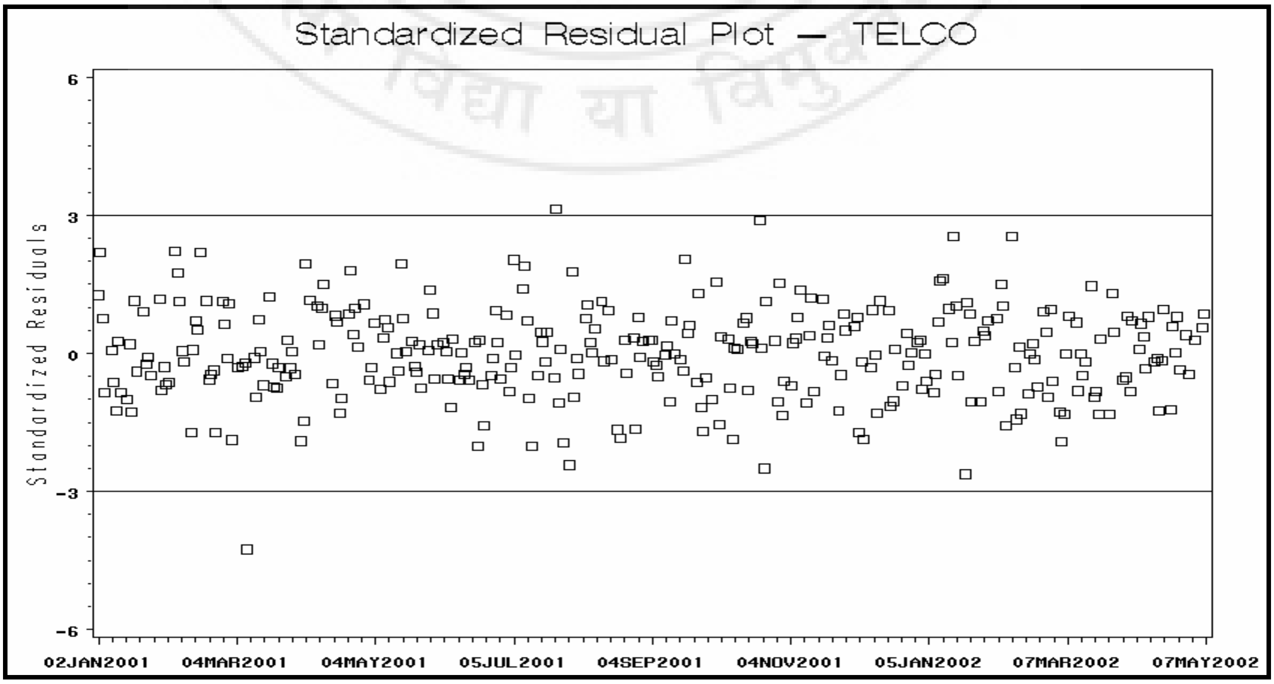
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


TELCO Daily Returns: Pre & Post Inception of Futures
Daily Returns
12
9
6
3
0
-3
-6
-9
-12
-15
-18
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Cusum Plot for TELCO Squared Daily Returns
CUSUM
600
500
400
300
200
100
0
-100
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Standardized Residual Plot — TELCO
Standardized Residuals
6
3
0
-3
-6
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002

Stock Symbol – TISCO (Now Tata Steel Ltd.)

Table No. 42a: Regression Results-Evidence of ARCH Effects. R_t takes stock symbol TISCO, Mkt_t takes Nifty.

$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	0.010 (>0.10)
θ_1	1.104 (<0.01)
F-stat	160.8 (<0.01)
G (4) test-statistic	1.785 (>0.10)
Q (4) test-statistic	9.662 (<0.05)
LM (4) test-static	8.578 (<0.10)

Table No. 42b:
Results of ARCH (1) model for TISCO using robust standard errors, R_t, Mkt_t are same as defined above, FD_t takes on value of zero before SSFs introduction and a value of one afterwards and OD_t takes on value of zero before 'stock options' introduction and a value of one afterwards.

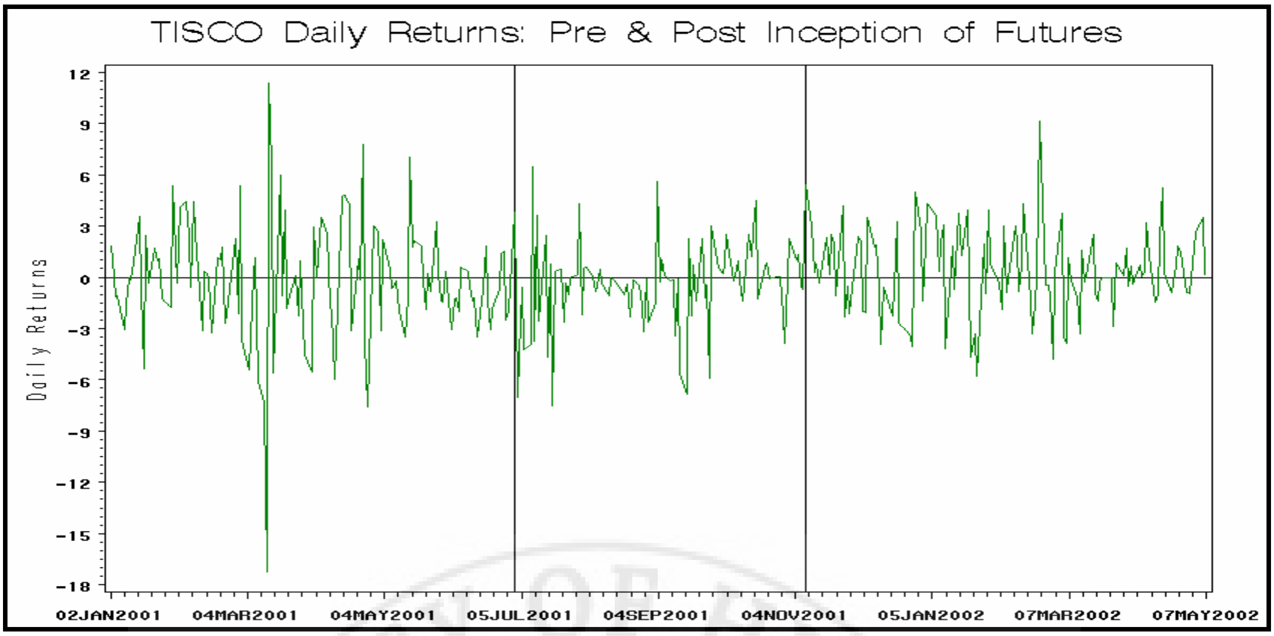
$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

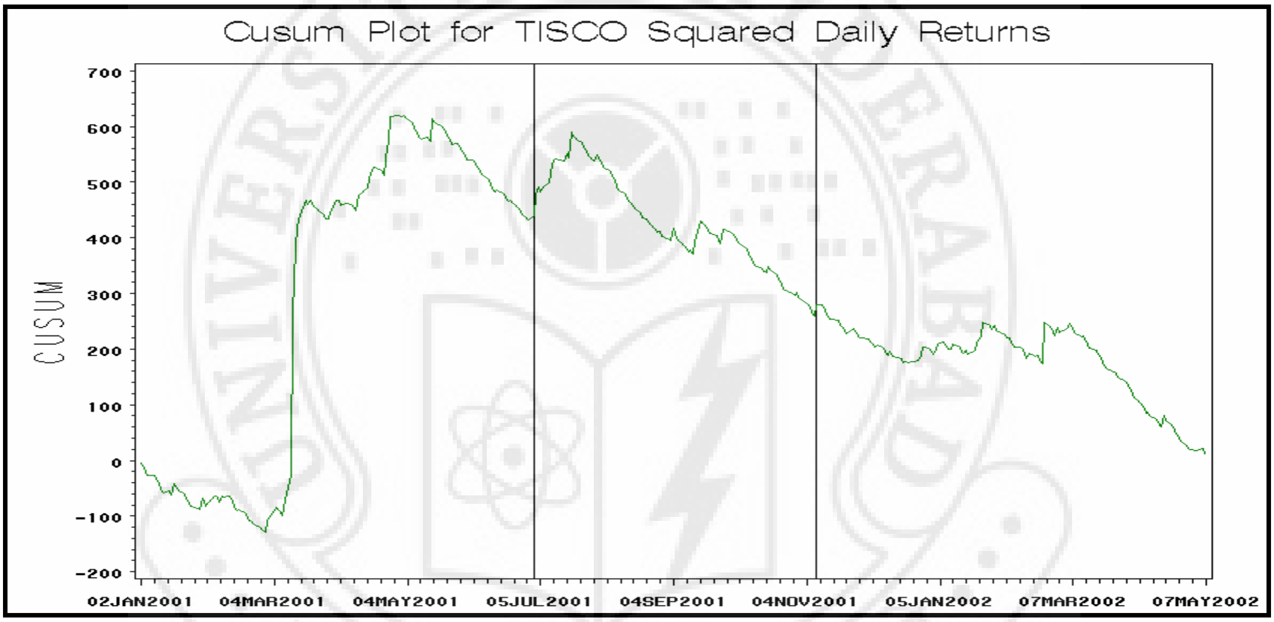
$$\varepsilon_t \sim N(0, h_t)$$

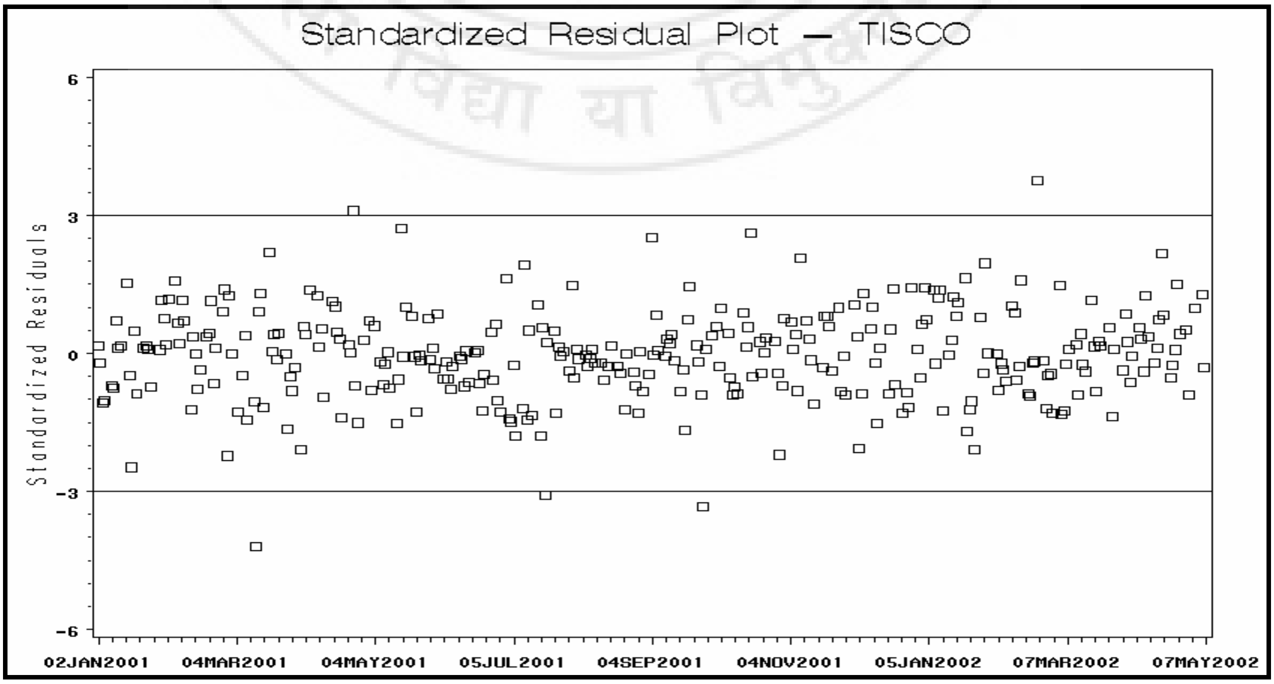
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \gamma_{d1} FD_t + \gamma_{d2} OD_t$$

Parameter	Estimate	p-value
ϕ_0	0.072	>0.10
θ_1	0.967	<0.01
α_0	4.944	<0.01
α_1	0.243	<0.05
γ_{d1}	-0.128	>0.10
γ_{d2}	-0.474	>0.10
Diagnostics		
G (4) test-statistic	1.621	>0.10
Q (4) test-statistic	2.833	>0.10
LM (4) test-static	2.542	>0.10
Sign Bias	0.317	>0.10
Negative Size Bias	-0.096	>0.10
Positive Size Bias	0.187	>0.10
Joint Bias	2.694	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 = 1$	18.76	<0.01

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


TISCO Daily Returns: Pre & Post Inception of Futures
Daily Returns
12
9
6
3
0
-3
-6
-9
-12
-15
-18
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Cusum Plot for TISCO Squared Daily Returns
CUSUM
700
600
500
400
300
200
100
0
-100
-200
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Standardized Residual Plot — TISCO
Standardized Residuals
6
3
0
-3
-6
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002

Stock Symbol – VSNL (Videshi Sanchar Nigam Ltd.)

Table No. XX:

Regression Results for VSNL using robust standard errors, R_t takes stock symbol VSNL, Mkt_t takes Nifty, FD_t takes on value of zero before SSFs introduction and a value of one afterwards, OD_t takes on value of zero before 'stock options' introduction and a value of one afterwards and ED_t is dummy which takes the value of one for date 17th Jan 2002 where there was sudden fall in stock price.

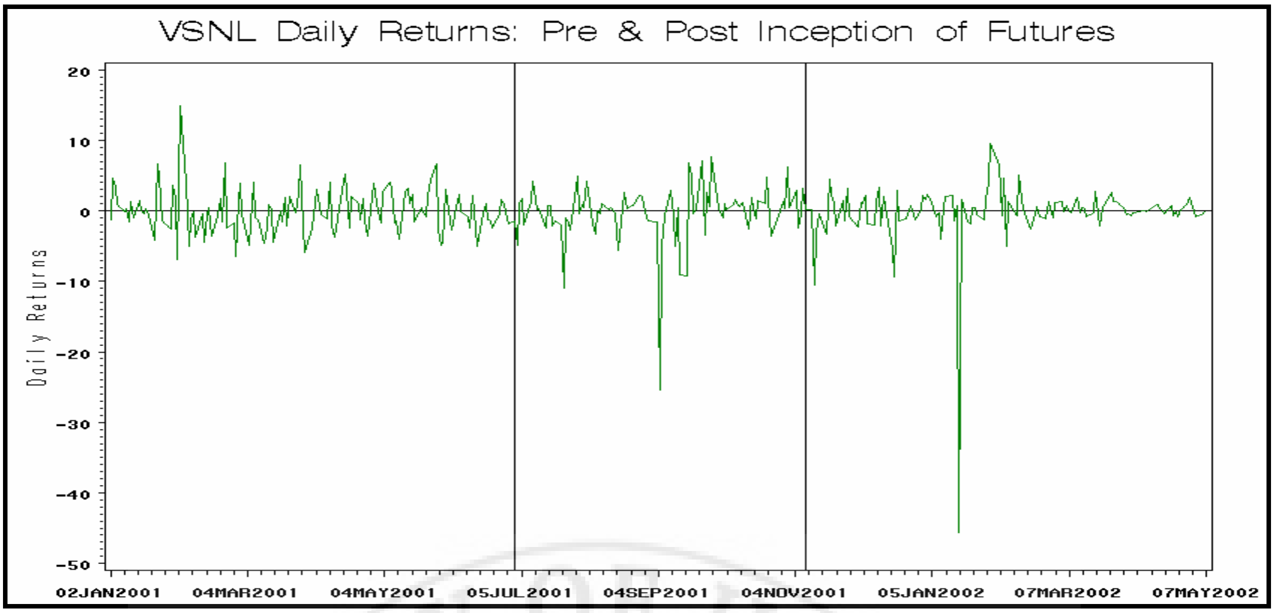
$$R_t = \phi_0 + \theta_1 Mkt_t + \gamma_{d1} FD_t + \gamma_{d2} OD_t + \kappa ED_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0,1)$$

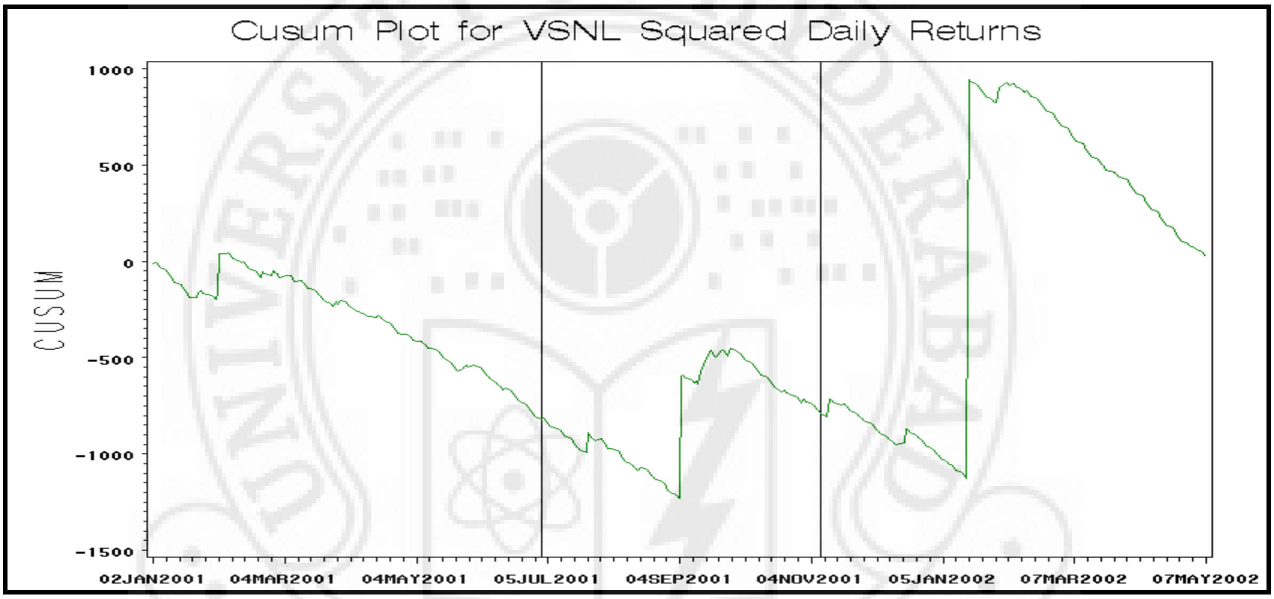
Parameter	Estimate
ϕ_0	0.127 (>0.10)
θ_1	0.841 (<0.01)
γ_{d1}	0.219 (>0.10)
γ_{d2}	-0.281 (>0.10)
κ	-47.21 (<0.01)
F-stat	74.34 (<0.01)
G (4) test-statistic	5.979 (>0.10)
Q (4) test-statistic	0.556 (>0.10)
LM (4) test-static	0.564 (>0.10)

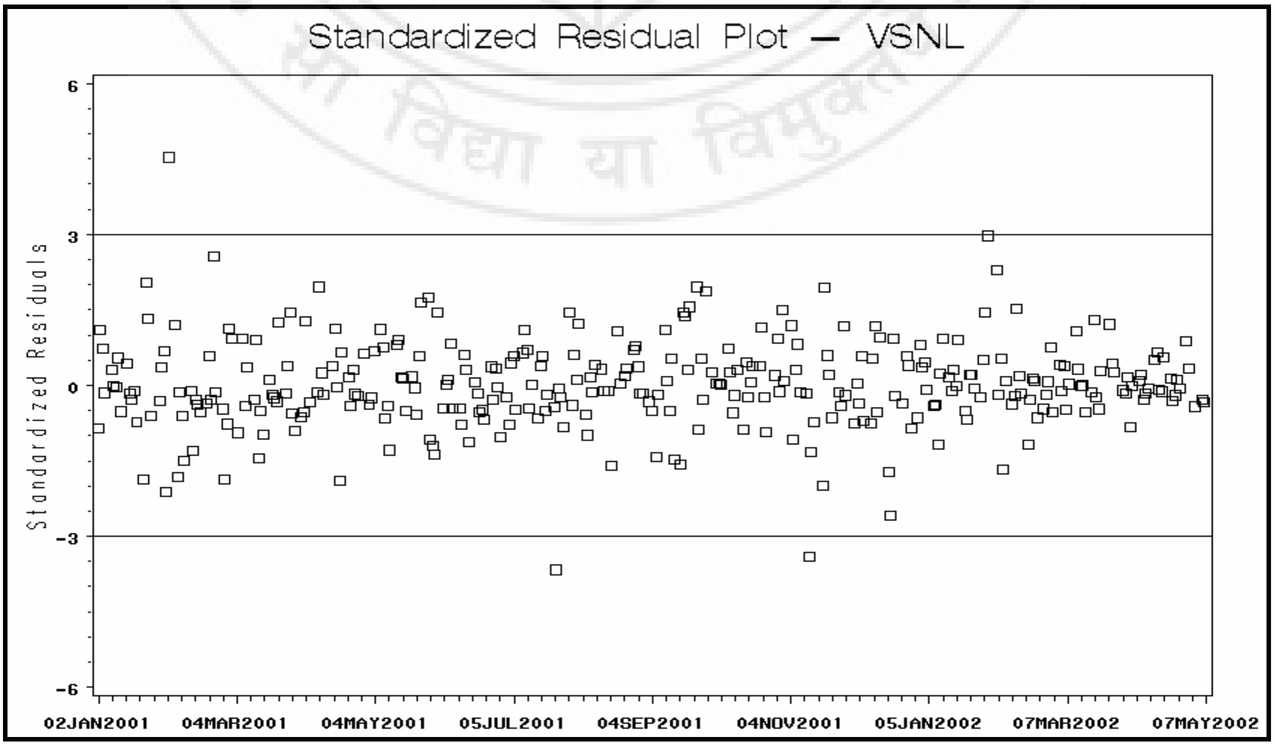
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


VSNL Daily Returns: Pre & Post Inception of Futures
Daily Returns
20
10
0
-10
-20
-30
-40
-50
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Cusum Plot for VSNL Squared Daily Returns
CUSUM
1000
500
0
-500
-1000
-1500
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002


Standardized Residual Plot — VSNL
Standardized Residuals
6
3
0
-3
-6
02JAN2001
04MAR2001
04MAY2001
05JUL2001
04SEP2001
04NOV2001
05JAN2002
07MAR2002
07MAY2002

Stock Symbol – BEL (Bharat Electronics Ltd.)

Table No. 44:

Regression Results for BEL using robust standard errors, R_t takes stock symbol BEL, Mkt_t takes Nifty and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

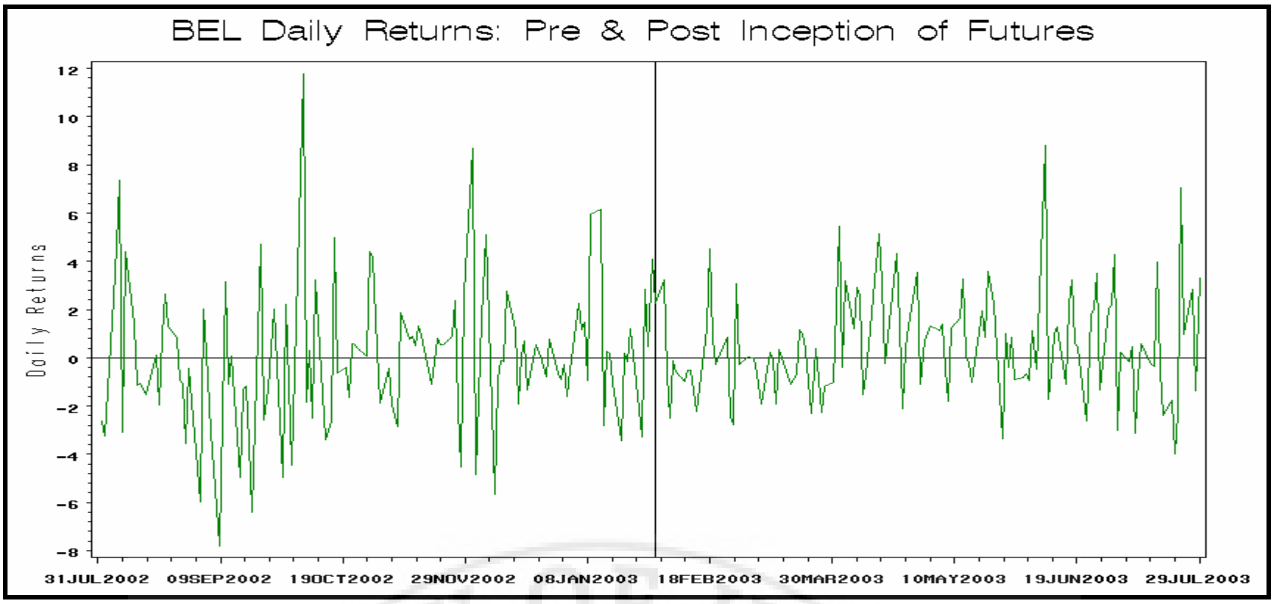
$$R_t = \phi_0 + \theta_1 Mkt_t + \gamma D_t + \varepsilon_t$$
$$\varepsilon_t \mid \varepsilon_{t-5} \sim N(0,1)$$

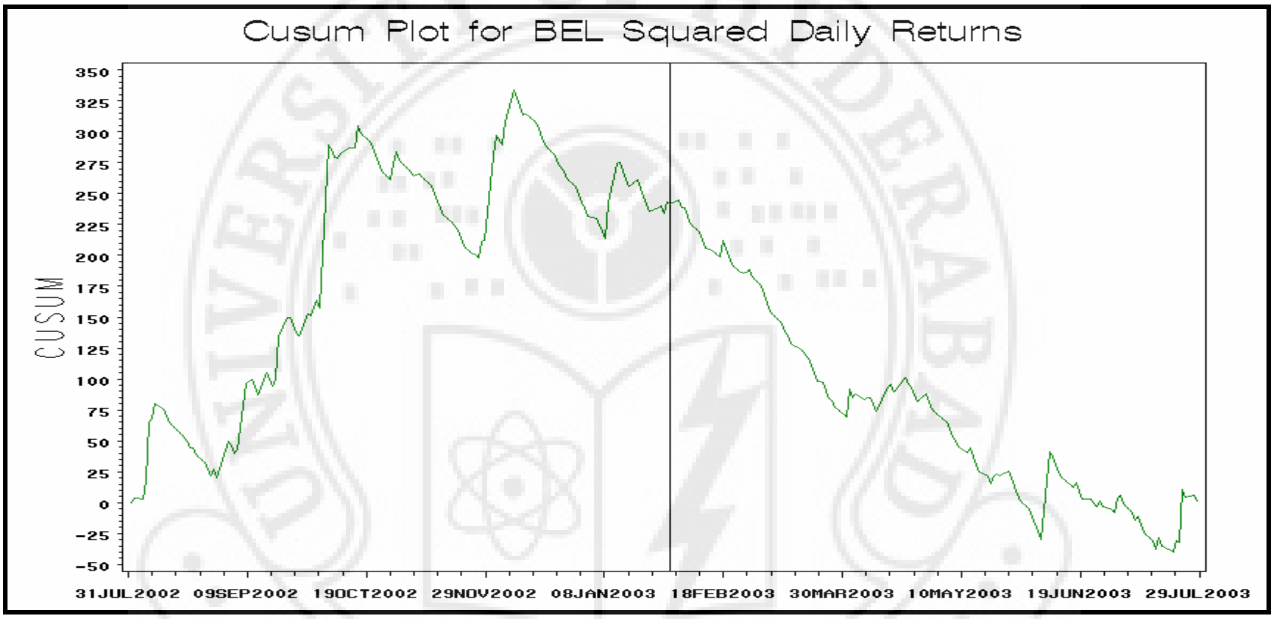
Parameter	Estimate
ϕ_0	-0.042 (>0.10)
θ_1	0.843 (<0.01)
γ	0.442 (<0.10)
ε_{t-5}	0.118 (<0.05)
F-stat	11.44 (<0.01)
G (4) test-statistic	4.240 (>0.10)
Q (4) test-statistic	3.958 (>0.10)
LM (4) test-static	3.783 (>0.10)

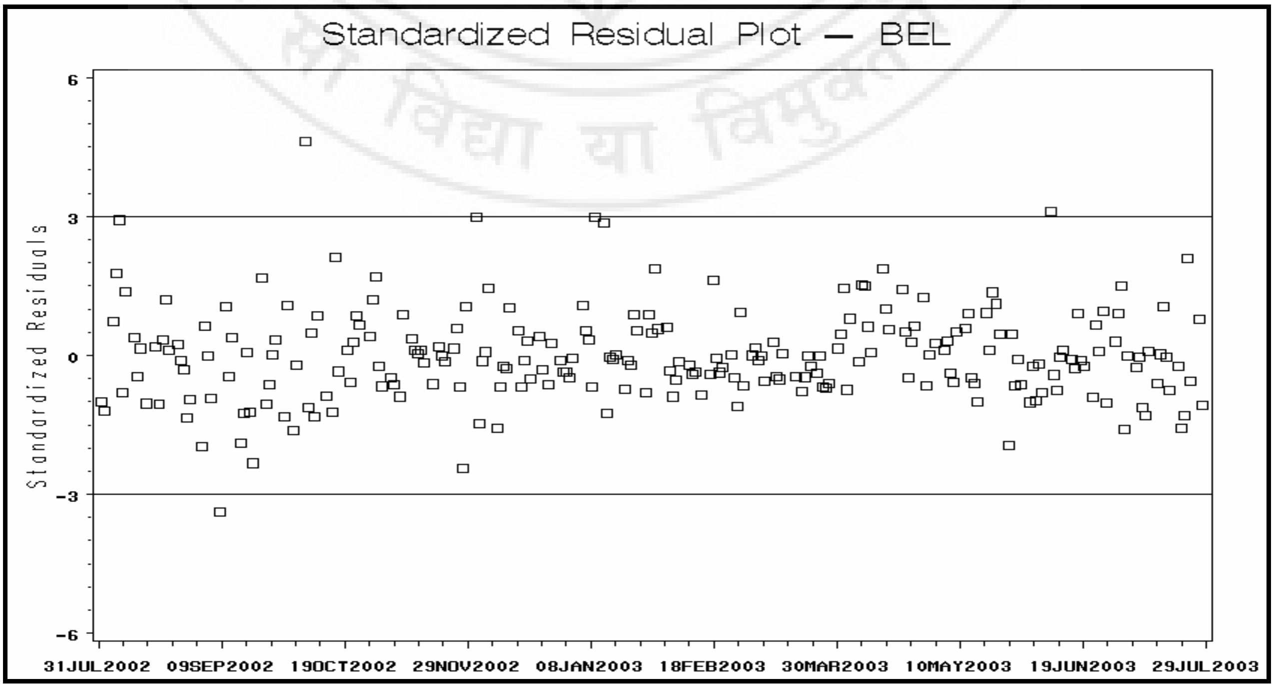
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


BEL Daily Returns: Pre & Post Inception of Futures
Daily Returns
12
10
8
6
4
2
0
-2
-4
-6
-8
31JUL2002 09SEP2002 19OCT2002 29NOV2002 08JAN2003 18FEB2003 30MAR2003 10MAY2003 19JUN2003 29JUL2003


Cusum Plot for BEL Squared Daily Returns
CUSUM
350
325
300
275
250
225
200
175
150
125
100
75
50
25
0
-25
-50
31JUL2002 09SEP2002 19OCT2002 29NOV2002 08JAN2003 18FEB2003 30MAR2003 10MAY2003 19JUN2003 29JUL2003


Standardized Residual Plot — BEL
Standardized Residuals
6
3
0
-3
-6
31JUL2002 09SEP2002 19OCT2002 29NOV2002 08JAN2003 18FEB2003 30MAR2003 10MAY2003 19JUN2003 29JUL2003

Stock Symbol – HCLTECH (HCL Technologies Ltd.)

Table No. 45:

Regression Results for HCLTECH using robust standard errors, R_t takes stock symbol HCLTECH, Mkt_t takes Nifty, D_t takes on value of zero before SSFs introduction and a value of one afterwards and ED_t is dummy which takes the value of one for date's 22nd Oct 2002 and 10th April 2003 for unforeseen fall in price.

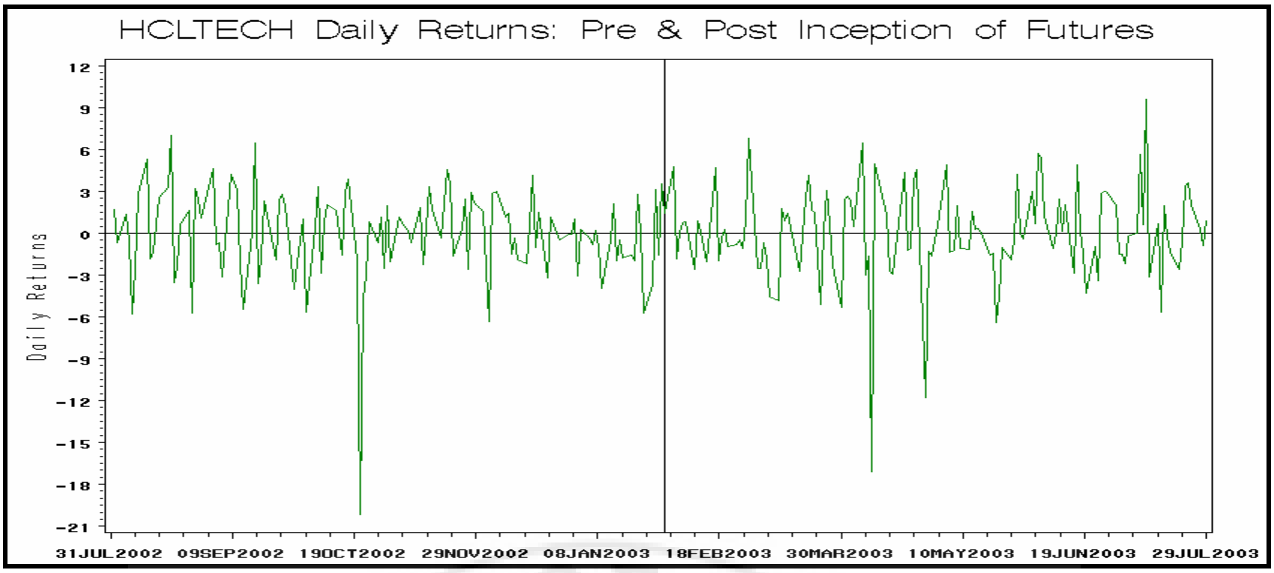
$$R_t = \phi_0 + \phi_1 R_{t-2} + \theta_1 Mkt_t + \gamma D_t + \kappa ED_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0,1)$$

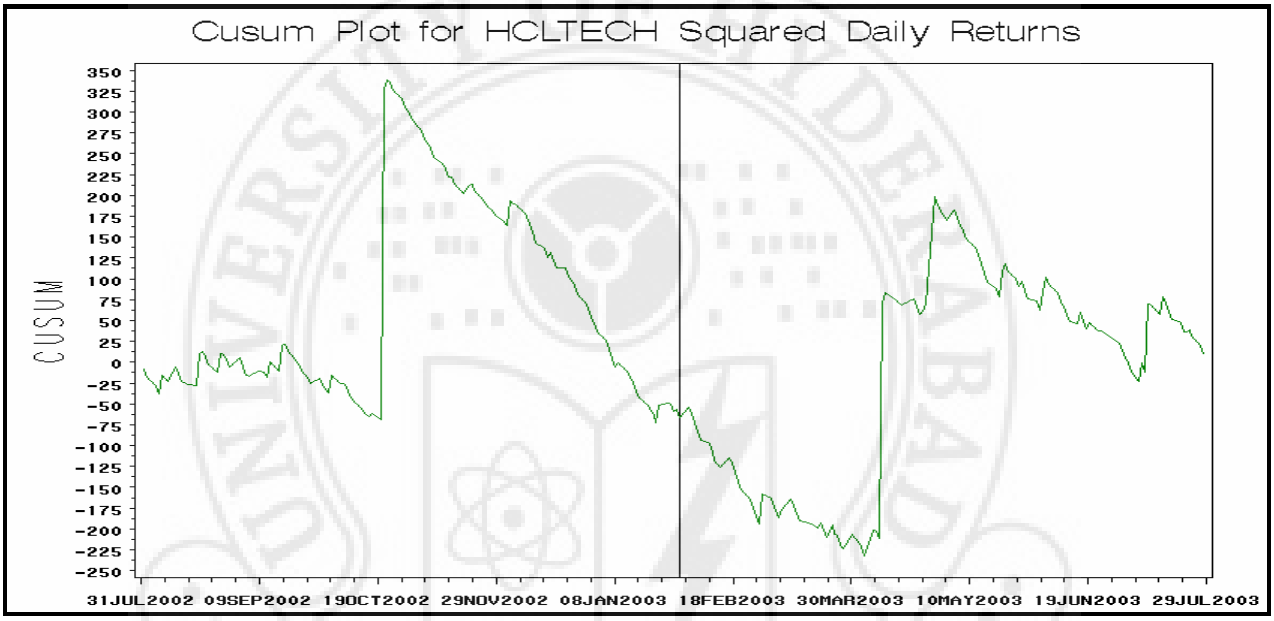
Parameter	Estimate
ϕ_0	-0.231 (>0.10)
ϕ_1	-0.137 (<0.05)
θ_1	1.689 (<0.01)
γ	0.146 (>0.10)
κ	-9.641 (<0.01)
F-stat	31.98 (<0.01)
G (4) test-statistic	3.257 (>0.10)
Q (4) test-statistic	1.119 (>0.10)
LM (4) test-static	1.115 (>0.10)

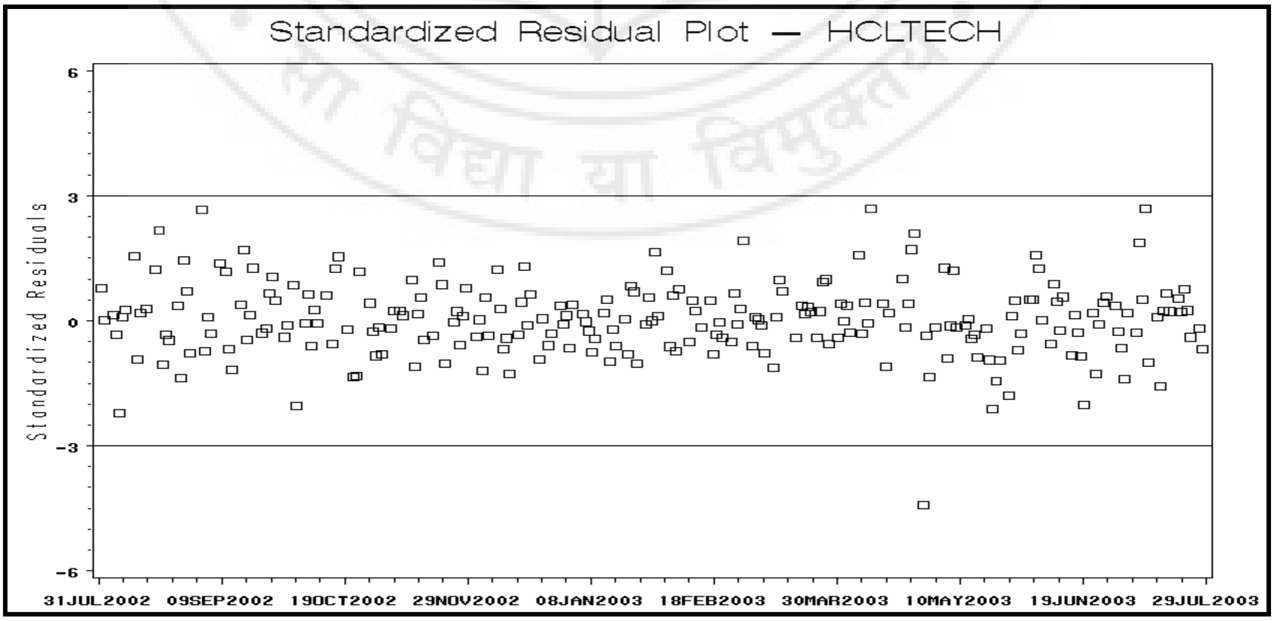
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.







Stock Symbol – HEROHONDA (Hero Honda Motors Ltd.)

Table No. 46a: Regression Results-Evidence of GARCH Effects. R_t takes stock symbol HEROHONDA, Mkt_t takes Nifty.

$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	-0.040 (>0.10)
θ_1	0.480 (<0.01)
F-stat	8.395 (<0.01)
G (4) test-statistic	5.733 (>0.10)
Q (4) test-statistic	9.246 (<0.01)
LM (4) test-static	9.811 (<0.01)

Table No. 46b:

Results of IGARCH (1, 1) model for HEROHONDA using robust standard errors, R_t, Mkt_t are same as defined above and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

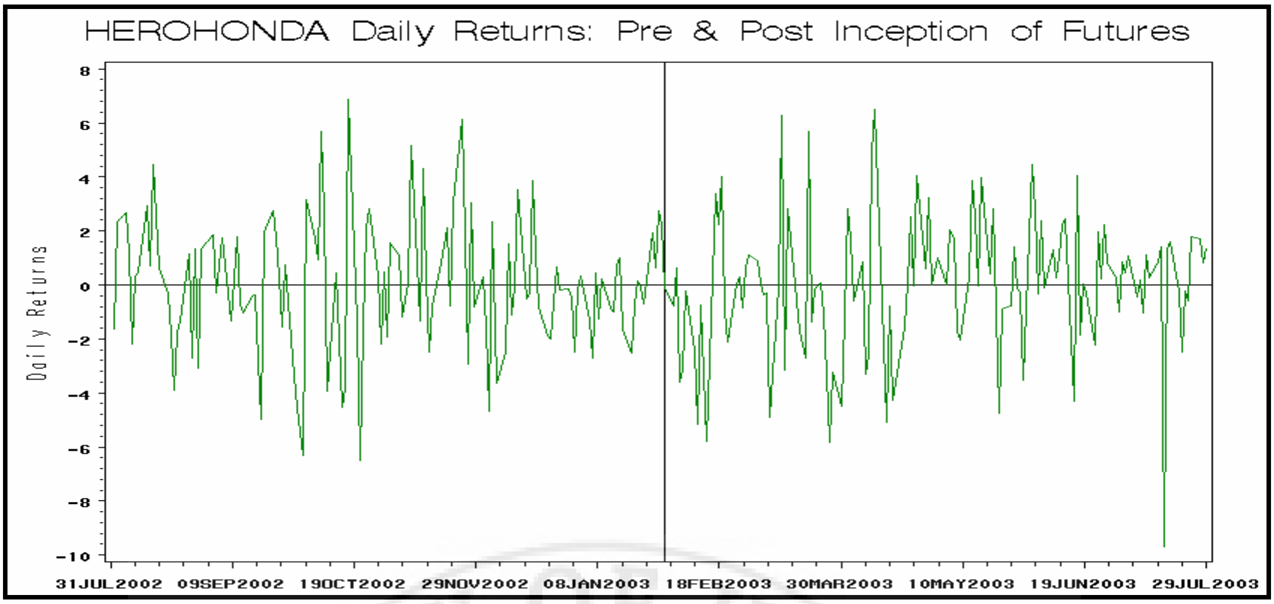
$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

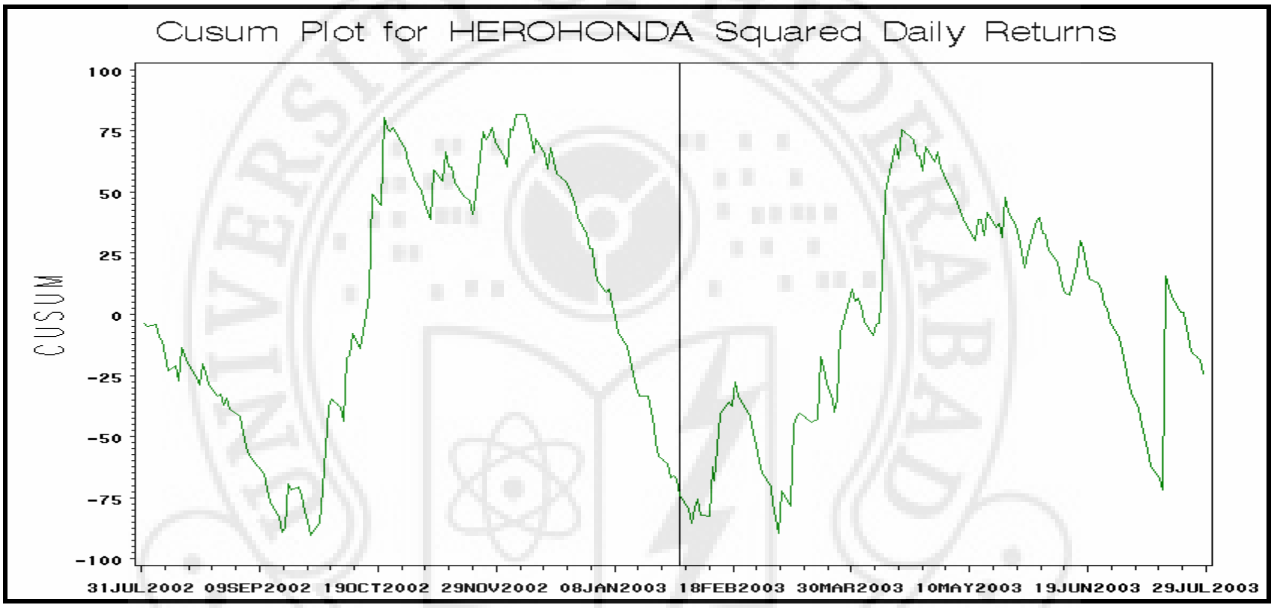
$$\varepsilon_t \sim N(0, h_t)$$

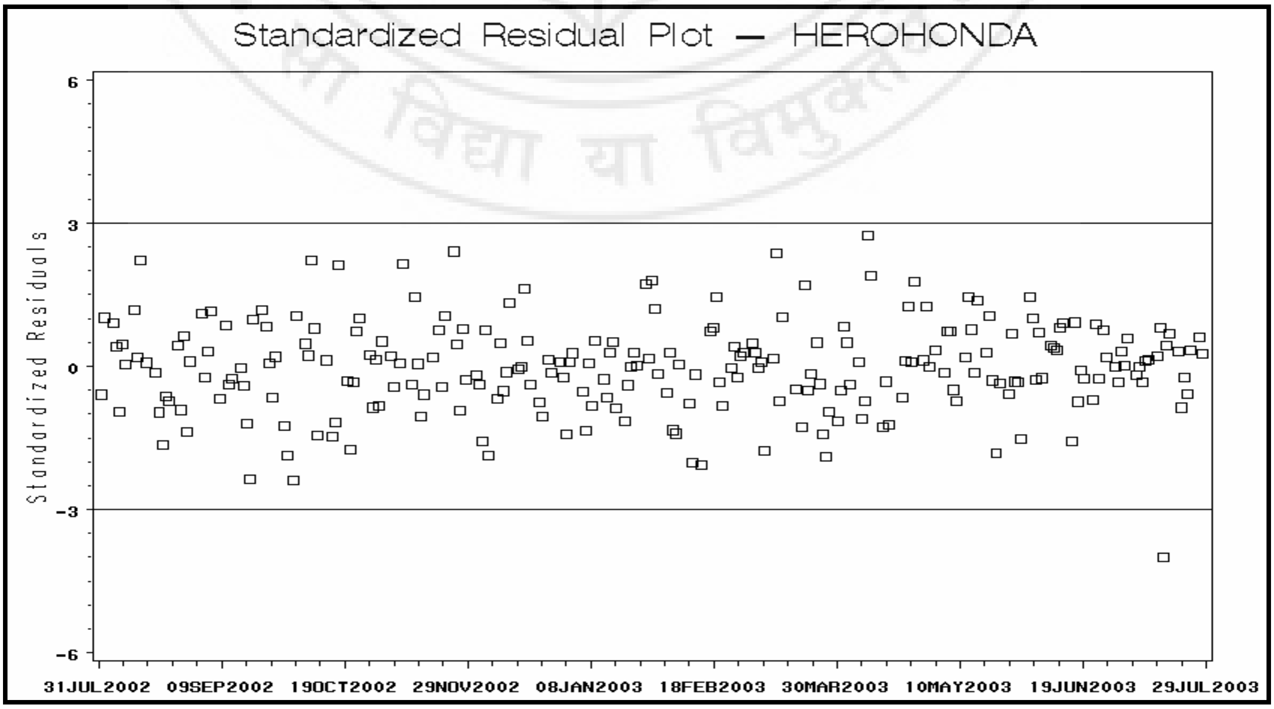
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \alpha_{0,d} D_t + \alpha_{1,d} D_t * \varepsilon_{t-1}^2 + \beta_{1,d} D_t * h_{t-1}$$

Parameter	Estimate	p-value
ϕ_0	-0.049	>0.10
θ_1	0.485	<0.01
α_0	0.222	>0.10
α_1	0.092	<0.05
β_1	0.868	<0.01
$\alpha_{0,d}$	3.989	<0.05
$\alpha_{1,d}$	0.071	>0.10
$\beta_{1,d}$	-0.658	<0.05
Diagnostics		
G (4) test-statistic	4.954	>0.10
Q (4) test-statistic	4.621	>0.10
LM (4) test-static	4.630	>0.10
Sign Bias	-0.078	>0.10
Negative Size Bias	-0.056	>0.10
Positive Size Bias	-0.135	>0.10
Joint Bias	1.270	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 + \beta_1 = 1$	1.110*	>0.10

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).
* Likelihood Ratio test statistic for GARCH (1, 1).


HEROHONDA Daily Returns: Pre & Post Inception of Futures
Daily Returns
8
6
4
2
0
-2
-4
-6
-8
-10
31JUL2002 09SEP2002 19OCT2002 29NOV2002 08JAN2003 18FEB2003 30MAR2003 10MAY2003 19JUN2003 29JUL2003


Cusum Plot for HEROHONDA Squared Daily Returns
CUSUM
100
75
50
25
0
-25
-50
-75
-100
31JUL2002 09SEP2002 19OCT2002 29NOV2002 08JAN2003 18FEB2003 30MAR2003 10MAY2003 19JUN2003 29JUL2003


Standardized Residual Plot — HEROHONDA
Standardized Residuals
6
3
0
-3
-6
31JUL2002 09SEP2002 19OCT2002 29NOV2002 08JAN2003 18FEB2003 30MAR2003 10MAY2003 19JUN2003 29JUL2003

Stock Symbol – ICICIBANK (ICICI Bank Ltd.)

Table No. 47a: Regression Results-Evidence of GARCH Effects. R_t takes stock symbol ICICIBANK, Mkt_t takes Nifty.

$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	-0.001 (>0.10)
θ_1	0.604 (<0.01)
F-stat	21.39 (<0.01)
G (4) test-statistic	1.794 (>0.10)
Q (4) test-statistic	10.88 (<0.05)
LM (4) test-static	9.751 (<0.05)

Table No. 47b:

Results of GARCH (1, 1) model for ICICIBANK using robust standard errors, R_t, Mkt_t are same as defined above and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

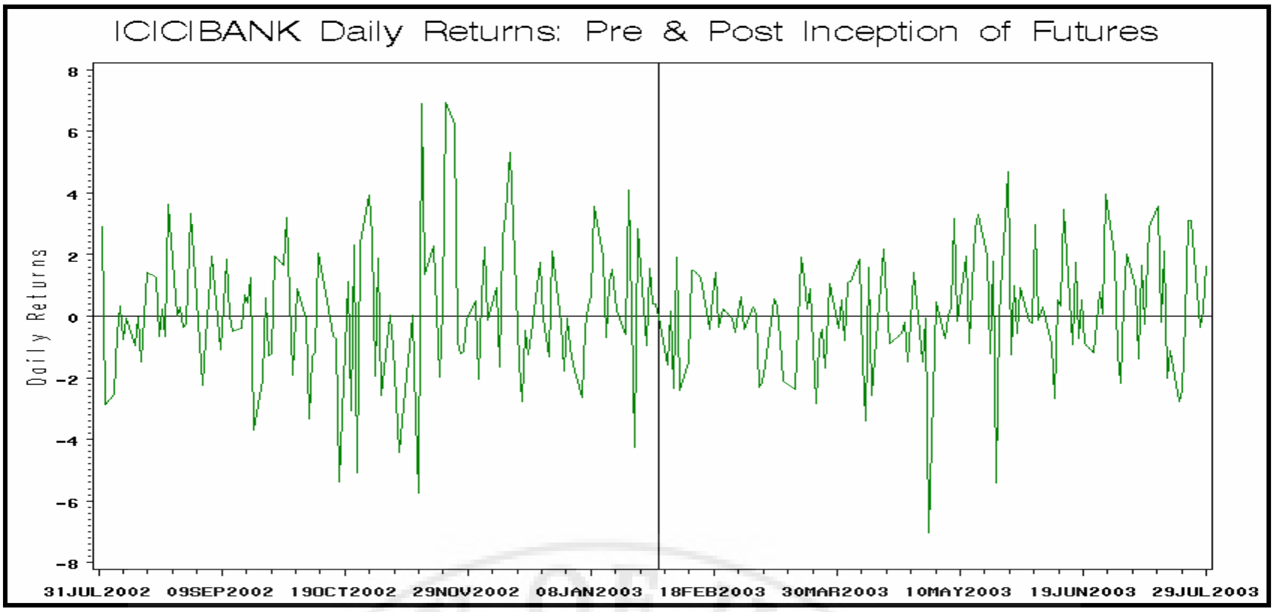
$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

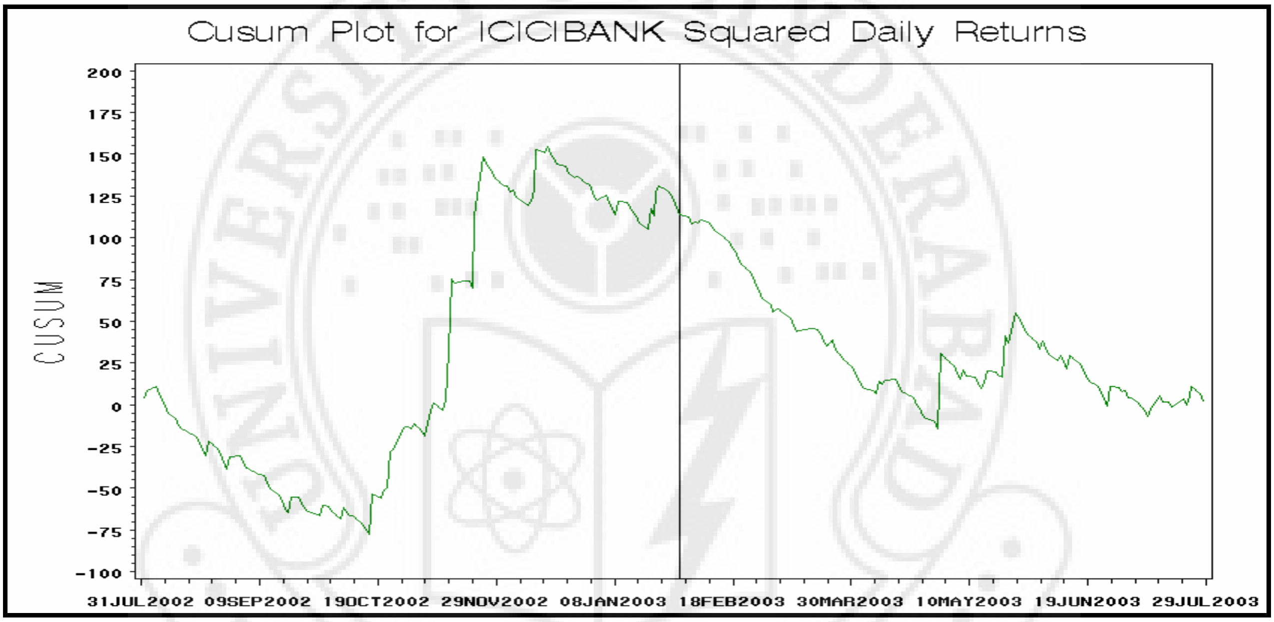
$$\varepsilon_t \sim N(0, h_t)$$

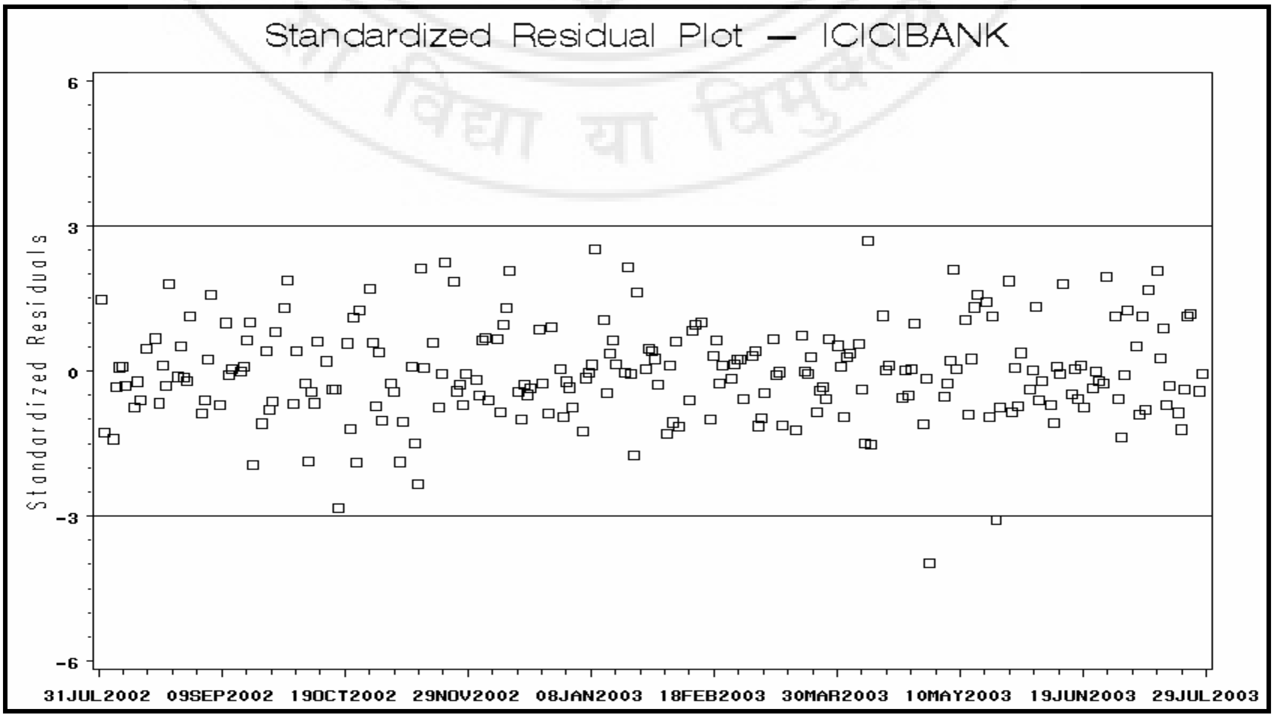
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \alpha_{0,d} D_t + \alpha_{1,d} D_t * \varepsilon_{t-1}^2 + \beta_{1,d} D_t * h_{t-1}$$

Parameter	Estimate	p-value
ϕ_0	0.006	>0.10
θ_1	0.588	<0.01
α_0	0.265	>0.10
α_1	0.083	<0.10
β_1	0.860	<0.01
$\alpha_{0,d}$	3.759	<0.01
$\alpha_{1,d}$	-0.198	<0.01
$\beta_{1,d}$	-1.180	<0.01
Diagnostics		
G (4) test-statistic	3.063	>0.10
Q (4) test-statistic	1.541	>0.10
LM (4) test-static	1.819	>0.10
Sign Bias	0.062	>0.10
Negative Size Bias	-0.048	>0.10
Positive Size Bias	0.131	>0.10
Joint Bias	1.601	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 + \beta_1 = 1$	2.370	>0.10

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


ICICIBANK Daily Returns: Pre & Post Inception of Futures
Daily Returns
8
6
4
2
0
-2
-4
-6
-8
31JUL2002 09SEP2002 19OCT2002 29NOV2002 08JAN2003 18FEB2003 30MAR2003 10MAY2003 19JUN2003 29JUL2003


Cusum Plot for ICICIBANK Squared Daily Returns
CUSUM
200
175
150
125
100
75
50
25
0
-25
-50
-75
-100
31JUL2002 09SEP2002 19OCT2002 29NOV2002 08JAN2003 18FEB2003 30MAR2003 10MAY2003 19JUN2003 29JUL2003


Standardized Residual Plot — ICICIBANK
Standardized Residuals
6
3
0
-3
-6
31JUL2002 09SEP2002 19OCT2002 29NOV2002 08JAN2003 18FEB2003 30MAR2003 10MAY2003 19JUN2003 29JUL2003

Stock Symbol – IPCL (Indian Petrochemicals Corporation Ltd.)

Table No. 48:

Regression Results for IPCL using robust standard errors, R_t takes stock symbol IPCL, Mkt_t takes Nifty, D_t takes on value of zero before SSFs introduction and a value of one afterwards and ED_t is dummy which takes the value of one for date 29th Aug 2002 where there was sudden fall in stock price.

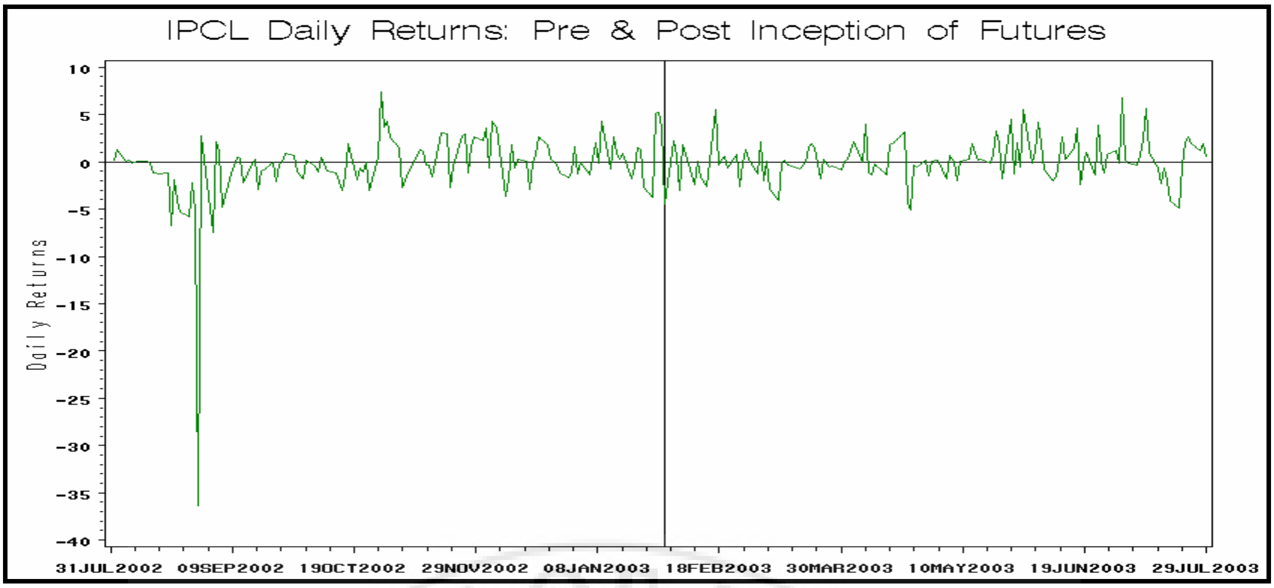
$$R_t = \phi_0 + \phi_1 R_{t-1} + \theta_1 Mkt_t + \gamma D_t + \kappa ED_t + \varepsilon_t$$
$$\varepsilon_t \mid \varepsilon_{t-1} \sim N(0,1)$$

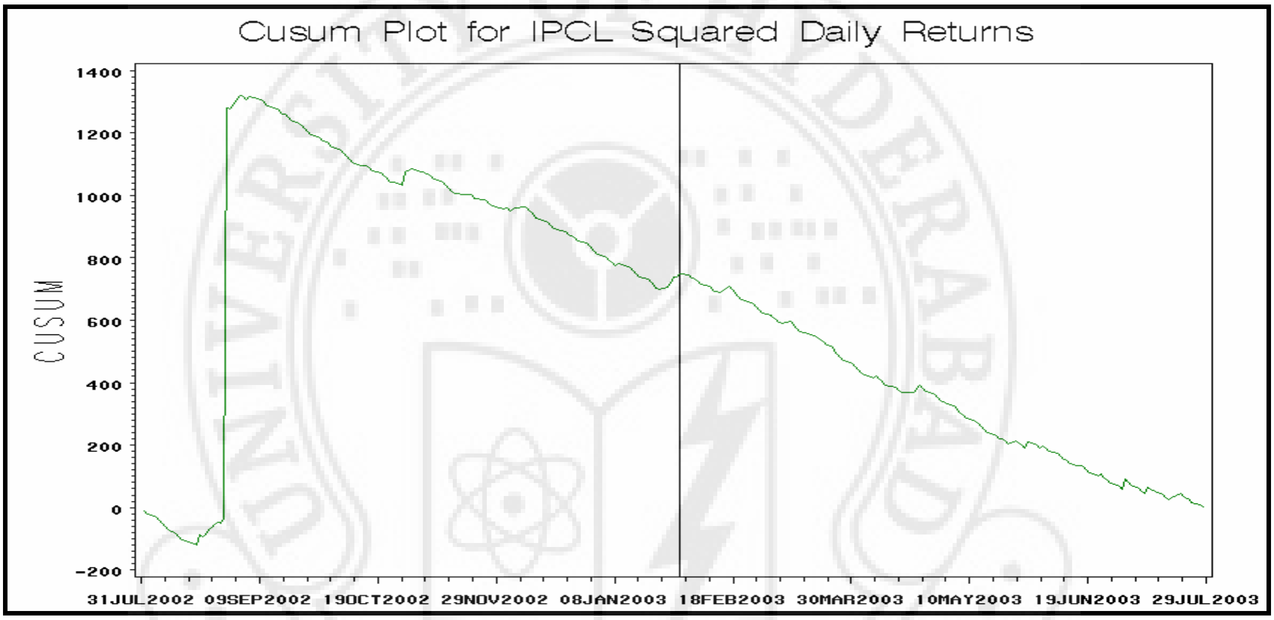
Parameter	Estimate
ϕ_0	-0.028 (>0.10)
ϕ_1	0.830 (<0.01)
θ_1	0.913 (<0.01)
γ	-0.049 (>0.10)
κ	-34.767 (<0.01)
ε_{t-1}	0.702 (<0.01)
F-stat	72.63 (<0.01)
G (4) test-statistic	2.765 (>0.10)
Q (4) test-statistic	4.6982 (>0.10)
LM (4) test-static	4.378 (>0.10)

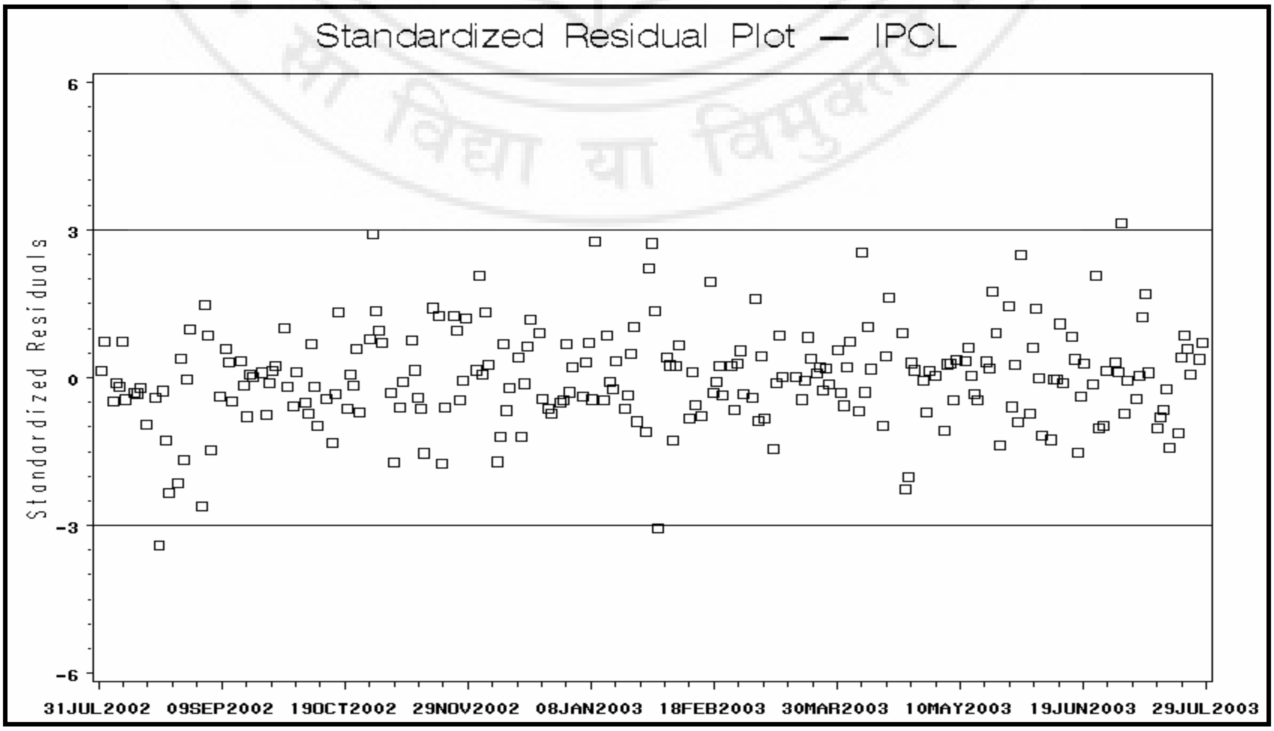
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


IPCL Daily Returns: Pre & Post Inception of Futures
Daily Returns
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
31JUL2002 09SEP2002 19OCT2002 29NOV2002 08JAN2003 18FEB2003 30MAR2003 10MAY2003 19JUN2003 29JUL2003


Cusum Plot for IPCL Squared Daily Returns
CUSUM
1400
1200
1000
800
600
400
200
0
-200
31JUL2002 09SEP2002 19OCT2002 29NOV2002 08JAN2003 18FEB2003 30MAR2003 10MAY2003 19JUN2003 29JUL2003


Standardized Residual Plot — IPCL
Standardized Residuals
6
3
0
-3
-6
31JUL2002 09SEP2002 19OCT2002 29NOV2002 08JAN2003 18FEB2003 30MAR2003 10MAY2003 19JUN2003 29JUL2003

Stock Symbol – MASTEK (MASTEK Ltd.)

Table No. 49:

Regression Results for MASTEK using robust standard errors, R_t takes stock symbol MASTEK, Mkt_t takes Nifty, D_t takes on value of zero before SSFs introduction and a value of one after wards and ED_t is dummy which takes the value of one for date's 10th April 2003 and 15th July 2003 for unforeseen fall in price.

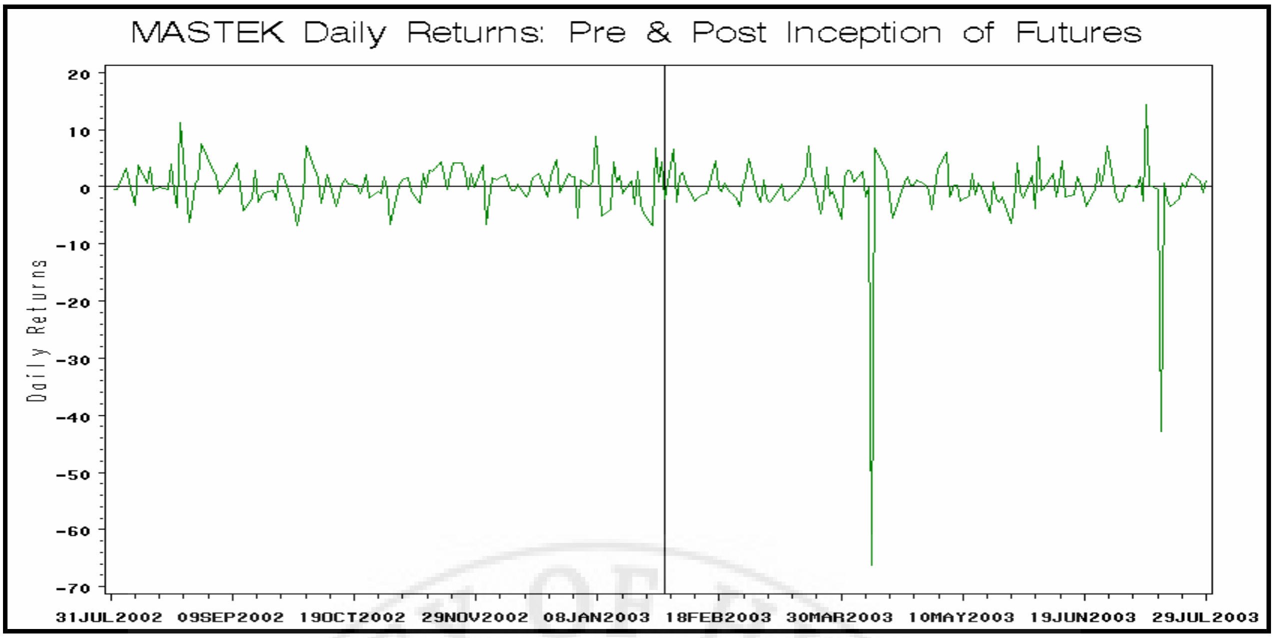
$$R_t = \phi_0 + \phi_1 R_{t-1} + \theta_1 Mkt_t + \gamma D_t + \kappa ED_t + \varepsilon_t$$
$$\varepsilon_t \mid \varepsilon_{t-1} \sim N(0,1)$$

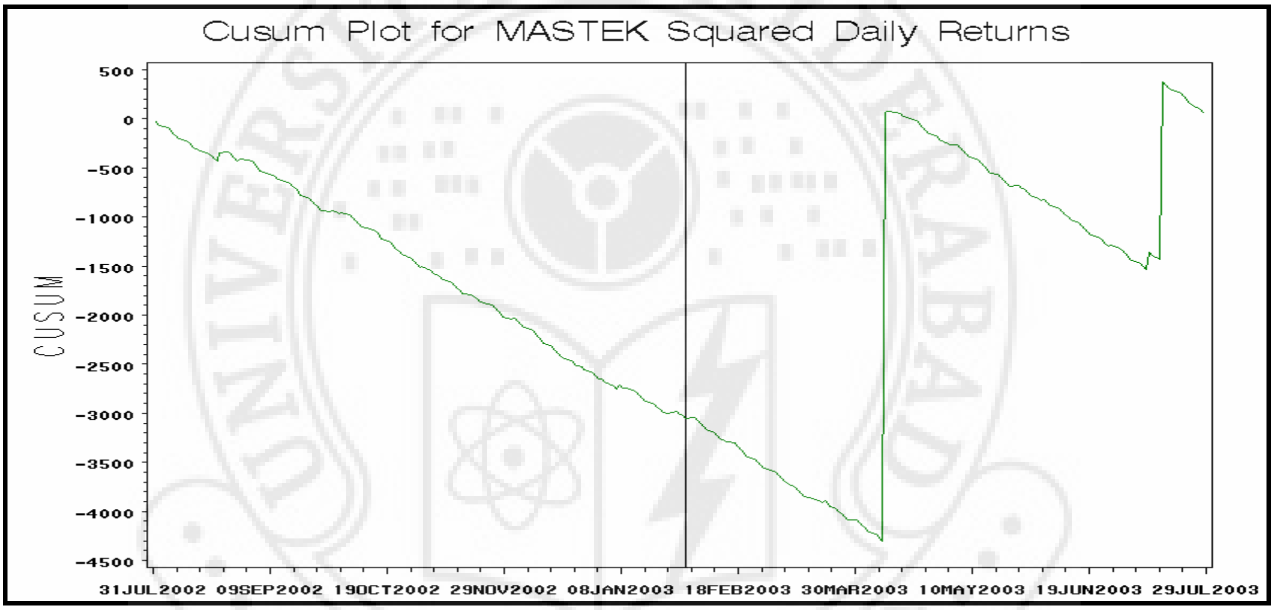
Parameter	Estimate
ϕ_0	0.199 (>0.10)
ϕ_1	-0.181 (<0.01)
θ_1	2.955 (<0.05)
γ	-1.008 (<0.01)
κ	-39.64 (<0.01)
F-stat	53.37 (<0.01)
G (4) test-statistic	2.861 (>0.10)
Q (4) test-statistic	0.036 (>0.10)
LM (4) test-static	0.034 (>0.10)

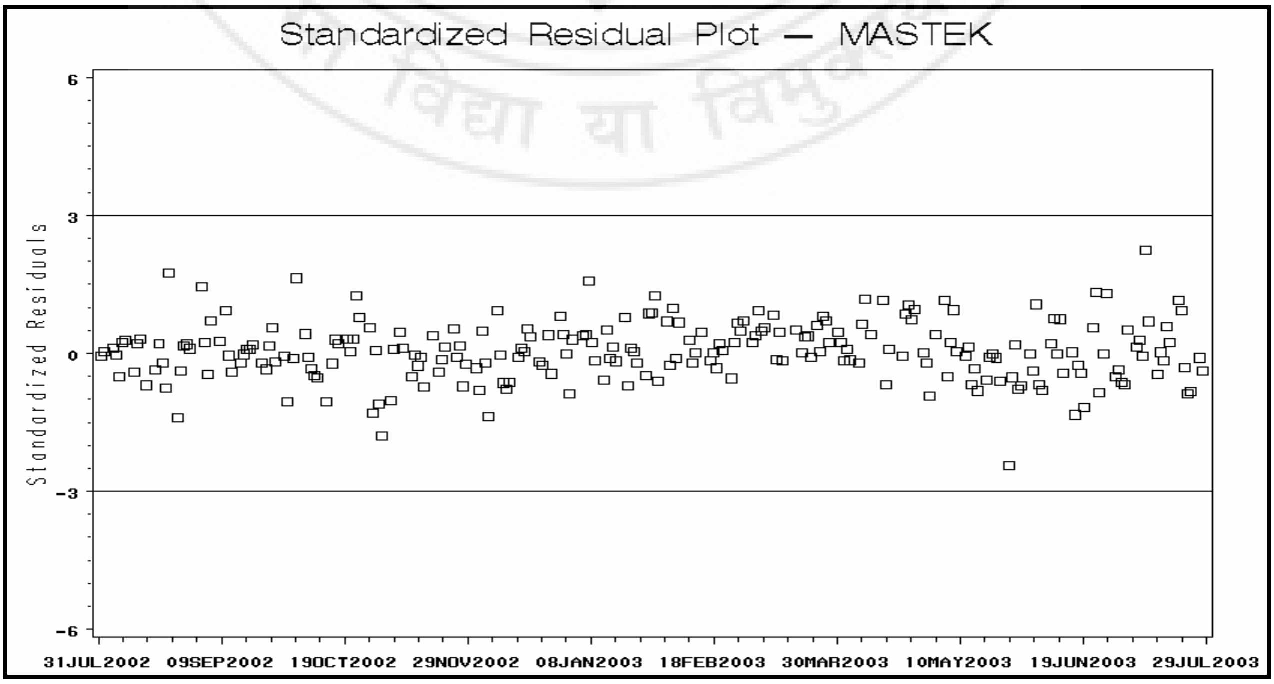
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


MASTEK Daily Returns: Pre & Post Inception of Futures
Daily Returns
20
10
0
-10
-20
-30
-40
-50
-60
-70
31JUL2002 09SEP2002 19OCT2002 29NOV2002 08JAN2003 18FEB2003 30MAR2003 10MAY2003 19JUN2003 29JUL2003


Cusum Plot for MASTEK Squared Daily Returns
CUSUM
500
0
-500
-1000
-1500
-2000
-2500
-3000
-3500
-4000
-4500
31JUL2002 09SEP2002 19OCT2002 29NOV2002 08JAN2003 18FEB2003 30MAR2003 10MAY2003 19JUN2003 29JUL2003


Standardized Residual Plot — MASTEK
Standardized Residuals
6
3
0
-3
-6
31JUL2002 09SEP2002 19OCT2002 29NOV2002 08JAN2003 18FEB2003 30MAR2003 10MAY2003 19JUN2003 29JUL2003

Stock Symbol – NATIONALUM (National Aluminum Company Ltd.)

Table No. 50a: Regression Results-Evidence of GARCH Effects. R_t takes stock symbol NATIONALUM, Mkt_t takes Nifty.

$$R_t = \phi_0 + \phi_1 R_{t-3} + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	-0.092 (>0.10)
ϕ_1	-0.148 (<0.01)
θ_1	1.097 (<0.01)
F-stat	12.52 (<0.01)
G (4) test-statistic	5.681 (>0.10)
Q (4) test-statistic	28.05 (<0.01)
LM (4) test-static	26.70 (<0.01)

Table No. 50b:

Results of AR(3)-GARCH (1, 1) model for NATIONALUM using robust standard errors, R_t, Mkt_t are same as defined above and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

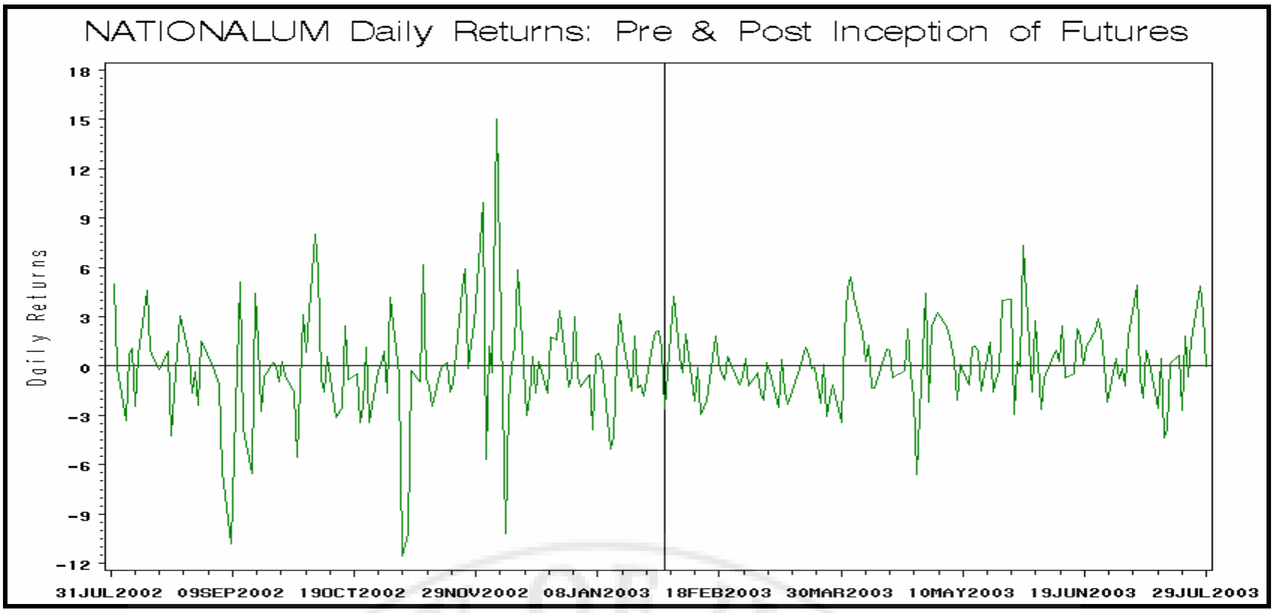
$$R_t = \phi_0 + R_{t-3} + \theta_1 Mkt_t + \varepsilon_t$$

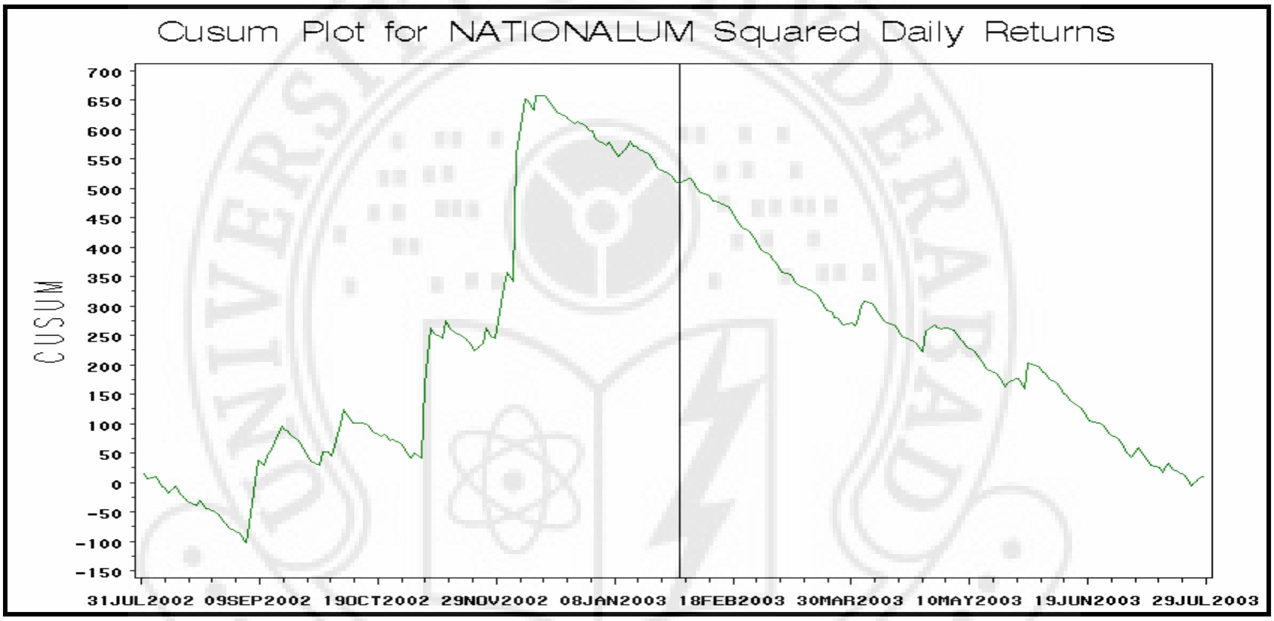
$$\varepsilon_t \sim N(0, h_t)$$

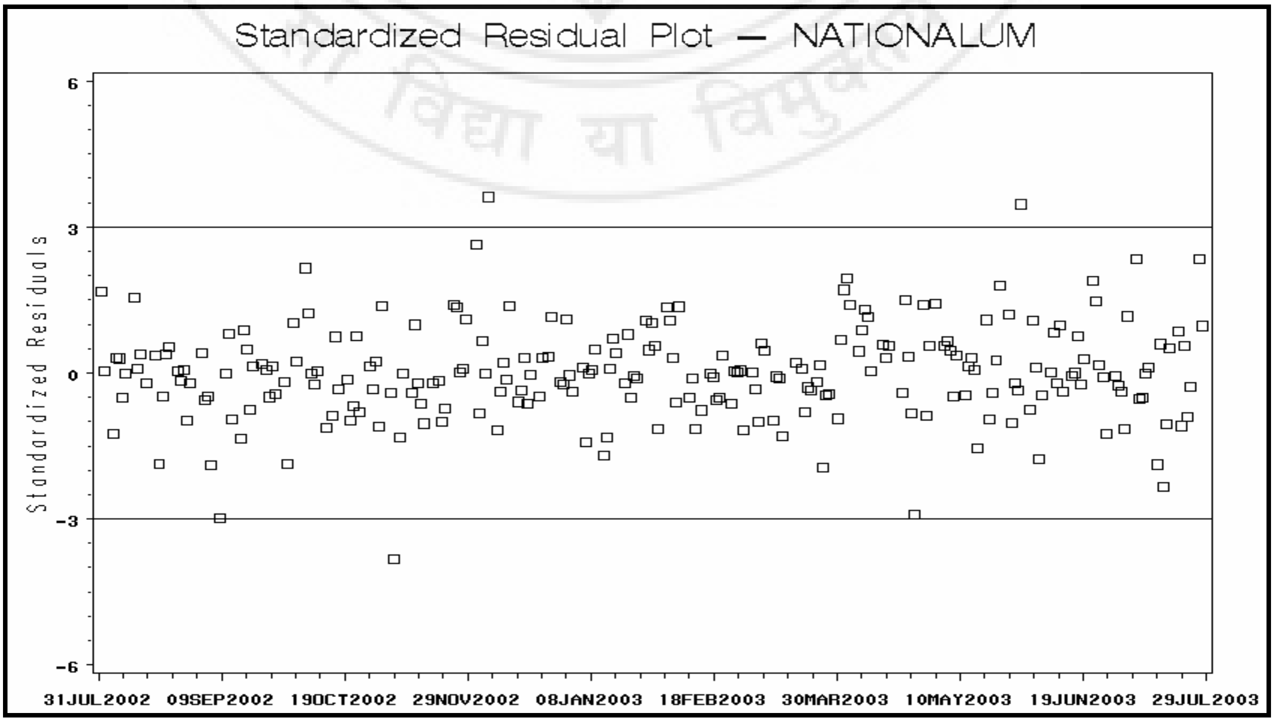
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \alpha_{0,d} D_t + \alpha_{1,d} D_t * \varepsilon_{t-1}^2 + \beta_{1,d} D_t * h_{t-1}$$

Parameter	Estimate	p-value
ϕ_0	-0.056	>0.10
ϕ_1	-0.133	<0.01
θ_1	0.906	<0.05
α_0	2.876	<0.05
α_1	0.283	<0.05
β_1	0.481	<0.01
$\alpha_{0,d}$	-1.786	>0.10
$\alpha_{1,d}$	-0.137	>0.10
$\beta_{1,d}$	0.100	>0.10
Diagnostics		
G (4) test-statistic	4.120	>0.10
Q (4) test-statistic	4.221	>0.10
LM (4) test-static	4.077	>0.10
Sign Bias	0.099	>0.10
Negative Size Bias	-0.031	>0.10
Positive Size Bias	-0.025	>0.10
Joint Bias	0.238	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 + \beta_1 = 1$	8.510	<0.01

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


NATIONALUM Daily Returns: Pre & Post Inception of Futures
Daily Returns
18
15
12
9
6
3
0
-3
-6
-9
-12
31JUL2002 09SEP2002 19OCT2002 29NOV2002 08JAN2003 18FEB2003 30MAR2003 10MAY2003 19JUN2003 29JUL2003


Cusum Plot for NATIONALUM Squared Daily Returns
CUSUM
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
-50
-100
-150
31JUL2002 09SEP2002 19OCT2002 29NOV2002 08JAN2003 18FEB2003 30MAR2003 10MAY2003 19JUN2003 29JUL2003


Standardized Residual Plot — NATIONALUM
Standardized Residuals
6
3
0
-3
-6
31JUL2002 09SEP2002 19OCT2002 29NOV2002 08JAN2003 18FEB2003 30MAR2003 10MAY2003 19JUN2003 29JUL2003

Stock Symbol – NIIT (National Institute of Information Technology Ltd.)

Table No. 51a: Regression Results-Evidence of GARCH Effects. R_t takes stock symbol NIIT, Mkt_t takes Nifty.

$$R_t = \phi_0 + \phi_1 R_{t-4} + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	-0.218 (>0.10)
ϕ_1	0.171 (<0.01)
θ_1	2.169 (<0.01)
F-stat	50.83 (<0.01)
G (4) test-statistic	0.522 (>0.10)
Q (4) test-statistic	23.43 (<0.01)
LM (4) test-static	25.31 (<0.01)

Table No. 51b:

Results of AR(4)-GARCH (1, 1) model for NIIT using robust standard errors, R_t, Mkt_t are same as defined above and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

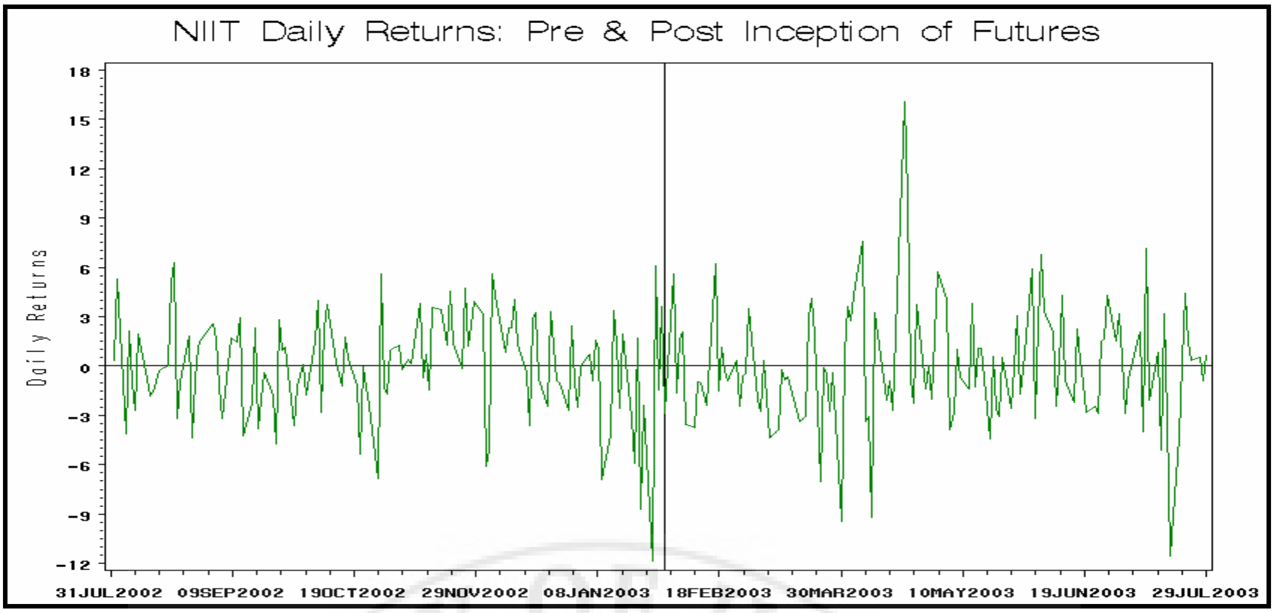
$$R_t = \phi_0 + R_{t-4} + \theta_1 Mkt_t + \varepsilon_t$$

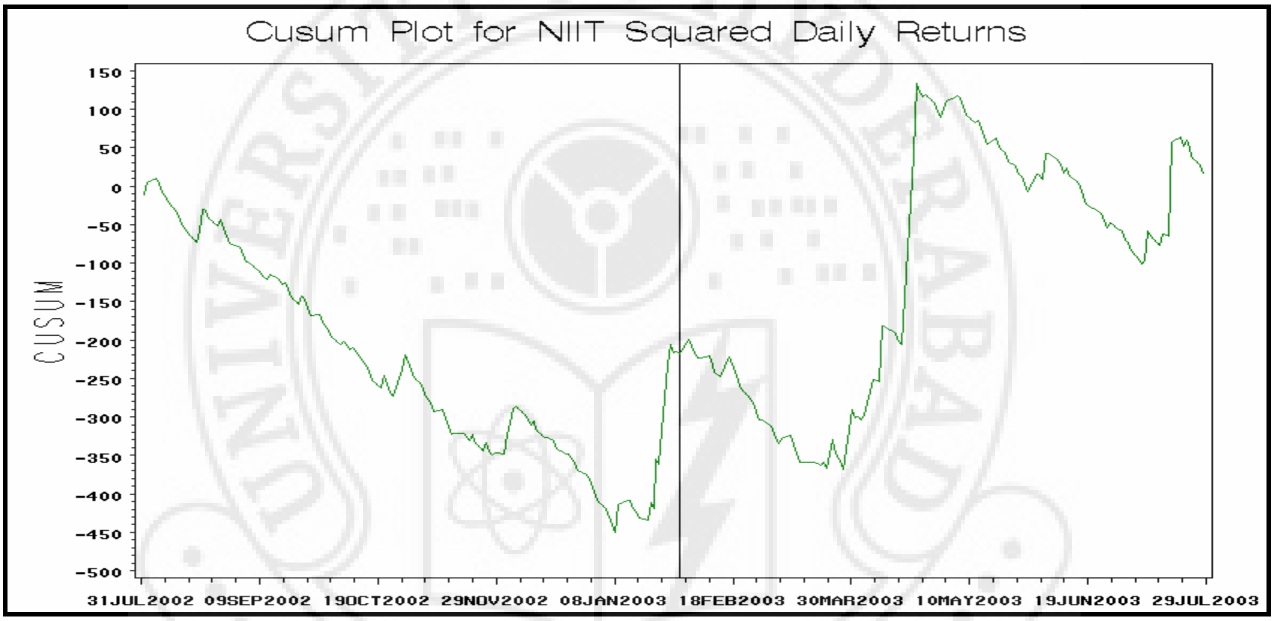
$$\varepsilon_t \sim N(0, h_t)$$

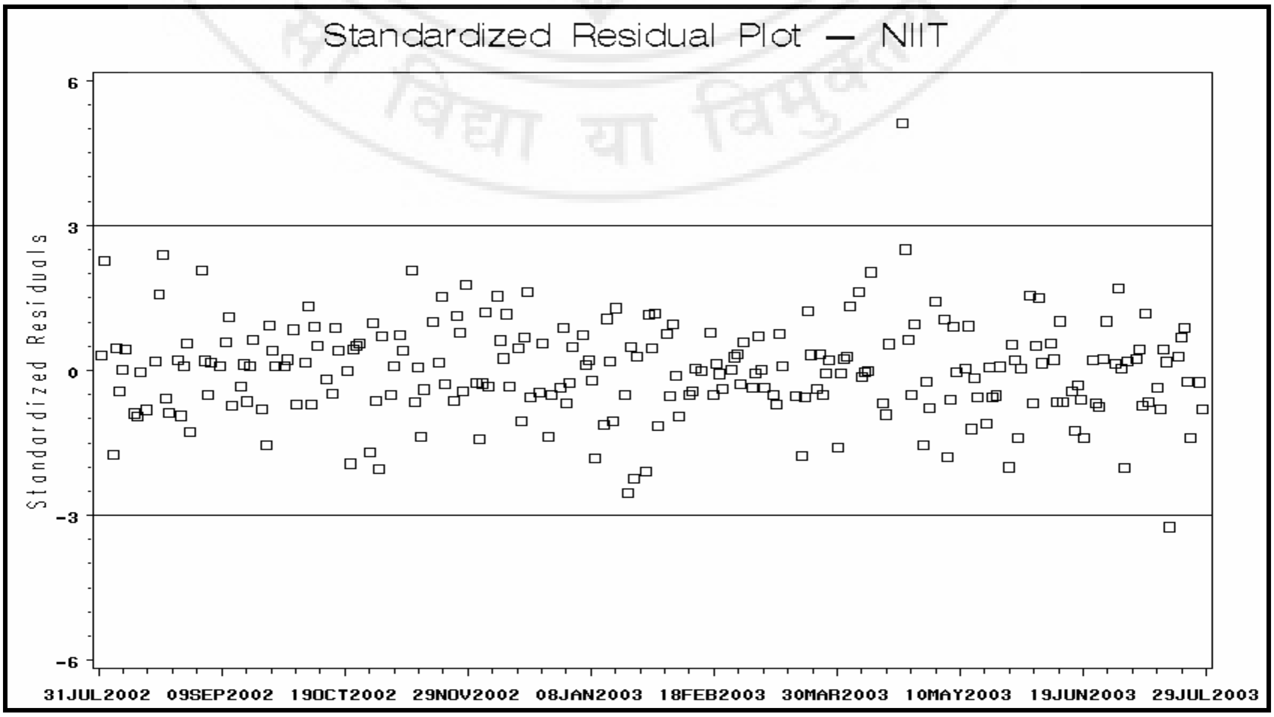
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \alpha_{0,d} D_t + \alpha_{1,d} D_t * \varepsilon_{t-1}^2 + \beta_{1,d} D_t * h_{t-1}$$

Parameter	Estimate	p-value
ϕ_0	-0.266	>0.10
ϕ_1	0.171	<0.01
θ_1	2.170	<0.01
α_0	0.381	>0.10
α_1	0.091	<0.10
β_1	0.839	<0.01
$\alpha_{0,d}$	8.411	<0.01
$\alpha_{1,d}$	-0.027	>0.10
$\beta_{1,d}$	-1.375	<0.01
Diagnostics		
G (4) test-statistic	1.601	>0.10
Q (4) test-statistic	3.212	>0.10
LM (4) test-static	3.359	>0.10
Sign Bias	-0.522	<0.10
Negative Size Bias	0.456	<0.10
Positive Size Bias	0.304	>0.10
Joint Bias	3.811	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 + \beta_1 = 1$	3.250	<0.10

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


NIIT Daily Returns: Pre & Post Inception of Futures
Daily Returns
18
15
12
9
6
3
0
-3
-6
-9
-12
31JUL2002 09SEP2002 19OCT2002 29NOV2002 08JAN2003 18FEB2003 30MAR2003 10MAY2003 19JUN2003 29JUL2003


Cusum Plot for NIIT Squared Daily Returns
CUSUM
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
-400
-450
-500
31JUL2002 09SEP2002 19OCT2002 29NOV2002 08JAN2003 18FEB2003 30MAR2003 10MAY2003 19JUN2003 29JUL2003


Standardized Residual Plot — NIIT
Standardized Residuals
6
3
0
-3
-6
31JUL2002 09SEP2002 19OCT2002 29NOV2002 08JAN2003 18FEB2003 30MAR2003 10MAY2003 19JUN2003 29JUL2003

Stock Symbol – ONGC (Oil & Natural Gas Corporation Ltd.)

Table No. 52a: Regression Results-Evidence of GARCH Effects. R_t takes stock symbol ONGC, Mkt_t takes Nifty.

$$R_t = \phi_0 + \phi_1 R_{t-2} + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	0.090 (>0.10)
ϕ_1	-0.153 (<0.01)
θ_1	0.274 (<0.01)
F-stat	6.178 (<0.01)
G (4) test-statistic	4.290 (>0.10)
Q (4) test-statistic	9.009 (<0.01)
LM (4) test-static	8.342 (<0.01)

Table No. 52b:

Results of AR(2)-GARCH (1,1) model for ONGC using robust standard errors, R_t, Mkt_t are same as defined above and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

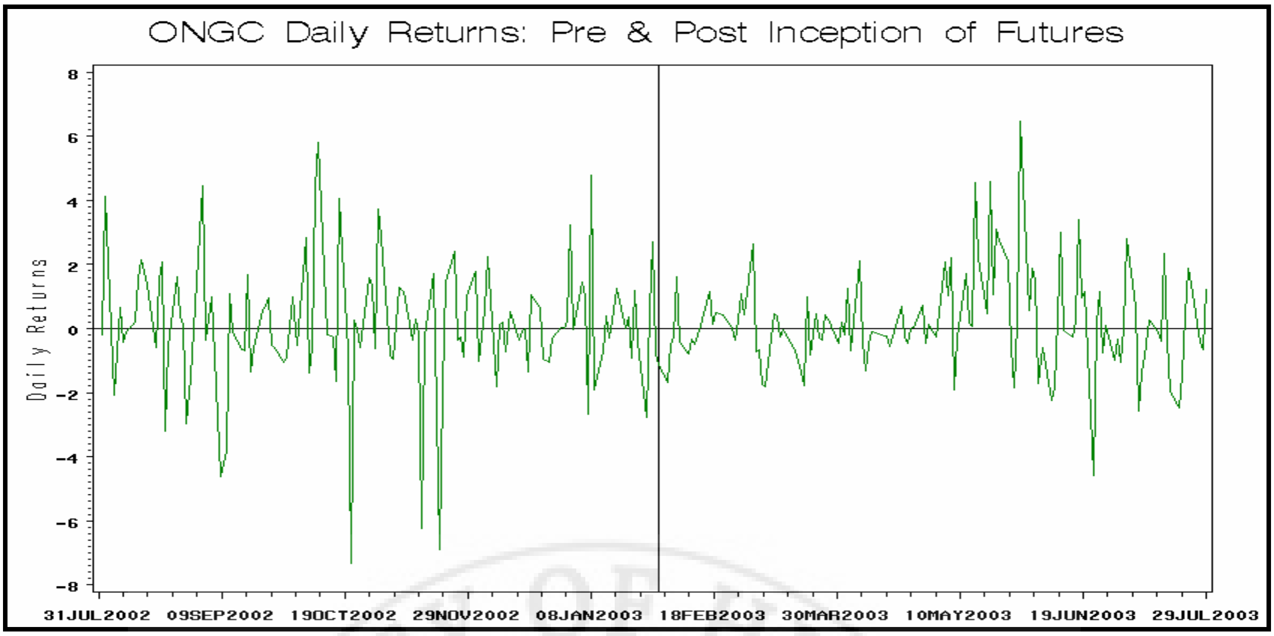
$$R_t = \phi_0 + R_{t-2} + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0, h_t)$$

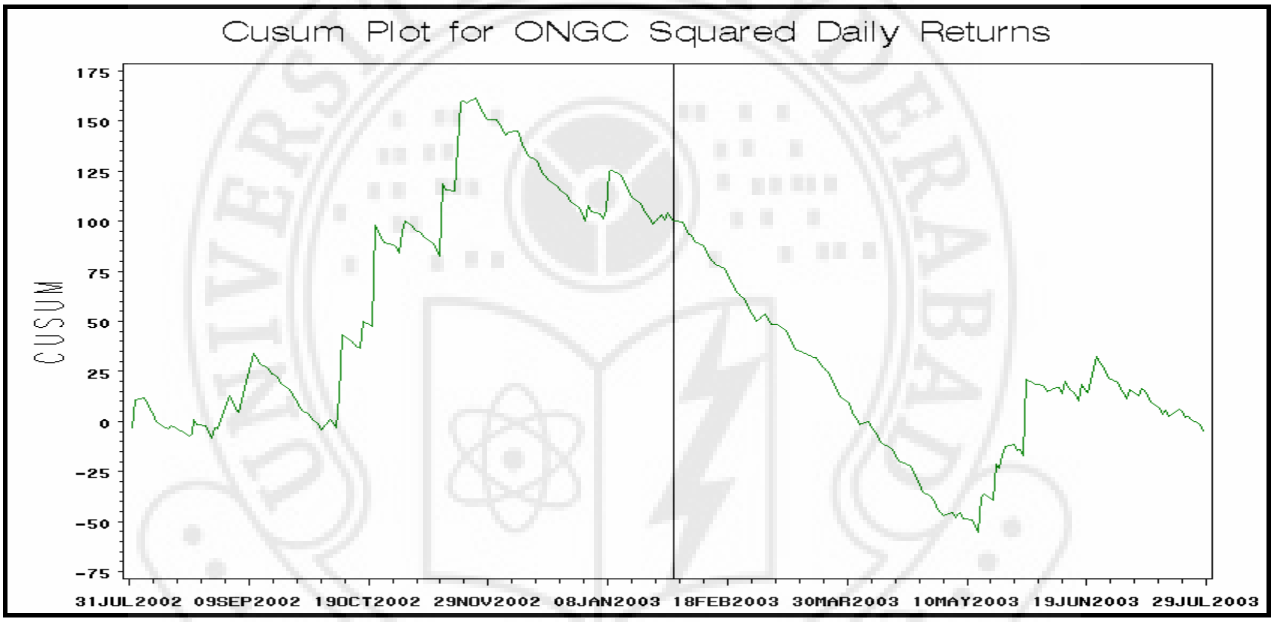
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \alpha_{0,d} D_t + \alpha_{1,d} D_t * \varepsilon_{t-1}^2 + \beta_{1,d} D_t * h_{t-1}$$

Parameter	Estimate	p-value
ϕ_0	0.027	>0.10
ϕ_1	-0.151	<0.01
θ_1	0.296	<0.01
α_0	1.169	<0.10
α_1	0.187	<0.01
β_1	0.536	<0.01
$\alpha_{0,d}$	-0.975	>0.10
$\alpha_{1,d}$	-0.007	>0.10
$\beta_{1,d}$	0.196	>0.10
Diagnostics		
G (4) test-statistic	1.881	>0.10
Q (4) test-statistic	3.650	>0.10
LM (4) test-static	3.825	>0.10
Sign Bias	0.035	<0.10
Negative Size Bias	-0.005	<0.10
Positive Size Bias	0.001	>0.10
Joint Bias	0.025	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 + \beta_1 = 1$	5.210	<0.05

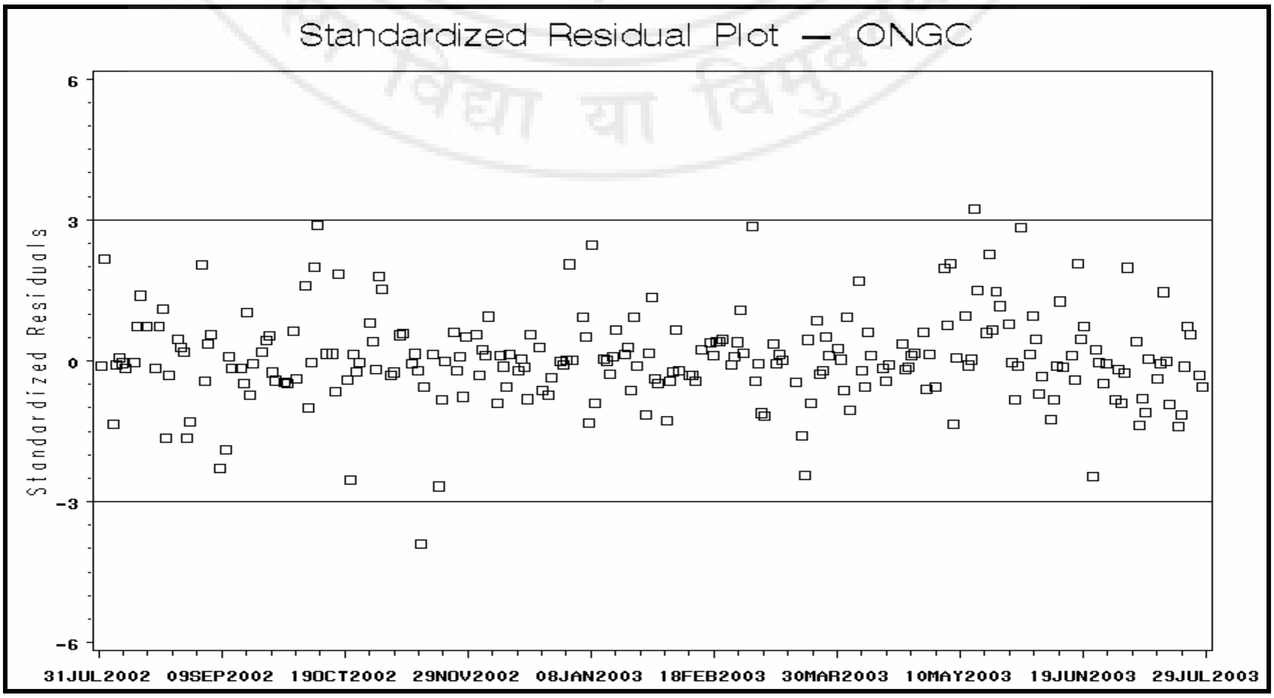
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).



ONGC Daily Returns: Pre & Post Inception of Futures
Daily Returns
8
6
4
2
0
-2
-4
-6
-8
31JUL2002
09SEP2002
19OCT2002
29NOV2002
08JAN2003
18FEB2003
30MAR2003
10MAY2003
19JUN2003
29JUL2003



Cusum Plot for ONGC Squared Daily Returns
CUSUM
175
150
125
100
75
50
25
0
-25
-50
-75
31JUL2002
09SEP2002
19OCT2002
29NOV2002
08JAN2003
18FEB2003
30MAR2003
10MAY2003
19JUN2003
29JUL2003



Standardized Residual Plot — ONGC
Standardized Residuals
6
3
0
-3
-6
31JUL2002
09SEP2002
19OCT2002
29NOV2002
08JAN2003
18FEB2003
30MAR2003
10MAY2003
19JUN2003
29JUL2003

Stock Symbol – POLARIS (Polaris Software Lab Ltd.)

Table No. 53:

Regression Results for POLARIS using robust standard errors, R_t takes stock symbol POLARIS, Mkt_t takes Nifty and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

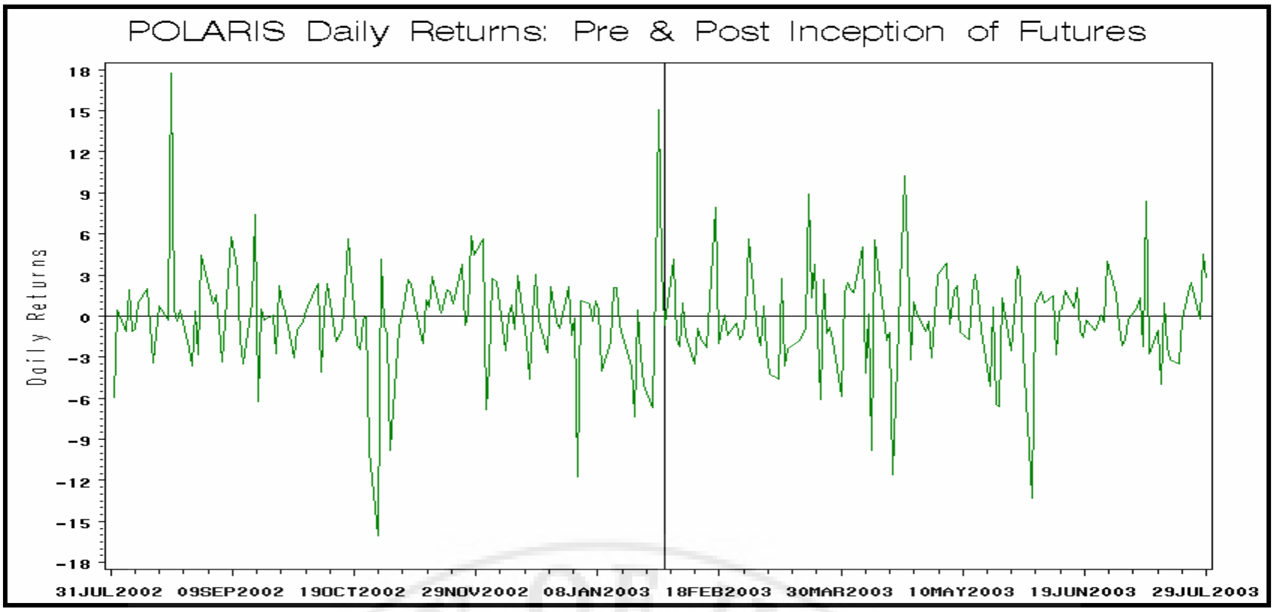
$$R_t = \phi_0 + \phi_1 R_{t-2} + \theta_1 Mkt_t + \gamma D_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0,1)$$

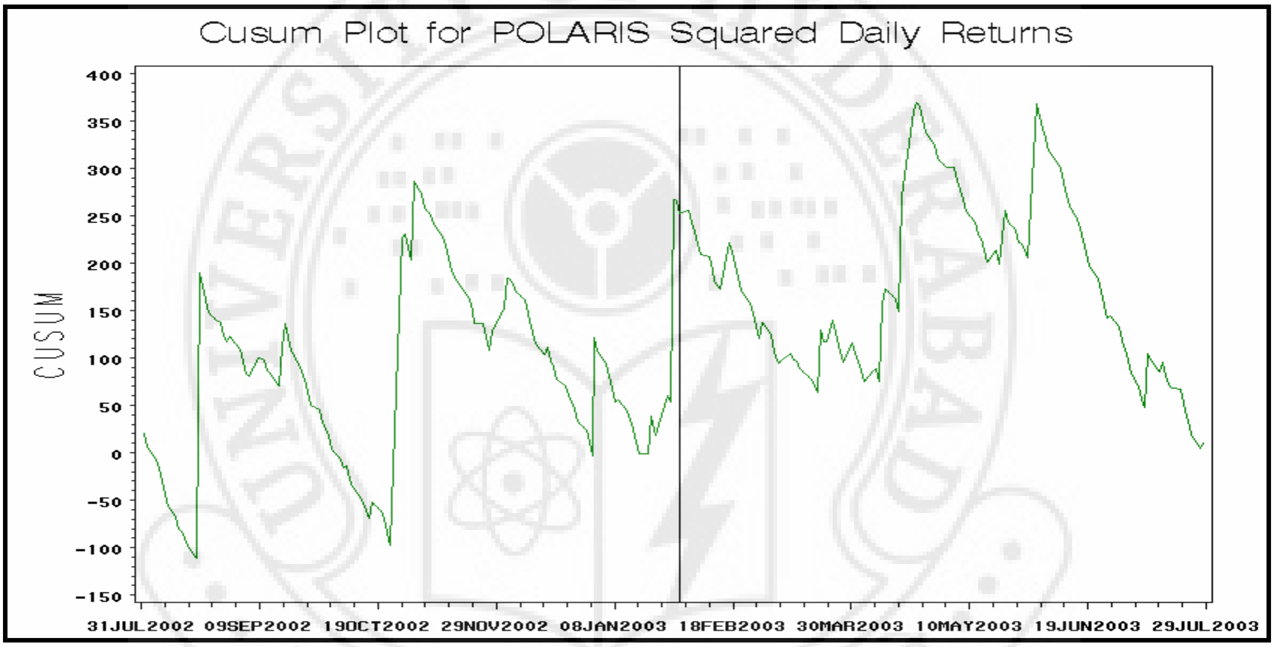
Parameter	**Estimate**
ϕ_0	-0.282 (>0.10)
ϕ_1	-0.107 (<0.10)
θ_1	2.060 (<0.01)
γ	-0.207 (>0.10)
F-stat	33.366 (<0.01)
G (4) test-statistic	5.223 (>0.10)
Q (4) test-statistic	1.013 (>0.10)
LM (4) test-static	0.980 (>0.10)

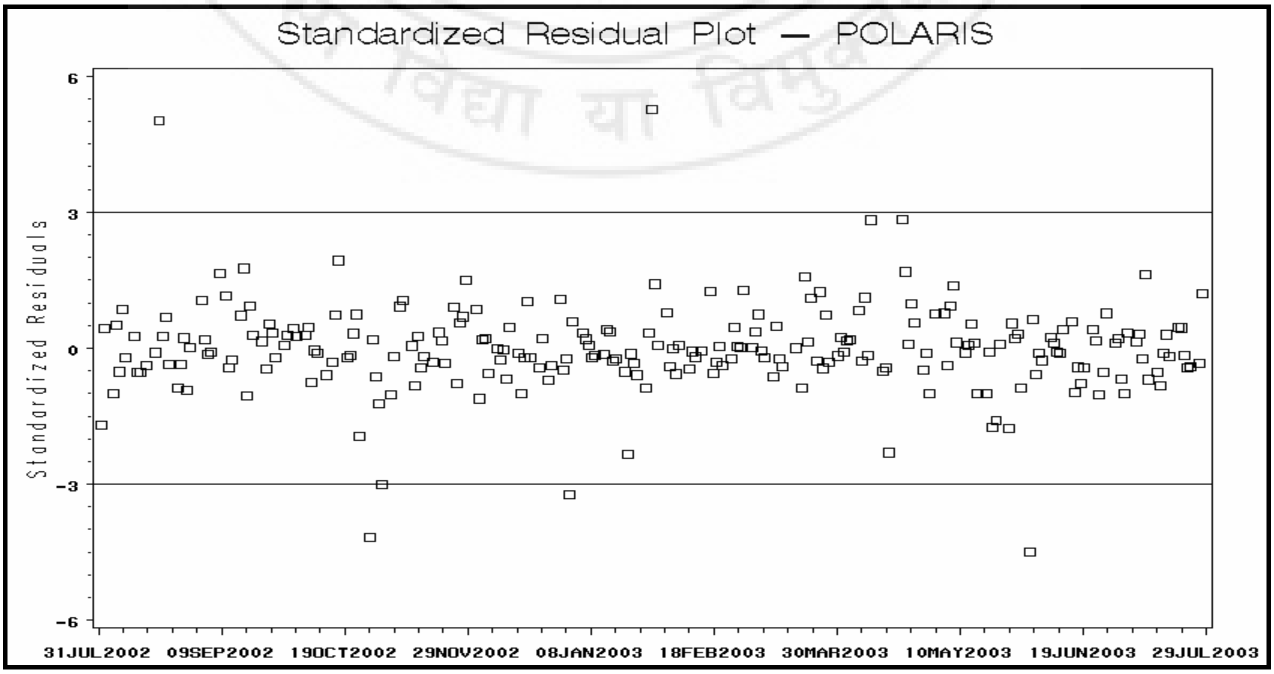
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


POLARIS Daily Returns: Pre & Post Inception of Futures
Daily Returns
18
15
12
9
6
3
0
-3
-6
-9
-12
-15
-18
31JUL2002
09SEP2002
19OCT2002
29NOV2002
08JAN2003
18FEB2003
30MAR2003
10MAY2003
19JUN2003
29JUL2003


Cusum Plot for POLARIS Squared Daily Returns
CUSUM
400
350
300
250
200
150
100
50
0
-50
-100
-150
31JUL2002
09SEP2002
19OCT2002
29NOV2002
08JAN2003
18FEB2003
30MAR2003
10MAY2003
19JUN2003
29JUL2003


Standardized Residual Plot — POLARIS
Standardized Residuals
6
3
0
-3
-6
31JUL2002
09SEP2002
19OCT2002
29NOV2002
08JAN2003
18FEB2003
30MAR2003
10MAY2003
19JUN2003
29JUL2003

Stock Symbol – SCI (Shipping Corporation of India Ltd.)

Table No. 54:

Regression Results for SCI using robust standard errors, R_t takes stock symbol SCI, Mkt_t takes Nifty and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

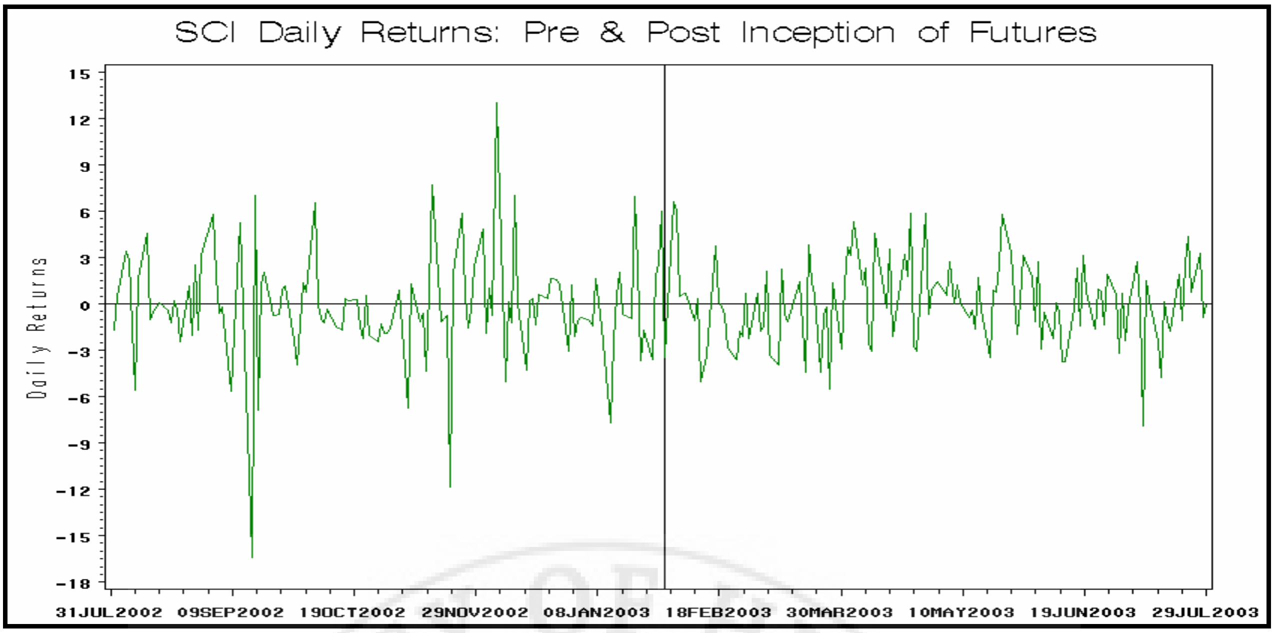
$$R_t = \phi_0 + \theta_1 Mkt_t + \gamma D_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0,1)$$

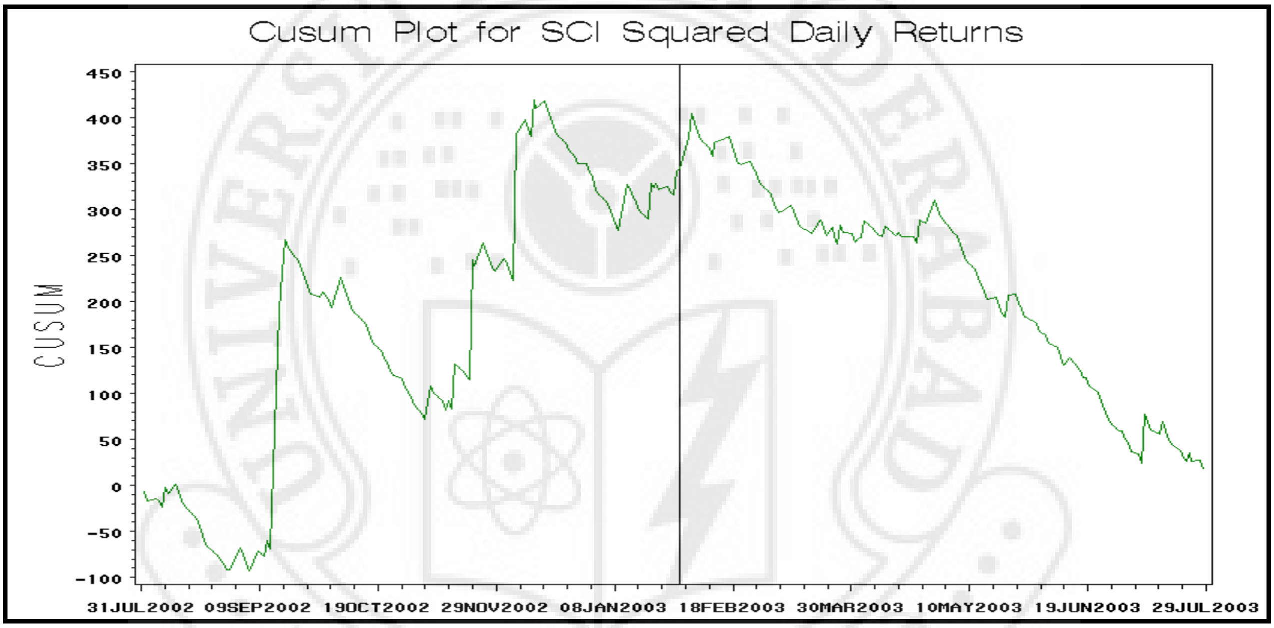
Parameter	Estimate
ϕ_0	-0.222 (>0.10)
θ_1	1.174 (<0.01)
γ	0.143 (>0.10)
F-stat	18.415 (<0.01)
G (4) test-statistic	4.419 (>0.10)
Q (4) test-statistic	3.756 (>0.10)
LM (4) test-static	3.428 (>0.10)

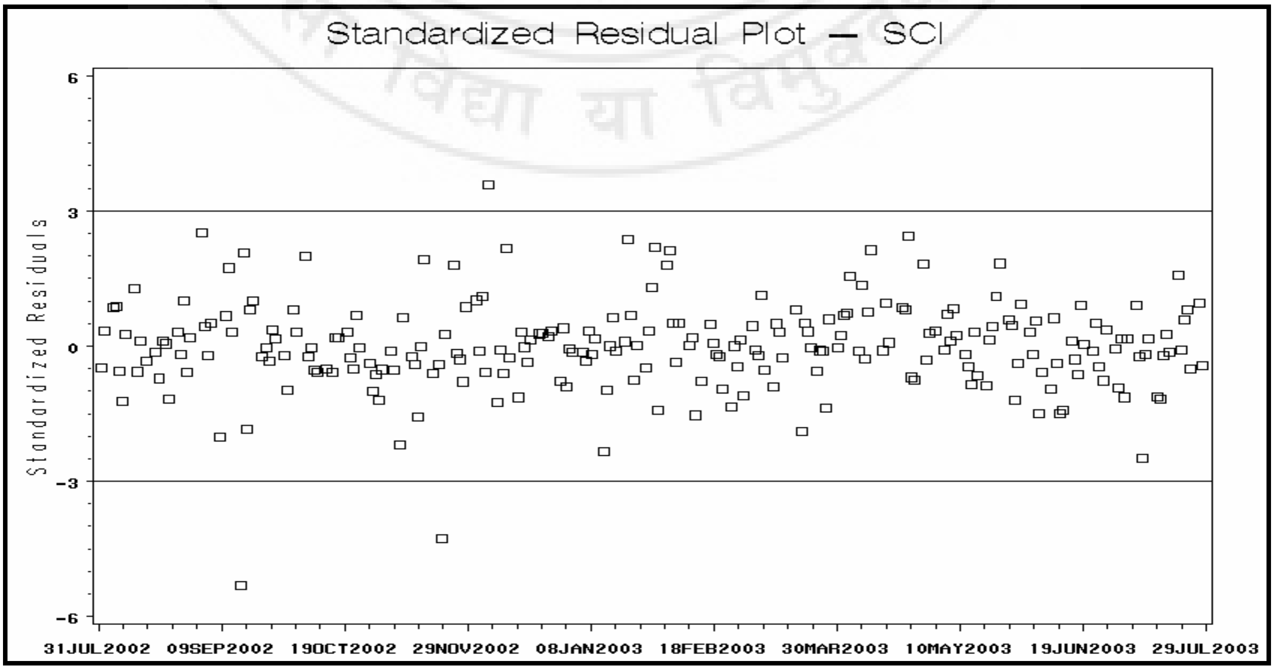
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


SCI Daily Returns: Pre & Post Inception of Futures
Daily Returns
15
12
9
6
3
0
-3
-6
-9
-12
-15
-18
31JUL2002 09SEP2002 19OCT2002 29NOV2002 08JAN2003 18FEB2003 30MAR2003 10MAY2003 19JUN2003 29JUL2003


Cusum Plot for SCI Squared Daily Returns
CUSUM
450
400
350
300
250
200
150
100
50
0
-50
-100
31JUL2002 09SEP2002 19OCT2002 29NOV2002 08JAN2003 18FEB2003 30MAR2003 10MAY2003 19JUN2003 29JUL2003


Standardized Residual Plot — SCI
Standardized Residuals
6
3
0
-3
-6
31JUL2002 09SEP2002 19OCT2002 29NOV2002 08JAN2003 18FEB2003 30MAR2003 10MAY2003 19JUN2003 29JUL2003

Stock Symbol – WIPRO (Wipro Ltd.)

Table No. 55:

Regression Results for WIPRO using robust standard errors, R_t takes stock symbol WIPRO, Mkt_t takes Nifty, D_t takes on value of zero before SSFs introduction and a value of one afterwards and ED_t is dummy which takes the value of one for date's 09th Sep 2002 and 10th April 2003 for unforeseen fall in price.

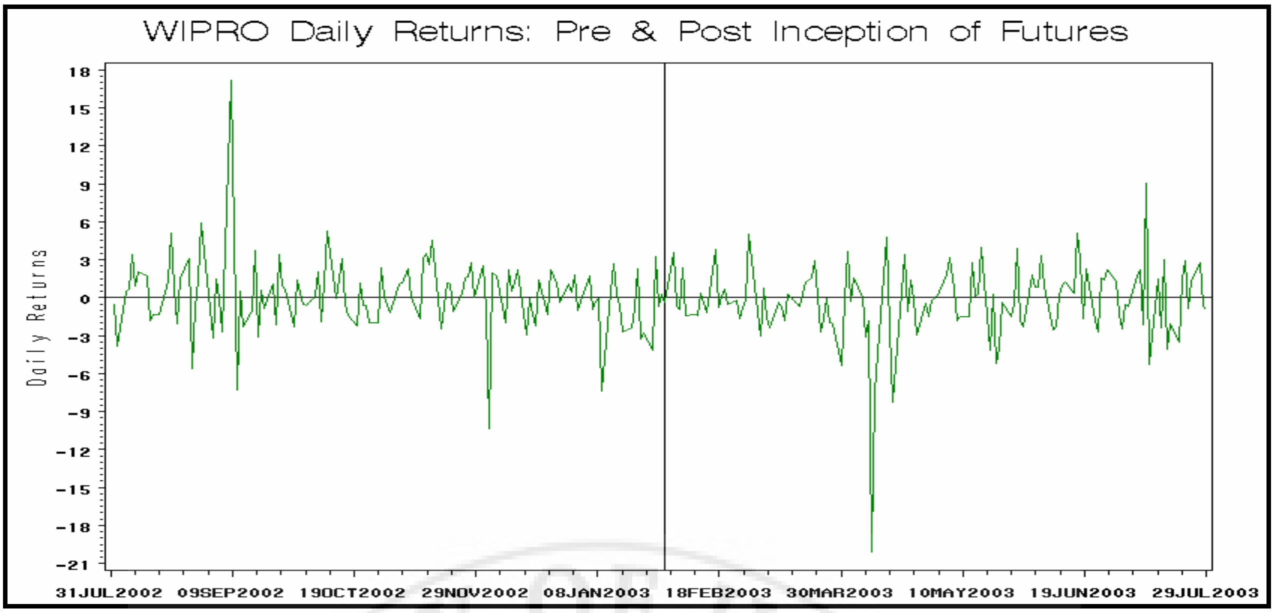
$$R_t = \phi_0 + \theta_1 Mkt_t + \gamma D_t + \kappa ED_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0,1)$$

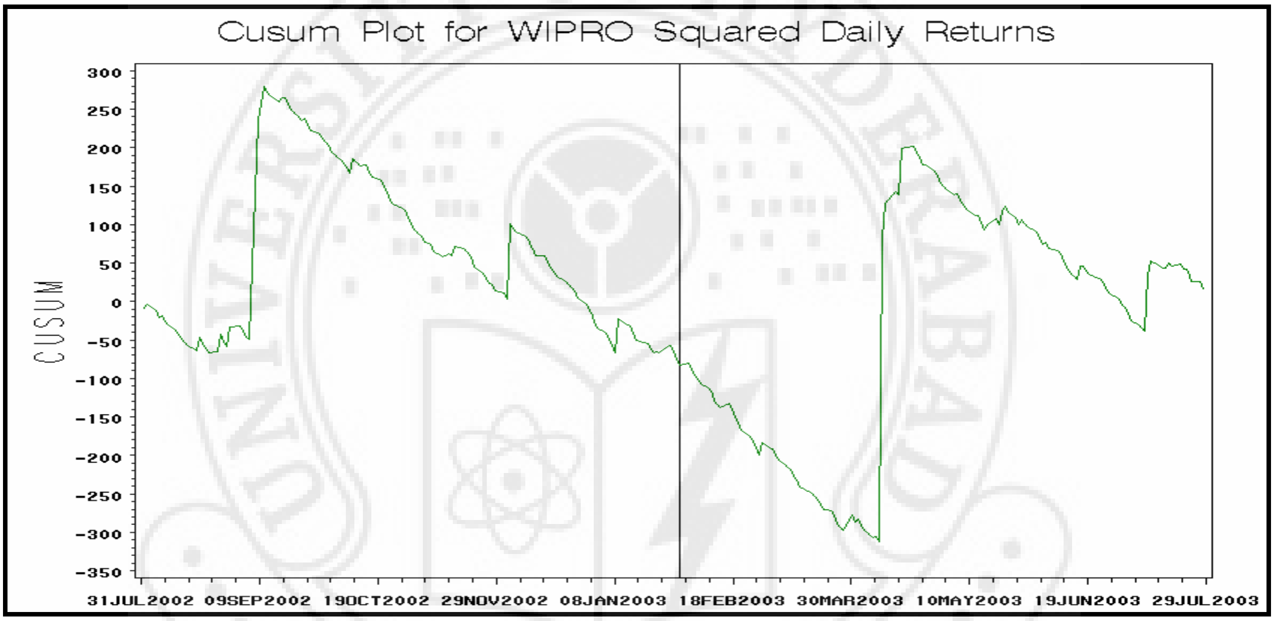
Parameter	Estimate
ϕ_0	-0.081 (>0.10)
θ_1	2.057 (<0.01)
γ	-0.460 (<0.10)
κ	16.52 (<0.01)
F-stat	107.5 (<0.01)
G (4) test-statistic	1.836 (>0.10)
Q (4) test-statistic	5.736 (>0.10)
LM (4) test-static	4.608 (>0.10)

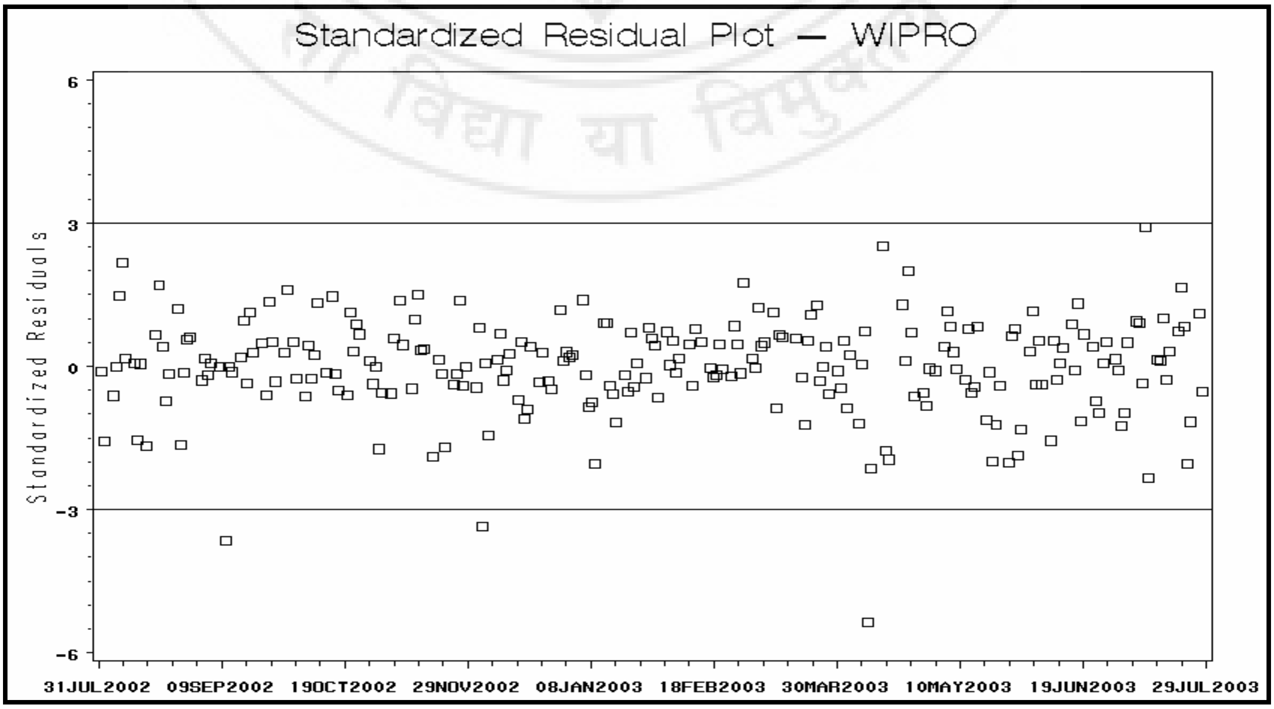
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


WIPRO Daily Returns: Pre & Post Inception of Futures
Daily Returns
31JUL2002 09SEP2002 19OCT2002 29NOV2002 08JAN2003 18FEB2003 30MAR2003 10MAY2003 19JUN2003 29JUL2003


Cusum Plot for WIPRO Squared Daily Returns
CUSUM
31JUL2002 09SEP2002 19OCT2002 29NOV2002 08JAN2003 18FEB2003 30MAR2003 10MAY2003 19JUN2003 29JUL2003


Standardized Residual Plot — WIPRO
Standardized Residuals
31JUL2002 09SEP2002 19OCT2002 29NOV2002 08JAN2003 18FEB2003 30MAR2003 10MAY2003 19JUN2003 29JUL2003

Stock Symbol – ANDHRABANK (Andhra Bank Ltd.)

Table No. 56:

Regression Results for ANDHRABANK using robust standard errors, R_t takes stock symbol ANDHRABANK, Mkt_t takes Nifty and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

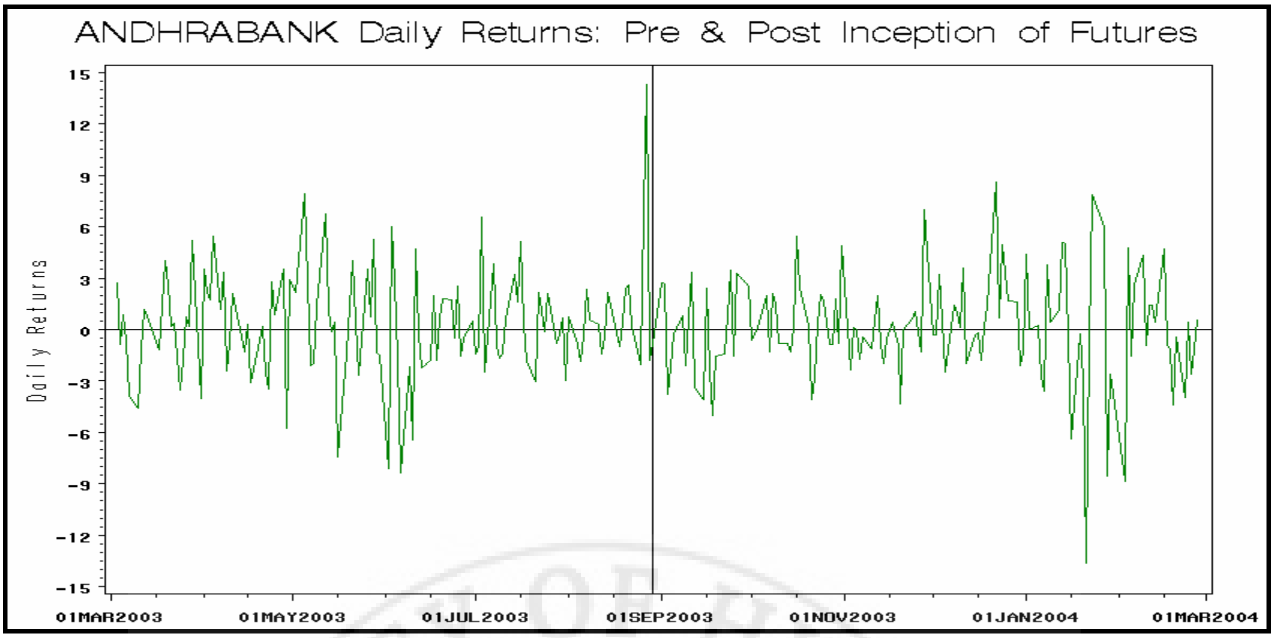
$$R_t = \phi_0 + \phi_1 R_{t-3} + \theta_1 Mkt_t + \gamma D_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0,1)$$

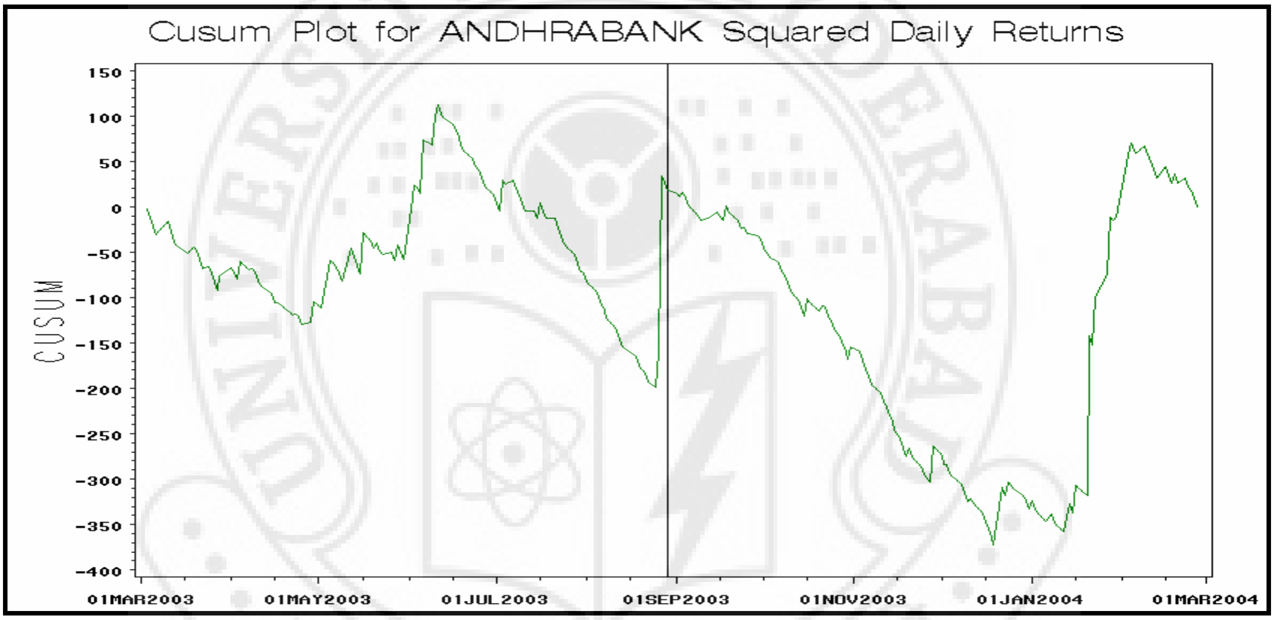
Parameter	Estimate
ϕ_0	0.147 (>0.10)
ϕ_1	-0.140 (<0.05)
θ_1	1.170 (<0.01)
γ	-0.378 (>0.10)
F-stat	32.94 (<0.01)
G (4) test-statistic	0.806 (>0.10)
Q (4) test-statistic	4.011 (>0.10)
LM (4) test-static	3.993 (>0.10)

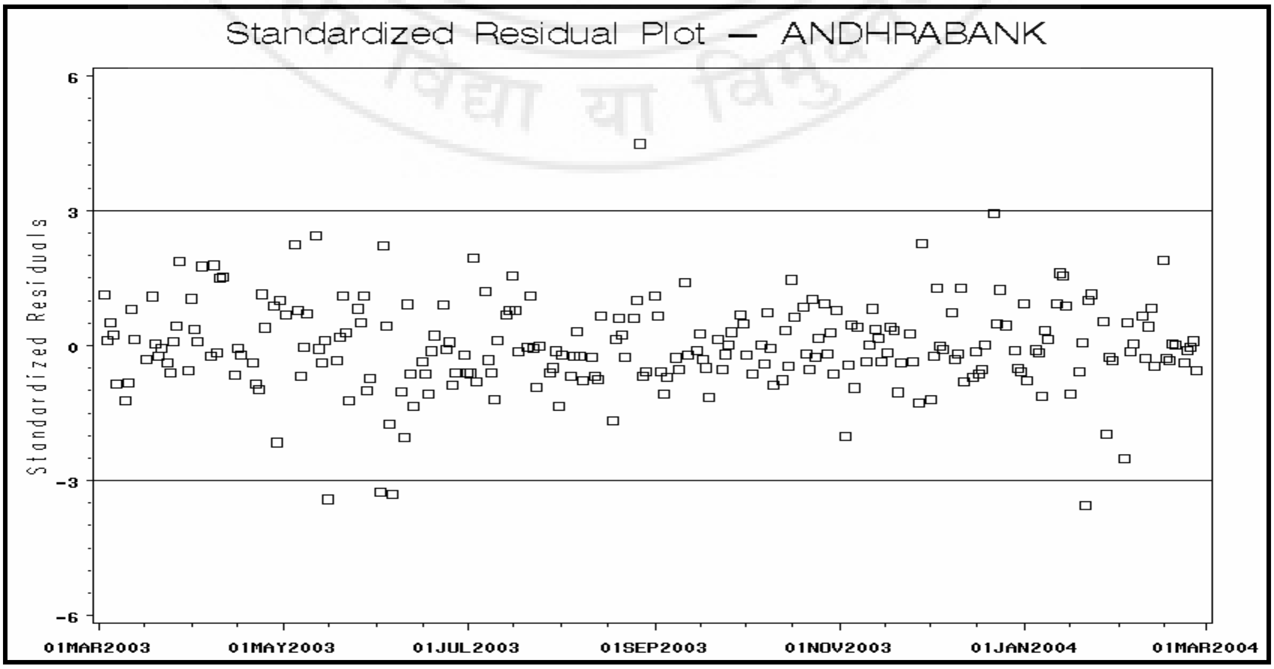
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


ANDHRABANK Daily Returns: Pre & Post Inception of Futures
Daily Returns
15
12
9
6
3
0
-3
-6
-9
-12
-15
01MAR2003
01MAY2003
01JUL2003
01SEP2003
01NOV2003
01JAN2004
01MAR2004


Cusum Plot for ANDHRABANK Squared Daily Returns
CUSUM
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
-400
01MAR2003
01MAY2003
01JUL2003
01SEP2003
01NOV2003
01JAN2004
01MAR2004


Standardized Residual Plot — ANDHRABANK
Standardized Residuals
6
3
0
-3
-6
01MAR2003
01MAY2003
01JUL2003
01SEP2003
01NOV2003
01JAN2004
01MAR2004

Stock Symbol – BANKBARODA (Bank of Baroda Ltd.)

Table No. 57:

Regression Results for BANKBARODA using robust standard errors, R_t takes stock symbol BANKBARODA, Mkt_t takes Nifty and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

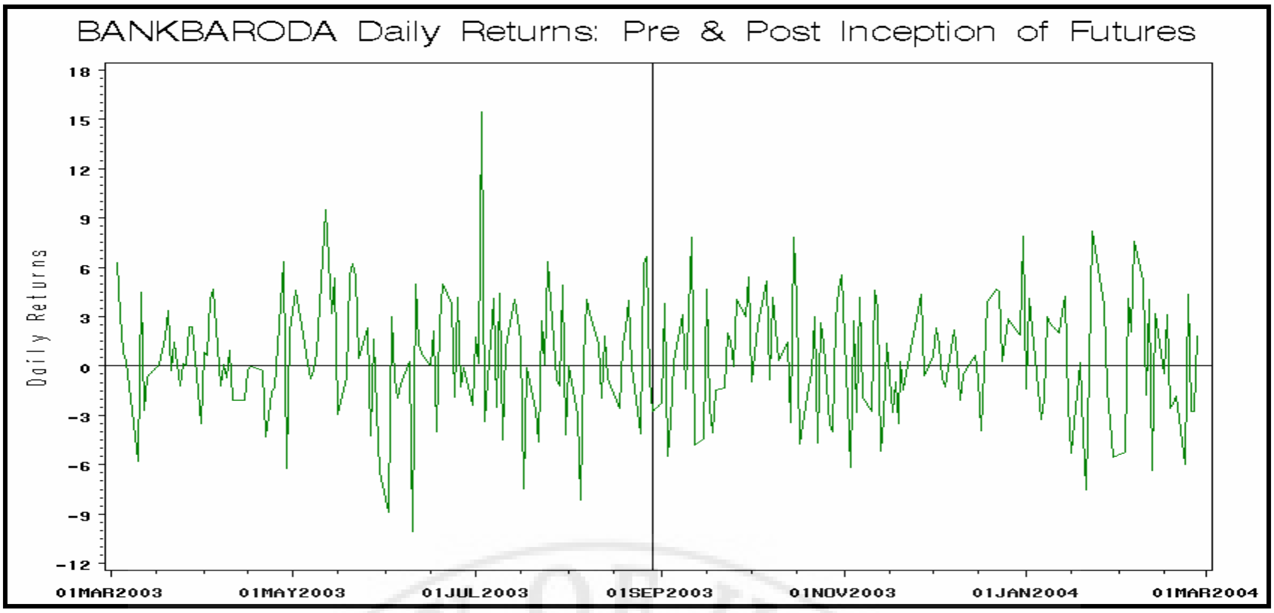
$$R_t = \phi_0 + \theta_1 Mkt_t + \gamma D_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0,1)$$

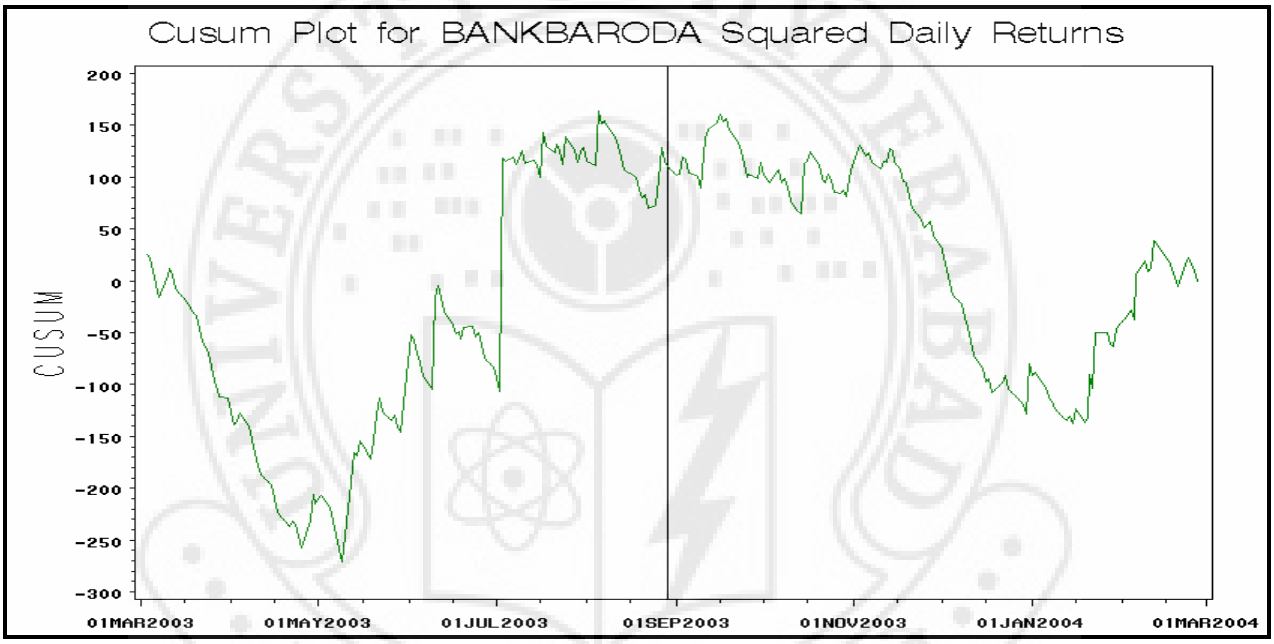
Parameter	Estimate
ϕ_0	0.305 (>0.10)
θ_1	1.205 (<0.01)
γ	-0.254 (>0.10)
F-stat	34.61 (<0.01)
G (4) test-statistic	2.403 (>0.10)
Q (4) test-statistic	1.113 (>0.10)
LM (4) test-static	1.187 (>0.10)

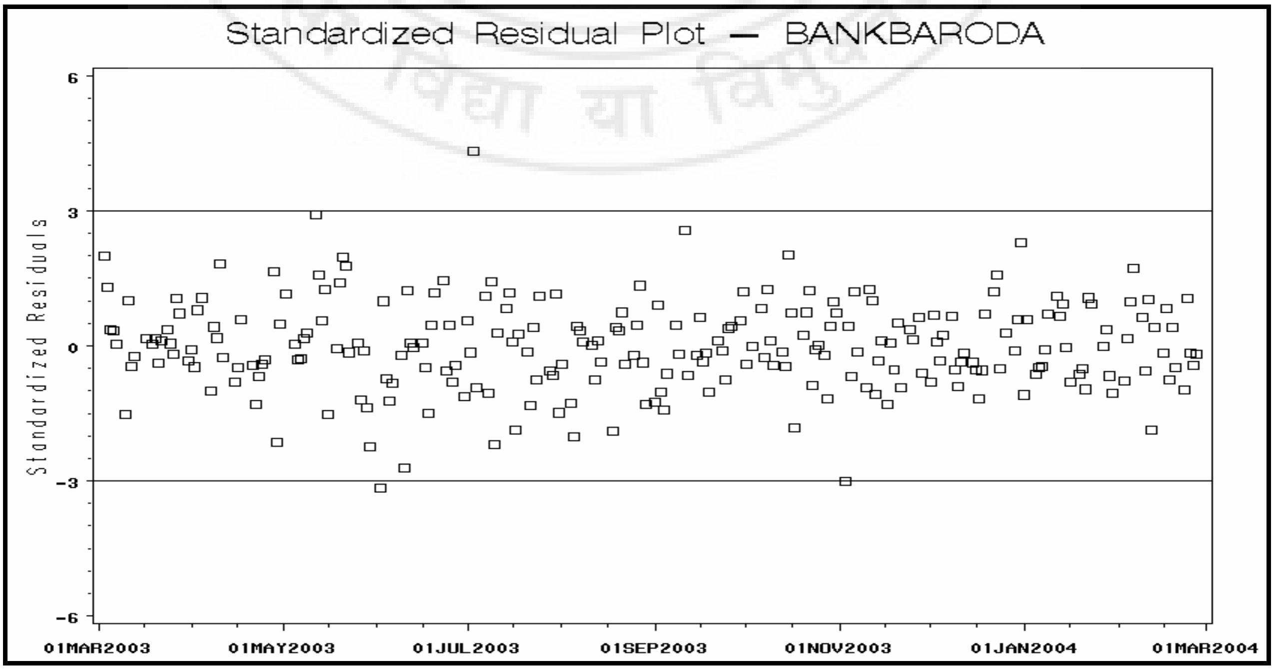
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


BANKBARODA Daily Returns: Pre & Post Inception of Futures
Daily Returns
18
15
12
9
6
3
0
-3
-6
-9
-12
01MAR2003
01MAY2003
01JUL2003
01SEP2003
01NOV2003
01JAN2004
01MAR2004


Cusum Plot for BANKBARODA Squared Daily Returns
CUSUM
200
150
100
50
0
-50
-100
-150
-200
-250
-300
01MAR2003
01MAY2003
01JUL2003
01SEP2003
01NOV2003
01JAN2004
01MAR2004


Standardized Residual Plot — BANKBARODA
Standardized Residuals
6
3
0
-3
-6
01MAR2003
01MAY2003
01JUL2003
01SEP2003
01NOV2003
01JAN2004
01MAR2004

Stock Symbol – BANKINDIA (Bank of India Ltd.)

Table No. 58:

Regression Results for BANKINDIA using robust standard errors, R_t takes stock symbol BANKINDIA, Mkt_t takes Nifty and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

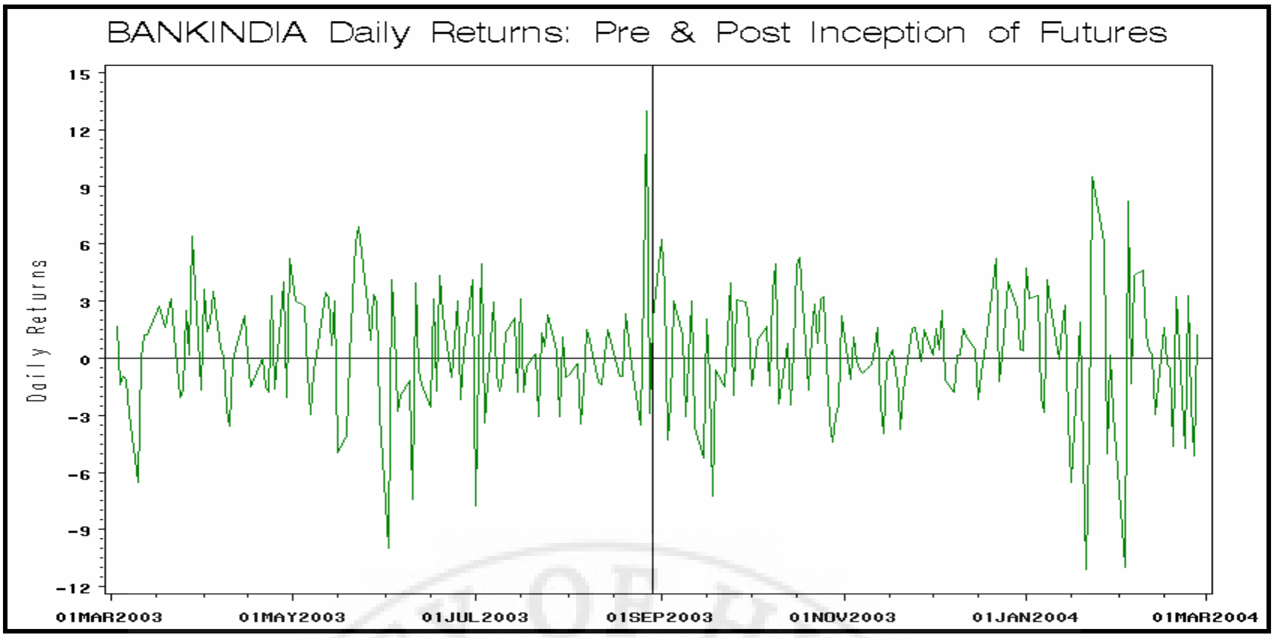
$$R_t = \phi_0 + \theta_1 Mkt_t + \gamma D_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0,1)$$

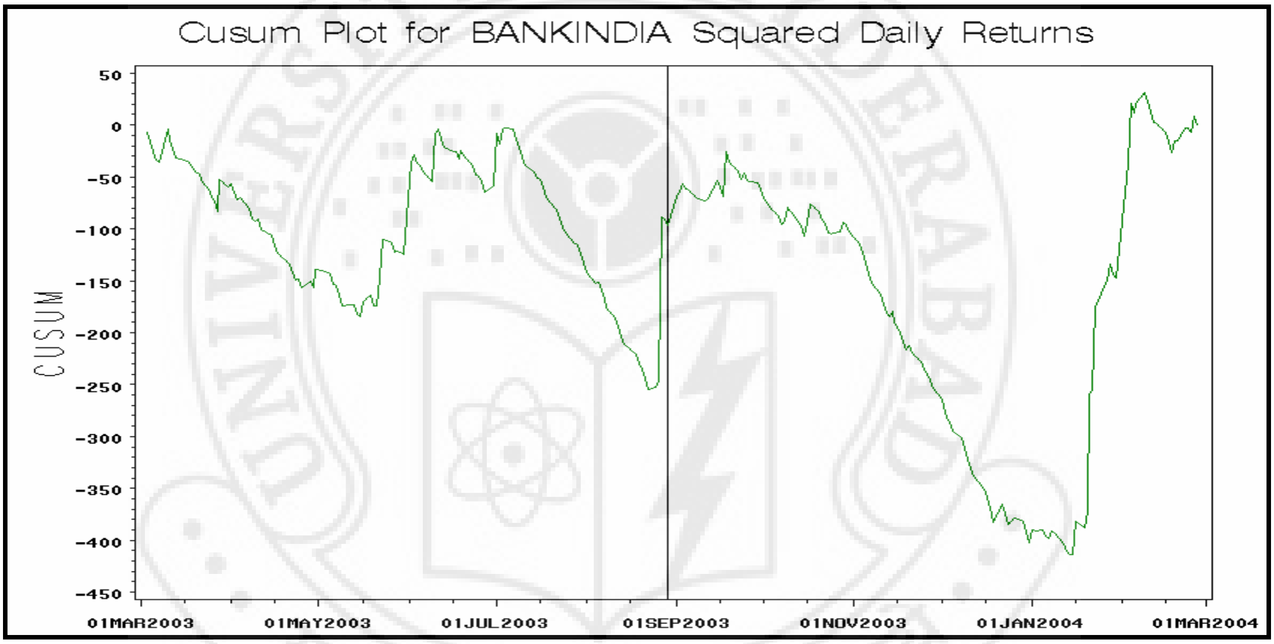
Parameter	Estimate
ϕ_0	0.065 (>0.10)
θ_1	1.322 (<0.01)
γ	-0.248 (>0.10)
F-stat	64.21 (<0.01)
G (4) test-statistic	3.388 (>0.10)
Q (4) test-statistic	3.526 (>0.10)
LM (4) test-static	3.901 (>0.10)

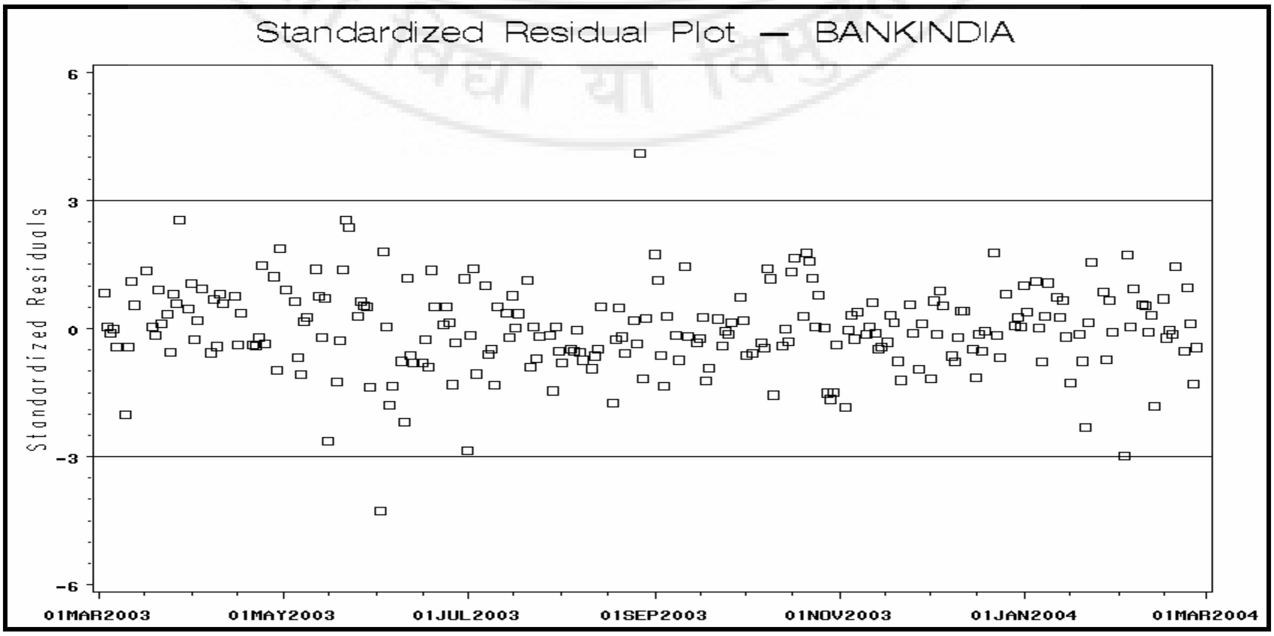
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


BANKINDIA Daily Returns: Pre & Post Inception of Futures
Daily Returns
15
12
9
6
3
0
-3
-6
-9
-12
01MAR2003
01MAY2003
01JUL2003
01SEP2003
01NOV2003
01JAN2004
01MAR2004


Cusum Plot for BANKINDIA Squared Daily Returns
CUSUM
50
0
-50
-100
-150
-200
-250
-300
-350
-400
-450
01MAR2003
01MAY2003
01JUL2003
01SEP2003
01NOV2003
01JAN2004
01MAR2004


Standardized Residual Plot — BANKINDIA
Standardized Residuals
6
3
0
-3
-6
01MAR2003
01MAY2003
01JUL2003
01SEP2003
01NOV2003
01JAN2004
01MAR2004

Stock Symbol – CANBK (Canara Bank Ltd.)

Table No. 59a: Regression Results-Evidence of GARCH Effects. R_t takes stock symbol CANBK, Mkt_t takes Nifty.

$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	0.007 (>0.10)
θ_1	1.353 (<0.01)
F-stat	88.01 (<0.01)
G (4) test-statistic	0.679 (>0.10)
Q (4) test-statistic	16.51 (<0.01)
LM (4) test-static	16.18 (<0.01)

Table No. 59b:

Results of GARCH (1, 1) model for CANBK using robust standard errors, R_t, Mkt_t are same as defined above and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

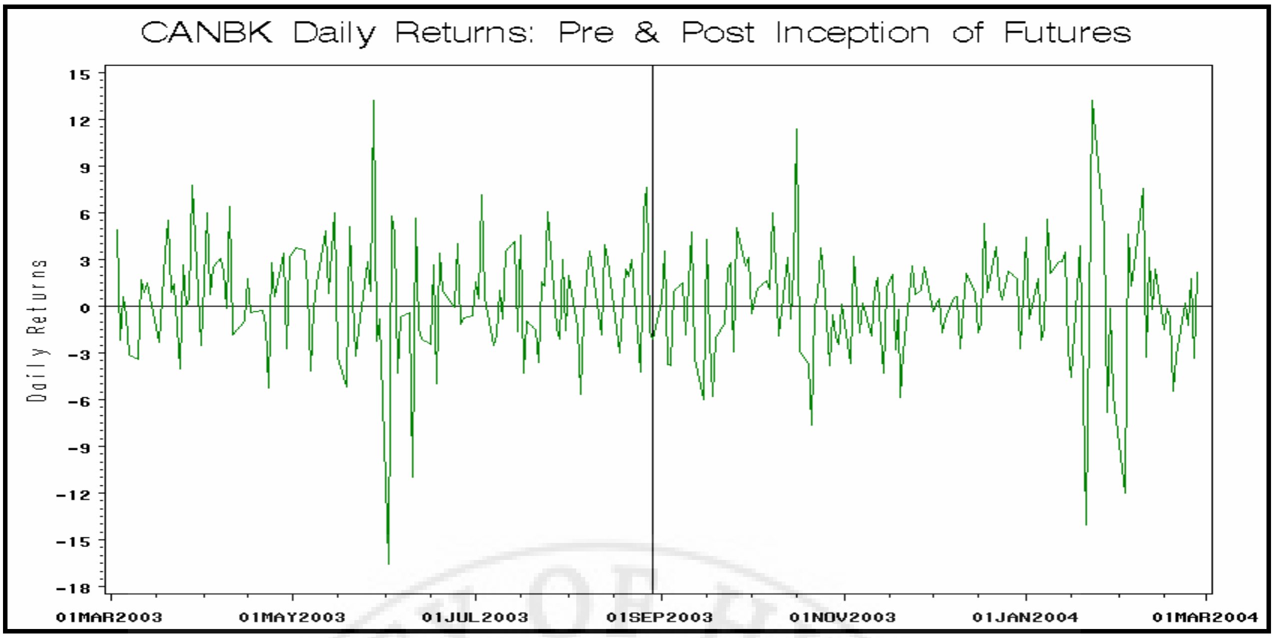
$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

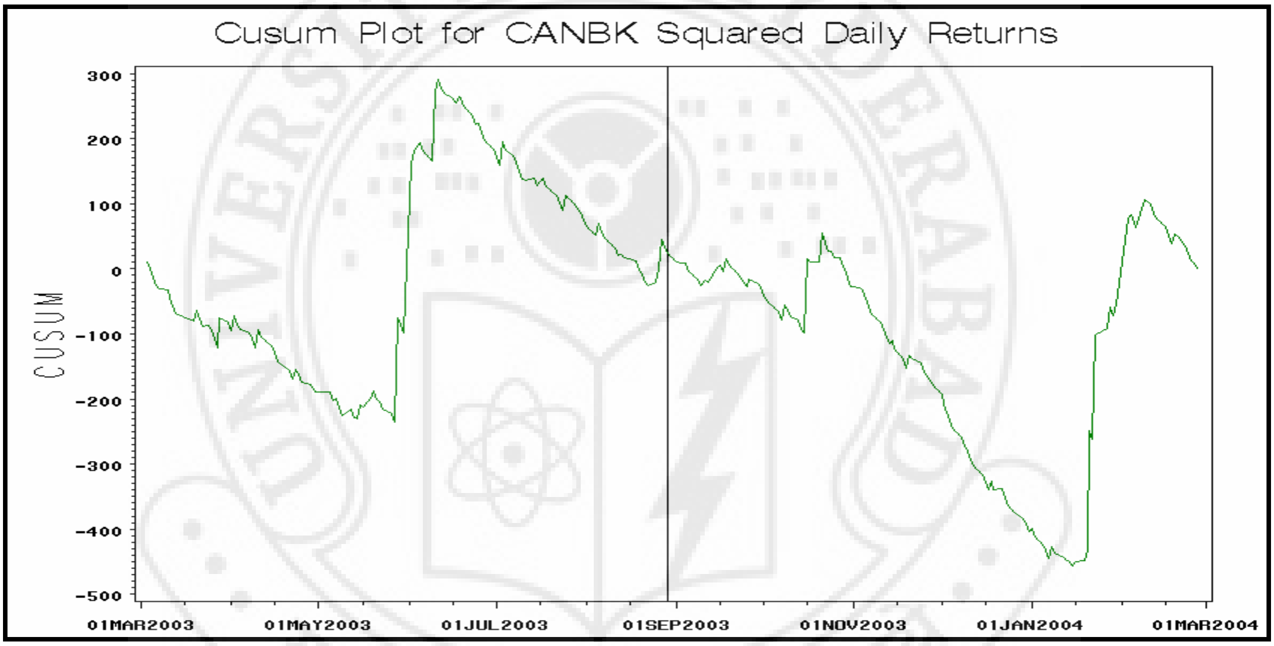
$$\varepsilon_t \sim N(0, h_t)$$

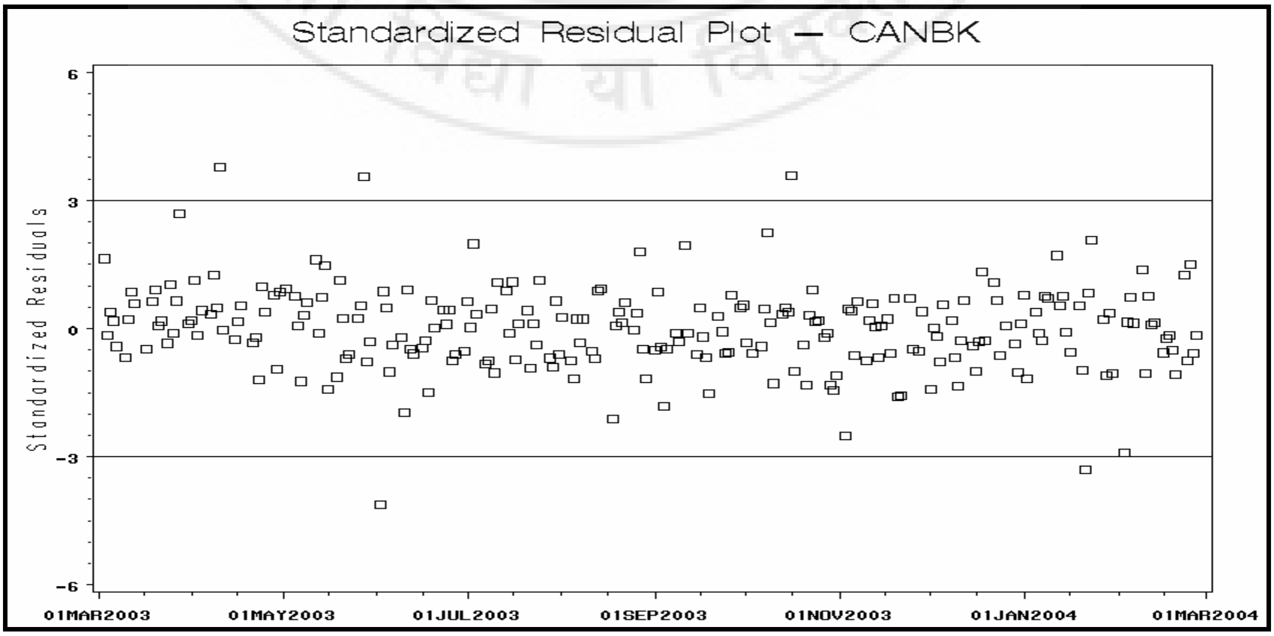
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \alpha_{0,d} D_t + \alpha_{1,d} D_t * \varepsilon_{t-1}^2 + \beta_{1,d} D_t * h_{t-1}$$

Parameter	Estimate	p-value
ϕ_0	0.009	>0.10
θ_1	1.337	<0.01
α_0	1.862	<0.10
α_1	0.114	<0.10
β_1	0.731	<0.01
$\alpha_{0,d}$	0.610	>0.10
$\alpha_{1,d}$	-0.017	>0.10
$\beta_{1,d}$	-0.136	>0.10
Diagnostics		
G (4) test-statistic	1.635	>0.10
Q (4) test-statistic	6.393	>0.10
LM (4) test-static	5.799	>0.10
Sign Bias	0.001	>0.10
Negative Size Bias	0.060	>0.10
Positive Size Bias	-0.175	>0.10
Joint Bias	1.002	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 + \beta_1 = 1$	7.410	<0.01

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


CANBK Daily Returns: Pre & Post Inception of Futures
Daily Returns
15
12
9
6
3
0
-3
-6
-9
-12
-15
-18
01MAR2003
01MAY2003
01JUL2003
01SEP2003
01NOV2003
01JAN2004
01MAR2004


Cusum Plot for CANBK Squared Daily Returns
CUSUM
300
200
100
0
-100
-200
-300
-400
-500
01MAR2003
01MAY2003
01JUL2003
01SEP2003
01NOV2003
01JAN2004
01MAR2004


Standardized Residual Plot — CANBK
Standardized Residuals
6
3
0
-3
-6
01MAR2003
01MAY2003
01JUL2003
01SEP2003
01NOV2003
01JAN2004
01MAR2004

Stock Symbol – HDFCBANK (HDFC Bank Ltd.)

Table No. 60:

Regression Results for HDFCBANK using robust standard errors, R_t takes stock symbol HDFCBANK, Mkt_t takes Nifty and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

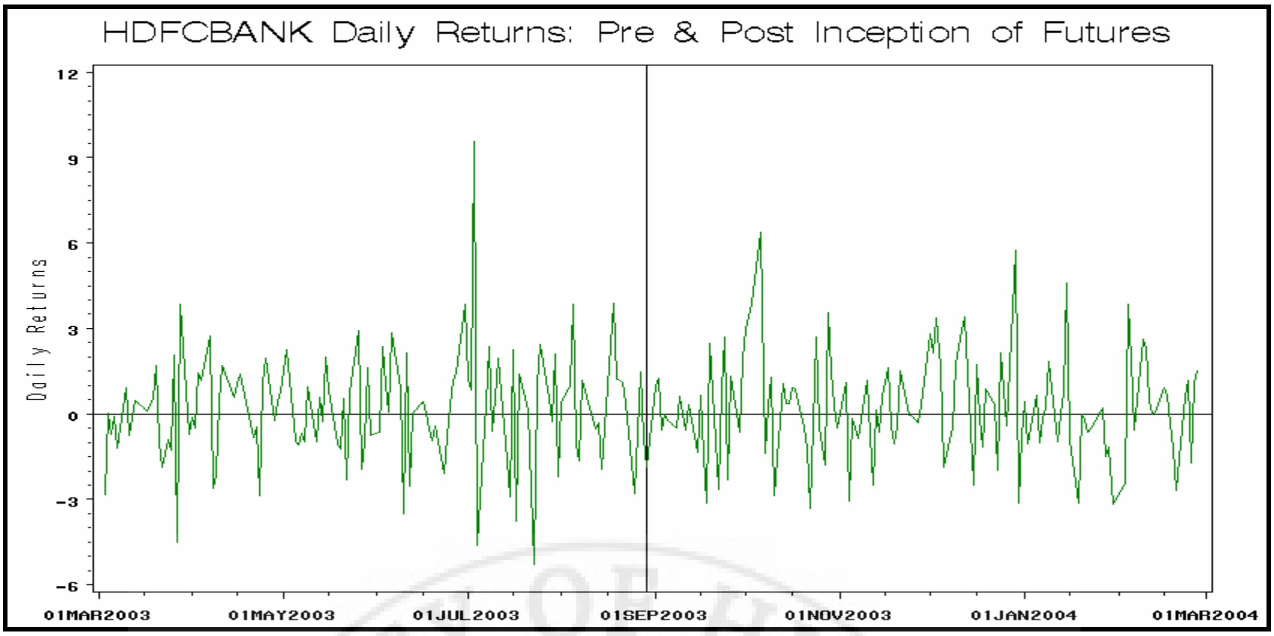
$$R_t = \phi_0 + \theta_1 Mkt_t + \gamma D_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0,1)$$

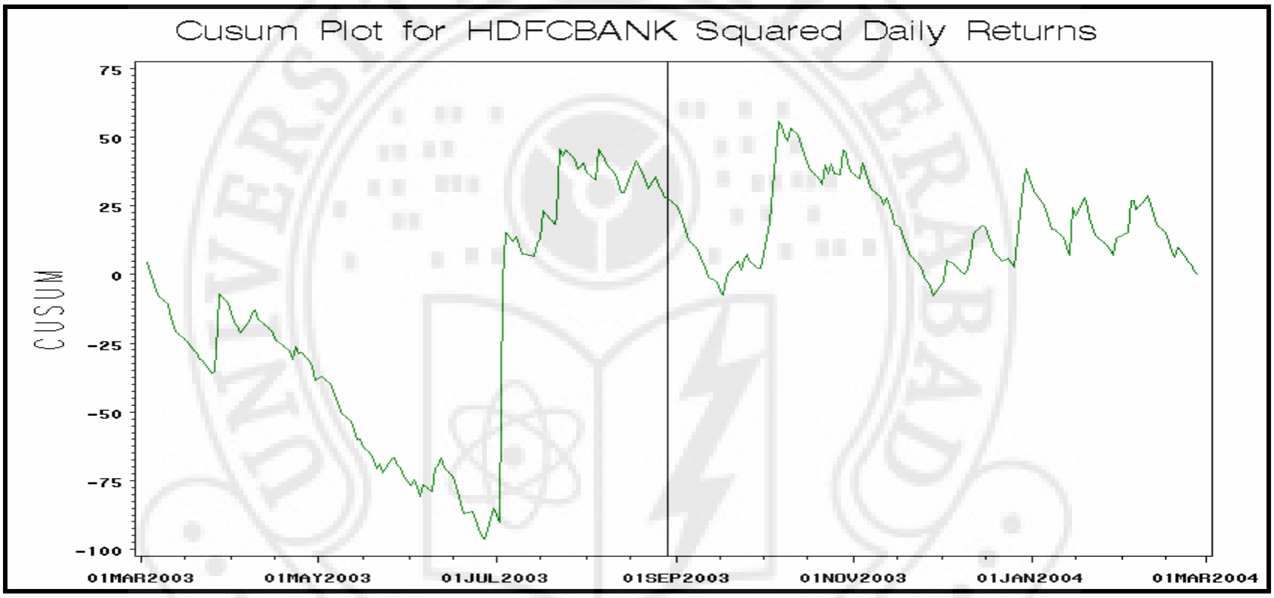
Parameter	Estimate
ϕ_0	0.008 (>0.10)
θ_1	0.4605 (<0.01)
γ	0.112 (>0.10)
F-stat	16.61 (<0.01)
G (4) test-statistic	5.079 (>0.10)
Q (4) test-statistic	3.410 (>0.10)
LM (4) test-static	3.459 (>0.10)

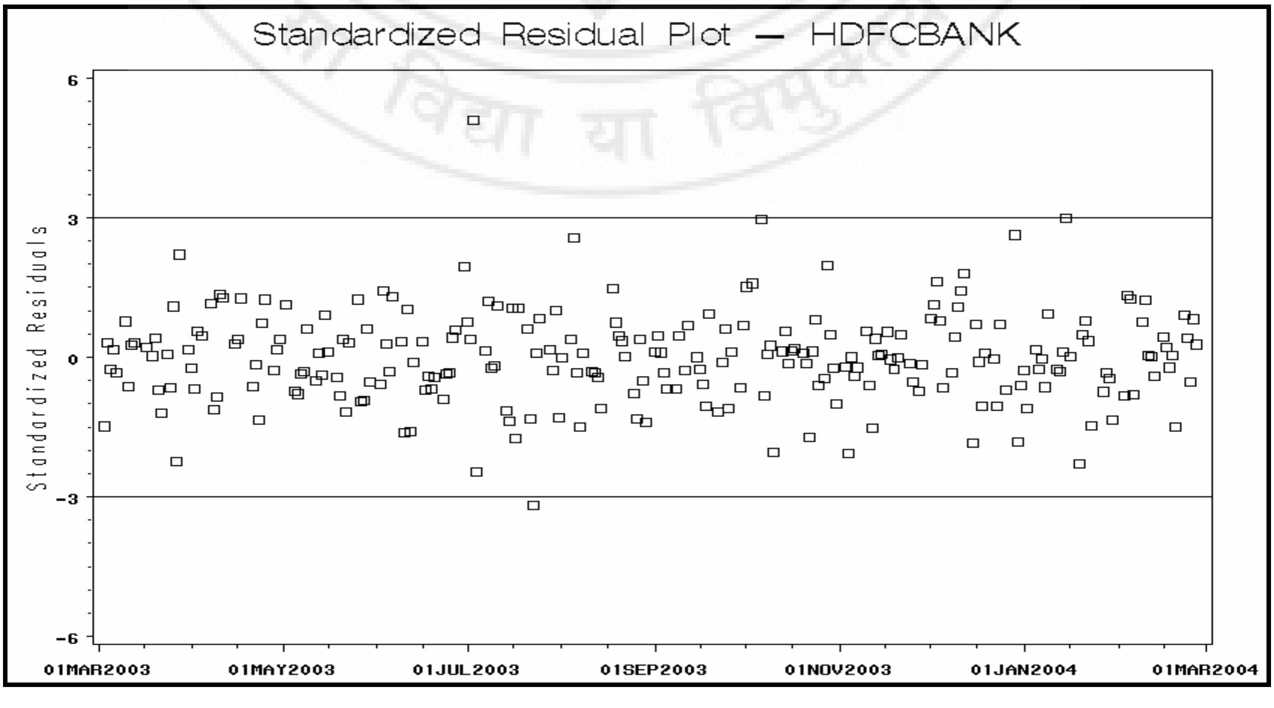
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


HDFCBANK Daily Returns: Pre & Post Inception of Futures
Daily Returns
12
9
6
3
0
-3
-6
01MAR2003
01MAY2003
01JUL2003
01SEP2003
01NOV2003
01JAN2004
01MAR2004


Cusum Plot for HDFCBANK Squared Daily Returns
CUSUM
75
50
25
0
-25
-50
-75
-100
01MAR2003
01MAY2003
01JUL2003
01SEP2003
01NOV2003
01JAN2004
01MAR2004


Standardized Residual Plot — HDFCBANK
Standardized Residuals
6
3
0
-3
-6
01MAR2003
01MAY2003
01JUL2003
01SEP2003
01NOV2003
01JAN2004
01MAR2004

Stock Symbol – ORIENTBANK (Oriental Bank of Commerce Ltd.)

Table No. 61:

Regression Results for ORIENTBANK using robust standard errors, R_t takes stock symbol ORIENTBANK, Mkt_t takes Nifty and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

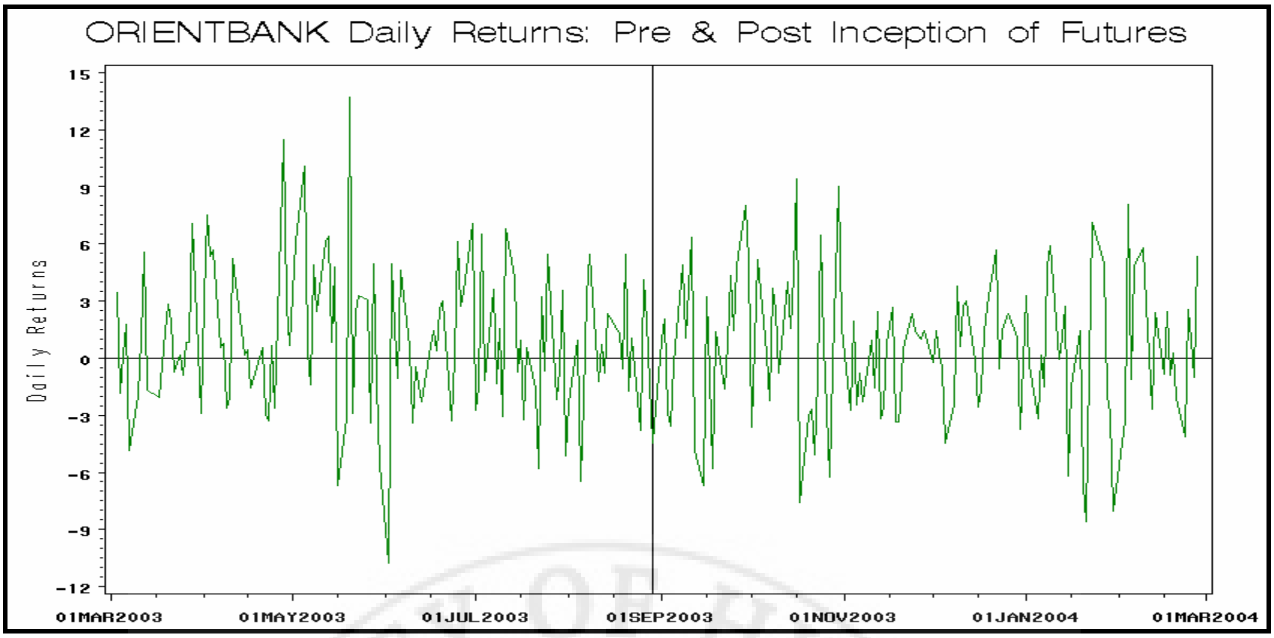
$$R_t = \phi_0 + \theta_1 Mkt_t + \gamma D_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0,1)$$

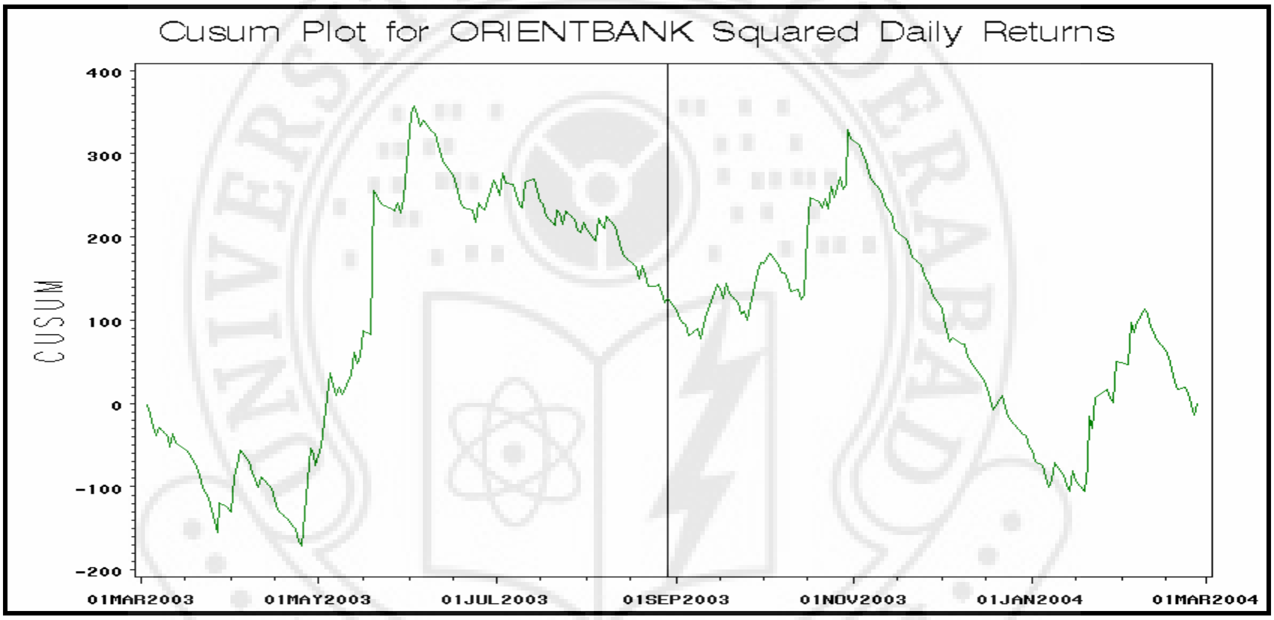
Parameter	Estimate
ϕ_0	0.670 (<0.05)
θ_1	0.134 (<0.01)
γ	-0.632 (>0.10)
F-stat	44.23 (<0.01)
G (4) test-statistic	3.624 (>0.10)
Q (4) test-statistic	4.326 (>0.10)
LM (4) test-static	3.786 (>0.10)

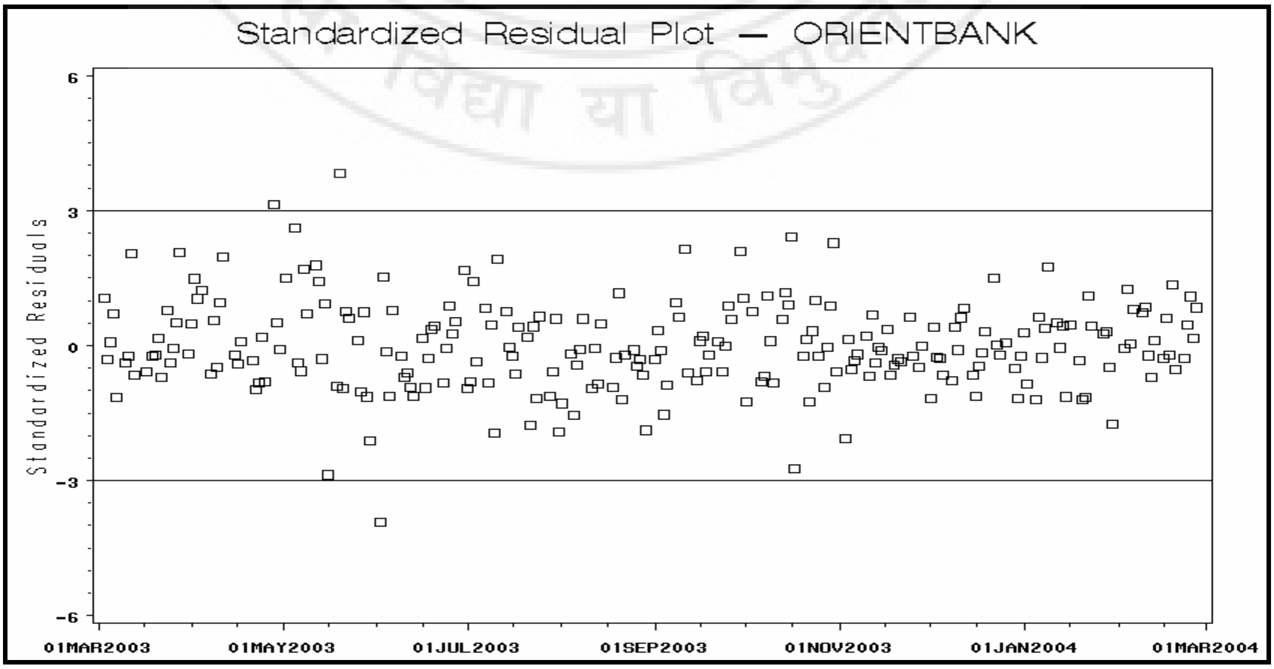
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


ORIENTBANK Daily Returns: Pre & Post Inception of Futures
Daily Returns
15
12
9
6
3
0
-3
-6
-9
-12
01MAR2003
01MAY2003
01JUL2003
01SEP2003
01NOV2003
01JAN2004
01MAR2004


Cusum Plot for ORIENTBANK Squared Daily Returns
CUSUM
400
300
200
100
0
-100
-200
01MAR2003
01MAY2003
01JUL2003
01SEP2003
01NOV2003
01JAN2004
01MAR2004


Standardized Residual Plot — ORIENTBANK
Standardized Residuals
6
3
0
-3
-6
01MAR2003
01MAY2003
01JUL2003
01SEP2003
01NOV2003
01JAN2004
01MAR2004

Stock Symbol – PNB (Punjab National Bank Ltd.)

Table No. 62a: Regression Results-Evidence of GARCH Effects. R_t takes stock symbol PNB, Mkt_t takes Nifty.

$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	**Estimate**
ϕ_0	0.158 (>0.10)
θ_1	1.279 (<0.01)
F-stat	56.54 (<0.01)
G (4) test-statistic	3.240 (>0.10)
Q (4) test-statistic	7.554 (<0.10)
LM (4) test-static	6.442 (>0.10)

Table No. 62b:
Results of GARCH (1, 1) model for PNB using robust standard errors, R_t, Mkt_t are same as defined above and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

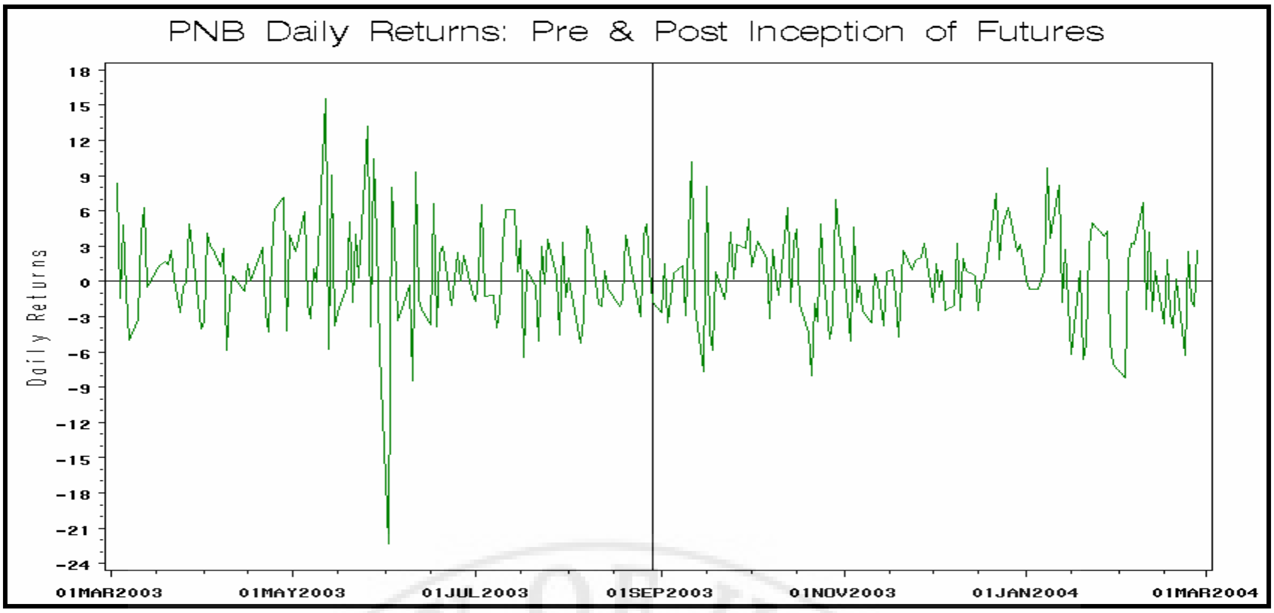
$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

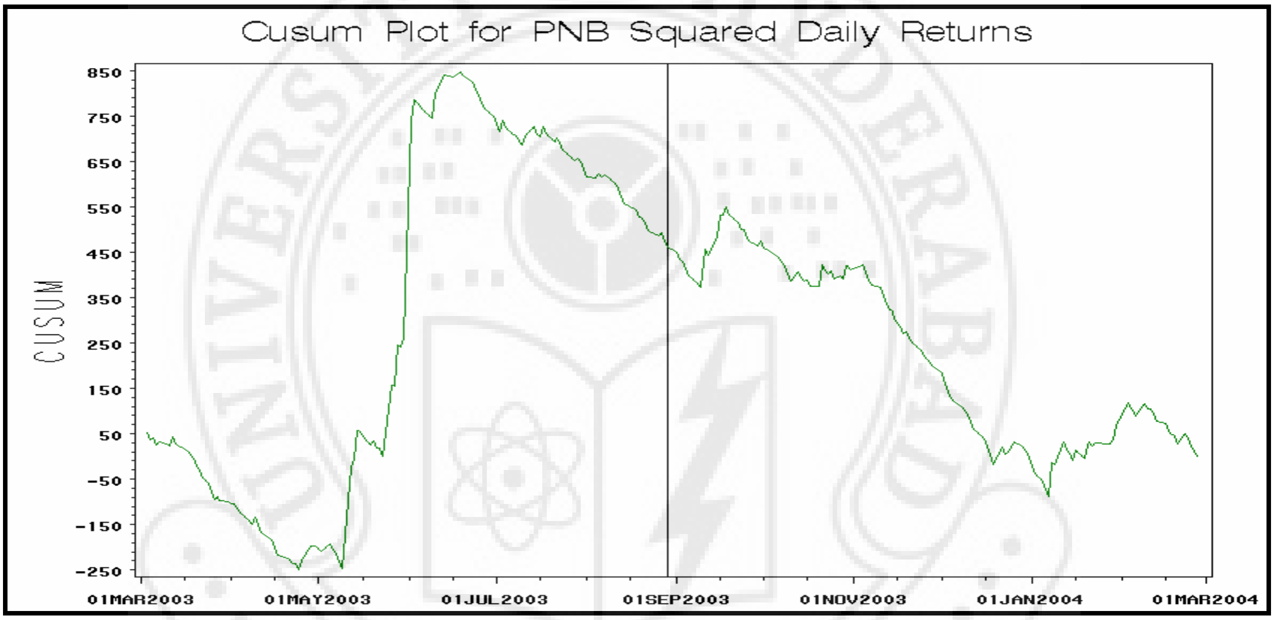
$$\varepsilon_t \sim N(0, h_t)$$

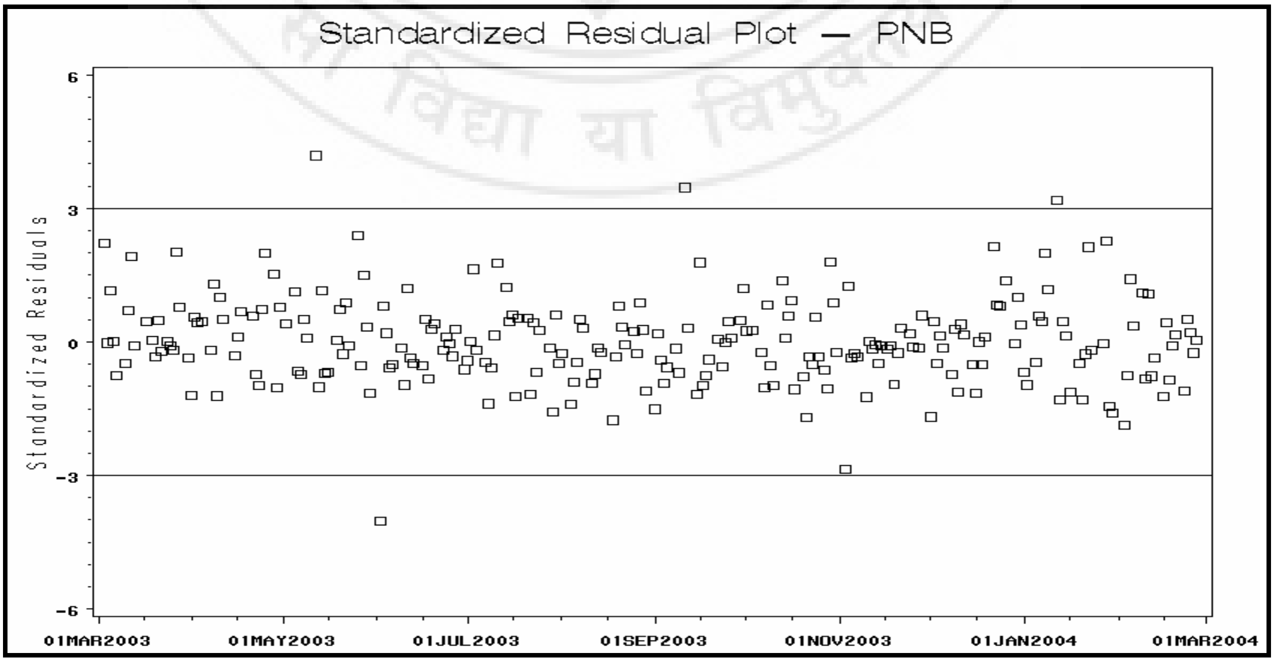
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \alpha_{0,d} D_t + \alpha_{1,d} D_t * \varepsilon_{t-1}^2 + \beta_{1,d} D_t * h_{t-1}$$

Parameter	**Estimate**	**p-value**
ϕ_0	0.115	>0.10
θ_1	1.254	<0.01
α_0	1.170	>0.10
α_1	0.136	<0.05
β_1	0.808	<0.01
$\alpha_{0,d}$	9.718	<0.10
$\alpha_{1,d}$	-0.175	<0.05
$\beta_{1,d}$	-1.025	<0.10
Diagnostics		
G (4) test-statistic	2.182	>0.10
Q (4) test-statistic	0.705	>0.10
LM (4) test-static	0.665	>0.10
Sign Bias	0.144	>0.10
Negative Size Bias	0.112	>0.10
Positive Size Bias	-0.128	>0.10
Joint Bias	0.462	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 + \beta_1 = 1$	4.810	<0.05

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


PNB Daily Returns: Pre & Post Inception of Futures
Daily Returns
18
15
12
9
6
3
0
-3
-6
-9
-12
-15
-18
-21
-24
01MAR2003
01MAY2003
01JUL2003
01SEP2003
01NOV2003
01JAN2004
01MAR2004


Cusum Plot for PNB Squared Daily Returns
CUSUM
850
750
650
550
450
350
250
150
50
-50
-150
-250
01MAR2003
01MAY2003
01JUL2003
01SEP2003
01NOV2003
01JAN2004
01MAR2004


Standardized Residual Plot — PNB
Standardized Residuals
6
3
0
-3
-6
01MAR2003
01MAY2003
01JUL2003
01SEP2003
01NOV2003
01JAN2004
01MAR2004

Stock Symbol – UNIONBANK (Union Bank of India Ltd.)

Table No. 63a: Regression Results-Evidence of GARCH Effects. R_t takes stock symbol UNIONBANK, Mkt_t takes Nifty.

$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	0.059 (>0.10)
θ_1	1.030 (<0.01)
F-stat	73.93 (<0.01)
G (4) test-statistic	6.865 (>0.10)
Q (4) test-statistic	17.41 (<0.01)
LM (4) test-static	12.50 (<0.01)

Table No. 63b:

Results of ARCH (1) model for UNIONBANK using robust standard errors, R_t, Mkt_t are same as defined above and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0, h_t)$$

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_{0,d} D_t + \alpha_{1,d} D_t * \varepsilon_{t-1}^2$$

Parameter	Estimate	p-value
ϕ_0	0.012	>0.10
θ_1	1.029	<0.01
α_0	7.628	<0.01
α_1	0.238	<0.10
$\alpha_{0,d}$	-3.692	<0.01
$\alpha_{1,d}$	-0.185	>0.10
Diagnostics		
G (4) test-statistic	7.474	>0.10
Q (4) test-statistic	0.572	>0.10
LM (4) test-static	0.570	>0.10
Sign Bias	0.028	>0.10
Negative Size Bias	-0.314	<0.10
Positive Size Bias	-0.320	<0.10
Joint Bias	9.538	<0.05
Likelihood Ratio Test		
$H_0 : \alpha_1 = 1$	11.12	<0.01

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).

As there is a significant Joint Bias along with Negative & Positive tests for asymmetry is significant, one needs to correct for them. Hence, a GJR-ARCH model has been estimated.

Table No. 63c:

Results of GJR-ARCH (1) model for UNIONBANK using robust standard errors, R_t, Mkt_t are same as defined above and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0, h_t)$$

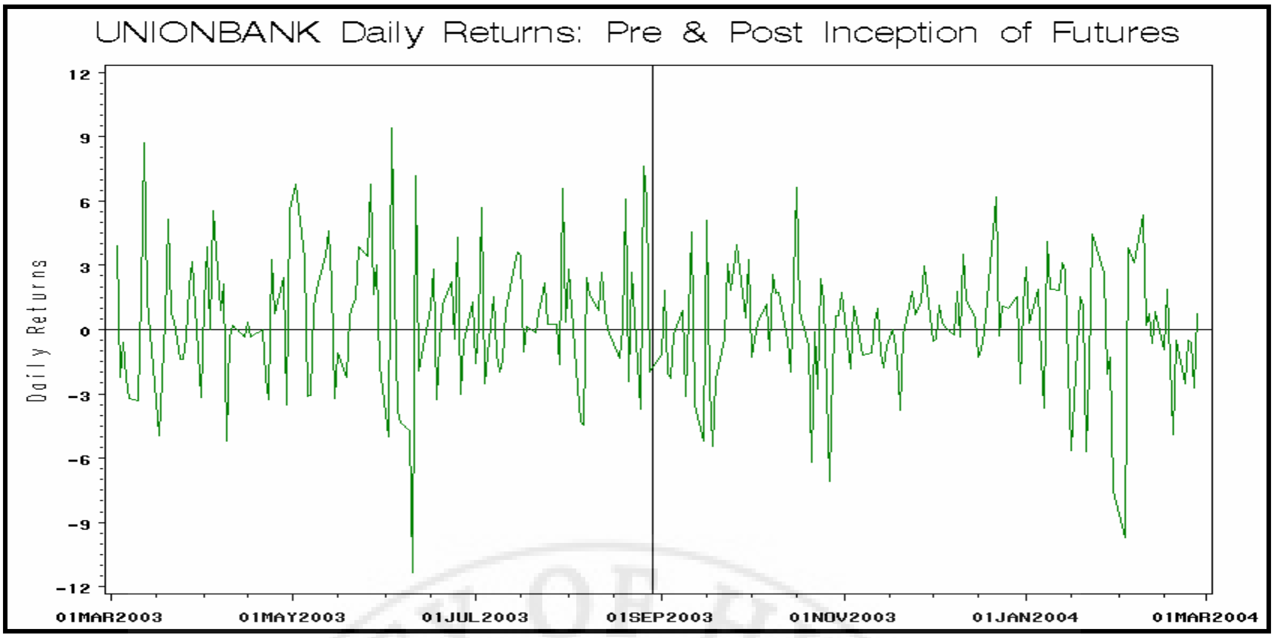
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_{0,d} D_t + \alpha_{1,d} D_t * \varepsilon_{t-1}^2 + \gamma \varepsilon_{t-1}^2 I_{t-1}$$

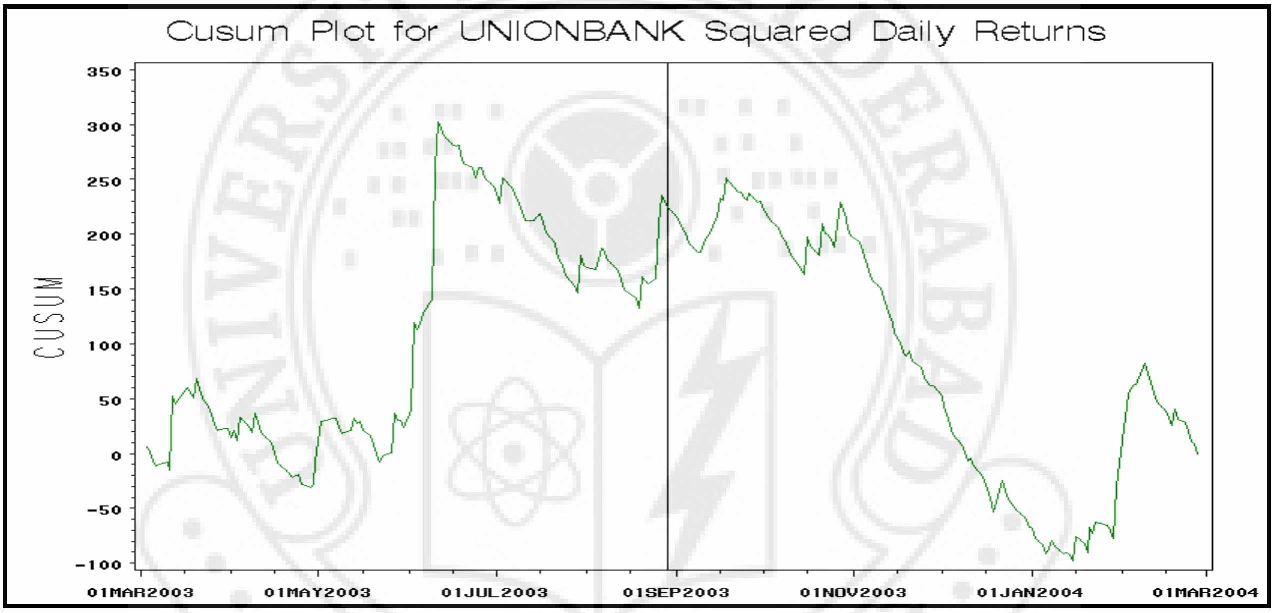
$$\text{where } I_{t-1} = 1 \text{ if } \varepsilon_{t-1} < 0$$

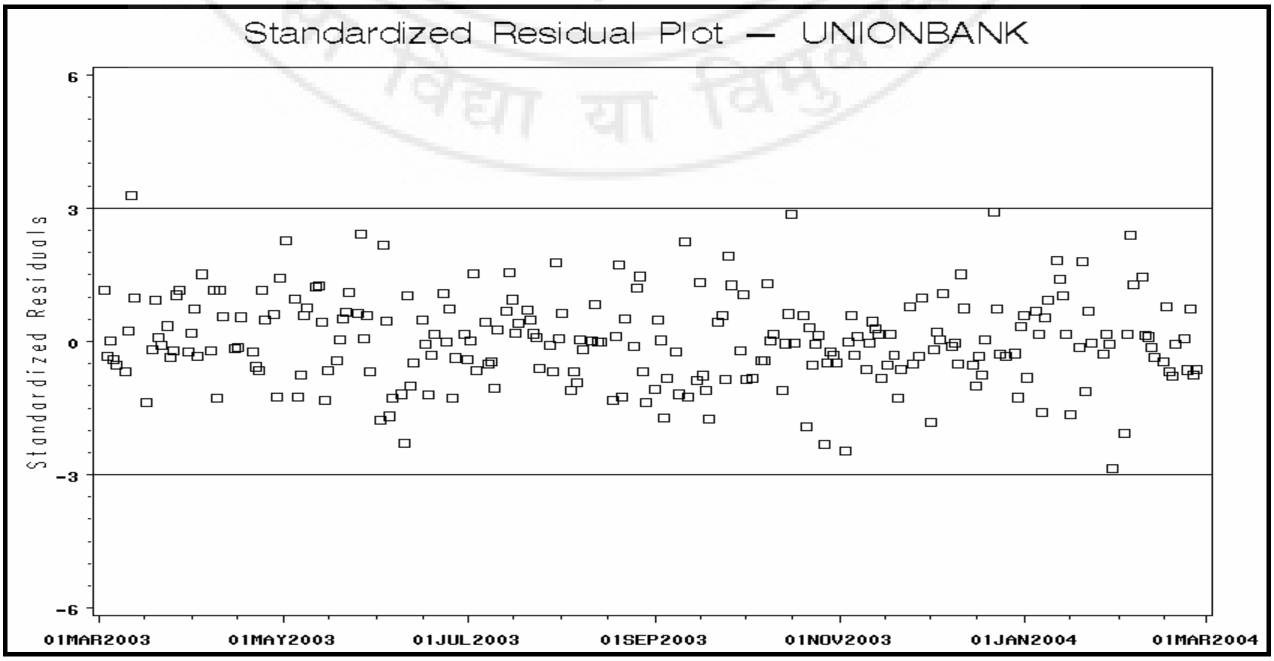
$$= 0 \text{ otherwise}$$

Parameter	Estimate	p-value
ϕ_0	0.058	>0.10
θ_1	1.070	<0.01
α_0	8.763	<0.01
α_1	0.298	<0.05
$\alpha_{0,d}$	-5.409	<0.01
$\alpha_{1,d}$	0.043	>0.10
γ	0.357	<0.01
Diagnostics		
G (4) test-statistic	6.093	>0.10
Q (4) test-statistic	1.194	>0.10
LM (4) test-static	1.187	>0.10
Sign Bias	-0.283	>0.10
Negative Size Bias	-0.042	>0.10
Positive Size Bias	-0.008	>0.10
Joint Bias	3.805	>0.10

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


UNIONBANK Daily Returns: Pre & Post Inception of Futures
Daily Returns
12
9
6
3
0
-3
-6
-9
-12
01MAR2003
01MAY2003
01JUL2003
01SEP2003
01NOV2003
01JAN2004
01MAR2004


Cusum Plot for UNIONBANK Squared Daily Returns
CUSUM
350
300
250
200
150
100
50
0
-50
-100
01MAR2003
01MAY2003
01JUL2003
01SEP2003
01NOV2003
01JAN2004
01MAR2004


Standardized Residual Plot — UNIONBANK
Standardized Residuals
6
3
0
-3
-6
01MAR2003
01MAY2003
01JUL2003
01SEP2003
01NOV2003
01JAN2004
01MAR2004

Stock Symbol – ARVINDMILL (Arvind Mills Ltd.)

Table No. 64a: Regression Results-Evidence of GARCH Effects. R_t takes stock symbol ARVINDMILL, Mkt_t takes Nifty.

$$R_t = \phi_0 + \phi_1 R_{t-2} + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	0.040 (>0.10)
ϕ_1	0.131 (<0.05)
θ_1	1.321 (<0.01)
F-stat	33.88 (<0.01)
G (4) test-statistic	3.073 (>0.10)
Q (4) test-statistic	13.81 (<0.01)
LM (4) test-static	15.29 (<0.01)

Table No. 64b:

Results of GARCH (1, 1) model for ARVINDMILL using robust standard errors, R_t, Mkt_t are same as defined above and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

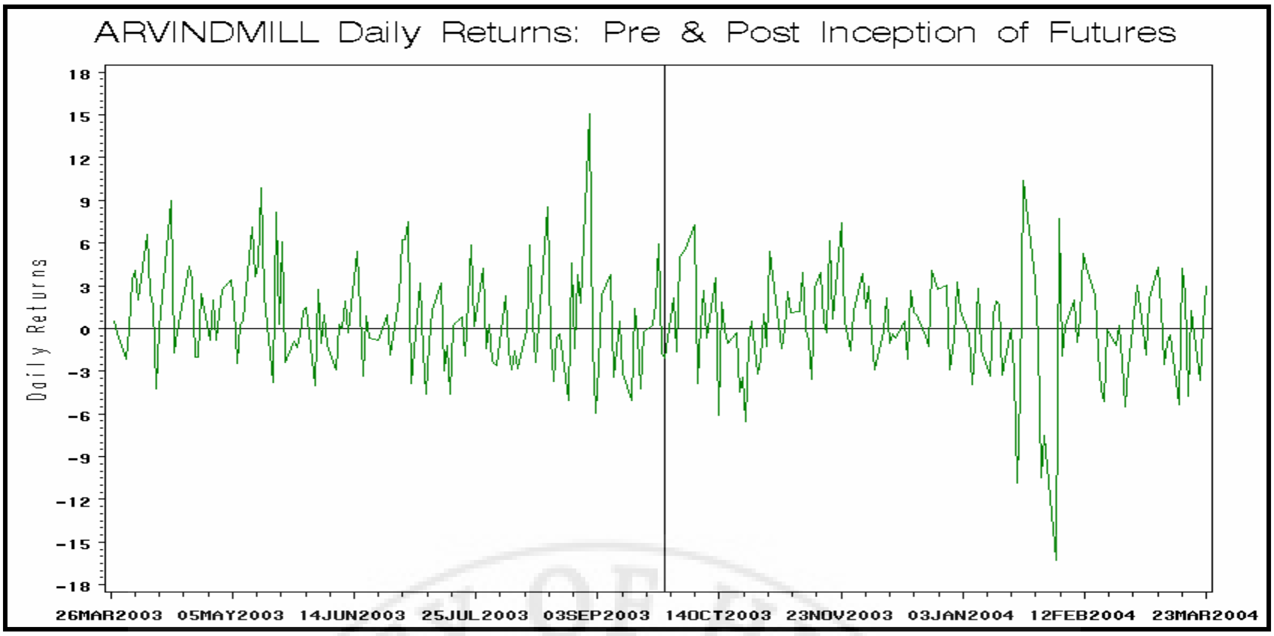
$$R_t = \phi_0 + \phi_1 R_{t-2} + \theta_1 Mkt_t + \varepsilon_t$$

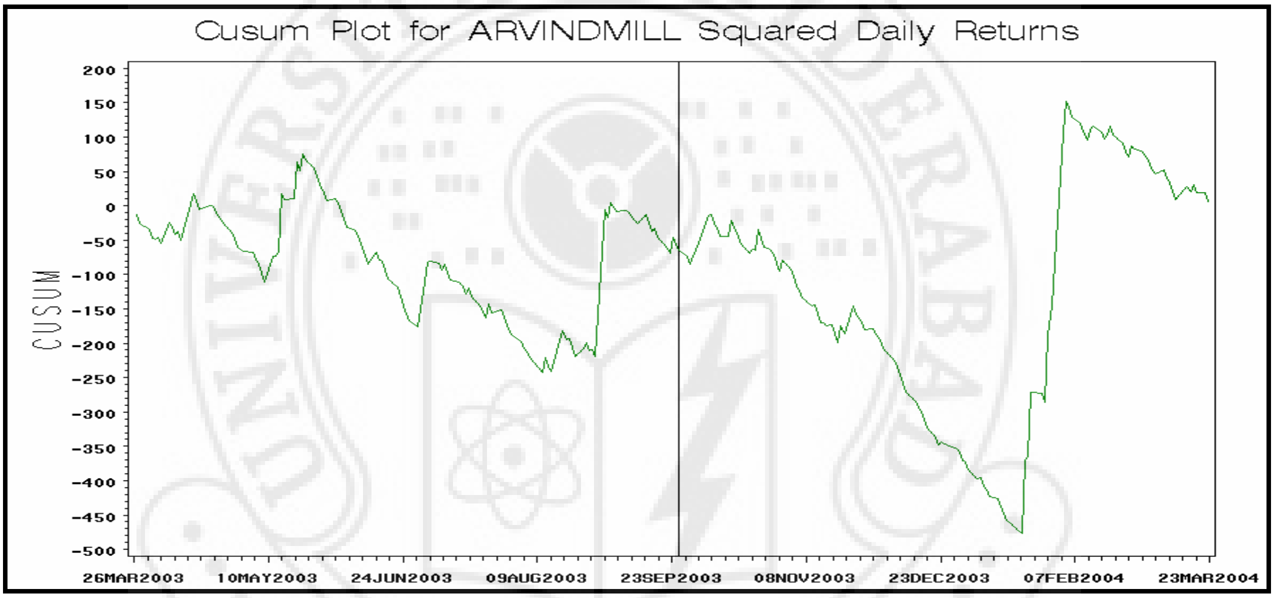
$$\varepsilon_t \sim N(0, h_t)$$

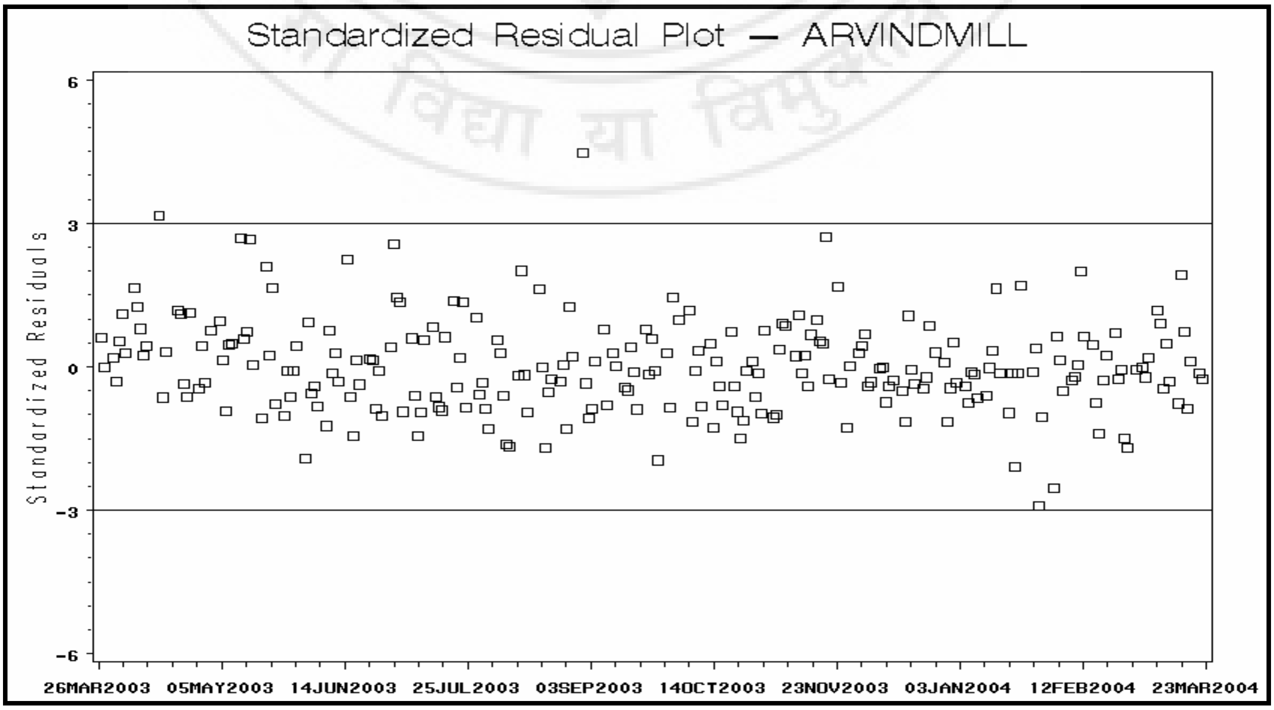
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \alpha_{0,d} D_t + \alpha_{1,d} D_t * \varepsilon_{t-1}^2 + \beta_{1,d} D_t * h_{t-1}$$

Parameter	Estimate	p-value
ϕ_0	0.007	>0.10
ϕ_1	0.114	<0.10
θ_1	1.277	<0.01
α_0	2.829	<0.05
α_1	0.153	<0.10
β_1	0.482	<0.05
$\alpha_{0,d}$	-0.665	>0.10
$\alpha_{1,d}$	0.030	>0.10
$\beta_{1,d}$	0.101	>0.10
Diagnostics		
G (4) test-statistic	2.529	>0.10
Q (4) test-statistic	6.142	>0.10
LM (4) test-static	5.919	>0.10
Sign Bias	-0.424	>0.10
Negative Size Bias	0.238	>0.10
Positive Size Bias	-0.180	>0.10
Joint Bias	8.472	<0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 + \beta_1 = 1$	2.860	<0.10

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993). Though, partial evidence of Sign Bias was found, due to non-significant evidence in asymmetric GJR-GARCH (1, 1) reverted back to original model.


ARVINDMILL Daily Returns: Pre & Post Inception of Futures
Daily Returns
18
15
12
9
6
3
0
-3
-6
-9
-12
-15
-18
26MAR2003 05MAY2003 14JUN2003 25JUL2003 03SEP2003 14OCT2003 23NOV2003 03JAN2004 12FEB2004 23MAR2004


Cusum Plot for ARVINDMILL Squared Daily Returns
CUSUM
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
-400
-450
-500
26MAR2003 10MAY2003 24JUN2003 09AUG2003 23SEP2003 08NOV2003 23DEC2003 07FEB2004 23MAR2004


Standardized Residual Plot — ARVINDMILL
Standardized Residuals
6
3
0
-3
-6
26MAR2003 05MAY2003 14JUN2003 25JUL2003 03SEP2003 14OCT2003 23NOV2003 03JAN2004 12FEB2004 23MAR2004

Stock Symbol – GAIL (Gas Authority of India Ltd.)

Table No. 65:

Regression Results for GAIL using robust standard errors, R_t takes stock symbol GAIL, Mkt_t takes Nifty and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

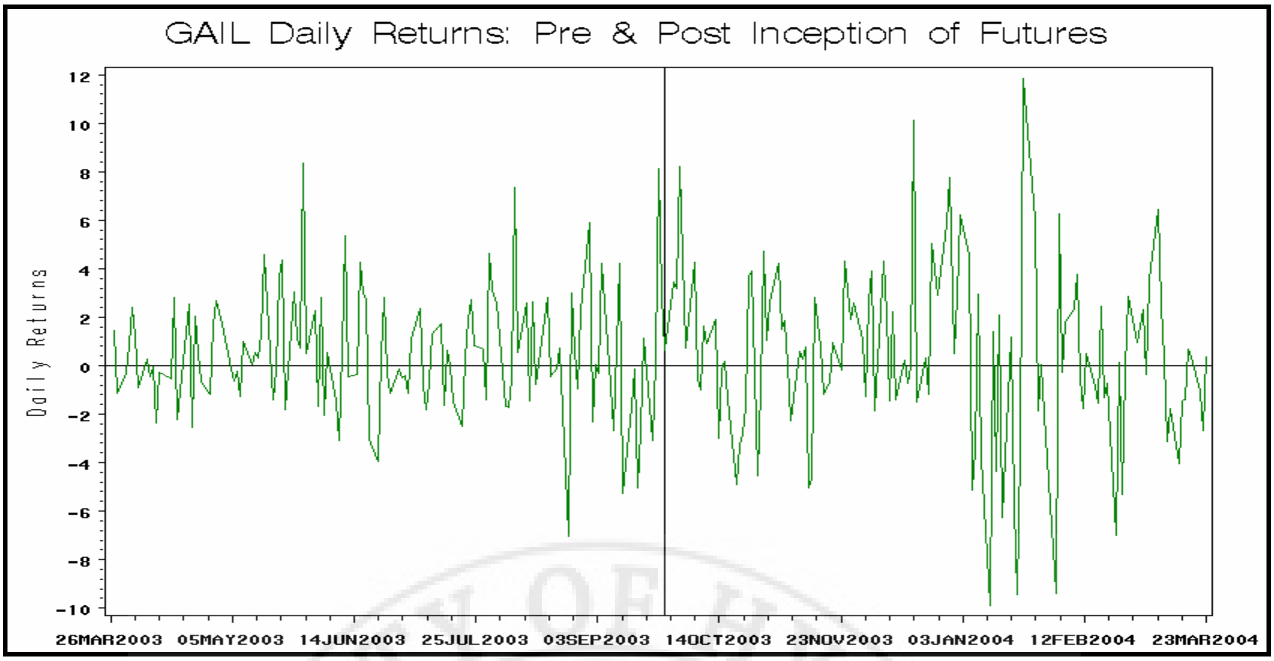
$$R_t = \phi_0 + \theta_1 Mkt_t + \gamma D_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0,1)$$

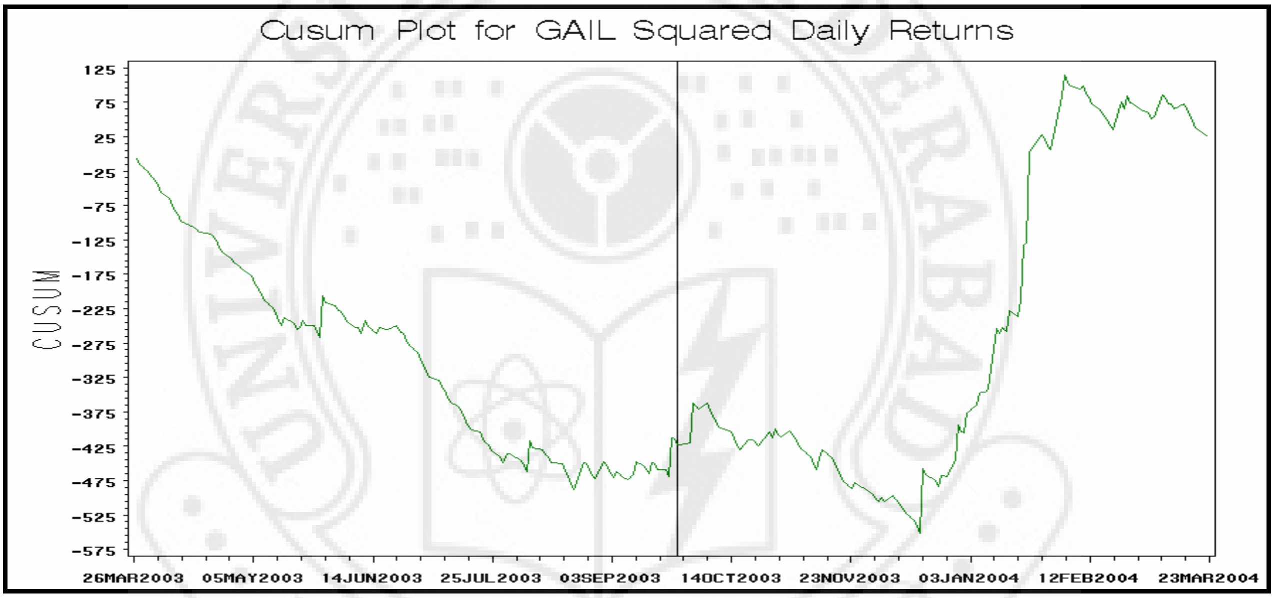
Parameter	Estimate
ϕ_0	0.166 (>0.10)
θ_1	1.363 (<0.01)
γ	-0.114 (>0.10)
F-stat	83.90 (<0.01)
G (4) test-statistic	1.811 (>0.10)
Q (4) test-statistic	1.878 (>0.10)
LM (4) test-static	1.794 (>0.10)

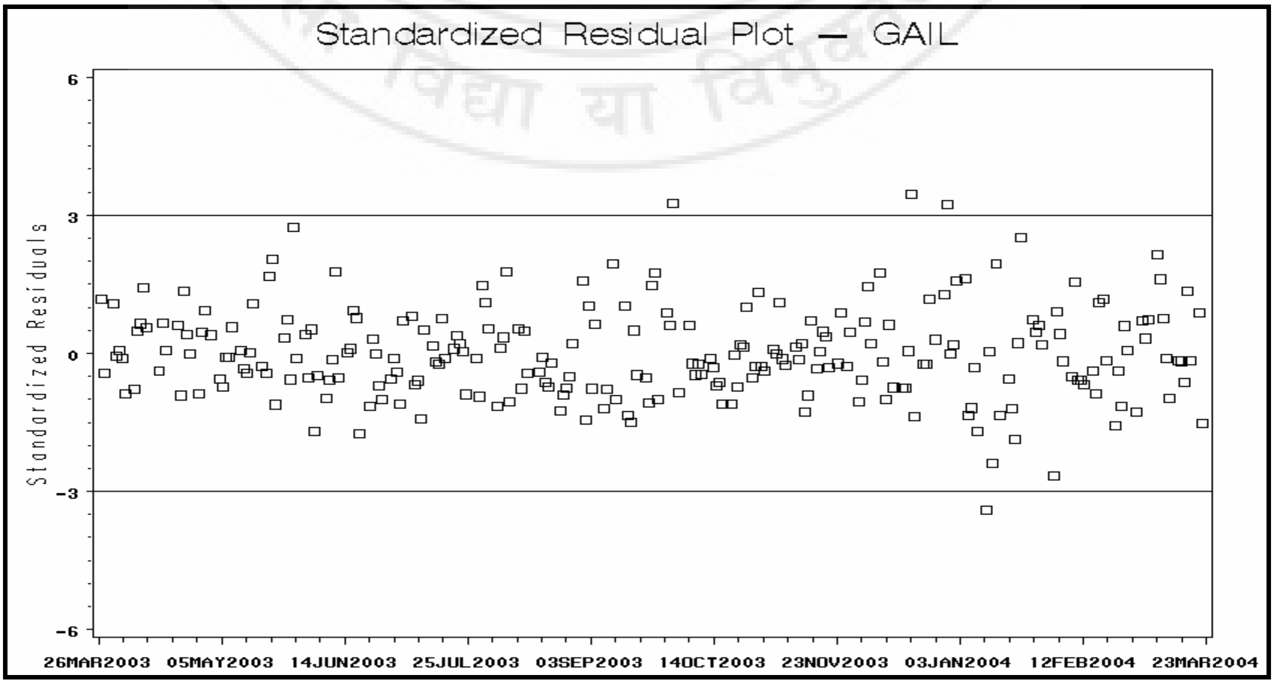
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


GAIL Daily Returns: Pre & Post Inception of Futures
Daily Returns
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
26MAR2003
05MAY2003
14JUN2003
25JUL2003
03SEP2003
14OCT2003
23NOV2003
03JAN2004
12FEB2004
23MAR2004


Cusum Plot for GAIL Squared Daily Returns
CUSUM
125
75
25
-25
-75
-125
-175
-225
-275
-325
-375
-425
-475
-525
-575
26MAR2003
05MAY2003
14JUN2003
25JUL2003
03SEP2003
14OCT2003
23NOV2003
03JAN2004
12FEB2004
23MAR2004


Standardized Residual Plot — GAIL
Standardized Residuals
6
3
0
-3
-6
26MAR2003
05MAY2003
14JUN2003
25JUL2003
03SEP2003
14OCT2003
23NOV2003
03JAN2004
12FEB2004
23MAR2004

Stock Symbol – IOC (Indian Oil Corporation Ltd.)

Table No. 66:

Regression Results for IOC using robust standard errors, R_t takes stock symbol IOC, Mkt_t takes Nifty, D_t takes on value of zero before SSFs introduction and a value of one afterwards and BD_t is bonus share dummy takes the value of one for date 14th Aug 2003 on which IOC has given a bonus of 1:2 for each share.

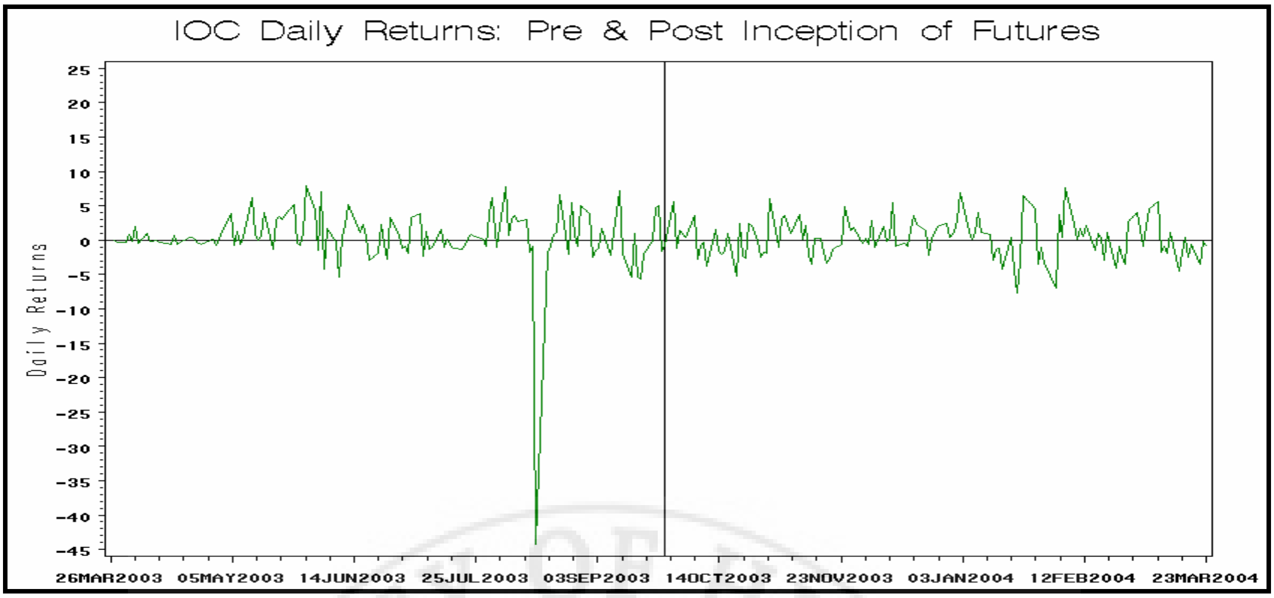
$$R_t = \phi_0 + \theta_1 Mkt_t + \gamma D_t + \eta BD_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0,1)$$

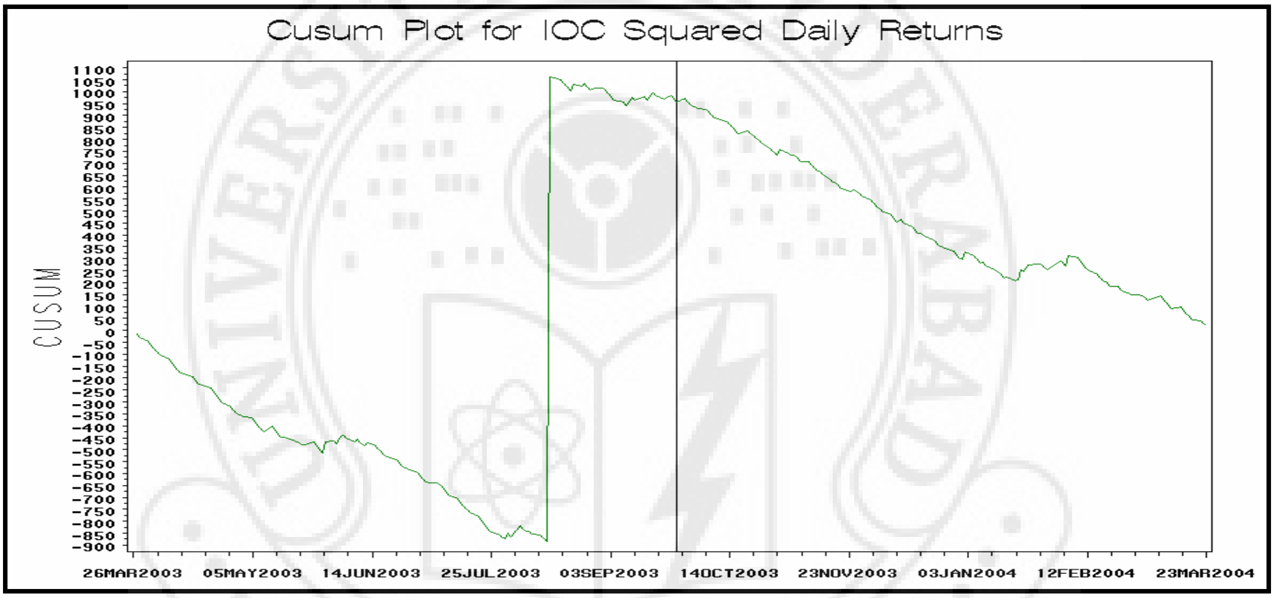
Parameter	**Estimate**
ϕ_0	0.475 (<0.05)
θ_1	1.001 (<0.01)
γ	-0.483 (<0.10)
η	-44.84 (<0.01)
F-stat	150.7 (<0.01)
G (4) test-statistic	5.188 (>0.10)
Q (4) test-statistic	2.986 (>0.10)
LM (4) test-static	2.884 (>0.10)

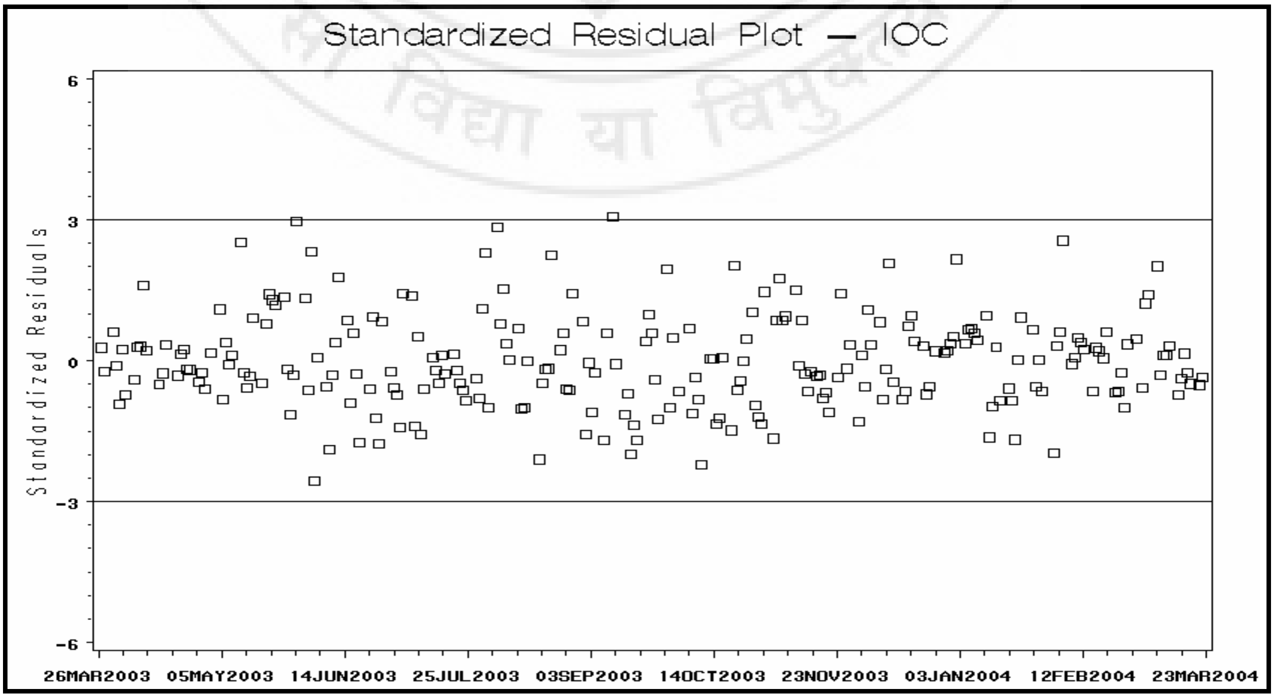
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


IOC Daily Returns: Pre & Post Inception of Futures
Daily Returns
26MAR2003 05MAY2003 14JUN2003 25JUL2003 03SEP2003 14OCT2003 23NOV2003 03JAN2004 12FEB2004 23MAR2004


Cusum Plot for IOC Squared Daily Returns
CUSUM
26MAR2003 05MAY2003 14JUN2003 25JUL2003 03SEP2003 14OCT2003 23NOV2003 03JAN2004 12FEB2004 23MAR2004


Standardized Residual Plot — IOC
Standardized Residuals
26MAR2003 05MAY2003 14JUN2003 25JUL2003 03SEP2003 14OCT2003 23NOV2003 03JAN2004 12FEB2004 23MAR2004

Stock Symbol – SYNDIBANK (Syndicate Bank)

Table No. 67a: Regression Results: Evidence of GARCH Effects

$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Variable	Estimate
ϕ_0	0.101 (>0.10)
θ_1	1.148 (<0.01)
F-stat	92.36 (<0.01)
G (4) test-statistic	4.870 (>0.10)
Q (4) test-statistic	32.80 (<0.01)
LM (4) test-static	21.62 (<0.01)

Table No. 67b:

Results of GARCH (1, 1) model for SYNDIBANK using robust standard errors, R_t takes stock symbol SYNDIBANK, Mkt_t takes Nifty and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

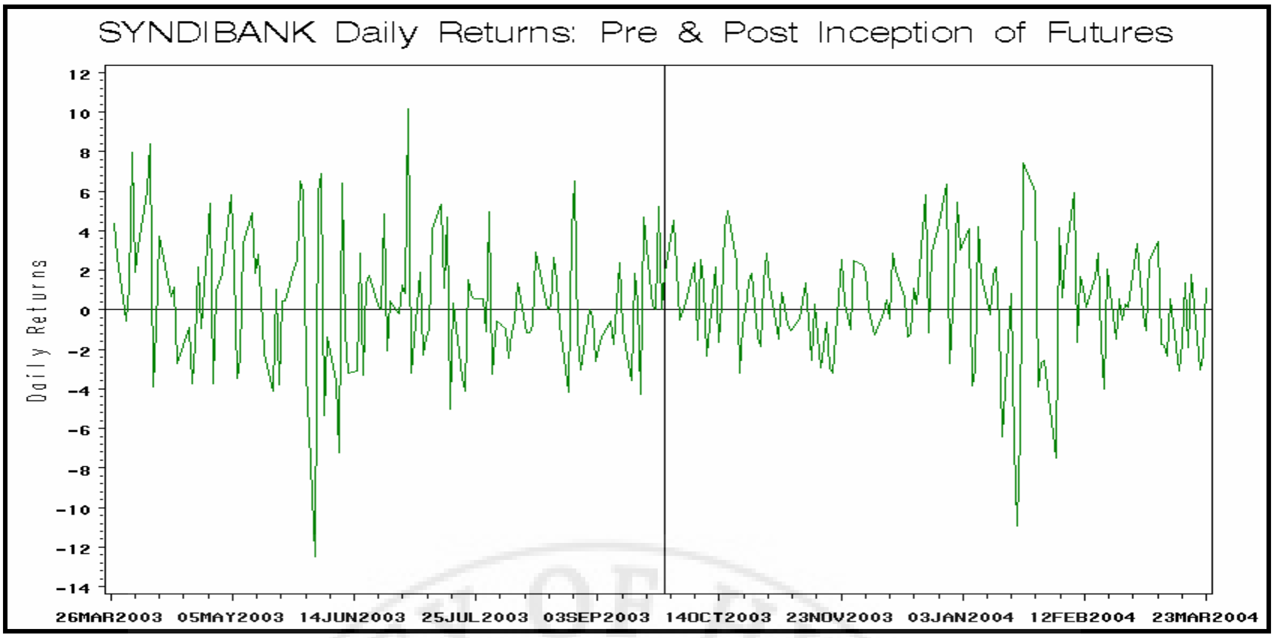
$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

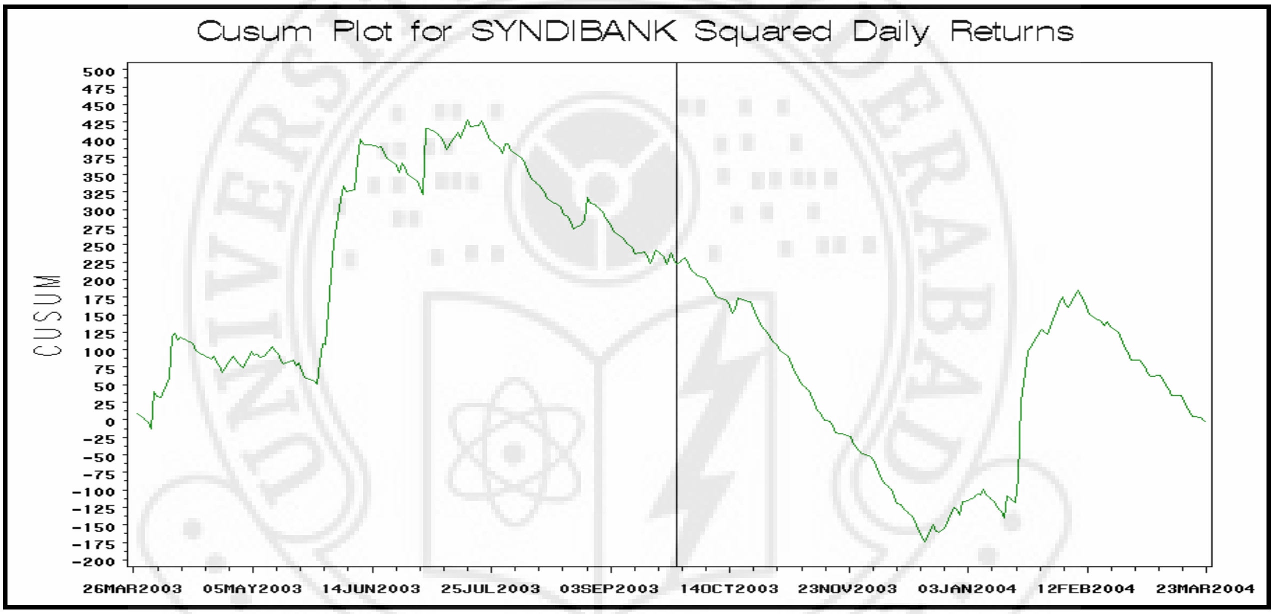
$$\varepsilon_t \sim N(0, h_t)$$

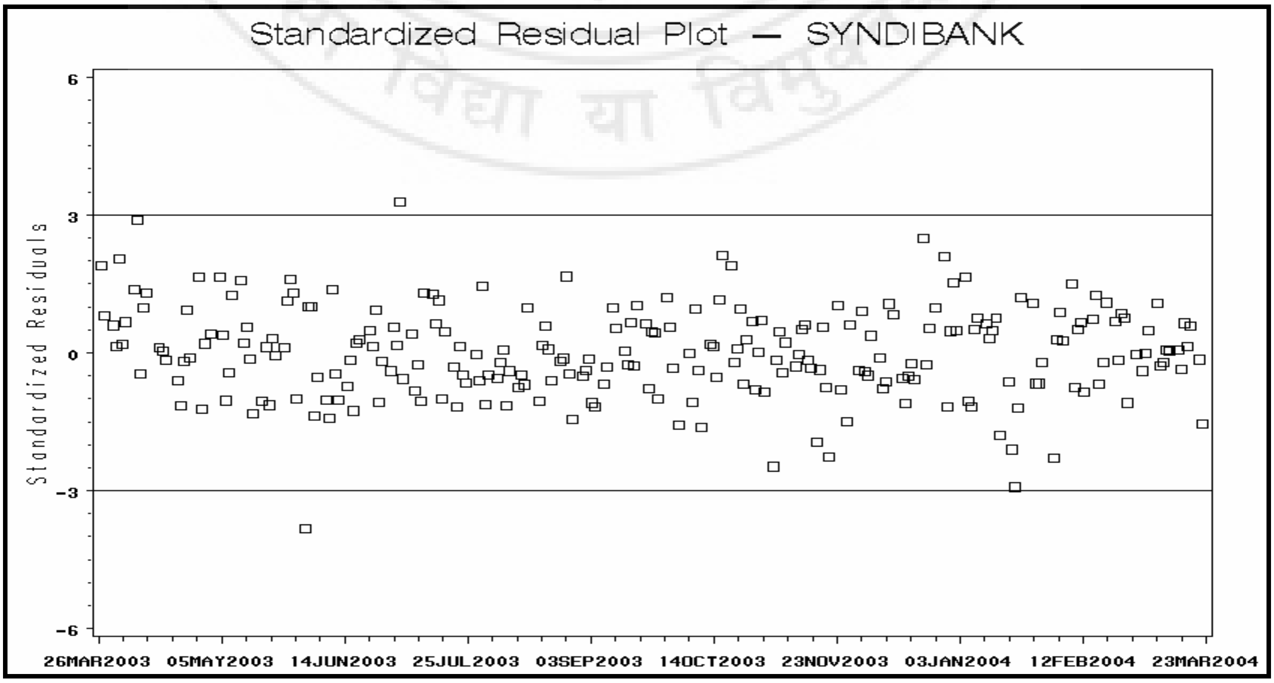
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \alpha_{0,d} D_t + \alpha_{1,d} D_t * \varepsilon_{t-1}^2 + \beta_{1,d} D_t * h_{t-1}$$

Parameter	Estimate	p-value
ϕ_0	0.019	>0.10
θ_1	1.182	<0.01
α_0	3.110	>0.10
α_1	0.157	<0.10
β_1	0.532	<0.05
$\alpha_{0,d}$	4.648	<0.05
$\alpha_{1,d}$	-0.127	>0.10
$\beta_{1,d}$	-1.472	<0.01
Diagnostics		
G (4) test-statistic	5.212	>0.10
Q (4) test-statistic	2.045	>0.10
LM (4) test-static	1.859	>0.10
Sign Bias	0.124	>0.10
Negative Size Bias	-0.129	>0.10
Positive Size Bias	-0.024	>0.10
Joint Bias	0.647	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 + \beta_1 = 1$	15.74	<0.01

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sing bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


SYNDIBANK Daily Returns: Pre & Post Inception of Futures
Daily Returns
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
26MAR2003
05MAY2003
14JUN2003
25JUL2003
03SEP2003
14OCT2003
23NOV2003
03JAN2004
12FEB2004
23MAR2004


Cusum Plot for SYNDIBANK Squared Daily Returns
CUSUM
500
475
450
425
400
375
350
325
300
275
250
225
200
175
150
125
100
75
50
25
0
-25
-50
-75
-100
-125
-150
-175
-200
26MAR2003
05MAY2003
14JUN2003
25JUL2003
03SEP2003
14OCT2003
23NOV2003
03JAN2004
12FEB2004
23MAR2004


Standardized Residual Plot — SYNDIBANK
Standardized Residuals
6
3
0
-3
-6
26MAR2003
05MAY2003
14JUN2003
25JUL2003
03SEP2003
14OCT2003
23NOV2003
03JAN2004
12FEB2004
23MAR2004

Stock Symbol – ABB (Asea Brown Boveri Ltd.)

Table No. 68a: Regression Results-Evidence of ARCH Effects. R_t takes stock symbol ABB, Mkt_t takes Nifty.

$$R_t = \phi_0 + \phi_1 R_{t-1} + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	0.244 (<0.10)
ϕ_1	0.168 (<0.01)
θ_1	0.432 (<0.01)
F-stat	13.64 (<0.01)
G (4) test-statistic	2.007 (>0.10)
Q (4) test-statistic	12.10 (<0.01)
LM (4) test-static	12.39 (<0.01)

Table No. 68b:
Results of AR(1)-ARCH (1) model for ABB using robust standard errors, R_t, Mkt_t are same as defined above and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

$$R_t = \phi_0 + R_{t-1} + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0, h_t)$$

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_{0,d} D_t + \alpha_{1,d} D_t * \varepsilon_{t-1}^2$$

Parameter	Estimate	p-value
ϕ_0	0.311	<0.05
ϕ_1	0.490	<0.01
θ_1	0.184	<0.01
α_0	2.022	<0.01
α_1	0.304	<0.10
$\alpha_{0,d}$	-0.752	<0.05
$\alpha_{1,d}$	-0.419	<0.05
Diagnostics		
G (4) test-statistic	1.727	>0.10
Q (4) test-statistic	1.470	>0.10
LM (4) test-static	1.607	>0.10
Sign Bias	-0.258	>0.10
Negative Size Bias	0.054	>0.10
Positive Size Bias	0.669	>0.10
Joint Bias	4.293	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 = 1$	16.19	<0.01

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).

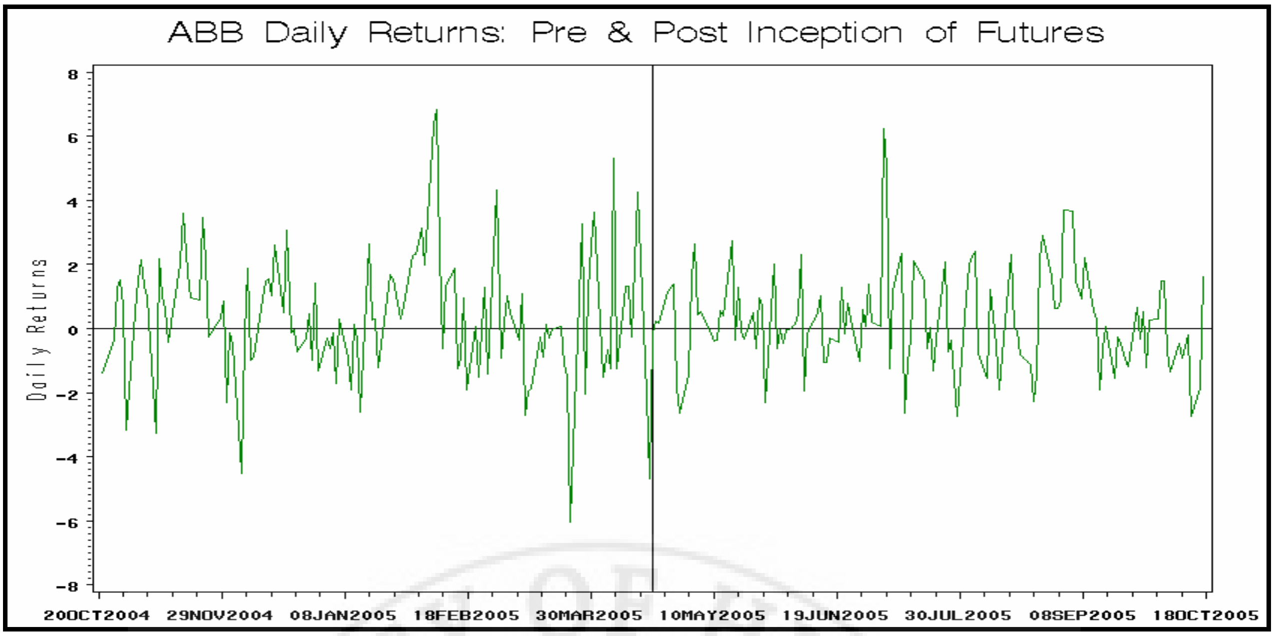
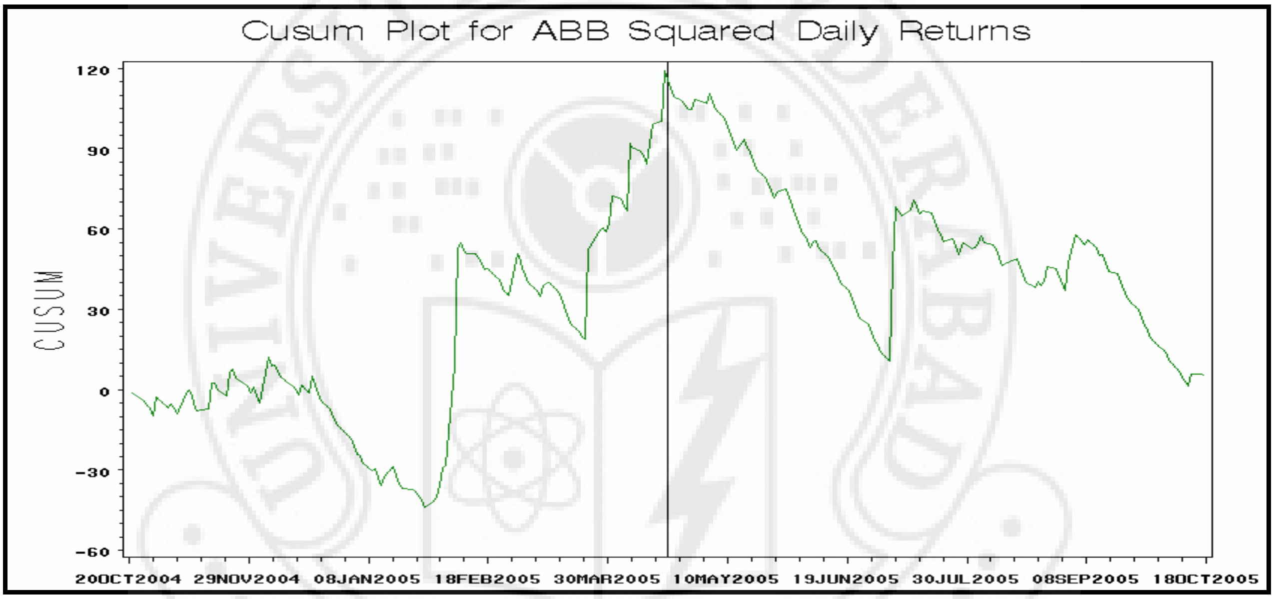
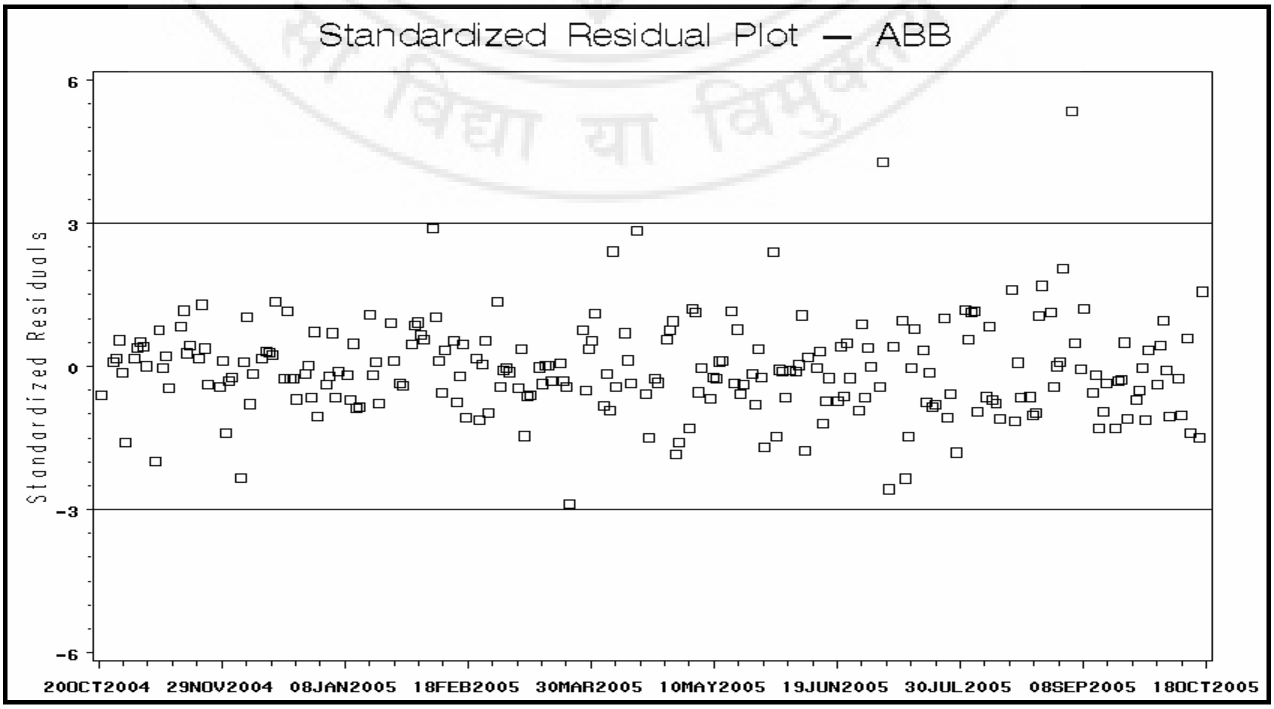


ABB Daily Returns: Pre & Post Inception of Futures
Daily Returns
8
6
4
2
0
-2
-4
-6
-8
20OCT2004
29NOV2004
08JAN2005
18FEB2005
30MAR2005
10MAY2005
19JUN2005
30JUL2005
08SEP2005
18OCT2005



Cusum Plot for ABB Squared Daily Returns
CUSUM
120
90
60
30
0
-30
-60
20OCT2004
29NOV2004
08JAN2005
18FEB2005
30MAR2005
10MAY2005
19JUN2005
30JUL2005
08SEP2005
18OCT2005



Standardized Residual Plot — ABB
Standardized Residuals
6
3
0
-3
-6
20OCT2004
29NOV2004
08JAN2005
18FEB2005
30MAR2005
10MAY2005
19JUN2005
30JUL2005
08SEP2005
18OCT2005

Stock Symbol – ALBK (Allahabad Bank Ltd.)

Table No. 69a: Regression Results-Evidence of ARCH Effects. R_t takes stock symbol ALBK, Mkt_t takes Nifty.

$$R_t = \phi_0 + \phi_1 R_{t-2} + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	0.081 (<0.10)
ϕ_1	-0.128 (<0.05)
θ_1	1.087 (<0.01)
F-stat	29.46 (<0.01)
G (4) test-statistic	1.372 (>0.10)
Q (4) test-statistic	9.543 (<0.01)
LM (4) test-static	9.663 (<0.01)

Table No. 69b:
Results of AR(2)-ARCH (1) model for ALBK using robust standard errors, R_t, Mkt_t are same as defined above and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

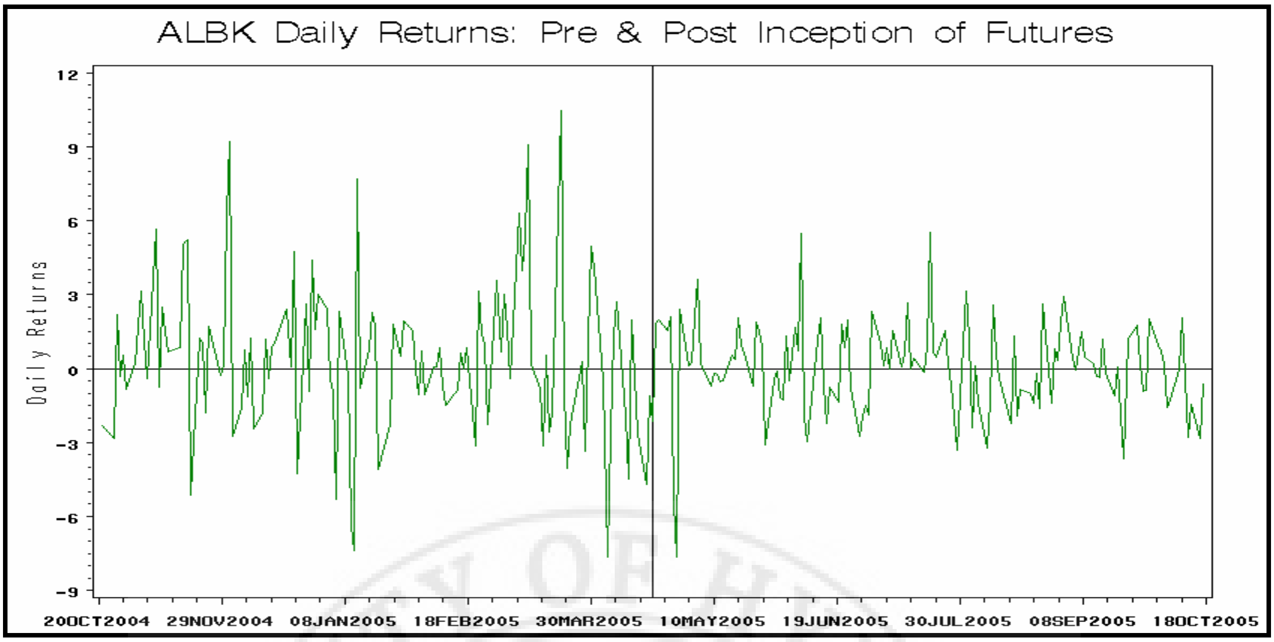
$$R_t = \phi_0 + R_{t-2} + \theta_1 Mkt_t + \varepsilon_t$$

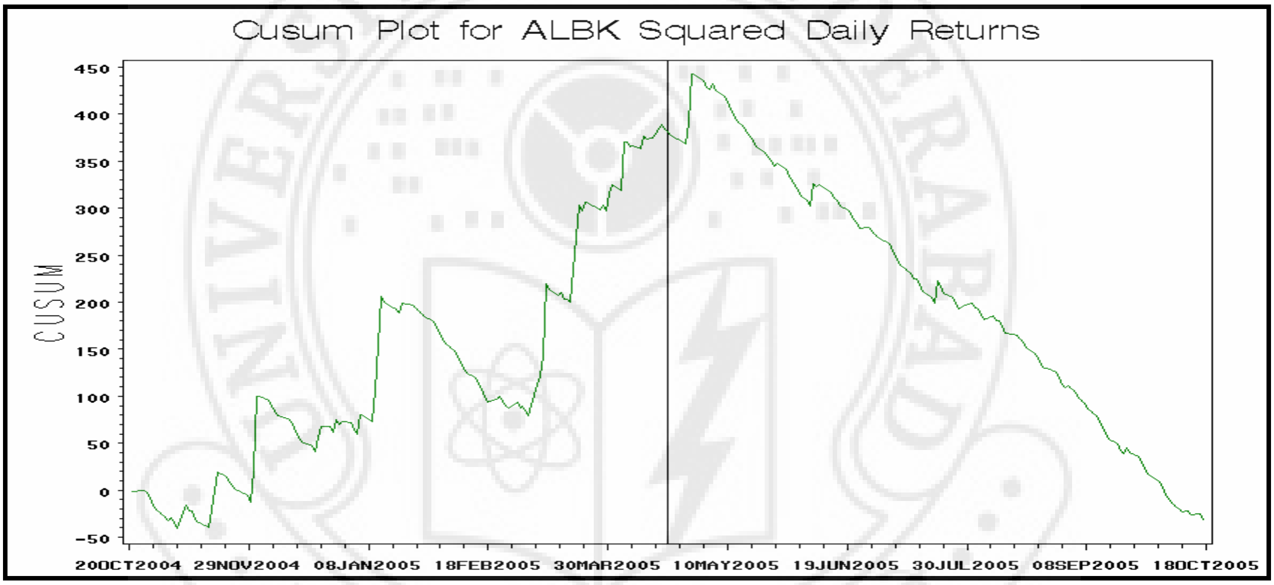
$$\varepsilon_t \sim N(0, h_t)$$

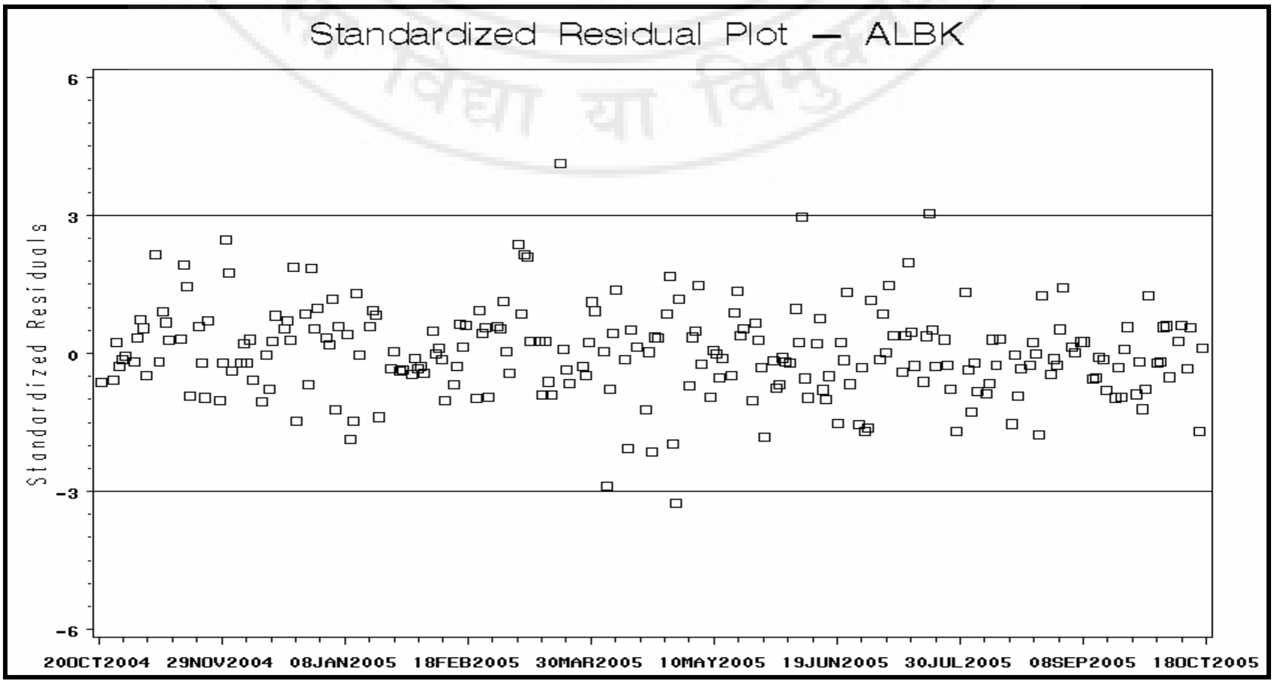
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_{0,d} D_t + \alpha_{1,d} D_t * \varepsilon_{t-1}^2$$

Parameter	Estimate	p-value
ϕ_0	0.036	>0.10
ϕ_1	-0.124	<0.05
θ_1	1.059	<0.01
α_0	5.419	<0.01
α_1	0.316	<0.05
$\alpha_{0,d}$	-2.618	<0.05
$\alpha_{1,d}$	-0.165	>0.10
Diagnostics		
G (4) test-statistic	0.957	>0.10
Q (4) test-statistic	2.382	>0.10
LM (4) test-static	2.225	>0.10
Sign Bias	-0.120	>0.10
Negative Size Bias	-0.097	>0.10
Positive Size Bias	-0.105	>0.10
Joint Bias	2.416	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 = 1$	10.43	<0.01

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


ALBK Daily Returns: Pre & Post Inception of Futures
Daily Returns
12
9
6
3
0
-3
-6
-9
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Cusum Plot for ALBK Squared Daily Returns
CUSUM
450
400
350
300
250
200
150
100
50
0
-50
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Standardized Residual Plot — ALBK
Standardized Residuals
6
3
0
-3
-6
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005

Stock Symbol – ASHOKLEY (Ashok Leyland Ltd.)

Table No. 70:

Regression Results for ASHOKLEY using robust standard errors, R_t takes stock symbol ASHOKLEY, Mkt_t takes Nifty and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

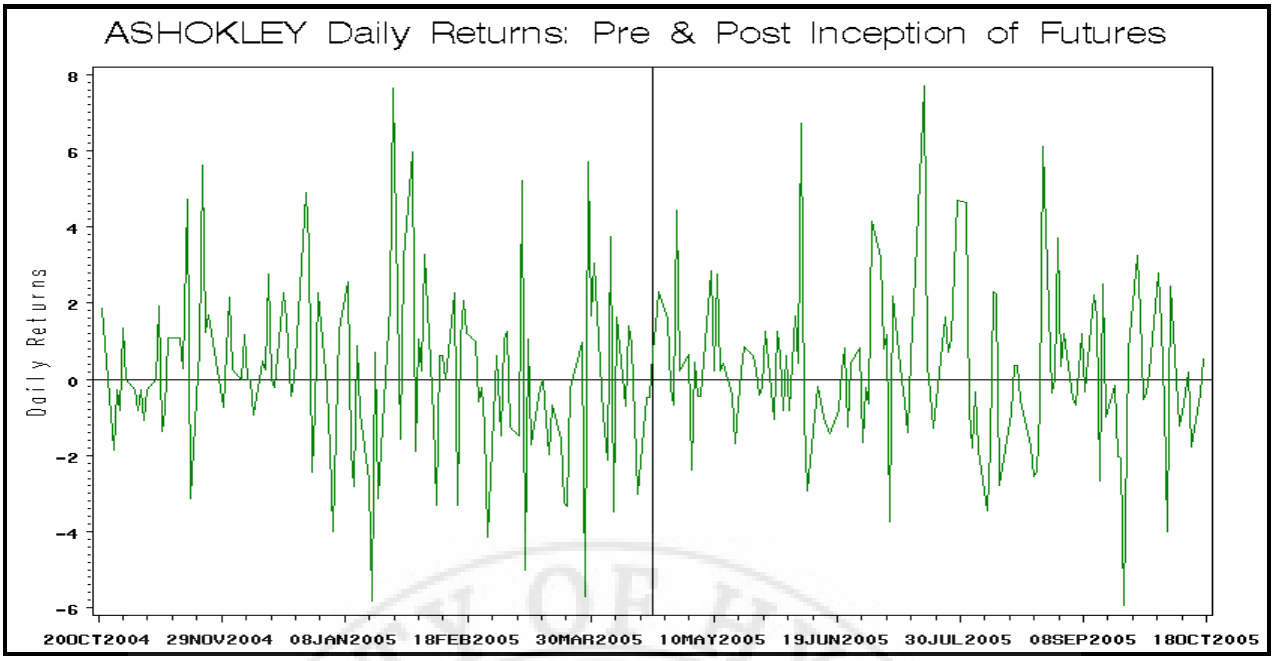
$$R_t = \phi_0 + \phi_1 R_{t-4} + \theta_1 Mkt_t + \gamma D_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0,1)$$

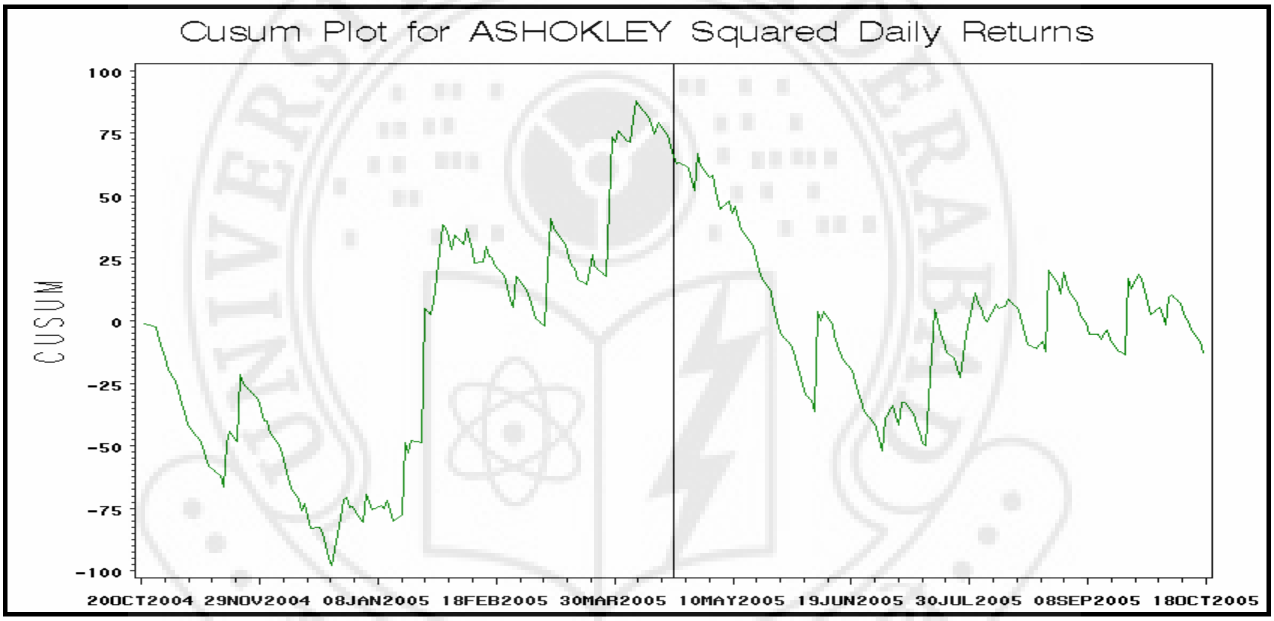
Parameter	Estimate
ϕ_0	0.041 (>0.10)
ϕ_1	-0.154 (<0.05)
θ_1	1.061 (<0.01)
γ	-0.053 (>0.10)
F-stat	27.97 (<0.01)
G (4) test-statistic	0.664 (>0.10)
Q (4) test-statistic	1.604 (>0.10)
LM (4) test-static	1.506 (>0.10)

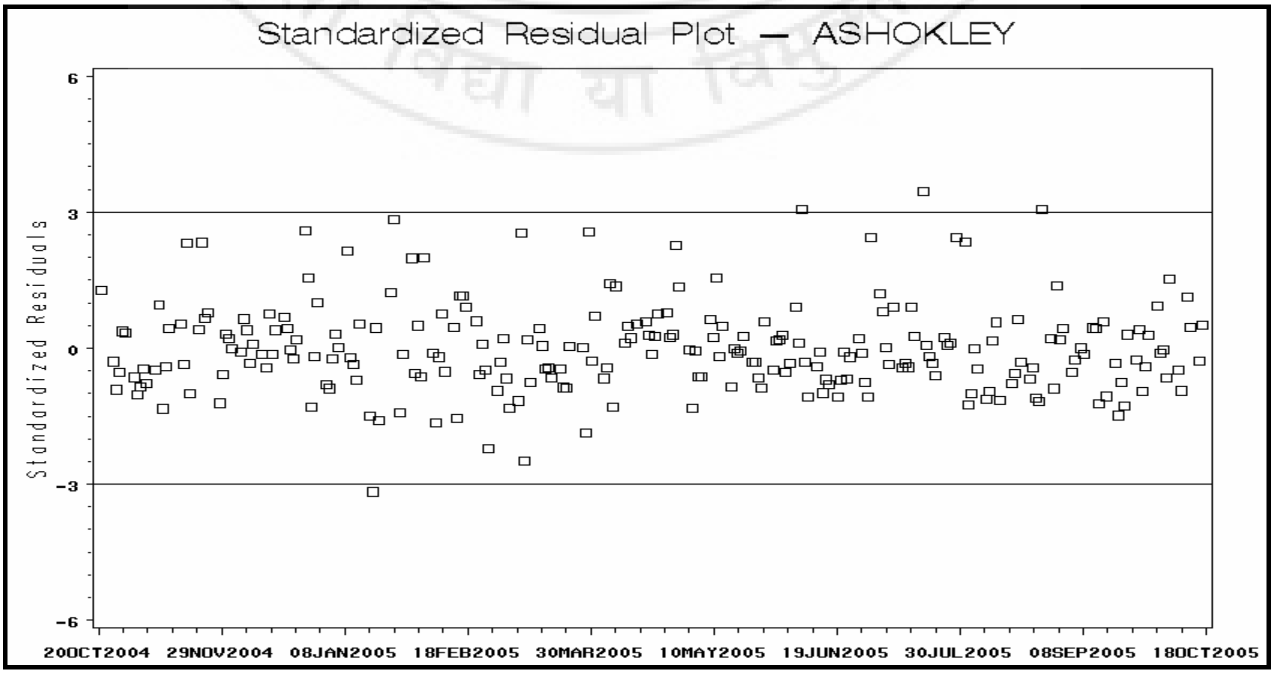
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


ASHOKLEY Daily Returns: Pre & Post Inception of Futures
Daily Returns
8
6
4
2
0
-2
-4
-6
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Cusum Plot for ASHOKLEY Squared Daily Returns
CUSUM
100
75
50
25
0
-25
-50
-75
-100
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Standardized Residual Plot — ASHOKLEY
Standardized Residuals
6
3
0
-3
-6
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005

Stock Symbol – BHARATFORG (Bharat Forge Ltd.)

Table No. 71:

Regression Results for BHARATFORG using robust standard errors, R_t takes stock symbol BHARATFORG, Mkt_t takes Nifty and D_t takes on value of zero before SSFs introduction and a value of one afterwards. SD_t is stock split dummy takes the value of one for date 20th July 2005 on which BHARATFORG has gone for stock split of 5 for 1 and dividend of 125%.

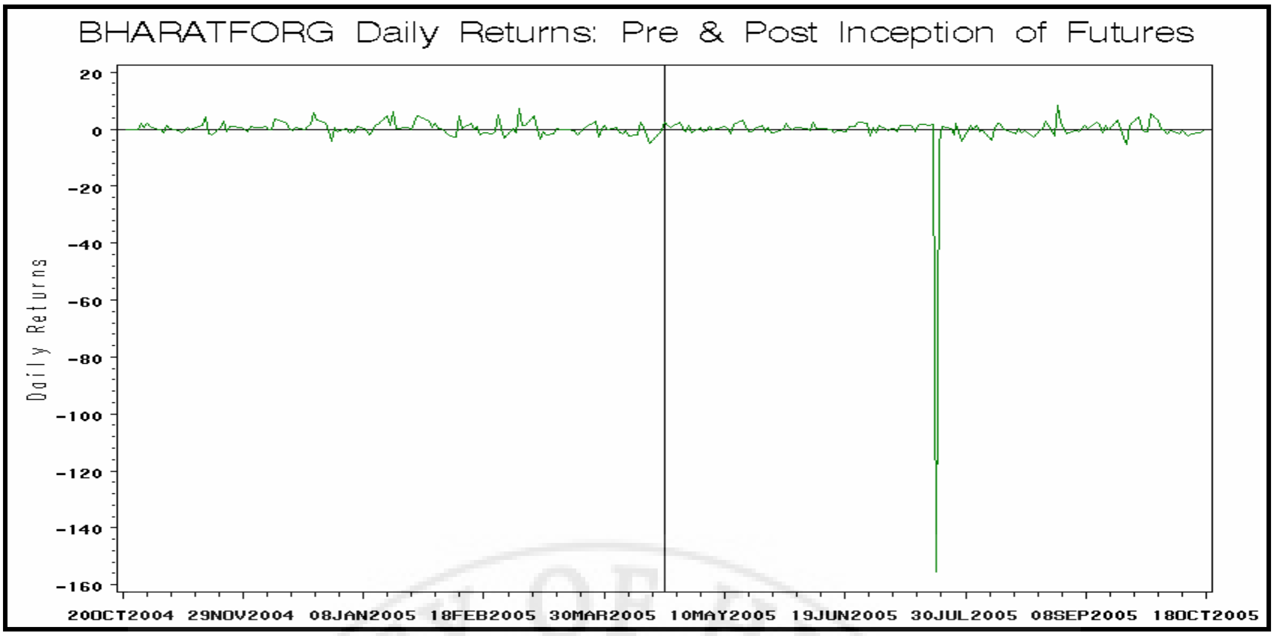
$$R_t = \phi_0 + \theta_1 Mkt_t + \gamma D_t + \eta SD_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0,1)$$

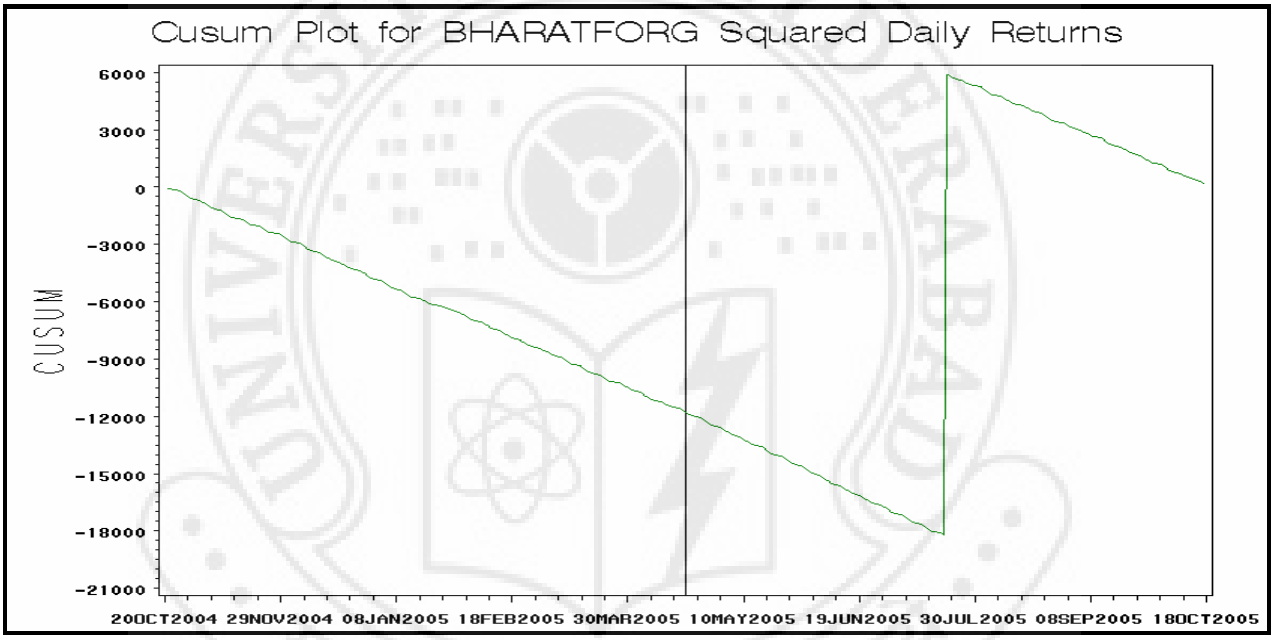
Parameter	Estimate
ϕ_0	0.277 (<0.10)
θ_1	0.825 (<0.01)
γ	-0.266 (>0.10)
η	-155.7 (<0.01)
F-stat	2582.1 (<0.01)
G (4) test-statistic	3.356 (>0.10)
Q (4) test-statistic	2.809 (>0.10)
LM (4) test-static	2.980 (>0.10)

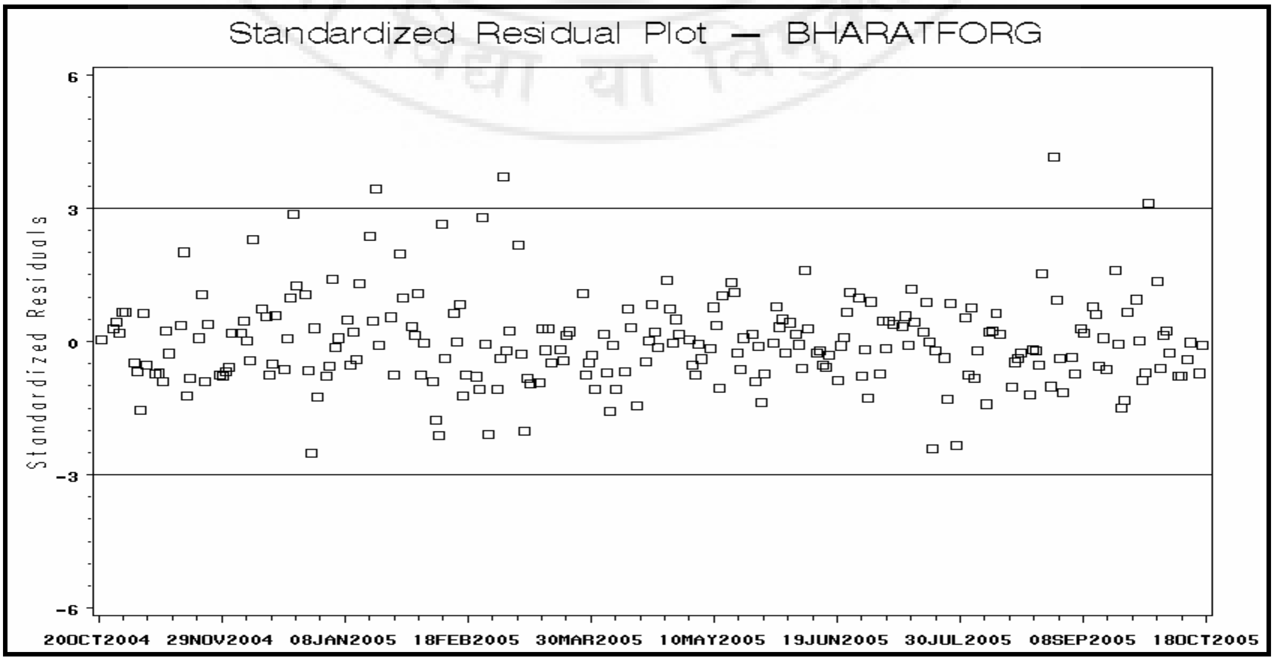
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


BHARATFORG Daily Returns: Pre & Post Inception of Futures
Daily Returns
20
0
-20
-40
-60
-80
-100
-120
-140
-160
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Cusum Plot for BHARATFORG Squared Daily Returns
CUSUM
6000
3000
0
-3000
-6000
-9000
-12000
-15000
-18000
-21000
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Standardized Residual Plot — BHARATFORG
Standardized Residuals
6
3
0
-3
-6
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005

Stock Symbol – BHARATI (Bharati Airtel Ltd.)

Table No. 72:

Regression Results for BHARTI using robust standard errors, R_t takes stock symbol BHARTI, Mkt_t takes Nifty and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

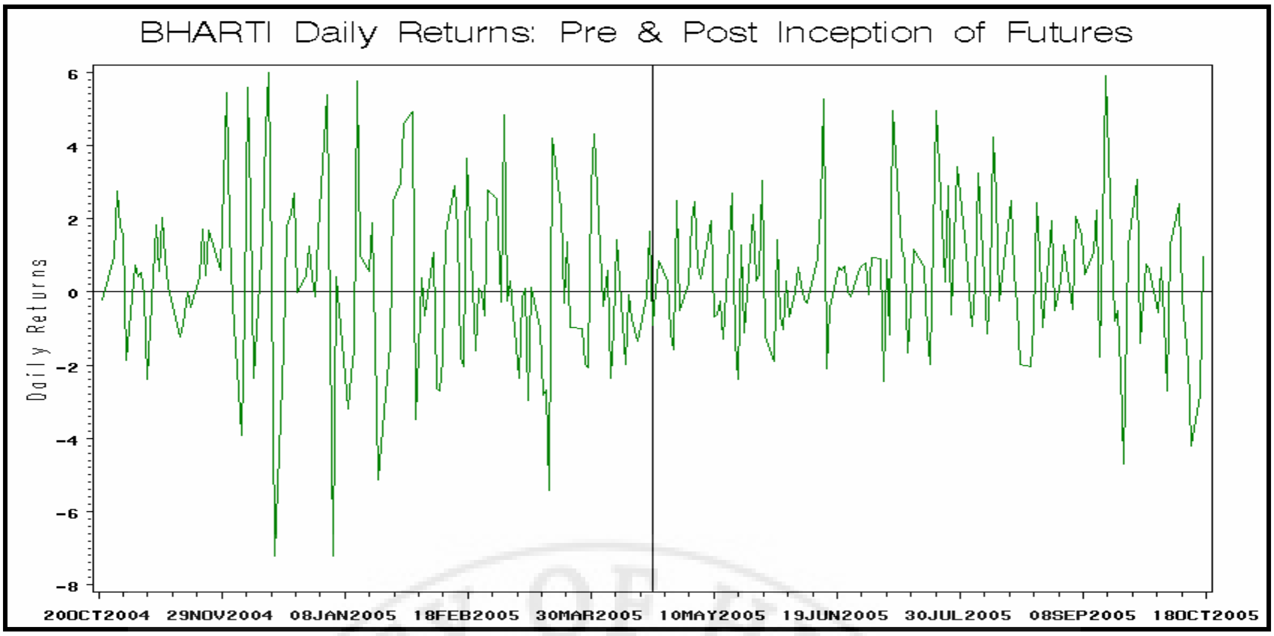
$$R_t = \phi_0 + \phi_1 R_{t-1} + \phi_2 R_{t-2} + \phi_3 R_{t-4} + \phi_4 R_{t-5} + \phi_5 R_{t-6}$$
$$+ \theta_1 Mkt_t + \gamma D_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	0.192 (<0.10)
ϕ_1	0.128 (<0.05)
ϕ_2	-0.237 (<0.01)
ϕ_3	-0.230 (<0.01)
ϕ_4	-0.176 (<0.01)
ϕ_5	-0.158 (<0.01)
θ_1	1.051 (<0.01)
γ	-0.040 (>0.10)
F-stat	20.42 (<0.01)
G (4) test-statistic	1.479 (>0.10)
Q (4) test-statistic	1.365 (>0.10)
LM (4) test-static	1.326 (>0.10)

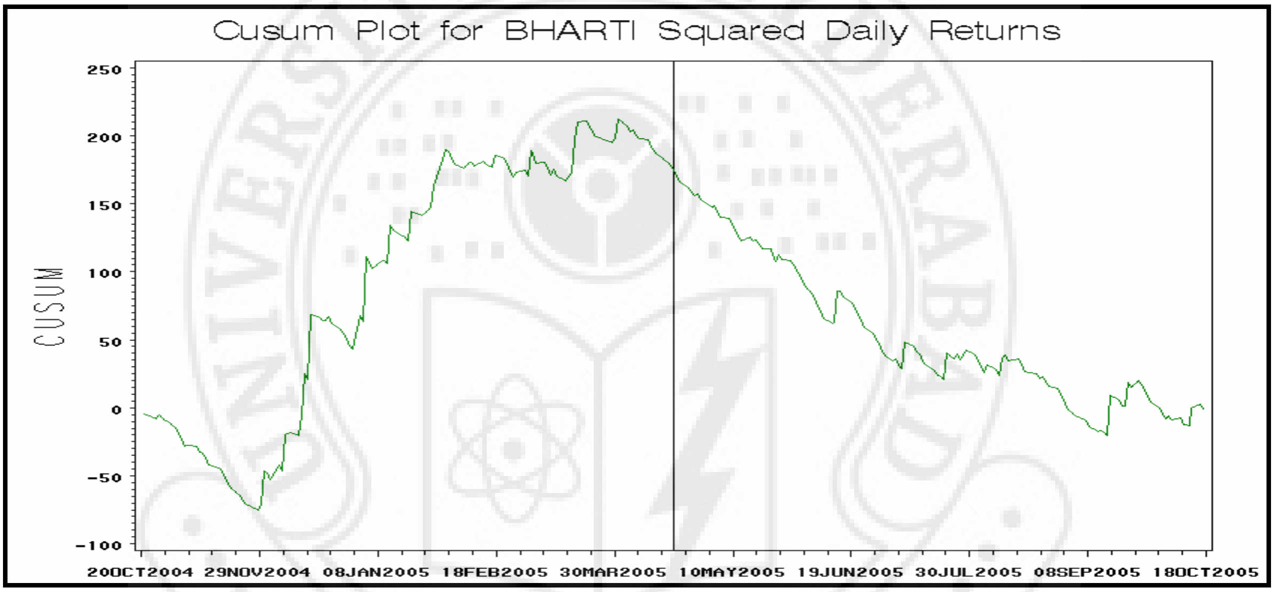
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

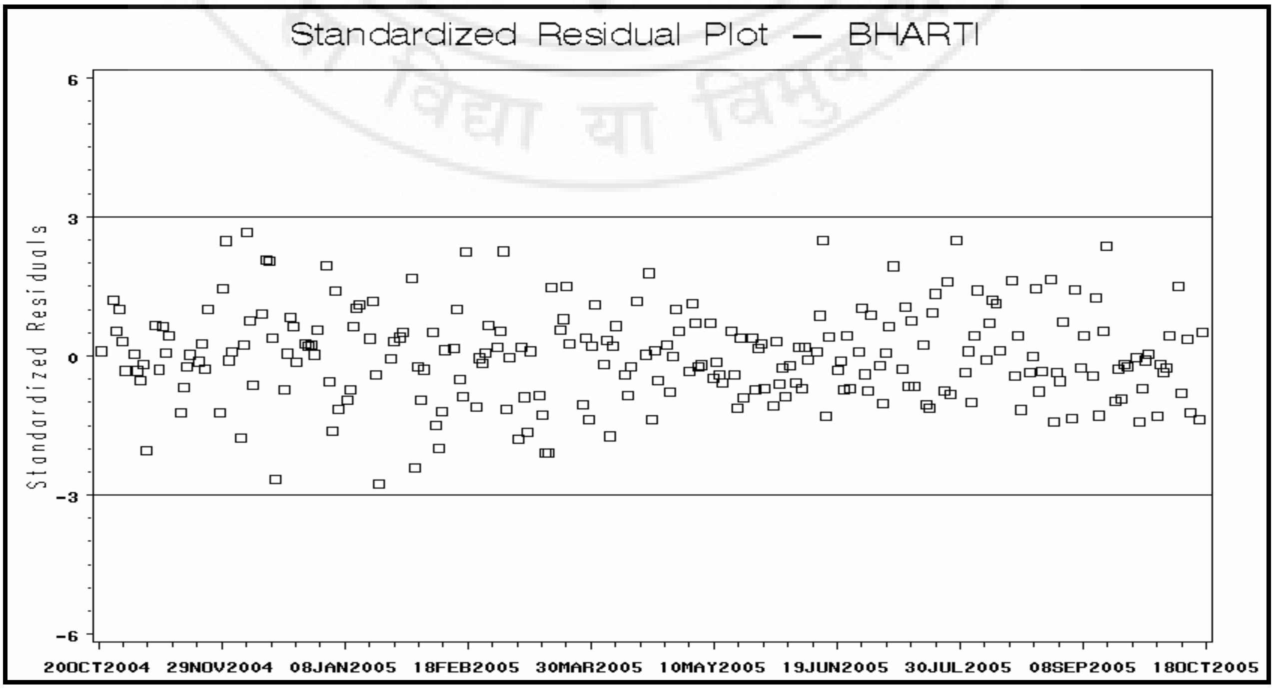
LM (k) is the statistic testing the presence of ARCH effects up to lag k.



BHARTI Daily Returns: Pre & Post Inception of Futures
Daily Returns
6
4
2
0
-2
-4
-6
-8
20OCT2004
29NOV2004
08JAN2005
18FEB2005
30MAR2005
10MAY2005
19JUN2005
30JUL2005
08SEP2005
18OCT2005



Cusum Plot for BHARTI Squared Daily Returns
CUSUM
250
200
150
100
50
0
-50
-100
20OCT2004
29NOV2004
08JAN2005
18FEB2005
30MAR2005
10MAY2005
19JUN2005
30JUL2005
08SEP2005
18OCT2005



Standardized Residual Plot — BHARTI
Standardized Residuals
6
3
0
-3
-6
20OCT2004
29NOV2004
08JAN2005
18FEB2005
30MAR2005
10MAY2005
19JUN2005
30JUL2005
08SEP2005
18OCT2005

Stock Symbol – CENTURYTEX (Century Textiles & Industries Ltd.)

Table No. 73:

Regression Results for CENTURYTEX using robust standard errors, R_t takes stock symbol CENTURYTEX, Mkt_t takes Nifty and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

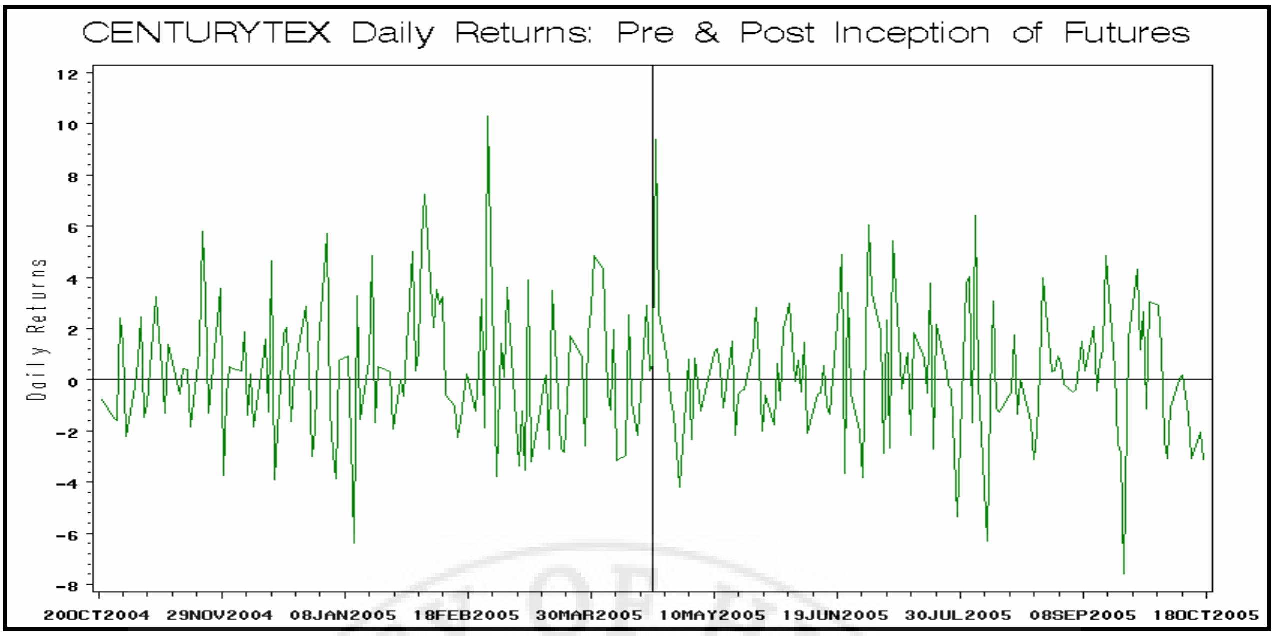
$$R_t = \phi_0 + \theta_1 Mkt_t + \gamma D_t + \varepsilon_t$$
$$\varepsilon_t / \varepsilon_{t-2} \sim N(0,1)$$

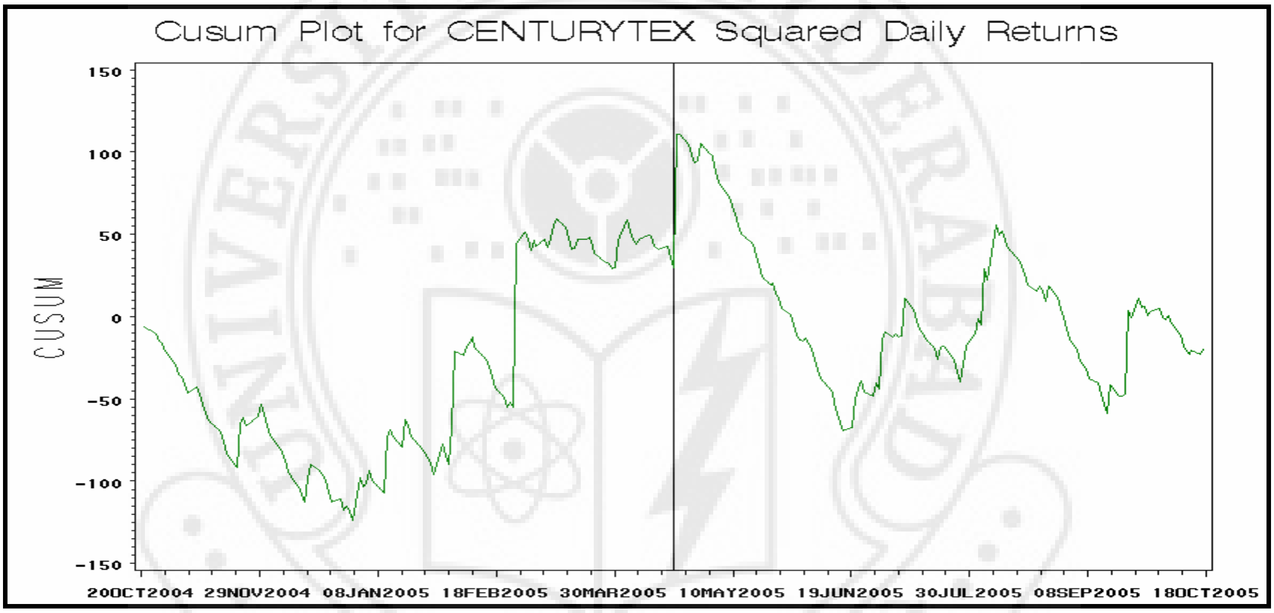
Parameter	Estimate
ϕ_0	0.293 (>0.10)
θ_1	1.320 (<0.01)
γ	-0.401 (>0.10)
ε_{t-2}	-0.106 (<0.10)
F-stat	32.22 (<0.01)
G (4) test-statistic	1.358 (>0.10)
Q (4) test-statistic	6.485 (<0.10)
LM (4) test-static	6.519 (>0.10)

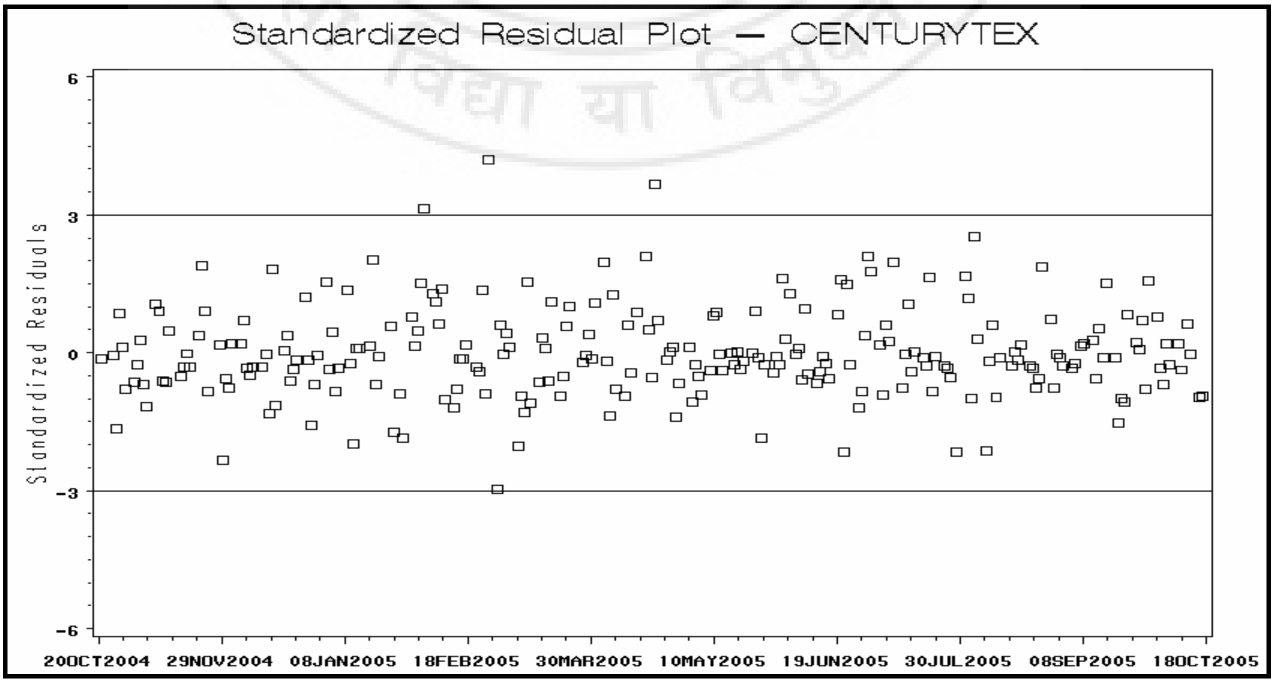
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


CENTURYTEX Daily Returns: Pre & Post Inception of Futures
Daily Returns
12
10
8
6
4
2
0
-2
-4
-6
-8
20OCT2004
29NOV2004
08JAN2005
18FEB2005
30MAR2005
10MAY2005
19JUN2005
30JUL2005
08SEP2005
18OCT2005


Cusum Plot for CENTURYTEX Squared Daily Returns
CUSUM
150
100
50
0
-50
-100
-150
20OCT2004
29NOV2004
08JAN2005
18FEB2005
30MAR2005
10MAY2005
19JUN2005
30JUL2005
08SEP2005
18OCT2005


Standardized Residual Plot — CENTURYTEX
Standardized Residuals
6
3
0
-3
-6
20OCT2004
29NOV2004
08JAN2005
18FEB2005
30MAR2005
10MAY2005
19JUN2005
30JUL2005
08SEP2005
18OCT2005

Stock Symbol – CHENNPETRO (Chennai Petroleum Corporation Ltd.)

Table No. 74a: Regression Results-Evidence of ARCH Effects. R_t takes stock symbol CHENNPETRO, Mkt_t takes Nifty.

$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	-0.044 (<0.10)
θ_1	0.817 (<0.01)
F-stat	33.53 (<0.01)
G (4) test-statistic	1.642 (>0.10)
Q (4) test-statistic	10.91 (<0.01)
LM (4) test-static	11.26 (<0.01)

Table No. 74b:
Results of GARCH (1, 1) model for CHENNPETRO using robust standard errors, R_t, Mkt_t are same as defined above and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

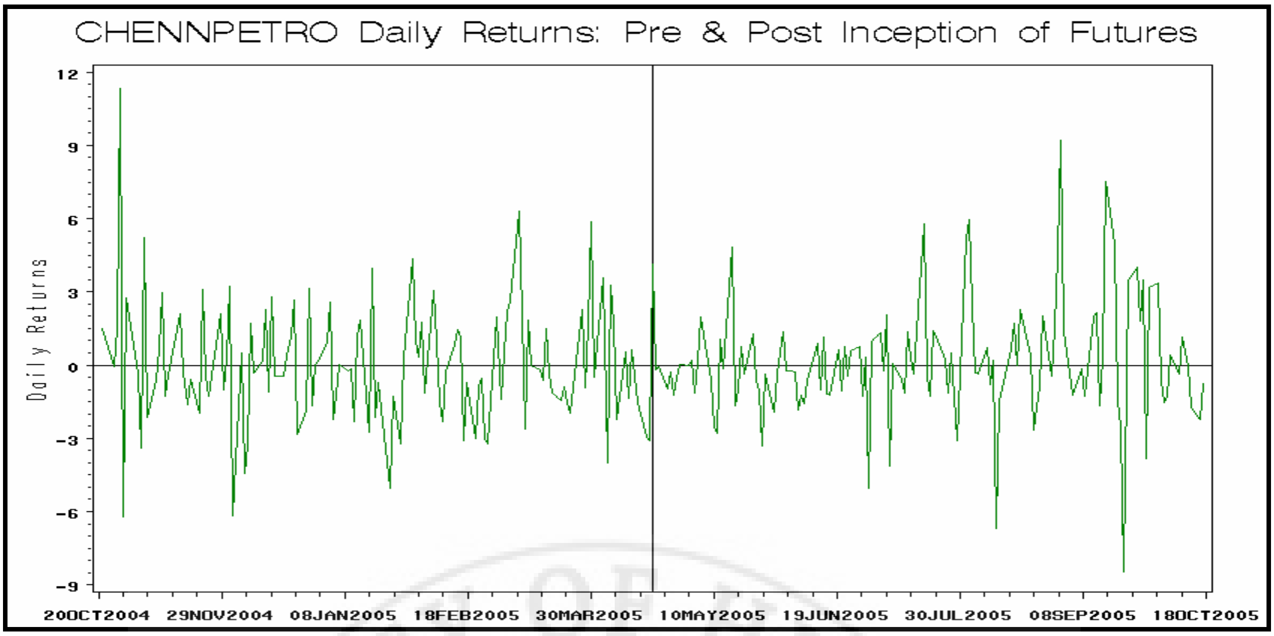
$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

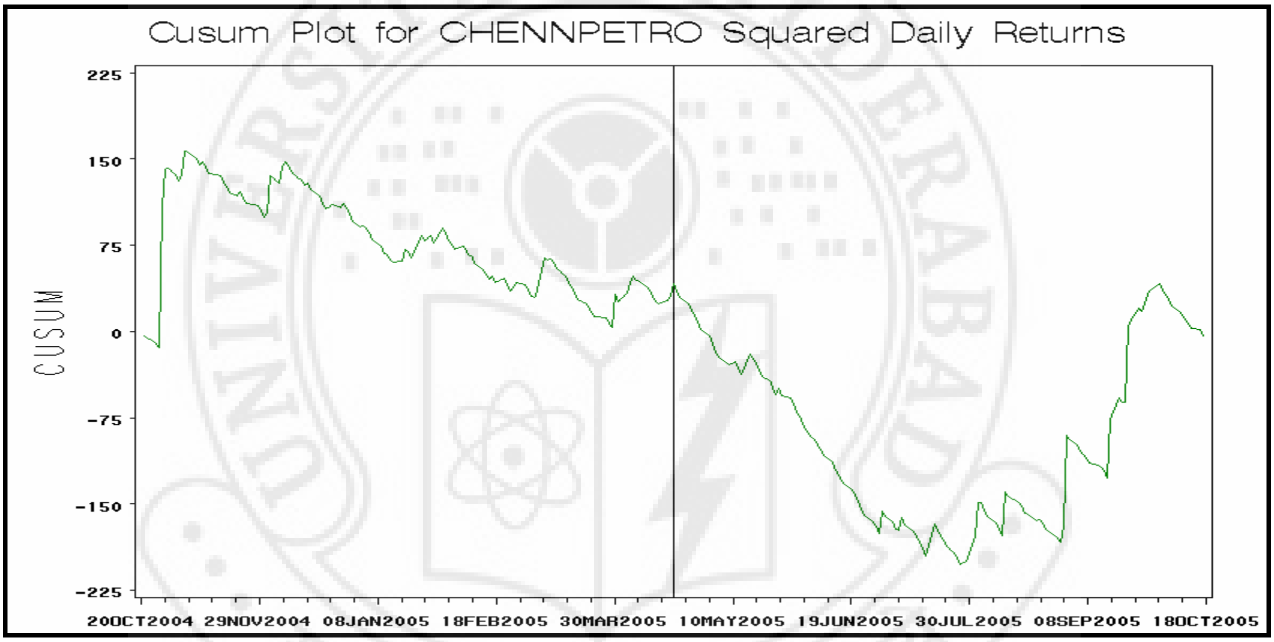
$$\varepsilon_t \sim N(0, h_t)$$

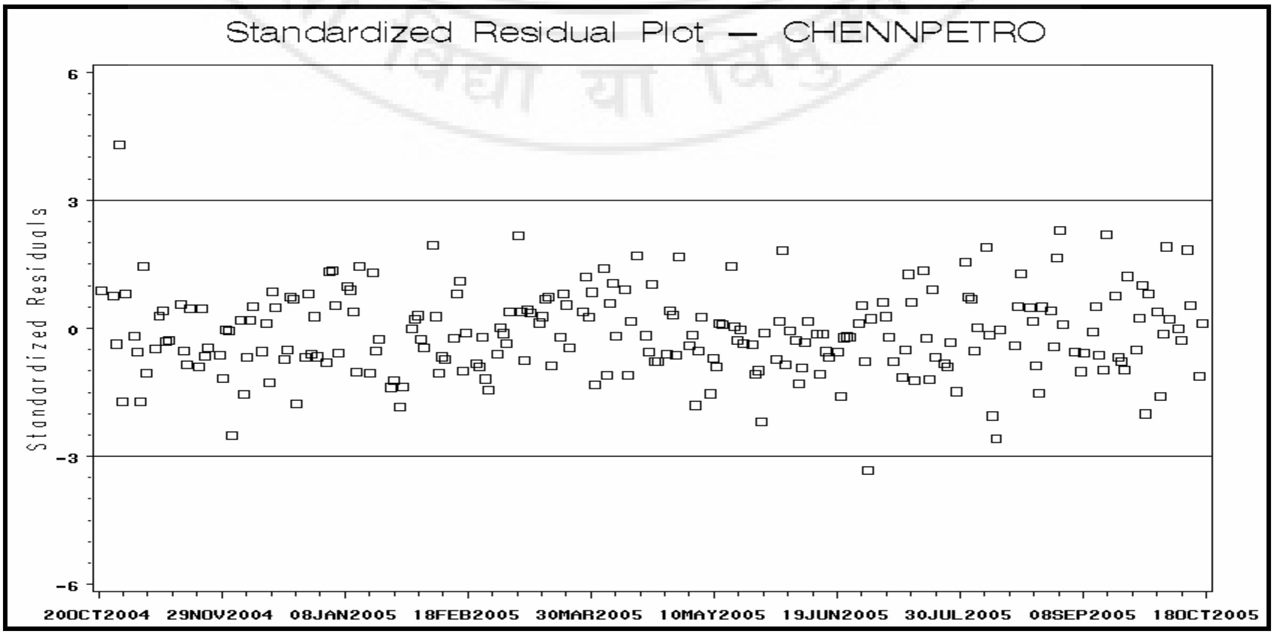
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \alpha_{0,d} D_t + \alpha_{1,d} D_t * \varepsilon_{t-1}^2 + \beta_{1,d} D_t * h_{t-1}$$

Parameter	Estimate	p-value
ϕ_0	0.117	>0.10
θ_1	1.747	<0.01
α_0	1.398	<0.10
α_1	0.095	<0.10
β_1	0.641	<0.05
$\alpha_{0,d}$	1.345	>0.10
$\alpha_{1,d}$	0.488	<0.10
$\beta_{1,d}$	-0.783	<0.01
Diagnostics		
G (4) test-statistic	1.068	>0.10
Q (4) test-statistic	2.558	>0.10
LM (4) test-static	3.727	>0.10
Sign Bias	0.383	>0.10
Negative Size Bias	-0.086	>0.10
Positive Size Bias	-0.196	>0.10
Joint Bias	2.468	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 + \beta_1 = 1$	5.690	<0.05

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


CHENNPETRO Daily Returns: Pre & Post Inception of Futures
Daily Returns
12
9
6
3
0
-3
-6
-9
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Cusum Plot for CHENNPETRO Squared Daily Returns
CUSUM
225
150
75
0
-75
-150
-225
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Standardized Residual Plot — CHENNPETRO
Standardized Residuals
6
3
0
-3
-6
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005

Stock Symbol – COCHINREFN (Kochi Refineries Ltd.)

Table No. 75:

Regression Results for COCHINREFN using robust standard errors, R_t takes stock symbol COCHINREFN, Mkt_t takes Nifty, D_t takes on value of zero before SSFs introduction and a value of one afterwards and ED_t is dummy which takes the value of one for date's 18th Jan 2005 for unforeseen fall in price.

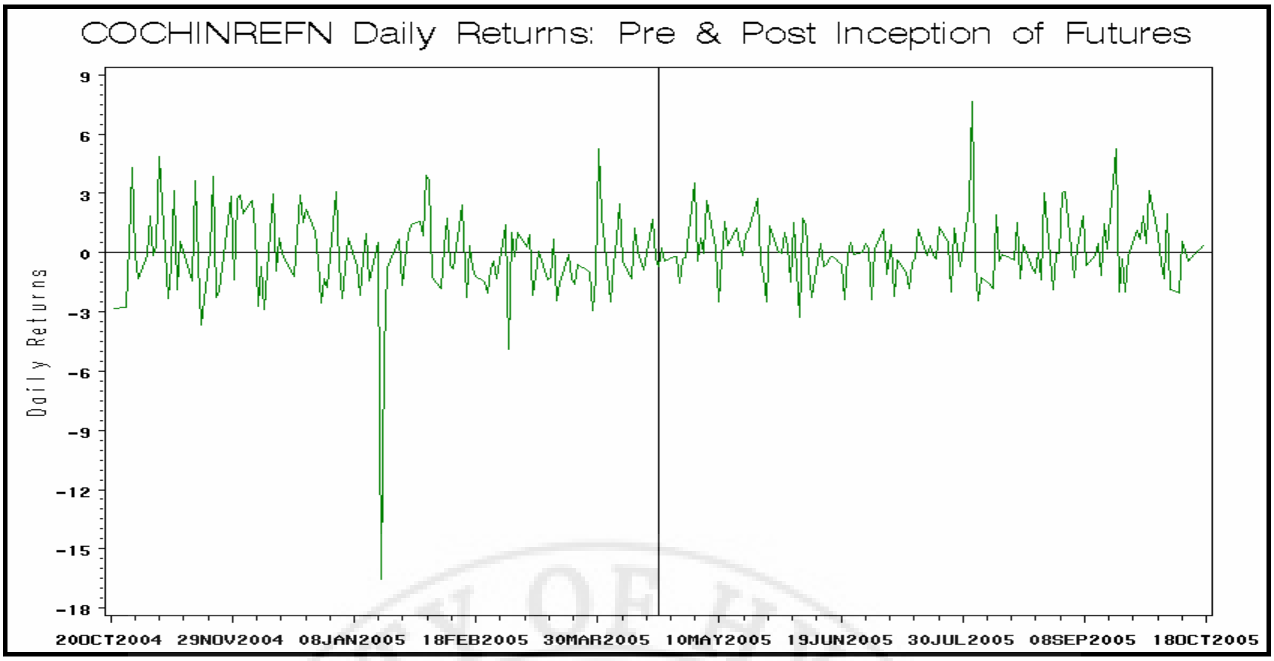
$$R_t = \phi_0 + \phi_1 R_{t-2} + \theta_1 Mkt_t + \gamma D_t + \kappa ED_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0,1)$$

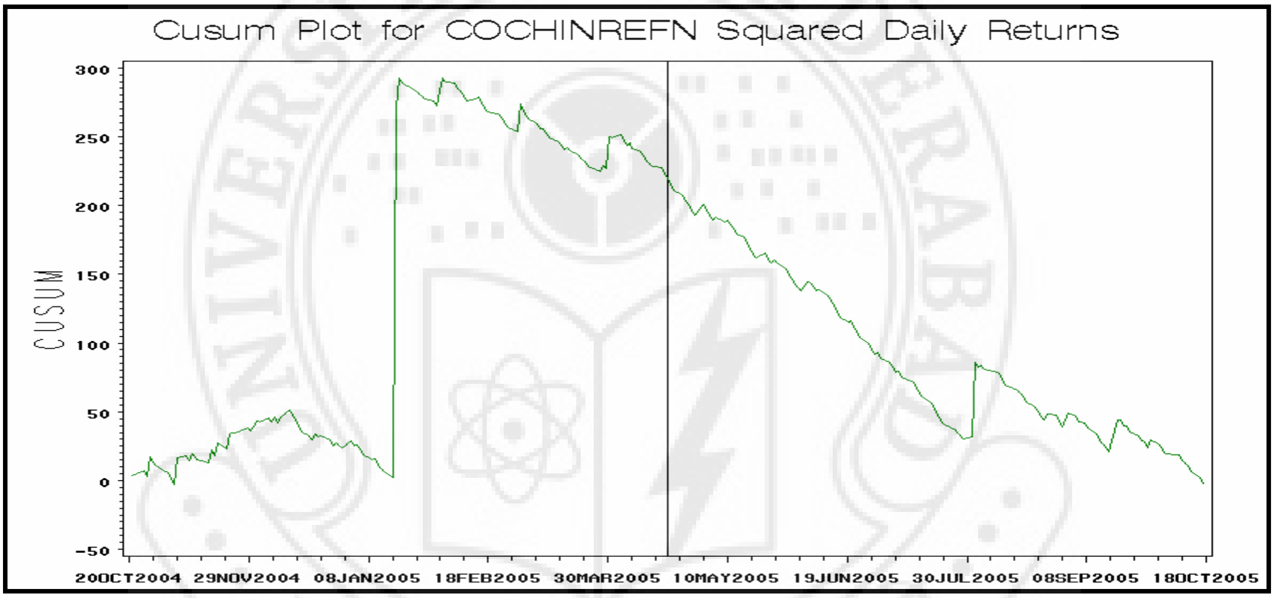
Parameter	Estimate
ϕ_0	-0.099 (>0.10)
ϕ_1	-0.125 (<0.05)
θ_1	0.687 (<0.01)
γ	0.014 (>0.10)
κ	-16.598 (<0.01)
F-stat	51.76 (<0.01)
G (4) test-statistic	0.692 (>0.10)
Q (4) test-statistic	2.131 (>0.10)
LM (4) test-static	2.281 (>0.10)

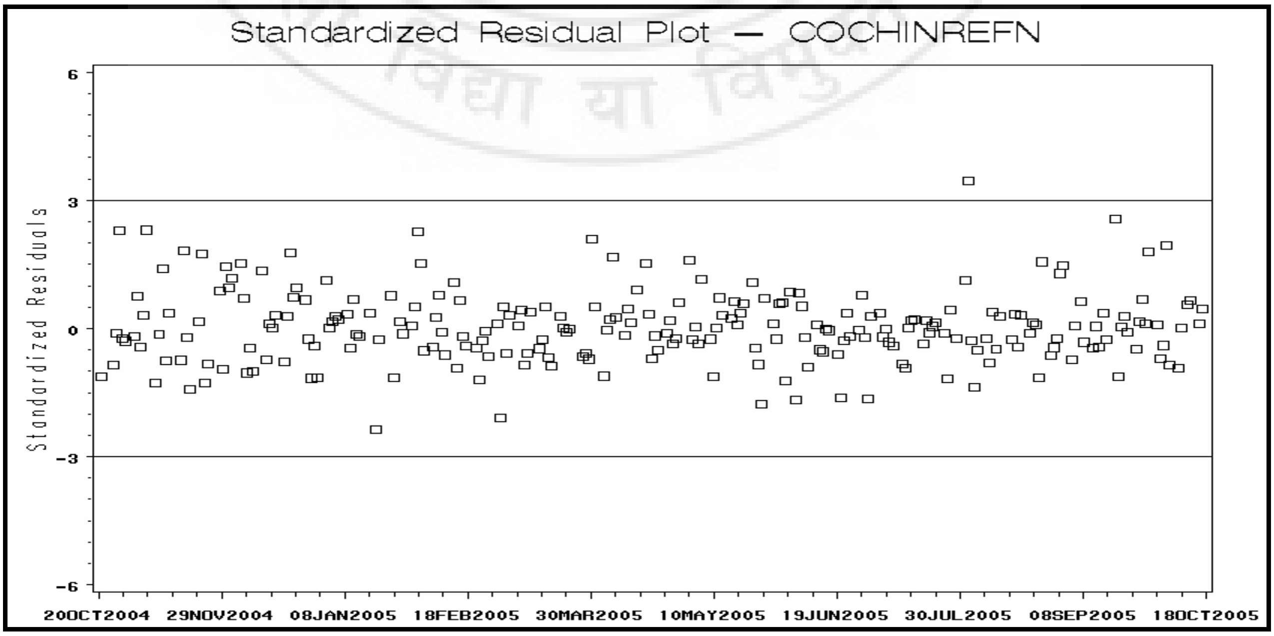
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


COCHINREFN Daily Returns: Pre & Post Inception of Futures
Daily Returns
9
6
3
0
-3
-6
-9
-12
-15
-18
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Cusum Plot for COCHINREFN Squared Daily Returns
CUSUM
300
250
200
150
100
50
0
-50
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Standardized Residual Plot — COCHINREFN
Standardized Residuals
6
3
0
-3
-6
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005

Stock Symbol – COLGATE (Colgate Palmolive (India) Ltd.)

Table No. 76a: Regression Results-Evidence of ARCH Effects. R_t takes stock symbol COLGATE, Mkt_t takes Nifty.

$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \mid \varepsilon_{t-5} \sim N(0,1)$$

Parameter	Estimate
ϕ_0	0.134 (<0.10)
θ_1	0.575 (<0.01)
ε_{t-5}	0.163 (<0.01)
F-stat	20.81 (<0.01)
G (4) test-statistic	3.144 (>0.10)
Q (4) test-statistic	9.279 (<0.05)
LM (4) test-static	8.499 (<0.10)

Table No. 76b:
Results of MA(5)-ARCH (1) model for COLGATE using robust standard errors, R_t, Mkt_t are same as defined above and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

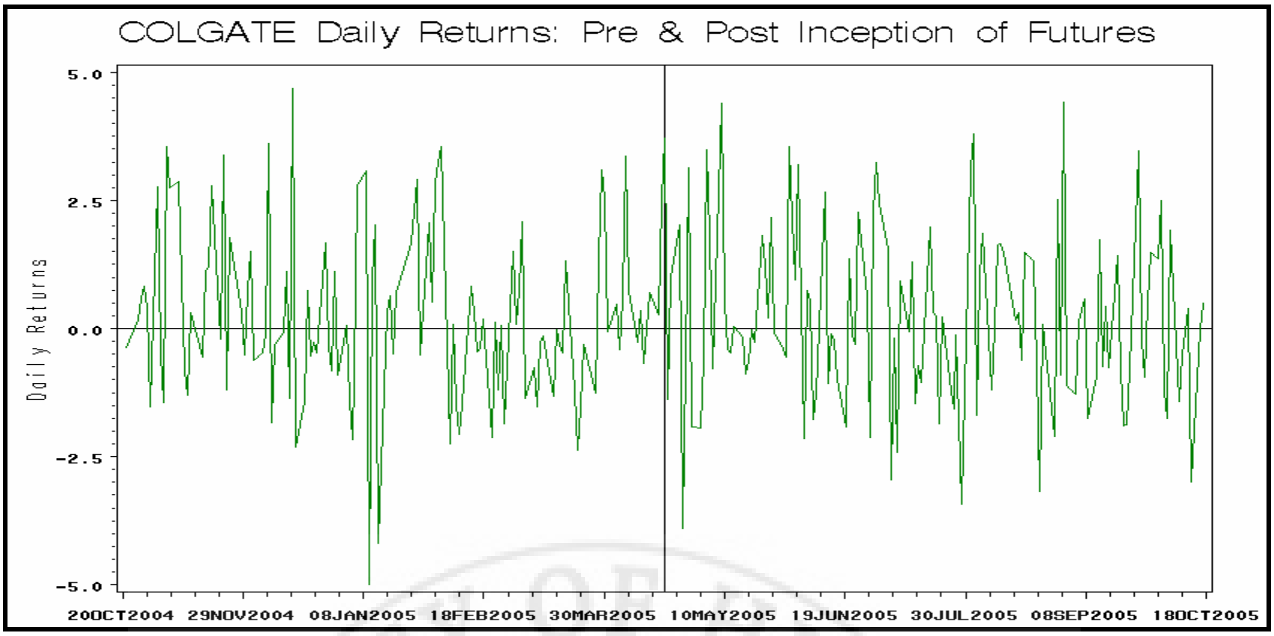
$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \mid \varepsilon_{t-5} \sim N(0,h_t)$$

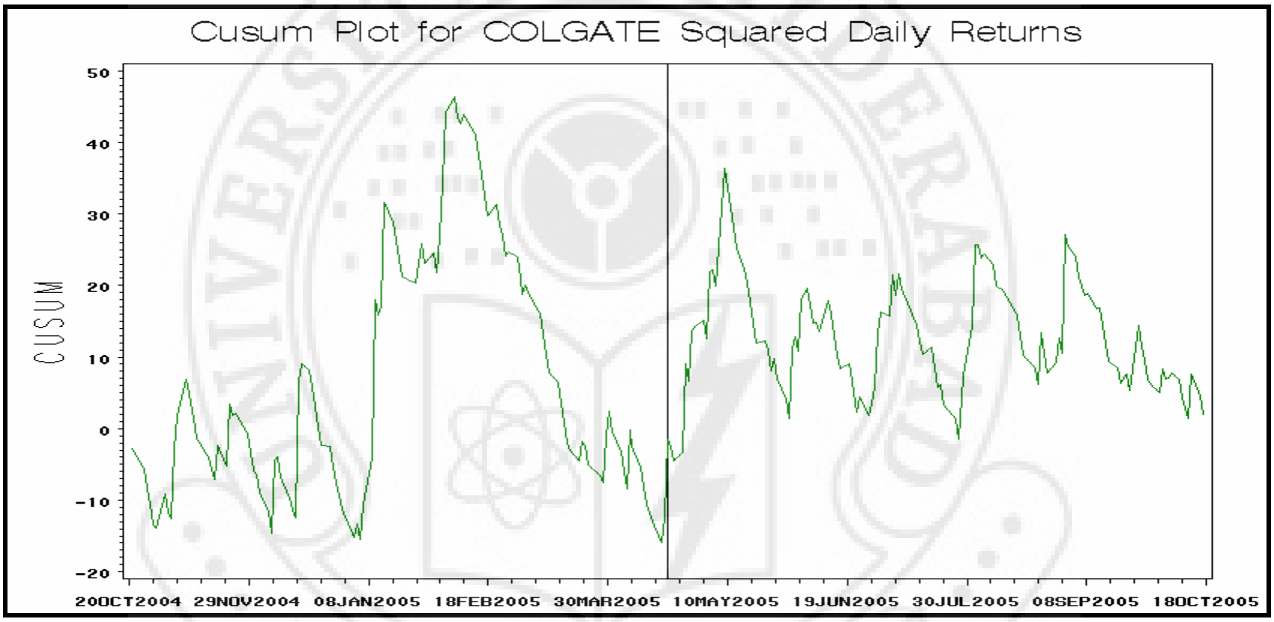
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_{0,d} D_t + \alpha_{1,d} D_t * \varepsilon_{t-1}^2$$

Parameter	Estimate	p-value
ϕ_0	0.096	>0.10
θ_1	0.580	<0.01
ε_{t-5}	0.163	<0.01
α_0	2.148	<0.01
α_1	0.173	<0.10
$\alpha_{0,d}$	-0.197	>0.10
$\alpha_{1,d}$	-0.005	>0.10
Diagnostics		
G (4) test-statistic	2.906	>0.10
Q (4) test-statistic	1.124	>0.10
LM (4) test-static	1.115	>0.10
Sign Bias	0.113	>0.10
Negative Size Bias	0.163	>0.10
Positive Size Bias	0.120	>0.10
Joint Bias	1.285	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 = 0$	20.080	<0.01

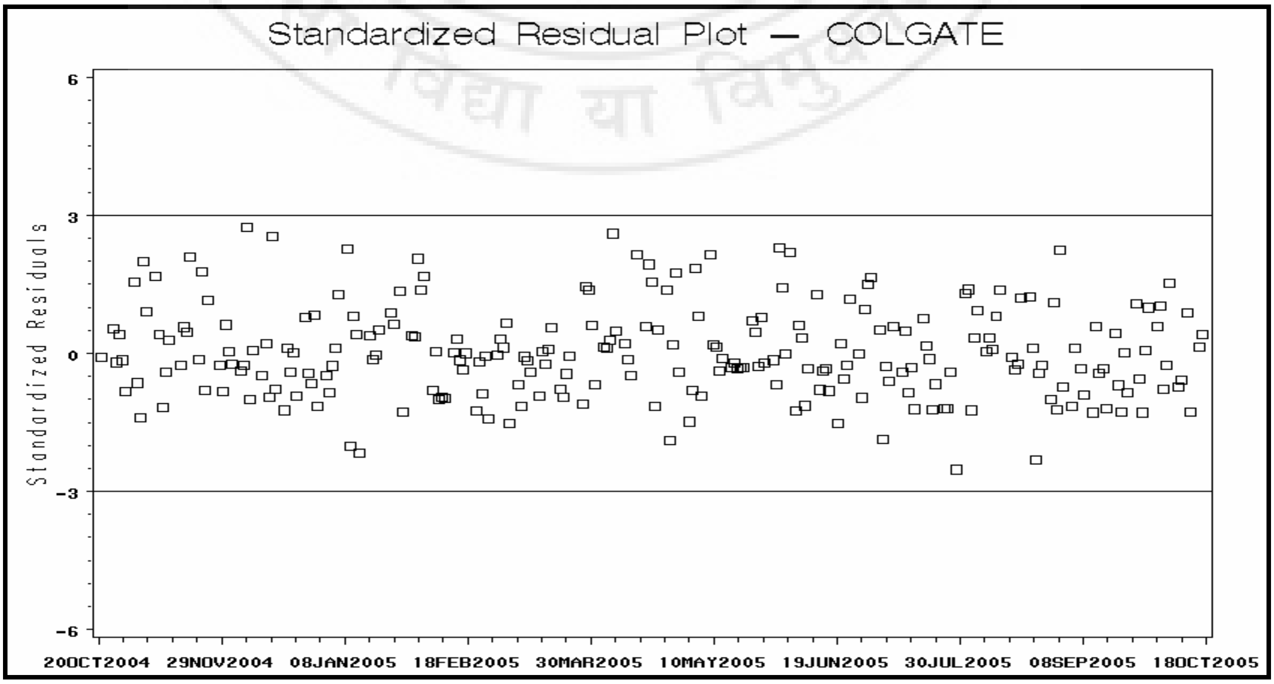
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).



COLGATE Daily Returns: Pre & Post Inception of Futures
Daily Returns
5.0
2.5
0.0
-2.5
-5.0
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005



Cusum Plot for COLGATE Squared Daily Returns
CUSUM
50
40
30
20
10
0
-10
-20
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005



Standardized Residual Plot — COLGATE
Standardized Residuals
6
3
0
-3
-6
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005

Stock Symbol – DABUR (Dabur India Ltd.)

Table No. 77:

Regression Results for DABUR using robust standard errors, R_t takes stock symbol DABUR, Mkt_t takes Nifty and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

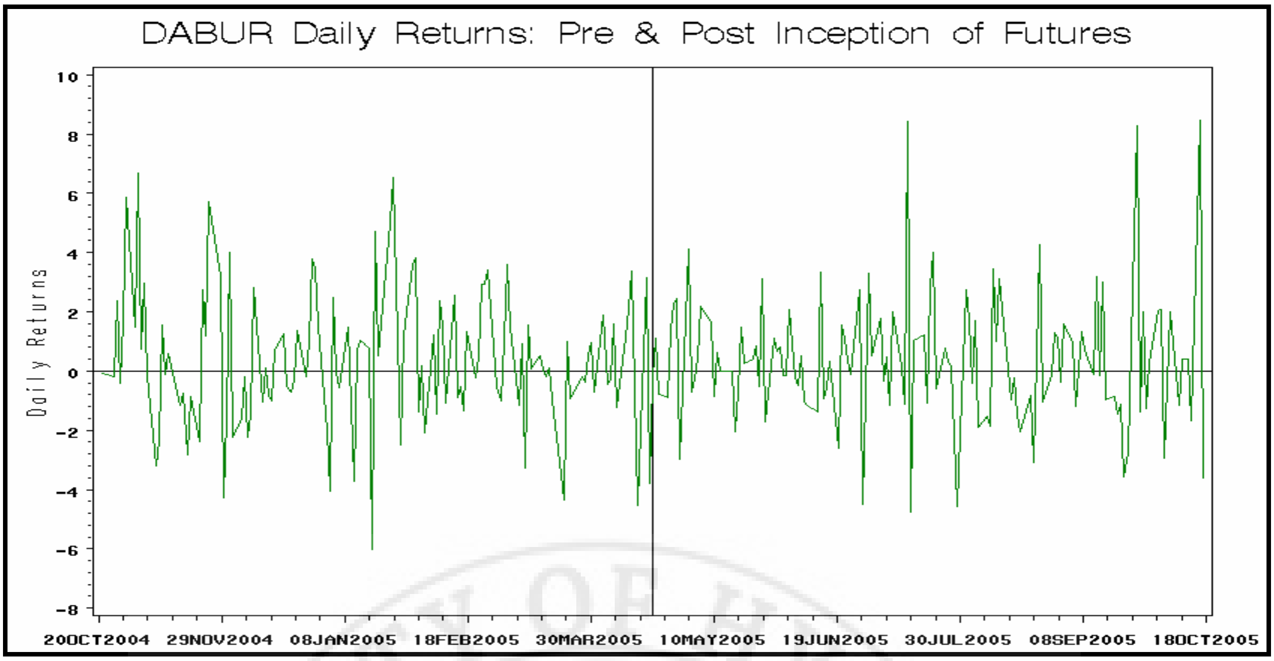
$$R_t = \phi_0 + \phi_1 R_{t-1} + \theta_1 Mkt_t + \gamma D_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0,1)$$

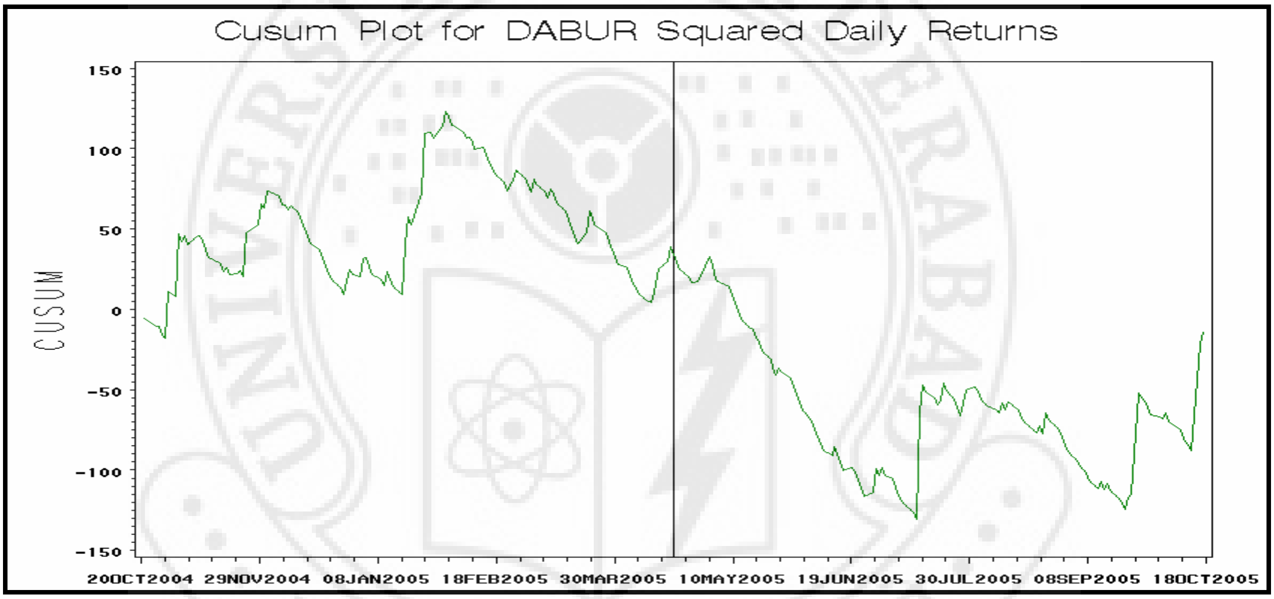
Parameter	Estimate
ϕ_0	0.323 (<0.10)
ϕ_1	-0.157 (<0.01)
θ_1	0.649 (<0.01)
γ	-0.140 (>0.10)
F-stat	10.15 (<0.01)
G (4) test-statistic	2.048 (>0.10)
Q (4) test-statistic	3.696 (>0.10)
LM (4) test-static	3.657 (>0.10)

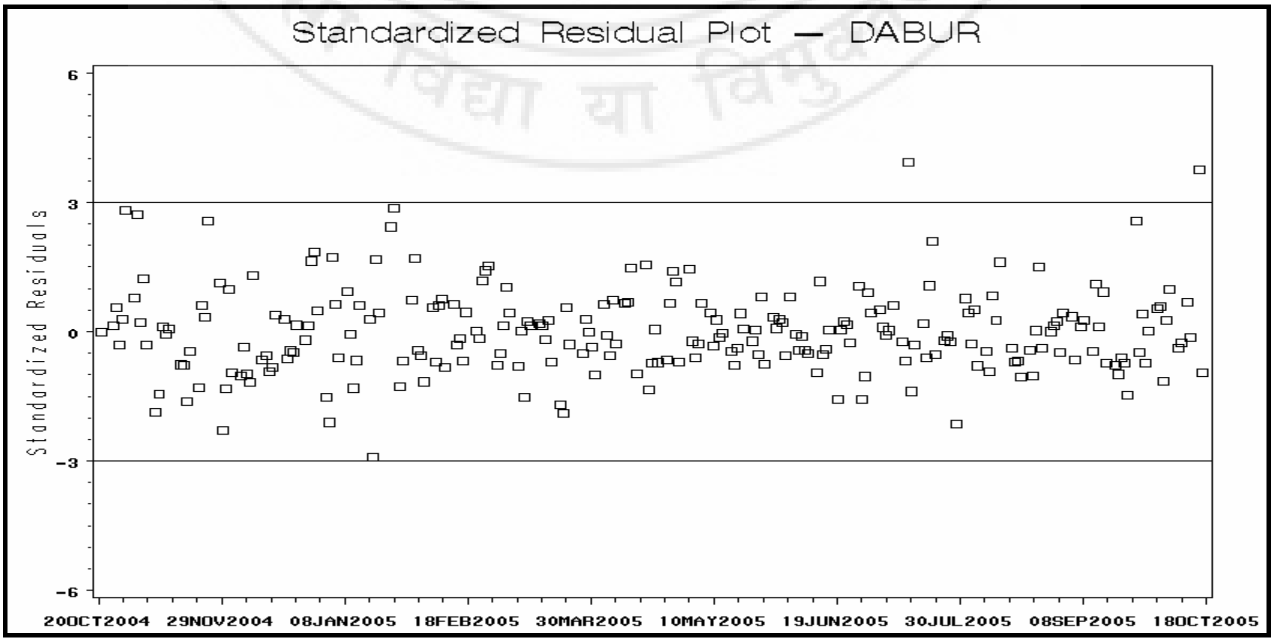
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


DABUR Daily Returns: Pre & Post Inception of Futures
Daily Returns
10
8
6
4
2
0
-2
-4
-6
-8
20OCT2004
29NOV2004
08JAN2005
18FEB2005
30MAR2005
10MAY2005
19JUN2005
30JUL2005
08SEP2005
18OCT2005


Cusum Plot for DABUR Squared Daily Returns
CUSUM
150
100
50
0
-50
-100
-150
20OCT2004
29NOV2004
08JAN2005
18FEB2005
30MAR2005
10MAY2005
19JUN2005
30JUL2005
08SEP2005
18OCT2005


Standardized Residual Plot — DABUR
Standardized Residuals
6
3
0
-3
-6
20OCT2004
29NOV2004
08JAN2005
18FEB2005
30MAR2005
10MAY2005
19JUN2005
30JUL2005
08SEP2005
18OCT2005

Stock Symbol – GESHIPPING (The Great Eastern Shipping Company Ltd.)

Table No.78:

Regression Results for GESHIPPING using robust standard errors, R_t takes stock symbol GESHIPPING, Mkt_t takes Nifty and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

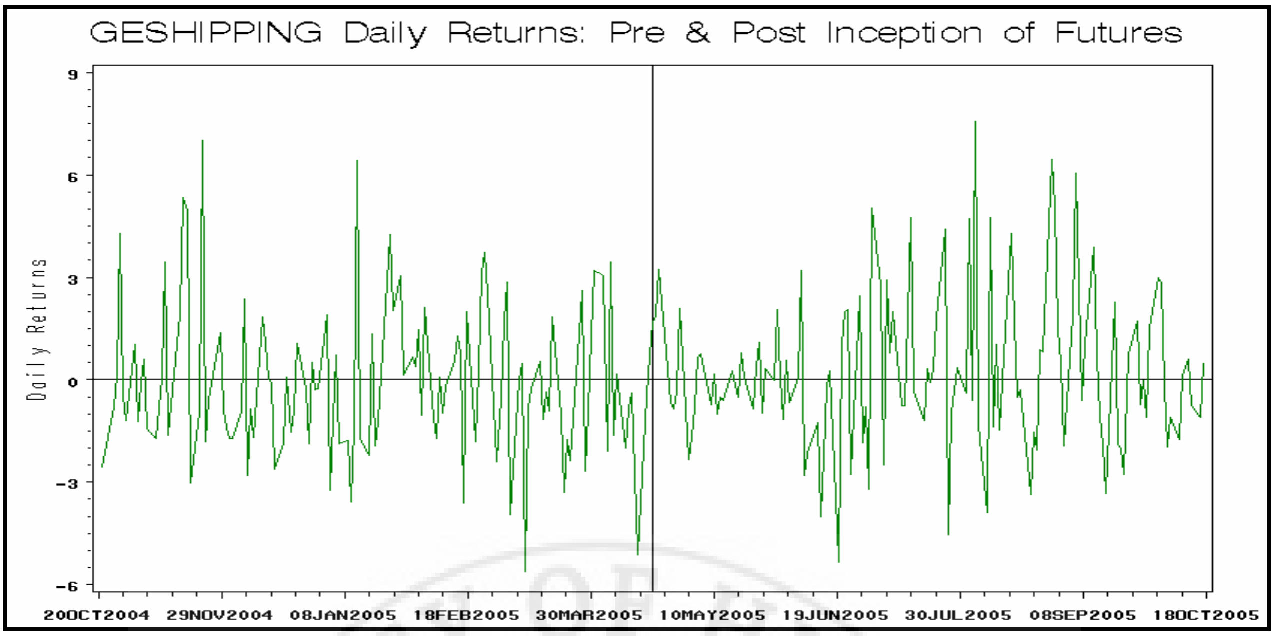
$$R_t = \phi_0 + \theta_1 Mkt_t + \gamma D_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0,1)$$

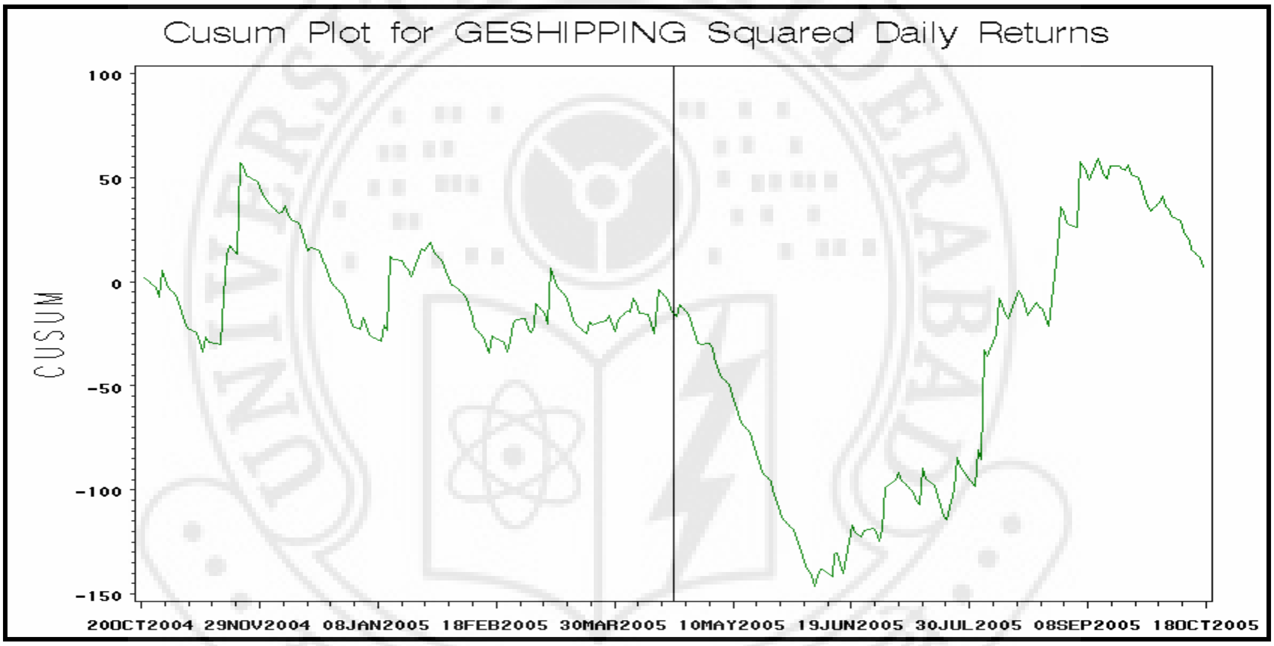
Parameter	Estimate
ϕ_0	-0.142 (>0.10)
θ_1	0.604 (<0.01)
γ	0.266 (>0.10)
F-stat	11.45 (<0.01)
G (4) test-statistic	2.576 (>0.10)
Q (4) test-statistic	7.237 (>0.10)
LM (4) test-static	6.653 (>0.10)

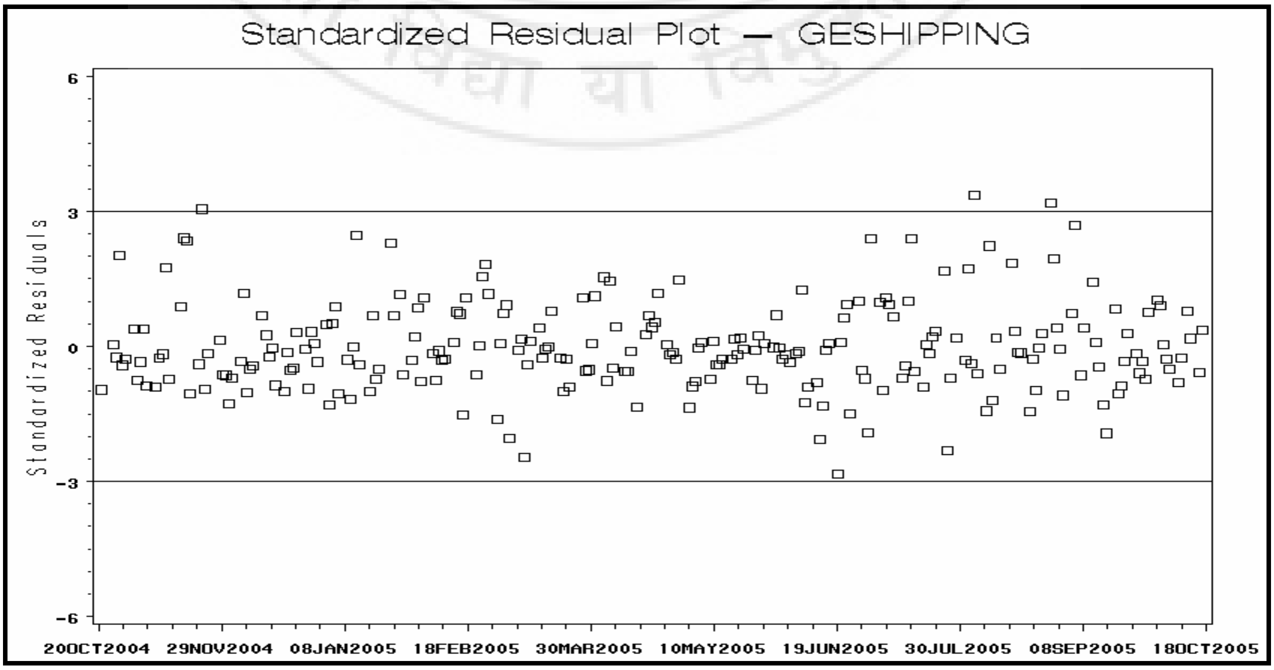
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


GESHIPPING Daily Returns: Pre & Post Inception of Futures
Daily Returns
9
6
3
0
-3
-6
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Cusum Plot for GESHIPPING Squared Daily Returns
CUSUM
100
50
0
-50
-100
-150
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Standardized Residual Plot — GESHIPPING
Standardized Residuals
6
3
0
-3
-6
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005

Stock Symbol – GLAXO (Glaxo-Smith-Kline Pharmaceuticals Ltd.)

Table No. 79:

Regression Results for GLAXO using robust standard errors, R_t takes stock symbol GLAXO, Mkt_t takes Nifty and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

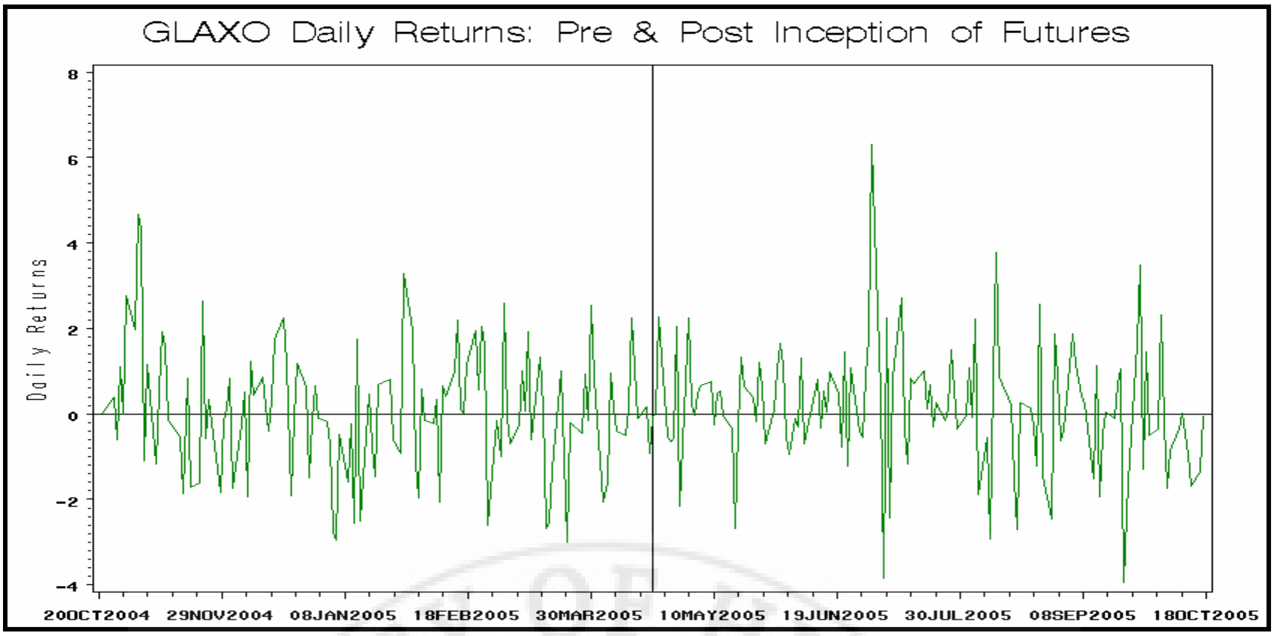
$$R_t = \phi_0 + \theta_1 Mkt_t + \gamma D_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0,1)$$

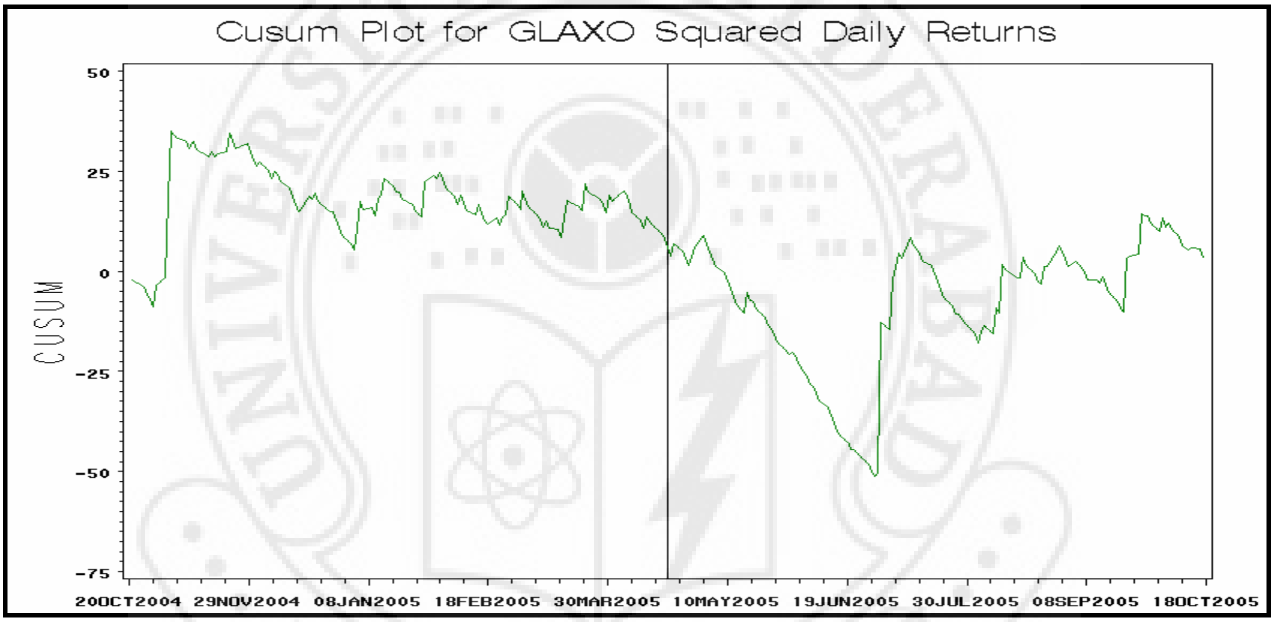
Parameter	Estimate
ϕ_0	0.043 (>0.10)
θ_1	0.583 (<0.01)
γ	-0.006 (>0.10)
F-stat	25.722 (<0.01)
G (4) test-statistic	4.206 (>0.10)
Q (4) test-statistic	7.315 (>0.10)
LM (4) test-static	7.201 (>0.10)

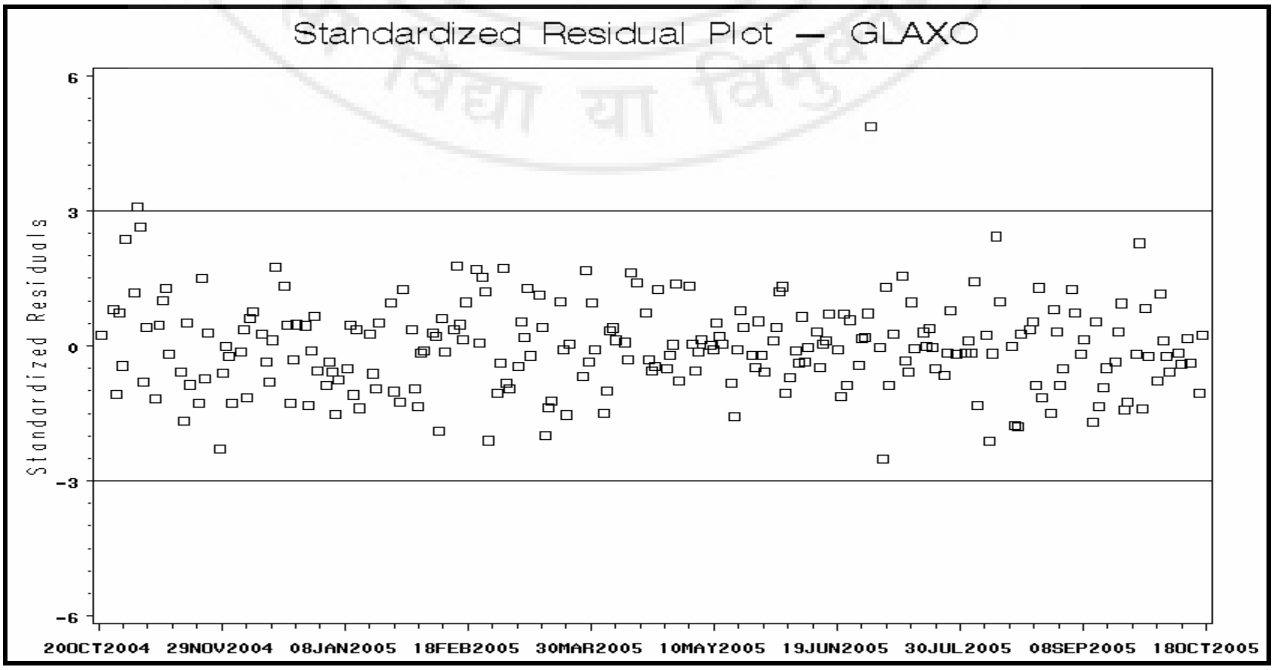
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


GLAXO Daily Returns: Pre & Post Inception of Futures
Daily Returns
8
6
4
2
0
-2
-4
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Cusum Plot for GLAXO Squared Daily Returns
CUSUM
50
25
0
-25
-50
-75
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Standardized Residual Plot — GLAXO
Standardized Residuals
6
3
0
-3
-6
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005

Stock Symbol – IDBI (Industrial Development Bank of India Ltd.)

Table No. 80a: Regression Results-Evidence of ARCH Effects. R_t takes stock symbol IDBI, Mkt_t takes Nifty.

$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	-0.086 (<0.10)
θ_1	1.230 (<0.01)
F-stat	63.30 (<0.01)
G (4) test-statistic	3.702 (>0.10)
Q (4) test-statistic	12.62 (<0.01)
LM (4) test-static	12.06 (<0.05)

Table No. 80b:
Results of ARCH (2) model for IDBI using robust standard errors, R_t, Mkt_t are same as defined above and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

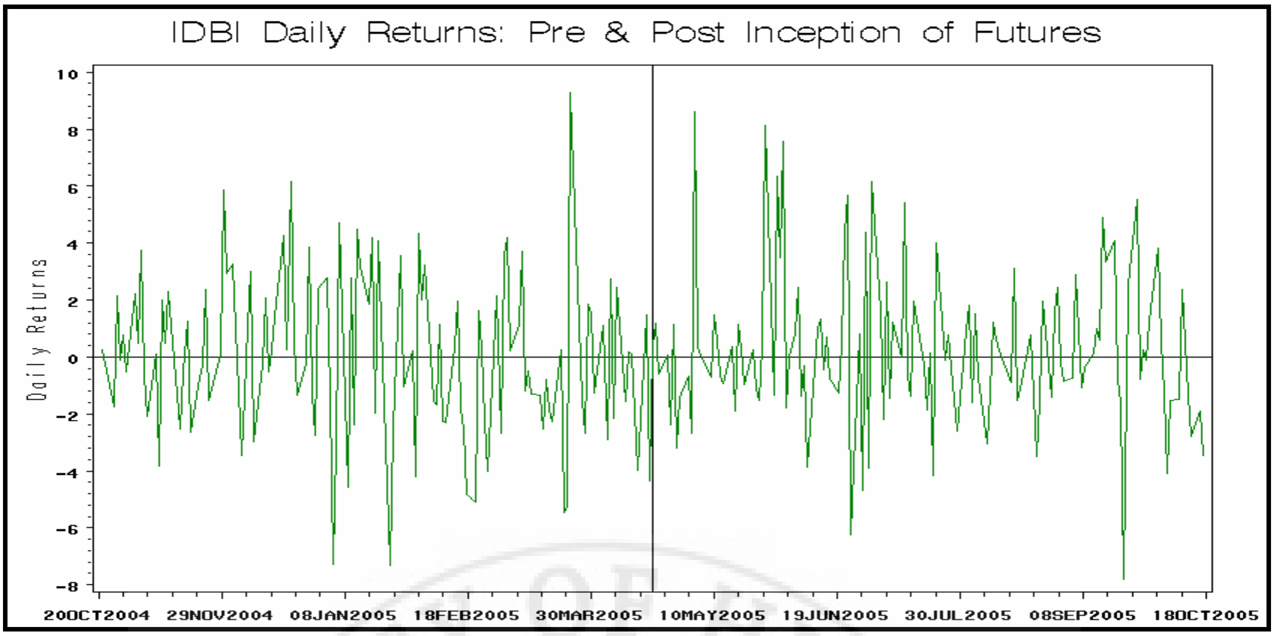
$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

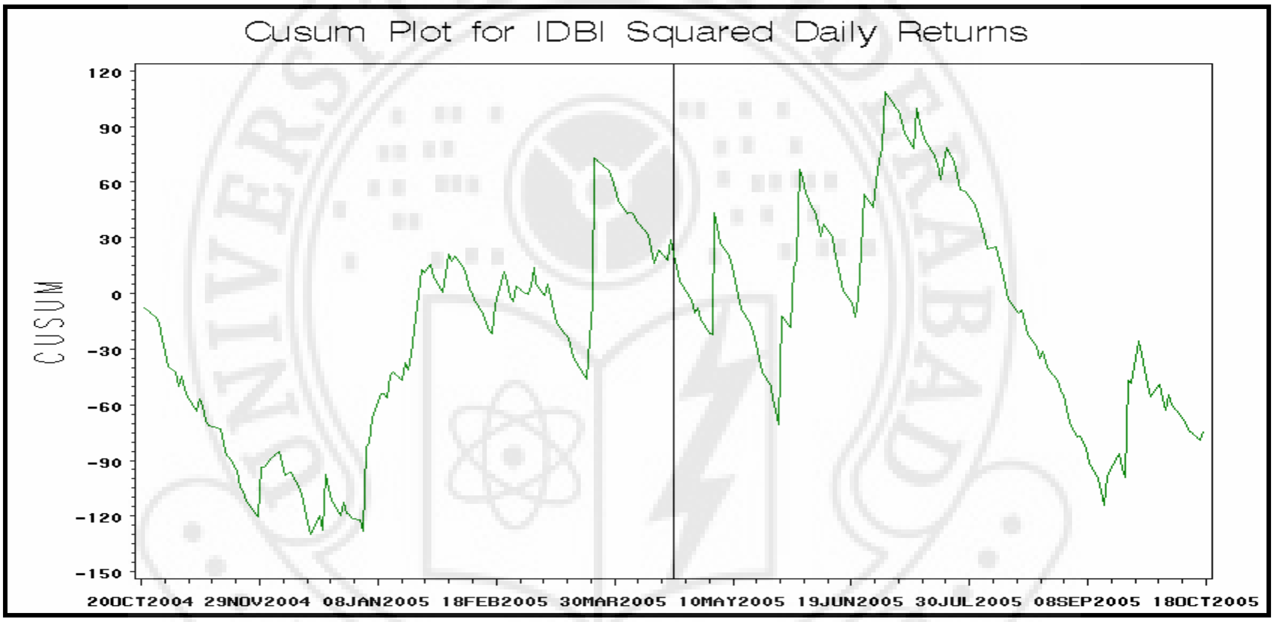
$$\varepsilon_t \sim N(0, h_t)$$

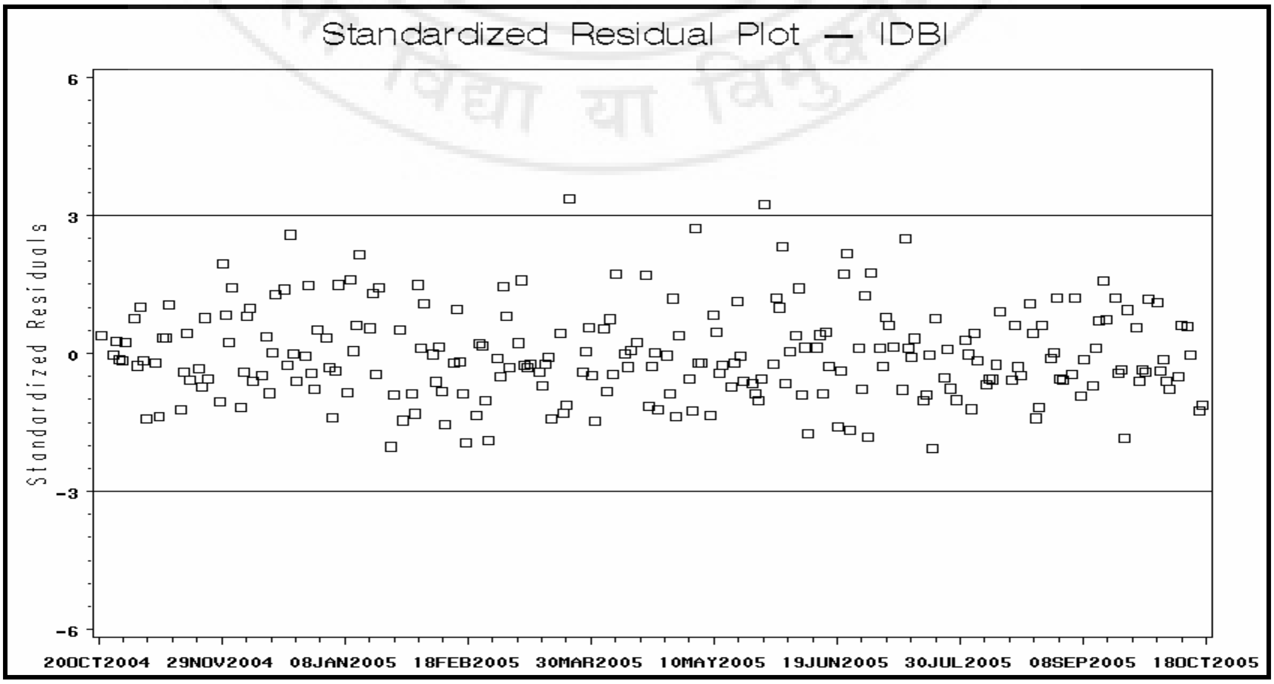
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 \varepsilon_{t-2}^2 + \alpha_{0,d} D_t + \alpha_{1,d} D_t * \varepsilon_{t-1}^2$$

Parameter	Estimate	p-value
ϕ_0	-0.072	<0.01
θ_1	1.260	<0.01
α_0	3.820	<0.01
α_1	0.260	<0.10
α_2	0.240	<0.10
$\alpha_{0,d}$	-2.027	<0.05
$\alpha_{1,d}$	0.366	<0.10
Diagnostics		
G (4) test-statistic	0.936	>0.10
Q (4) test-statistic	4.778	>0.10
LM (4) test-static	4.787	>0.10
Sign Bias	0.283	>0.10
Negative Size Bias	-0.238	>0.10
Positive Size Bias	-0.188	>0.10
Joint Bias	2.416	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 + \alpha_2 = 1$	5.800	<0.05

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


IDBI Daily Returns: Pre & Post Inception of Futures
Daily Returns
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Cusum Plot for IDBI Squared Daily Returns
CUSUM
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Standardized Residual Plot — IDBI
Standardized Residuals
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005

Stock Symbol – INDHOTEL (The Indian Hotels Company Ltd.)

Table No. 81:

Regression Results for INDHOTEL using robust standard errors, R_t takes stock symbol INDHOTEL, Mkt_t takes Nifty and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

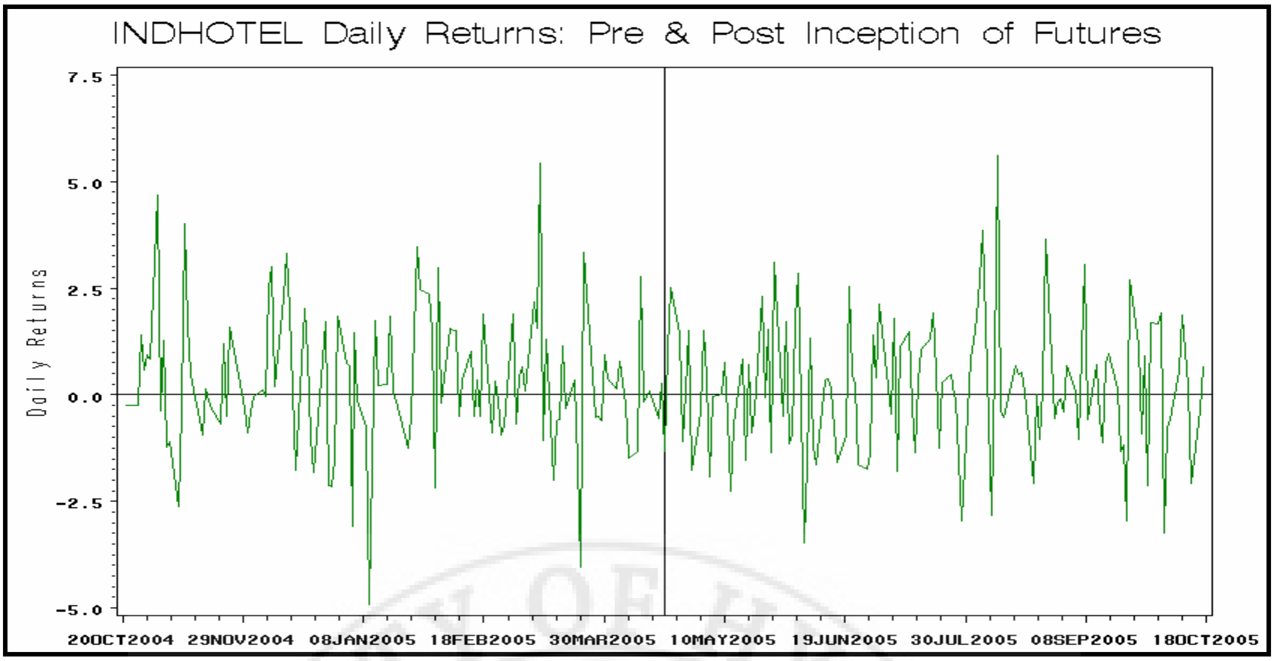
$$R_t = \phi_0 + \theta_1 Mkt_t + \gamma D_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0,1)$$

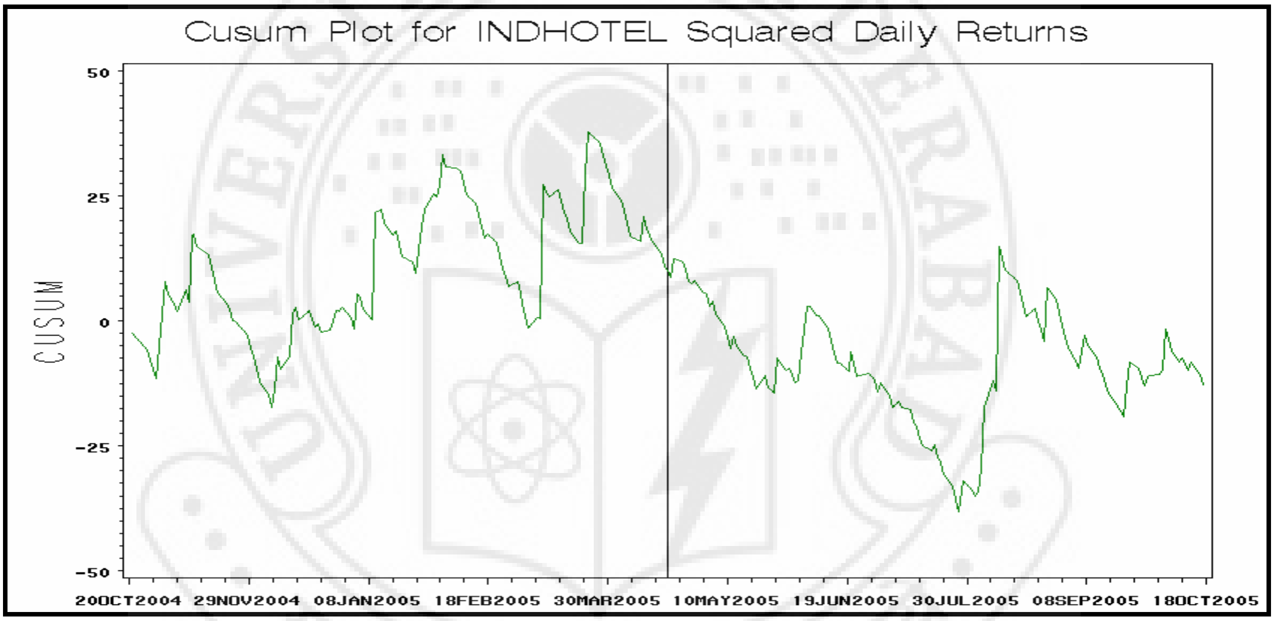
Parameter	Estimate
ϕ_0	0.242 (<0.10)
θ_1	0.669 (<0.01)
γ	-0.265 (>0.10)
F-stat	29.08 (<0.01)
G (4) test-statistic	2.566 (>0.10)
Q (4) test-statistic	2.571 (>0.10)
LM (4) test-static	2.952 (>0.10)

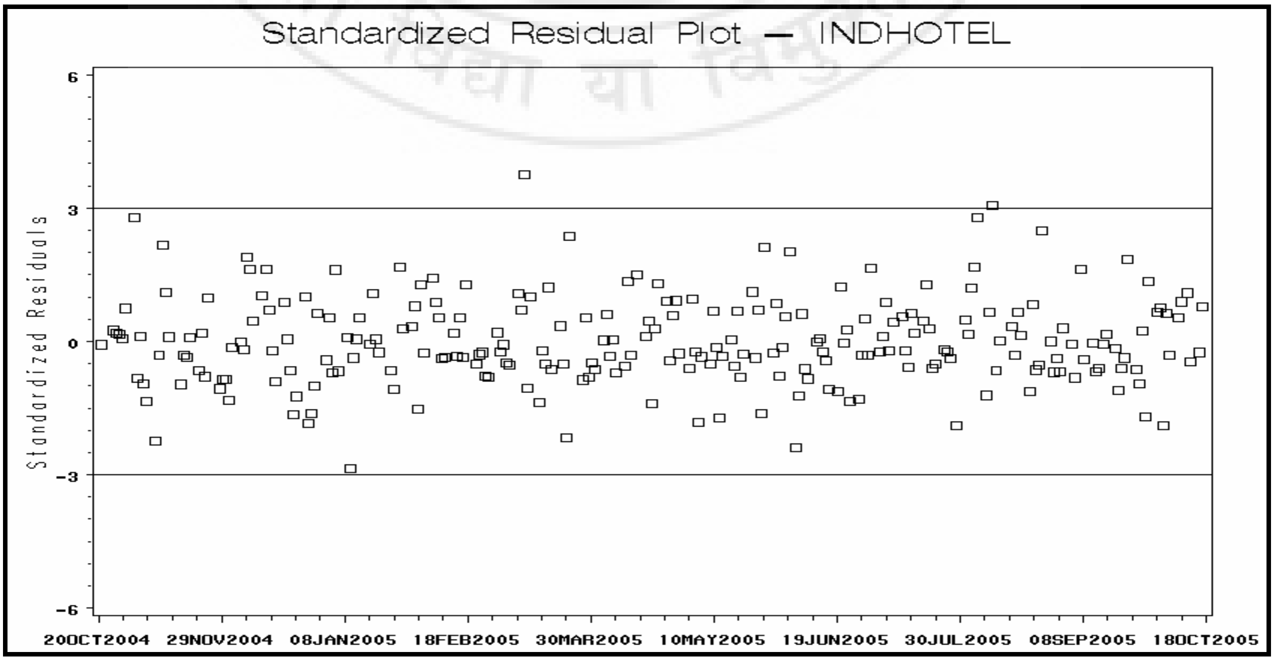
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


INDHOTEL Daily Returns: Pre & Post Inception of Futures
Daily Returns
7.5
5.0
2.5
0.0
-2.5
-5.0
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Cusum Plot for INDHOTEL Squared Daily Returns
CUSUM
50
25
0
-25
-50
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Standardized Residual Plot — INDHOTEL
Standardized Residuals
6
3
0
-3
-6
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005

Stock Symbol – IOB (Indian Overseas Bank Ltd.)

Table No. 82a: Regression Results-Evidence of ARCH Effects. R_t takes stock symbol IOB, Mkt_t takes Nifty.

$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	0.098 (<0.10)
θ_1	1.249 (<0.01)
F-stat	69.86 (<0.01)
G (4) test-statistic	4.028 (>0.10)
Q (4) test-statistic	13.36 (<0.01)
LM (4) test-static	12.51 (<0.01)

Table No. 82b:
Results of ARCH (1) model for IOB using robust standard errors, R_t, Mkt_t are same as defined above and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

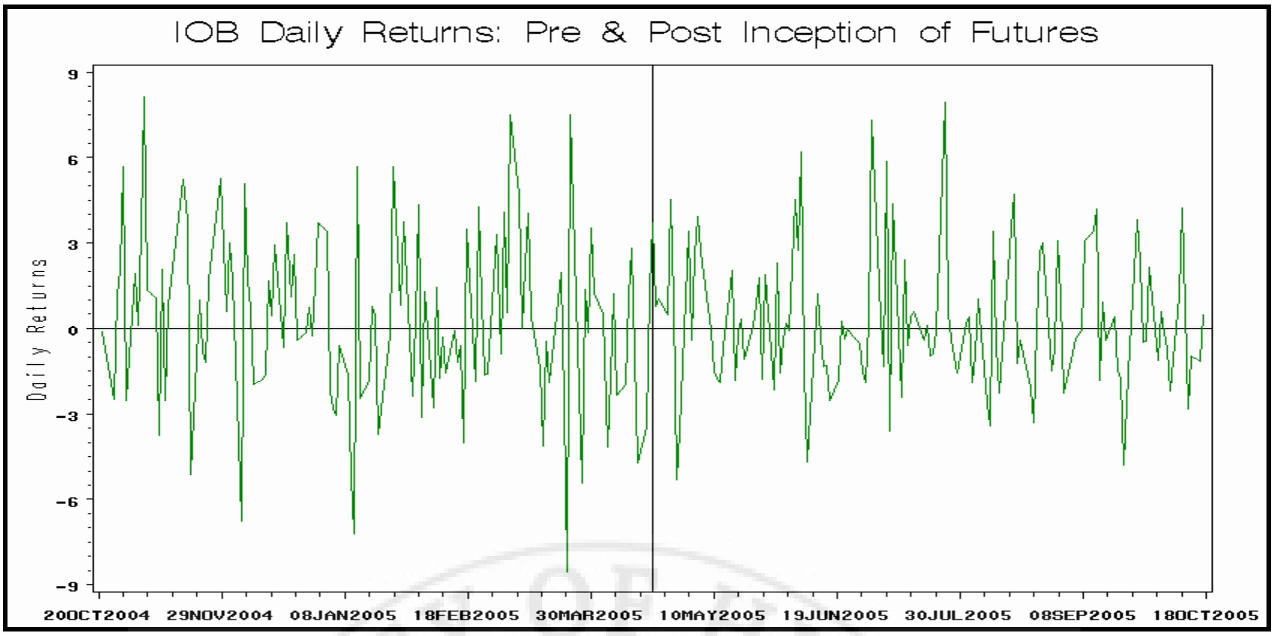
$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

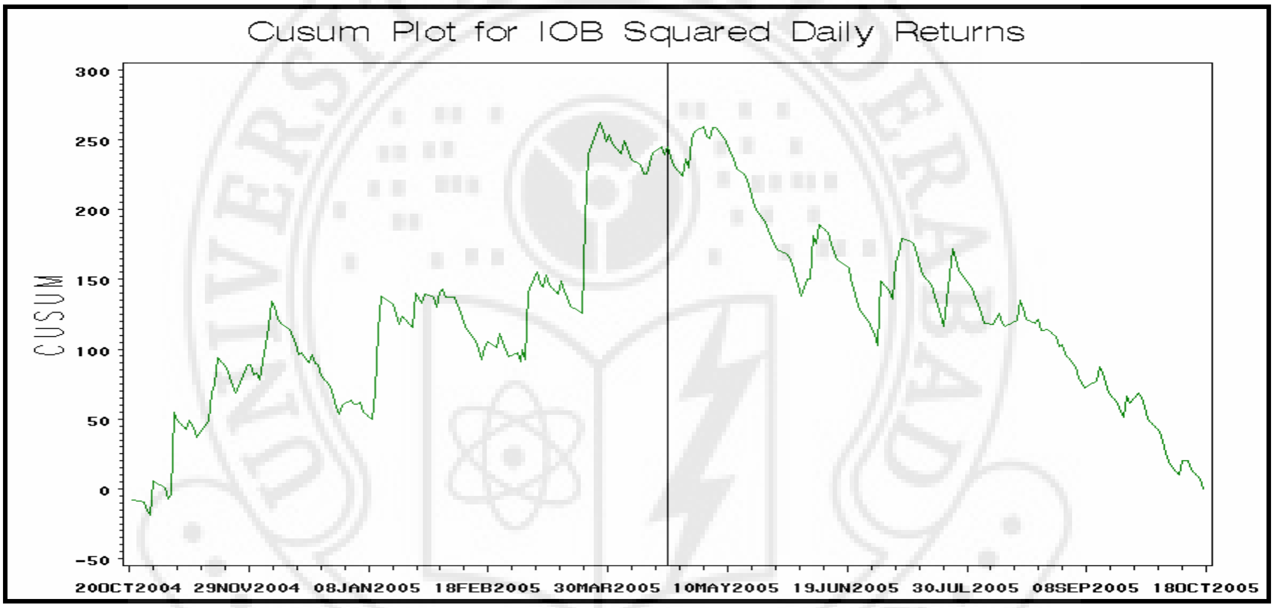
$$\varepsilon_t \sim N(0, h_t)$$

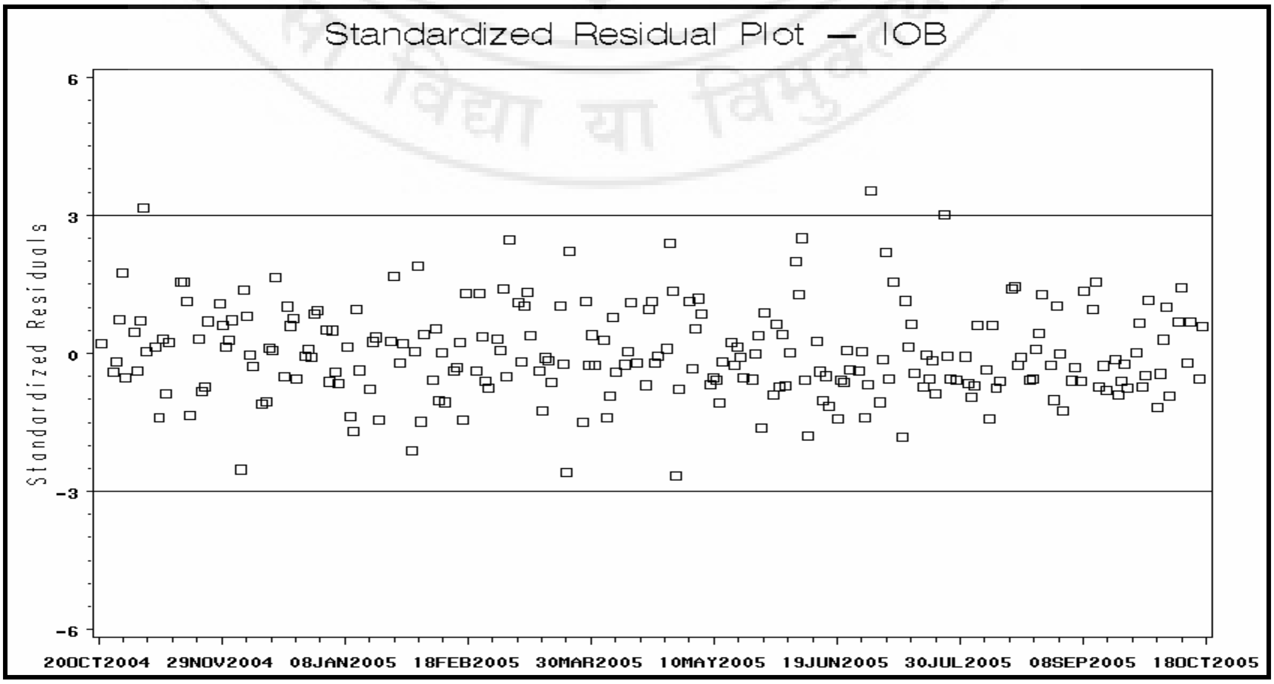
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_{0,d} D_t + \alpha_{1,d} D_t * \varepsilon_{t-1}^2$$

Parameter	Estimate	p-value
ϕ_0	0.026	>0.10
θ_1	1.198	<0.01
α_0	6.146	<0.01
α_1	0.164	<0.10
$\alpha_{0,d}$	-0.126	>0.10
$\alpha_{1,d}$	-0.239	<0.05
Diagnostics		
G (4) test-statistic	2.011	>0.10
Q (4) test-statistic	5.876	>0.10
LM (4) test-static	5.914	>0.10
Sign Bias	-0.342	>0.10
Negative Size Bias	0.080	>0.10
Positive Size Bias	0.087	>0.10
Joint Bias	3.959	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 = 1$	15.85	<0.01

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


IOB Daily Returns: Pre & Post Inception of Futures
Daily Returns
9
6
3
0
-3
-6
-9
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Cusum Plot for IOB Squared Daily Returns
CUSUM
300
250
200
150
100
50
0
-50
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Standardized Residual Plot — IOB
Standardized Residuals
6
3
0
-3
-6
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005

Stock Symbol – JINDALSTEL (Jindal Steel & Power Ltd.)

Table No. 83:

Regression Results for JINDALSTEL using robust standard errors, R_t takes stock symbol JINDALSTEL, Mkt_t takes Nifty and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

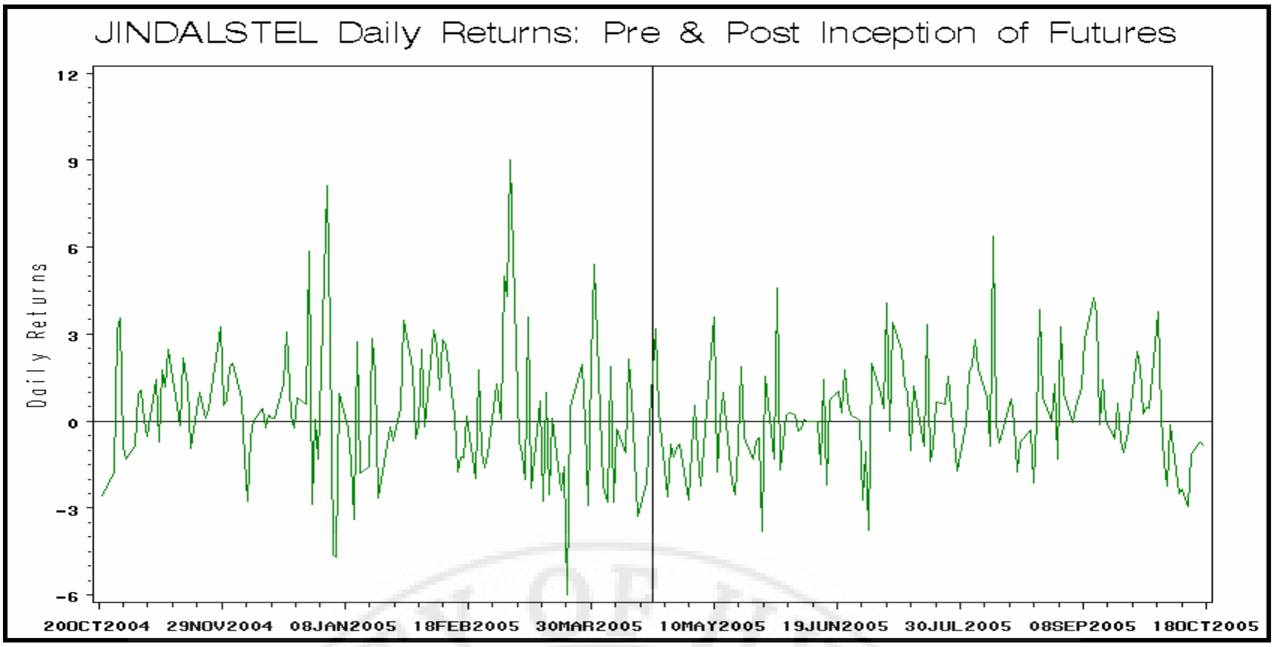
$$R_t = \phi_0 + \phi_1 R_{t-4} + \theta_1 Mkt_t + \gamma D_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0,1)$$

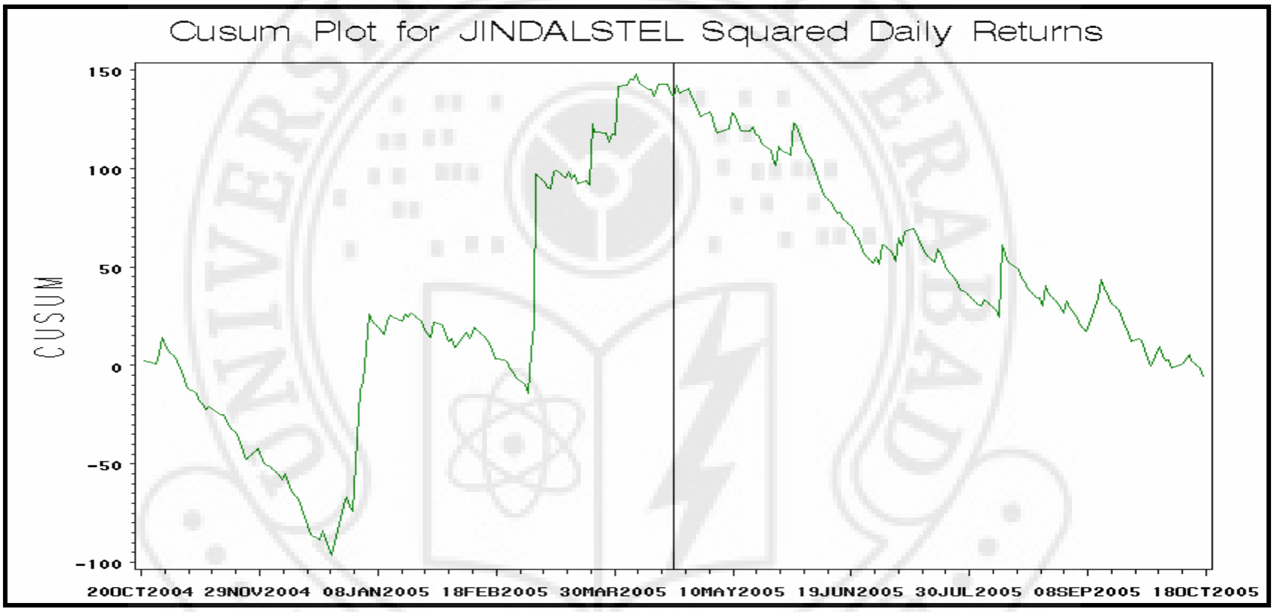
Parameter	Estimate
ϕ_0	0.231 (>0.10)
ϕ_1	0.112 (<0.10)
θ_1	0.985 (<0.01)
γ	-0.240 (>0.10)
F-stat	28.64 (<0.01)
G (4) test-statistic	3.415 (>0.10)
Q (4) test-statistic	7.912 (<0.10)
LM (4) test-static	6.168 (>0.10)

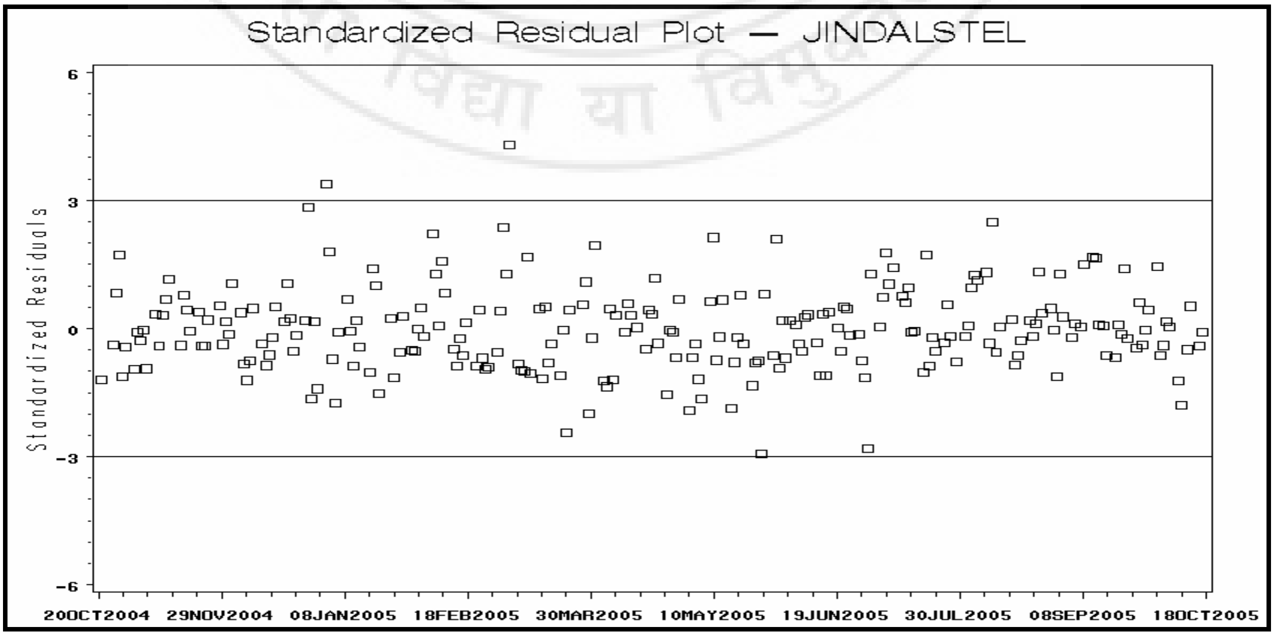
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


JINDALSTEL Daily Returns: Pre & Post Inception of Futures
Daily Returns
12
9
6
3
0
-3
-6
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Cusum Plot for JINDALSTEL Squared Daily Returns
CUSUM
150
100
50
0
-50
-100
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Standardized Residual Plot — JINDALSTEL
Standardized Residuals
6
3
0
-3
-6
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005

Stock Symbol – LICHSGFIN (LIC Housing Finance Ltd.)

Table No. 84a: Regression Results-Evidence of ARCH Effects. R_t takes stock symbol LICHSGFIN, Mkt_t takes Nifty.

$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	0.044 (<0.10)
θ_1	0.712 (<0.01)
F-stat	27.75 (<0.01)
G (4) test-statistic	3.651 (>0.10)
Q (4) test-statistic	9.597 (<0.01)
LM (4) test-static	9.134 (<0.01)

Table No. 84b:
Results of GARCH (1, 1) model for LICHSGFIN using robust standard errors, R_t, Mkt_t are same as defined above and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

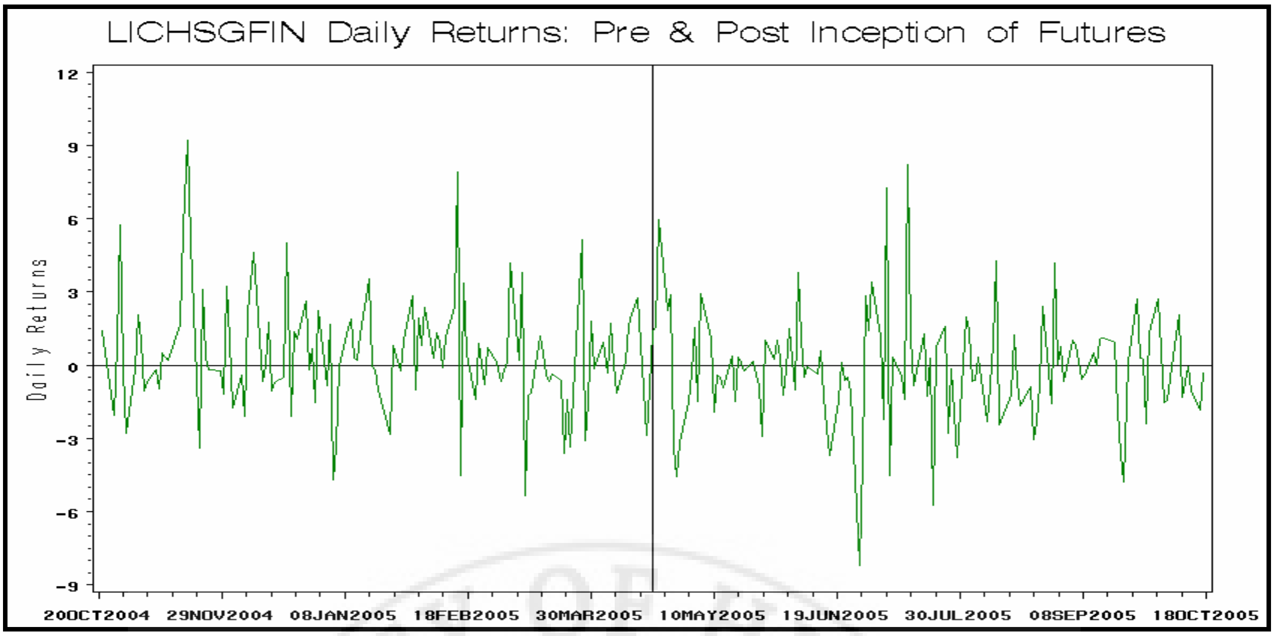
$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

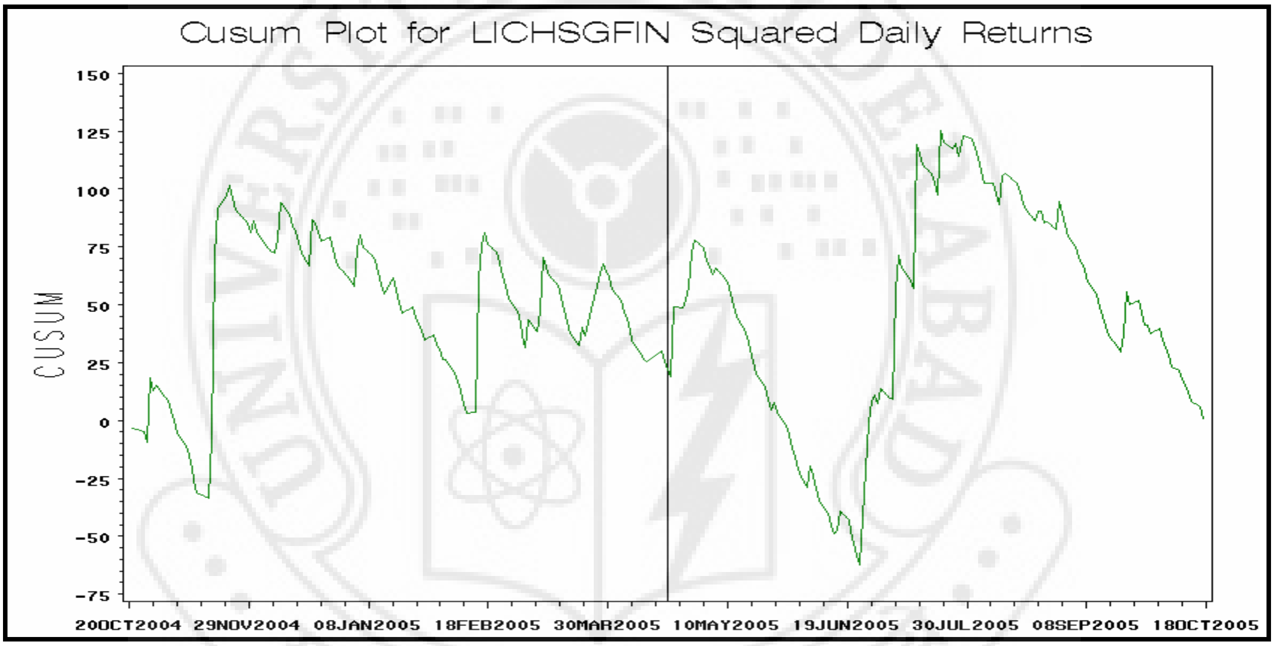
$$\varepsilon_t \sim N(0, h_t)$$

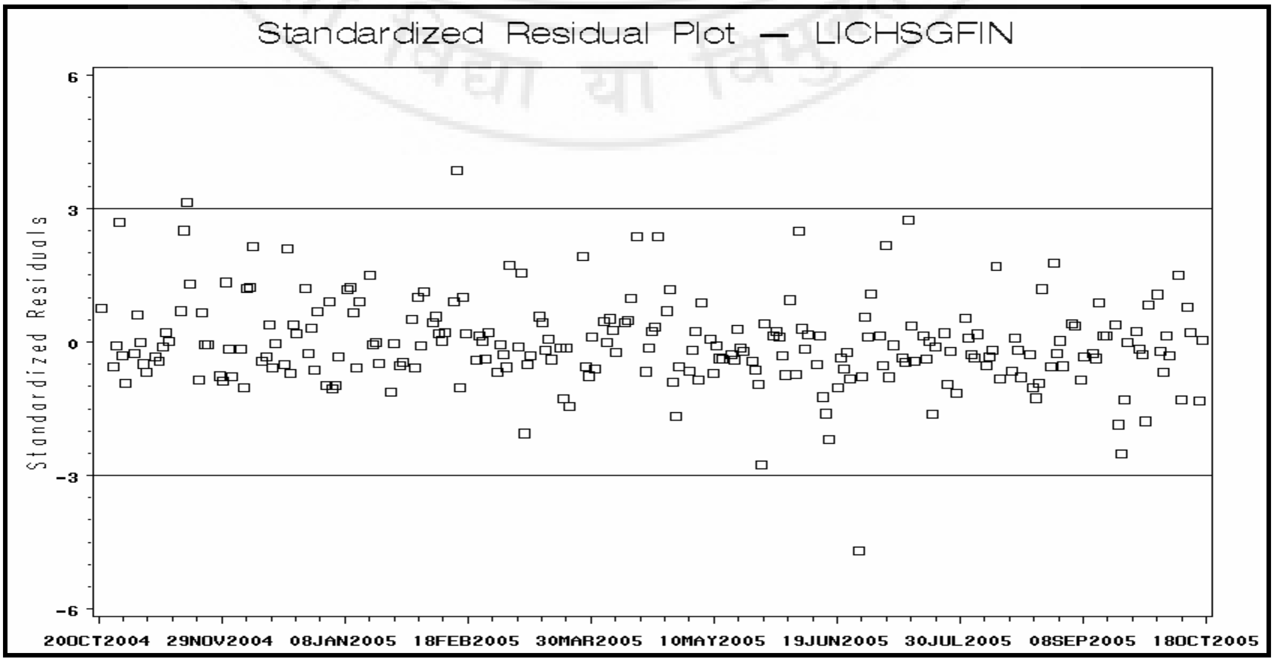
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \alpha_{0,d} D_t + \alpha_{1,d} D_t * \varepsilon_{t-1}^2 + \beta_{1,d} D_t * h_{t-1}$$

Parameter	Estimate	p-value
ϕ_0	0.073	>0.10
θ_1	0.698	<0.01
α_0	1.742	<0.01
α_1	0.147	<0.10
β_1	0.505	<0.01
$\alpha_{0,d}$	-1.664	<0.01
$\alpha_{1,d}$	-0.048	>0.10
$\beta_{1,d}$	0.370	<0.05
Diagnostics		
G (4) test-statistic	3.562	>0.10
Q (4) test-statistic	5.770	>0.10
LM (4) test-static	5.230	>0.10
Sign Bias	0.139	>0.10
Negative Size Bias	-0.310	>0.10
Positive Size Bias	0.189	>0.10
Joint Bias	3.547	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 + \beta_1 = 1$	8.230	<0.01

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


LICHSGFIN Daily Returns: Pre & Post Inception of Futures
Daily Returns
12
9
6
3
0
-3
-6
-9
20OCT2004
29NOV2004
08JAN2005
18FEB2005
30MAR2005
10MAY2005
19JUN2005
30JUL2005
08SEP2005
18OCT2005


Cusum Plot for LICHSGFIN Squared Daily Returns
CUSUM
150
125
100
75
50
25
0
-25
-50
-75
20OCT2004
29NOV2004
08JAN2005
18FEB2005
30MAR2005
10MAY2005
19JUN2005
30JUL2005
08SEP2005
18OCT2005


Standardized Residual Plot — LICHSGFIN
Standardized Residuals
6
3
0
-3
-6
20OCT2004
29NOV2004
08JAN2005
18FEB2005
30MAR2005
10MAY2005
19JUN2005
30JUL2005
08SEP2005
18OCT2005

Stock Symbol – MATRIXLABS (Matrix Laboratories Ltd.)

Table No. 85:

Regression Results for MATRIXLABS using robust standard errors, R_t takes stock symbol MATRIXLABS, Mkt_t takes Nifty and D_t takes on value of zero before SSFs introduction and a value of one afterwards. SD_t is stock split dummy takes the value of one for date 13th Jan 2005 on which MATRIXLABS has gone for stock split of 5 for 1.

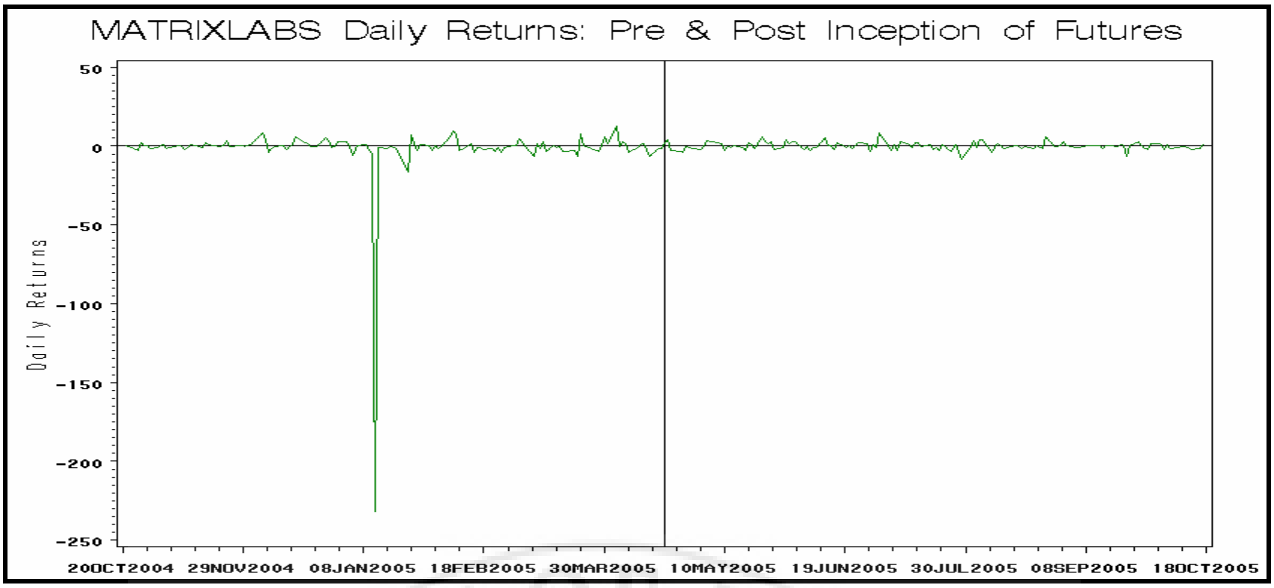
$$R_t = \phi_0 + \theta_1 Mkt_t + \gamma D_t + \eta SD_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0,1)$$

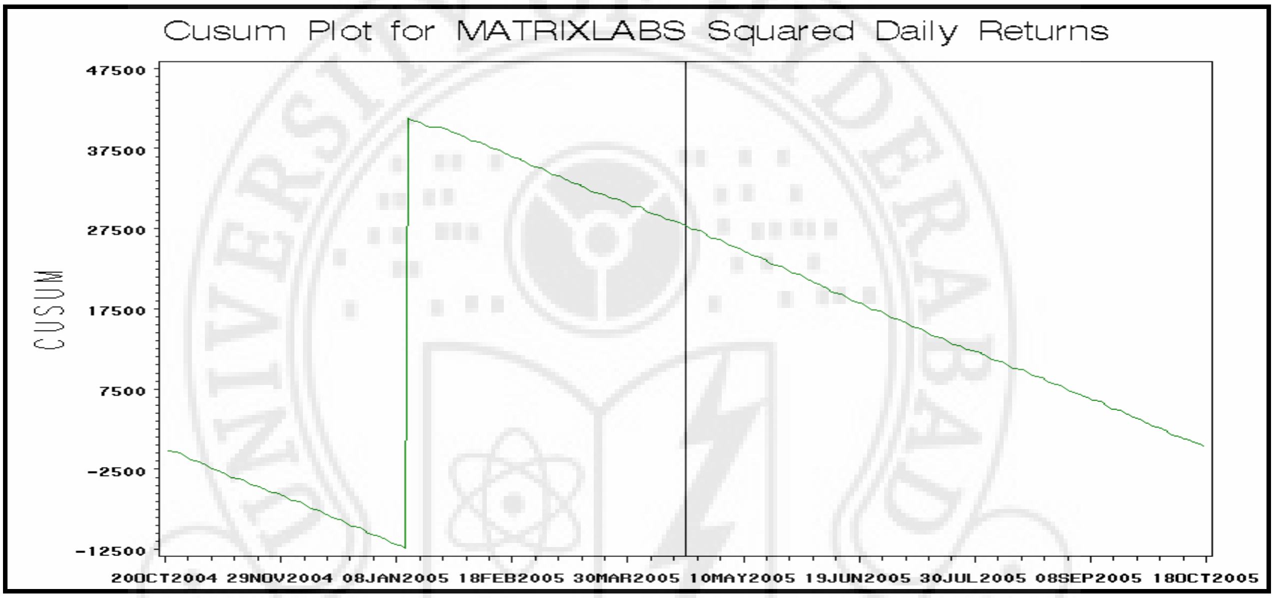
Parameter	Estimate
ϕ_0	-0.111 (>0.10)
θ_1	0.978 (<0.01)
γ	-0.045 (>0.10)
η	-233.9 (<0.01)
F-stat	2325.0 (<0.01)
G (4) test-statistic	2.474 (>0.10)
Q (4) test-statistic	3.698 (>0.10)
LM (4) test-static	3.489 (>0.10)

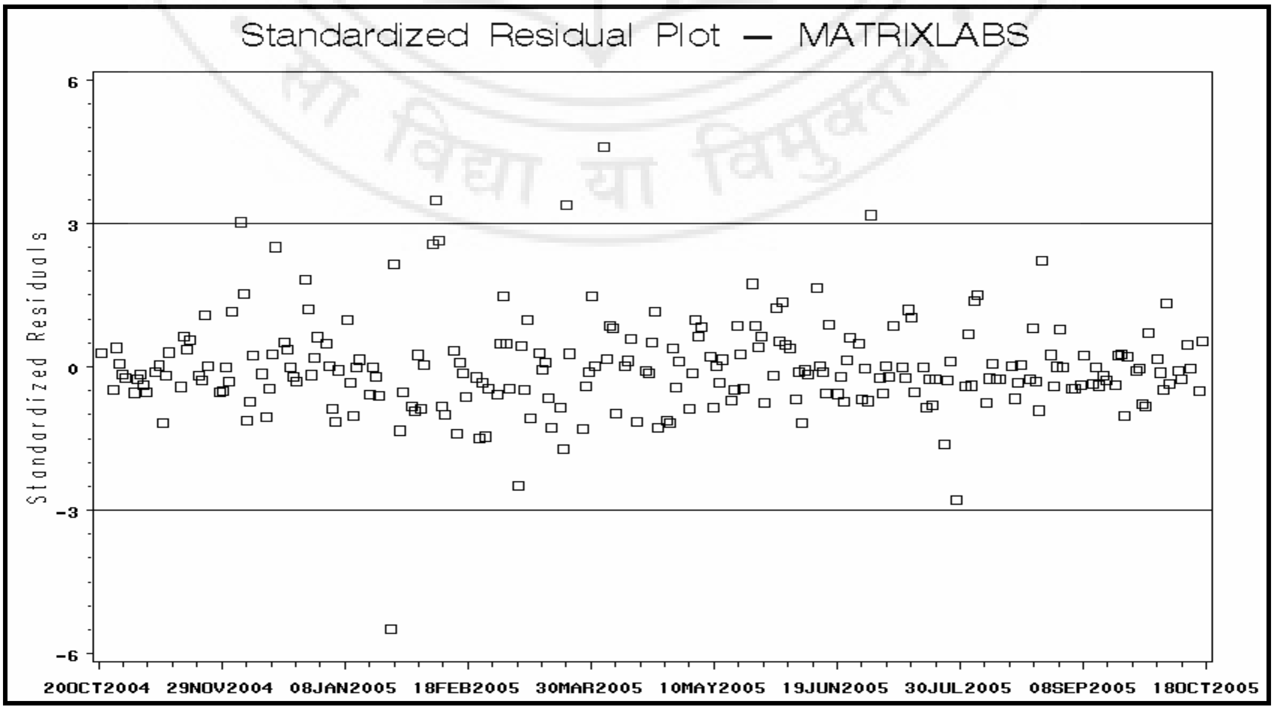
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


MATRIXLABS Daily Returns: Pre & Post Inception of Futures
Daily Returns
50
0
-50
-100
-150
-200
-250
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Cusum Plot for MATRIXLABS Squared Daily Returns
CUSUM
47500
37500
27500
17500
7500
-2500
-12500
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Standardized Residual Plot — MATRIXLABS
Standardized Residuals
6
3
0
-3
-6
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005

Stock Symbol – MRPL (Mangalore Refinery and Petrochemicals Ltd.)

Table No. 86:

Regression Results for MRPL using robust standard errors, R_t takes stock symbol MRPL, Mkt_t takes Nifty and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

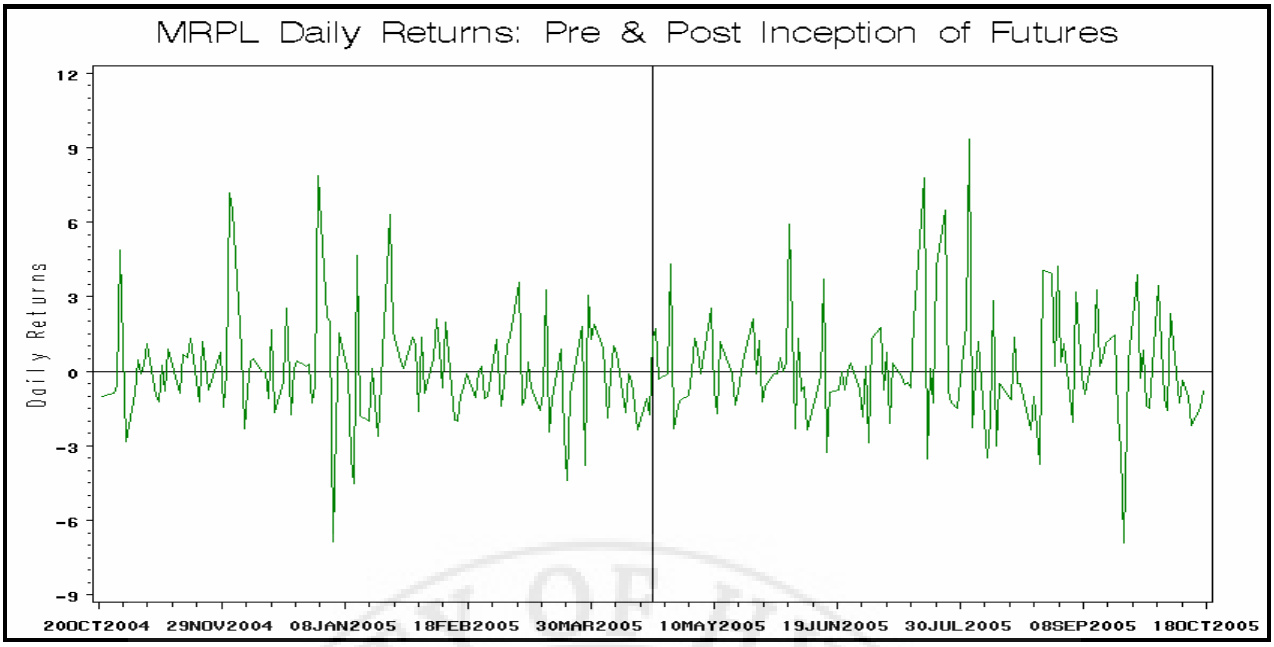
$$R_t = \phi_0 + \phi_1 R_{t-2} + \theta_1 Mkt_t + \gamma D_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	-0.043 (>0.10)
ϕ_1	-0.083 (<0.01)
θ_1	1.060 (<0.01)
γ	-0.083 (>0.10)
F-stat	29.39 (<0.01)
G (4) test-statistic	2.809 (>0.10)
Q (4) test-statistic	2.939 (>0.10)
LM (4) test-static	2.866 (>0.10)

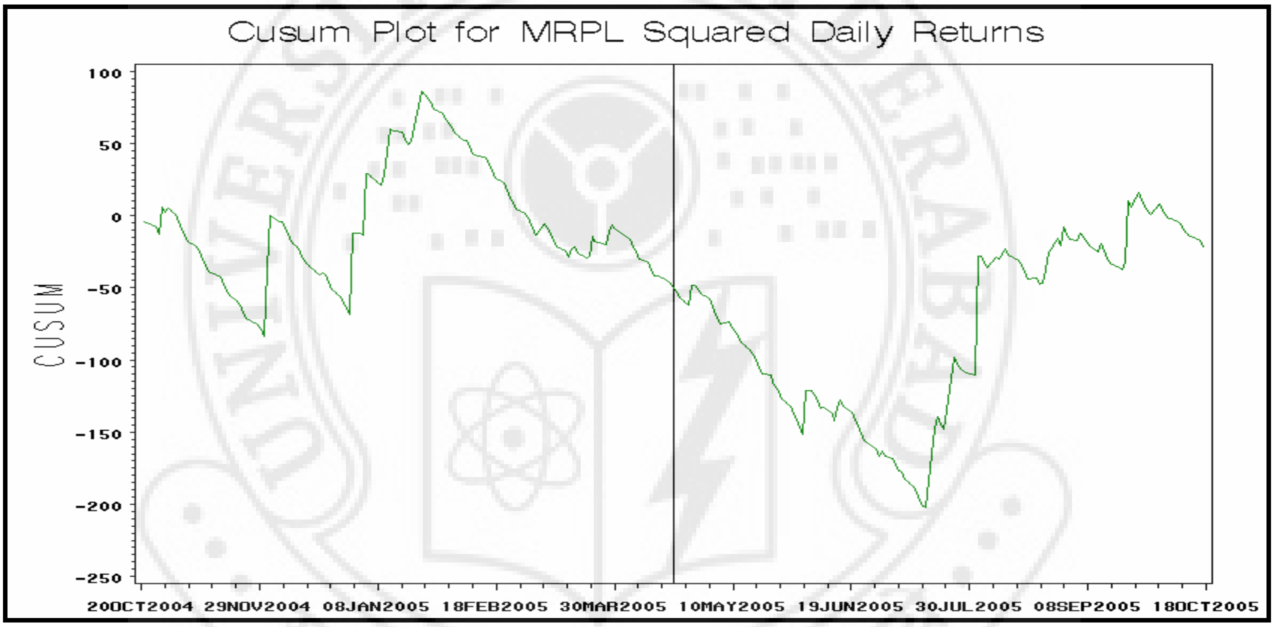
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

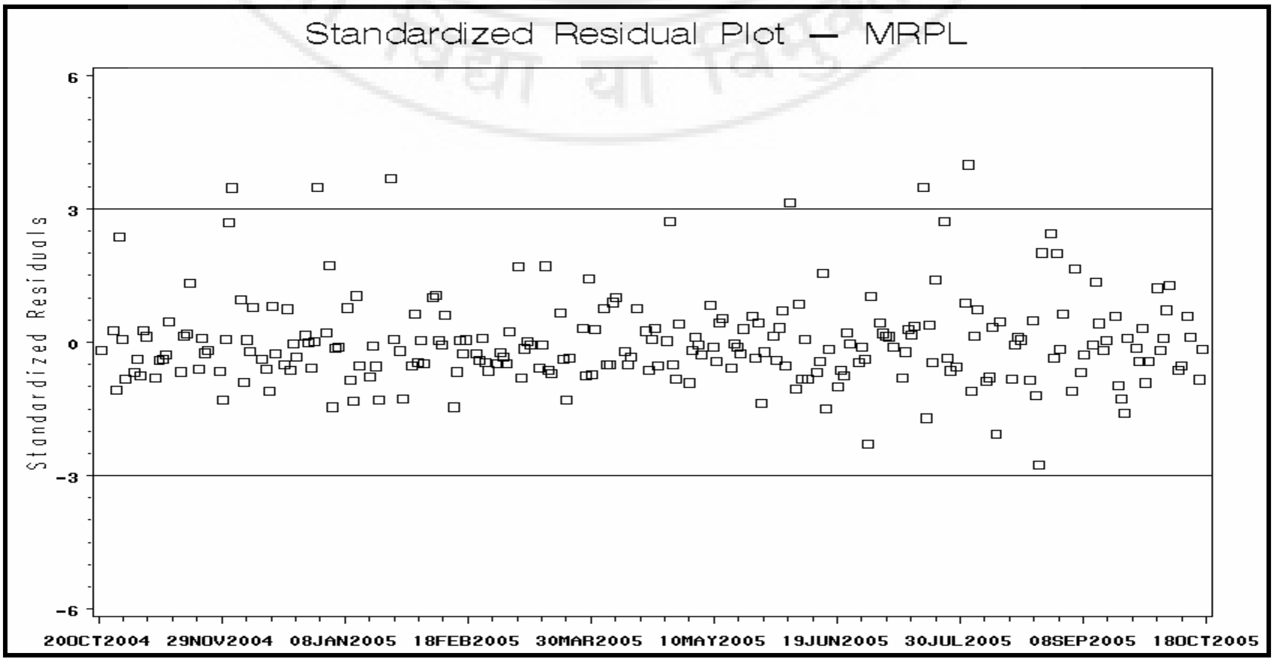
LM (k) is the statistic testing the presence of ARCH effects up to lag k.



MRPL Daily Returns: Pre & Post Inception of Futures
Daily Returns
12
9
6
3
0
-3
-6
-9
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005



Cusum Plot for MRPL Squared Daily Returns
CUSUM
100
50
0
-50
-100
-150
-200
-250
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005



Standardized Residual Plot — MRPL
Standardized Residuals
6
3
0
-3
-6
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005

Stock Symbol – NEYVELILIG (Neyveli Lignite Corporation Ltd.)

Table No. 87:

Regression Results for NEYVELILIG using robust standard errors, R_t takes stock symbol NEYVELILIG, Mkt_t takes Nifty and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

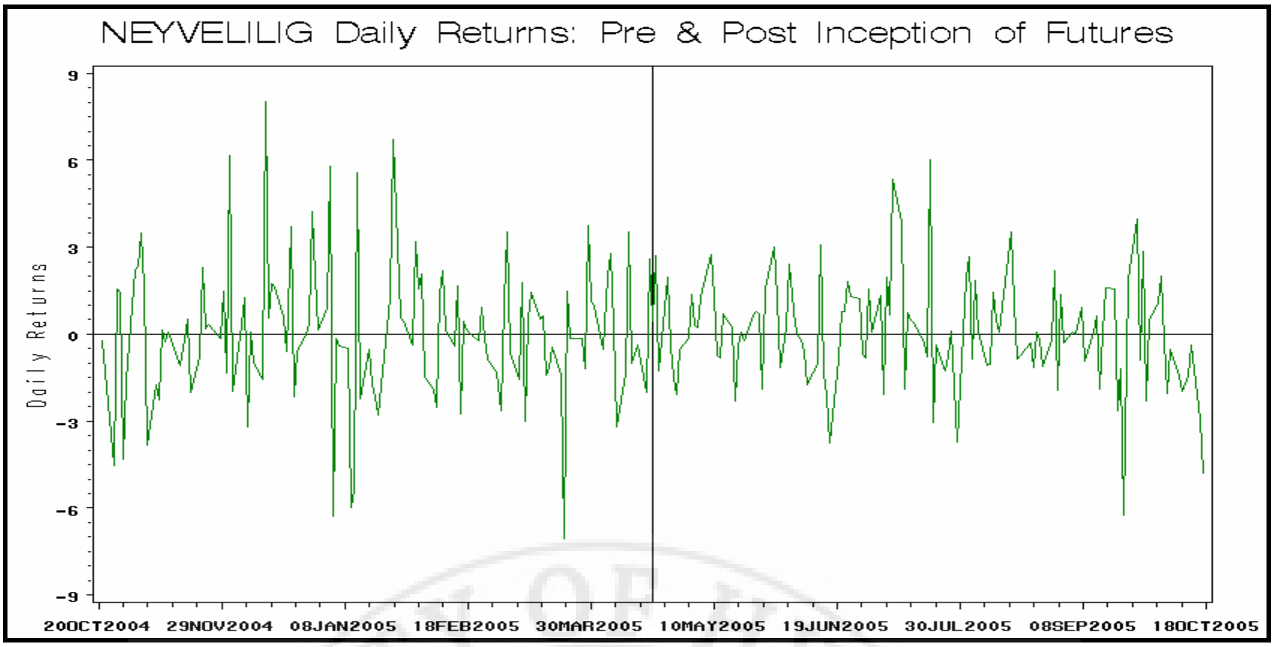
$$R_t = \phi_0 + \theta_1 Mkt_t + \gamma D_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0,1)$$

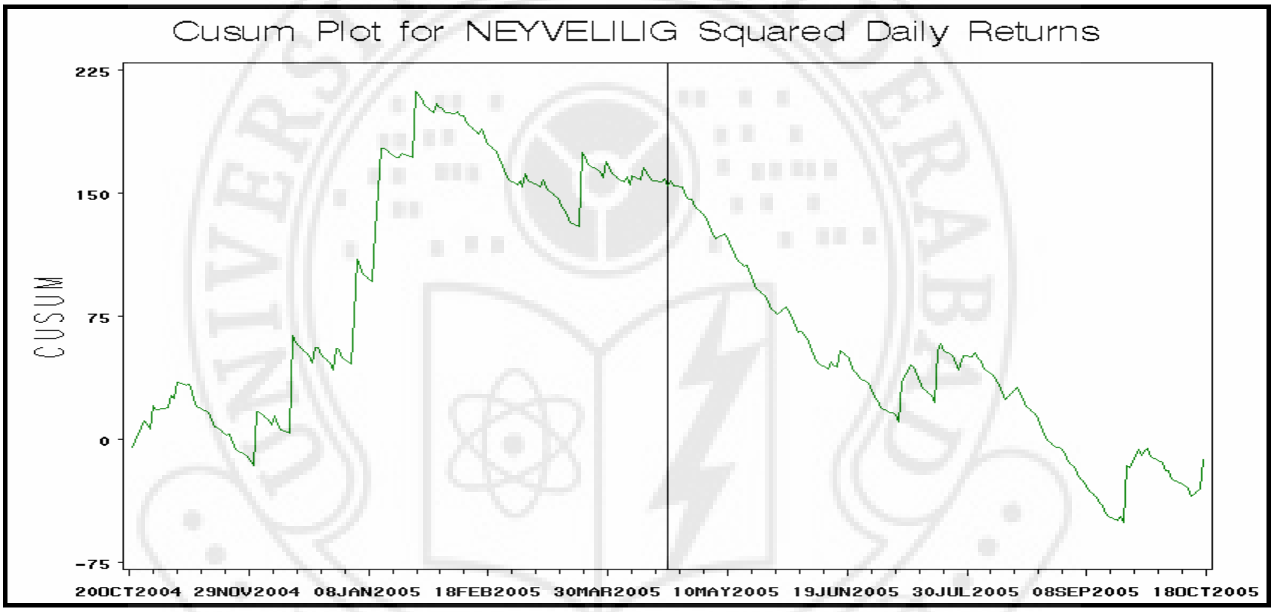
Parameter	**Estimate**
ϕ_0	0.003 (<0.10)
θ_1	0.929 (<0.01)
γ	-0.162 (>0.10)
F-stat	30.53 (<0.01)
G (4) test-statistic	2.498 (>0.10)
Q (4) test-statistic	2.556 (>0.10)
LM (4) test-static	2.661 (>0.10)

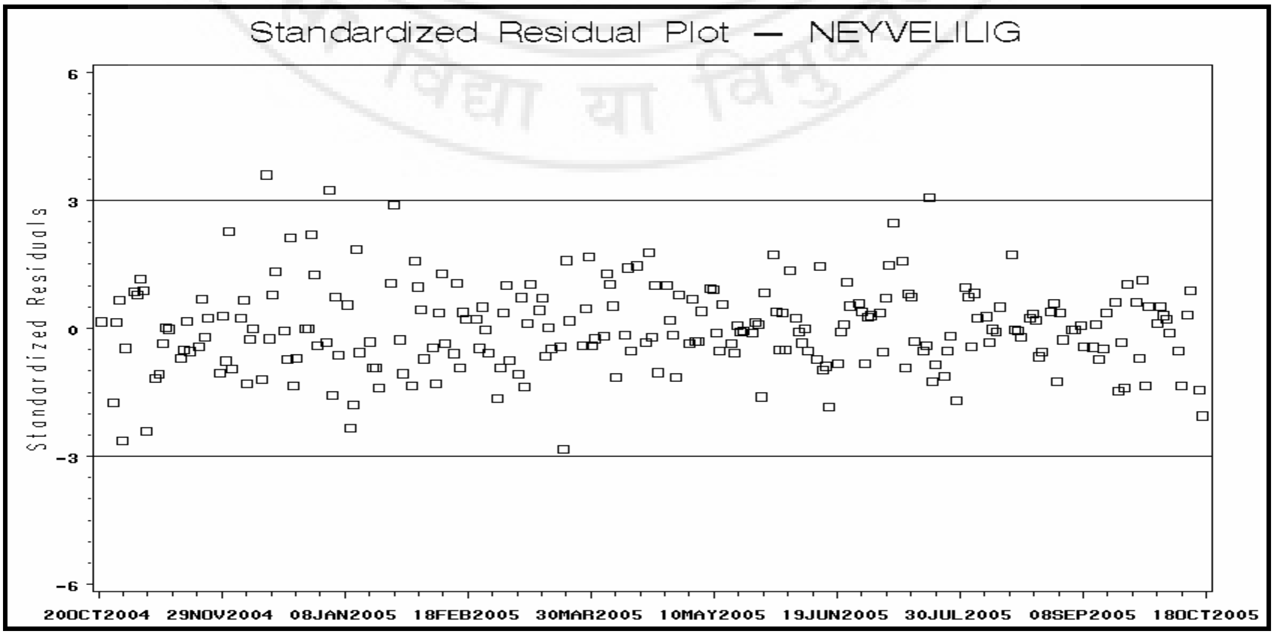
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


NEYVELILIG Daily Returns: Pre & Post Inception of Futures
Daily Returns
9
6
3
0
-3
-6
-9
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Cusum Plot for NEYVELILIG Squared Daily Returns
CUSUM
225
150
75
0
-75
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Standardized Residual Plot — NEYVELILIG
Standardized Residuals
6
3
0
-3
-6
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005

Stock Symbol – NICOLASPIR (Nicholas Pirmal India Ltd.)

Table No. 88:

Regression Results for NICOLASPIR using robust standard errors, R_t takes stock symbol NICOLASPIR, Mkt_t takes Nifty and D_t takes on value of zero before SSFs introduction and a value of one afterwards. SD_t is stock split dummy takes the value of one for date 27th Dec 2004 on which NICOLASPIR has gone for stock split of 5 for 1.

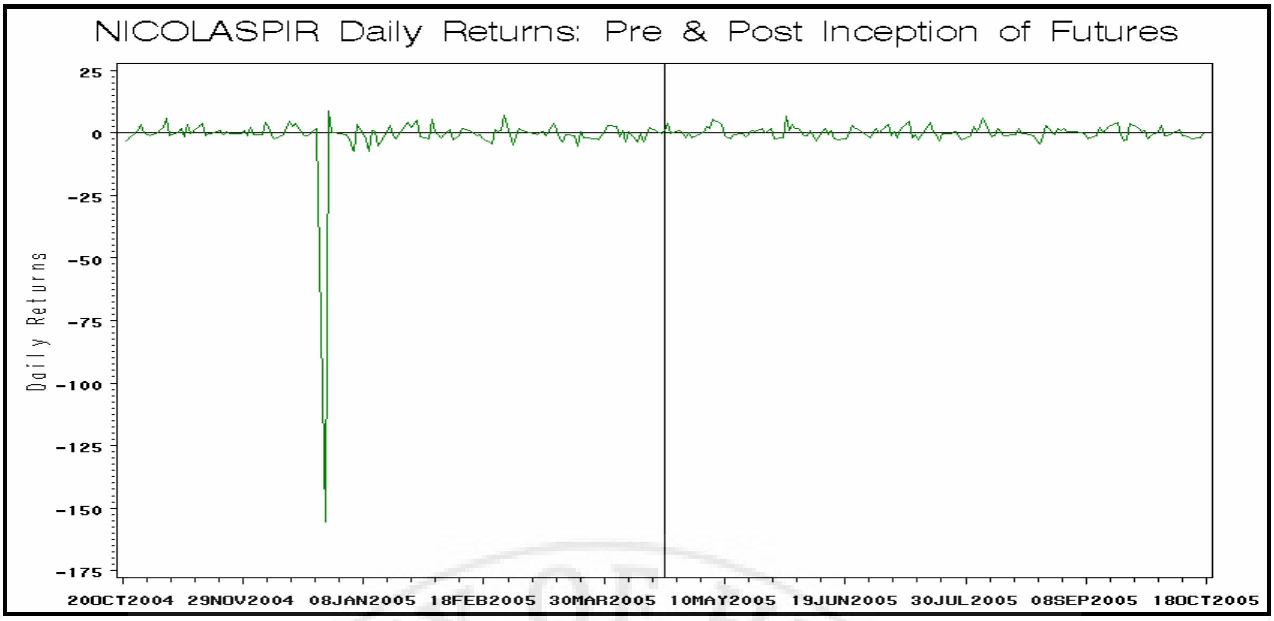
$$R_t = \phi_0 + \theta_1 Mkt_t + \gamma D_t + \eta SD_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0,1)$$

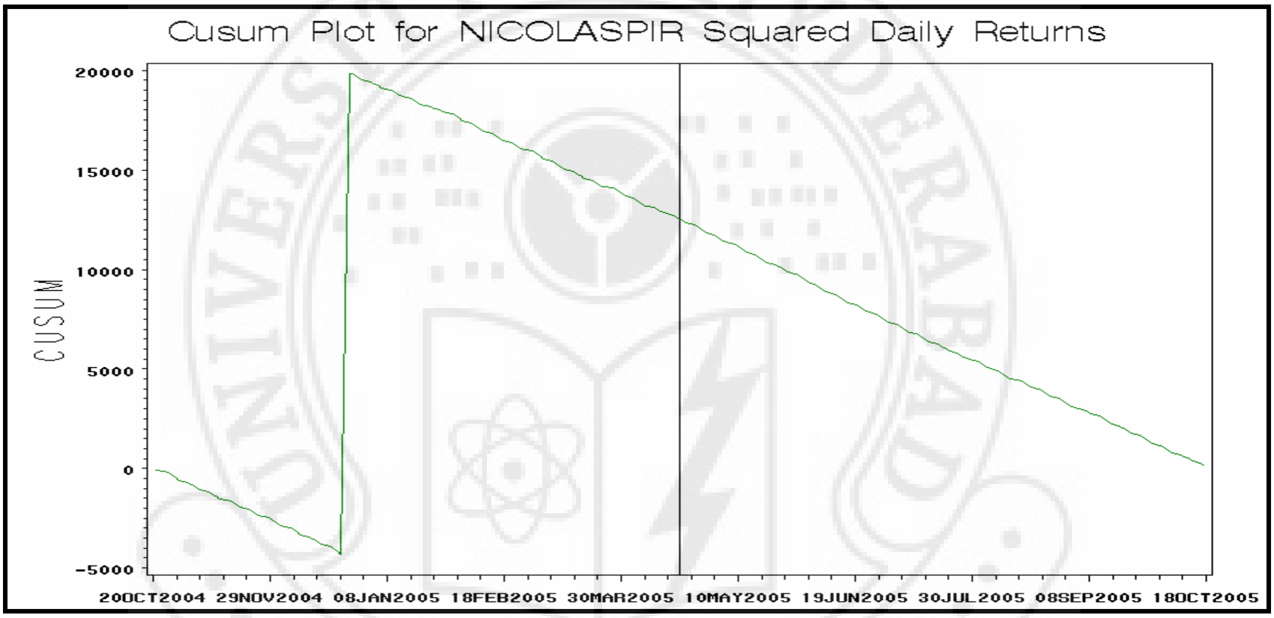
Parameter	Estimate
ϕ_0	-0.049 (>0.10)
θ_1	0.840 (<0.01)
γ	0.031 (>0.10)
η	-155.6 (<0.01)
F-stat	1647.3 (<0.01)
G (4) test-statistic	2.103 (>0.10)
Q (4) test-statistic	2.269 (>0.10)
LM (4) test-static	2.203 (>0.10)

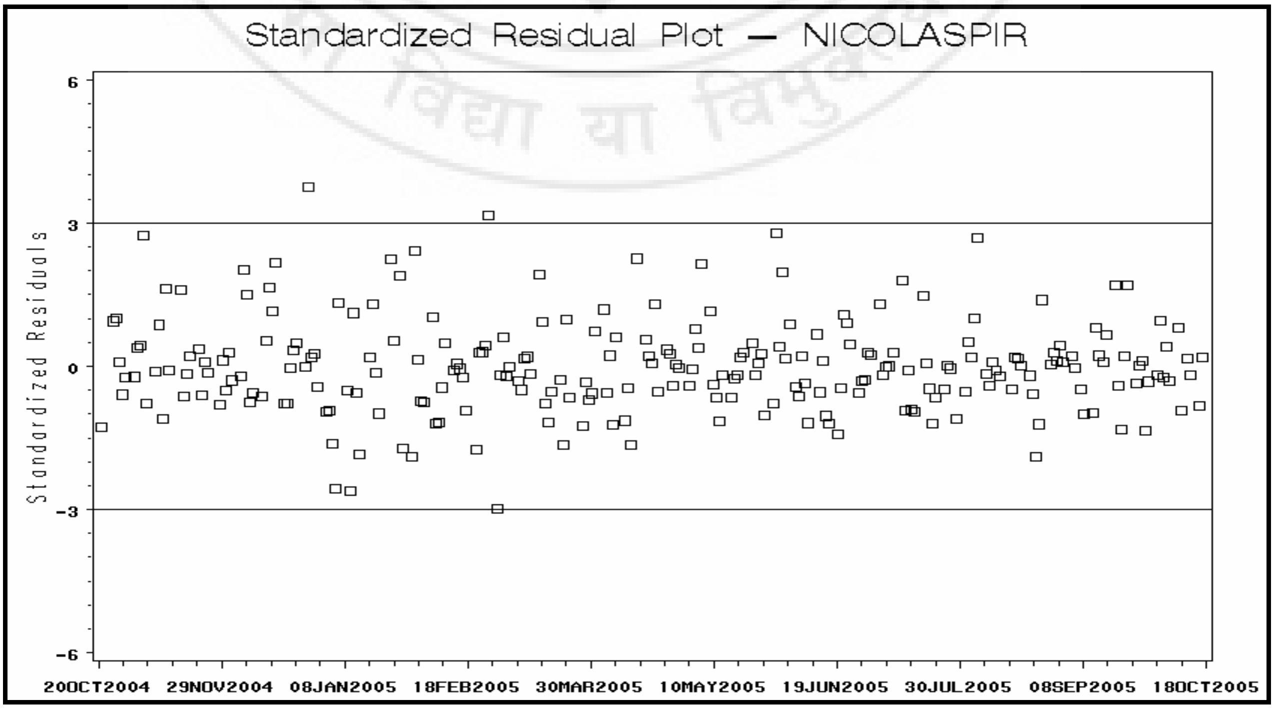
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


NICOLASPIR Daily Returns: Pre & Post Inception of Futures
Daily Returns
25
0
-25
-50
-75
-100
-125
-150
-175
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Cusum Plot for NICOLASPIR Squared Daily Returns
CUSUM
20000
15000
10000
5000
0
-5000
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Standardized Residual Plot — NICOLASPIR
Standardized Residuals
6
3
0
-3
-6
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005

Stock Symbol – PATNI (Patni Computers Systems Ltd.)

Table No.89:

Regression Results for PATNI using robust standard errors, R_t takes stock symbol PATNI, Mkt_t takes Nifty and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

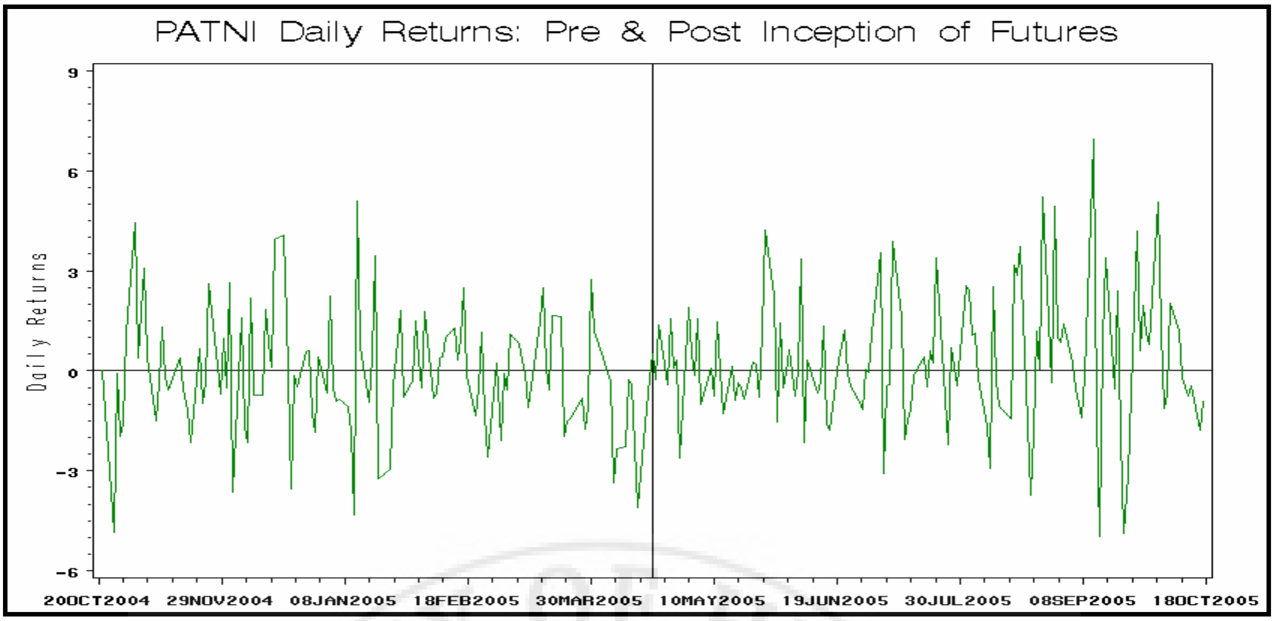
$$R_t = \phi_0 + \phi_1 R_{t-2} + \theta_1 Mkt_t + \gamma D_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0,1)$$

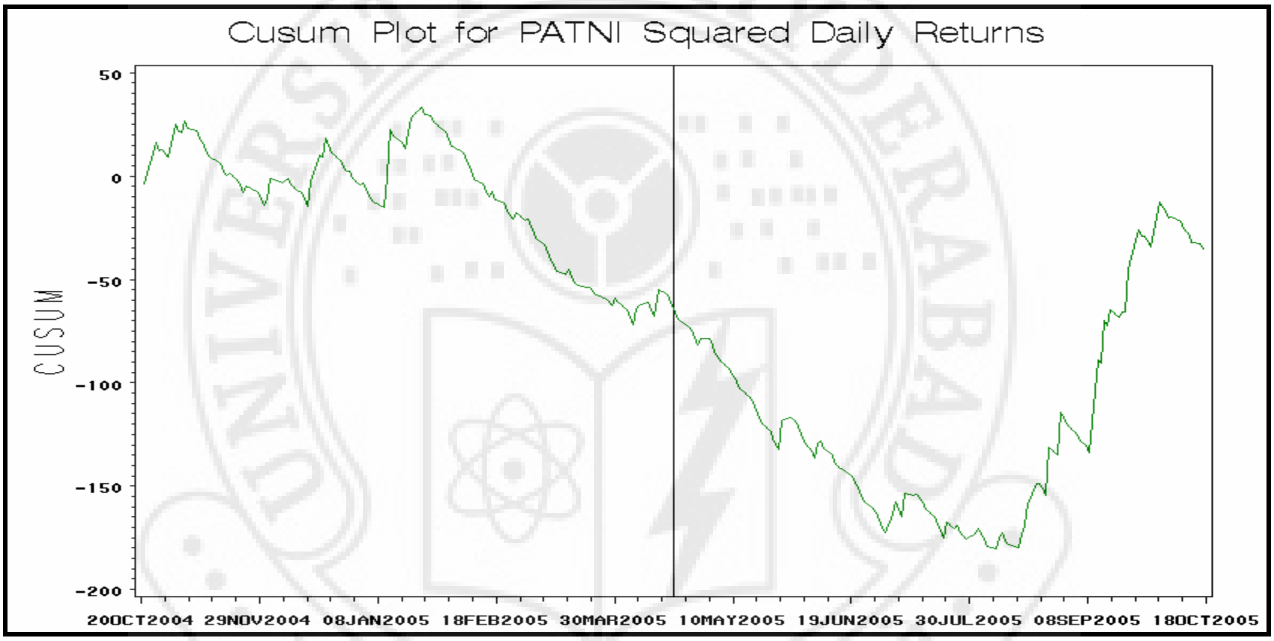
Parameter	Estimate
ϕ_0	-0.136 (>0.10)
ϕ_1	-0.133 (<0.05)
θ_1	0.797 (<0.01)
γ	0.264 (>0.10)
F-stat	21.57 (<0.01)
G (4) test-statistic	1.224 (>0.10)
Q (4) test-statistic	7.274 (>0.10)
LM (4) test-static	7.109 (>0.10)

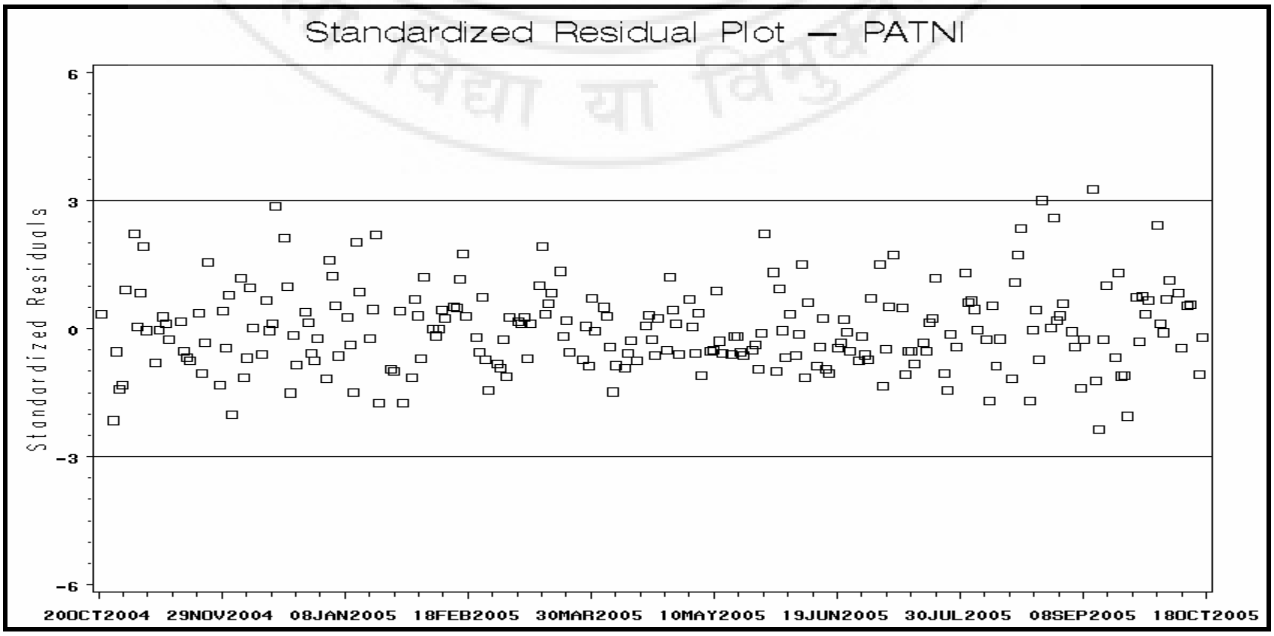
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


PATNI Daily Returns: Pre & Post Inception of Futures
Daily Returns
9
6
3
0
-3
-6
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Cusum Plot for PATNI Squared Daily Returns
CUSUM
50
0
-50
-100
-150
-200
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Standardized Residual Plot — PATNI
Standardized Residuals
6
3
0
-3
-6
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005

Stock Symbol – RELCAPITAL (Reliance Capital Ltd.)

Table No. 90:

Regression Results for RELCAPITAL using robust standard errors, R_t takes stock symbol RELCAPITAL, Mkt_t takes Nifty and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

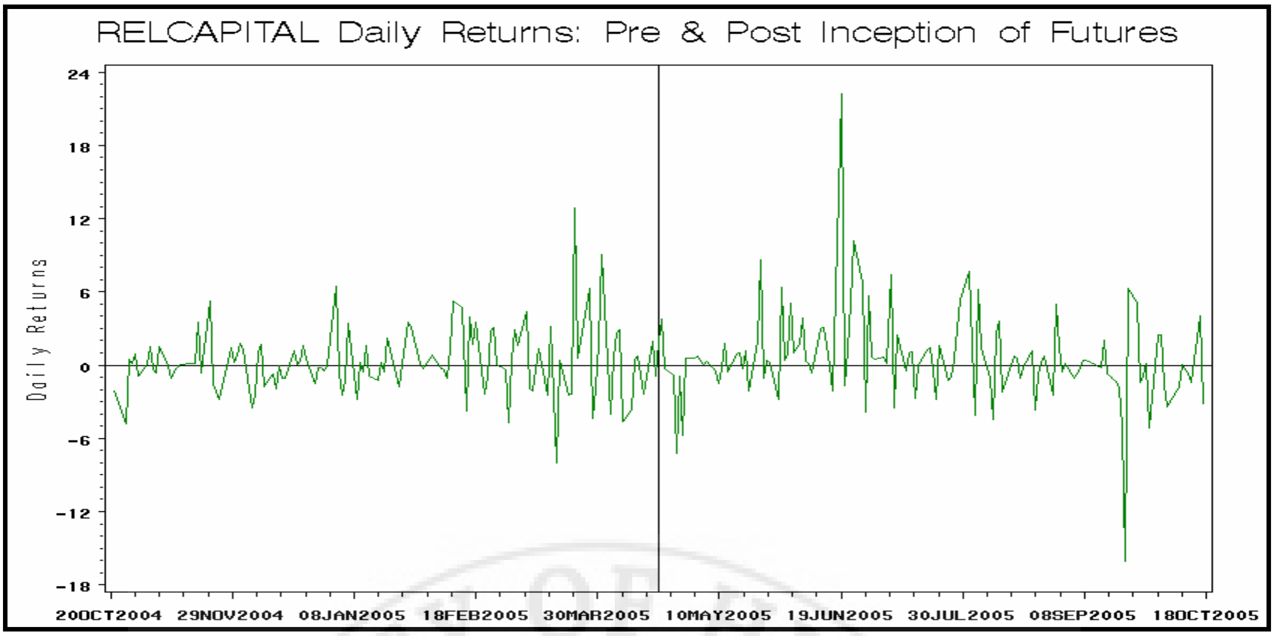
$$R_t = \phi_0 + \theta_1 Mkt_t + \gamma D_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0,1)$$

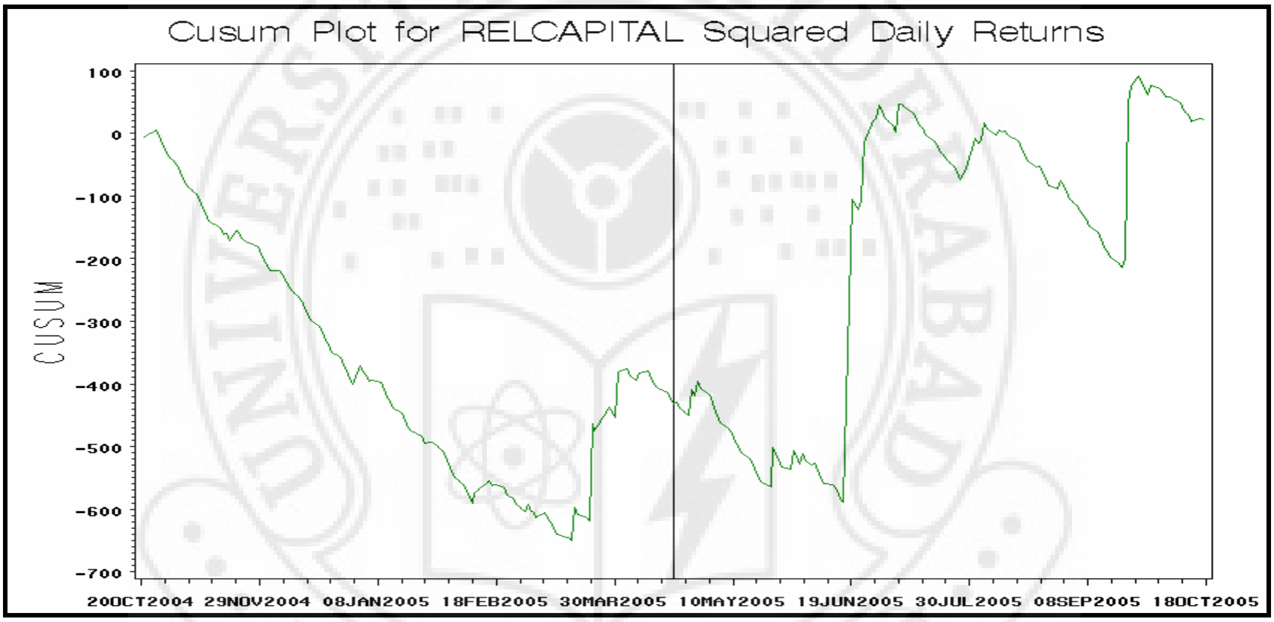
Parameter	Estimate
ϕ_0	0.144 (>0.10)
θ_1	1.270 (<0.01)
γ	0.163 (>0.10)
F-stat	23.77 (<0.01)
G (4) test-statistic	3.103 (>0.10)
Q (4) test-statistic	5.879 (>0.10)
LM (4) test-static	5.744 (>0.10)

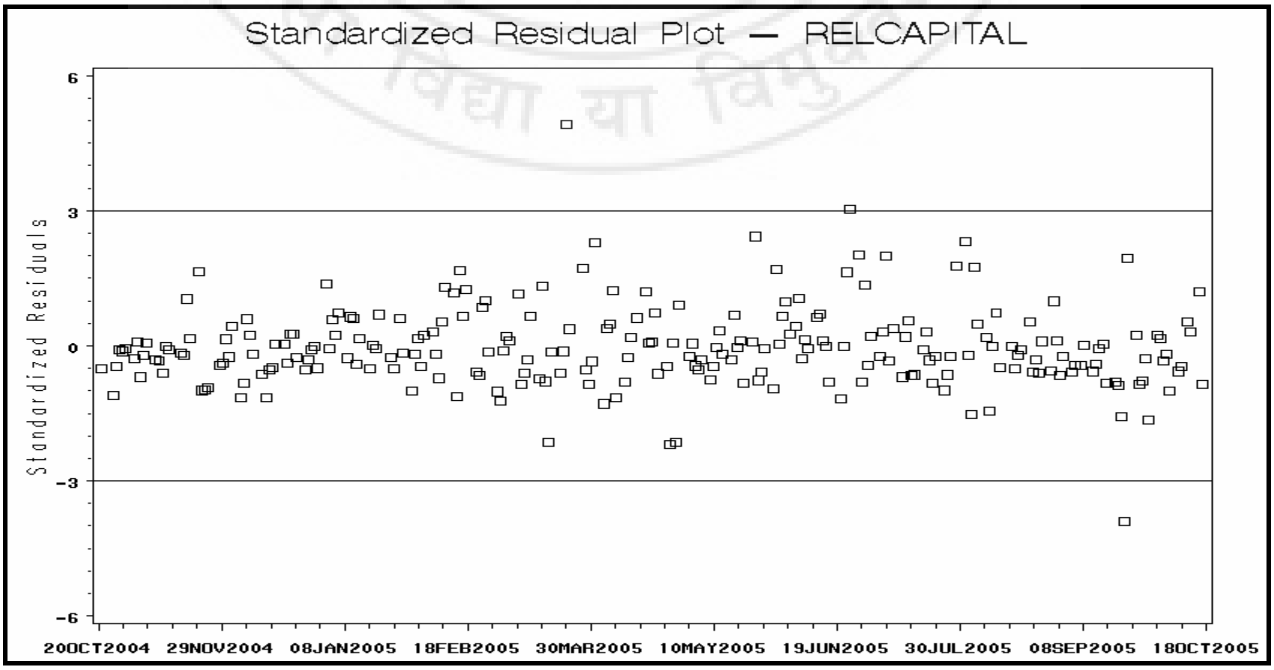
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


RELCAPITAL Daily Returns: Pre & Post Inception of Futures
Daily Returns
24
18
12
6
0
-6
-12
-18
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Cusum Plot for RELCAPITAL Squared Daily Returns
CUSUM
100
0
-100
-200
-300
-400
-500
-600
-700
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Standardized Residual Plot — RELCAPITAL
Standardized Residuals
6
3
0
-3
-6
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005

Stock Symbol – SIEMENS (Siemens Ltd.)

Table No. 91:

Regression Results for SIEMENS using robust standard errors, R_t takes stock symbol SIEMENS, Mkt_t takes Nifty and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

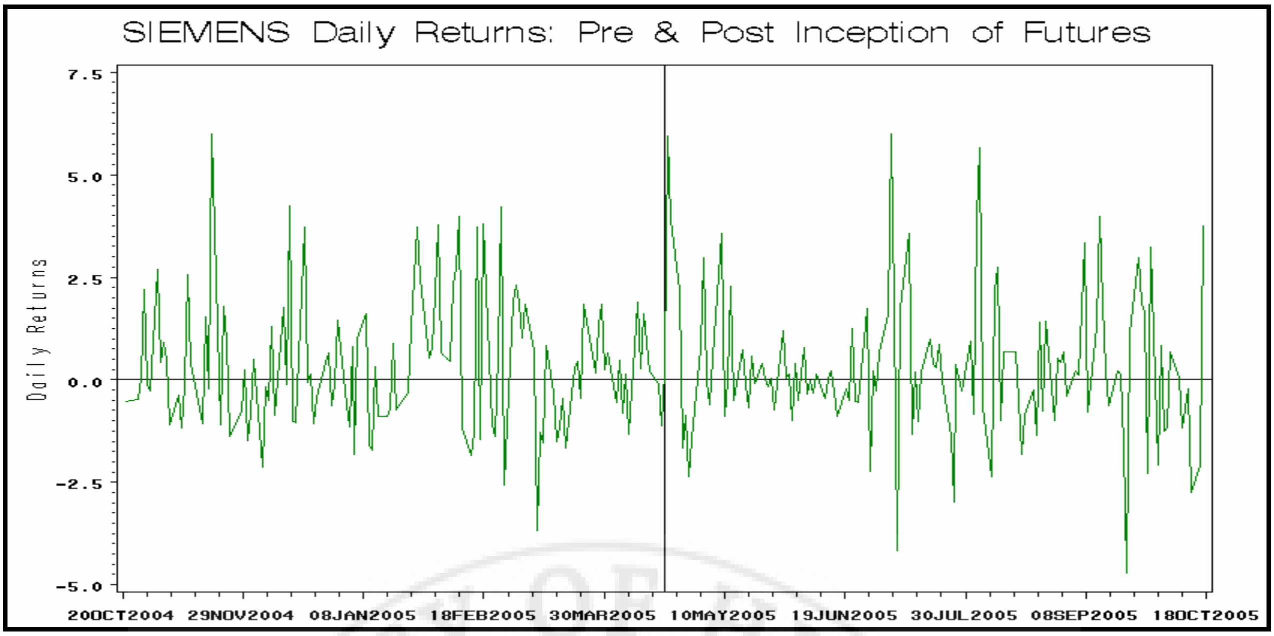
$$R_t = \phi_0 + \theta_1 Mkt_t + \gamma D_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0,1)$$

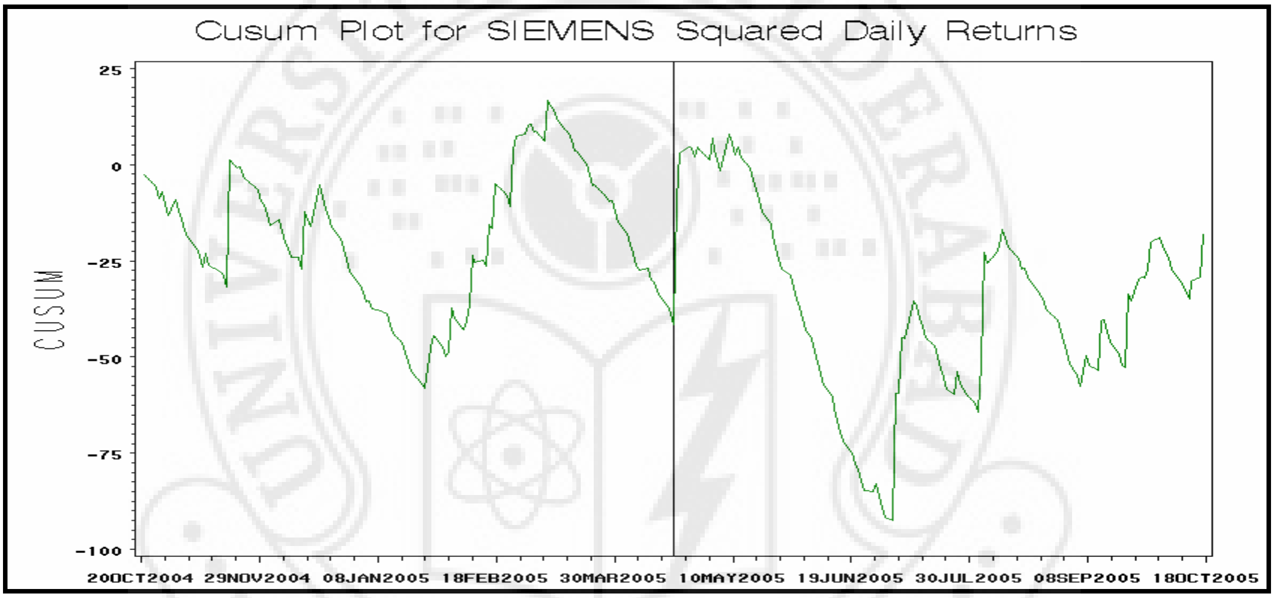
Parameter	Estimate
ϕ_0	0.318 (<0.05)
θ_1	0.445 (<0.01)
γ	-0.172 (>0.10)
F-stat	9.563 (<0.01)
G (4) test-statistic	3.158 (>0.10)
Q (4) test-statistic	3.797 (>0.10)
LM (4) test-static	3.809 (>0.10)

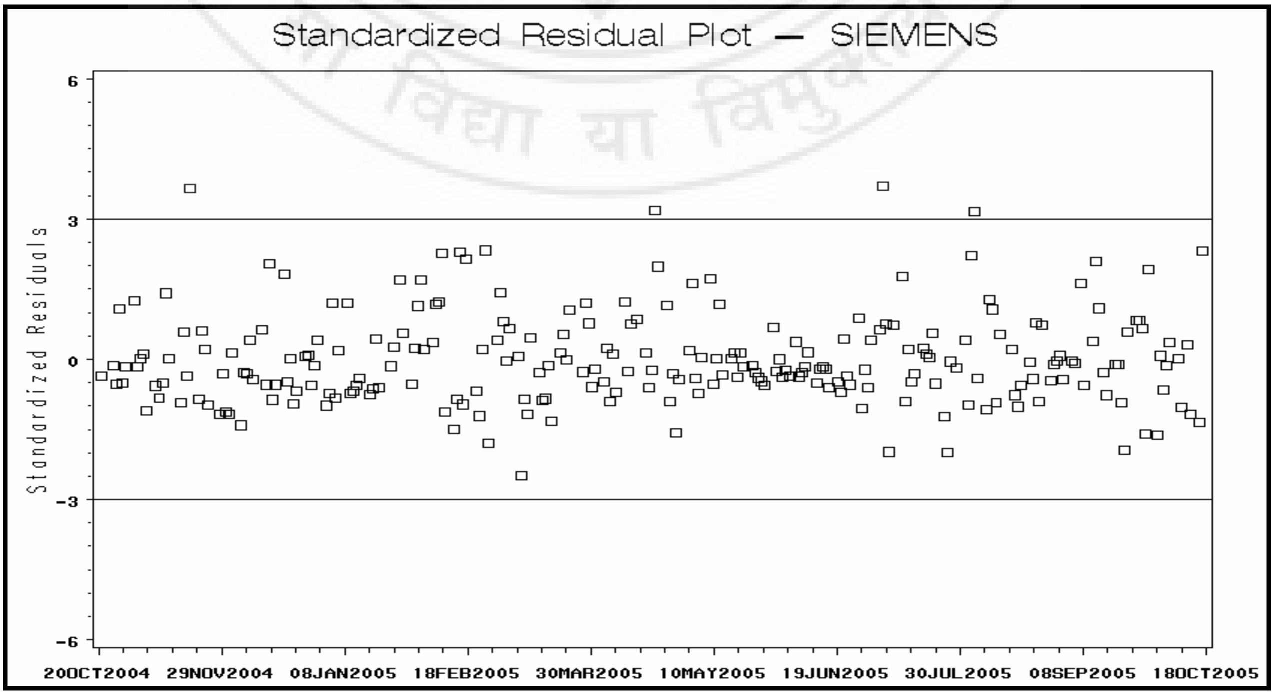
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


SIEMENS Daily Returns: Pre & Post Inception of Futures
Daily Returns
7.5
5.0
2.5
0.0
-2.5
-5.0
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Cusum Plot for SIEMENS Squared Daily Returns
CUSUM
25
0
-25
-50
-75
-100
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Standardized Residual Plot — SIEMENS
Standardized Residuals
6
3
0
-3
-6
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005

Stock Symbol – STER (Sterlite Industries (India) Ltd.)

Table No. 92a: Regression Results-Evidence of ARCH Effects. R_t takes stock symbol STER, Mkt_t takes Nifty.

$$R_t = \phi_0 + \phi_1 R_{t-2} + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	-0.061 (<0.10)
ϕ_1	-0.140 (<0.05)
θ_1	1.291 (<0.01)
F-stat	60.15 (<0.01)
G (4) test-statistic	2.004 (>0.10)
Q (4) test-statistic	16.17 (<0.01)
LM (4) test-static	15.71 (<0.01)

Table No. 92b:

Results of GARCH (1, 1) model for STER using robust standard errors, R_t, Mkt_t are same as defined above and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

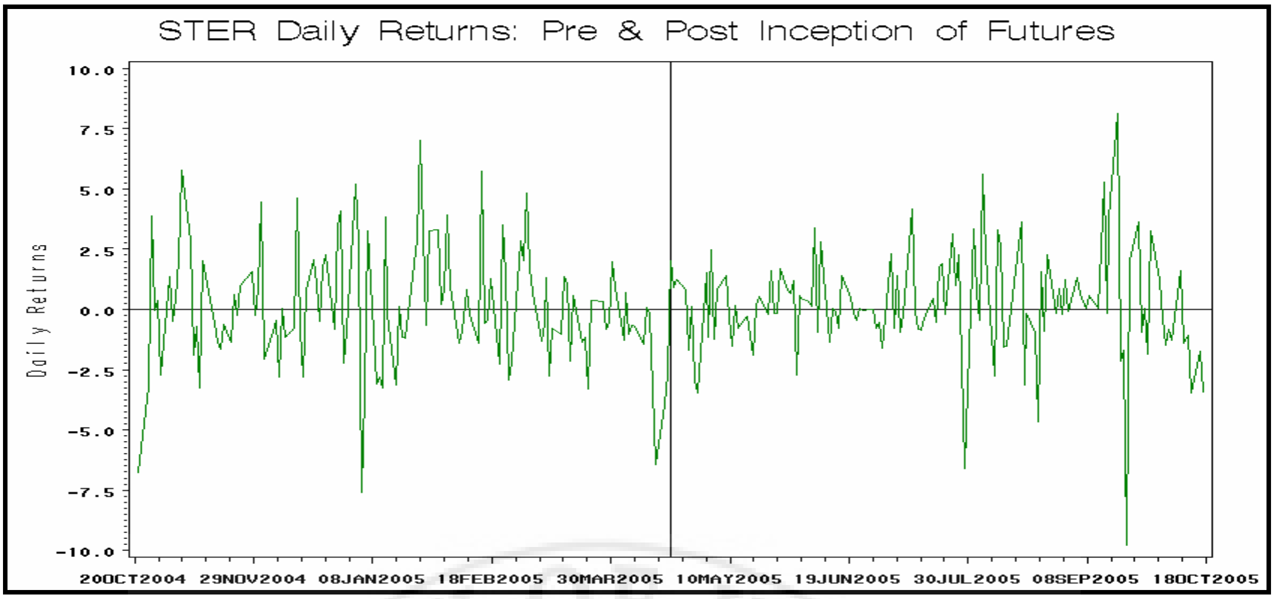
$$R_t = \phi_0 + \phi_1 R_{t-2} + \theta_1 Mkt_t + \varepsilon_t$$

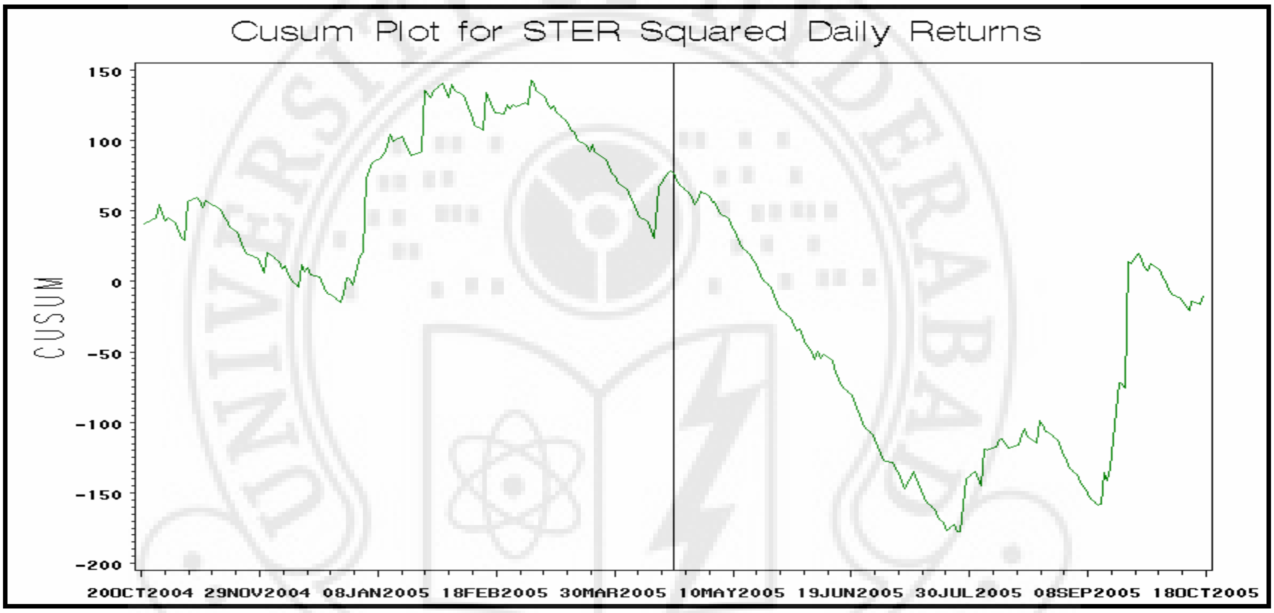
$$\varepsilon_t \sim N(0, h_t)$$

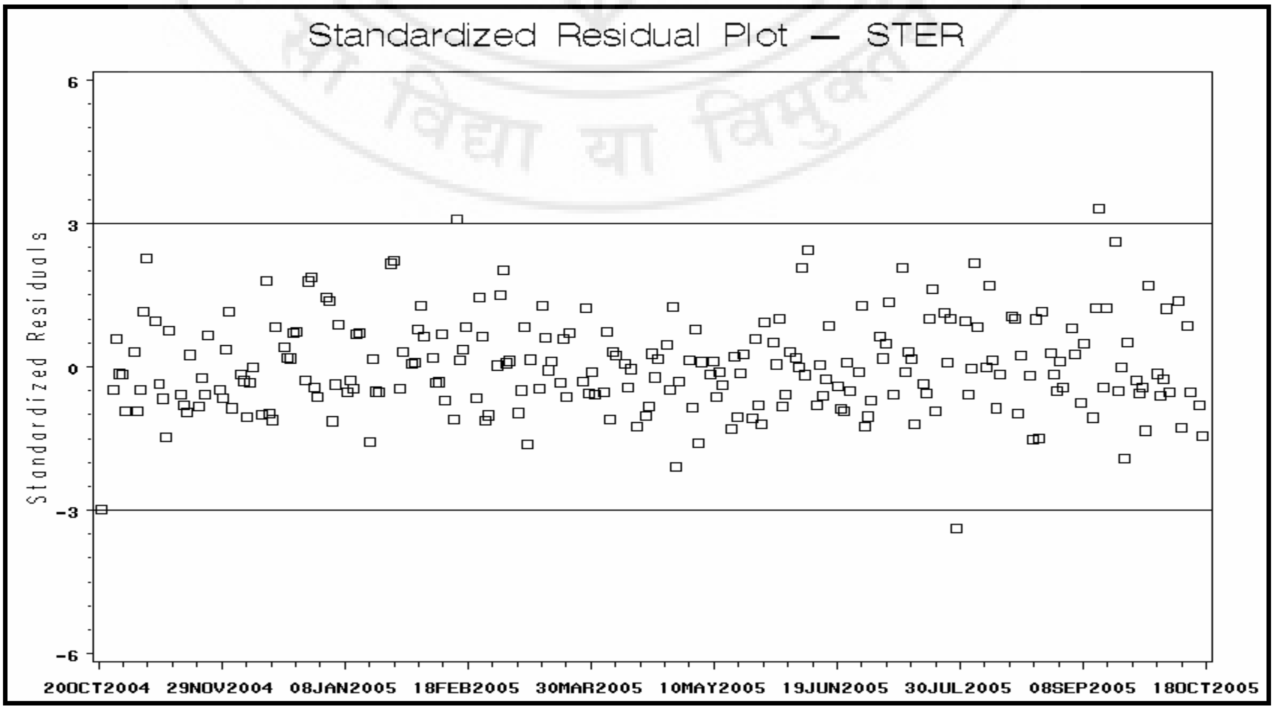
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \alpha_{0,d} D_t + \alpha_{1,d} D_t * \varepsilon_{t-1}^2 + \beta_{1,d} D_t * h_{t-1}$$

Parameter	Estimate	p-value
ϕ_0	-0.105	>0.10
ϕ_1	-0.145	<0.05
θ_1	1.220	<0.01
α_0	0.979	<0.01
α_1	0.299	<0.01
β_1	0.471	<0.01
$\alpha_{0,d}$	-0.014	>0.10
$\alpha_{1,d}$	0.079	>0.10
$\beta_{1,d}$	0.106	>0.10
Diagnostics		
G (4) test-statistic	3.133	>0.10
Q (4) test-statistic	1.875	>0.10
LM (4) test-static	2.143	>0.10
Sign Bias	-0.097	>0.10
Negative Size Bias	0.211	>0.10
Positive Size Bias	0.241	>0.10
Joint Bias	4.113	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 + \beta_1 = 1$	4.360	<0.05

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


STER Daily Returns: Pre & Post Inception of Futures
Daily Returns
10.0
7.5
5.0
2.5
0.0
-2.5
-5.0
-7.5
-10.0
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Cusum Plot for STER Squared Daily Returns
CUSUM
150
100
50
0
-50
-100
-150
-200
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Standardized Residual Plot — STER
Standardized Residuals
6
3
0
-3
-6
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005

Stock Symbol – SUNPHARMA (Sun Pharmaceuticals Industries Ltd.)

Table No. 93:

Regression Results for SUNPHARMA using robust standard errors, R_t takes stock symbol SUNPHARMA, Mkt_t takes Nifty and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

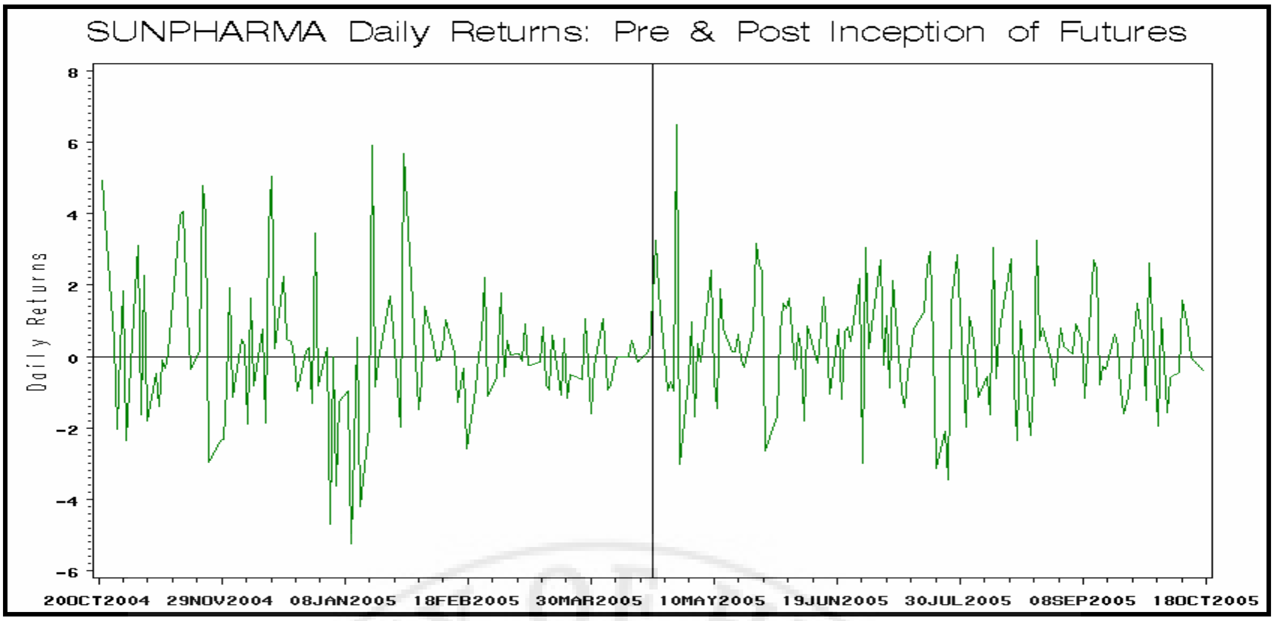
$$R_t = \phi_0 + \theta_1 Mkt_t + \gamma D_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0,1)$$

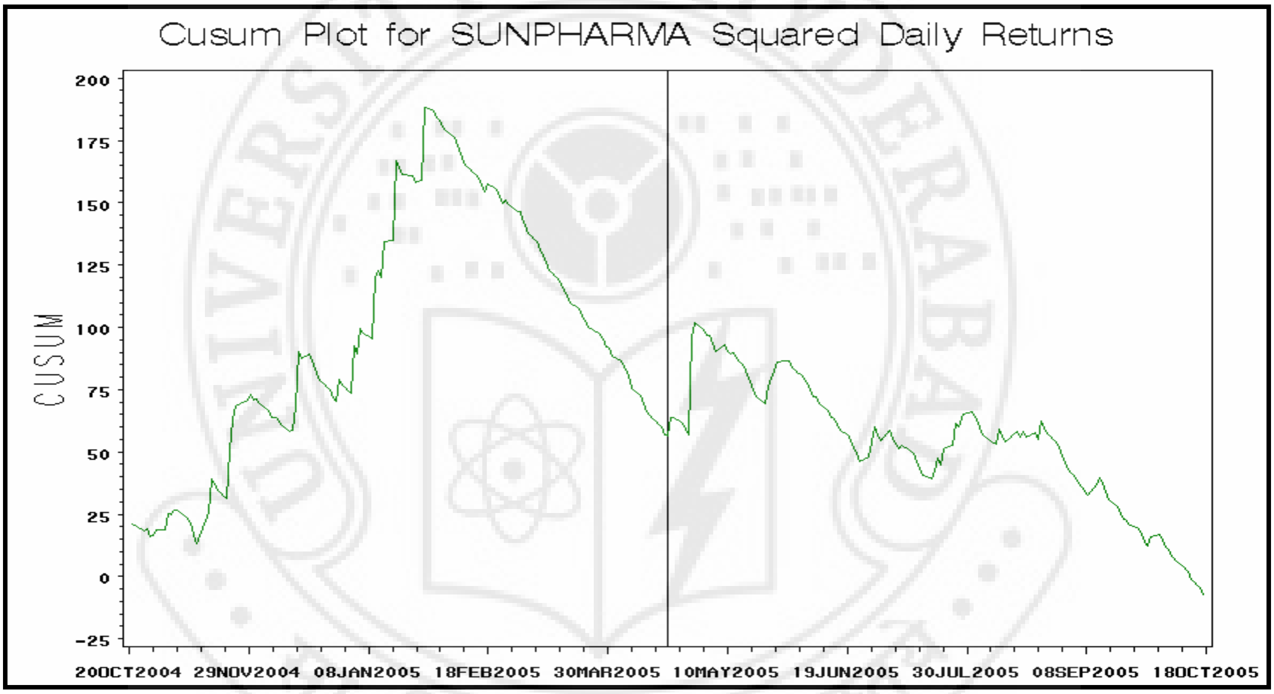
Parameter	Estimate
ϕ_0	0.039 (>0.10)
θ_1	0.444 (<0.01)
γ	0.111 (>0.10)
F-stat	9.290 (<0.01)
G (4) test-statistic	4.553 (>0.10)
Q (4) test-statistic	6.490 (>0.10)
LM (4) test-static	4.414 (>0.10)

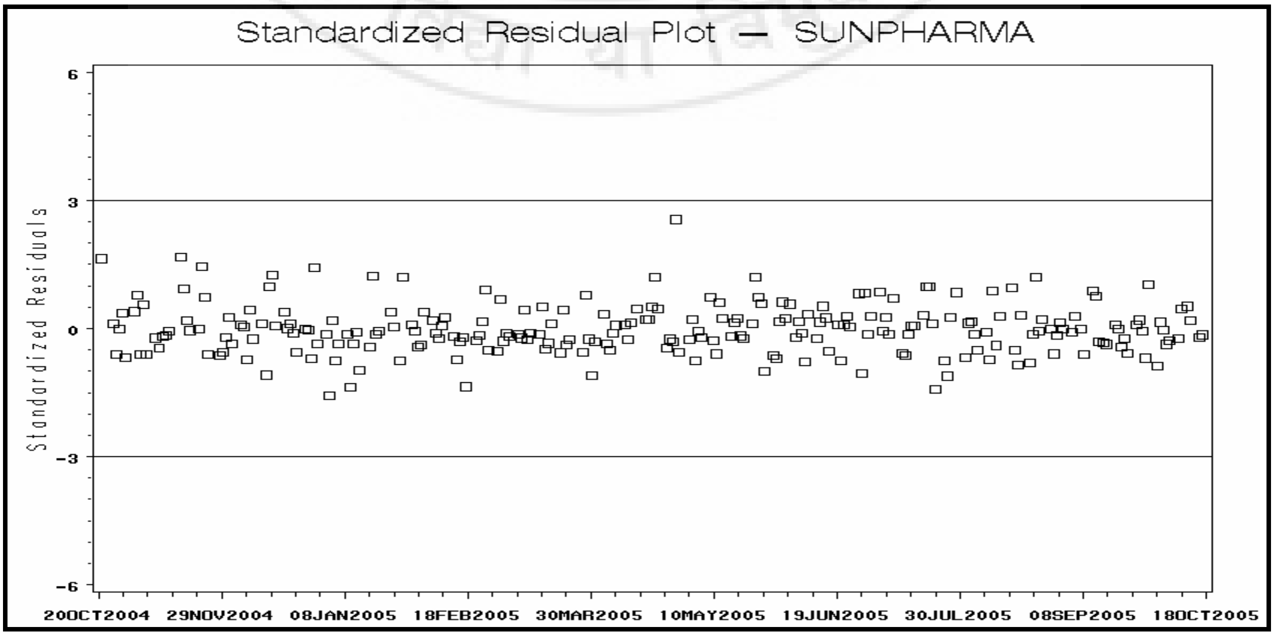
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

LM (k) is the statistic testing the presence of ARCH effects up to lag k.


SUNPHARMA Daily Returns: Pre & Post Inception of Futures
Daily Returns
8
6
4
2
0
-2
-4
-6
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Cusum Plot for SUNPHARMA Squared Daily Returns
CUSUM
200
175
150
125
100
75
50
25
0
-25
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Standardized Residual Plot — SUNPHARMA
Standardized Residuals
6
3
0
-3
-6
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005

Stock Symbol – TATACHEM (Tata Chemicals Ltd.)

Table No. 94a: Regression Results-Evidence of ARCH Effects. R_t takes stock symbol TATACHEM, Mkt_t takes Nifty.

$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	0.055 (>0.10)
θ_1	0.714 (<0.01)
F-stat	45.29 (<0.01)
G (4) test-statistic	2.335 (>0.10)
Q (4) test-statistic	12.73 (<0.01)
LM (4) test-static	12.39 (<0.01)

Table No. 94b:

Results of ARCH (1) model for TATACHEM using robust standard errors, R_t, Mkt_t are same as defined above and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

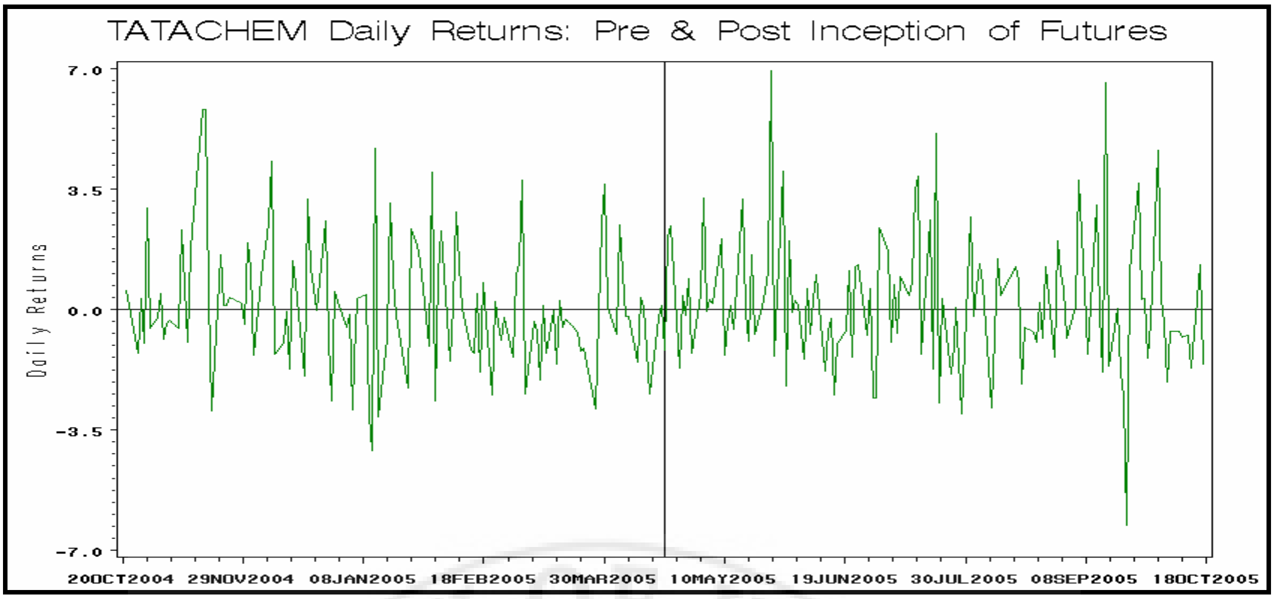
$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

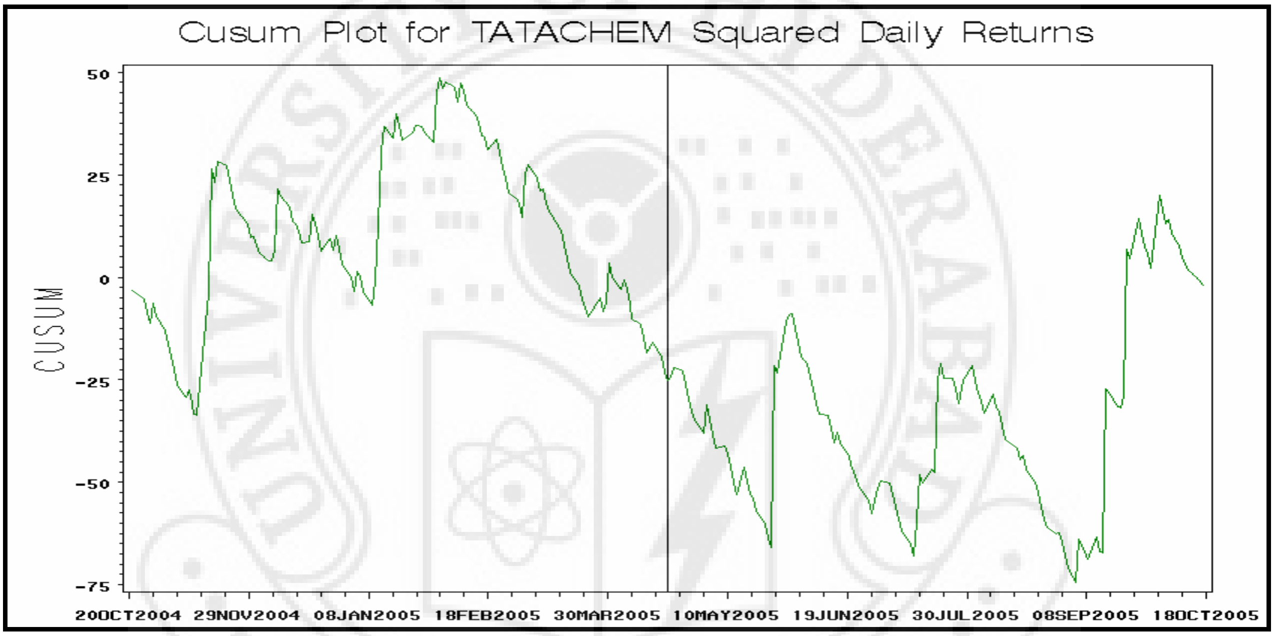
$$\varepsilon_t \sim N(0, h_t)$$

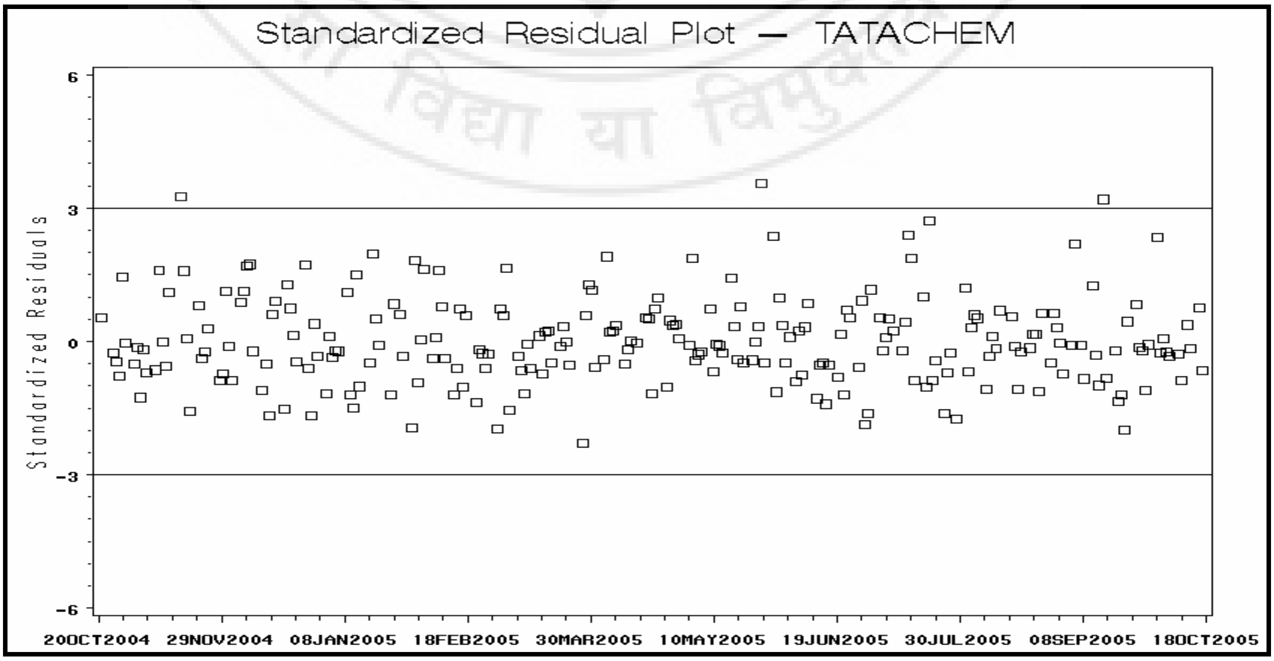
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_{0,d} D_t + \alpha_{1,d} D_t * \varepsilon_{t-1}^2$$

Parameter	Estimate	p-value
ϕ_0	0.025	>0.10
θ_1	0.706	<0.01
α_0	1.991	<0.01
α_1	0.306	<0.10
$\alpha_{0,d}$	0.588	>0.10
$\alpha_{1,d}$	-0.120	>0.10
Diagnostics		
G (4) test-statistic	2.070	>0.10
Q (4) test-statistic	0.581	>0.10
LM (4) test-static	0.680	>0.10
Sign Bias	0.105	>0.10
Negative Size Bias	-0.089	>0.10
Positive Size Bias	-0.019	>0.10
Joint Bias	0.334	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 = 1$	7.710	<0.01

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


TATACHEM Daily Returns: Pre & Post Inception of Futures
Daily Returns
7.0
3.5
0.0
-3.5
-7.0
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Cusum Plot for TATACHEM Squared Daily Returns
CUSUM
50
25
0
-25
-50
-75
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Standardized Residual Plot — TATACHEM
Standardized Residuals
6
3
0
-3
-6
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005

Stock Symbol – UTIBANK (Unit Trust of Bank Ltd.)

Table No. 95a: Regression Results-Evidence of ARCH Effects. R_t takes stock symbol UTIBANK, Mkt_t takes Nifty.

$$R_t = \phi_0 + \phi_1 R_{t-1} + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	0.090 (>0.10)
ϕ_1	-0.172 (<0.01)
θ_1	0.768 (<0.01)
F-stat	16.19 (<0.01)
G (4) test-statistic	3.587 (>0.10)
Q (4) test-statistic	13.76 (<0.01)
LM (4) test-static	11.87 (<0.01)

Table No. 95b:

Results of GARCH (1, 1) model for UTIBANK using robust standard errors, R_t, Mkt_t are same as defined above and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

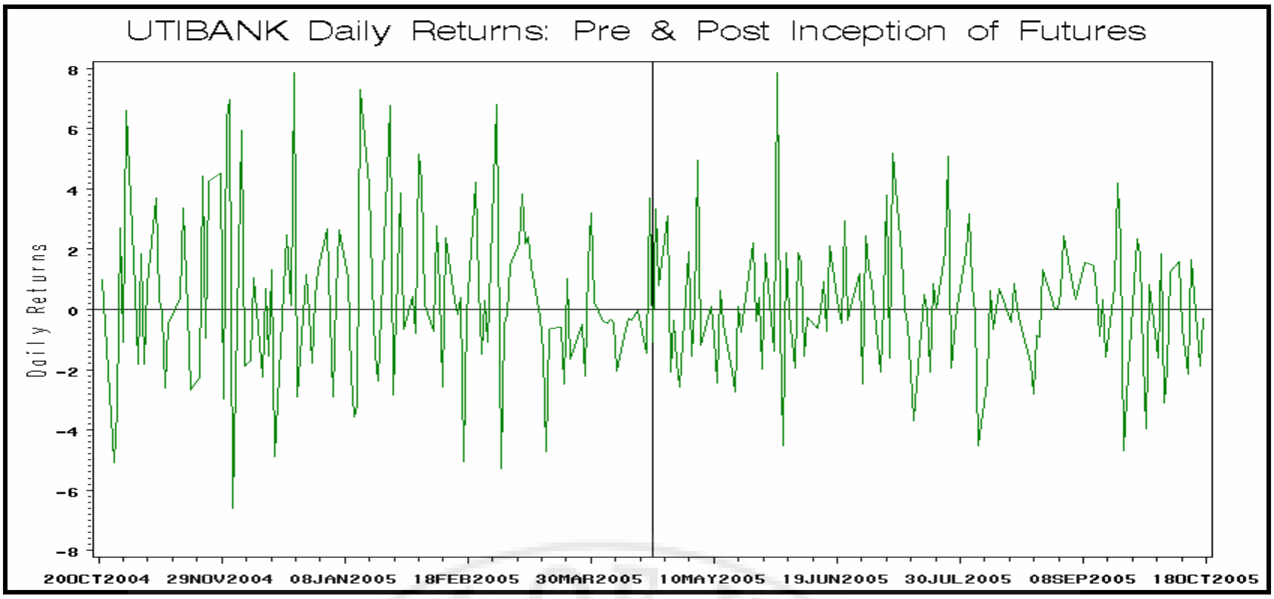
$$R_t = \phi_0 + \phi_1 R_{t-1} + \theta_1 Mkt_t + \varepsilon_t$$

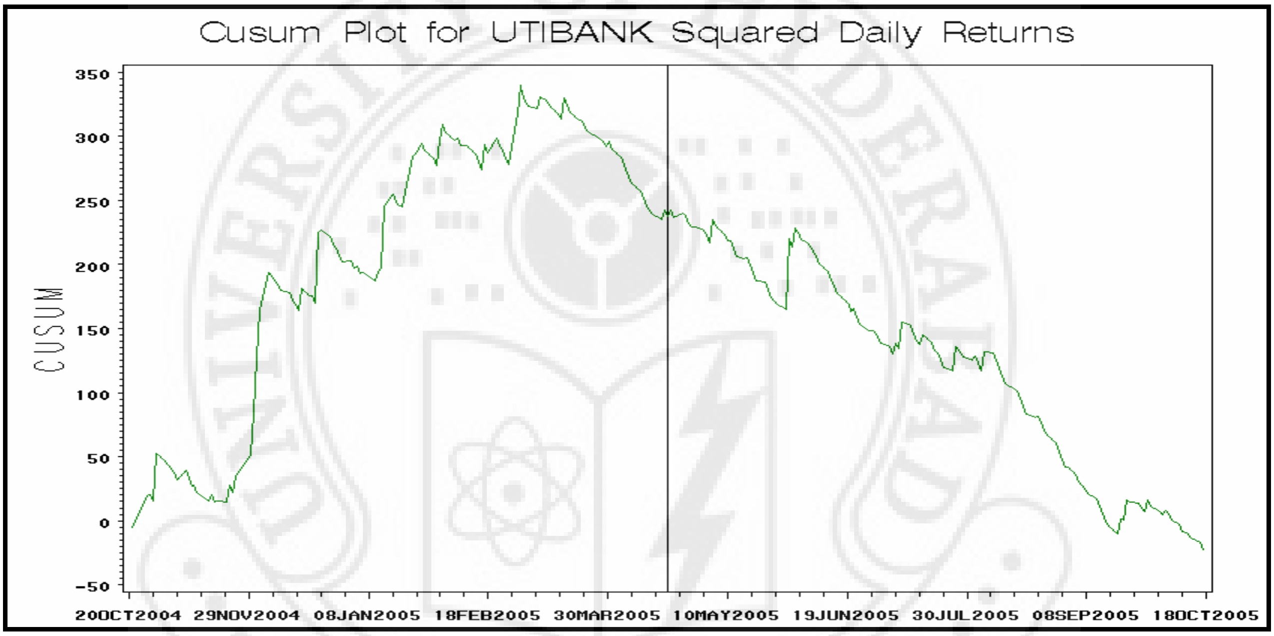
$$\varepsilon_t \sim N(0, h_t)$$

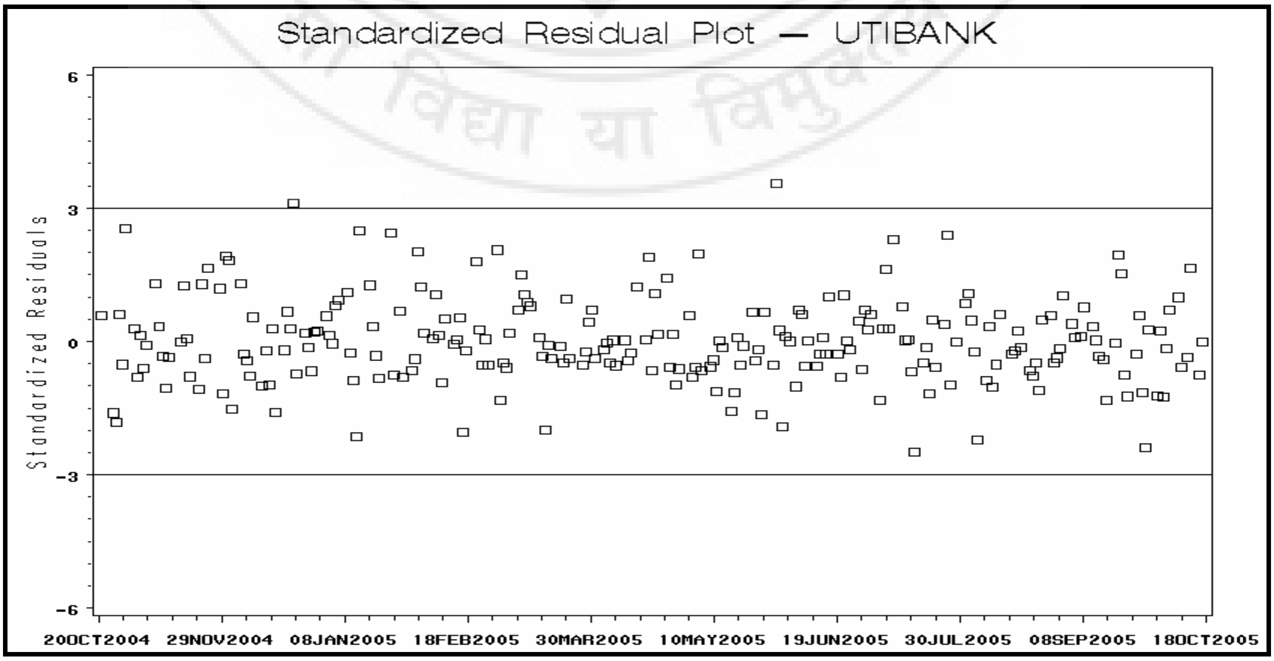
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \alpha_{0,d} D_t + \alpha_{1,d} D_t * \varepsilon_{t-1}^2 + \beta_{1,d} D_t * h_{t-1}$$

Parameter	Estimate	p-value
ϕ_0	0.026	>0.10
ϕ_1	-0.131	<0.05
θ_1	0.814	<0.01
α_0	1.625	>0.10
α_1	0.133	<0.10
β_1	0.633	<0.01
$\alpha_{0,d}$	-0.181	>0.10
$\alpha_{1,d}$	-0.139	>0.10
$\beta_{1,d}$	-0.014	>0.10
Diagnostics		
G (4) test-statistic	3.669	>0.10
Q (4) test-statistic	0.692	>0.10
LM (4) test-static	0.675	>0.10
Sign Bias	0.201	>0.10
Negative Size Bias	-0.079	>0.10
Positive Size Bias	-0.146	>0.10
Joint Bias	1.105	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 + \beta_1 = 1$	5.950	<0.05

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


UTIBANK Daily Returns: Pre & Post Inception of Futures
Daily Returns
8
6
4
2
0
-2
-4
-6
-8
20OCT2004
29NOV2004
08JAN2005
18FEB2005
30MAR2005
10MAY2005
19JUN2005
30JUL2005
08SEP2005
18OCT2005


Cusum Plot for UTIBANK Squared Daily Returns
CUSUM
350
300
250
200
150
100
50
0
-50
20OCT2004
29NOV2004
08JAN2005
18FEB2005
30MAR2005
10MAY2005
19JUN2005
30JUL2005
08SEP2005
18OCT2005


Standardized Residual Plot — UTIBANK
Standardized Residuals
6
3
0
-3
-6
20OCT2004
29NOV2004
08JAN2005
18FEB2005
30MAR2005
10MAY2005
19JUN2005
30JUL2005
08SEP2005
18OCT2005

Stock Symbol – VIJAYABANK (Vijaya Bank Ltd.)

Table No. 96a: Regression Results-Evidence of ARCH Effects. R_t takes stock symbol VIJAYABANK, Mkt_t takes Nifty.

$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	-0.122 (>0.10)
θ_1	1.331 (<0.01)
F-stat	98.03 (<0.01)
G (4) test-statistic	4.883 (>0.10)
Q (4) test-statistic	15.28 (<0.01)
LM (4) test-static	13.37 (<0.01)

Table No. 96b:

Results of GARCH (1, 1) model for VIJAYABANK using robust standard errors, R_t, Mkt_t are same as defined above and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

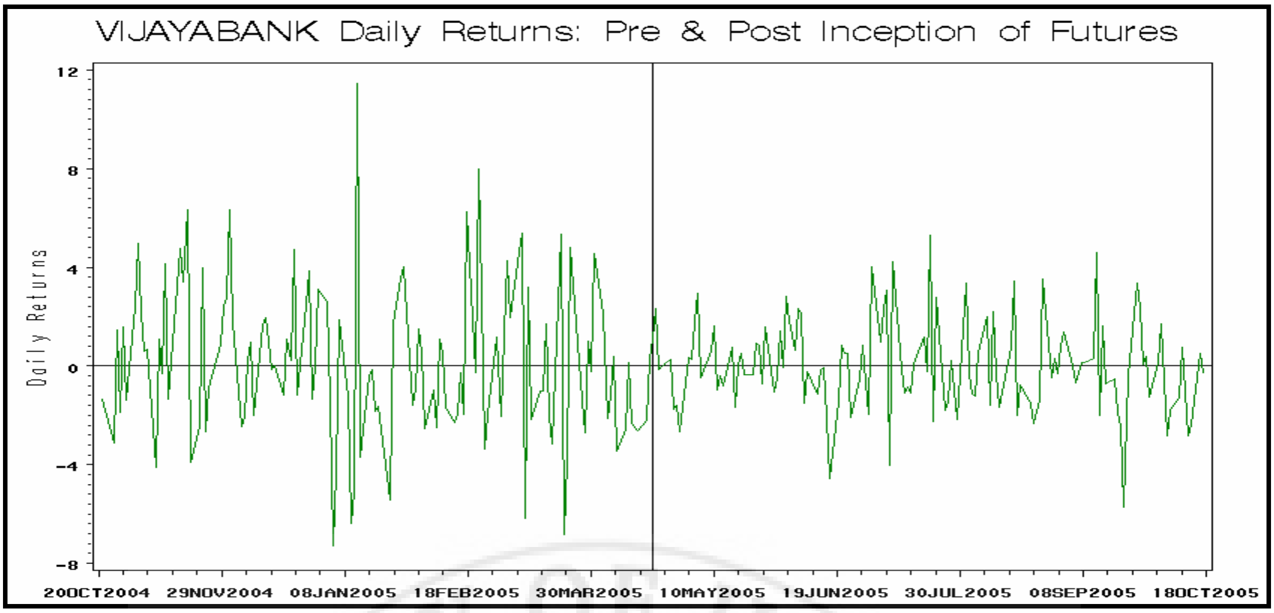
$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

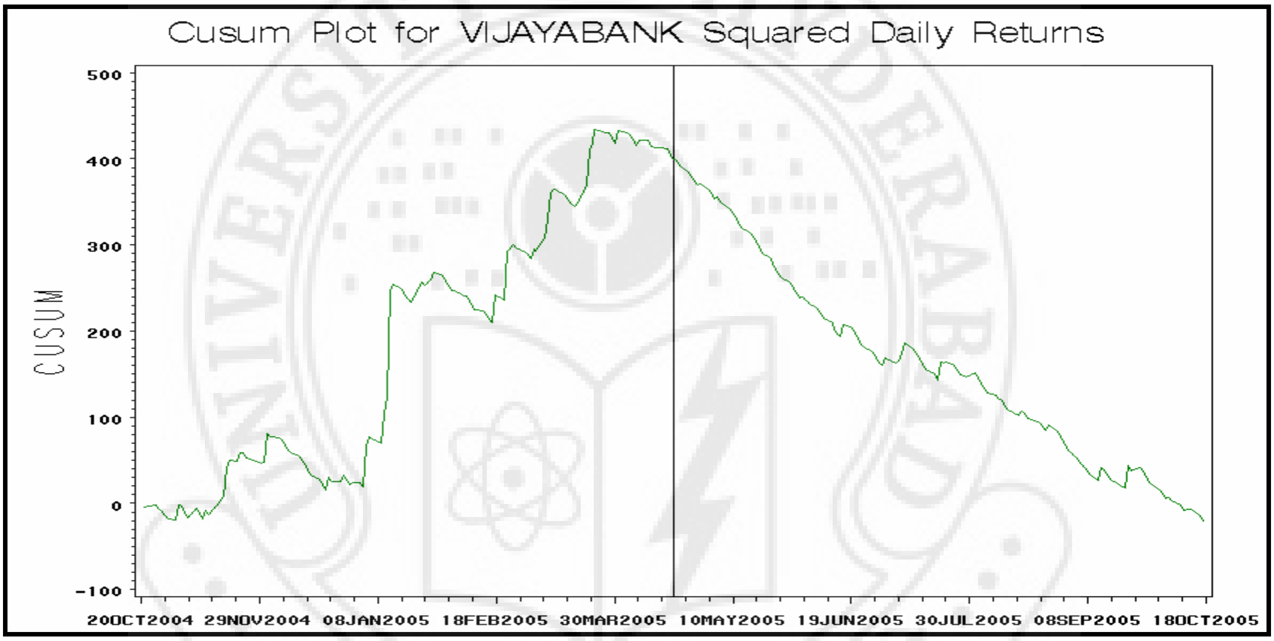
$$\varepsilon_t \sim N(0, h_t)$$

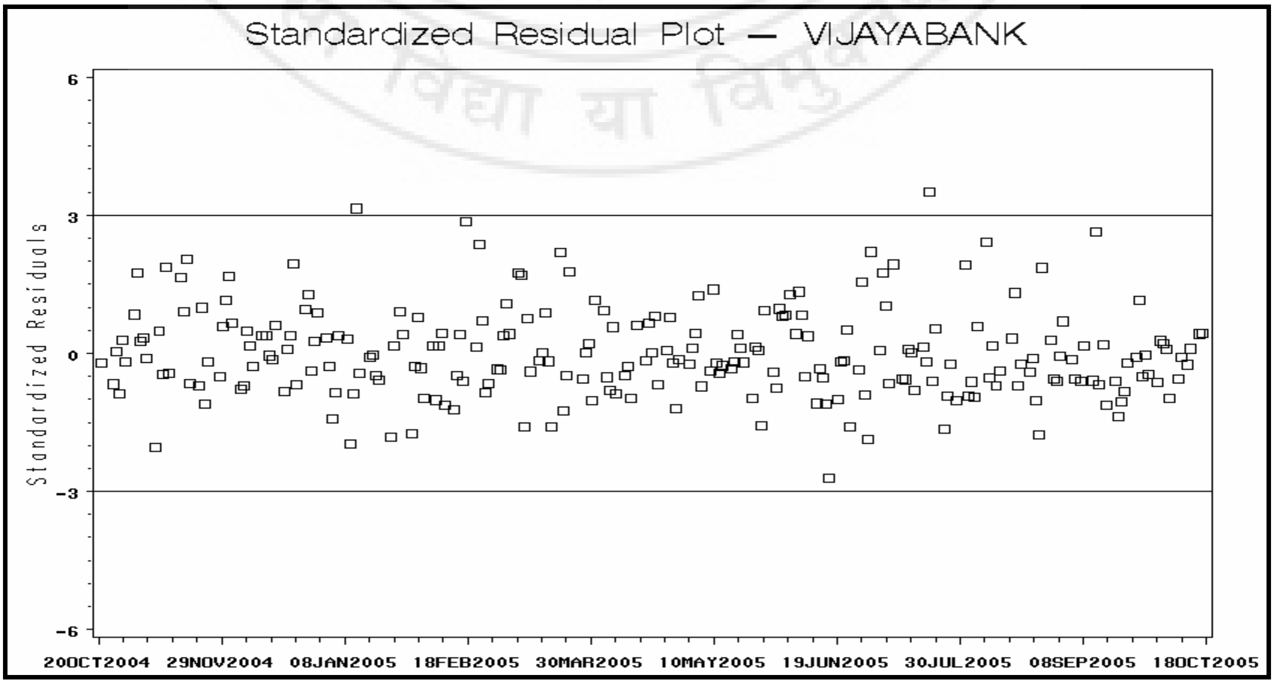
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \alpha_{0,d} D_t + \alpha_{1,d} D_t * \varepsilon_{t-1}^2 + \beta_{1,d} D_t * h_{t-1}$$

Parameter	Estimate	p-value
ϕ_0	-0.141	>0.10
θ_1	1.143	<0.01
α_0	2.033	<0.10
α_1	0.185	<0.10
β_1	0.463	<0.10
$\alpha_{0,d}$	-1.009	>0.10
$\alpha_{1,d}$	-0.047	>0.10
$\beta_{1,d}$	-0.045	>0.10
Diagnostics		
G (4) test-statistic	1.780	>0.10
Q (4) test-statistic	1.011	>0.10
LM (4) test-static	0.994	>0.10
Sign Bias	0.230	>0.10
Negative Size Bias	-0.279	>0.10
Positive Size Bias	-0.220	>0.10
Joint Bias	2.265	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 + \beta_1 = 1$	10.75	<0.01

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


VIJAYABANK Daily Returns: Pre & Post Inception of Futures
Daily Returns
12
8
4
0
-4
-8
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Cusum Plot for VIJAYABANK Squared Daily Returns
CUSUM
500
400
300
200
100
0
-100
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Standardized Residual Plot — VIJAYABANK
Standardized Residuals
6
3
0
-3
-6
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005

Stock Symbol – VSNL (Videshi Sanchar Nigam Ltd.)

Table No. 97a: Regression Results-Evidence of ARCH Effects. R_t takes stock symbol VSNL, Mkt_t takes Nifty.

$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	0.091 (>0.10)
θ_1	1.190 (<0.01)
F-stat	59.55 (<0.01)
G (4) test-statistic	1.209 (>0.10)
Q (4) test-statistic	11.56 (<0.01)
LM (4) test-static	9.731 (<0.01)

Table No. 97b:

Results of ARCH (1) model for VSNL using robust standard errors, R_t, Mkt_t are same as defined above and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

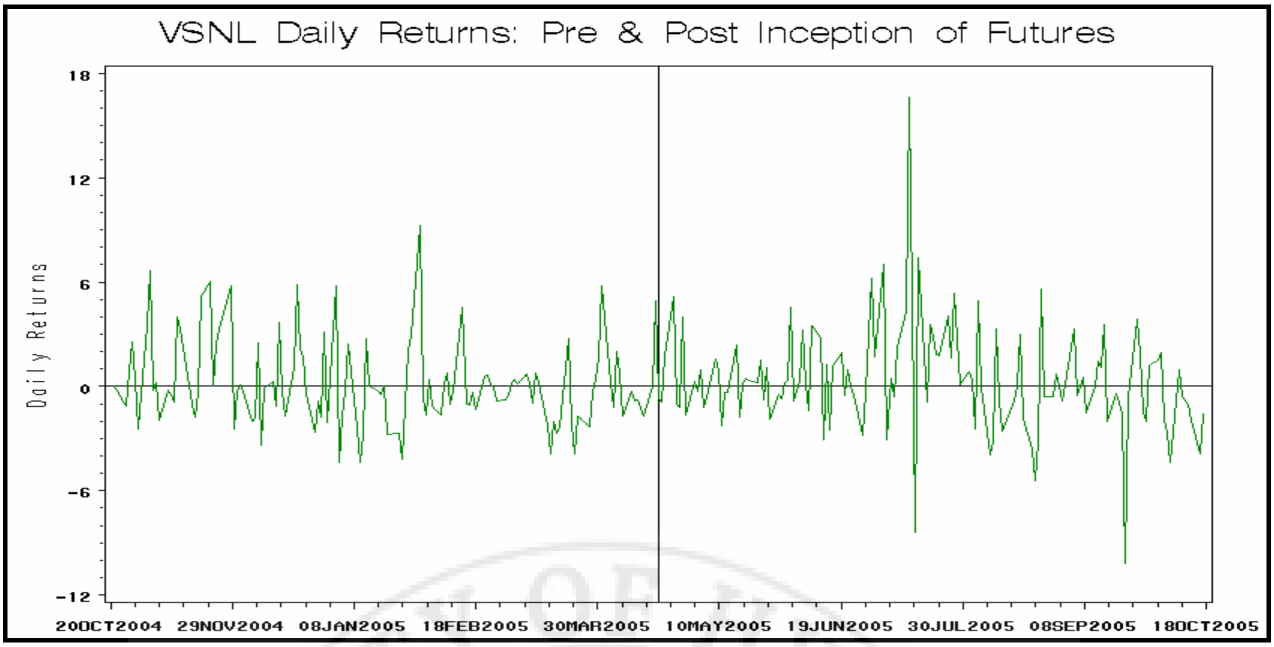
$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t$$

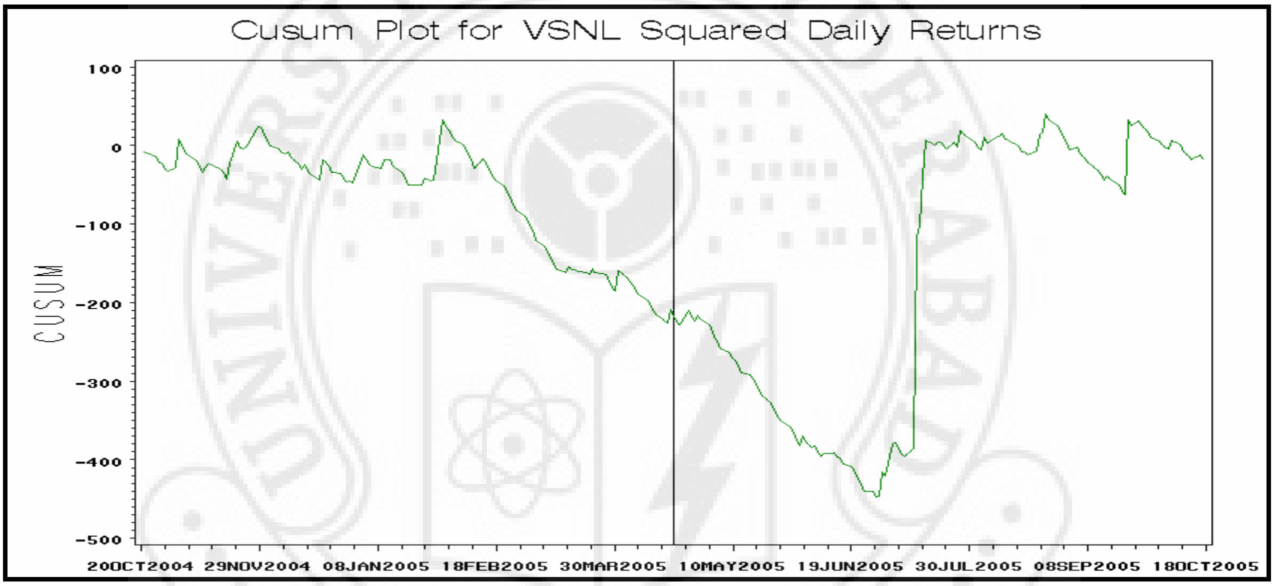
$$\varepsilon_t \sim N(0, h_t)$$

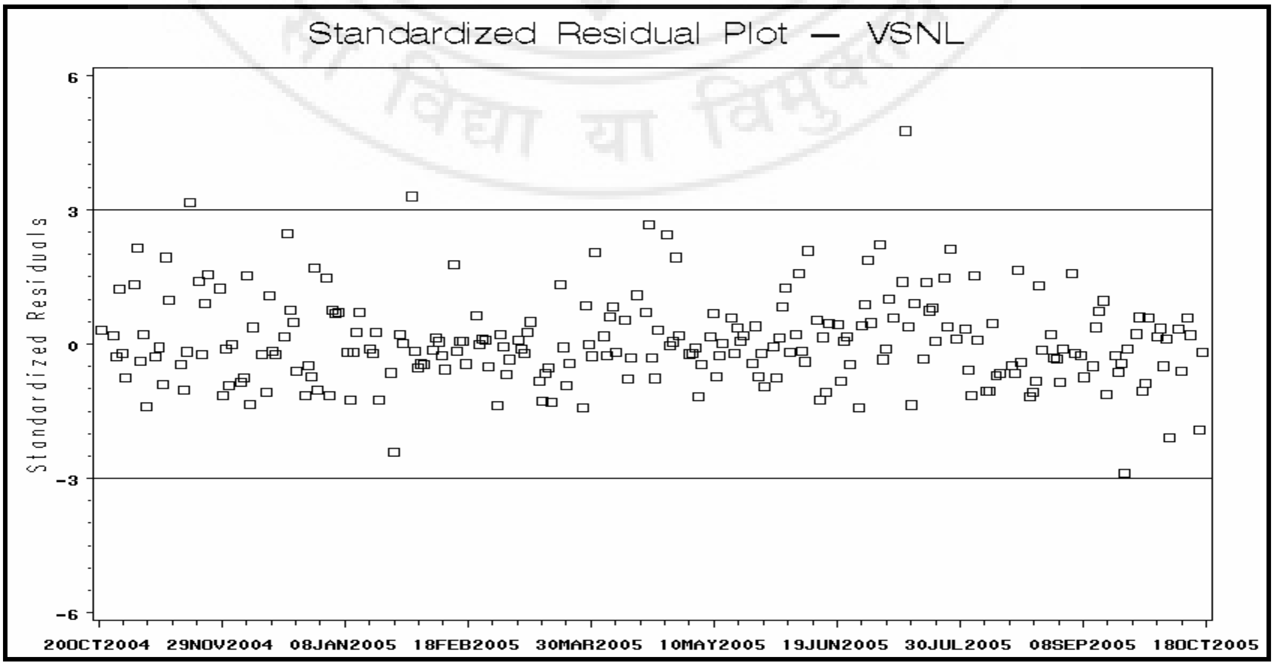
$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_{0,d} D_t + \alpha_{1,d} D_t * \varepsilon_{t-1}^2$$

Parameter	Estimate	p-value
ϕ_0	-0.115	>0.10
θ_1	1.104	<0.01
α_0	3.546	<0.01
α_1	0.311	<0.10
$\alpha_{0,d}$	-0.315	>0.10
$\alpha_{1,d}$	0.363	>0.10
Diagnostics		
G (4) test-statistic	1.846	>0.10
Q (4) test-statistic	1.675	>0.10
LM (4) test-static	1.667	>0.10
Sign Bias	-0.334	>0.10
Negative Size Bias	0.390	>0.10
Positive Size Bias	0.001	>0.10
Joint Bias	2.662	>0.10
Likelihood Ratio Test		
$H_0 : \alpha_1 = 1$	9.010	<0.01

G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.
Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.
LM (k) is the statistic testing the presence of ARCH effects up to lag k.
Sign bias, Negative size, Positive size and Joint bias tests are asymmetric test statistics given by Engle and Ng (1993).


VSNL Daily Returns: Pre & Post Inception of Futures
Daily Returns
18
12
6
0
-6
-12
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Cusum Plot for VSNL Squared Daily Returns
CUSUM
100
0
-100
-200
-300
-400
-500
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005


Standardized Residual Plot — VSNL
Standardized Residuals
6
3
0
-3
-6
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005

Stock Symbol – WOCKPHARMA (Wockhard Ltd.)

Table No. 98:

Regression Results for WOCKPHARMA using robust standard errors, R_t takes stock symbol WOCKPHARMA, Mkt_t takes Nifty and D_t takes on value of zero before SSFs introduction and a value of one afterwards.

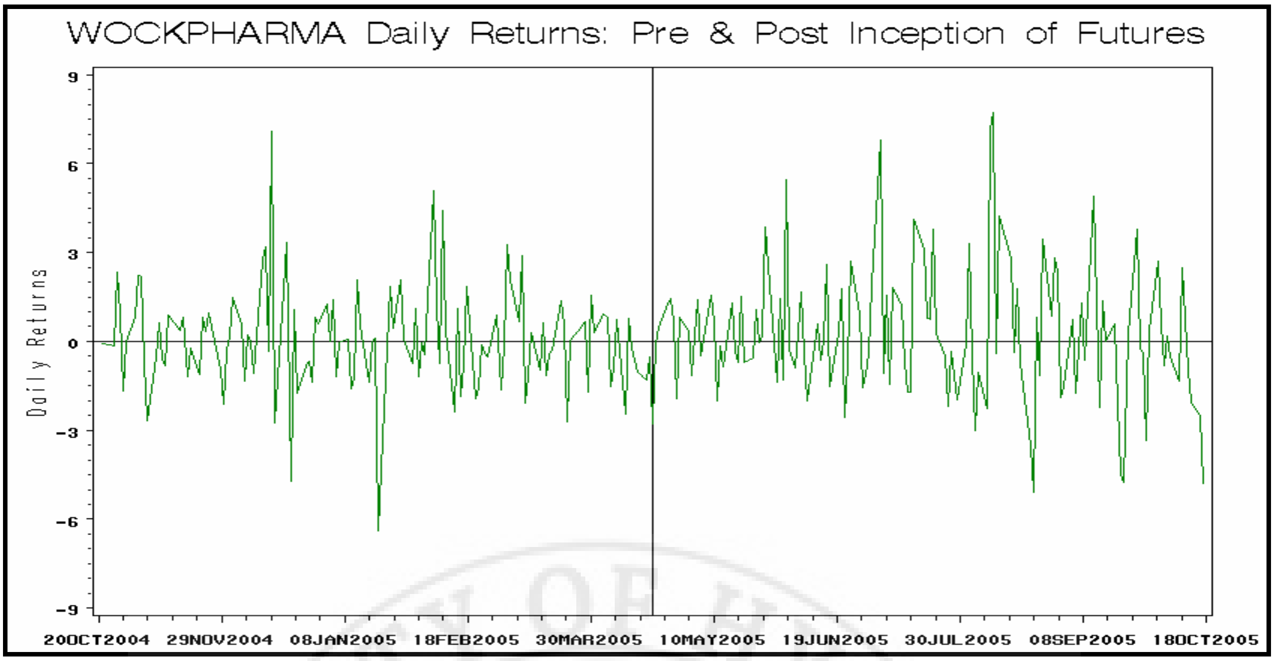
$$R_t = \phi_0 + \phi_1 R_{t-4} + \theta_1 Mkt_t + \gamma D_t + \varepsilon_t$$
$$\varepsilon_t \sim N(0,1)$$

Parameter	Estimate
ϕ_0	-0.232 (>0.10)
ϕ_1	-0.158 (<0.05)
θ_1	0.607 (<0.01)
γ	-0.001 (>0.10)
F-stat	11.15 (<0.01)
G (4) test-statistic	2.727 (>0.10)
Q (4) test-statistic	6.691 (>0.10)
LM (4) test-static	6.629 (>0.10)

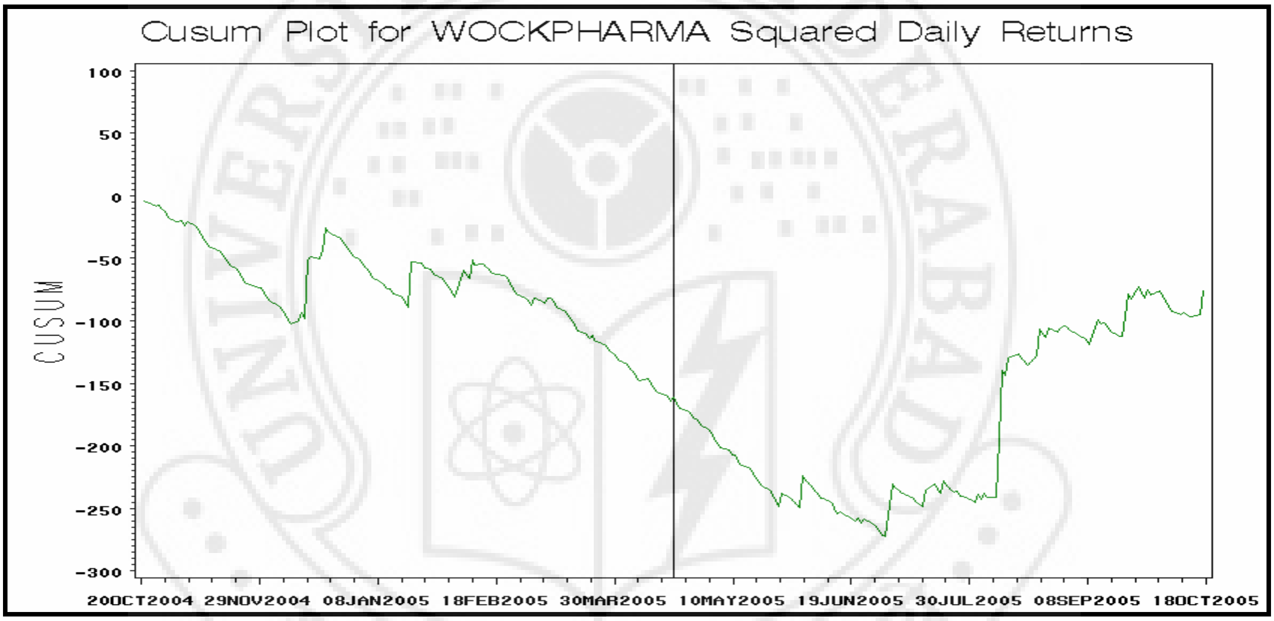
G (k) is the Godfrey test statistic for residual serial-correlation up to lag k.

Q (k) is the portmanteau test statistic for squared-residuals serial-correlation up to lag k.

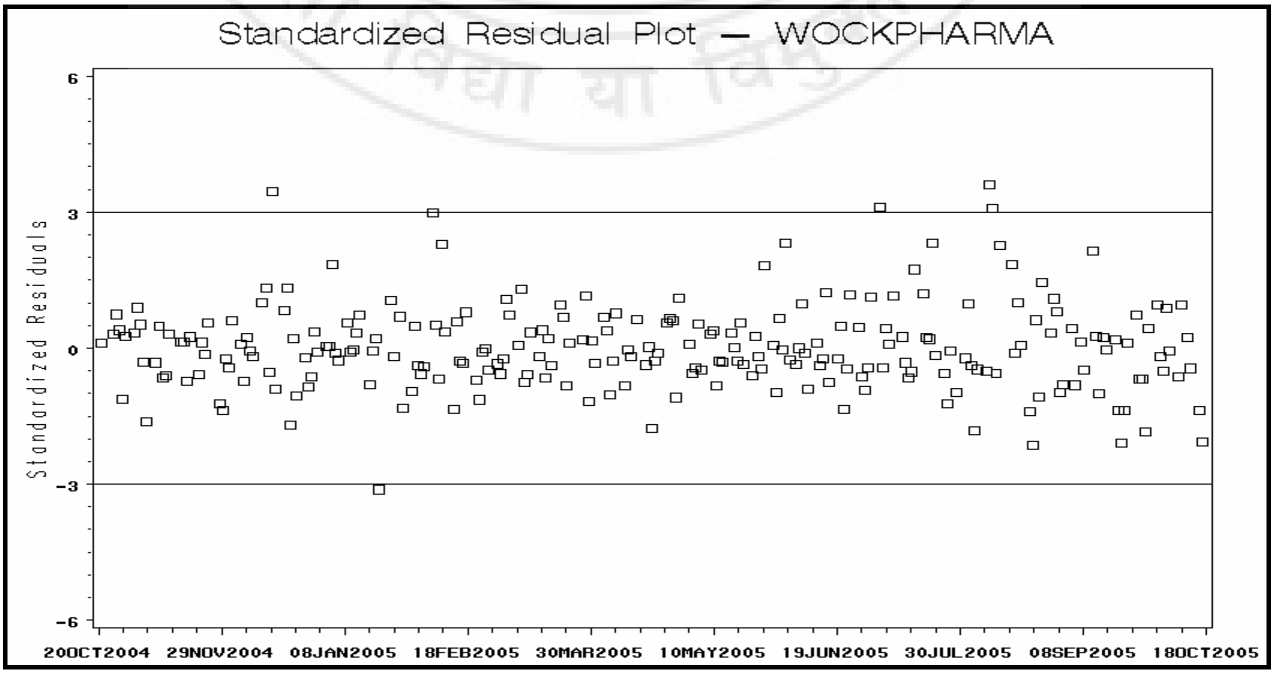
LM (k) is the statistic testing the presence of ARCH effects up to lag k.



WOCKPHARMA Daily Returns: Pre & Post Inception of Futures
Daily Returns
9
6
3
0
-3
-6
-9
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005



Cusum Plot for WOCKPHARMA Squared Daily Returns
CUSUM
100
50
0
-50
-100
-150
-200
-250
-300
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005



Standardized Residual Plot — WOCKPHARMA
Standardized Residuals
6
3
0
-3
-6
20OCT2004 29NOV2004 08JAN2005 18FEB2005 30MAR2005 10MAY2005 19JUN2005 30JUL2005 08SEP2005 18OCT2005

Appendix D:

Cumulative Sum (CUSUM) plots are proposed by Talyor (2000) to discover the likely shift level in a continuum (especially in a time series data). These are built by computing and plotting a cumulative sum based on the data as follows:

Let X_1, X_2, …, X_n represent the n consecutive observations of a time series, then cumulative sums S_0, S_1, …, S_n are calculated as follows:

1) First calculate the average $\overline{X} = \dfrac{X_1 + X_2 + ... + X_n}{n}$
2) Start the cumulative sum at zero by setting $S_0 = 0$.
3) Calculate the other cumulative sums by adding the difference between current value and the average to the previous sum, that is $S_i = S_{i-1} + (X_i - \overline{X})$ for i=1,2,..n.
4) Plot the S_i series.

The CUSUM plots give us an estimate of how each return series deport around its mean. If the CUSUM chart exhibits an upward slope during a period, this indicates that the returns in that period tend to be above the overall average, and similarly, a segment with a downward slope indicates a period of time where the returns tend to be below the overall average. Thus, a sudden change in direction of the CUSUM indicates a shift in the value of the time series which tends to be above the average instead of below or below instead of above. Thus, it shows a change of trend's value compared to the overall average. A period of time where CUSUM statistics remains relatively the same refers to a segment where the average did not change.

A Transition in Indian Derivative Markets – A Case Study of Single Stock Futures

Chapter V

Summary

i. OVERVIEW:

SSFs introduction in India presumed a lot of debate before their introduction, regardless of all those, their commencement was a concomitant due to oblige as mentioned in the previous chapters of the current study. Subsequently, within no time these SSFs promptly occupied number one position in the world with respect to notional trading volumes. However, the frequent arguments of their highly risk nature was haunted across the financial system with several incoherent arguments based on the experiences of developed markets. As Indian case is different being an emerging market rather than by statements, it has to be addressed through empirical evidence. Therefore the present study made an attempt to examine the impact of introduction of SSFs in India. The study focused on liquidity and volatility, two crucial characteristics of any stock market. We consider five different dates of futures introduction (till 2005) that comprise 86 stock futures listing. The liquidity and volatility features are analyzed six months before and after listing of futures for each stock. First, the study concentrates on Liquidity of the spot market measured by using a proxy namely Trading Volume and concludes that the liquidity of spot segment improved substantially after SSFs introduction. Next, the study looks at Volatility of the spot market, proxy being daily log-returns. Further, the volatility estimate is linked with information absorption process by modeling return process in ARMA-GARCH framework.

ii. CONCLUSIONS OF THE STUDY:

- The initial analysis of liquidity, with regard to five different listings suggests an increase in the stocks spot volumes after SSFs introduction.

- Study observes what appears to be a strong gain in the liquidity of SSFs traded stocks in post introduction period.
- Liquidity effects across different type of companies/industries/sectors are not similar.
- Analysis of impact costs also revealed the same for liquidity effects.
- A shift in the level of the underlying volatility has been observed but not of same sign and magnitude across different listings.
- From time-varying systematic volatility, it has been observed that after the introduction of SSFs a decrease in the persistence of volatility shocks are apparent across different listings.
- In fact, there was scarce evidence for the measure which reflects the ability to quickly incorporate new information.
- The sign and magnitude of estimated volatility coefficients varied significantly across different companies/industries/sectors.
- Stock options effect was negligible and interestingly near evidence of both impacts to be null.
- There was clearly no manifestation towards unsystematic volatility i.e. asymmetries in almost all cases except for one stock.
- Presented outcomes are more robust to the model specification and market wide movements.
- The results for the Indian market are not in accordance with the majority of arguments based on the developed market studies as we cannot identify a decline in the underlying spot volumes.

- At the same time market seemed to become/towards more efficient as the volatility shocks became less persistent after the start of SSFs.
- However, study observes diametric results in very rare cases.
- Altogether, results indicate that the underlying spot market has evidence towards more market efficiency direction though not strong enough.
- We demonstrated coherent arguments with respect to SSFs introduction in India on basis of empirical evidence.

iii. LIMITATIONS OF THE STUDY:

- Study has not considered an in depth Liquidity measurement.
- Expiration effects of SSFs and fractionally integrated models.

iv. SCOPE FOR FURTHER RESEARCH:

This study is one of the first of its kind in addressing the SSFs introduction impact from liquidity and informational absorption aspects (a significant contribution as against other studies) which has several implications for policy makers, traders and academicians. Study being in the context of emerging market is considered to be more meaningful as guidance for following emerging markets. However results should be cautionary taken into account due to differential existences of micro market structure across markets. At this juncture, the present study would be very utile to extend the scope of research to study the co-integration between the prices of the stock futures and the underlying spot markets or even the consideration of analyzing the behavior around a coming to an end of a contract period analysis are good and relevant directions for future research.

v. FINALE:

The present study made an attempt to assess the few key aspects of the spot market after a drastic transition with the inception of equity derivative product viz. SSFs that took place in Indian stock markets. As the study being an earlier attempt in Indian context and also for emerging markets context, carries out logical assessment and the evaluations hold more proficiency.

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Synopsis OF THESIS

TITLED

A TRANSITION IN INDIAN DERIVATIVE MARKETS – A CASE STUDY OF SINGLE STOCK FUTURES

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UNDER THE SUPERVISION OF
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TO BE SUBMITTED FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY IN ECONOMICS

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A TRANSITION IN INDIAN DERIVATIVE MARKETS – A CASE STUDY OF SINGLE STOCK FUTURES

INTRODUCTION:

After the March 2001 scam, the SEBI, Indian capital market regulator introduced a package of reforms. These reforms comprise the abolition of badla, the adoption of rolling settlement, introducing stock derivatives. The futures trading on stocks[1] carries a huge success story and NSE tops the exchanges across the world in terms of trading volume on stock futures. In developed markets, like US, stock futures have not received sufficient trading interest and whereas for the Indian investors the stock futures meant as continuation of the badla system combined with long settlement cycles. Though, stock futures are popular now, little is relatively known to the researchers and regulators around the world on how these new trading instruments impact the spot market characteristics. The present study makes an attempt to examine the impact of introduction of stock futures contracts on quality of spot market, NSE, India.

REVIEW OF LITERATURE-SUM-UP:

Summing up the review of literature is a colossal task, hitherto, attempt had made to encapsulate major findings and problems reported by them on the centre of liquidity rooting from volatility that are significant from efficiency perspective, traders' perspective

[1] Through out this study 'stock futures', 'futures on individual stocks', 'individual stock futures' which are synonymous words are referred as 'Single Stock Futures (SSFs)'.

and of course undoubtedly to the academicians also. It has been observed that for International and Indian studies on index futures provided mixed results, which point out that this raises specifically when index futures not being an exogenous event, accompanied by several other internal policy matters, reforms and exchange related reorganizations. Though some studies conclude specific outcome of either increased or decreased volatility, one can observe from above that the pattern found not to be same across studies within the country and naturally differs from across the countries classified to be developed and new markets. Together, there is no firm evidence from the literature exists, which says that these products have been apparently optimistic and specific to developed markets.

Even, for India (being an emerging market), there was inconclusiveness whether the introduction of index futures have resulted in decrease or increase in volatility. And all most all studies more or less accept that in India inception of index futures has been accompanied with lot of reforms put forth by regulator, for securities trading both before and after giving permission for index futures, importantly it has to change the norms for stock exchanges to introduce these derivative securities. Further index futures accompanied other derivative instruments like index option in June 4, 2001 and stock options in July 2, 2001. Since, index options and stock options failed in creating volumes accompanied by market crisis in March 2001 made regulator to implement reforms like removal of badla system, adoption of rolling settlement and finally the introduction of SSFs. These stock futures which flourished in India with in no time and grown to be the largest in notional trading volumes in contradictory to other markets where commodity, index and currency futures thrive a lot have been discontinued in several stock exchanges for their characterisitics which can be used for speculative purposes. Since, these SSFs existed in few that too for few stocks not bringing heavy contribution in contrast to the Indian case where there size is almost double to cash market segment, provides the need for empirical assessment in the given backdrop of market reforms aimed at global standards in the Indian capital markets. One can see such examination based on pragmatic evaluation could be a study that provides in abundance the consequences in advance for the other markets. Hence, this study enquires the nature of SSFs with in the framework of set objectives mentioned below.

OBJECTIVES OF THE STUDY:

With all the above point of views the following questions are central to the present analysis in order to explain the transition outcomes interconnected to market efficiency after the introduction of SSFs in Indian capital market:

- Is there any conversion in the underlying spot volume after SSFs introduction? Since, the volume effect is not only important for investors but also for regulators, one need to find out what was the influence of SSFs introduction on spot volume. As stocks with high volumes are very liquid, volumes affect the liquidity of the stocks. And the following possibilities may arise which affect the liquidity in the market; because of low margins, in general SSFs give better hedging opportunities, here arises the odds of investors going only for the stocks where SSFs are available, this in turn decreases the liquidity in the market. Also because of low margins SSFs direct speculators to trade more which not only influence the spot prices but also hazardous i.e. as whole a shrink in market liquidity coursing inefficiency. Thus, first objective of the present study aims at liquidity after SSFs introduction i.e. whether the trading volume of the spot market decreased (shifted to futures grounding insecure ness to the market) or increased (building market towards effective track)?

- Is there any change in the underlying spot volatility after SSFs introduction? As observed from the words of R. H. Patil (2006), these SSFs carry high risk with them i.e. risk of high variability in prices (volatility) which are not hard with low margins. Consequently, what happened to the underlying market i.e. spot volatility is the present study's second objective? Since, due to lower margins, it is anticipated that speculators with motive of increasing leverage positions will set off recurrent purchases at different prices rooting added explosive nature to the existing prices. However, an alternate opinion is that these instrument besides acting as tools for hedging, supply an extra course of information transmission which causes recurrent and rapid dispensation of information in the market which is synonymous to efficient market.

- Also study aims at cross checking whether the effects of futures introduction are same across the similar stocks i.e. to look at industry/sector specific after SSFs commencement.

This study resting on few aspects after transition in Indian derivative markets is an earlier attempt in Indian context holds several policy implications for regulators, researchers, policy makers, and investors. In addition, India market being an emerging market, where as rare existing research available is of developed markets, assessment and evaluation may throw more proficiency.

DATA EMPLOYED & SOURCES:

The study focus on liquidity and volatility, two crucial characteristics of any spot market. We consider five different dates of futures introduction (till 2005). The liquidity and volatility features are analyzed six months before and after listing of futures for each stock. All the data employed in the present study has been obtained from NSE published daily "Bhavcopy" that are available at www.nseindia.com. In total, SSFs during all these listings constitutes to 95 in number on NSE over a period of time. However, due to the non availability of data for the duration of observed period, nine stocks that have SSFs are excluded from the study. These SSFs are excluded from the analysis since either some of these were encompassing a simultaneous listing in both cash & derivatives segment or been de-listed for not meeting the norms laid by the NSE that are customary on the prescribed criterion suggested by the SEBI for the commencement and prolongation on the stock exchanges. Thus, total sample abbreviates to 86 SSFs that draw out of five different listing periods (see Table 1).

Table.1: SSFs –Sample

S. No	Listing Date	No. of Stocks Employed
1	09-11-2001	31
2	31-01-2003	12
3	29-08-2003	8
4	26-09-2003	4
5	20-04-2005	31
	Total	**86**

METHODOLOGY:

First, study concentrates on Liquidity of the spot market measured by using a proxy namely Trading Volume. Descriptive statistics of data employed are presented in tables for each stock listing-wise respectively. For each listing (also occasionally referred as an event) presented the mean, standard deviation values of the empirical proxy for both pre and post listing periods along with the normality test statistic respectively. Therefore, for an examination of whether SSFs have an effect on liquidity, if so, increased or decreased after SSFs inception, the present study formulates the following hypotheses:

H_0: No difference between two means.

H_1: A true difference does exist between two means.

To test the above i.e. average total traded value for pre and post listing is equal to zero, *t*-test is not appropriate. Since it is evident from the normality test statistic values reported in the descriptive statistics for different listings, where not even a single underlying stock's total traded value is normal directs us to use a non-parametric test for empirical verification of the above. Subsequently, to determine if there is any significant change in the underlying trading volumes after the inception of SSFs current study employs Wilcoxon Rank Sum test.

Wilcoxon Rank Sum (WRS) test is a non-parametric analogue of two sample t-test. This test is based on the ranks of the data, and is used to compare means between two independent groups without the assumption of the normally distributed data. This non-parametric test provides a correct answer than the t-test when data is not normal (Siegel &

Castellan, 1988). A two-sided WRS test statistic was used to compare the ranks for test of significance. If the two-tailed p-value is less than the significance levels, then there is a significant difference between the underlying trading volumes.

Next, the study looks at Volatility of the spot market. To examine the underlying volatility aspects of SSFs, study obtains daily closing price of each underlying stock for the same sample list of stocks. And then computed daily stock returns, as the difference in logs between closing prices i.e. $r_t = \log(p_t) - \log(p_{t-1})$ as a measure of proxy for volatility. Empirical finance literature commonly employs log-returns since these have the good property i.e. can be interpreted as continuously compounded returns--so that the frequency of compounding of the return does not matter and thus returns across assets can more easily be compared and above all these are unit free (Brooks 2002). The preliminary estimation model is as follows:

$$R_t = \phi_0 + \theta_1 Mkt_t + \varepsilon_t \qquad (1)$$

where, R_t is the daily log returns of the listed stock, Mkt_t is the daily log returns of the Nifty. Next step is to take away any predictability colligated with lagged returns by fitting adequate number of auto-regressive (AR) and moving-average (MA) terms for equation (1) that can be re-written as follows:

$$\begin{aligned} &R_t = \phi_0 + \sum_{j=1}^{m} \phi_j R_{t-j} + \theta_1 Mkt_t + \varepsilon_t \\ &\varepsilon_t / \sum_{k=1}^{n} \psi_k \varepsilon_{t-k} \sim N(0,1) \end{aligned} \qquad (2)$$

Since, estimations done using above equation will be inappropriate when there is presence of Auto-regressive Conditional Heteroscedasticity (ARCH). So, for the identification of ARCH disturbances in estimated residuals, this study employs Lagrange Multiplier (LM) test proposed by Engle (1982) which has null hypothesis as 'there is no ARCH'. Also, study employs another test namely portmanteau Q-test[2] with the same null hypothesis for robustness. Thus, if residuals obtained from above estimated equation exhibit presence of ARCH, then to model the time-varying variance and to verify proposed examination between volatility and information, the conditional variance for the above equation which represents conditional mean equation for each return series in the GARCH framework modeling is expressed using Bollerslev (1986) widely conversant with in the literature as standard GARCH (p, q) model:

$$\varepsilon_t / \Omega_{t-1} \sim N(0, h_t)$$
$$h_t = \alpha_0 + \sum_{j=1}^{p} \beta_j h_{t-j} + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 \qquad (3)$$

Equation (3) contains same error term as defined in equations (2) which has mean zero and time-varying variance of h_t defined as the conditional variance of the return series based on the information set Ω_t till time t. α_i's are coefficients related to the lagged squared error term that measures the impact of recent news on volatility and β_j's are the coefficients associated with the past variance term and measures the impact of less recent news on the volatility. There exist two sufficient conditions for the equation (3). Firstly, from non-negativity property of variances, the constant (α_0), coefficients (α_i's and β_j's) should be

[2] Portmanteau Q-test is used for testing serial-correlation of the squared residual series and functional for examining GARCH effects.

positive all i, j respectively. Secondly, conditional variance should not explode; thus, to provide non-explosiveness, the sum of the coefficients (α_i's and β_j's) excluding the constant (α_0) should be less than 1 as defined below:

$$\sum_{j=1}^{p} \beta_j h_{t-j} + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 < 1 \tag{4}$$

The above conditional mean and variance parameters are estimated using the maximum likelihood method (ML). But it was pointed out that ML estimated standardized residuals tend to not follow normal distribution assumption, thus, with the objective of improving robustness of the model we use Bollerslev and Wooldrige (1992) suggested adjustment in the covariance matrix that validates the inference statistic by employing quasi-maximum likelihood method (QML). Succeeding, in order to verify the objective of current research, GARCH (1, 1) or ARCH (q)[3] models are employed with following specifications. Firstly, to observe the differentiations for the periods before and after the SSFs introduction, an exogenous (additive) dummy variable is used to represent the time of SSFs inception in the conditional variance. Further, as we need to dissipate effects of 'stock options' for first listing stocks, it takes the following form:

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \gamma_{d1} FD_t + \gamma_{d2} OD_t \tag{5}$$

[3] The current study would also verify by employing different GARCH orders, but not did for two reasons. First, as observed from the literature examined GARCH (1, 1), turns out to be most sufficient and commonly employed GARCH order for the conditional variances in general followed by ARCH (q) models. Second, study executes a set of robustness statistics on GARCH (1, 1) that provides enough evidence in support of the employed GARCH or ARCH order.

where, FD_t takes on value of one after SSFs introduction, zero otherwise. Similarly, OD_t takes on value of one after 'stock options' introduction, zero otherwise. Equation (5) is used for estimating only the *first* listing stocks in order to separate the 'stock options' effect. That is if from the estimated results of the equation (5), FD_t comes out to be significant then one can demonstrate that altered underlying volatility is due to the SSFs inception disregarding 'stock options' introduction. Once, found evidence of underlying volatility is due to SSFs from equation (5) or presence of ARCH after estimating equation (2) for following listings, then next step is to model for implication of market hypothesis. Thus, secondly, besides an additive dummy variable in the variance equation, two multiplicative dummy variables were incorporated; first multiplicative dummy is employed with the lag of squared residual term, the second one is used with the lagged conditional variance.

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \alpha_{0,d} D_t + \alpha_{1,d} D_t * \varepsilon_{t-1}^2 + \beta_{1,d} D_t * h_{t-1} \qquad (6)$$

where, D_t takes on value of one after SSFs introduction, zero otherwise. The above variance equation allows us to observe simultaneously the behaviour of persistence and impulse volatility of SSFs, respectively, before and after their introduction. The multiplicative dummies employed enable us to find the amount and significance of a potential change through the parameters viz. $\alpha_{1,d}$, $\beta_{1,d}$ of our variance equation due to SSFs inception. That is, following the onset of SSFs, a positive (negative) significant value of $\alpha_{1,d}$ would suggest that news absorption is more (less) rapid, at the same time a negative (positive) significant value of $\beta_{1,d}$ implies that "less recent news" have less (larger) impact on today's volatility. Further, if $\alpha_{0,d}$ is positive (negative) then altered volatility exhibits an increase (decrease) after SSFs inception. Similarly, some times all return series may not follow order of GARCH (1, 1) hence ARCH (q) order of the above time-varying variance takes the following form:

$$h_t = \alpha_0 + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 + \alpha_{0,d} D_t + \sum_{i=1}^{q} \alpha_{i,d} D_t * \varepsilon_{t-i}^2 \tag{7}$$

Herein there is a need to memorize one of the primary restrictions of GARCH models that is they enforce a symmetric response of volatility to positive and negative shocks. This arises since the conditional variance is a function of the magnitudes of the lagged residuals and not their signs, in other words, by squaring the lagged error, the sign is lost. Since, such asymmetries are typically attributed to leverage effects, one need to verify of such existence in the employed GARCH framework. For this the current research employs sign bias, negative size, positive size and joint bias tests given by Engle and Ng (1993) as asymmetric test statistics.

Next, about the estimation of models which do not have the presence of ARCH? As noted from descriptive statistical measures, some return series do not exhibit much excess kurtosis, for those we have done estimations using following model:

$$\begin{aligned} &R_t = \phi_0 + \sum_{j=1}^{m} \phi_j R_{t-j} + \theta_1 Mkt_t + \gamma D_t + \varepsilon_t \\ &\varepsilon_t / \sum_{k=1}^{n} \psi_k \varepsilon_{t-k} \sim N(0,1) \end{aligned} \tag{8}$$

where, D_t takes on value of one after SSFs introduction, zero otherwise.

ORGANIZATION OF THE THESIS:

The study has been organized into five chapters along with annexure and tables. The first chapter discusses the introduction, need & importance along with the objectives of the study. Next chapter 'Review of Literature' discusses the theoretical debate and summarizes the pertinent observed literature concerning equity based derivatives focusing on the relationship between spot markets. As large literature exists for the index futures compared to SSFs, an attempt has been made even to understand their effects to assess the relationship between spot market and SSFs. Chapter 3 'Liquidity of Single Stock Futures' exposes the methodology, data employed, results pertaining to the liquidity aspect of the SSFs introduction. Chapter 4 'Volatility of Single Stock Futures' presents the methodology, data employed used in this study along with the discussion of empirical results. Chapter 5 'Conclusions and Scope for Further Research' summarizes the empirical analysis, results and finally presents the concluding remarks with limitations of the study and further research prospects followed by appendices and references.

SUMMARY AND CONCLUSIONS:

SSFs introduction in India presumed a lot of debate before their introduction, regardless of all those, their commencement was a concomitant due to oblige as mentioned in the previous chapters of the current study. Subsequently, within no time these SSFs promptly occupied number one position in the world with respect to notional trading volumes. However, the frequent arguments of their highly risk nature was haunted across the financial system with several incoherent arguments based on the experiences of developed markets. As Indian case is different being an emerging market rather than by statements, it has to be addressed through empirical evidence. Therefore the present study made an attempt to examine the impact of introduction of SSFs in India. The study focused on liquidity and volatility, two crucial characteristics of any stock market. We consider five different dates of futures introduction (till 2005) that comprise 86 stock futures listing. The liquidity and volatility features are analyzed six months before and after listing of futures for each stock. First, the study concentrates on Liquidity of the spot market measured by using a proxy namely Trading Volume and concludes that the liquidity of spot segment improved substantially after SSFs introduction. Next, the study looks at Volatility of the spot market, proxy being daily log-returns. Further, the volatility estimate is linked with information absorption process by modeling return process in ARMA-GARCH framework. The study reports mixed results in case of volatility.

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