Trading in single stock futures contracts and stock price behavior of the underlying stocks

By

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Trading in single stock futures contracts and stock price behavior of the underlying stocks

Abstract

This study examines the impact of the introduction of trading in the single stock futures (SSFs) contracts on the stock price behavior, liquidity, price volatility dynamics and behavior of the systematic risk of the underlying stocks in the Pakistan's market. The study documents a significant decrease in return volatility for the SSFs-underlying stocks, relative to the matching non-SSFs stocks, subsequent to the introduction of single stock futures contracts on the Karachi Stock Exchange. The multivariate analysis in which the spot trading volumes, SSFs trading volumes open interest were partitioned into news and informationless components, the estimated coefficient of expected futures volume component is statistically significant and negatively related to volatility, suggesting that equity volatility is mitigated at the time of high expected level of futures activity. The findings of the decreased spot price volatility of the SSFs-underlined stocks associated with large expected futures activity is important to the debate regarding the role of the equity derivatives trading in stock market volatility. These empirical results for the Pakistan's equity market support theories implying that equity derivates trading improves liquidity provision and depth in the equity markets, and appear to be in contrast to the theories implying that equity derivatives markets provide a medium for destabilizing speculation. Finally, the SSFs-listed stocks were grouped with a sample of non-SSFs stocks to conduct cross-sectional analysis for comparing behavior of return volatility in the post-futures period, after accounting for a number of other determinants of volatility. The study finds sufficient evidence to support the view that this multivariate specification, like the previous specification, provides no evidence that the volatility of the SSFs- underlying stocks is positively related to the

introduction of the single stock futures trading in the Pakistan's market. Rather, overall, there is a decrease in return volatility for the SSFs-underlying stocks in the post-futures period, relative to the non-SSFs stocks.

In the next phase of the analysis, the study focuses on the behavior of systematic risk for the underlying SSFs stocks in the post futures period. The paper documents a significant decrease in beta estimates for many of the SSFs-listed stocks in the post-futures period. However, a considerable number of control stocks also behave in a similar fashion. This indicate that the observed reduction in the beta estimates for the SSFs-listed stocks may not necessarily be caused by the introduction of the SSFs trading for those stocks but it may be due to other market-wide and/or industry changes that has affected the overall market. Hence this study finds no evidence that the introduction of futures trading increase the systematic risk of the underlying stocks.

Finally, the study examines the changes in the nature of volatility in the post-SSFs period versus the pre-SSFs period, particularly with reference to the arrival of new information in the market. Further, it examines the changes in the asymmetric response of volatility to news in returns for the SSFs-listed stocks in the post-SSFs period. The empirical evidence demonstrates that the asymmetric effect has reduced in the post-futures period. The evidence therefore, suggests futures trading has had a considerable impact on the way information impact on the volatility of the underlying stocks and highlights the importance of changes in market dynamics as a cause of changes in asymmetric responses of volatility.

CHAPTER 1
INTRODUCTION

1.1 Background

The issue of the impact of trading in derivatives on the volatility of the underlying asset/market has long interested both the academicians and the practitioners alike, though this debate has gained increasing importance in recent decades. This debate has attracted a large number of empirical studies to settle the issue empirically, though the evidence has not been entirely conclusive and conflicting empirical results have been obtained as to whether stock index futures and/or options initiation has led to an increase or a decrease in the volatility of the underlying market/asset. At the theoretical level, the effect of stock index futures (and options) on the stock market volatility has also not been resolved. The relationship between these derivatives markets and the underlying market is established through arbitrage activities. Because of the low transaction cost and high degree of financial leverage, both arbitrageurs/hedgers and speculators are attracted to the futures market, which trade on the basis of their expectations of the future price movements in the derivatives as well as the underlying market. Theoretically, the effects of their trading on the underlying, however, depend to a large extent on what assumptions we make about the arbitragers and/or speculators. One of the key assumptions relates to the ability of the index futures and options to attract either the more informed or uninformed traders to the stock market. Two contrasting opinions/hypotheses[1] and arguments have developed, over the course of the time, with respect to the relationship between the derivative market and the underlying asset/market. One group of researchers and commentators asserts that arbitraging or speculative activities in the futures markets add additional informed traders to the stock market. Herbest and Maberly (1992) argue that lower transaction cost and higher liquidity in the futures market attract informed traders to trade in the futures market. This in turn increases liquidity in the market,

[1] These are sometimes referred to as competing hypotheses

which leads to a decrease in the volatility. Derivatives securities have been argued to be as one of the means for informed traders to trade on their information and for others to discover that information. Additionally, derivatives may not only work as a catalyst for the underlying asset in imparting information, they may also provide additional information that the markets cannot infer from other sources from the markets in the underlying asset. The other contrasting view emphasizes that because of the low transaction cost and high leverage, the index futures and options attracts more uninformed or irrational traders in both the derivatives and the stock markets in pursuit of short term gains. These uninformed traders trade not on the fundamentals but on the noise, leading to an increase in volatility.

The empirical findings on the issue of derivatives trading and their impact on the volatility of the underlying has also been inconclusive. Edwards (1988), Besssimender and Seguin (1992), Boyer and Popiela (2004) among others, for instance, have reported empirical evidence that index futures and options do not lead to increased market volatility. A large body of papers, on the other hand, has documented evidence supporting the view that futures trading has caused an increase in stock market volatility. Significant among them includes studies by Sahrown and Gregary (1995), Maberrly et al (1989), Lee and Ohak (1992), Rehman (2001) to mention a few.

Single Stock Futures (SSFs) is a futures contract written on individual shares. SSFs are a relatively new derivative product and are traded on fewer stock markets, in contrast to the universally adopted stock index futures—a market-wide derivative product. Interest in SSFs is growing and more markets are contemplating to introduce SSFs[2]. So is the case with the research on the effect of introducing SSFs on the underlying asset market. Most of the research so far done on the SSFs focuses on the effect of their trading on the volatility, volume and, to a lesser extent, on the returns and market efficiency of the underlying asset. Beginning with the first formal study of Lee and Tong (1997), most studies[3], which followed after, report a decrease in the price volatility of the underlying shares in the spot market post-SSFs period. These studies mainly use an event study methodology comparing the volatility of the underlying in the post-

[2] Presently, SSFs are traded in Australia, UK, South Africa, India, Malaysia, Hong Kong, and some other markets

[3] Dennis and Sim (1999), Mckenzie, Brailsford and Faff (2001)

SSFs versus the pre-SSFs period, with little consideration being given to using the SSFs trading activity variables, namely SSFs trading volume and open interest to specifically examine the SSFs role on the underlying market dynamics.

In recent times, interest also grew in examining the market efficiency aspects of SSFs trading and some studies, e.g., Ang and Cheng (2005), by comparing the number of large unexplained positive/negative returns for SSFs-underlying stocks and a control group of non-SSF stocks, find reduction in the number of unexplained large stock returns which is also found to be positively correlated to trading in SSFs and, hence, an increase in market efficiency. Similar results are reported by Mazouz and Bowe (2006) for UK market. Chau, Holmes and Paudyal (2005) documented a more pronounced relative low feedback trading for USF[4] than for stocks of control group in the post-USF trading. The study also finds not sufficient evidence to suggest that USF has contributed to the underlying stock market volatility.

The other relatively under-explored area of research is the effect of SSFs on the systematic risk of the underlying stocks. Though finance literature has not provided any justification as to why should there be an increase or a decrease in the beta coefficients of the underlying stocks after the introduction of futures (e.g., SSFs) or options trading for those stocks. However, there are many empirical studies, particularly the ones for the U.S. markets that do report an increase in beta coefficients[5] for index component stocks relative to non-index stocks after the introduction of the index futures contracts for that index. Many of these studies, particularly the ones conducted on the U.S. markets, attribute such an increase in the beta coefficients or the correlations among the index-component stocks, to the index trading strategies such as program trading.[6] However, these studies examine the stock index futures contracts and the studies for

[4] Universal Stock Futures contracts are single stock futures contracts introduced on LIFE (UK)

[5] Martin and Senchack (1989, 1991), Vijh (1994). However, Galloway and Miller (1997) reports a significant decrease in beta estimates for samples of medium and large capitalization stocks while no change in beta estimates for the component stocks in the MidCap index futures. This led them to infer that the trading in the index futures had no effect on the systematic risk, beta coefficient, of the index stocks.

[6] Program trading is mainly used for index arbitrage by investors. Though program trading can be in a variety of ways, the most widely known trading strategy is the index arbitraging that involves purchasing (selling) the cash stock portfolio and simultaneously selling the (purchasing) the index futures contracts when the futures price exceeds (is less than) the spot price of the index, net of carry cost.

SSFs markets are almost non-existent, given that SSFs can provide a better hedging tool than the stock index futures contract[7].

This study investigates the introduction of the equity derivatives (single stock futures contracts trading) and their impact on the stock price behavior, level and structure of price volatility, liquidity and market efficiency aspects of the underlying stocks in the Pakistan's market. Research on the effect of SSFs on the underlying stocks in terms of price, volume, volatility, efficiency, is limited mainly to Australia, United Kingdom and, to a lesser extent, United States and South Africa. This study adds a Pakistani perspective to this growing, but relatively under-explored, area of research. This study is the first and the most comprehensive one on the SSFs market in Pakistan.

1.2 Problem Statement

As compared to universal adoption of stock index futures contracts, SSFs are a relatively new derivative product at the global financial landscape and are traded on a few exchanges around the world. The impact of the introduction of these SSFs contracts on the domestic market dynamics, in general, and the underlying individual shares, in particular, have not been evaluated extensively and the research on this area is scarce. Being a relatively underexplored area, absence of research on the effect SSFs trading on the Pakistan's market is no exception and this market has not, as yet, been formally studied. This study attempts to fill this gap and is the first comprehensive study on this market to cover range of issues related to the introduction of SSFs contracts on the price, liquidity and volatility dynamics of the underlying stocks in the Pakistan's market.

[7] Dawson (2007) shows that SSFs can act as a near-perfect hedging tool using a sample of 80 U.S. stocks over a 12-month period. They consider SSFs as close to meeting exacting specifications sought for a perfect hedging instrument. The study mathematically and empirically show that SSFs in the U.S. market expose the overseas investors to significantly less foreign exchange risk can a simple cash holding. Further, Brooks, Davies and Kim (2006) evaluate the efficiency of cross-hedging with SSFs and achieve a better hedging performance using a portfolio hedged with market index futures and SSFs. The authors also discuss, theoretically, that SSFs can be a superior and effective hedging tool for retail and institutional investors who have substantial undiversified exposure to individual stocks. In this case, hedging with stock index futures may render an inadequate hedge to such investors should the returns profile of the stock exposure is quite different to that of the index as whole. As an alternative, one may consider hedging with single stock futures (SSF) contracts. Such a hedge is likely to work well if there is a traded future on the required stock

1.3 Objectives of the study

The purpose of the study is to address whether the introduction of trading in the SSFs contracts on the Karachi Stock Exchange has any impact on the volatility, liquidity and market dynamics for the underlying stocks. Specifically, the study focuses the following objectives.

1) The behavior of stock returns volatility is examined both in the pre- and the post-SSFs period. This will allow us to determine if there is any change in the stock returns volatility in the Post-SSFs period.

2) Has the trading of single stock futures affected the simple risk- reward characteristics of the underlying stocks? This issue is addressed through analysis of the means and variances of the daily stock returns of the underlying stocks of the SSFs contracts on the Karachi Stock Exchange. The analysis is undertaken both in the pre and the post-futures periods. With the possibility that the factors other than the initiation of SSFs contracts may have affected the means and variances of returns in the two sub-periods, a select sample of matching non-SSFs stocks is also formed and same procedure is adopted for the control sample. The mean-variance analysis of the SSFs-listed stocks can then be compared with the "benchmark" mean-variance performance of the control group stocks.

3) The study also examines the changes in the market microstructure that may have occurred in the post-futures trading. Specifically, the study examines the changes in the way volatility is impacted by the arrival of new information in to the market. Put it another way, has the SSFs innovation changed the market dynamics in the Pakistan's stock market. This issue is examined by the asymmetric response of volatility to news both in the pre and post-futures period.

Traditionally, the "leverage effect" and the "risk premium" hypotheses are traditionally considered to explain the asymmetries in returns volatility. However many empirical studies have identified the limitations of these theories in explaining the magnitude of the observed asymmetries in return volatility. In recent times, the concept of "volatility clustering" and the role of "market dynamics" have been put forth as alternative explanations of asymmetries in returns volatility. If this view holds true then we can expect that new products such as index futures may have an impact on the level and structure of volatility for the underlying asset/market.

4) The study examines impact of SSFs trading on the market efficiency both in the short and the long-term. This can be judged by the impact of new information arrival on the persistence of volatility subsequent to the introduction of the futures trading.

5) The study examines the impact of futures trading on the level of market trading activity and liquidity (trading volumes) of the underlying stocks in the post- futures period. Moreover, as pointed out by Robanni and Bhuyan (2004), this can also help ascertain whether the increased volatility, if any, can be, at least in part, be attributable to an increase in the trading volume of stocks in the ready market

6) The study also examines the behavior of systematic risks for SSFs-listed stocks surrounding the introduction of the Futures trading. In other words, has the futures trading changed the market model relationship of underling stocks? Do the underlying stocks exhibit different betas in the post- and the pre-futures periods? These questions are dealt with through event study methodology. Event study methodology is undertaken for both the SSFs-listed and sample of control group stocks so as to provide a "benchmark" of relative performance.

Further, most of the studies on the issue of derivatives-volatility relationship have been conducted on the data from more developed and sophisticated markets and stock exchanges such as the US and the UK, with little work on developing markets. This study addresses the impact of single stock futures trading on the stock market volatility in general and the underlying individual stocks, in particular, in a developing market that where no such empirical study has so far, to the best of our knowledge, been conducted though SSF contracts were introduced on the Karachi Stock Exchange in July 2001. The study will also present an overview of the single stock futures in Pakistan and how it has developed since its introduction in the Pakistan's stock market. Furthermore, in line with the international practices, 90-days cash-settled SSF contracts were introduced in Pakistan in March 2007 and the efforts are on to introduce stock index futures and options in Pakistan. In this respect, the findings of this study are important, particularly given the limitations that previously no such study, to the best of our knowledge, has been carried out to examine the effect of SSFs trading on the Pakistan's stock market volatility dynamics.

1.4 Significance of the study

The study of the impact of SSF contracts on the underlying stocks provides several advantages over the study on the stock index futures, because of the unique characteristics of the SSFs contracts which distinguish them from the stock index futures contracts. First, majority of prior studies focused primarily on examining the impact of trading in the market-wide financial derivatives such as stock index futures. These types of studies, as Mckenzie, Brailsford and Faff (2001) argue, are helpful in estimating the nature of the market-wide impact. However, since the underlying index is made up of many component stocks, the effect of index futures cannot be accurately identified since this effect may dissipate across these many component stocks, which in turn makes it difficult to find its true effect. Additionally, unlike for index futures contracts for which trading in the underlying index cannot be directly observed although the index futures contracts themselves are tradable instruments, trading for SSFs in the underlined stocks can be directly observed in the stock's spot market. Thus, the effect of SSFs trading may be more evident at the individual stocks level and this effect can be more accurately measured as well.

Second, most of the studies that examine the underlying market volatility-futures trading relationship have by default examined single event date—the introduction of futures trading. With a single event date the possibility that other market-wide factors that has occurred around the futures initiation may affect the results, cannot be ruled out. An additional benefit of examining SSFs is that they are characterized by several introduction dates within a given market[8]. Unlike a single event analysis in case of stock index futures initiation, this multiple introduction dates helps us to evaluate their effect on the underlined in different time periods. Third, given that the SSFs contracts are written on stocks belonging to various industries in the

[8] In Pakistan, for instance, SSFs contracts on stocks have been introduced at different time periods.

economy, the possibility that the impact of futures trading may differ across industries, can also be analyzed with SSFs trading.

Moreover, today Pakistan's equity market is viewed as one of the most volatile markets in the region because of exceptional volatility that it has undergone in the recent years. Subsequent to various episodes of market crashes at the Karachi Stock Exchange, several investigations were conducted that have identified causes of irritating market volatility. One of the potent reasons for such high volatility is the lack of hedging instruments that could protect the investors, both individuals as well as institutions (SECP, 2007). Securities and Exchange Commission of Pakistan (SECP) is working towards the introduction of new derivatives products and some of them have only recently been introduced such as Cash-settled 90-days individual stock futures contracts, stock Index Futures, and the SECP is working to introduce other derivatives such as Options. This study will help the policy makers in analyzing the current equity market in bringing the much-needed reforms in the equity and derivatives markets. There has been little research on the Pakistan's stock market relative to other emerging markets. Our objective is to fill this gap and add some evidence on these issues in the context of an emerging market.

1.5 Organization of the study

The rest of the thesis is organized as follows.

Chapter 2 provides main features of the single stock futures (SSFs) contracts traded in Pakistan and provides an overview of SSFs contracts. The chapter then compares the average daily and total volumes in SSFs to the average daily and total volumes in the underlying stocks.

Chapter 3 provides a brief literature overview relevant to this study. This chapter thoroughly discusses the previous theoretical and empirical work related to the effects of futures trading on the liquidity, systematic risks and other aspects of stock price volatility. The chapter includes empirical studies relating to both the school of thoughts; one that supports the view of an increase in volatility in the spot market prices and the other school of thought that does not support the view that futures trading has increased cash price volatility. Chapters 4, 5 and 6 are the core chapters of the study.

Chapter 4 provides a detailed description of the research methodologies and statistical methods used to examine impact of the introduction of SSFs contracts on the stock price behavior (price effect), level of the price volatility dynamics (volatility effect) and market efficiency effect, of the SSFs-listed underlying stocks. The chapter also outlines the sample selection procedure for SSFs-listed stocks and the control group stocks. As a preliminary investigation, the analysis is conducted using the event-study methodology comparing the returns, volatility and trading volumes in the post-futures versus the pre-futures periods, as well as the more detailed econometric models. The chapter also discusses the econometric methodologies used for examining the systematic risk effects and the market efficiency effects of SSFs trading.

Chapter 5 provides results of the statistical methods and econometric models used to examine the effect of SSFs trading on the price behavior, price volatility and trading volumes for the underlying as well as the control group stocks. Chapter 6 report results for examining the behavior of systematic risk for underlying SSFs stocks in the post-futures period. Chapter 7 looks at the volatility dynamics in terms of the market efficiency and asymmetric response of volatility to news for the SSFs stocks and explores whether the "market dynamics" argument can lend itself as an alternative explanation for the more traditional explanations of volatility clustering and asymmetric response of volatility to news. Chapter 8 concludes the study and provides some policy implications and major contributions of the study.

CHAPTER 2

FEATURES OF SINGLE STOCK FUTURES CONTRACT IN PAKISTAN

SSFs are futures contracts for which the underlying assets are individual stocks. They are written for delivery of a particular stock for some pre-determined quantity on a specific date. The contract price usually reflects trader's expectation (opinions) about where the price of the underlying will be at the expiration of the contract. For example, purchaser of a ,say Pak Rs. 100 December 2007 futures contract on OGDC stock is obligated to buy OGDC stock for Rs. 100 at a specified date during December[9]. The buyer of SSFs contract will make money in case price appreciates during the relevant period, whereas the seller will lose money. From a purely financial perspective, SSF futures contracts behave much like ordinary stocks.

2.1 Features of SSFs Contracts in Pakistan

Single Stock Futures contracts were first introduced on Karachi Stock Exchange on July 1, 2001. Initially, 9 stocks were listed by the exchange for trading of SSFs contracts. Over the years, the exchange has gradually increased the number of listed stocks and presently KSE has SSF contracts traded on 46 stocks. Together, the 46 single stock futures contracts provide market coverage to each of the major sectors in the Pakistan economy: Commercial Banks (17 SSFs), Textile (1 SSF), Cement (5 SSFs), Power Generation and Distribution (3), Oil and Gas Marketing (3 SSFs), Oil and Gas Exploration (3), Synthetic and Rayon (2), Transport (1), Technology and Communication (2), Refinery (4), insurance (1), and Fertilizer sector (3). The stocks for SSFs are selected on the basis of liquidity, market capitalization and past track record in terms of the stock's trading volume and liquidity.

[9] The buyer will be obligated to buy specified number of ODGC shares if the SSFs contracts are to be settled through physical delivery of the shares. Of course, SSFs contracts can also be settled through cash settlement or roll over to the next period.

Unlike other international futures markets where there is a standard contract size for every SSFs contract, which normally is set equal to 100 or 1000 underlying shares, the size of each SSFs contract in particular scrip in Pakistan is determined by the Karachi Stock Exchange keeping in view various stock-specific characteristics such as price per share, etc. However, the contract size is set normally of the same size as that of a marketable lot in the ready market of the underlying stock. The contract values are derived by multiplying the contract unit by the underlying stock price. Thus the contract derives its value from the underlying stock.

Unlike stock index futures contracts which has to be settled in cash as actual delivery of stock index is almost impossible to achieve, there are three standard ways available to investors to settle the expiration of an SSFs contract[10]. An investor can offset his position by taking the opposite side of the initial transaction before the expiry of the contract thus effectively eliminating the obligation to buy (sell) the shares at the expiry of the contract. Secondly, an investor can hold the contract until expiry and fulfill the obligation by taking (making) delivery of the shares or by cash-settling the difference between spot and the settlement price[11]. Third, an investor can roll over his current position in to a latter contract thereby delaying the expiration of the strategy until a later date. This strategy is achieved by offsetting the current position and entering into a new position with a subsequent expiration.

In Pakistan, the SSFs contracts are settled through a physical delivery of shares at the expiration of the contract as there is no option for cash settlement and the final holder of the futures contract has to take delivery of the underlying stock[12]. Moreover, an investor can roll over his current position in to a latter contract and can delay the expiration of the strategy until a later date. Trading in SSFs takes place through computerized system called the Karachi Automated Trading System (KATS) and displayed on the Market Information System of the Exchange. SSF

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[10] The difference between the price (stock index value) set at the time of the auction when the stock index futures is initiated and the closing price (value of the stock index) of the index on the date of expiration of the stock index futures is paid in cash by the loser to the winner, through the clearing house.

[11] In India, which is one of the largest market in the world for SSFs contracts, has cash-settlement of SSFs contracts.

[12] Physical settlement is implemented in both One Chicago and NQLX exchanges US and it is in contrast to the cash settlement in LIFFE Universal Stock Futures contracts (UK).

contracts are available on one calendar month expiry cycle[13], with last Friday of a month being the last trading day in a contract, and are settled on the following Wednesday through a clearinghouse of KSE as there is no separate and independent futures exchange for SSFs trading in Pakistan. Contracts for different months can trade on the exchange simultaneously. There is an overlapping period for the contracts, with the period for the new contract can start at least two trading days before the close of the old contract period. A circuit breaker gets in place if there is a price fluctuation of 7.5% or PK Rs. 1.5, whichever is higher, compared to the previous day closing price. Trading in a particular Futures Contracts is not allowed beyond this price fluctuation. Table 2.2 summarizes the salient features and contract specifications of the single stocks futures contracts traded on the Karachi Stock Exchange[14].

2.2 Analysis of SSFs trading in Pakistan's stock market

This section briefly reviews the progression of SSFs market since the beginning of the trading till Feb 2008. In general, this section reviews the trading volume, both average and total, of the SSFs contracts and that of the underlying stocks. The data for this section consists of daily trading volume form Nov 1, 2001, almost six months from the launch of SSFs trading[15] until December 2005. SSFs volume data were sourced from the online database of the Karachi Stock Exchange, the only exchange in Pakistan where SSFs contracts are traded. Daily closing and opening prices, daily high-low prices, trading volumes, trading value, number of trades, market capitalization and other information related to the underlying stocks were obtained from the online database of "The Businessrecorder", a premier daily business news paper in Pakistan.

[13] Recently Karachi Stock Exchange introduced 90-days cash-settled SSFs in a few stocks. Initially these were introduced in only three stocks. The KSE plans to gradually increase them to other stocks. Besides, the KSE has also introduced the stock index futures with KSE-30 index as the underlying asset. KSE-30 index is composed of the 30 stocks and is based on the free-float.

[14] SSFs contracts are known as Deliverable Futures Contracts (DFC) in Pakistan—a name, probably, given to it because they are settled though the physical delivery of the underlying shares.

[15] The starting date for analysis from Nov 1, 2001 instead of July 1, 2001 is limited by non-availability of data from July 1 to Oct 30, 2001 for futures contracts

This section first examines the daily and total trading volume levels of the SSFs contracts on the Karachi Stock Exchange since Nov 1, 2001 and examines total and average volume for some of the individual SSFs as well as the underlying stocks. The study also compares the average daily volume in SSFs contracts to that of the underlying SSFs-stocks. Volume is considered as the total volume on a particular day for all the SSFs contracts for a particular company. The data shows that average daily volume of traded SSFs contracts has increased since the November 2001. The average volume increased from 54,014 contracts in 2001 to 2, 36,038 contracts in 2002, then further increased to 3, 93, 828 contracts in 2003. A further increase in average volume was observed in 2004 where it was 4, 11, 232 contracts. The increase in trading volume of SSFs contracts could be partially attributed to the increasing number of new stocks added for listing of SSFs contracts. However, the average volume of traded contracts touched unprecedented high of 11, 81, 446 contracts in 2005. It is the same year when stock market experienced an unprecedented increase in value and trading volumes, and a subsequent plunge in value as well as trading volumes. Trading, and excessive trading, in futures contracts was one of the reasons identified by subsequent studies as one of the causes of the excessive volatility in the market.

Top ten companies in respect of trading volumes in the futures contracts are reported in Table 2.1. The first column of the table contains total volume of SSFs, the second column consists of the average daily volume, and the third column shows the average daily volume of the underlying stocks in the ready market while the fourth column reports days with zero volume in SSFs, if any. As is evident from the table, that Oil and Gas Development Corporation (ODGCL) has the largest total and average volume, with 9, 200, 538, 999 shares. Comparison of OGDCL's average daily volume of 7,952,065 shares in the futures contracts for the period with that of 41,109,283 equivalent shares in the underlying market represents a reasonable trading in SSFs contracts for the period. OGDCL is closely followed by Pakistan Petroleum Ltd (PPL) in terms average daily volume in SSFs contracts. No company, from the top ten selected sample, had days with zero volume in SSFs for sample time period. The comparison of the SSFs volume with that of the underlying stock shows that many hedgers and speculators have been able to use SSFs to reasonably meet their demand, as single stock futures are an additional instrument for investors for investment and risk management purposes.

Table 2.1

Top 10 companies by volume in futures

Variable	Total Volume of SSF (in number of shares)	Average Daily Vol. of SSFs (in number of shares)	Average Daily Vol. (underlying)	Days with Zero volume in SSF
OGDC	9200538999	7,952,065	41,109,283	None
PPL	8489984000	7,941,987		None
NBP	5831505000	5,079,708	21,215,916	None
PSO	6460461000	3,315,567	15,467,668	None
FFBL	4366019500	3,315,125		None
LUCK	3543616800	3,102,992	8,463,088	None
BOP	3161366000	2,951,789	11,274,529	None
POL	3238431199	2,816,027	13,441,661	None
PTCL	1532629000	2,167,792	37,940,621	None
NML	1844575000	1,354,314	3,327,031	None

Note: Each SSFs contract is comprised of 500 shares of the underlying stock. Total and average volumes of the SSFs are given in number of shares for comparison purposes with the underlying stock. Total volume of SSFs contract is from launching date till the end of March 31, 2008.

Table 2.2

Specifications of SSF contracts traded on Karachi Stock Exchange

Period of Contract	1 calendar month
Expiration Date/Last Trading Day	Last Friday of the calendar month, f last Friday is not a trading day, then immediate preceding trading day.
Final Settlement	Physical Delivery of underlying shares on the basis of T+2, falling immediate after the close of contract.
Initial Margin	50% cash of the total value of the contract[16]
Settlement Day	Wednesday following last Friday of the calendar month
Settlement Method	Physical delivery of the underlying shares
Overlapping Period	None. Contract for different months can trade Simultaneously
Contract Size	Larger than or equal to that of a marketable lot In the underlying share in ready market
Opening of contract	At least two days before the close of the old contract period.
Regular Trading Hours	Monday – Thursday: 9:45 a.m. – 2: 15 p.m. Friday 9:30 a.m. – 12:00 p.m. 2:30 p.m. – 4:00 p.m.
Corporate Events	SSFs contracts adjusted to reflect changes to underlying stocks
Quotations/tick size	Rs. 0.05 per share
Contract Size	500 Shares
Contract Multiplier	500 shares, subjected to changes when adjustments are made in respect to corporate events. Contract value = Futures price x Contract Multiplier
Position Limits	Individual broker or client-wise position limit is 1% of the free float of a scrip

Source: Adapted from Karachi Stock Exchange's "Regulations governing deliverable futures contracts 2004"

[16] In the new rules, amended in 2010, the initial margin has been increased to 100% cash or bank guarantee

CHAPTER 3
REVIEW OF LITERATURE

Three areas in the existing finance literature are more closely related to this dissertation's research objectives outlined in section 1.3. These research areas are 1) previous research in to the issue of the introduction of derivatives, in general, and the equity derivatives, in particular, and their impact on the returns of the underlying asset or market, primarily on the variances (volatility) of those returns; 2) previous analysis of risk and return within a general market model approach, with main focus on the changes in the systematic risk components of the underlying asset, and 3) previous analysis of the asymmetric response of volatility to news and the improvement in market efficiency in terms of the way information is incorporated into the prices. Other research issues, such as market liquidity, market depth, etc, are also related to the dissertation, though they are of secondary nature to the topic of our interest.

A voluminous body of empirical studies has investigated the effect of stock index futures and options on the volatility of the underlying stock market in almost all the markets around the world that have introduced these derivatives products. Although there is a general perception, driven largely by empirical evidence and popular press outcry that volatility has increased in stock market because of the trading in derivatives, the abundance of empirical evidence has not brought the researchers together to a common conclusion and the empirical evidence, too, is entirely inconclusive. Put it differently, contradictory theoretical arguments and empirical evidence exist attempting to explain the reasons for the possibility that futures trading may increase or decrease stock price volatility in the underlying asset/market.

3.1 Theoretical discussion and empirical evidence of futures-induced volatility

There are two contrasting opinions and arguments that have developed, in the course of the time, in an attempt to explain the question of why derivatives markets, in general, might affect the volatility of the underlying asset market. The debate centers on an association between the derivatives markets and the underlying through an arbitrage activities. The arguments and the results rest, mainly, on the type of assumptions made about the arbitrageurs. One school of thought opines that futures' trading has caused an increase in volatility in the underlying market[17]. Excessive and, perhaps, irrational speculative activities are mainly blamed for such an increased volatility in the stock market. (Robbani and Bhuyan 2005; Bae, Kwon and Park, 2004). Trading in futures market offers some advantages to the traders over the trading in the cash market. As compared to the positions that a trader can take in the spot market, futures markets allow traders to obtain market-wide risk exposure with substantially lower transaction cost and lower amount of invested capital. This helps them to take a larger position than would be possible in the spot. This higher degree of leverage in the futures markets as compared to the underlying, are more prone to attract uninformed speculative and/or irrational traders in the derivatives as well as the spot markets in pursuit of short-term gains, which may, in turn, lead to an increase in the stock market volatility. Moreover, lower transaction cost in the futures markets is also considered to cause uninformed speculation to be higher in futures markets. Stein (1987, pp.1123-1124) develops an argument that trading in the futures market by inadequately informed speculators can lead to the destabilization of the spot market. He states:

> "One of the most important implications of the stabilization- destabilization debate concerns the desirability of opening futures or options markets. Such markets can be thought of as a conduit through which a greater number of speculators can flow into an already existing spot market..... In some cases the externality is negative: the entry of new speculators lowers the informativeness of the price to the existing traders. The net result can be one of price destabilization and welfare reduction."

This point is further supported by Simpson and Ireland (1985) who state that "if destabilizing speculation occurs in futures markets, then it is highly probable that these price distortions will be transferred to the associated cash markets through arbitrage."

[17] It is sometimes called as destabilization hypothesis (see e.g., Kumar and Mukhopadhyay,

The finance literature identifies two types of speculators, namely rational speculators and noise traders. Kyle (1985) and Admati et al (1988) assume that rational uninformed traders trade for liquidity and hedging purposes. Antonio et al. (2005) states that rational investors, by trading on fundamentals, are likely to stabilize markets, and in the process dampening the excessive price fluctuations. On the other hand, speculation may sometimes have a destabilizing effect if it is based on noise trading[18]. Numerous studies (e.g., Shiller, 1984; Shleifer and Summers, 1990) have suggested that such irrational noise trading exists in securities markets. Antonio et al (2005) argues that positive feedback trading by noise traders has a destabilizing effect on volatility:

> "Critics of index futures seem to imply that, because of ease and low cost of transacting, futures markets attract noise traders who cause prices to deviate from fundamentals and hence increase volatility in a destabilizing fashion. A particularly destabilizing form of noise trading is positive feedback trading...... if derivative markets were to attract noise traders in general and positive feedback traders in particular, then the potential for destabilization would be real and the claim for further regulation warranted."

The theoretical discussion of futures-induced volatility in the underlying market has firm roots in the finance literature and is supported by numerous empirical findings. A study by Maberly, Allen and Gillbret (1989) reports a rise in volatility in the post-index futures period. At the same time, similar results are also reported by Harris (1989), and latter by Damodaran (1990), Lockwood and Lin (1990) and Schwert (1999). Later on, Lee and Ohak (1992) extends the then existing literature on the issue, then primarily limited to and carried out for the US markets, to other markets including Japan, Australia, Hong Kong, UK and the US. The paper finds significant increase in volatility in all markets, except Australia and HK, subsequent to index futures initiation.

Bae et al (2004) finds an increase in spot price volatility for the underlying KOSPI 200 index stocks in the Korean market, with an associated spillover effect for non-futures stocks. Robbani and Bhuyan (2005) provide more recent evidence of an increase in volatility subsequent to futures and options initiation on the DJIA index. The paper finds evidence of a significant

[18] Black (1986) defines noise trading as "trading on noise as if it were information".

increase in return volatility as well as trading volumes for most of the 30 DJIA stocks using both the traditional as well as the GARCH (1, 1) methodology.

3.2 Theoretical Discussion and Empirical Evidence of Futures-Reduced Return Volatility

The second group of commentators asserts that futures trading has caused a decrease in stock price volatility. They argue that the low transaction cost, higher degree of leverage, and less time requirements to execute a trade are some of the distinguishing characteristic of the futures markets that attract differentially informed traders and induce them to trade on their superior (differential) information set in the futures market, and thus increase the possible channels of information flow[19]. Many authors, e.g., Anthony (1988), Miller (1990), Homes and Tomset (2004) also suggest that market participants prefer to trade in the derivatives markets as compared to the trading in the spot market, because of market frictions such as transaction costs, capital requirements, etc. These factors are also mentioned by Faff and Hiller to suggest that speculators have an incentive to migrate to the derivatives market and move their "risky" actions to the derivatives markets, thus reducing noise in the market and leading to lower volatility in the underlying market. This theory suggest decrease in the trading volumes in the underlying market because of the expected influx of informed and or/speculative traders to the derivatives market.

Another aspect of the informed trading hypothesis suggests that introduction of options (or single stock futures, in this case) increase media/analyst coverage of the underlying stock thus leading to increased investor awareness and participation, leading to an increased interest in the security and, hence, to an increased liquidity in the market for the underlying.

Empirical also tends to support this theory. Antoniou et al (2005) tests the hypothesis of changes in positive feedback trading for six markets namely Japan, UK, US, Germany, Canada and

[19] This hypothesis or theory is known as "Improved Information Hypothesis" or the "Informed Trading Hypothesis", first presented by Ross (1977). This theory has various sub-hypotheses. The first sub-hypothesis is related to the informed traders.

France using models of shiller (1984) and Sentana and Wadhwani (1992) with two sets of investors: smart money or rational speculators with expected utility maximization, and the positive feedback (trend chasing) investors. The paper specifies the conditional variance of the returns series using the GARCH. The paper finds evidence in line with the positive feedback trading in the pre-index futures period for all the markets but finds no such evidence in the post-index futures trading period. The paper also finds no evidence for the possibility of the positive feedback traders migrating to the futures market. Overall, the findings of their study support the evidence in favor of the hypothesis that futures market help stabilize the spot market by way of reducing the impact of feedback traders. This, in turn, attracts more rational investors to markets who are catalyst in making the market informationally more efficient. Boyer and Popiela (2004) find no increase in price volatility for the added stocks after trading began in the S&P 500 Index futures. Similar results are found by Darat and Rehman (1995) for S&P 500 index and find no support for the notion that index futures increase spot price volatility

Galloway and Miller (1997) document a decrease in return volatility for stocks subsequent to the index futures initiation. Two separate control samples of medium-capitalization and large capitalization stocks also exhibits a similar decrease in the return volatility and systematic risk which led the authors to confidently conclude that the apparent changes in the risk and liquidity of the MidCap 400 stocks may actually be result of the market wide changes and not associated with the index futures initiation. Pericli and Koutmos (1997), uses an expanded Exponential Generalized Autoregressive conditional heteroscedasticity (EGARCH) model for examining the impact of index futures and options on the spot market volatility. The paper uses three separate dummy variables for three periods namely, 1987 crash, the flexible exchange rate and the post-index future/options periods, with an objective to test for the structural changes in the conditional distributions of returns. Though many developments took place during the period of the study, the paper finds sufficient evidence to conclude that, excluding the effect of 1987 crash, no additional structural changes in the spot market volatility occurred in the post-futures and options period.

A large body of empirical studies has also focused on the lead-lag relation between the futures and the spot markets, both in terms of returns and volatility. This lead-lag studies deal with the question of whether the price changes in one market leads the price movements in the other market or whether this is a two-way traffic. Additionally, many of these studies also investigate the pattern of lead-lag interactions in volatilities between the spot and the futures markets. Some studies find bidirectional volatility movements between futures markets and the underlying spot market (Chan, Chung, 1995; Min and Njand, 1999; Chan, Chan and Karolyi, 1991), with some authors finding a unidirectional lead-lag volatility relationship from futures to spot market (e.g., Iehara, Kato and Tokunaga, 1996) and causality from spot to futures market (Shyy, Vijayraghavan and Quin, 1996), while some other studies do not find such inter-dependence in volatilities of the two markets (e.g., Kawaller et al, 1987; Arshanapali and Doukas, 1994; Abhyankar, 1995).

In summary, the most common conclusions of the previous studies on the lead-lag relationships are that the futures market prices appear to lead the prices in the underlying market. The major argument for this observed uni-directional lead-lag relationship is that since futures markets are characterized by lower transaction cost, less capital requirement, less time to execute trades and fewer short-selling restrictions. This induces the informed traders to trade in the futures market and the futures prices respond quickly to the new information arrival, supporting the argument of the price discovery role of the futures markets.

Overall, it is apparent from the discussion of the above studies that the findings of the impact of stock index futures and options on the volatility dynamics of the underlying depend on the time period, the market examined and the various methodologies used in the studies. The debate however, remains unresolved, both at the theoretical and empirical level.

3.3 Literature Overview on Single Stock Futures Contracts

Most of the existing literature on SSFs contracts has focused on the relations between the SSF contracts and their impact on volatility, liquidity, market efficiency for the underlined market in general and the underlying stocks, in particular, though currently there is little empirical research in this area as SSF contracts are a relatively new financial innovation and have only been recently introduced in major markets around the world[20]. These empirical studies have not yet reached a consensus on the impact of SSFs trading on its effect on the price, volatility, liquidity or market efficiency aspects on the underlying asset markets. Early research such as Lee and Tong (1998), Dennis and Sim (1999), Mckenzie, Brailsford and Faff (2001) report a decrease in the price volatility of the underlying shares in the spot market post-futures period[21]. However, more recent work by Hung, Lee and So (2003) found that the foreign-listed SSFs contracts had a positive effect on the conditional volatility of the underlying domestic stocks.

Peat and McCorry (1997) is the first author to examine the effect of SSFs listing on the volatility of the underlying shares and found that these SSFs had resulted in a significant increase in the volatility and trading volumes for the underlying stocks, while no price effect was found for these stocks. However, in the following year, Lee and Tong (1998) documents a decrease in volatility of underlying stocks in Australian market in the post-futures period coupled with an increase in trading volume for the underlying stocks. For this purpose, the authors use parametric tests (t-test and F-test) and non-parametric test (Wilcoxon rank sum test) to examine hypotheses of identical distribution, equal mean and equal variance pre-futures versus post-futures periods. The paper also reports results for the GARCH model. The paper also uses a sample of control stocks. However, the use of only 7 stocks in their study renders their conclusions insufficient to draw strong generalizations.

Mckenzie, Brailsford and Faff (2001) examine the impact of SSF listing on the systematic risk and volatility of the underlying SSFs stocks in Australian market. Threshold Auto Regressive Conditional Heteroscedasticity (T-ARCH) model incorporating dummy variables for pre-SSFs and post-SSFs listing periods and for individual terms, was used to examine both conditional and unconditional volatility effects and the asymmetric information hypotheses. An equally weighted control portfolio of similar non-SSF stocks was also used to control for biases in results and to rule out the possibility that the changes in volatility may be due other market-wide factors/events. The beta risk change (and unconditional volatility change) coefficients in 5 (and

[20] As compared to universal adoption of stock index futures, SSFs are traded relatively on a fewer exchanges.
[21] Peat and McCorry (1997), who pioneered the research on the impact of SSFs introduction, found an evidence of an increase in the volatility of the 10 underlying shares in the Australian market.

7) out of 10 cases, show a significant decline in volatility in the post SSF listing period. Finally, the paper finds some evidence, though inconsistent and weak, in support of some changes in the asymmetric response in returns for individual stocks after futures listing.

Hung, Lee and So (2003) used the GJR-GARCH (1, 1)[22] model to examine the impact of foreign-listed SSFs on the level of price volatility of domestic underlying stocks. The authors included SSFs trading activity variables namely SSFs volume and open interest in the variance equation of the GJR-GARCH model after decomposing them into expected (informationless) and unexpected (volume shocks) components using appropriated ARMA models. The study documents that the unexpected components of futures trading had a positive effect while the unexpected (informationless) component had a negative effect (reduction in volatility) on the conditional volatility of the underlying domestics stocks.

Ang and Cheng (2005) examine the changes in market efficiency and market stabilization in the post SSFs period. The paper uses a 10-days (- 5, +5) event window and examine the underlying stock volatility by comparing the number of days with large positive or negative returns for SSFs-underlying stocks and a control group of matching non-SSF stocks. The study finds that the number of unexplained large stock returns decreases for SSF stocks in the post-SSF period and is smaller as compared to non-SSF stocks. This reduction is also found to be positively correlated to trading in SSFs. Therefore; the authors conclude that the introduction of SSF has contributed to the market efficiency. In addition, Rahman (2001) uses GARCH (1, 1) model for estimating intra-day returns volatility for each of the 30 individual stocks for DJIA index for a sample period of 3-months before and after futures trading initiation. The empirical results do not report any change in the volatility in the post-futures period. Similarly, Kan (1997) does not find increase in the volatility of the individual index-constituent stocks when compared to the non-constituents after the introduction of the futures on the Hong Kong Stock Exchange. Whereas, Kasman and Kasman (2008) report a reduction in volatility on Istanbul Stock Index (ISE-30) for Turkish stock market using an Exponential GARCH model.

[22] Glosten, Jagannathan and Runkle (1993)

Recently, Floros and Vougas (2006) examine the effect of index futures trading on the underlying spot market volatility for indices in Greece over the period 1997-2001. The paper conducts the empirical analysis in the two stages. First, it uses dummy variable (taking value of 1 post-futures and 0 for pre-futures) in the variance equation of various GARCH class of models to analyze the relationship between information and volatility for the two indices in the pre-futures versus the post-index futures periods. In the second part of the analysis, the authors estimate the GARCH-Class of models separately for each period and the volatility parameters are examined and compared across the two sub-periods. The paper reports a measured decrease in volatility for FTSE/ASE20 and an increase in volatility for the other index in the post-index futures period. Mazouz and Bowe (2006) employ Fama and French Three factor Model and the characteristics of the systematic risk of the underlying SSFs stocks on London Stock Exchange (LSE), and finds evidence of an increased stock market efficiency following the introduction of SSFs on LSE. Chau, Holmes and Paudyal (2005) examines feedback, autocorrelation, and behavior of volatility of the underlying stocks subsequent to the introduction of trading in domestic and cross-border Universal Stock Futures contracts on the LIFFE, employing the Santa and Wadhwani (1992) heterogeneous trader model approach using asymmetric model of Golsten et al (1993) GJR-GARCH (1, 1). Additionally, the paper uses a sample of non-USF stocks to account for the possible effects of the factors other than the introduction of USFs trading and also to remove possible sources of biases in the empirical results and conclusions. Using a 6 years window (3 years pre and 3 years post-futures) the study documents a relatively low feedback trading, more pronounced for USF than for stocks of control group in the post-USF trading. The study also finds not sufficient evidence to suggest that USF has contributed to the underlying stock market volatility. Dennis and Sim (1999) find insignificant change in volatility for most of SSF stocks for the Sydney Futures Exchange in the post SSF-period.

Most recently, Beer (2009) evaluates a possible volatility effect of the initial trading of SSFs contracts for the South African market using GARCH (1, 1) methodology and finds a significant reduction in the level and structure of the price volatility for the shares in the underlying market. Similar results are reported by Narasimhan and Ubaidullah (2007) for the Indian market and they find an evidence of a decline in volatility for the underlying stocks, though there was an evident shift in the trading volumes from the spot to the SSFs market. Similar results of shifts in the volume to the SSFs market are also reported for the Indian market by a Srinivasan and Chundru (2008).

As regards Pakistan's stock market, researchers started taking some interest in the Pakistan's stock market following economic liberalization in 1990s and some preliminary work was done in areas of stock market behavior including relationship between stock prices and trading volume (Ali, 1997, Khan, 2007, Mamoon, 2007, Mustafa and Nishat, 2004), the nature of volatility in stock prices (Mamoon, 2007, Khilji, 1993). However, despite the fact that single stock futures were first introduced on the Pakistan's stock market in 2001, a paper by Khan (2006) is the only study to have been conducted, to the best knowledge of the author, on the impact of the futures trading on the volatility of the Pakistan's stock market. GARCH model was used in this paper to examine the volatility spillover from the futures to spot market and vice versa, while the Vector Autoregressive models was used to examine the lead-lag relationship between the two markets. Empirical results of his study documents a unidirectional causality from spot to futures prices, no evidence that futures trading cause spot price volatility in the Pakistan's market. However, Khan (2006) paper does not include the analysis of volatility in the context of pre-versus-post futures trading. So, it is not clear whether volatility has actually increased, decreased or no change in volatility pre-versus-post futures period for the underlined stocks. The paper examines only the impact of SSFs on the overall index return's volatility while this study looks at the volatility of the individual underlying stocks in the post futures period. This study additionally considers the futures trading activity variables, such as SSFs contracts volume and open interest to have an additional insight as to whether these variables are important in explaining the volatility of the underlying stocks.

The findings of this study can be important to general investors, academics and financial market regulators. If there were no change in the market micro structure in the post-SSFs period, or that the futures initiation has contributed to the reduction in volatility, increase in liquidity, market depth and market efficiency and the results are consistent with the theories that implies a favorable impact of the introduction of derivatives trading, then calls for higher regulations would be unwarranted, and efforts should be directed towards introduction of other derivatives products in the Pakistan's market to provide investors alternative avenues for investment, hedging and other risk management purposes. Moreover, this study will help to ascertain whether the increased volatility, if any, for SSFs and non-SSFs stocks may be related to either SSFs trading or is the result of other market-wide changes.

CHAPTER 4

RESEARCH METHODOLOGIES AND STATISTICAL METHODS

As discussed in the first chapter (section 1.3) that this study examines three different aspects of the effect of introducing SSFs trading on the underlying asset market. These aspects include stock price volatility effect, systematic risk effect and the market efficiency effect[23]. This chapter outlines the research methodology and various statistical techniques used to examine SSFs introduction and trading effects on these aspects of the underlying stocks. Section 4.1 of this chapter describes the sample, followed by the control group selection procedure and criteria (4.2) while section 4.3 provides an in-depth description of the methodology used in the study to examine the stock price volatility effects of SSFs introduction, section 4.4 examines the volume effects, section 4.5 looks at the systematic risk effect of introducing SSFs, and the description of the data in provided in section 4.6. The analysis of the data and main findings of the study are provided in the chapters to follow.

4.1 Sample selection procedure for SSFs-listed stocks

The initial step in the sample selection process was to determine the sample time period of the analysis for a stock. We find sample time periods of varying intervals in empirical studies on the topic. These sample periods rank from three months up to three years[24]. Some studies on futures have included 1- year observations pre and post-futures periods[25]. Other studies have included

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[23] The other minor aspects include price and volume (liquidity) effects of introducing SSFs on the Pakistan's market. The theoretical discussions for these aspects are provided in their respective chapters (Chapter 5,6 and 7)

[24] Rehman (2001) and Choi and Subrahmanyam (1994) uses 3 months and 6 months, respectively, pre-futures and post-futures periods, in their analysis of the effect of futures trading on the price volatility of the underlying markets.

[25] This includes studies by Boyer and Popiela (2004) and Galloway and Miller (1997)

up to three years before and three years after introducing futures trading[26]. Similar to a study by Laatsch (1991), in this study, we have selected 2 years before and two years after the SSFs listing for a stock to avoid possible biases in empirical results that can arise because of using a lengthy sample and thus mix any possible impact of futures trading with the effect of any other market wide changes, occurred during the period under the study, that could possibly alter the results of this study. The procedure for selection of an SSFs-listed stock is as follows:

A) Any stock(s) for which the SSFs contract was removed from the exchange during the sample period were not selected in the sample for analysis purpose as there could be other fundamental factors affecting the price performance of the stock. The other reason may be that the SSFs trading may be characterized by thin trading and not meeting the exchange requirements.

B) Only those stocks were selected in the sample for analysis that had complete data for the whole sample time period. There were some stocks, e.g., POL, for which SSFs were introduced soon after their listing with the Karachi Stock Exchange, yielding insufficient daily price data in the pre-SSF listing period. Such stocks were, therefore, excluded from the sample;

C) Finally; those stocks were also excluded from the sample that did not have 2-years post-futures daily price data till June 30, 2008. The final sample consists of 28 out of 46 that fulfilled these criteria. Table 4.1 reports details of the sample SSFs stocks that were used for analysis in this study. The table reports name, code, industry classification to which a stock belongs to, and listing dates of the corresponding SSFs contracts. In Pakistan, the SSFs contracts were introduced in July 2001. There are 46 stocks that have SSFs written on them[27]. As shown in the table that the SSFs were gradually introduced in various phases on the Karachi Stock Exchange. The pre-futures and the post-futures period for each individual stock; both SSFs-listed and the matching non-SSFs stock, was selected keeping in view the listing date of each SSFs contract.

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[26] Edwards (1988)

[27] Trading in these SSFs contracts (along with CFS-MK II) were discontinued on April 8, 2009. This decision was taken by Securities and Exchange Commission of Pakistan (SECP) in light of the CFS-MK II Review Committee. No new contracts opened in SSFs from April 20, 2009. Trading in SSFs was restarted on July 27, 2009, after a ban of three and a half months. This time the SECP approved more exhaustive eligibility criteria for selection of a sock for SSFs listing. This rigorous method resulted in 18 stocks to qualify as eligible for SSFs contracts. Presently 18 stocks has SSFs written on them. These 18 stocks, together, account for 57 percent of the market capitalization.

Table 4.1—Listing History of Sample SSF contracts at the Karachi Stock Exchange

S. No	Code	Company Name	Industry/Sector	Listing date
1	DSFL	Dewan Salman Fibers Ltd.	Synthetic and Rayon	1-Jul-01
2	ENGRO	Engro Chemicals Ltd.	Fertilizer	1-Jul-01
3	FFC	Fauji Fertilizer Co. Ltd.	Fertilizer	1-Jul-01
4	HUBC	Hub Power Co Ltd.	Power Generation and Distribution	1-Jul-01
5	MCB	MCB Bank Limited.	Commercial Banks	1-Jul-01
6	NML	Nishat Mills Ltd.	Textile composite	1-Jul-01
7	PIA (A)	Pakistan International Airline (A)	Transport	1-Jul-01
8	PSO	Pakistan State Oil Co Ltd.	Oil and Gas Marketing	1-Jul-01
9	PTCL	Pakistan Telecommunication Ltd.	Technology and Communication	1-Jul-01
10	SNGP	Sui Northern Gas Pipe Line Ltd.	Oil and Gas Marketing	1-Jul-01
11	IBFL	Ibrahim Fibers Ltd	Synthetic and Ryon	1-Jan-02
12	FFBL	Fauji Fertilizer Bin Qasim Ltd.	Fertilizer	25-Nov-03
13	DGKC	D. G. Khan Cement Co. Ltd.	Cement	21-Jun-04
14	SSGC	Sui Southern Gas Co Ltd.	Oil and Gas Marketing	21-Jun-04
15	LUCK	Lucky Cement Limited.	Cement	21-Jun-04
16	MLCF	Maple Leaf Cement Factory Ltd.	Cement	21-Jun-04
17	NBP	National Bank Of Pakistan	Commercial Banks	21-Jun-04
18	OGDC	Oil & Gas Developt Company Ltd	Oil and Gas Exploration	21-Jun-04
19	POL	Pakistan Oilfields Limited.	Oil and Gas Exploration	21-Jun-04
20	AKBL	Askari Commercial Bank Limited.	Commercial Bank	Sep. 20, 2004
21	BOP	Bank Of Punjab	Commercial Bank	Sep. 20, 2004
22	FABL	Faysal Bank Limited.	Commercial Bank	Sep. 20, 2004
23	PPL	Pakistan Petroleum Limited.	Oil and Gas Exploration Companies	Sep. 20, 2004
24	TELE	Telecard Ltd.	Technology and communication	Sep. 20, 2004
25	UBL	Union Bank Ltd	Commercial Banks	Sep. 20, 2004
26	BAFL	Bank Alfalah Ltd.	Commercial Banks	20-Feb-06
27	KAPCO	Kot Addu Power Company	Power Generation and Distribution	20-Feb-06
28	KESC	Karachi Electric Supply Corporation	Power Generation and Distribution	20-Feb-06
29	PIOC	Pioneer Cement Ltd.	Cement	20-Feb-06

NOTE: sufficient data not available for PPL as SSF contract was introduced soon after its listings with KSE. FFBQ was de-listed from Futures trading during the sample period.

4.2 Control Group Stocks

There may be other events and factors, besides the introduction of the SSFs trading that have also affected the price performance characteristics of the stocks during the sample period. Such factors may include, for instance, that firm-specific and/or industry-specific factors or changes in the macroeconomic factors that may have occurred at the time of SSFs initiation or during the sample period that have changed the dynamics of the market. The tests, therefore, may mistakenly attribute such a change, if it occurred, to the introduction of SSFs contracts. It is therefore, essential to study a sample of non-SSFs stocks to separate the effects of SSFS-initiation from the effects of other factors. In case the SSFs-introduced stocks behave differently to the stocks of the control group in the post SSFs period, this mechanism will strengthen the conclusions that we will draw relating to the effects of futures trading.

4.2.1 Construction of Control Portfolio

A procedure adopted by Laatsch (1991) is followed in this study to select stocks for a control sample. This procedure is based on the mean net sales values for both the SSFs and the non-SSFs stocks. The relevance of "net sales" in the selection process of non-SSFs stocks is based on the need to avoid confounding the findings of the study with the "small size effect" reported by many previous studies (e.g., Banz, 1981; Reinganum, 1981). The steps followed for the selection of control sample is as follows:

A) Since the Karachi Stock Exchange listed companies are grouped by industry classification, the control group stocks were selected from those industry groups which also had SSFs-listed stocks.

B) Those firms in the industry, whose average net sales over the last five years before the listing of an SSFs contract for a particular stock(s), falls within the $\pm 20\%$ of the average net sales of SSFs-listed stock in that particular industry group are selected as candidate stocks for control group;

C) In case there are less than two firms with $\pm 20\%$ average net sales of SSFs-listed stock(s), then only two candidate firms are selected; one with the lowest and the other with the highest average net sales, respectively.

D) In case it is the SSFs-listed stock(s) that has the highest net average sales in the industry group and less than two firms falls in the range of $\pm 20\%$, then the firms that had the two next lower net average sales are selected as candidate firms.

Table 4.2 contains a list of the candidate non-SSFs stocks with their respective SSFs stocks by industry classification. To select control group stocks from among the candidate stocks, these non-SSFs stocks are then matched to their respective SSFs stock(s). This matching technique is based on seven ratios, which Pinches, Mingo and Carthers (1973) factor-analysis showed as having high factor loads[28]. The seven ratios are: net income divided by net worth, sales divided by total assets, inventory divided by sales, debt divided by total capital, receivables divided by inventory, current ratio and cash/uses of funds[29]. The purpose of this technique is to select a stock that is best match to the SSFs-listed stock, i.e., the one which is least distant from the SSFs underlying stock. In order to measure this technique, the five-year average value of each ratio of each candidate non-SSFs stock was "standardized" by dividing by the average value of the corresponding ratio of the SSFs-listed stock in the industry group. This process is repeated for all the candidate stocks in the sample. The seven distance values (standardized ratio values) for each stock are added up and divided by seven to arrive at the average distance value for each candidate stock. The stocks with the least distance were then selected for the control group. The control sample thus selected consists of 23 non- futures listed stocks.[30]

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[28] Laatse (1999) has also used this technique to select control group stocks for Major Market Index (MMI) to examine the effect of index futures trading on the index component stocks.

[29] Because of the data limitations in the available source (Balance sheet analysis of listed firms, published by the State Bank of Pakistan), only five ratios were calculated for each stock (the ratios excluded from the analysis were current ratio and cash/uses of funds). In addition to the use of the five ratios, two more ratios were also included in the analysis for control group stocks selection. These two measures are: i) the market value of equity to book value of equity, and ii) trading value ratio

[30] It mentions a merit to point out that only those firms in the industry were considered as candidate stocks for control group which were actively traded in the stock exchange, as there were many stocks in every industry that were not being traded and hence no trading data was available for such stocks for either side of the SSFs listing dates and such companies were not considered in the sample selection procedure.

Table 4.2 List of candidate Non-SSFs stocks and the corresponding SSFs-listed Stocks

Industry	SSFs-Listed Stocks	Non-SSFs Candidate Stocks
Synthetic and Rayon	Dewan Salman Fibers Ltd., Ibrahim Fibers Ltd	Garton Industries Ltd, Liberty Mills Ltd, Rupali Polyester Ltd
Chemical and Pharmaceuticals	Engro Chemcials Ltd, Fauji Fertilzer Comp. Ltd	Clareant Pak Ltd, Dawood Hercuels Chemicals Ltd, BOC Pak Ltd, Sitara Chemcials Ltd
Textile Composite	Nishat Mills Ltd	Crescent Textile Mills Ltd, Kohinoor Textile Mills Ltd, Nishat Chunian Ltd
Cement	DG Khan Cement Ltd, Lucky Cement Ltd, Mapple Leaf Cement Ltd, Poineer Cement Ltd	Attock Cement Ltd, Bestway Cement Ltd, Cherat Cement Ltd, Kohat Cement Ltd, Fecto Cement Industrial Ltd, Fauji Cement Company Ltd, Javedan Cement Ltd
Oil and Gas Marketing companies	Pakstan Stat Oil, Sui Northern Gas Pipe Line Ltd, Sui Southern Gas Pipe Line Ltd	Attock Refinery Ltd, Kohinoor Energy Ltd, Marigas Comp. Ltd, National Refinery Ltd
Transport and Communication	Pakistan International Airlines, Pakistan Telecommunication Comp. Ltd	Telecard Ltd, Worldcall Pay Phones Ltd,
Commercial Banks	Muslim Commercial Banks, Bank Al Falah Ltd., Askari Commercial Bank, National Bank of Pakistan, Bank of Punjab, Faysal Bank Ltd, Union Bank Ltd	Askari Commercial Bank, Bank Al Habib, PICIC Comm. Bank Metero Politan Bank, Soneri Bank, Crescent Comm. Bank Ltd Bank Alfalah Ltd, Meezan Bank,
Oil and Gas Exploration	Oil and Gas Development Comp. Ltd, Pakistan Oils Ltd, Pak Petroleum Ltd.	Mari Gas Company Ltd
Power Generation and Distribution	Kot Addu Power Company, Hub Power Co Ltd., Karachi Electric Supply Corp.	Kohinoor Energy Ltd. Sitara Energy Ltd, Altern Energy Ltd
Technology and Communication	Telecard	Pak Data Communication Ltd

Table 4.3 Control Group Stocks

	Symbol	Control Group Stocks	Industry
1	GATI	Garton Industries Limited	Synthetic and Rayon
2	DAWH	Dawood Hercuels Chemicals limited	Chemical and Pharmaceuticals
3	SITC	Sitara Chemicals Industries Limited	Chemical and Pharmaceuticals
4	CRTM	Crescent Textile Mills Ltd	Textile Composite
5	ACPL	Attock Cement Ltd	Cement
6	CHCC	Cherat Cement Company Ltd	Cement
7	KOHC	Kohat Cement Company Ltd	Cement
8	FECTC	Fecto Cement Industries Ltd	Cement
9	FABL	Faysal Bank Ltd	Commercial Banks
10	ATRL	Attock Refinery	Oil and Gas Marketing Companies
11	KOHE	Kohinoor Energy Ltd	Oil and Gas Marketing Companies
12	PAKD	Pak Data Com Ltd	Transport and Communication
13	TELE	Telecard Ltd	Transport and Communication
14	PNSC	Pakistan National Shipping Corporation	Transport and Communication
15	AKBL	Askari Commercial Bank Ltd	Commercial Banks
16	BAHL	Bank Al Habib Ltd	Commercial Banks
17	SNBL	Soneri Bank Ltd	Commercial Banks
18	BAFL	Bank Al Falah Ltd	Commercial Banks
19	ABL	Allied Bank Ltd	Commercial Banks
20	FABL	Faysal Bank Ltd	Commercial Banks
21	SEL	Sitara Energy Ltd	Power Generation and Distribution
22	FFC	Fauji Fertilzer Company Ltd	Fertilizer
23	SSGC	Sui Southern Gas Company Ltd	Oil and Gas Exploration

Table 4.3 lists the selected non-SSFs stocks in a particular industry group and the stock with the value closest to one was considered as the best match and selected for the control group. Next section of the chapter describes the methodologies used to examine the price effect, volatility effect and the volume effect of introducing SSFs on the Pakistan's market.

4.3 Stock Price Volatility Effect: Statistical Methods and Econometric Analysis

To test the hypothesis the trading activities of the SSFs has an impact on the price volatility of the underlying stocks subsequent to the SSFs contracts trading initiation in the Pakistan's stock market. To be more accurate, the study seeks to address the following objectives:

1. The behavior of stock returns volatility is examined both in the pre- and the post-SSFs period using an event study methodology. This will allow us to determine if there is any shift in the returns volatility in the Post-SSFs period.

2. Has the trading of single stock futures affected the simple risk- reward characteristics of the underlying stocks? This issue is addressed through analysis of the means and variances of the daily stock returns of the underlying SSFs stocks. The analysis is undertaken both in the pre-futures and the post-futures periods. With the possibility that the factors other than the initiation of SSFs contracts may have affected the means and variances of returns in the two sub-periods, a select sample of matching non-SSFs stocks is also formed and same procedure is adopted for the control sample. The mean-variance analysis of the SSFs-listed stocks can then be compared with the "benchmark" mean-variance performance of the control group stocks.

3. As some informed traders may migrate from the underlying market to the SSFs market because of higher leverage and lower transaction costs properties of the futures (SSFs) market, SSFs volumes may contain some information not revealed by the trading volumes of the underlying stocks. Consequently, stock's price volatility may be related to the SSFs trading volume. The third objective of this study is, therefore, to examine if the SSFs trading is related to the stock price volatility of the underlying stocks.

4. The study examines the impact of futures trading on the level of market trading activity (trading volumes) of the underlying stocks in the post-futures period. As pointed out by Robbani and Bhuyan (2005), this can also help ascertain whether the increased volatility, if any, can at least in part, be attributable to an increase in the trading volume of stocks in the ready market. Moreover, single stock futures trading activity variables namely SSFs volume and open interest have also been included in the analysis to examine whether these futures trading activity variables affect return volatility of the underlying stocks.

To achieve the above-stated objectives, this section of the study uses a two-pronged approach to analyze the effect of futures trading on the returns and variances of the underlying stocks. First, as a preliminary test, a simple examination of the means and variances of the returns of SSFs-listed stocks is undertaken using the traditional methods of return volatility estimation, and for that purpose using parametric and non-parametric tests. This procedure is also adopted for a sample of non-SSFs stocks. In the second phase of the analysis, more detailed econometric models are applied to test the effect of introducing SSFs on the level of the price volatility of the underlying shares, using a measure of volatility suggested by Schwert (1990b). The second part of this dispensation uses a cross-sectional analysis to compare the level of price volatility of the SSFs-listed stocks with those of the control group socks through a dummy variable regression equation that also incorporates some of control variables that are known to affect volatility.

4.3.1 Measures of Return Volatility

Two measures of stock return volatility are used in this study, in the first and preliminary part of the analysis, to compare and examine changes in volatility pre-futures versus post-futures period for each individual SSFs and the control group of matching non-SSFs stocks. First measure of volatility is the variance[31] of the daily returns with the definition of returns in equation (4.2). This measure of return volatility has extensively been used in many studies (e.g., Edwards (1988); Franklin, 1988; kamara et. al (1992); Lee and Tong (1998); Najand (2002); Jagadesh and Subrahmanyahm (1993)] to analyze and compare return volatility in the pre- and the post-futures periods.

The second measure of volatility employed in this study is the Parkinson's (1980) estimator, with the definition of returns in equation (4.1), i.e., variance of High-Low intra-day returns[32].

$$HLR_{it}^2 = \frac{[\ln(P_{HT}) - \ln(P_{LT})]^2}{4\ln 2} \text{------------------------------------} (4.1)$$

Where:

P_{HT} = The daily highest price for stock i during trading day t

P_{LT} = The daily lowest price for stock i during trading day t

Parkinson's estimator is considered more efficient measure of volatility than the close-to-lose measure of volatility as it conveys more information.

This study uses the following definition of returns for each stock:

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[31] Variance (historical) is the measure of variability of a security or portfolio returns, indicating the spread of historical values around the mean value. Larger the value of variance higher is the volatility, and consequently, higher the risk.

[32] These measures was also used by Edwards (1988), Robbani and Bhuyan (2005), Chorrado and Troung (2007) compares the intra-day high-low price range estimator with the implied volatility indexes, published by the Chicago Board Options Exchange for various US market indices, for forecasting return volatility and finds this volatility measure to perform as efficiently in in-sample and out-of sample volatility forecasts.

$$R_{it} = \ln(P_t / P_{t-1}) \text{-------------------------------------(4.2)}$$

Where:

R_{it} = Daily stock returns for stock i at time period t,

P_t = Closing price of stock i on day t

P_{t-1} = Closing price of stock i on previous day

4.3.2 Stock Price Volatility Effect: Statistical methods

As an initial investigation of the volatility effects of the SSFs trading, we conduct a simple examination of the means and variances of the returns of SSFs-listed stocks using the measures of return volatility estimation outlined in section 4.3.1. To this end, the following parametric (two-sample t-test and F-test) and non-parametric (Wilcoxon Rank Sum Test) tests are employed to test for changes in the stock returns, return volatility and trading volume in the post-SSFs period for both the individual SSFs-listed and the non-SSFs stocks. As an alternative to F-test, other equality of variance tests used in this study include Bartlett's (1946) Homogenity of Variance Test, Brown-Forsythe's (1974) test and Levin's test. Further, the above-mentioned tests are also applied to a select group of non-SSFs stocks to compare whether the changes in return, return volatility and trading volume for the individual stocks is SSFs-trading innovation specific or rather a market-wide phenomenon and/or changes that has affected all the stocks in the market.

4.3.2.1 The t-Test of Equality of Means

The t-test of equality of means can be used in this study to test whether the mean value of variable, X, is the same for two set of samples (populations). With the assumptions that the distribution of the variable is normal and that the variance of the variable is same in both set of populations, the test statistic is given by equation (4.3):

$$t = \frac{(\overline{X}_1 - \overline{X}_j)}{S_k\left[\frac{1}{n_1} + \frac{1}{n_j}\right]^{\frac{1}{2}}} \quad (4.3)$$

Where $\overline{X}_1$ and $\overline{X}_j$ (n_1 and n_2) are the sample means of the two samples (in this case, the pre-SSFs and the post-SSFs periods for each underlying stock,_and S_k is the pooled sample variance. The test statistic has t distribution with the null hypothesis:

$H_0 : \mu_1 = \mu_j$,

with degrees of freedom equal to $n_1 + n_2 - 2$. The pooled sample variance, S_k^2, is estimated by equation (4.4):

$$S_k^2 = \frac{(n_1 - 1)S_1^2 + (n_j - 1)S_j^2}{n_1 + n_j - 2} \quad (4.4)$$

It is appropriate only to pool the variances of the two samples if the samples are independent. Since the same stocks are contained in each of the sub samples (i.e., pre- and the post-futures periods), the independence assumption becomes an area of concern. However, as pointed out by Laatsch (1988), the arguments that the successive stock returns are serially independent, alleviates the independence concern, though it still lingers on. It is probably because of this concern that practitioners and researchers familiar with the use of the t-test and F-test suggest that these tests should be used in addition to the more rigorous tests based on the event study methodology.

4.3.2.2 The Wilcoxon Rank-Sum Test (WRST)[33]

The Wilcoxon Ran Sum Test (WRST), an equivalent to the Mann-Whitney U test, can be employed as an alternative to a two-sample t-test when the population that are examined

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[33] Also known as the Mann–Whitney U test, it is considered as one of the best-known non-parametric significance tests. It was proposed initially by Wilcoxon in 1945, for equal sample sizes, and extended to arbitrary sample sizes and in other ways by Mann and Whitney (1947)

do not fulfill the assumption of being normally distributed. WRST tests the null hypothesis that the median (location) of the two populations, represented by two random samples, are identical, against an alternative hypothesis that they are not same in terms of location.

4.3.2.3 F-test of Equality of Returns Variance[34]

The parametric test employed in this study to examine the equality of stock return variance pre-futures versus post-futures period for the SSFs-listed stocks is the F-test. This test is simply the ratio of the variances of the two samples; post and pre-futures periods in this study. the variance with the larger value is placed in the nominator and the variance with the lower value is place in the denominator. That is why the value of the F-statistic is either equal to one or is greater than one.

Mathematically;

$$F = \frac{S_1^2}{S_2^2} \qquad (4.5)$$

Where:

S_1^2 = Variance of pre-futures period

S_2^2 = Variance of Post-futures period

Under the null hypothesis of equal sample variances, F-test is based on two main underlying assumptions which are; a) Samples are independent random samples and b) Variables are normally distributed. As F-test is highly sensitive to the assumption of the normal distributions of variables, we perform Bartlett's (1946) homogeneity test of equal variance besides the standard F-test. However, as Bartlett's test is responsive to non-normality, we also use Levene's (1960) test of equality of variance.

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[34] Snedecor and Cochran (1989)

4.3.3 Stock Price Volatility Effect: Econometric Methods

In addition to comparing trading volume for the SSFs-listed and non-SSFs listed stocks in the pre-futures and the post-futures period, this study also carries out detailed econometric analysis to provide further evidence on the inter-relations between spot-trading volume, SSFs trading activity and the underlying stock's price volatility by including the observed trading activity variables of the two alternative markets in the model specification. For this purpose, the analysis is conducted in the following two parts.

4.3.3.1 Schwert's procedure for volatility Analysis

This section tests the hypothesis that trading activity in the single stock futures contracts has an impact on the market price volatility of the underlying stocks in the Pakistan's market. To this end, we measure daily stock return volatility by adopting a procedure introduced by Schwert (1990b), and further followed by other studies (e. g., Bessimender and Seguin, 1992, 1993; Wang, 2002). This volatility measure is based on observable variables. The process involves iterating between the following conditional mean and volatility equations:

$$R_t = \alpha + \sum_{j=1}^{n} \gamma_j R_{t-j} + \sum_{i=1}^{4} \rho d_i + \sum_{j=1}^{n} \eta_i \hat{\sigma}_{t-j} + U_t \text{ ---------------------- (4.6)}$$

$$\hat{\sigma}_t = \beta + \sum_{i=1}^{4} \theta_i d_i + \sum_{j=1}^{n} \eta_i \hat{\sigma}_{t-j} \sum_{j=1}^{n} \varpi_j U_{t-j} + \varepsilon_t \text{ ---------------------- (4.7)}$$

Where:

R_t = Daily stock returns on day t,

d_t= Corresponds to four dummy variables used for the four days of the week. That is $D_1 = 1$ for Tuesday and 0 for other days; $D_2 = 1$ for Wednesday and 0 for other days, and so on.

U_t = the residuals (unexpected returns) form equation (4.6),

σ= the estimated conditional volatility of returns at time t, and is given by equation (4.8):

$$\sigma_t = |U_t|\sqrt{\pi/2} \text{ ---------------------------------(4.8)}$$

The daily dummies were included in the equations (4.6 and 4.7) to capture the extensively documented phenomenon of differing mean daily returns and daily volatility (French, 1980; Gibson and Hess, 1981, Keim and Stambausgh, 1984)[35]. The lagged daily returns (R_{t-j}) in equation (4.6) accounts for changes in expected returns and lagged U_t was included in equation (4.7) to capture the possible asymmetry in the returns-volatility relationship (Wang, 2002). Equation (4.7) estimates conditional standard deviation (volatility). Lagged standard deviation estimates in equation (4.7) accounts for the persistence of volatility shocks (French, Schwert and Stanbough, 1987; Bessimender and Segiun, 1992; Wang, 2002).

To obtain volatility estimates, equation (4.6) is first estimated without the lagged standard deviation estimates to obtain residuals from the regression. The residuals obtained are the unexpected returns. The conditional volatility series is generated using equation (4.8) by

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[35] The day-of-the week effect refers to returns not being homogenously distributed over the trading days of the week. The main findings have been lowest and on average negative returns on Mondays and large returns on Fridays as compared to other days of the week (French, 1980; Gibson and Hess, 1981; Theobald and Price, 1984; Jeff and Westerfield, 1985, to mention a few). With respect to Pakistan's stock market, a study by Husain (1998) reports some evidence of significant differences in mean returns across days. Also, a study by Khan (2007) also documents some evidence of the day of the week effect for KSE-100 Index using GARCH (1, 1) estimation. This study, however, finds no evidence to suggest the presence of the day-of-the-week effect in first sub sample (1995 to 2000), which indicates that the day of the week effect, has only recently surfaced in Pakistan's stock market.

transforming these residuals, and then we estimate equation (4.7). The process is iterated with volatility estimates (lagged terms) as independent variable in equation (4.6).

To study the relation between stock price volatility and trading activity, we include daily spot trading volume of each underlying stock, futures (SSFs) trading volume and open interest as activity variables in equation (4.7). Open interest provides an additional measure of trading activity[36]. Iteration is, therefore, between equation (4.6) and an augmented equation (4.9)[37]:

$$\hat{\sigma}_t = \beta + \sum_{i=1}^{4}\theta_i d_i + \sum_{j=1}^{n}\eta_i \hat{\sigma}_{t-j} \sum_{j=1}^{n}\varpi_j U_{t-j} + \sum_{j=1}^{m}\mu_k A_k + \varepsilon_t \text{ ----------------(4.9)}$$

where A_k is the m trading activity variables, i. e, spot trading volume, SSFs trading volume and open interest. All other variables are same as explained in the equation (4.8).

Many studies (e.g., Chen, Ferth and Rui (2001) and Gallent et al (1992) document evidence of time trends in trading volumes series. To mitigate any effects, therefore, of secular growth in volume, we first construct a detrended activity series by subtracting 100-day moving average from the original series[38]. Each detrended activity series is then decomposed into expected and unexpected components using an appropriate ARIMA (p, I, q) specification[39]. The decomposition of each activity series into expected and unexpected parts allows each component to have a separable effect on price volatility. The expected component of trading volume or open interest series is the fitted values

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[36] Open interest refers to the total number of outstanding futures contracts (Long and Short). Open interest is an indicative of market depth and the willingness of the market participants to hold onto their positions. Rising (declining) open interest indicates that the market participants benefiting (losing) from the current movements in the market are willing to increase (liquidate) their commitments.

[37] Besseminder and Seguin (1992, 1993) also included these three activity variables

[38] The same procedure was also followed by Bessimender and Seguin (1992)

[39] The number of lags for ARIMA model for each activity series was chosen using Akaike Information Criteria (1969) and Schwarz Information Criteria (SIC).

from the ARMA model while the unexpected trading activity series was generated by subtracting the expected trading activity series from the original detrended series. This series can be interpreted as the daily activity shock, whereas, the expected component reflects activity which can be forecasted but highly variable across days. Slower adjustment changes are captured by the 100-day moving average series. Thus, the equation (4.9) contains six additional activity variables namely, expected-spot–volume, unexpected-spot-volume, moving average-spot-volume, expected-SSFs-volume, unexpected-SSFs-volume and moving average-SSFs-volume.

4.3.3.2 Cross-sectional analysis for volatility comparisons

To further the process of analysis and augment the results of the section 4.3.1 and to separate the compounding effects associated with various firm- specific factors that have been identified to have an effect on spot price volatility and that have been commonly employed in many studies include size of the firm, systematic risk (beta coefficient), and stock price level. (See e.g., Bae et al, 2004; Harris, 1989; Karpoff, 1987; Choi and Rajan, 1997 and Fang and Loo, 1996). These firm-specific factors were, therefore, employed as independent variables in the regression equation to account for the variations in the price volatility of the underlying stocks. Following the methodology of Galloway and Miller (1997), SSFs-listed stocks are grouped with a sample of non-SSFs stocks and changes in the level of return volatility for the SSFs-underlying stocks are compared to that of the level of volatility of the control group stocks in the post SSFs period.
The regression equation is expressed as:

$$\hat{\sigma}_t = \beta_1 + \sum_{i=1}^{4}\theta_i d_i + \sum_{j=1}^{n}\eta_i \hat{\sigma}_{t-j} + \beta_2 LNVOL_t + \beta_3 LN(Firm)_t + \beta_4 FUTDUMY_t + \varepsilon_t \quad --(4.10)$$

where $\hat{\sigma}_t$ is the measure of the daily return volatility in the post-futures period. d_i represents days of the week, as explained in equation (4.9). Of the control variables,

$LN(Firm)$ is the natural logarithm of firm's value, obtained by multiplying the firm's stock price with the number of outstanding common shares. This variable is included in the model to control for firm-specific, non-systematic portion of stock price volatility and cross sectional variation related to bid/ask spreads (Glosten and Harris, 1988). Bae et al (2004) argues that larger firms have two advantages over smaller firms when we compare them in terms of non-systematic variations and bid-ask spreads. First, larger firms are better diversified, and secondly, these stocks are more liquid than smaller stocks. Because of these two advantages, we expect that the larger firms will have smaller non-systematic variation and bid-ask spreads as compared to smaller firms. Further, as argued by Galloway and Miller (1997), if the introduction of futures trading improves the liquidity of the underlying stocks with a resulting decline in stock price volatility, this effect is more evident in case of smaller firms which are lesser liquid stocks. In this case, we a expect a negative sign for the estimated coefficient, β_3, i.e., $\beta_3 \langle 0$). In the light of the above discussion, inclusion of the firm's market value of equity in the model is aimed to control for this "size effect".

$LNVOL$ is the control variable in the equation (4.10) and represents the natural logarithm of spot trading volume. There is an abundance of literature that documents a positive contemporaneous relationship between trading volume and stock return volatility. We therefore, expect the coefficient on trading volume to be positive (i .e., $\beta_2 \rangle 0$). Thus the spot trading volume of the underlying stocks and that of control group stocks are included in the model to control for this positive return volatility-volume effect. Other independent variables include coefficients for days of the week to account for observed days of the week volatility seasonality, lagged volatility estimates to account for the autocorrelation and persistence in volatility, and a binary variable (FUTDUMY) that is equal to one for the SSFs-listed stocks and zero for the control group stocks.

We are mainly interested in estimating β_4 coefficient which measures the average difference in the volatility between the SSFs-listed stock and that of the matching non-SSFs listed stock in the post-futures period. In other words, this binary variable indicates whether the stock price volatility of the SSFs-underlying stocks behaves in a different way than that of control group stocks in the post-SSFs trading period, at the same time as controlling for other factors that are known to influence stock price volatility. Since FUTDUMY takes on a value of 1 when the stock belongs to SSFs group, when the β_4 coefficient is negative (positive), this implies that the average stock price volatility of the SSFs-listed stocks is lower (higher) than that of the matching non- SSFs listed stocks in the post-futures period. Results of this model are presented in Table 4.9 (chapter 5).

4.4 Liquidity effects of SSFs trading

Liquidity is one of the important indicators that investors look for in the market. In general, liquidity is reflected by the ability of the market participants to execute large trades rather quickly and with minimum of impact on stock prices. In finance literature various measures have been used to measure market liquidity. In general, trading volume has been considered as a standard measure for estimating liquidity levels. Daily trading volumes of the underlying stocks is, therefore, taken in this study as a proxy for liquidity. It can be of considerable interest to examine whether SSFs trading has led to an increase in the trading volumes of the underlying stocks. Moreover, as pointed out by Robbani and Bhuyan (2005), this can also help ascertain whether the increased volatility, if any, can be attributed, at least in part, to an increase in the trading volume of stocks in the ready market. Stocks that had no trading during a particular day were assigned a value of zero for trading volume, which, in fact, is their actual trading volume for that particular day.
It is argued in the 'informed trading hypothesis' that the influx of informed traders to the futures market may lead to a decrease in the trading volumes in the underlying stocks as this influx of informed traders reduces liquidity in the cash market. It would therefore, be interesting to see if the introduction of SSFs trading leads to a reduction in the trading volumes in the underlying stocks. On the other hand, another aspect of the informed trading hypothesis is the increased media coverage to the stocks after the introduction of the SSFs contracts for that stock. This may lead to more financial analyst and investor interest in the stock, leading to an increase in the trading volumes for the stocks. Hence,

according the informed trading hypothesis, effect of SSFs introduction on the trading volumes of the underlying stocks may lead to an increases or decreases in the trading volumes of the underlying stocks.

4.5 Single Stock Futures Trading and Systematic Risk Effect

The second part of the dissertation examines the effect of introducing SSFs on the systematic risk (beta) coefficients of the underlying stocks. To be more specific, the study attempts to explore the following research questions:

i. Has the futures trading changed the market model relationship of underling stocks?
ii. Do the underlying stocks exhibit different betas in the post-SSfs period and the pre-futures periods?

In finance literature we do not find convincing theoretical arguments as to the effect the futures trading may or may not have on the market relationship (systematic risk) of the underlying assets (stocks), although we do find empirical evidences of both an increase[40] and decrease (rather no effect)[41] in beta coefficients of the underlying shares in the post-stock index futures trading. This section of the chapter presents the methodology used to explore the research questions stated above, while chapter five discusses the results of the model.

4.5.1 Model Selection: GJR-GARCH Model for Systematic Risk Estimates

Of the many approaches developed and proposed in the finance literature to model volatility of the financial time series, the most popular and the most extensively used is

[40] Martin and Senchack (1989, 1991), Vijh (1994)

[41] Skinner (1989), Galloway and Miller (1997), Kan and Tang (1999).

the Auto Regressive Conditional Heteroscedasticity (ARCH model), introduced first by Engel (1982) and extended to Generalized ARCH (GARCH) by Bollerslev (1986). The family of GARCH models has been found to be very successful in modeling volatility in empirical studies. Of these, the GARCH (1, 1) model has been extensively applied in the stock returns analysis studies in almost all the major stock markets.

The ARCH-family of models starts with the ARCH specification, which was developed by Engel (1982). The conditional variance, h_t, is modeled as a function of lagged squared residuals, ε^x, which is an ARCH (q) procedure, and specified as:

$$h_t = \alpha_o + \sum_{i=1}^{p} \alpha_i \varepsilon_{t-i}^2, \text{ where } \alpha_i \geq 0 \text{ ,--------------------------------------(4.11)}$$

In the ARCH model the variance of the error term is a function of the magnitude of the lagged error terms (ε_{t-i}^2), whether these errors has positive or negative signs. Bollerslev (1986) introduced the generalized ARCH (GARCH) model. The GARCH (p, q) specification is given by the following equation:

$$h_t = \alpha_o + \sum_{i=1}^{m} \alpha_i \varepsilon_{t-i}^2 + \sum_{i=1}^{q} \beta_i h_{t-it} \text{ - - - - - - - - - - - - - - -(4.12)}$$

With, $\alpha_0 \rangle 0, \alpha_i \geq 0, \beta_i \geq 0$, to make sure conditional variance to be positive. According to this GARCH model, unexpected positive or negative return shock, but of the same magnitude, produce the same amount of volatility. However, this specification fails to account for an important empirically observed phenomenon of asymmetries in return volatility where return shocks of the same magnitude but with either sign produce different amount of volatility.

Despite the universal application and success of the GARCH-class of models in the empirical studies, these models impose some limitations, and cannot capture some important and empirically proven features of the data of the economic time series, particularly the distribution of the stock market returns series. One such important characteristic not addressed by the GARCH-family of models is the leverage or the asymmetric effect, first identified by Black (1976) and subsequently reported in large number of empirical studies including Antoniou et al (1998), Pericli and Koutmos (1997), Mckenzie et al (2001), Chong, Ahmed and Abdullah (1999), Engel and Ng (1993), among others. In statistical terms, this asymmetric effect takes place when a bad news (for instance, an unexpected drop in price) has a greater or smaller effect on stock price volatility than a good news (e.g., an unexpected increase in price) of a similar magnitude. This asymmetry effect renders the GARCH-class of model's symmetric constraints on the conditional variance function in past error terms as inappropriate.

Another limitation of the GARCH models is the inequality constraints on the coefficients ($\alpha_0 \rangle 0, \alpha_i \geq 0, \beta_i \geq 0$) to ensure non-negativity of conditional variance (h_t). According to this GARCH model, an unexpected return shock, whether positive or negative, produce the same amount of volatility. However, Engel and Ng (1993) argues that if the effect of the negative return shock on volatility is more than that of a positive shock of the same magnitude, the GACH model would under-predict (over-predict) the amount of volatility following bad (good) news.

Nelson's (1990) exponential GARCH (EGARCH) model captures such asymmetric effect in financial time series. The other model that has also been extensively used in empirical studies to capture this effect is the GJR-GARCH model of Zakoian (1990), and Glosten, Jagannathan and Runkle (1993). This model contains a dummy variable that captures the influence of the sign (positive or negative) of stock returns on the conditional variance. Engel and Ng (1993) compares various new and existing asymmetric (G) ARCH-classes of models using Japanese daily stock returns data. Their analysis suggests that the model by Golston et al (GJR-GARCH) is best in capturing the asymmetric impact of news on volatility. In this study, we use the GJR-GARCH model to account for the established and proven phenomenon of the asymmetric impact of news on volatility.

4.5.1.1 Specification of the conditional mean equation for GJR-GARCH Model

Before estimating the impact for the variance equation for the daily individual stock returns series, the mean equation for each data series (stock) was specified in one of the two ways along with the equation (4.13). In the first instance, suppose that the returns series of a stock exhibits significantly serial autocorrelation, ARMA (p, q)[42] process was then adopted in the mean equation for that series with the following specification:

Conditional Mean Equation:

$$R_{,it} = \phi_i + \phi_{1,i}D_1 + \phi_{2,i}R_{m,t} + \phi_3 D_1 R_{m,t} + \sum_{i=1}^{p}\eta_i R_{t-i} + \sum_{i=1}^{q}\varepsilon_{t-i} + \varepsilon_t \text{ -------- } (4.13)$$

Where:

$R_{i,t}$ = Daily stock returns for a stock i and was calculated using equation (4.2)

ϕ_i = A stock specific constant,

D_1= Dummy variable that is equal to one for post-futures period for a particular stock,

ϕ_3 = Change in the beta coefficient in the post-futures period,

$R_{m,t}$ = Daily returns on KSE-100 Index, calculated using the definition of returns in equation (4.2)

η_i and ϖ_i = Represents Auto Regressive and Moving Average parameters, respectively

In equation 4.13, when D1 =1 (post-futures period) the beta coefficient is $(\phi_2, i + \phi_{3,i})$. When D1 =0 the beta coefficient is ϕ_2 . Thus, ϕ_3 represents change in the beta estimate for a stock from pre- to the post-futures period. The statistical significance of ϕ_3 establishes a change in the systematic risk of a stock after the introduction of SSFs on that stock. A positive coefficient ϕ_3 implies that beta risk is greater in the post-SSF

[42] Though the stocks on which SSFs are traded in the Pakistan's stock market are usually the ones most frequently traded stocks, however, the inclusion of Auto Regressive Moving Average (ARMA) terms, whenever necessary for a particular stock, eliminates the possibility of a thin trading bias in the mean equation.

period than in the pre-SSFs period. The symbol, $R_{m,t}$, represents stock index (KSE-100 index) return. $R_{m,t}$, in this thesis, is the log price relative on the KSE-100 Index, used as a proxy for the overall market. The reason for using this index as a substitute for the overall market is that this index is a fair representation of the market capitalization, and also it is the most widely followed index in the Pakistan's market.

In case, an individual stock returns series does not appear to be serially correlated with the errors, the naïve no change mean equation with the following specifications is employed:

$$R_{i,t} = \phi_i + \phi_1 D_1 + \phi_2 R_{m,t} + \phi_3 D_1 R_{m,t} + \varepsilon_{i,t} \text{ -------------- } (4.14)$$

where $R_{i,t}$ is daily stock returns for a stock i and other coefficients ϕ_1, ϕ_2 and ϕ_3 have the same meaning as explained in equation (4.13). The methodology used in this study, in this section, closely resembles that of Meckenzie et al (2001), Pericli and Koutmos (1997) and Antoniou and Holmes (1995). They have employed the threshold autoregressive conditional heteroscedasticity model of Zoakian (1994). The variance equation of the model is given by following specification.

Variance Equation:

$$\delta_{i,t}^2 = \omega_i + \alpha\varepsilon_{t-1}^2 + \gamma\varepsilon_{t-1}^2 d_{t-1} + \beta\delta_{t-1}^2 \text{ ---------- } (4.15)$$

In equation (4.15), d_t is a dummy variable that takes on a value 1 or zero. $d_t = 1$ if $\varepsilon_t < 0$ and $d_t = 0$ otherwise. This specification allows the effect of the error terms (squared) on volatility to be different in accordance with the sign of the error terms. A statistically significant positive (negative) γ coefficient indicates a negative (positive) shock in the series to have greater impact on future volatility (leverage effect). If $\gamma = 0$ there will be no asymmetric effect in return volatility.

4.5.2 Varying-Risk Market Model for Systematic Risk Estimates

In section 4.5.1 we have used a constant-risk market model approach to examine changes in the beta for the SSFs-listed and the control group of non-SSFs stocks. In this model, we assume the risk to be constant. While there is abundance of studies in the literature that shows that systematic risk varies with time. Some studies have documented changes in beta estimates for individual stocks over varying market conditions such as 'bull' and 'bear' markets. Fabozzi and Francis (1977, 1979), for instance, report varying beta and alpha estimates for stocks over bull and bear markets. A latter study by Francis and Fabozi (1979) also reports similar results. Jagannathan and Wang (1996) also point out the tendency of betas to vary with market conditions. Howton and Peterson (1998) find a relationship between beta and stock returns that changes over bull and bear markets, even after controlling for other determinants of stock returns such as size, book-to-market ratio, and earnings-price ratio. The findings of their study highlight importance of using varying-risk model approach to estimate stock betas.

Conover, Friday and Howton (2000) employ the dual-beta asset pricing model of Howton and Peterson (1997) that allows beta to vary over bull and bear markets. Their paper finds a significant and positive relationship between beta and stock returns during bull market conditions.

Domodaran (1990) employed daily returns data to compare beta changes for S&P500 constituent stocks and non-index firms in the pre-versus-post index futures period, and finds, on average, higher betas for S&P500 index stocks in the post-futures period as compared to non-index stocks, which reveal, on average, no change in betas. Even after accounting for firm-specific fundamental (accounting) variables (such as dividend yields, D/E ratio, book value of assets, cash-to-total assets), the authors find that these fundamental variables fail to account for the increase in the beta for the index-firms and conclude that this increase in beta may be related to the trading activity variables, which shows much more trading and noise subsequent to the index futures trading.

In light of the above discussion and the methodologies used by previous studies to account for varying market condition, a varying-risk market model was also employed to control for the possible differential return premiums between the bull and the bear markets. Adopting the procedure by Kan and Tang (1999), the following varying-risk market model approach is employed here to test the hypothesis that SSFs trading increase the systematic risks of the SSFs-underlying stocks. The model is represented by the equation:

$$R_{i,t} = \phi_1 + \phi_2 D_1 + \phi_3 D_2 + \phi_4 D_1 D_2 + \beta_0 R_{m,t} + \beta_1 D_1 R_{m,t} + \beta_2 D_2 R_{m,t} + \beta_3 D_1 D_2 R_{m,t} + \varepsilon_{i,t} \quad --(4.16)$$

Where:

$R_{i,t}$= Daily return on a stock i at time t;

$R_{m,t}$ = Daily return on KSE-100 index, taken as a proxy for the overall market returns;

D_1= A dummy variable that is equal to one for post-SSFs period and zero for pre-SSFs period,

D_2= A dummy variable that is equal to one for bear months and zero for bull months for either the post-futures or the pre-futures periods.

The model also allows the slope dummies to vary in the post-SSFs period. The product of the D_1 and D_2, therefore, were incorporated in the equation to account for the possibility that the "bull and bear market" effect on the stock beta may be influenced by the initiation of SSFs trading.

In equation (4.16) when $D_1 = 1$, the beta coefficient is $\beta_0 + \beta_1 + \beta_2 D_2 + \beta_3 D_2$, and when $D_1 = 0$ then the beta coefficient is $\beta_0 + \beta_2 D_2$. Therefore, the change in the beta coefficient for a particular stock in the pre-SSFs and the post-SSFs period is $\beta_1 + \beta_3 D_2$. The statistical significance of the $\beta_1 + \beta_3 D_2$ will indicate whether the beta of a stock has changed after SSFs trading introduction in the Pakistan's stock market. If the β_3

coefficient turns out be insignificant (statistically), then β_1 can be used to measure changes in the stock's beta in the post-futures period.

Several alternative bear and bull market definitions are found in the literature. In this study, each month of the sampling interval was categorized as a bull (a month with positive rates of returns) or a bear month (a month with negative rates of returns) using a definition given by Kan and Tang (1999). This definition of bear and bull months is similar to the "up and down market" definition of Fabozzi and Francis (1979) for bull and bear markets.

4.5.3 Diagnostic Tests

In order to test whether the GJR-GARCH has been correctly specified and has captured all the persistence of in the variance of returns series, the Ljung-Box Q statistics with some specific lagged autocorrelations will be used in this study. This requires an assessment of the correlogram (ACFs and PACs) of the standardized residuals (E-views 2007, a: 326). In case the variance equation was specified correctly then we expect all Q-statistics to be insignificant. The results of the models are reported in the chapters to follow.

4.6 Data Description

Trading in SSFs contracts on the Karachi Stock Exchange commenced in July 2001. The sample period for the study extends from June 1, 1999 to Jan 31, 2008[43]. Information about the listing date of each SSFs contract was retrieved from the online database of

[43] Selection of data from two years prior to the commencement of SSFs trading constitutes the pre-SSFs period for those stocks for which SSFs were introduced in July 2001. There are ten such stocks. Moreover, other stocks that had SSFs introduced on different dates for which pre-SSFs and post-SSFs periods were selected at different time periods during the sample interval, stretching up to June 2008.

Karachi Stocks, a database maintained by "The Businessrecorder", a prestigious business daily newspaper in Pakistan. The list includes a total of 46 listed SSFs contracts written on the firms traded on the exchange. Daily closing, high and low share prices along with trading volumes for each underlying stock and the sample of non-SSFS stocks were sourced from the online database of exchange for the whole sample period, yielding more than 500 daily observations per stock for each of the sub-period.

CHAPTER 5

SINGLE STOCK FUTURES TRADING AND STOCK PRICE VOLATILITY

5.1 Introduction

A large number of studies examine the relationship between futures trading activity variables and the price volatility in the underlying asset or market. Inconsistent results, however, have been obtained to the effect that futures trading may increase or decrease volatility in the underlying market. Among the previous studies on this issue, Schwert (1990b) finds that, at the time of high volatility for the S&P500 index, stock market and futures volume are also found to be high. Smith (1989) observes no effect by S&P500 futures volume on the changes in the volatility of S&P500 index returns. Similar results were also reported by Darat and Rehman (1995) for S&P500 stock index returns. Board et al (2001) applied the Stochastic Volatility (SV) model to the daily stock price data of London Stock Exchange and the FTSE 100 contracts traded on LIFE. The authors found no evidence in support of the hypothesis that futures trading volume destabilizes the spot market, or that an increase in trading volume in one market relative to the other market destabilizes the spot market. Overall, their results indicate that contemporaneous futures trading, after adjusting for the effects of information arrival and time trends, does not destabilize the spot market.

Some studies even find a negative relationship between stock index futures volume and the underlying price volatility (see e.g., Santoni, 1987; Brown and Kuserk, 1995). Bessimender and Segiun (1992) adopted an estimation procedure proposed by Schwert (1990b) by iterating between a pair of regression equations which describe the evolution of the mean and volatility of the process in terms of the exogenous and lagged endogenous variables. The authors include three trading activity variables (spot trading volume, futures trading volume and open interest in the augmented conditional return standard deviation (volatility) equation. Having selected the trading activity variables, the authors then removes the time trend in the activity variables by subtracting 100-day moving average series from the volume in both the markets. They then fit the univariate ARIMA (0, 1, 10) specifications to the detrended series to get the expected (fitted values from ARIMA model) and the unexpected (residuals from ARIMA model) components of the series. The sum of the components gives the original detrended activity series. This process is performed for the underlying stock's trading volume, futures volume and open interest separately, and all six variables are included as explanatory variables in the model to examine the volume-volatility relations. The authors observes a negative relation between the expected (i. e. informationless) S&P500 futures trading activity and the equity volatility, when the spot-trading activity variables were included in the model. These findings led the authors to conclude that futures trading improve liquidity provision and depth in the equity markets, and reject the theories supporting the hypothesis of the destabilizing effect of the futures trading.

In contrast to these studies, Yang, Balyeat and Leatham (2005) finds that unexpected futures trading volume positively affect cash price volatility for most of commodity futures markets selected for the study. Using a GARCH model, Kyriacou and Sarno (1999) finds that futures volume is positively related to the spot market volatility. Illueca and Lafuente (2003) examine the contemporaneous trading volume-return relation in the Spanish stock index futures market, using a non-parametric approach for hourly return and futures trading activity variables. The total futures volume were decomposed in to expected (informationless trading activity) and unexpected (shocks in trading activity) components. The study documents a positive relation between unexpected component of trading volume and price volatility. The authors attribute this relationship to the arrival of new information (unexpected trading activity).

This section of the thesis tests the hypothesis that increases in the SSFs trading activity has an impact on price volatility of the underlying stocks subsequent to the SSFs contracts trading initiation in the Pakistan's stock market. To be more accurate, the study seeks to address the objectives provided in the section (4.3) of chapter 4. To achieve these objectives, this section provides results of the methodologies outlined in sections 4.3.2, 4.3.3 and 4.4 of chapter 4. These sections consist of two approaches to analyze the effect of SSFs trading on the returns (i. e., Price Effect,) variances of returns (i. e. volatility effect) and trading volumes (i.e, Liquidity Effect) of the underlying stocks. Before we go into the analysis of these effects, next section provides analysis of the data particularly the descriptive statistics.

5.2 Data Analysis

The first section provides a simple examination of the SSFs-listed stocks and non-SSFs stocks in the following section using the two measures of return volatility estimations. As a starting point, descriptive statistics of all individual SSFs-listed stock's returns series are reported in Annexure I for both periods, namely, a pre-SSF listing period and post-SSF listing period. Daily returns were calculated using the definition of rate of returns in equation (4.2). The statistics reported are the mean and standard deviation of daily stock returns for each stock, the measure of skewness and kurtosis and Bera-jerque (1987) statistics for normality test.

Based on the value of the mean, daily returns are, on average, higher than pre-futures returns for 12 stocks, of which, mean daily returns for 11 stocks have changed from negative in the pre-SSF listing to positive in the post-SSF period, though one of it is statistically different from zero in the post- SSF period. Moreover, all the daily stock return series show significant skewness and high excess kurtosis, which are typical of daily stock returns. These two measures provide evidence that the daily returns series of the individual stocks are not normally distributed.

Likewise, the Bera-jerque statistics (1987) suggest significant departure from normality for all the series, as shown by the rejection of null hypothesis for normal distribution of residuals. Rejection of normality can, partly, be caused by the temporal dependencies in the moments of the series. Such dependencies can be tested employing the Ljung-Box portmanteau test (LB). The value of the LB statistics, in the table, shows presence of temporal dependencies in returns distribution in the pre-SSF listing period in more than half of the stocks (13 in all) while evidence of such temporal dependence is evident only in 3 stocks in the post-SSF listing period. The problem of the presence of the linear dependencies (serial correlation) in the stock returns in the pre- SSFs period for the individual stocks may be due to the non-synchronous trading; a characteristic of a thinly traded market.

LB statistic provides evidence on higher order temporal dependence when it is applied to the squared daily continuously compounded returns for each stock. The LB statistics for squared returns is significant for all but two stocks in the pre-SSFs listing and three stocks in the post-SSFs listing period. Moreover, the size of the LB statistic for the square of the returns compared with that of the returns series indicate that the non-linear dependencies are much more prevalent in the returns series for the individual stocks. This evidence suggests that the volatility of the daily returns series for individual stocks follows ARCH-type models, initially developed by Engel (1982). Thus our use of the GARCH-family of models in this study is justified.

In Annexure I, of greater interest, however, are the values for the standard deviation estimates. Standard deviation appears to be substantially higher in the pre-SSF period, except for Telecard. In the pre-SSF listing period, DSFL, FABL and PIA have the highest standard deviation while OGDC, NBP and TELE have the lowest standard deviation. In the post-futures period, PTCL, POL and ENGRO have the lowest standard deviation. Overall, all the stocks except OGDC and TELE exhibit a substantial reduction in volatility (standard deviation) from the pre-SSF listing period to the post-SSF listing period. This initial investigation indicates that futures trading is associated with a decrease in return volatility for the underlying stocks and may not necessarily be related to the destabilization of the underlying spot market. A more in depth analysis, however, needs to be carried out to validate these results. The next section deals with the main objective of this chapter, the volatility effect analysis of SSFs trading.

5.3 Analyses of Stock Price Volatility Effect: Statistical Methods

To examine changes in return volatility, if any, in the post-SSFs period, the daily return volatility for each stock is estimated using two measures of volatility. First is the variance of the daily returns for individual stocks and the second is the variance of High-Low intra-day price range[44]. These alternative measures of volatility were estimated and compared to determine if our conclusions regarding changes in the return volatility for the underlying SSFs stocks and/or the matching non-SSFs stocks across the post and the pre-futures periods are sensitive to the measures of volatility used in this study.

Panel A of Table 5.1 shows the number and percentage of stocks with significant changes for the two measures of volatility across the pre-futures and the post-futures periods using the F-test, Bartlet and Leven's tests[45]. The results indicate that volatility—as measured by the daily stock returns variance—has decreased significantly for 21 out of 26 stocks after introducing the SSFs trading for those stocks on the Karachi Stock Exchange. Of these 21 stocks, the decrease in volatility is statistically significant for 20 stocks according to F-test and Bartlet's tests and for 13 stocks according to Leven's test at the conventional five percent level of significance. The five stocks whose return volatility slightly decreased are not significant at 5 percent level using Leven's test, though three stocks has return volatility decreased significantly using F-test and Bartlet's test. To measure the economic significance, the average decrease in volatility for all the 26 stocks from the pre-SSFs period to the post-SSF period is 60.5 percent. In the similar vein, the average decrease in volatility for the 21 stocks is 71.6 percent while the average increase in volatility for the five stocks is about 14.7 percent. These results indicate that the stock price volatility of the underlying stocks has decreased significantly after the introduction of individual stock futures contracts on the Karachi Stock Exchange. This further

[44] Section 4.3.1 for measures of sock price volatility

[45] Values along with p-values for the two measures of volatility for the SSFs-stocks and the non-SSFs stocks are not reported in the table for brevity and are provided in the annexure IV and annexure E for SSFs stocks and in annexure VI and annexure G for control portfolio stocks.

warrants detailed econometric investigation, though. Next, we consider the volatility estimator suggested by Parkinson (1980).

Results from the Parkinson's efficient high-low variance estimator, reported in Panel B of Table 5.1, are not much different to those found using the variance of close-to-close returns technique reported in the same table. The results show a decrease of volatility for 22 out of 26 stocks, with 15 of them significant at 1 percent level using t-test and non-parametric Wilcoxon Rank sum test. On the other hand, of the 4 stocks that showed an increase in volatility, only one is statistically significant according to t-test and Wilcoxon test. Again, the average decrease in volatility for all the 26 stocks is about 45.75 percent. The average decrease in volatility for the 22 stocks is about 58 percent, while the average change for the 4 stocks with increased volatility is only about 18.2 percent. Again, these results indicate that return volatility of the underlying SSFs stocks appear to have decreased in post-SSFs period on these stocks in the Karachi stock exchange. This evidence suggests that some change in the return volatility may have occurred over the relevant period, and warrants further investigation. It is not clear from these comparisons, though, that these changes in volatility are necessarily futures-induced.

Comparing the alternative volatility measures, one can notice some differences between the two volatility measures. For instance, Parkinson's (1980) volatility estimator is smaller than variance of Close-to-Close prices both in the pre- and the post-futures periods for the majority of the SSFs-stocks. However, in terms of statistical significance of changes in return volatility from the pre- to the post-futures period, we do not observe much of a difference in the two alternative measures of volatility and the conclusions are robust across the two measures for the SSFs-listed stocks.

Similar to a procedure for SSFs-listed stocks, the two alternative measures of return volatility were also estimated for matching non-SSFs firms to examine whether the changes in return volatility for the SSFs-stocks are futures trading-induced or is the result

Table 5.1
Comparison of Volatility Estimates for SSFs-listed and Non-SSFs stocks in the Pre-futures and Post-Futures Periods

Panel A: SSFs-Listed Stocks			
	Variance of Close-to-Close prices		
	F-test	Bartlet	Leven's
Significant Decrease (Number of stocks)	20	20	13
Significant Decrease (Percentage of stocks)	76.90%	76.90%	50.00%
	Parkinson's Estimator		
	T-test	WRST	
Significant Decrease (Number of Stocks)	15	15	
Significant Decrease (Percentage of Stocks)	57.00%	57.00%	

Panel B: Control Portfolio			
	Variance of Close-to-Close prices		
	F-test	Bartlet	Leven's
Significant Decrease (Number of stocks)	12	12	9
Significant Decrease (Percentage of stocks)	57.14%	57.14%	42.86%
Significant Increase (Number of stocks)	4	4	
Significant Increase (Percentage of stocks)	19.05%	19.05%	
	Parkinson's Estimator		
	T-test	WRST	
Significant Decrease (Number of stocks)	9	9	
Significant Decrease (Percentage of stocks)	42.86%	42.86%	
Significant Increase (Number of stocks)	5	5	
Significant Increase (Percentage of stocks)	23.81%	23.81%	

Note: values of volatility measures for each SSFs-listed and control group stocks are not reported here in the table for brevity and are provided in the annexure IV and annexure V for SSFs stocks and in annexure VI and Annexure VII for control portfolio stocks.

of market-wide and/or industry specific changes affecting majority of the stocks as a whole. The results for the number and percentages of stocks with significant changes (using t-test and the Wilcoxon test) across the two periods for the two measures of volatility are reported in panel B of Table 5.1. The empirical results in terms of changes in return volatility in the post-futures period and the statistical significance, are mixed for the two volatility measures. The number of stocks for which the volatility has decreased is more than half irrespective of the measure of volatility used. The significant decrease in return volatility are 12 (close-to-close variance) and 9 (Parkinson estimator) respectively, using either t-test or the Wilcoxon test. Interpreting the results reported in this panel (A) of Table 5.1 collectively, there has been an observed reduction in the return volatility for more than half of stocks for the control group, though one cannot conclude convincingly that the reduction in return volatility is universal for the stocks of the control group. Looking, however, at the reduction in return volatility for the control group stocks on the basis of the specific time period of the sample, the reduction in return volatility, again, irrespective of the measure of return volatility used, occurs during the 2001- 2003 period. This is the time period when the Karachi Stock Exchange experienced exceptional growth in terms of market capitalization, trading volume and new listings. Interestingly, it is also the same time period during which a reduction in volatility was also observed for the majority of the SSFs-listed stocks for which the SSFs were introduced during this time period.

5.4 Analysis of Average stock returns Pre-SSFs versus Post-SSFss periods

To examine whether the apparently decreased volatility in the post-SSF period for majority of the stocks is associated with any change in returns for each of the SSFs-listed 28 securities used in this study, the null hypothesis that the mean pre-futures return equals the mean post-futures return against an alternative hypothesis that mean returns for the two periods are different, is tested using the two-tailed t-test and non-parametric Wilcoxon test for the SSFs-listed and non-SSFs stocks. Results of these tests for SSFs-listed stocks are reported in panel A of Table 5.2. Unlike the clear evidence that we find in case of volatility change, mean daily returns show mixed results. Daily Average returns for 13 stocks have declined while those of 14 stocks have increased in the post-SSFs period compared with the pre-futures period. As reported, the apparently higher average returns for many stocks turn out to be statistically insignificant using the t-test. No clear differences in the pattern of behavior of SSFs-listed stock's mean returns, when compared across pre versus post futures, can be seen in panel A of Table 5.2[46].

Panel A of Table 5.2 has also reported results for the non-parametric equivalent of the t-test of equality of mean return. The Wilcoxon test statistics are in general agreement with the t-test results, except for SNGP for which this test statistic rejects the null hypothesis of equal mean returns. Thus both the t-test and the non-parametric Wilcoxon test do not reject the null hypothesis that the pre- and the post-futures stock returns for the SSFs-listed stocks have the same distribution. This vast failure in rejecting the null hypothesis of equal means should not be surprising given that most of the returns are not statistically significant as reported in Annexure I (Descriptive statistics).

Panel B of Table 5.2 provides results of applying the t-test and WRST tests for a sample of control group stocks. Similar to the results for the SSFs-listed stocks, all the statistics, except for FECTO, are not significant for both the tests. No clear differences can be observed in the pattern of behavior of SSFs-listed stock's mean returns in the pre versus the post-futures period, compared to the patterns shown by the control group.

Interpreting Tables 5.1 and 5.2 together, one can conclude that the empirical results are in line with the hypothesis that the daily location (mean returns) has not changed for the SSFs-listed stocks while there are significant changes in the daily dispersion (variance) for many stocks across the two periods—post and pre-futures. It cannot, however, be concluded from these tables that the significant decrease in the daily return volatility for many SSFs-listed stocks in the post-futures period is necessarily induced by the

[46] This table provides only the number and percentage of stocks with significant changes in daily stock returns for each stock. Values of mean daily returns for each stock have not been reported for brevity and are provided in the annexure VIII for SSFs stocks and in annexure IX for control portfolio stocks.

Table 5.2

Comparison of Daily Stock Returns Pre-Futures versus Post-Futures Periods

Individual stocks average daily returns for the pre-SSFs and Post-SSFs period for the SSFs-listed and the control group stocks. Daily percentage returns were calculated for each SSFs underlying stock and the control group stock using the definition of returns given in equation (4.2).

Panel A: SSFs-Listed Stocks		
	T-test	WRST
Significant Decrease (Number of stocks)	1	0
Significant Decrease (Percentage of stocks)	3.70%	0.00%
Significant Increase (Number of stocks)	0	0
Significant Increase (Percentage of stocks)	0.00%	0.00%

Panel B: Control Portfolio		
	T-test	Bartlet
Significant Decrease (Number of stocks)	1	1
Significant Decrease (Percentage of stocks)	5.01%	57.14%
Significant Increase (Number of stocks)	0	1
Significant Increase (Percentage of stocks)	0.00%	5.01%

Note: This table provides only the number and percentage of stocks with significant changes in daily stock returns for each stock. Values of mean daily returns for each stock have not been reported for brevity and are provided in annexure VIII and annexure IX for SSFs stocks and control portfolio stocks, respectively.

introduction of the SSFs trading in those stocks in the Pakistan's stock market. We therefore, turn our attention to the more detailed and econometric analysis. Consequently, the methodology used and the results obtained are reported in the next section.

5.5 Stock Price Volatility Effect: Econometric Methods

In addition to comparing returns, variances of returns and trading volumes for the SSFs-listed and the stocks of the control group in the pre-futures and the post-futures periods, this study also carries out detailed econometric analysis to provide further evidence on the inter-relations between spot trading volumes of the underlying stocks, SSFs trading activity and the underlying stock's price volatility by including the observed trading activity variables of the two alternative markets (Spot and Futures markets) in the model specification. For this purpose, two approaches are used, one is Schwert (1990) procedure[47] and the other is the cross-sectional comparisons of volatility behavior of SSFs-listed and the control group stocks in the post-futures period. Section 5.5.1 provides results for the Schwert's procedure.

5.5.1 Schwert's procedure

This section tests the hypothesis that trading activity in the single stock futures contracts has an impact on the spot market price volatility of the underlying stocks in the Pakistan's stock market. To this end, we measure daily stock return volatility by adopting a procedure introduced by Schwert (1990b). This procedure involves iteration between two sets of equations. First equation is the mean equation and the second one is the variance equations. This section only provides results of the methodology discussed in the chapter 4.

[47] Section 4.3.3.1 (chapter 4) for details of the methodology

5.5.1.1 Empirical Analysis: Spot Trading Volume and Stock Return Volatility

Initially, we estimate equations (4.6) and (4.9)[48] with the daily spot trading volumes as the only activity variable (the other two trading activity variables, namely SSFs trading volumes and open interest were excluded from the analysis). These empirical results are shown in Table 5.3 (column 1). As the table reports that all of the estimated coefficients for daily dummies are significant, indicating that the model has adequately captured the seasonal effects associated with the different days in a week. Estimated coefficient on the unexpected component of the spot trading volume is positive and highly significant. Moreover, this coefficient is also larger than the estimated coefficients on the expected trading volume and the moving average trading volume. This implies that surprises (unexpected component) in the spot trading volume convey more information, and thus are more important in explaining equity volatility than either the variations in the anticipated (expected trading volume and moving average) level of trading activity. These results are consistent with the findings of many empirical studies conducted in other markets. For instance, Patti (2008) finds positive relation of price volatility to expected and unexpected components of trading volume for the Indian stock market. The author also documents that an unexpected component of trading volume has greater impact on trading volume than the expected volume.

5.5.1.2 Empirical Analysis: SSFs trading and Stock price volatility

As an initial econometric examination of the single stock futures trading on the equity volatility of the underlying stocks in the spot market, we include a dummy variable in equation (4.9)[49] that takes on a value equal to one for post-SSFs period (two years time period, with almost 500 observations for each stock), and equal to zero for the pre-SSFs

[48] Refer to chapter 4, section 4.3.3.1

[49] Refer to Chapter 4, section 4.3.3.1

period, containing almost same number of observations compared to post-SSFs period[50]. We also allow the regression intercept and the slope coefficients on trading volume variables to shift subsequent to the introduction of SSFs trading.

Empirical results of equation (4.9) are shown in the second column of Table 5.3. Notable result of this analysis is that the observed change in the slope coefficient associated with the unanticipated spot trading volume is negative and highly significant (at 1% level of significance). This implies that the spot volume shocks are associated with smaller price movements subsequent to the introduction of the SSFs trading. Similarly, the estimated coefficient for the slope dummy on the moving average volume is negative though it is not statistically significant. Again, this also implies a reduction in the magnitude of the relation subsequent to the introduction of the SSFs. In contrast, the estimated coefficient for the shift in the regression intercept subsequent to the introduction of SSFs trading is negative and statistically significant. This finding is consistent with the view that stock return volatility (equity volatility) has been reduced, and market depth (as measured by the volume of shares required to move prices) has been increased by the introduction of SSFs trading. There may have been other changes in the overall financial and capital markets in Pakistan, or even some of the sectors/stock specific factors, during the period examined in the study, and these reductions in equity volatility need not be solely attributable to the introduction of SSFs trading in Pakistan's stock market.

Results in the above paragraph indicate that the equity market depth has increased, at least, for the SSFs-listed stocks since the introduction of the single stock futures trading. However, as indicated by Table 5.6 and annexure II and annexure C that trading volume has increased throughout the sample period, both for SSFs-listed and the non-SSFs stocks. Table 5.6 shows that the average increase in the daily trading volume from the pre-SSFs period to the post-SSFs period for all the SSFs-listed stocks, as a whole, is 25.5 percent, while the average daily trading volume for the control group stocks also rises in the post futures period, though the rise in the daily trading volume for the control group stocks from the pre-SSFs period to the post-SSFs period is not as dramatic as it is for the

[50] Refer to sample selection procedure in chapter 4, section 4.1

SSFs-listed stocks in the post-futures period. Thus, similar to the results for SSFs stocks, we also find an evidence of an increase in trading volumes for the control portfolio stocks in the underlying spot market. This shows that increases in liquidity (trading volumes) for market may be due other market-wide changes that has led to an increase in trading volumes in the market, and may not necessarily be futures trading-induced changes.

5.5.1.3 Empirical Analysis: SSFs trading activity variables and stock price volatility

Evidence relating to futures trading and stock price volatility, reported in the prior section, is not entirely conclusive, at least in part, because the introduction of futures trading constitutes but a single event. To further augment the specificity of the evidence, this study further examines this relationship by including SSFs trading volume and open interest in the analysis[51]. Following the methodology adopted by Besseminder and Seguin (1992), for each trading date, futures volume and open interest are summed across contracts to obtain aggregate futures activity.

We again decompose each trading activity (spot trading volume, SSFs trading volume and open interest) in to three additive components namely moving average, expected and unexpected components[52]. Empirical results of estimating equation (4.9) with these activity series are reported in Table 5.4. As the table shows that the inclusion of SSFs trading variables does not change the sign of coefficient estimates on the expected and unexpected components of the spot-trading variables. They remain the same as given in the previous section (Table 5.3). The coefficient estimate for unexpected SSFs-trading volume, like that for unexpected spot- trading volume, is positive and significant, and is larger in magnitude than the spot-trading volume coefficient. As Besseminder and Seguin

[51] Open interest is the sum total of all outstanding long and short positions of futures contracts that have not been closed out, at the end of the trading day. Open interest represents one of the trading activity variables related to futures trading. It has been used by many studies as an independent variable in the regression equation to account for one the trading activity variables.

[52] Refer to Chapter 4, section 4.3.3.1

(1992) points out that, this positive coefficient implies that information shocks move prices and generate trading in both markets.

Unlike the results for the expected (i. e., informationless) component of the spot trading volume, the coefficient estimate for the expected SSFs-volume is negative and significant, indicating decreased stock price volatility when expected SSFs-volume is high[53]. On the other hand, coefficient estimates for both the expected and unexpected components of the open interest are negative, but neither is statistically different from zero. These empirical results are in line with the study of Bessimender and Seguin (1992, 1993) for S&P500 Index. Contrary to the findings of their study in case of moving average, estimated coefficient on all three moving average series (spot-trading volume, SSFs-volume and open interest) in this paper are statistically insignificant, indicating that long-term variations may not be relevant for explaining volatility in Pakistan's equity market.

To summarize, empirical evidence indicates that equity volatility is positively related to spot-trading activity, whether expected (i.e., informationless trading) or unexpected, and to the contemporaneous futures trading shocks. Whereas, the partial effects on equity volatility of expected and moving average (though insignificant in case of moving average) are negative, suggesting that equity volatility is mitigated when the expected level of futures activity is high[54]. The findings of the decreased spot price volatility associated with large expected futures activity is important to the debate of regarding the role of equity derivatives trading in stock market volatility. These empirical results for the Pakistan's equity market support theories implying that equity derivatives trading improves liquidity provision and depth in the equity markets, and appear to be in contrast to the theories implying that equity derivatives markets provide a medium for destabilizing speculation and leads to an increase in price volatility of the underlying asset/market.

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[53] These results are in line with the findings of the studies of Hung, Lee and So (2003) for the London International Financial Future and Options Exchange (LIFFE) and Bessimender and Seguin (1992, 1993) for S&P500 Index.

[54] Bessimender and Seguin (1992) term this level of trading activity as back ground level of activity

Table 5.3
Regression of Daily Return Standard Deviation Estimates on Spot Trading Volume and Futures Trading Dummy

Spot trading volume is detrended before partitioned into respective expected and unexpected components. FUTDUMY denotes a dummy variable that takes on a value of unity for post-SSFs period and zero otherwise, for each stock.

Variable	Coefficient	t-Statistic		Coefficient	t-Stat
	(1)			(2)	
Intercept	0.014	22.65*		0.014	20.98*
FUTDUMY				-0.001	-1.77**
Daily Dummies					
Tuesday	0.011	18.90*		0.012	17.65*
Wednesday	0.009	15.69*		0.010	14.66*
Thursday	0.010	15.88*		0.010	14.81*
Friday	0.009	14.85*		0.009	14.00*
Trading Volumes					
Expected	0.024	7.98*		0.027	5.48*
Expected*FUTDUMY				-0.065	-1.03
Unexpected	0.043	17.32*		0.059	15.21*
Unexpected*FUTDUMY				-0.027	-5.53*
Moving Average	-0.021	-1.20		-0.039	-1.44
Moving Average*FUTDUMY				0.028	0.78
10 Lagged Volatility Estimates	0.377	23.08*		0.176	22.92*
Lagged Unexpected Returns	0.041	5.57*		0.021	2.95*
Durbin Watson	2.00			2.00	
Adjusted R^2	0.11			0.11	
Diagnostic Checks	Estimate	P-value			
LBX-Q(36)	34.379	0.546			
LBX-Q^2 (36)	25.226	0.91			

Note: * (**) denotes statistical significance at 0.01 (0.05) level, LBX-Q(p) and LBX-Q^2 (p) stands for the portmanteau Ljung-Box Q test statistics, used to test the significance of autocorrelation of standardized and squared residuals, respectively.

Table 5.4
Regression estimates for Return Standard Deviation Estimates on Spot Trading Volume and Futures Trading Volume

Spot and futures trading volumes series for each stock were first detereended by subtracting 100 day moving average volume from each series before dividing into expected and unexpected components.

Variable	Coefficient	t-Statistic	Prob.
Intercept	0.012559	(5.84)*	0.000
Daily Dummies			
Tuesday	0.008801	(4.16)*	0.000
Wednesday	0.00912	(4.40)*	0.000
Thursday	0.007306	(3.43)*	0.001
Friday	0.004645	(2.08)**	0.038
Trading Activity			
Spot Volumes			
Expected	0.0223	(5.95)*	0.000
Unexpected	0.0317	(12.07)*	0.000
Moving Average	0.0381	(0.98)	0.327
SSFs Futures Volume			
Expected	-0.0190	(3.27)*	0.001
Unexpected	0.0456	(3.12)*	0.002
Moving Average	-0.0194	(0.02)	0.983
SSFs Open Interest			
Expected	-0.0264	(-0.54)	0.587
Unexpected	-0.0370	-0.32	0.748
Moving Average	0.0654	0.84	0.401
Lagged Volatility Estimates	0.254868	(5.42)*	0.000
Lagged Unexpected Return	0.141833	(3.48)*	0.001
Durbin-Watson	2.03		
Adj. R-squared	0.25		

5.5.2 Cross-Sectional Analysis for Volatility Comparisons

As the analysis in the previous section provides some evidence that supports a decrease in spot price volatility for the SSFs-listed stocks in the post- futures trading period when the futures trading activity variables are included in the analysis. To further augment the results, the methodology of Galloway and Miller (1997)[55] in which the SSFs-listed stocks are pooled with a sample of control group stocks and the level of price volatility of the SSfs stocks are compared with the level of price volatility of the control group stocks, using the methodology outlined in equation (4.10, chapter 4). Table 5.5 presents results for the regression equation (4.10). The coefficients of the control variables have the positive or negative signs as predicted in the theoretical discussion. Further, these coefficients are statistically significant, too. This indicates that we have used the relevant control variables in the cross-sectional volatility model of equation (4.10).

However, our primary interest lies in the coefficient estimate, β_4, a binary variable that takes a value of 1 for SSFs-listed stock and 0 for non-SSFs stocks. The coefficient estimate (β_4), as reported by the table, is negative and highly statistically significant at the 0.01 level. This finding indicates a notable difference in the spot price volatility between the SSFs-listed and the non-SSFs stocks in the post-futures period. The negative and statistically significant [β_4] coefficient indicates that SSFs-listed stocks have lower spot price volatility than the sample of non-SSFs stocks in the post-futures period. This multivariate specification, like the previous analysis, provides no evidence that the volatility of the SSFs-underlying stocks is positively related to the introduction of the single stock futures trading in the Pakistan's stock market. Rather, the negative binary coefficient indicates that, overall, there is a decrease in return volatility for the SSFs-underlying stocks in the post-futures period. Thus the evidence tends to support the notion that the single stock futures trading had a negative impact (i.e., reduction in volatility) on the level of price volatility for the underlying stocks.

[55] Refer to section 4.3.3.2 (Chapter 4) for details of the methodology

SSFs stocks suggests that the increase in trading volume for the SSFs-stocks may not necessarily be futures-induced but may the result of market-wide changes.

Table 5.6

Wilcoxon Rank sum test and t-test for trading volume of SSFs-listed stocks and control group stocks

Panel A: SSFs-Listed Stocks

	T-test	WRST
Significant Increase (Number of stocks)	21	21
Significant Increase (Percentage of stocks)	80.80%	80.80%
Significant Decrease (Number of stocks)	0	0
Significant Decrease (Percentage of stocks)	0.00%	0.00%
Average Increase in Daily Trading Volume		25.5%

Panel B: Control Portfolio stocks

	T-test	WRST
Significant Increase (Number of stocks)	18	18
Significant Increase (Percentage of stocks)	90%	90%
Significant Decrease (Number of stocks)	0	0
Significant Decrease (Percentage of stocks)	0.00%	0.00%

Note: Mean daily trading volume (along with p-values of t-test and Wilcoxon Rank Sum Test) for all SSFs-listed stocks and the matching non-SSFs stocks are not provided here for brevity and are provided in annexure II and C for SSFs stocks and control portfolio stocks, respectively.

5.7 Summary

This section of the study examines the effect of single stock futures trading on the level and changes in the price volatility of the underlying stocks in the Pakistan's equity market. First, a simple examination of the means and variances of the returns of SSFs-listed stocks, using the traditional methods of return volatility estimation, reveals no clear pattern of volatility changes for both the SSFs-listed and non-SSFs stocks in the post-futures period. The second part of this chapter examines the nature of relationship between spot price volatility of the underlying SSFs stocks and the trading activity variables of the SSFs contracts market in Pakistan. We adopt Schwert's (1990) procedure for volatility estimation and including the trading activity variables of the underlying stock's spot market and futures market in the volatility regression equation. The results show that stock price volatility of the underlying stocks is positively related to both the expected and unexpected components of the spot trading volume. However, the unexpected component of the volume has a greater impact on the equity volatility than the expected (informationless) volume. This analysis confirms the findings of many other studies showing a positive relationship between spot trading volume and spot price volatility. Equity volatility is also positively related to the contemporaneous futures shocks (unexpected component of futures volume). These results are quite consistent with the view that information shocks move prices and generate trading in the market. However, the most striking finding of the study is that the 'expected SSFs volume significantly negatively related to the price volatility of the underlying stocks, suggesting that equity volatility is mitigated when the expected[59] level of futures activity is high. The findings of the decreased spot price volatility associated with large expected futures activity is important to the debate regarding the role of equity derivatives trading in stock market volatility. These empirical results for the Pakistan's equity market support theories implying that equity derivatives trading improves liquidity provision and depth in the equity markets, and appear to be in contrast to the theories implying that equity derivatives markets provide a medium for destabilizing speculation.

[59] Bessimender and Seguin (1992) call it as background level of trading

CHAPTER 6

SINGLE STOCK FUTURES TRADING AND THE SYSTEMATIC RISK OF THE UNDERLYING STOCKS

6.1 Introduction

This portion of the dissertation focuses on the effect of the introduction of the single stock futures contracts on the systematic risks[60] of the underlying stocks in the Pakistan's stock market. It is important to conduct such type of analysis because of conflicting and varying results reported by various studies on the subject of the effect of derivatives introduction on the return volatility and systematic risk for the underlying assets. For instance, Skinner (1989) reports that with the initiation of the options on stocks the return volatility decreases while the beta is unaffected. Similar results are also reported by Connard (1989). In contrast, Martin and Senchack (1989), using monthly returns for stocks comprising the Major Market Index (MMI) by employing event study (before and after) methodology, report an increase in the systematic risk of the 20 MMI stocks after the introduction of the MMI index futures, which they attribute it to the use of the controversial techniques such as program trading[61] by the investors in the US market. In an extension to the earlier study and bringing about methodological improvements, Martin and Senchack (1991) uses daily returns data for the MMI-constituent stocks and compares changes in these stock's percentage systematic risk with a control sample of 20 stocks that are not member of an index with a traded futures/options contract. The results

[60] Systematic risk, also known as market risk or non-diversifiable risk, affects all the risky assets in a market. It is the variability of a security's returns with that of the overall stock market, and is statistically measured by beta. This beta is a covariance of an asset's returns with that of market returns.

[61] Programmed trading strategies are used for spot/futures arbitrage, market timing and portfolio insurance. Though program trading can be in a variety of ways, the most widely known strategy is index arbitraging, that involves purchasing (selling) the cash stock portfolio and simultaneously selling (purchasing) the index futures contract when the futures price exceeds (is less than) the spot price of the index, net of the cost carry (Martin et al, 1989). See Hill and Jones (1988) for an excellent discussion of various programming techniques and their effect on stock market prices

indicate an average increase in percentage systematic risk for the 20 MMI-index stocks. The non-index stocks show little evidence of increased systematic risk. The paper also reports an increase in average correlations among index stocks which they do not find such pattern for non-index stocks. These findings led them to conclude that this increase in systematic risk for the index stocks may be due to the program trading in the MMI stocks associated with the MMI index futures contracts. Similar results are also reported by Vijh (1994) with significant increases in beta estimates for S&P 500 stocks relative to the non-index stocks, which the author attributes, in part, to the price pressures or excess volatility caused by the S&P 500 trading strategy that also includes program trading. Since then, very few studies have focused on this issue, though much has been written and investigated about the volatility effects of the futures trading.

Galloway and Miller (1997) examine the effect of the MidCap index futures trading on the changes in the systematic risk for the stocks composing the Index and two control samples that consisted of the medium- and the large-capitalization stocks, using both the ordinary least squares betas and the ones that were adjusted to account for non-synchronous trading that could cause bias in the beta estimates, with various lead/lag structures. The paper reports a significant decrease in beta estimates for samples of medium and large capitalization stocks while no change in beta estimates for the component stocks in the MidCap index futures. These findings led them to infer that the trading in the index futures had no effect on the systematic risk, beta coefficient, of the index stocks.

Kan and Tang (1999) examine the effect of the HSI futures trading on the systematic risks (change of beta coefficients) for the HSI constituent stocks using the varying risk market model approach on a daily stock return data in the context of the pre-versus-post HSI index futures period. The paper finds no evidence of an increase in the systematic risk of the HS-constituent stocks, in the post-futures trading period, both in the short and the long-run.

One of the problems associated with the beta estimation is, as numerous previous empirical studies have found, that the beta estimates can be biased because of non-synchronous trading and market frictions, such as thin trading, trading delays and price adjustment delays. The phenomenon of non-synchronous trading mainly occurs in markets characterized by thin trading as closing prices are normally recorded at the close of session. These prices may reflect transactions that had occurred well before the close of session for many stocks. This phenomenon of non-synchronous trading has been considered as the prime source of autocorrelation in the securities and portfolio returns. Iqbal and Brooks (2007) acknowledge and document the infrequent trading feature of the Karachi Stock Exchange in their study. The authors, therefore, adopt the Dimson's (1979) technique in their study for correcting the bias in the beta estimation.

This section of the thesis examines the behavior of systematic risk around the introduction of futures contracts in the Pakistan's stock market. While finance literature do not provide any theoretical justifications for the increase or otherwise decrease in the systematic risk of the stocks in the post-futures or post-options periods for the underlying stocks, some studies have attributed this increase in the beta coefficients to index arbitrage trading strategies, such as program trading. It would be interesting to examine the effect of SSFs trading on the beta coefficients since SSFs are better hedging and speculative instrument than the index futures contract. Section 4.5 of Chapter 4 provides the econometric model used to examine this issue while this chapter provides results of the model, in the next section.

6.2 Empirical Analysis: SSFs trading and Systematic Risk Effects

Two models were used in this study to examine the effect of SSFs trading on the systematic risk (beta coefficients) estimates of the underlying stocks. One model assumes the risk (beta coefficients) to be constant over time while the second model takes in to account the empirically observed fact that beta changes over time, particularly in relation to various market conditions such as bull or bear markets. Empirical results of the constant-risk market model are provided in section 6.2.1 while that of the varying-risk model are provided in section 6.2.2

6.2.1 Empirical Analysis: GJR-GARCH Model

First, we consider systematic risk estimates of the mean equation results (equations 4.13 and 4.14) for each SSFs-listed stock provided in Table 6.1. The pre-SSFs beta risk estimates are presented by ϕ_2. Our main interest lies in estimating the coefficient, ϕ_3 (the post-SSF increment to beta risk relative to the coefficient, ϕ_2, bench mark). The change in the beta estimate in the post-SSFs period can be inferred from the t-statistic associated with the coefficient ϕ_3, reported in annexure X, while Table 6.1 reports only the number of stocks (along with percentages) with significant increases and decreases of beta coefficients in the post-futures period for both the SSFs-listed and control group stocks. As annexure X reports, 15 out of 24 post-SSFs beta coefficient for the underlying stocks is greater than one. The negative sign of the coefficient, ϕ_3, indicate that for 13 stocks (i.e., more than half), we observe a significant decrease in beta risk in the post-SSF period, and a decrease, though not statistically significant, in 6 more cases. Hence, the evidence tends to support a decline in the systematic risk of the underlying stocks after the introduction of the SSFs trading in those stocks, as most stocks experience a decrease in the systematic risk subsequent to futures listing.

However, as pointed out by Mckenzie et al (2001), the reduction in beta may be due to the market-wide movements. We therefore, also consider results for the control group stocks. A similar procedure was also followed for a sample of non-SSFs stocks. The results for the number (and percentages) of stocks with significant changes in the systematic risk estimates are reported in the panel B of Table 6.1[62]. When we consider the ϕ_3 coefficient (the post-SSF increment to beta risk relative to the coefficient, ϕ_2,

[62] Estimates of the model along with the systematic risk estimates values for each control group stocks are reported in annexure XI. This annexure indicates that the pre-futures systematic risk coefficient for only 4 out of 20 stocks is greater than 1

Table 6.1

Systematic Risk Estimates for SSFs-listed and control group stocks

Panel A: SSFs-listed Stocks

	Number of Stocks	Percentage
Decrease in beta coefficient	20	80%
Increase in beta coefficient	5	20%
Total	25	100%
Significant Decrease in beta coefficient	14	56%
Significant Increase in beta coefficient	3	12%
Total	17	68%

Panel B: Control Group Stocks

	Number of Stocks	Percentage
Decrease in beta coefficient	18	81.82%
Increase in beta coefficient	4	18.18%
Total	22	100%
Significant Decrease in beta coefficient	6	27.27%
Significant Increase in beta coefficient	1	4.55%
Total	7	31.82%

Note: Estimates of the model along with the systematic risk estimates values for each SSFs-listed and control group stocks are not reported here for brevity and are reported in annexure X (SSFs-listed stocks) and annexure XI (control group stocks). L-B Q statistics for model specification are provided in Annexure X-B for SSFs stocks.

bench mark), we interestingly find results similar to the one reported for the sample of SSFs-listed stocks. Looking at the sign and the significance of the coefficient, ϕ_3 , we observe that for 11 stocks (i.e., more than half of the sample), there is an observed significant decrease in beta risk in the post-SSF period, and a decrease, though not statistically significant, in 4 more cases. Thus, similar to SSFs stocks, we also observe an empirical evidence of a decrease in systematic risk for non-SSFs listed stocks.

If we look at the observed reductions in beta estimates in the post-futures period for SSFs-listed and the matching non-SSFs listed sample of control stocks, we observe that the reduction in beta occurs for the period 2001- 2003 for both SSFs-listed and the control sample stocks. This indicate that the observed reduction in beta estimates for the SSFs-listed stocks may not necessarily be induced by the introduction of the SSFs trading for those stocks but it may be due to other market-wide and/or industry changes that has affected the overall market. Hence this study finds no evidence that the introduction of futures trading increase the systematic risk of the underlying stocks.

Finally, the Ljung-Box Q statistics[63] (Annexure X-B) reports that all the Q-statistics are insignificant suggesting that the GJR-GARCH model was correctly specified for each of the data series and it has captured adequately all of the persistence in the variance of returns, with no remaining ARCH effects detected.

6.2.2 Empirical Results: Varying-Risk Market Model for Systematic Risk Effects

Equation (4.16)[64] was applied to each of the SSFs-listed and the non-SSFs stocks for the pre-SSFs and the post-SSFs period for the three different sampling intervals, namely, the six-months time, one-year time and two-year time, to look at the impact of SSFs trading on beta coefficients of the underlying stocks in the short-term, medium-term and longer-

[63] Refer to section 4.5.3 (chapter 4) for details of the test

[64] Refer to section 4.5.2 (Chapter 4) for details about the econometric model

term, respectively. The β_3 coefficient is not statistically significant for most of the SSFs-listed and non-SSFs stocks in all of the three sampling intervals. We can, therefore, consider β_1 coefficient estimate to determine if the systematic risk (beta coefficient) of SSFs stocks have changed after SSFs trading began for those stocks. Table 6.2 only provides the number of stocks (along with percentages) for changes (significant increase, decrease or no change) in beta coefficient for SSFs and a sample of non-SSFs stocks, for the three different sampling intervals (six-month, one-year and two-year time periods). Table 6.2 presents no systematic pattern in the change (increase or decrease) in the beta coefficients for either the SSFs or the sample of non-SSFs stocks in the post-futures period. For instance, in case of the six-months interval, the beta coefficients for two (19.23%) SSFs stocks and another six (23.07%) SSFs-listed stocks exhibit significant increase and decrease, respectively, after the futures trading began for these stocks. More than 69 percent of the SSFs stocks experience no significant change in the systematic risk coefficient for the same period.

For the sample of non-SSFs stocks for same period (six-month time), one (5%) non-SSFs stock and another two (10%) non-SSFs stocks exhibit a significant increase or decrease, respectively. On the other hand, for majority of the non-SSFs stocks there are no significant changes in the beta coefficient. For longer sample intervals (one and two-year time periods), there is a slight increase in the number of stocks (both SSFs-listed and control group stocks) with a reduction in beta estimate in the post-futures period.

To test whether SSFs-listed stocks beta changes are different than that for control group stocks in each of the three sampling intervals, a Z-statistics are also calculated and shown in the Table 6.2. The test statistic indicates no significant difference in the proportion of stocks with significant changes (increase or decrease) between the SSFs-listed and non-SSFs stocks for each of the three sampling intervals. These results find evidence to indicate that the SSFs trading may not have an impact on the systematic risk of the SSFs-listed stocks either in the short or the long run.

Table 6.2

Percentage of stocks with beta changes for SSFs-listed and Control Group stocks between post-futures and pre-futures periods

	6-months time	**1-year time**	**2-year time**
SSFs-listed stocks			
Increases	2 (19.23%)	5 (19.23%)	3 (11.53%)
Decreases	6 (23.07%)	10 (38.46%)	14 (53.84%)
No Changes	18 (69.23%)	11 (42.23%)	9 (34.62%)
Total	26 (100%)	26 (100%)	26 (100%)
Non-SSFs Stocks	**6-months time**	**1-year time**	**2-year time**
Increases	1 (5%)	4 (20%)	4 (4.8%)
z-statistic	[0.681]	[-.0652]	[-0.7993]
Decreases	2(10%)	6 (30%)	11 (52.4%)
z-statistic	[1.1599]	[0.597]	[-0.0774]
No Changes	17(94%)	10 (50%)	9 (43%)
Test Statistic			
z-statistic	[-1.243]	[-0.5741]	[-0.5704]
Total	26 (100%)	26 (100%)	26 (100%)

Note: the words 'increases' and 'decreases' represent the number and percentage of stocks with significant increase or decrease in the post futures period while 'no change' represents the number of stocks with no significant change in beta estimates in the post-futures period. The results for the whole model for both the SSFs-listed and non-SSFs stocks are not reported here and provided in Annexure X (2-Year time for SSFs), Annexure XI (2-Year time for control group stocks), Annexure XII (1-Year time for SSFs stocks), Annexure XX (1-Year time for control stocks), Annexure XIX (6-months time for control group stocks)

6.3 Conclusion

This paper examines the changes in beta coefficients (systematic risk) for underlying stocks after the introduction of futures contracts in the Pakistan's stock market by employing models that accounts for the non-synchronous trading and varying market conditions such as 'bull' and 'bear' markets. Unlike results in some earlier studies for US markets, the evidence, in this study, tends to support a decline in the systematic risk of the underlying stocks after the introduction of the SSFs trading in those stocks, as most stocks experience a decrease in the systematic risk subsequent to futures listing. However, as pointed out by Mckenzie et al (2001), the reduction in beta may be due to the market-wide movements. We therefore, also consider results for control group. Thus, similar to SSFs stocks, we also observe an empirical evidence of a decrease in systematic risk for many of the non-SSFs listed stocks. This indicate that the observed reduction in beta estimates for the SSFs-listed stocks may not necessarily be induced by the introduction of the SSFs trading for those stocks but it may be due to other market-wide and/or industry changes that has affected the overall market. Hence this study finds no evidence that the introduction of futures trading has any impact on the systematic risk of the underlying stocks. These results are further supplemented by a Z-statistics that indicates no significant difference in the proportion of stocks with significant changes (increase or decrease) between the SSFs-listed and non-SSFs stocks for each of the three sampling intervals. These results find evidence to indicate that the SSFs trading may not have an impact on the systematic risk of the SSFs-listed stocks either in the short or the long run. These results for the Pakistan's SSFs market are consistent with findings by Galloway and Miller (1997) who document a decrease in a similar decrease in the beta coefficients for the index-component stocks which led the authors to confidently conclude that the apparent changes in the risk of the MidCap 400 stocks may actually be result of the market wide changes and not associated with the index futures initiation.

CHAPTER 7

SINGLE STOCK FUTURES TRADING: MARKET EFFICIENCY AND ASYMMETRY IN VOLATILITY

7.1 Introduction

As discussed in the previous chapters of this dissertation, that many studies have documented an increase in stock price volatility following the onset of the futures trading in many markets. Traditionally, this increased volatility has been considered by some authors and commentators as a consequence of the presence of destabilizing forces (e.g., speculators, who are believed to trade mainly on the basis of noise rather than information. Their actions may, therefore, cause prices in the spot as well as in the derivatives market, to deviate from the fundamental values, and hence increase volatility) in the market. This apparently increased volatility has negative implications for investor's required rate of return and, consequently, an increase in the cost of equity capital for the firms. In contrast, some authors also argue that futures markets provide an avenue that helps to improve the mechanism for the transmission of news into market[65]. This, in turn, leads to a more speedy incorporation of information into prices and, and as a result, more stock price volatility. This stock price volatility may, therefore, not necessarily be a negative consequence of futures trading. For instance, Cox (1976), Antoniou and Holmes (1995) argue that futures markets can attract additional and informed traders to the market and, consequently, increase the possible channels of information flow. Further, some authors assert that because of the lower transaction cost, higher degree of leverage and less time to execute a trade in the futures market, it is possible that information may be transmitted to the cash market more quickly.

[65] See, e.g., Antoniou and Holmes, 1995; Chatrath and Song, 1998

Given that trading in futures market provides additional avenues for information transmission in to prices, the question that the futures trading driven changes in stock price volatility of the underlying asset are desirable or otherwise undesirable, depend on the nature of these changes and the underlying market dynamics. For instance, Merton (1995) argues that the futures trading and the derivatives markets, in general, can improve market efficiency by way of reducing asymmetric responses of stock price volatility to information. Hence, to evaluate the utility of the impact of futures trading on the stock market volatility, it is imperative to consider the causes of volatility. This, in turn, requires an understanding of the empirically observed phenomenon of volatility clustering and asymmetric response of volatility to news.

The phenomenon of volatility clustering relates to the arrival as well as transmission of new information (news) in the market. Considering the arrival of information, it is argued that pieces of information (news) which can have large impact on prices tends to cluster together, in a similar fashion as the pieces of information (news) that have a small impact on prices (Engel, 1982). On the other hand, considering the transmission of news in the market, it is argued that it is related to the concept of market dynamics that helps to explain the volatility clustering. For instance, if market participants have heterogeneous expectations then it is possible that the news will take some time to be eradicated and this spell of volatility may be spread over more than one period. These two concepts (volatility transmission and the role of market dynamics) are an alternative to "The leverage effect" and "the volatility feedback effect" theories, that are regarded as the traditional explanations for the asymmetries in return volatility, and these two theories have been widely made use of in finance literature in an attempt to explain the observed phenomenon of the asymmetries in volatility.

The 'leverage effect' hypothesis attempts to explain the occurrence of the asymmetries because of the effect of price falls (negative shocks to returns) on financial leverage (and to some extent, operating leverage, though it has not received much attention in the literature). A fall in the price of the stock (i.e., negative returns) reduces the equity portion and increases its financial leverage. This increase in leverage causes the stock to be more risky, and hence, induces an increase in its price volatility (Nelson, 1991, Black, 1976; Christie, 1982). On the other hand, according to the volatility feedback effect theory, increases in volatility (shocks to volatility) cause a decrease in returns as the investors require a compensation for higher expected future return which is induced by higher volatility (Pindyck, 1984; French et al 1987; Campbell and Hentshel, 1992). Hence this "time-varying risk premium" attributes return shocks to changes in conditional volatility. In practice, these two theories are expected to work together and may reinforce each other. Despite these theoretical underpinnings, many studies (e.g., French et al, 1987; Schwert, 1989; and Nelson et al, 1991) have questioned the ability of these traditional explanations to account fully for the observed asymmetric effects. Avramov, Chordia and Goyal (2006) have reported asymmetric effects for stocks that had no leverage. The "market dynamics" argument can, therefore, qualify itself to explain, at least partly, these observed asymmetries in the volatility.

If we accept the argument that "market dynamics" can be a cause of asymmetries then we may expect new products, such as trading in stock index futures/SSFs contracts, to have an effect on the level and structure of volatility in the underlying. This study attempts to examine the level and structure of volatility dynamics for Pakistan's market keeping in view the "market dynamics" as a possible cause of asymmetries in return volatility, and in an approach that takes into account the "volatility clustering" and the asymmetric response of volatility to news. Antoniou et al (1998) argues that adopting an approach that takes into account the volatility clustering and asymmetric response of volatility to news can be useful in providing insights into the causes of volatility clustering. If the empirical results show that asymmetries are present only in the pre-futures period in the underlying market, and are removed or shifted to the futures market, then the leverage or the risk premium hypotheses alone are not sufficient to explain asymmetries in return volatility.

To examine these issues this section follows the methodology adopted by Engel and Ng (1993), Pagan and Schwert (1990) Florous and Vougas (2006), and Antoniou et al.

(1998), by estimating equations 4.13, 4.14 and 4.15 (GRJ-GARCH Model), explained in section 4.5 of chapter 4.

The GJR-GARCH model was applied to the data in two steps. First, we estimate the GJR-GARCH model for the two sub-samples, i.e., the pre-SSF and the post-SSF period for all the underlying stocks as a whole through pooled regression. We then compare the estimated coefficients of the pre-futures and post-SSFs periods regarding the nature and level of the volatility of the underlying stocks. To be more specific, we test the null hypothesis of no difference across the pre- and the post-futures periods in relation to the coefficients relating to the asymmetric volatility i.e., γ_i.

If the view that the introduction of the futures trading leads to an improvement in information flow is correct in case of Pakistan's stock market, then we can expect to reject the null hypothesis. More specifically, we would expect a reduction in the asymmetric response of volatility to news and the persistence coefficients, and an increase in the news coefficient, in the post-futures period. Conversely, if futures trading is destabilizing we could expect the opposite.

7.2 Measuring 'News impact' component of stock returns

Before undertaking the empirical analysis it is relevant to generate a news impact component of returns. To this end, the methodology adopted by Antoniou et al (1998) is followed in generating the news impact component of returns.

Let Y_{it} be the rate of return from a stock for a period from time $t-1$ up to time t. Further, let I_{t-1} be the past set of information containing the observed values of all the relevant variables up to time $t-1$. The expected return and volatility relevant to an investor, who is making an investment decision at time $t-1$, given an information set of

I_{t-1}, are the conditional expected value of Y_{it}, given I_{t-1} and the conditional variance of Y_{it} , given I_{t-1}.

We denote these by R_{it} and h_{it} respectively, i.e., $R_{it} \equiv E(Y_{it}|I_{t-1})$ and $h_{it} \equiv Var(Y_{it}|I_{t-1})$. The news can then be defined as the unexpected component of returns, given by equation (7.1):

$$\varepsilon_t = Y_{it} - R_{it} \tag{7.1}$$

We can treat good news as a positive ε_t and negative ε_t as bad news. Since the objective of this section is to analyze the impact of news on the conditional volatility, we construct a measure of news following the procedure adopted by Antoniou et al. (1998), Pagan et al (1990), by regressing returns on day-of-the-week dummies[66] and latter making sure that the residuals from this equation are serially uncorrelated in order to obtain white noise component, expressed by equation (7.2).

$$R_{it} = \alpha + \sum_{i}^{4} \gamma_i D_{it} + \varepsilon_{it} \tag{7.2}$$

Where:

R_{it} = Daily Stock return for a stock i at time. Daily stock returns are calculated using definition of returns in equation (4.2).

D_i = Dummy variable, e.g., $D_1 = 1$ if day is Tuesday and 0 for other days. Similarly, $D_2 = 1$ if day is Wednesday and 0 for other days,

$D_3 = 1$ if the day is Thursday and 0 for other days,

$D_4 = 1$ if the day is Friday and 0 for other days, and

[66] The evidence of existence of day of the week and/or weekend effect in the daily stock return has long been established and reported by hundreds of studies conducted in almost all the major stock exchanges of the world. See e.g studies by Agarwal et al., 2003, Tang (1998), Agarwal and Rivoli (1989), Chan, et al. (1996), to mention a few. Regarding Pakistan's stock market, a study by Khan (2007) also find some evidence of day of the week effect in the daily stock index returns for KSE-100 index.

α = A bench mark day relative to other days.

If the residuals from equation (7.2) are serially correlated, and to correct for any spurious autocorrelation due to non-synchronous trading, then using the first step, we form an Auto Regressive (AR) model of the residuals to remove any linear temporal predictability, using the following autocorrelation adjustment equation (7.3):

$$\varepsilon_t = \phi + \sum_{i=1}^{n} \varphi_i \varepsilon_{t-i} + \nu_t \tag{7.3}$$

Ljung and Box (1976) portmanteau statistics is used to examine whether the residuals from the day-of-the-week adjusted returns series are white noise[67]. After obtaining the unexpected components we then analyze the impact of the futures trading innovation on the nature and characteristics of return volatility for the underlying stocks.

7.3 Data Description

The data for this section of the thesis is the same as the data used for the volatility dynamics (chapter 5) and systematic risk (chapter 6) analysis. The sub-periods defining the pre-SSFs period and the post-SSFs period for each underlying stock and that for control group stocks are the same as defined in chapters 4. The details about the data description, control portfolio stocks and sub-periods are, therefore, not repeated in the section to avoid repetitions.

7.4 Empirical Analysis: GJR-GARCH Model

Before applying the asymmetric GJR-GARCH model we need to make sure that the residuals from the dummy-variable regression are white noise, Ljung and Box (1976)

[67] This process was repeated for every stock until we obtain white noise terms

portmanteaus statistics was applied to the adjusted returns series for the 1st, 4th, 8th and 12th autocorrelations of the adjusted returns series, for all the SSFs-listed stocks. As the Table 7.1 shows that there is no evidence of autocorrelations in the (adjusted) returns series, qualifying them to be treated as news.

Table 7.2 reports Ljung and Box portmanteau statistics for the 1st, 4th, 8th and 12th autocorrelations of the squared adjusted returns series for all the SSFs-listed stocks. The presence of the non-linear temporal dependence is evident in the adjusted squared returns series suggesting that the volatility of the (adjusted) returns series follows (G) ARCH-type modeling. Next, we look at the analysis of the presence of any asymmetries in the volatility series.

Results of the asymmetric GJR-GARCH model are reported in Table 7.3 (section A) for the pre-futures period for all the SSFs-listed stocks combined through pooled regression. The table reports a statistically significant positive asymmetric effect at the 0.01 significance level. The GJR-GARCH model is also estimated for stock returns of the SSFs-listed stocks for the post-futures period. This mechanism will help us to look into the causes of the asymmetries. If the leverage effect and the risk premium hypotheses alone are responsible for the asymmetric effect, then the introduction of futures contracts should have no discernable effect on the asymmetry.

Panel B of Table 7.3 reports estimates of the GJR-GARCH model for the post-futures period. Interestingly, the post-futures results depict a different picture than the pre-futures period. The most notable result is the reduction in the asymmetric response of volatility to news, which has changed from 0.350 in the pre- futures to 0.075 in the post-futures period. Moreover, a chi-squared test shows that the observed reduction in the value of the asymmetry coefficient is statistically significant. This empirical evidence clearly demonstrates that the asymmetric effect has reduced in the post-futures period. The evidence therefore, suggests futures trading has had a considerable impact on the way information impacts on the volatility of the underlying stocks and highlights the importance of changes in market dynamics as a cause of changes in asymmetric responses of volatility.

These results are consistent with the study by Antonio et al (1998) who argue that market dynamics have been altered by the introduction of futures trading. They further the argument by explaining that trading in the futures market has also mitigated the noise or over-reaction of noise traders in the market. This might happen because futures markets provides an avenue for price discovery process as more informed traders are attracted to the futures and, hence, other traders become better informed, and their decisions reflect less noise and more information. Antonio et al (1998) also provides an alternative explanation for this reduced asymmetries in the post futures market, and this could be that the noise traders could have shifted to the futures market because of relatively lower transaction cost and high degree of leverage in the futures markets. As such asymmetries may be prevalent in the futures market[68].

To examine this possibility, a similar procedure is adopted for the first two years data of single stock futures contracts price series. This series is the total nominal value of all the futures contracts traded in a particular day. The empirical results of the GJR-GARCH model applied to this data series are reported in panel C of Table 7.3. In line with the results for the pre-futures spot market sample, significant asymmetric effects are also found to be present in the futures market. This is judged by the significant asymmetric coefficient (γ_i). This coefficient is negative and significant. It provides ample evidence that the trading in the single stock futures contracts has, at least in part, caused transfer of the asymmetries to the futures market and are consistent with the view that asymmetric responses to information are, at least partly, the result of market dynamics, and that futures trading has led to an improvement in the dynamics of the underlying market.

[68] Koutmos and Tucker (1996) report that future return volatility is found to be more asymmetric than that for spot returns.

Table 7.1

LB Portmanteau Statistics for adjusted returns series for SSFs-listed Stocks

Stock	Lag 1	Prob.	Lag 4	Prob.	lag 8	Prob.	Lag 12	Prob.
AKBL	0.0714	0.7893	3.0153	0.5553	16.8186	0.0321	17.5983	0.1284
BAFL	2.7647	0.0964	6.4149	0.1702	10.5266	0.23	13.8641	0.3095
BOP	1.7292	0.1885	4.0456	0.3999	5.1985	0.7362	14.1512	0.2912
DGKC	1.0316	0.3098	3.0221	0.5541	7.9805	0.4354	9.0371	0.6998
DSFL	0.0005	0.9825	1.5622	0.8156	8.0952	0.424	19.6134	0.079
ENGRO	1.6636	0.1971	5.5384	0.236	19.656	0.0117	29.0581	0.0039
FABL	1.9664	0.1608	3.657	0.4544	12.2663	0.1397	14.9509	0.2441
FFC	0.0947	0.7583	7.231	0.1242	11.5313	0.1734	15.0767	0.2373
HUBC	1.034	0.3092	2.2372	0.6922	11.3679	0.1817	22.0238	0.0373
IBFL	0.5233	0.4694	3.5435	0.4713	7.9183	0.4415	13.939	0.3046
KAPCO	0.3373	0.5614	2.7118	0.6071	6.3596	0.607	13.5994	0.327
KESC	0.4662	0.4947	3.5402	0.4718	10.5617	0.2278	21.8097	0.0397
MCB	0.0005	0.9826	4.0978	0.3929	5.5039	0.7026	12.4664	0.409
MLCF	2.3528	0.1251	13.0511	0.011	13.7502	0.0885	18.6473	0.0974
NBP	0.1384	0.7099	1.2405	0.8714	4.8365	0.7749	7.4417	0.8271
NML	0.0785	0.7794	5.6614	0.2259	7.7687	0.4564	8.417	0.7518
ODGC	0.5171	0.4721	8.3576	0.0793	13.2439	0.1037	18.9163	0.0906
PIA	0.5645	0.4524	1.9394	0.7469	6.5198	0.5892	20.5049	0.0581
POIC	0.0229	0.8798	4.0323	0.4016	12.6991	0.1226	15.6528	0.2077
POL	0.9278	0.3354	1.1349	0.8887	8.4226	0.3933	9.8972	0.625
PSO	0.018	0.8934	4.1525	0.3858	7.4359	0.4904	10.8118	0.5451
PTCL	0.051	0.8213	1.2912	0.8629	2.3258	0.9694	7.4996	0.8229
SNGP	0.1199	0.7292	5.7011	0.2226	6.1446	0.631	16.3542	0.1755
SSGC	0	0.9963	2.2529	0.6894	11.5987	0.17	13.4668	0.336
TELE	0.7447	0.3882	6.6821	0.1537	11.9822	0.152	17.5861	0.1288
UNION	0.3662	0.5451	1.7723	0.7775	5.6459	0.6868	6.4186	0.8935

Table 7.2
LB Portmanteau Statistics for Non Linear Temporal Dependence for adjusted return series

	Lag 1	Prob.	Lag 4	Prob.	lag 8	Prob.	Lag 12	Prob.
AKBL	4.436	0.035	11.345	0.023	21.323	0.046	53.827	0.009
BAFL	7.985	0.063	20.422	0.041	38.381	0.082	96.888	0.016
BOP	53.237	0.000	72.707	0.000	74.413	0.000	85.682	0.000
DGKC	24.045	0.000	88.019	0.000	128.405	0.000	78.118	0.000
DSFL	13.740	0.000	50.296	0.000	73.375	0.000	44.639	0.000
ENGRO	26.481	0.000	65.600	0.000	67.029	0.000	69.818	0.000
FABL	73.767	0.000	99.576	0.000	132.260	0.000	156.800	0.000
FFC	14.087	0.000	41.914	0.000	46.811	0.000	74.183	0.000
HUBC	141.860	0.000	349.090	0.000	419.230	0.000	474.960	0.000
IBFL	24.045	0.000	76.999	0.000	88.121	0.000	120.230	0.000
KAPCO	9.240	0.002	19.303	0.001	26.158	0.001	26.936	0.008
KESC	43.282	0.000	59.111	0.000	60.498	0.000	69.660	0.000
MCB	22.853	0.000	35.253	0.000	40.098	0.000	43.711	0.000
MLCF	26.244	0.000	54.191	0.000	75.741	0.000	100.020	0.000
NBP	20.620	0.000	37.898	0.000	43.694	0.000	67.410	0.000
NML	21.505	0.000	31.020	0.000	34.121	0.000	39.083	0.000
ODGC	57.061	0.000	132.260	0.000	278.200	0.000	341.830	0.000
PIA	11.197	0.001	16.139	0.003	16.824	0.032	25.781	0.012
POIC	8.225	0.004	14.357	0.006	22.122	0.005	25.120	0.014
POL	46.783	0.000	93.993	0.000	98.782	0.000	108.530	0.000
PSO	5.647	0.017	34.669	0.000	41.967	0.000	47.568	0.000
PTCL	12.955	0.000	62.693	0.000	65.621	0.000	85.040	0.000
SNGP	28.892	0.000	41.743	0.000	46.708	0.000	50.071	0.000
SSGC	25.735	0.000	57.066	0.000	80.873	0.000	127.290	0.000
TELE	6.754	0.009	32.219	0.000	36.678	0.000	42.630	0.000
UNION	12.474	0.003	26.059	0.001	35.313	0.001	36.364	0.011

Table 7.3

Asymmetric Volatility Model

Panel A: Asymmetric Volatility Model of Stock Returns—2 Years before Futures Trading

	ω	α	β	γ
Overall	0.00033	0.327	0.358	0.350
	(0.000)	(0.000)	(0.000)	(0.000)

Panel B: Asymmetric Volatility Model of Stock Returns—2 Years After Futures Trading

	ω	α	β	γ	χ^2
Overall	0.0001	0.237	0.626	0.075	18.67
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Panel C: Asymmetric Volatility Model (GJR) of futures contracts—First Two years after introduction of SSFs contracts on KSE

	ω	α	β	γ
Coefficient	0.001	0.161	0.941	-0.156
z-Statistic	7.288	13.989	321.130	-11.799
Prob.	0.000	0.000	0.000	0.000

Note: figures in parenthesis are p-values

The Model:

$$\delta_{i,t}^{2} = \omega_{i} + \alpha\varepsilon_{t-1}^{2} + \gamma\varepsilon_{t-1}^{2} d_{t-1} + \beta\delta_{t-1i}^{2} \text{ - - - - - } (10\ b)$$

authors use a unique approach to test for market efficiency, using a 10- days (-5, +5) event window and examine the underlying stock volatility by comparing the number of days with large positive or negative returns for SSF and non-SSF stocks. The study finds reduction in the number of unexplained large stock returns for SSF stocks in the post-SSF period and changes are smaller as compared to that of non-SSF stocks. This reduction is also found to be positively correlated to trading in SSFs. This led the authors conclude that the introduction of SSF has contributed to the market efficiency. Their conclusions, however, needs to be read with caution as the authors have not used a rigor methodology in the paper and have relied only on one non-parametric test. It would have also been appropriate to test if the difference between the SSF and matched firm is also statistically significant, to arrive at a conclusion.

This study examines market for single stock futures to provide a test for whether SSFs are able to generate greater market efficiency in terms of the speed at which information are incorporated in to the prices. Empirical evidence suggests that SSFs trading improves market efficiency for the underlying stocks in the short term (100-day interval) in the post-futures period. However, the matching non-SSFs stocks also behave in a similar fashion in the post-futures period. Further, the non-parametric Mann-Whitney test indicates no significant difference in the GARCH coefficients between the SSFs and the non-SSFs stocks, which suggests, that SSFs trading may have a negligible effect on the market efficiency. The next section of the chapter outlines the econometric methodology, followed by analysis of empirical evidence and the last section concludes the chapter.

7.5.1 Econometric Methodology: SSFs Trading and Market Efficiency

This section examines the impact of the futures trading on the market efficiency using the GJR-GARCH (1, 1) model and is given by equations (4.13), (4.14) and (4.15). Under this specification, the parameters ω, α and β are estimated for pre-futures and post-futures periods for each individual underlying stock and the stocks for the control group. Comparisons are then made of the estimated coefficients across the post and the pre-futures period. More specifically, according to Butterworth (1998), an increase (decrease) in α_1 (a 'news' coefficient) in the post-SSF period implies that news is reflected in prices more quickly (slow). On the other hand, a reduction in β_1 in the post-SSF period indicates that old news has a less persistent effect on price changes, and hence an increase in the way new information is incorporated in the price; a sign of increase in the market efficiency due to the SSFs innovation. We estimated the GJR-GARCH model with Marquardt algorithm, with the heteroscedasticity Consistent Covariance option[70]. If the view that the introduction of the futures trading leads to improved information flow is correct in case of Pakistan's stock market, then we can expect to reject the null hypothesis. More specifically, we will expect an increase (decrease) in the news (persistence) coefficients in the post-futures period. Conversely, if futures trading is destabilizing we could expect the opposite. The same methodology was also repeated for the matching non-SSFs listed stocks, and the results are reported in the panel B of Table 7.4.

7.5.2 Empirical Analysis: SSFs trading and Market Efficiency

This section examines the impact of the futures trading on the market efficiency by specifically focusing on the information adjustment coefficient of the GJR-GARCH model of the equation (4.15). We estimate these equations for the two sub-samples, i.e., the pre-SSF and the post-SSF period for each individual SSFs-listed stock, and then examine and compare the volatility parameters (i. e., α and β coefficients) across the two sub-periods. The same methodology was also repeated for the matching non-SSFs listed stocks.

Table 7.4 (section A) reports results for equation (4.15) which was estimated separately for pre- and post-SSFs periods, which were further sub-divided into three sub-samples; the 100-, 200- and 500-days intervals for examining the effect of futures trading in the

[70] The same methodology was also used by Floros and Vougas, 2004

short-, medium- and long-term, respectively. In the GJR-GARCH model, the ARCH term shows an average decrease of 0.75% and 41.38%, measured over the 200- and 500-days interval, respectively. In contrast, we observe an average increase of 20.07% for ARCH term subsequent to introduction of SSFs trading, when measured over the 100-day interval. On the other hand, the GARCH term exhibit a decrease of 6.19% and 7.88%, measured for 100-day interval and 200-day interval, respectively, while it exhibits a small increase of 4.01% in the post-SSF period for 500-day interval.

Interpreting the above empirical results for changes in the coefficients of the impact of current (α_1) and old news (β_1) on the returns volatility, we can say that we obtain some empirical evidence which suggests that SSFs trading innovation improves market efficiency in the short term while it may have a reverse effect in the medium (200-day interval) and the long-term (500-day interval). In the short-term (100-day interval), we observe an increase (decrease) of ARCH (GARCH) terms in the post-SSF period indicating that the news is reflected in stock prices more quickly and the old news takes less time to persist and, hence, an increase in market efficiency. However, Wilcoxon Signed Rank Test (WSRT) and the pair-wise t-test suggest that in this GJR-GARCH model, the difference between pre-SSFs and post-SSFs period's ARCH(1) and GARCH(1) coefficients is not statistically significant. As such, it seems that SSFs contracts listing may have a negligible impact on the market efficiency, which measured as speed of information incorporation into the share prices.

However, it would be naïve to reach a final conclusion in this regard before analyzing the sample of control stocks. This dispensation allows us to look at the possibility that the observed changes in the behavior of the coefficients of the GJR model may be due to contemporaneous changes in market and/or industry-wide changes. To account, therefore, for these non-futures induced changes, this study carries out the same procedure for the sample of control stocks by estimating the GJR-GARCH model separately for pre-futures and post-futures periods. The results are reported in Table 7.4 (Panel B). Except for the results for the 500-day interval, qualitatively, the results are similar to that of a sample of SSFs-listed stocks. The control stocks exhibit, on average, a reduction in ARCH

(GARCH) terms in the short and the medium while it exhibits an increase for the 500-day interval. On the other hand, similar to that for the SSFs-listed stocks, the GARCH coefficient exhibits decrease in all the three sample intervals.

Panel B of Table 7.4 also reports Mann-Whitney test to test the null hypothesis of no difference in the GARCH and ARCH parameters in the samples of SSFs-listed and the non-SSFs stocks. These tests were applied for all the three sample intervals. As shown by these tests, that no significant difference is noticed in either the ARCH or the GARCH terms in any of the three sample intervals. This suggests that SSFs trading may have a negligible effect on the market efficiency, measured as the speed of information incorporation into the prices. This lack of evidence in terms of the impact of SSFs trading on the operating efficiency of the underlying stocks may be due to market frictions associated with less developed markets.

7.6 Conclusion

This section of the thesis examines the impact of trading in single stock futures on the volatility dynamics of the underlying stocks by considering the issues of asymmetries, market dynamics and the market efficiency. The results suggest that futures trading has had a considerable impact on the nature of underlying stock price volatility, particularly, the way that news impacts stock price volatility has undergone some changes with the introduction of trading in futures contracts. In general, asymmetric effect has been reduced in the price volatility for the underlying SSFs-listed stocks in the spot market. This result is inconsistent with the 'leverage effect or the risk premium hypotheses' being the only explanation for asymmetries present in the volatility, and provides some validity to the explanations based on the "market dynamics" arguments. This view is further strengthened by the evidence that trading in futures market is also characterized by asymmetric response of volatility to news. These evidences therefore, support the notion of a transfer of asymmetries from the underlying spot market to the futures markets.

The second portion of this chapter examines the market efficiency effect of SSFs contracts trading for the underlying socks. Market efficiency is measured in terms of the speed at which information is incorporated in to prices. For this purpose, the GARCH model was used in this section and the changes in the ARCH (news component) and GARCH (persistence in volatility) parameters were examined using the Wilcoxon Rank Sum Test (WRST). The same procedure was also adopted for a sample of non-SSFs stocks. Overall, the results suggest that SSFs trading may have a negligible effect on the market efficiency in terms of the speed with which information is incorporated in to the prices.

Table 7.4 SSFs trading and Market Efficiency using GJR-GARCH model

Panel A: Sample of SSFS-listed Stocks	100 days around SSFs listing	200 days around SSFs listing	500 days around SSFs listing
Average			
Post-listing ARCH coefficient	0.347	0.263	0.2716
Pre-listing ARCH Coefficient	0.289	0.265	0.32355
Change in ARCH coefficient	0.058	-0.002	-0.05193
Percentage change in ARCH coeff.	**20.07%**	**-0.75%**	**-16.05%**
Post-listing GARCH coefficient	0.53	0.491	0.5883
Pre-listing GARCH coefficient	0.565	0.533	0.6186
Change in GARCH coefficient	-0.035	-0.042	-0.0308
Percentage change in GARCH coeff.	**-6.19%**	**-7.88%**	**-4.91%**
Number of Stocks			
Increase (Decrease) in ARCH Coefficient	14 (12)	13 (13)	17 (9)
Increase (Decrease) in GARCH Coefficient	15 (11)	11 (15)	10 (16)
Moved to significant ARCH (GARCH) Coeff.		0(0)	4 (3)
Moved to insignificant ARCH (GARCH) Coeff.		0(2)	1 (1)
Wilcoxon Signed Rank Test (WRST)			
Z-score (P-value) for ARCH Coefficient	1.181 (0.237)	0.013 (0.989)	-1.571 (0.116)
Z-score (P-value) for GARCH Coefficient	-0.216 (0.829)	-0.495 (0.620)	0.214 (0.830)
Panel B: The Control Sample Stocks			
Average			
Post-listing ARCH coefficient	0.209	0.216	0.297
Pre-listing ARCH Coefficient	0.288	0.339	0.249
Change in ARCH coefficient	-0.079	-0.124	0.048
Percentage change in ARCH coeff	-27.43%	-36.58%	19.28%
Post-listing GARCH coefficient	0.518	0.417	0.459
Pre-listing GARCH coefficient	0.566	0.562	0.590
Change in GARCH coefficient	-0.048	-0.145	-0.131
Percentage change in GARCH coeff	-8.48%	-25.80%	-22.20%
Mann-Whitney Test			
Z-score (P-value) for ARCH Coefficient	1.539 (0.123)	0.689 (0.490)	0.489 (0.624)
Z-score (P-value) for GARCH Coefficient	0.398 (0.696)	0.879 (0.191)	1.01 (0.111)
Number of Stocks			
Increase (Decrease) in ARCH Coefficient			
Increase (Decrease) in GARCH Coefficient			
Moved to significant ARCH (GARCH) Coeff.	01 (4)	2 (2)	0 (0)
Moved to insignif. ARCH (GARCH) Coeff.	7 (4)	7 (7)	3 (4)

Note: See Annexure XIII, Annexure XIV, Annexure XV, d Annexure IV, Annexure XVII and Annexure XVIII for detailed results of the model for each SSFs-listed stock for 100-day, 200-day and 500 day intervals.

CHAPTER 8
SUMMARY, CONCLUSION AND RECOMMENDATIONS

8.1 Summary

This thesis has examined the effect of single stock futures trading on the volatility dynamics of the underlying stocks. Though the issue of the effect of stock index futures trading on the volatility of the underlying asset has been extensively examined in finance literature, the SSFs being relatively newer derivative products have not received much attention in the finance literature, particularly their effect in the emerging markets. Because of their unique characteristics the study of the SSFs contracts on the underlying offers several advantages over the study of index futures contracts. First, the effect of index futures on the underlying asset cannot be measured accurately as the effect dissipates across many constituent stocks whereas trading in the SSFs-underlying stocks can be directly observed in the spot market, making it easier to accurately measure SSFs-related effects for the underlined. Secondly, the multiple introduction dates mitigates the limitations of the single-event studies of index futures, and helps to evaluate their effect on the underlined in different time periods. Hence, any impact of derivatives is likely to be more evident in the behavior of individual stocks, than in an overall index returns. Perhaps, concerns that SSFs might have an adverse effect on the underlying stock's price behavior have led to tighter restrictions on such instruments than on index futures[71].

SSFs were introduced on the Karachi Stock Exchange in July 2001, interestingly seven years before the introduction of index futures in the Pakistan's market. While SSFs are useful addition to the range of instruments available to investors, with a better match for investment and risk management purposes than the wide-ranging index futures, concerns

[71] SSFs were banned in US market for 20 years and trading in these instruments was only allowed in Nov 2002 after lengthy deliberations.

about their impact on the underlying remain. Further, given the unique characteristics of SSFs, this market provides an important opportunity to examine a number of issues that have not been adequately addressed in the literature, particularly in the emerging markets. It is, therefore, imperative to examine the extent to which SSFs has an effect on the volatility, liquidity and market efficiency dynamics of the underlying. This thesis addresses these issues in detail using various econometric methodologies. Moreover, by first identifying the selection criteria for SSFs and then modeling the construction process of control group and basing the selection of control stocks on the model, this study attempts to overcome the endogenity problem inherent in many previous studies and also rules out the possibility that factors other than the introduction of SSFs might have affected the volatility dynamics of the SSFs underlying stocks. Conclusions drawn through this process are more robust and should provide more reliable insights about the extent to which SSFs trading has an effect on the market dynamics of the underlying.

Chapter 5 examines the effect of futures trading on the returns and volatility of the underlying stocks. First, the traditional methods of return volatility estimation does not provide a clear indication of changes in volatility as we observe a reduction in volatility for many of the SSFs-listed and non-SSFs stocks in the post-SSFs period. The second part of the chapter examines the nature of relationship between spot price volatility of the underlying SSFs stocks and futures trading activity variables namely futures volume and open interest, using Schwert's (1990) procedure for volatility estimation. Consistent with some previous findings[72] stock price volatility is found to be positively related to the contemporaneous futures shocks (unexpected component of futures volume) while expected futures volume is significant and negatively related to volatility, suggesting that equity volatility is mitigated when the expected[73] level of futures activity is high. The findings of the decreased spot price volatility associated with large expected futures activity is important to the debate regarding the role of equity derivatives trading in stock market volatility. These empirical results for the Pakistan's equity market support theories implying that equity derivatives trading improves liquidity provision and depth

[72] e.g., Bessimender and Segiun (1992, 1993)
[73] Bessimender and Seguin (1992) call it as background level of trading

in the equity markets, and appear to be in contrast to the theories implying that equity derivatives markets provide a medium for destabilizing speculation.

Chapter 6 examines the changes the effects of futures trading on the beta coefficients (systematic risk) for underlying stocks, by employing models that accounts for the non-synchronous trading and varying market conditions such as 'bull' and 'bear' markets. Unlike results in some earlier studies for US markets, the evidence tends to support a decline in the systematic risk of the underlying stocks, as most stocks experience a decrease in the systematic risk subsequent to futures listing. However, similar to SSFs stocks, we also observe an empirical evidence of a decrease in systematic risk for many of the control group stocks. This indicate that the observed reduction in beta estimates for the SSFs-listed stocks may not necessarily be induced by the introduction of the SSFs trading for those stocks but it may be due to other market-wide and/or industry changes that has affected the overall market. Hence this study finds no evidence that the introduction of futures trading increase the systematic risk of the underlying stocks.

Chapter 7 examines the impact of trading in SSFs on the volatility dynamics of the underlying stocks by considering the issues of asymmetries, market dynamics and the market efficiency. The results suggest that futures trading has had a considerable impact on the nature of underlying stock price volatility, particularly, the way that news impacts stock price volatility has undergone some changes with the introduction of trading in futures contracts. In general, asymmetric effect has been reduced in the price volatility for the underlying SSFs-listed stocks in the spot market. This result is inconsistent with the 'leverage effect or the risk premium hypotheses' being the only explanation for asymmetries present in the volatility, and provides some validity to the explanations based on the "market dynamics" arguments. This view is further strengthened by the evidence that trading in futures market is also characterized by asymmetric response of volatility to news. These evidences therefore, support the notion of a transfer of asymmetries from the underlying spot market to the futures markets. The second portion of this chapter examines the market efficiency effect of SSFs contracts trading for the underlying socks. Overall, the results suggest that SSFs trading may have a negligible effect on the market efficiency in terms of the speed with which information is incorporated in to the prices.

8.2 Contributions of the Study

This study makes several contributions to the literature on the effect of introducing derivatives trading (Single Stock Futures contracts) on price behavior dynamics of the underlying asset/market.

While the issue of the effect of stock index futures trading on the price volatility of the underlying asset/market has been extensively examined in finance literature, the SSFs being relatively newer derivative products have not received much attention in the finance literature, particularly their effect in the emerging markets. Bae et al. (2004) point out that derivative product in developing markets may be less efficient in incorporating new information arrivals because these markets are unfamiliar to investors and because of the presence of market frictions, liquidity, and restrictions. In this paper, we contribute to the literature by investigating one of the developing markets in Asia, a market that has so far, to the best of our knowledge, not been studied for the effects of derivatives on the underlying asset market.

Research on the effect of SSFs on the underlying stocks in terms of price, volume, volatility, efficiency, is limited mainly to Australia, United Kingdom and, to a lesser extent, United States and South Africa. This study adds a Pakistani perspective to this growing, but relatively under-explored, area of research. This study is the first and the most comprehensive one on the SSFs market in Pakistan.

SSFs represent new class of derivatives products that provide investors with an opportunity to take leveraged positions for investing, hedging or speculative purposes, with the added benefit of lower transaction costs and diminishing short-sales restrictions.

The effect of their launching on the underlying asset market should, therefore, be empirically examined to fully understand their utility in the capital market. This study is an attempt to evaluate the impact of SSFs trading from several aspects providing evidence from a market that is analyzed for the first time.

While the issue of the effect of trading in derivatives on the underlying asset/market has long been a subject of interest by many studies in many markets, this large body of literature has pre-dominantly examined the effect of stock index futures contracts—a market wide product, the effect of SSFs trading on the underlying assets remains to be examined. The study of the impact of SSF contracts on the underlying offers some advantages over the study on the stock index futures, because of the unique characteristics of the SSFs contracts which distinguish them from the stock index futures contracts. First, since the underlying index is made up of many component stocks, the effect of index futures cannot be accurately identified since this effect may dissipate across these many component stocks, which in turn makes it difficult to find its true effect. Thus, the effect of SSFs trading may be more evident at the individual stocks level and this effect can be more accurately measured as well. Another benefit of examining SSFs is that they are characterized by several introduction dates within a given market[74]. Unlike a single event analysis in case of stock index futures initiation, this multiple introduction dates helps us to evaluate their effect on the underlined in different time periods.

Most of the research so far done on the SSFs focuses on the effect of their trading on the volatility, volume and, to a lesser extent, on the returns mainly use an event study methodology comparing the volatility of the underlying in the post-SSFs and compare it to the pre-SSFs period, with little consideration being given to using the SSFs trading activity variables, namely SSFs trading volume and open interest to specifically examine the SSFs role on the underlying market dynamics. This study has gone one step further by including these trading activity variables in the econometric analysis and concludes that these variables, particularly the SSFs volume do have an impact on the level and structure

[74] In Pakistan, for instance, SSFs contracts were introduced at different time periods

of the volatility of the underlying shares and recommends that the investors and market participants may consider activities in the futures market to consider factors affecting stock returns for their portfolio considerations.

The other relatively under-explored area of research is the effect of SSFs on the systematic risk of the underlying stocks. While most of the studies have been conducted on the developed market like U.S. and the UK, and that too, on the effect of index futures trading on the systematic risks of the underlying index-component stocks, studies for SSFs markets are almost non-existent, given that SSFs can provide a better hedging tool than the stock index futures contract. This study has shown that SSFs trading has no discernable effect on the beta coefficients of the underlying stocks.

Further, given the unique characteristics of SSFs, this market provides an important opportunity to examine a number of issues that have not been adequately addressed in the literature, particularly in the developing markets. It is, therefore, imperative to examine the extent to which SSFs has an effect on the volatility, liquidity and market efficiency dynamics of the underlying. This thesis addresses these issues in detail using various econometric methodologies. Moreover, by first identifying the selection criteria for SSFs and then modeling the construction process of control group and basing the selection of control stocks on the model, this study attempts to overcome the endogenity problem inherent in many previous studies and also rules out the possibility that factors other than the introduction of SSFs might have affected the volatility dynamics of the SSFs underlying stocks. Conclusions drawn through this process are more robust and should provide more reliable insights about the extent to which SSFs trading has an effect on the market dynamics of the underlying. The main contributions of study are summarized as follows:

1 Consistent with some previous findings[75] the underlying stock price volatility is found to be significantly influenced by the trading in the SSFs, suggesting

[75] e.g., Bessimender and Segiun (1992, 1993)

that equity volatility is mitigated when the expected[76] level of futures activity is high. The findings of the decreased spot price volatility associated with large expected futures activity is important to the debate regarding the role of equity derivatives trading in stock market volatility. These empirical results for the Pakistan's equity market support theories implying that equity derivatives trading improves liquidity provision and depth in the equity markets (informed trading hypothesis), and appear to be in contrast to the theories implying that equity derivatives markets provide a medium for destabilizing speculation.

2 This study finds no evidence that the introduction of futures trading increase the systematic risk of the underlying stocks.

3 Considering the impact of trading in SSFs on the volatility dynamics of the underlying stocks by considering the issues of asymmetries, market dynamics and the market efficiency, the results suggest that futures trading has had a considerable impact on the nature of underlying stock price volatility, particularly, the way that news impacts stock price volatility has undergone some changes with the introduction of trading in futures contracts. In general, asymmetric effect has been reduced in the price volatility for the underlying SSFs-listed stocks in the spot market. This result is inconsistent with the 'leverage effect or the risk premium hypotheses' being the only explanation for asymmetries present in the volatility, and provides some validity to the explanations based on the "market dynamics" arguments. This view is further strengthened by the evidence that trading in futures market is also characterized by asymmetric response of volatility to news. These evidences therefore, support the notion of a transfer of asymmetries from the underlying spot market to the futures markets.

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[76] Bessimender and Seguin (1992) call it as background level of trading

8.3 Recommendations

8.3.1 Academic Recommendations for future research

Given that the SSFs contracts are written on stocks belonging to various industries in the economy, the possibility that the impact of futures trading may differ across industries, can also be analyzed with SSFs trading. This study, therefore, recommends examining SSFs for each industry separately to have a closer look at the SSFs effects on how they respond to different industries.

Liquidity is one the important factors for a market. Investors always prefer to trade in liquid markets. This study has not extensively examined the liquidity effects of the SSFs trading and other studies have only scratched the surface on this topic. It is therefore, recommended examining SSFs effect on the liquidity of the underlying stocks to see if the informed investors have migrated to the futures market to take advantage of the leverage properties and lower transaction costs. This may have an adverse effect on the underlying in terms of the liquidity as the migration of trading to SSFs market.

SSFs are considered as one of effective hedging tools, and even, considered superior to other available hedging tools such as index futures or equity options. Effectiveness of SSFs as a hedging tool is another area of research that needs attention.

8.3.2 Policy Recommendations

This study has examined a number of aspects of SSFs introduction on the underlying market dynamics and has concluded that SSFs trading do contribute to the better functioning of the market in terms of providing liquidity to the market, on one hand, and providing investors with new trading options which are based on a simple and cost-effective alternative to trading in the underlying stock.

Since 2001, equity market capitalization and share prices have increased substantially in Pakistan. Equity market capitalization increased from 9% of GDP in 2001 to 35% in 2006 ($45.5 billion equivalent)[77]. This increase was largely attributed to the listing of a number of large state-owned enterprises (SOEs) together with the growth in share prices rather than successful capital mobilization through equity issues. Further, the market remains narrow. The 10 largest companies alone account for 55% of market capitalization. However, only an average of 20% of their shares has been floated. This, like in other countries in the region, is an important factor behind low market liquidity. In this situation, the authorities should work to introduce derivatives products in the market, besides making sure to bring the existing leveraged products at par with international standards, to bring about the much-needed liquidity in the market.

India, which is one of the largest markets in the world for SSFs, has cash-settled SSFs. In Pakistan, cash-settled SSFs were introduced in 2007 but this product has failed to attract turnover and investor attention. The SECP and the Karachi Stock Exchange need to look into the matter and work it out to develop investor interest in the product.

Improvement in the operating efficiency of securities markets to optimize the allocation of financial resources, and this can be achieved by facilitating the development of corporate bond markets, increasing equity market breadth and reducing its volatility. The government also needs to strengthen the governance of capital markets to improve market transparency and protect investors, particularly the small retail investors.

Trading in the single stock futures contracts were restarted after a break (ban) of three and a half months in July 2009, after re-assessing the eligibility criteria for selection of stocks for SSFs listing, as well as making some amendments in the rules governing these SSFs contracts, particularly those relating to the risk management and counter party risks. One of the differences with the previous rules relates to an increase in the cash margin

[77] Asian Development Bank: Report and Recommendation of the President to the Board of Directors (2007)

from 50% to 100% cash margin/bank guarantee[78]. This, with some other amendments, indicate that trading in the futures contracts is not that easy as it used to be as it requires a lot of cash margins. The authorities concerned need to provide investors with better opportunities of leveraging (by developing new derivative products), hedging and short-selling[79], all of which would go to deepen the market and make larger investor participation possible.

[78] KSE amended rules governing Deliverable Futures Contracts, 2010

[79] Besides taking into account effective risk management considerations

APPENDICES

Annexure I

Descriptive Statistics of daily stock returns for individual SSFs-listed stocks both pre- and post-SSFs listing period

POST (June 2001-to-June 1999)

	Mean	Maxi	Mini	Std. Dev.	Skewness	Kurtosis	J-Bera	LB (5)	LB^2 (5)
DSFL	0.046	12.260	-11.376	3.143	0.160	4.260485*	35.66756*	5.984	68.109*
ENGRO	0.079	7.212	-12.000	2.359	-0.096	6.079293*	182.4531*	10.588	92.602*
HUBC	0.164	16.705	-17.247	2.829	-0.217707*	10.86245*	1263.408*	8.189	10.154*
IBFL	0.213	12.569	-11.206	2.469	0.395156*	6.265863*	229.5726*	8.886	76.3*
NML	0.108	13.884	-10.536	3.362	0.339069*	4.173968*	38.29318*	9.407	24.711
PIAA	0.363	62.415	-15.781	4.917	4.381355*	53.27231*	55119.91*	2.621	0.0926*
PSO	0.196	16.522	-15.473	2.880	0.212755*	6.806416*	294.6198*	6.089	25.797*
PTCL	0.139	16.071	-12.332	2.537	0.069	9.556785*	872.7488*	8.886	32.411*
SNGP	0.257	12.516	-16.666	2.889	-0.138	7.311853*	406.0384*	2.786	49.833*
MCB	0.128	7.746	-11.499	2.730	-0.097439	4.384069	40.7005*	5.715	40.206*
Control Portfolio	0.232	8.854	-7.291	1.847	0.2087*	4.917555*	80.87604*	22.022*	49.769*

PRE (July 2001 -June 2003)

	Mean	Maxi	Mini	Std. Dev.	Skewness	Kurtosis	J-Bera	LB (5)	LB^2 (5)
DSFL	-0.124	91.590	-86.732	10.190	-1.003651	53.12763	37122.93	67.798*	91.929*
ENGRO	-0.227	27.794	-29.870	4.395	-0.286088	23.27782	6052.732	20.125*	80.002*
HUBC	-0.039	37.052	-37.469	4.964	0.187073	26.24206	7947.405	20.287*	61.967*
IBFL	-0.036	36.350	-29.744	4.786	0.279094	26.29504	10565.3	25.261*	40.177*
NML	-0.134	49.021	-59.118	6.944	-0.719014	36.06003	16106.12	41.049*	76.567*
PIAA	-0.249	56.321	-56.497	7.752	0.120299	35.91902	15894.55	38.756*	44.399*
PSO	-0.152	43.472	-30.552	4.679	1.622076	36.61328	16725.53	16.396*	20.829*
PTCL	-0.067	37.336	-34.161	4.720	1.018433	34.38084	14545.16	22.038*	35.773*
SNGP	-0.066	70.220	-53.378	7.614	1.195051	41.02483	21350.62	20.241*	35.793*
MCB	-0.021	38.526	-48.037	5.617	-0.997895	33.85514	14021.67	36.363*	86.267*

POST 2004

BOP	0.0747	7.2254	-21.357	2.9058	-1.495047*	11.43762*	1906.525*	4.841	5.0475
DGKC	0.1455	8.6211	-12.85	2.6883	-0.303029*	5.077927*	66.56725*	5.2515	25.033*
FABL	0.1294	7.2226	-18.967	2.9384	-1.174946*	9.689108*	1076.533*	22.692*	6.7278*

PRE 2004

BOP	0.3339*	15.9914	-19.746	3.2201	-0.500503*	9.020958*	1013.618*	8.3324	77.418*
DGKC	0.404*	17.9048	-16.252	3.4982	0.197387*	6.122837*	242.745*	4.4608	129.86*
FABL	0.2122	135.963	-135.52	10.1486	-0.007845*	160.197*	413907.4*	7.0874	103.55*

LUCK	0.1463	9.0105	-11.882	2.677	0.034667*	4.94237*	53.67352*	9.1397*	34.255*	0.2991*	19.671	-18.344	3.2174	0.420883*	7.61056*	537.2476*	4.5216	58.043*
MLCF	-0.0392	7.5246	-11.123	2.7394	-0.012286*	3.934982*	12.32002*	9.978*	18.428*	0.4104*	19.671	-21.825	3.8222	0.250238*	7.329937*	465.4714*	11.432*	44.225*
NBP	0.2915	7.2196	-12.264	2.4156	-0.34056*	5.723657*	111.6649*	14.782*	102.06*	0.2503*	9.531	-17.658	2.5877	-0.576688*	9.530588*	1018.843*	2.0451	12.734*
OGDC	0.1458	8.1578	-6.4026	2.4837	0.161616*	4.15555*	20.45679*	48.862*	323.93*	0.3481	7.2257	-5.1109	2.409	0.411775*	4.248978*	13.05605*	9.6134	29.441*
POL	0.1891	9.5496	-5.6834	2.1926	0.431823*	5.308247*	86.29986*	5.7687	125.41*	0.1866	7.2321	-51.088	3.3469	-6.017687*	95.97577*	214606.5*	17.919*	0.062
SSGC	-0.0323	7.2281	-10.518	2.59	0.04747	3.447357*	4.496569*	21.408*	136.15*	0.1939	47.5734	-42.589	5.0123	1.680046*	45.42674*	38264.11*	0.6728	0.5111
TELE	-0.1208	10.536	-31.325	3.6799	-0.868301*	13.66647*	2291.991*	15.551*	1.381	0.0896	10.9199	-15.003	3.0863	0.239726*	4.632075*	49.19024*	15.652*	24.965*
AKBL	0.031	7.225	-30.614	2.823	-3.757877	40.78148	31780.76	18.724*	0.8971	0.267	7.232	-13.409	2.371	-0.288048	7.139473	357.3483	2.319	11.299*
UBL	0.267	7.232	-21.127	3.022	-0.996657	9.546933	1003.063	13.403*	6.781	0.339	12.375	-11.709	2.990	0.035406	4.272854	33.31602	6.6550	12.738*
Control Portfolio	0.11428	5.73134	-9.1175	1.64577	-0.38304*	4.758322*	75.71701*	22.461*	56.105*	0.22403	5.93027	-5.1421	1.84792	-0.0386	3.597678*	7.127428*	5.9011	58.65*

Table 1 POST March 2006-Feb 2008 PRE Feb 2006-Feb 2004

BAFL	-0.0641	20.7917	-28.8112	3.1827	-1.83225	23.50109*	9126.259*	8.3325	0.2841	0.1234	7.2299	-27.593	2.8775	-2.0611	24.1481	7543.812*	12.19*	0.2841
KAPCO	0.0217	4.879	-10.2734	1.6619	-0.95356	9.751478*	1035.662*	5.9783	27.867*	-0.0162	4.8726	-13.516	2.1578	-1.2111	11.005	562.526*	6.0947	0.331
KESC	-0.1749	14.4134	-12.4053	2.9811	0.759959	7.901993*	554.2309*	18.922*	65.623*	0.1062	18.9242	-13.447	3.3867	1.27246	8.9609	861.201*	11.118*	54.85*
POIC	-0.1472	5.0469	-12.7833	2.9737	-0.13718	3.141332*	200.4151*	24.281*	31.973*	0.3133	13.4733	-19.782	3.2745	0.11496	5.9087	174.535*	15.142*	17.93*
Control Portfolio	-0.0253	5.40652	-8.91681	1.4511	-0.560449	6.504659*	274.1657*	26.422*	3.6954	0.1713	6.11168	-10.938	1.7998	-0.8978	8.6668	724.435*	18.517*	35.92*

Note: Mean and standard deviations of daily stock returns are in percentages. (*) denotes significance at the 5% level. LB (n) and LB^2 (n) are the Ljung–Box statistics for R_t and R_t^2, respectively, distributed as χ^2 with n degrees of freedom, where n is number of lags. LB statistic at the 5% level of significance is 11.0705. J-Bera is Jerque-Bera test of normality. Under the null hypothesis of a normal distribution, the Jerque-Bera statistic is distributed as a χ^2 with 2 degrees of freedom.

Annexure II

Wilcoxon Rank sum test and t-test for trading volume of SSFs-listed stocks

	Post-SSFs Trading Volume		Pre-SSFs Trading Volume		t-test for mean difference		Wilcoxon Test		Ratio of Post-to-Pre Trading volume			Wilcoxon test	
	Mean	Median	Mean	Median	t-stat	p-value	z-score	p-value	Mean	Median	Std.Dev	z-score	p-value
AKBL	3.2901	1.4046	0.9445	0.2025	9.398	0.000	11.769	0.000	56.594	6.557	171.9343	15.565	0.000
BAFL	6.3965	3.7419	2.7380	1.1652	9.066	0.000	9.474	0.000	9.549	2.819	25.11361	12.901	0.000
BOP	11.2745	7.6669	1.8478	0.7755	18.914	0.000	18.301	0.000	32.334	8.383	68.66494	19.698	0.000
DSFL	3.3978	1.6305	3.0893	2.0618	0.966	0.334	-1.296	0.195	2.417	0.671	5.625542	1.283	0.200
DGKC	19.9646	15.0617	3.8080	1.6560	17.146	0.000	14.661	0.000	29.291	8.052	67.74385	15.508	0.000
ENGRO	5.4841	3.4806	3.5606	2.5980	5.474	0.000	4.38	0.000	5.984	1.311	19.0298	7.242	0.000
FABL	2.7293	1.2933	1.1004	0.4933	8.181	0.000	8.38	0.000	16.672	2.569	92.20884	11.843	0.000
HUBC	43.1057	29.2825	36.3322	32.4895	2.557	0.011	0.849	0.395	2.853	0.988	7.64288	4.208	0.000
IBFL	0.5933	0.3080	2.8745	0.9990	9.648	0.000	-11.589	0.000	4.785	0.326	20.13503	-2.449	0.014
KAPCO	0.7088	0.4125	2.2009	1.3799	8.897	0.000	-9.499	0.000	0.563	0.305	0.80298	-8.722	0.000
KESC	1.7662	0.7955	2.7594	1.1593	3.945	0.000	-4.745	0.000	1.716	0.802	3.121385	0.891	0.373
LUCK	8.4631	5.4725	1.1215	0.3555	12.817	0.000	14.362	0.000	69.474	9.357	213.1639	15.223	0.000
MLCG	4.0616	2.5828	0.7533	0.3330	12.01	0.000	14.274	0.000	39.121	7.676	142.9169	15.037	0.000

MCB	3.2359	2.0663	2.2519	1.6910	4.395	0.000	5.472	0.000	4.344	1.488	8.819052	9.019	0.000
NBP	21.2159	16.5886	6.0400	4.2953	16.219	0.000	13.913	0.000	9.34	3.897	14.79712	14.844	0.000
NML	1.7545	0.9680	1.4549	0.8760	1.864	0.062	1.243	0.213	14.178	1.169	88.65013	5.919	0.000
OGDC	25.6288	18.4350	53.2098	43.1242	6.581	0.000	-6.382	0.000	3.546	0.466	14.03971	-3.451	0.000
PIAA	1.3383	0.1725	0.2501	0.0743	6.853	0.000	6.539	0.000	80.732	2.451	443.585	9.185	0.000
POIC	0.6691	0.3545	1.3379	0.5938	6.698	0.000	6.539	0.000	3.111	0.501	10.761	-1.643	0.100
POL	13.4417	5.7363	1.5412	0.0573	2.808	0.005	13.41	0.000	24.195	101.652	13485.63	15.454	0.000
PSO	13.9263	11.3977	14.5166	13.3734	0.802	0.423	-0.883	0.377	13.862	1.017	62.27994	2.532	0.010
PTCL	33.4218	26.8220	40.0099	30.2095	2.785	0.006	-1.994	0.046	1.654	0.866	2.31168	1.703	0.089
SNGP	10.6936	5.8255	4.9708	3.1210	7.39	0.000	7.042	0.000	8.923	1.931	31.55287	9.93	0.000
SSGC	5.4802	2.6698	6.5244	1.7698	1.652	0.099	0.646	0.518	11.881	1.336	33.83352	9	0.000
TELE	2.4910	0.9620	2.4198	1.3973	0.31	0.757	-1.666	0.095	2.439	0.786	6.243694	1.255	0.230
UBL	2.0827	1.1208	0.4685	0.1280	12.506	0.000	15.751	0.000	16.152	5.701	47.85431	14.885	0.000
Average	**9.4852**		**7.6202**		**9.381**	**0.000**	**26.603**	**0.000**					

Note: mean daily trading volume are in millions of shares. Wilcoxon signed rank test statistic tests the null hypothesis that $H_o : \varpi = 1$ against an alternative hypothesis that $H_i : \varpi \rangle 1$ where ϖ is the population median.

Annexure III

T-test and Wilcoxon tests for trading volume for a sample of control stocks

	POST		PRE		t-test		Wilcoxon Sign Rank	
	Mean	Median	Mean	Median	t-test	p-value	z-score	p-value
ABL	170318.5	90750	163268.5	89250	0.229	0.819	0.190	0.849
ACPL	59012.71	8800	470072	137250	8.610	0.000	13.873	0.000
ATRL	33686.65	14400	15424.58	7050	6.666	0.000	6.454	0.000
BAHL	22353.62	13500	39235.48	13000	1.647	0.100	0.774	0.439
BAHL[a]	174150.7	63100	66857.29	36000	7.086	0.000	6.940	0.000
CHCC	68218.22	32100	54312.5	20000	2.007	0.045	4.149	0.000
CRTM	26989.93	6000	28422.82	7500	0.315	0.753	-2.043	0.041
DAWH	1354.362	400	401.3423	100	5.885	0.000	9.904	0.000
FECTC	37061.6	11000	30339.84	11000	1.025	0.306	-0.191	0.849
GATI	3607.129	1000	3371.287	500	5.367	0.000	0.182	0.855
KOHE	56294.66	22000	59360.37	19500	0.426	0.670	1.135	0.256
KOHE[b]	242081.2	75500	47070.3	13500	8.426	0.000	14.359	0.000
KOHC	364353.8	158700	89047.43	7100	9.815	0.000	12.153	0.000
PAKD[c]	13601.69	4000	12912.08	3000	0.347	0.729	2.539	0.011
PAKD	6363.535	500	3861.298	0	2.222	0.027	3.613	0.003
PNSC	71016.78	21000	9072.707	1500	10.171	0.000	13.285	0.000
SEL	34834.7	8000	22304.93	9000	2.985	0.003	-1.630	0.103
SNBL	54868.64	32500	38881.36	22000	4.019	0.000	4.735	0.000
SSGC	1153490	441000	669952.7	215500	4.531	0.000	5.606	0.000
TELE	1836779	934400	706717.2	340200	9.352	0.000	9.220	0.000
Average	226043.8	19000	126611	11500	9.408	0.000	18.92	0.000

Note: [a] Bank Al Habib for 2006 sample
[b] Kohinoor Energy for 2001 sample
[c] Pak data com for 2004 sample

Annexure IV

Volatility measured as variance of Close-to-Close prices for SSFs-listed Stocks

	POST	PRE	F-test	Bartlett	Levene
ACBL	0.8251	0.5623979	1.467*	17.870*	0.576
BAFL	1.1526	0.8279931	1.392*	10.579*	1.915
BOP	0.85518	0.8170165	1.047	0.270	0.477
DSFL	0.9564	10.384201	10.858*	414.111*	6.866*
DGKC	0.7227	1.1158265	1.544*	15.889*	8.705*
ENGRO	0.62901	1.9314047	3.071*	105.242*	6.393*
FABL	0.87847	10.299469	11.724*	496.249*	1.741
FFC	0.14213	0.16736	1.926*	52.31*	0.838
HUBC	0.94305	2.4643331	2.613*	78.142*	5.508*
IBFL	0.62597	2.2903451	3.659*	183.454*	10.574*
KAPCO	0.30822	0.4656148	1.511*	8.090*	4.352*
KESC	0.90634	1.1469845	1.266*	6.784*	3.010
LUCK	0.71665	0.990213	1.382*	8.835*	1.522
MLCF	0.7504	1.4697578	1.959*	37.322*	18.073*
MCB	0.76845	3.1549981	4.106*	161.946	8.573*
NBP	0.5835	0.6504015	1.115	0.997	0.702
NML	1.10793	4.821297	4.352*	175.033*	5.153*
OGDC	0.19646	0.5803291	2.954	38.781*	16.149*
PIAA	2.96863	6.0092651	2.024*	42.703*	0.039
POIC	0.88013	1.0722324	1.218*	4.772*	1.539
POL	0.48075	0.659427	1.372*	8.442*	5.146*
PSO	0.87015	2.1892489	2.516*	72.089*	0.114
PTCL	0.69443	2.2275578	3.208*	113.179*	2.046
SNGP	0.96814	5.7974747	5.988*	250.398	8.095*
SSGC	0.66124	2.5123272	3.799*	210.502*	5.143*
TELE	1.33896	0.9525346	1.406*	11.727*	1.367
UBL	0.9146	0.8941428	1.023	0.063	0.342

Note: * indicates significance at 5% level. Value are multiplied by 1000

Annexure V
Parkinson's variance estimator for SSFs stocks

	POST		PRE		T-TEST		WILCOXON	
	Mean	Median	Mean	Median	t-test	p-value	z-score	p-value
ACBL	0.487	0.229	0.463	0.249	0.584343	0.559	0.027	0.978
BAFL	0.554	0.383	0.571	0.332	0.407177	0.684	0.58	0.562
BOP	0.505	0.255	0.666	0.376	3.510267	0.001	-3.692	0.000
DSFL	0.674	0.409	1.186	0.38	3.203598	0.001	-1.785	0.074
DGKC	0.545	0.276	1.065	0.547	4.909296	0.000	-5.961	0.000
ENGRO	0.425	0.209	0.714	0.306	3.135586	0.002	-3.311	0.000
FABL	0.542	0.328	0.566	0.293	0.474784	0.635	0.162	0.871
HUB	0.401	0.168	0.785	0.286	3.762869	0.000	-5.266	0.000
IBFL	0.517	0.272	0.826	0.364	4.162988	0.000	-3.911	0.000
KAPCO	0.221	0.125	0.307	0.192	2.565242	0.011	-2.912	0.003
KESC	0.865	0.45	0.887	0.467	0.259871	0.795	0.126	0.899
LUCK	0.562	0.314	0.77	0.372	2.931837	0.004	-1.629	0.103
MLCF	0.581	0.346	1.171	0.63	5.219157	0.000	-5.689	0.000
MCB	0.483	0.278	1.079	0.415	4.629274	0.000	-4.964	0.000
NBP	0.382	0.157	0.458	0.29	1.796182	0.073	-3.482	0.000
NML	0.711	0.401	1.304	0.423	3.255753	0.001	-2.088	0.037
OGDC	0.125	0.0735	0.48	0.201	5.55713	0.000	-7.024	0.000
PIAA	1.289	0.656	0.91	0.447	3.084916	0.002	3.325	0.000
POIC	0.718	0.503	0.848	0.579	2.627943	0.009	-1.946	0.052
POL	0.362	0.131	0.356	0.19	0.162482	0.871	-1.522	0.128
PSO	0.44	0.232	0.56	0.182	1.207876	0.228	1.414	0.157
PTCL	0.341	0.179	0.389	0.179	0.973091	0.331	0.167	0.867
SNGP	0.568	0.324	1.02	0.444	3.939446	0.000	-3.808	0.000
SSGC	0.525	0.31	0.526	0.288	0.015212	0.988	0.503	0.615
TELE	0.932	0.584	0.827	0.509	1.46393	0.144	1.287	0.198
UBL	0.638	0.384	0.736	0.391	1.768711	0.077	-1.41	0.159

Note: Mean and Median values are multiplied by 1000

Annexure VI
Variance of Close-to-Close returns for Control Stocks

	VARPOST	VARPRE	F-test	Bartlett	Levene's
ABL	0.621758	0.7217	1.161	1.002	4.290*
ACPL	0.81746	0.983319	1.203*	4.102*	2.643
ATRL	0.876483	0.601398	1.457*	16.900*	14.667*
BAHL2001	0.541521	0.471397	1.149	1.992	0.023
BKHB2006	1.416335	0.885767	1.599*	26.052*	0.057
CHCC	0.79817	0.837148	1.049	0.273	3.632*
CRTM	0.7713	1.560659	2.023*	52.885*	16.896*
DAWH	0.713996	1.060393	1.485*	18.477*	0.026
FECTO	0.660431	0.962284	1.457*	17.547*	10.911*
FFC	0.397669	0.80519	2.025*	67.937*	2.060
GATI	0.873718	1.942992	2.224*	67.970*	4.063*
KOHC2006	0.780052	1.225196	1.571*	25.189*	1.744
KOHNR2006	0.375102	0.385723	1.028	0.097	0.106
KOHE2001	0.63317	0.949646	1.500*	17.439*	3.396
PAKD2004	0.794574	1.141066	1.436*	15.701*	0.675
PNSC	3.051859	5.123012	1.679*	28.537*	1.332
SEL	0.911467	0.490677	1.858*	46.293*	34.737*
SNBL	0.816457	0.56993	1.433*	15.402*	1.880
SSGC	0.828121	1.342651	1.621*	24.824*	1.483
SEL2006	0.913529	0.490677	1.862*	47.148*	36.967*
TELE	1.280347	1.976053	1.543*	20.001*	1.434

Note: VARPRE and VARPOST stands for Variance in the pre-futures and the post-futures period, respectively. P-values for each test statistic in parenthesis. Mean values are 10^{-3}

Annexure VII
Parkinson Estimator for control group

	POST	PRE	t-test		wilcoxon	
			t-test	p-value	z-score	p-value
	Mean	Mean				
ABL	0.672	1.005	0.872	0.384	1.385	0.159
ACPL	0.621	0.721	1.982	0.050	-2.755	0.006
ATRL	0.550	0.428	2.434	0.015	1.733	0.083
BAHL	0.237	0.203	0.966	0.334	3.928	0.000
BAHL2006	0.255	0.399	4.798	0.000	-5.103	0.000
CHCC	0.463	0.503	0.935	0.350	0.561	0.571
CRTM	0.390	1.106	5.542	0.000	-4.939	0.000
DAWH	0.192	0.138	1.289	0.198	6.535	0.000
FECTC	0.504	0.471	0.823	0.411	1.733	0.083
GATI	0.274	0.804	3.607	0.000	0.681	0.495
KOHE	0.385	0.638	1.568	0.117	2.171	0.030
KOHC06	0.654	0.402	6.846	0.000	-5.559	0.000
KOHE06	0.223	0.242	0.724	0.469	1.148	0.250
PAKD	0.337	0.420	1.429	0.153	2.826	0.004
PNSC	1.470	1.551	0.251	0.802	5.017	0.000
SEL06	0.514	0.263	6.395	0.000	6.008	0.000
SNBL	0.328	0.311	0.540	0.589	2.028	0.043
SSGC	0.506	0.965	3.163	0.002	-2.638	0.008
TELE	0.949	1.638	3.963	0.000	-2.444	0.014

Note: Mean and medians are 10^{-3}

Annexure VIII
Average daily returns for SSFs underlying stocks

COMPANY	Post	Pre	t-test	Prob.	wilcoxon Statistic	p-value
ACBL	0.0310	0.2666	1.432	0.151		
BOP	0.0747	0.3339	1.47(	0.142	1.046	0.296
DSFL	0.0462	-0.1244	0.353	0.724	-0.774	0.439
DGKC	0.1455	0.404	1.178	0.239	1.377	0.168
ENGRO	0.0789	-0.2271	1.274	0.203	-1.836	0.066
FABL	0.1294	0.2122	0.176	0.860	0.575	0.565
FFC	0.1889	-0.0297	1.423	0.156		
HUBC	0.1636	-0.0387	0.748	0.455	0.884	0.377
IBFL	0.2131	-0.0359	1.017	0.310	1.45	0.147
LUCK	0.1463	0.2991	0.741	0.459	-1.296	0.195
MLCF	-0.0392	0.4104	1.900	0.058	-1.952	0.051
MCB	0.128	-0.0208	0.513	0.608	0.728	0.467
NBP	0.2915	0.2503	0.238	0.812	-0.503	0.615
NML	0.1079	-0.1339	0.675	0.500	0.783	0.434
OGDC	0.1458	0.3481	0.818	0.414	-1.579	0.114
PIAA	0.363	-0.2494	1.416	0.157	1.785	0.074
POL	0.1891	0.1866	0.012	0.990	-0.101	0.920
PSO	0.1964	-0.1518	1.326	0.185	1.668	0.095
PTCL	0.1385	-0.0665	0.811	0.418	1.93	0.054
SSGC	-0.0323	0.1939	0.909	0.363	-0.981	0.327
SNGP	0.2565	-0.0655	0.877	0.381	2.187	0.029
TELE	-0.12081	0.08959	-0.910	0.181	-0.537	0.591
KESC	-0.1749	0.1062	1.3923	0.164		
KAPCO	0.0217	-0.0162	0.2466	0.805		
POIC	-0.1472	0.3133	2.3258	0.020		
UBL	0.267	0.3391	0.381	0.703		
BAFL	-0.0641	0.1234	0.9114	0.362		

Note: Daily mean returns are in percentages. $H_o : \mu_{pre} = \mu_{post}$. The t-test statistic is the t-test assumes i) normal distribution of the sample; ii) randomness and independence of the sample.

Annexure IX

Average Daily Returns for Control Group stocks

	Post	Pre	T-test	Prob.	Wilcoxon	Prob.
ABL	-0.02656	0.738578	1.966	0.051	-1.933	0.053
ACPL	0.157229	0.307744	0.774	0.439	-0.763	0.445
ATRL	0.110638	0.192553	0.462	0.644	-0.293	0.770
BAHL2001	0.115941	-0.09437	1.217	0.224	1.634	0.102
BAHL2006	0.020904	0.087048	0.298	0.766	-0.901	0.368
CHCC	-0.00662	0.269148	1.477	0.140	-1.328	0.184
CRTM	0.071819	-0.09759	0.665	0.506	0.317	0.751
DAWH	0.175626	-0.0733	1.234	0.217	1.561	0.119
FECTC	-0.23513	0.388392	3.445	0.001	-3.049	0.002
FFC	0.201637	-0.0657	1.739	0.082	1.866	0.062
GATI	0.27773	0.041124	0.858	0.391	1.018	0.309
KOHC2006	-0.10944	0.098859	1.031	0.303	-1.529	0.126
KOHE2001	0.273967	-0.01623	1.402	0.161	1.981	0.048
KOHE2006	0.040787	-0.04424	0.685	0.493	0.276	0.783
PAKD2004	0.304159	0.148235	0.765	0.445	0.549	0.583
PNSC	0.56351	-0.13092	1.395	0.163	0.913	0.362
SEL	0.07065	-0.13602	1.224	0.221	1.239	0.215
SNBL	0.084949	0.153677	0.397	0.692	-0.212	0.832
SSGC	0.113742	-0.08747	0.825	0.410	2.277	0.023
SWL2006	0.07065	-0.13602	1.224	0.221	1.239	0.215
TELE	0.118826	-0.20463	1.079	0.281	1.504	0.133

Note: Daily mean returns are in percentages. $H_o : \mu_{pre} = \mu_{post}$. The t-test statistic is the t-test assumes i) normal distribution of the sample; ii) randomness and independence of the sample.

Annexure X
Systematic Risk Estimates for SSFs-listed stocks using constant risk market model approach

	ϕ	ϕ_1	ϕ_2	ϕ_3	α_0	α_1	β_1	γ_2	R(1)	AR(2)	MA(1)	MA(2)
ACBL	-0.0862	0.109852	0.80722*	-0.03754	0.78811*	0.17393*	0.45988*	1.52524*				
BOP	0.000128	-0.00083	1.34204*	-0.1990*	9.02E-05*	0.861007*	0.407176*	-0.28472*				
DSFL	0.000196	-0.00373*	1.591227*	-0.15521**	1.83E-05*	0.209557*	0.74169*	0.349016*				-0.10714*
DGKC	-0.00033	0.000198	1.595697*	-0.34988*	4.66E-05*	0.142006*	0.735317*	0.147734*				
ENGRO	-0.00052	-0.00219*	0.840757*	0.10965*	3.39E-05*	0.425408*	0.55075*	0.545356*	-0.98431*		0.989949*	
FABL	-0.00013	-0.00664*	0.432349*	0.604998*	0.000123*	0.686787*	0.259071*	7.93604*		0.31879*	-0.3689*	
HUB	0.001008	-0.00212**	1.216615*	-0.15633*	4.32E-05*	0.343488*	0.60991*	0.407247*	-0.10992*			
IBFL	0.000735	-0.00212	0.976236*	-0.065	0.000384*	0.117075*	0.462186*	0.655166*				
LUCK	-0.00048	0.000253	1.33224*	-0.41935*	6.77E-05*	0.095855*	0.73057*	0.140899*	-0.65191*		0.685944*	
MLCF	-0.08745	-0.2111	1.588004*	-0.52424*	0.436243	0.085839*	8.40E-01*	0.043984*			-0.06811	
MCB	-0.00057	-0.00072	1.226637*	-0.12738	0.000172*	0.194646*	0.634769*	0.287125*			0.07069**	
NBP	-0.00018	0.001491	1.103449*	-0.28526*	0.000131*	0.446254*	0.231264*	0.664827*	-0.58051*		0.505493*	
NML	-0.00136	-0.00045	1.803772*	-0.3344*	4.14E-05*	0.20269*	0.794184*	0.040409				
OGDC	-0.00078	0.000728	1.318312*	-0.21391	2.38E-05*	0.324337*	0.687432*	-0.00462				
PIA	0.000506	-0.00445*	1.807501*	-0.04007	8.03E-05*	0.304658*	0.701507*	0.51286*	0.24685*		-0.54483*	
POL	-0.00175*	0.001375*	0.856126*	-0.00755	3.22E-05*	0.322735*	0.420693*	1.99266*				

PSO	-0.00111	0.001124	0.637437*	0.678666*		1.49E-05*	0.951322*	0.622693*	-0.6512*		-0.52336*		0.62079*
SNGPL	0.007328*	-0.0089*	2.700202*	-1.37188*		0.000301*	-0.00022*	0.296853*	0.201233*	3.024658*	-0.27924*		
PTCL	0.000836*	-0.00222*	1.674705*	-0.45431*		2.28E-05*	0.939329*	0.33743*	1.391778*	0.87849*		-1.28485*	0.33252*
TELE	-0.00229	-0.00096	1.234893*	-0.35844*		0.000172*	1.15E-06	0.167072*	0.391307*	1.032235*	-0.85191*		0.92956*
POIC	-0.04634	-0.15241	0.908528*	0.08861		0.337019*	0.013977	0.164296*	0.812289*	-0.03674			
BAFL	-0.04395	-0.09051	0.926695*	0.140224		1.793215*	0.375649*	0.055621	0.755621*	-0.06553	0.017231	-0.04303	
KAPCO	-0.18569	0.188686	0.583627*	-0.26366*		1.372518*	-0.57976*	0.780111*	0.187698*	-0.21377			
KESC	-0.13113*	-0.25427*	0.945525*	-0.14053*		1.732647*	-0.65694*	0.419083*	0.298959*	0.714481*		-0.10919	0.192996* (MA-3)
	C	D1	Rmt	D1*Rmt		C	D1	ARCH(1)	GARCH(1)	γ_2			
UBL	-0.04905	0.13206	1.079508*	-0.3379*		3.388897*	-0.53946	0.363478*	0.107941*	0.505457*			0.097642*
SSGC	-0.00087	-0.00174	1.107139*	-0.0538		0.002131*	-0.00186*	0.211057*	-0.05319	0.05157			0.105654*

Note: * (**) indicate significance at 5% (10%) levels, respectively

The Model is given by the following equations:

Mean Equation:

$$R_{it} = \phi + \phi_1 D_1 + \phi_2 R_{mt} + \phi_3 D_1 R_{mt} + \varepsilon_t$$

Variance Equation:

$$h_t = \alpha_0 + \gamma_1 D_1 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \gamma_2 \varepsilon_{t-1}^2 d_{t-1}$$

Annexure X—A

Ljung-Box Q statistics for residuals using the GRJ-GARCH Model for SSFs-listed underlying stocks

	ACBL	**BOP**	**DSFL**	**DGKC**	**ENGRO**	**FABL**	**HUB**
L-B Q Stat (36)	31.890	14.879	36.140	15.755	16.755	12.115	27.161
Probability value	0.567	0.413	0.462	0.999	0.997	0.907	0.467
Durbin-Watson stat	1.981	2.035	1.893	2.066	1.922	1.952	1.981
	NBP	**NML**	**OGDC**	**PIA**	**POL**	**PSO**	**SNGPL**
L-B Q Stat (36)	22.082	13.610	36.797	21.907	34.402	13.244	40.412
Probability value	0.880	0.999	0.386	0.946	0.545	0.994	0.208
Durbin-Watson stat	1.859	1.987	2.099	1.893	2.084	1.856	2.113
	LUCK	**MLCF**	**MCB**	**UBL**	**SSGC**	**IBFL**	**AKBL**
L-B Q Stat (36)	31.645	15.958	18.674	19.464	38.279	26.905	28.519
Probability value	0.676	0.998	0.992	0.335	0.366	0.864	0.490
Durbin-Watson stat	1.946	1.827	1.936	1.970	1.882	2.008	2.079
	TELE	**POIC**	**BAFL**	**KAPCO**	**KESC**	**PTCL**	
L-B Q Stat (36)	11.386	29.945	26.651	24.683	22.789	11.534	
Probability value	0.901	0.515	0.458	0.408	0.450	0.931	
Durbin-Watson stat	1.867	1.954	2.030	1.910	1.870	1.859	

Annexure XI

Systematic Risk Estimates for Control Group stocks using GARCH Model (Constant risk model approach)

	ϕ	ϕ_1	ϕ_2	ϕ_3	AR(1)	AR(2)		C	α_1	β_1	γ_2
CRESCENT	-0.000275	0.000312	1.060724*	-1.059278*	-0.14456*			0.000559*	0.406572*	0.378145*	-0.33018*
DAWOOD	-0.000182	0.000777	0.47031*	-0.468445*				0.00014*	0.22321*	0.477371*	0.774697*
GARTON	-0.00054	-0.001142	0.526957*	-0.524412*				9.70E-05*	0.156047*	0.762223*	0.12148*
KOHINOOR2001	-0.000505	0.001151	0.861139*	-0.851988*				2.44E-04*	0.261192*	0.32443*	0.426184*
PNSC	-0.00251	0.000613	0.916841*	-0.904156*	-0.18876*			0.000787*	0.266125*	0.529508*	0.327335*
SSGC	-0.001346	0.000436	1.179355*	-1.167926*				1.45E-05*	0.130272*	0.741199*	0.359229*
BANKHABIB2001	-0.003208*	0.001446	1.582971*	-1.569102*				0.000106*	0.1900*	0.675232*	0.118163**
PKDATA20001	-0.002103	0.001053	0.341746*	-0.338311*	-0.1135*	-0.07704		0.000114*	0.137632*	0.831667*	0.059137*
ATKCMNT	-0.001013	0.000304	1.206802*	-0.537924*				0.000132*	0.170442*	0.607642*	0.054003
ATKREF	-0.001778	-0.000111	0.714241*	-0.002625				9.12E-05*	0.19376*	0.565938*	0.299361*
CHRATCMNT	-0.000218	0.000987	0.762037*	-0.029263				0.000101*	0.117054*	0.62109*	0.294379*
PKDAT2004	-0.001271	0.001494	0.779762	-0.26315				0.000215*	0.246452*	0.5996*	-0.08457
SONERI	-0.002171*	0.001433	0.596933*	-0.107195				0.000123*	0.181007*	0.351429*	1.907424*
ALLIED	0.002633	-0.002012	0.357633*	0.510383*				0.000333*	0.525455*	0.033507	-0.24905
BKBHB2006	6.49E-05	-0.000258	0.705851*	-0.700912*				2.39E-05*	0.14614*	0.918325*	-0.13471*
FECTO	0.001008	-0.003113	0.673939*	-0.027697				0.000327*	0.277468*	0.37889*	-0.14195
KOHAT	0.000544	-0.001805	0.671778*	0.24999	0.041021			5.41E-04*	0.046367	0.544576*	-0.05389
KOHINOOR2006	-0.000999	0.000574	0.296838*	0.107998	-0.14554*			6.21E-05*	0.183869*	0.634853*	0.044209
SITARA	-0.001374	0.00164	0.357557*	0.173055	-0.11736*			4.29E-05*	0.11358*	0.759028*	0.065611

Model: $R_{it} = \phi + \phi_1 D_1 + \phi_2 R_{mt} + \phi_3 D_1 R_{mt} + \varepsilon_t \quad h_t = \alpha_0 + \gamma_1 D_1 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \gamma_2 \varepsilon_{t-1}^2 d_{t-1}$

ANNEXURE XII

Systematic Risk Estimates 1-year Time Period for SSFs Stocks using Varying-Risk Market Model Approach

	D1	D2	D1*D2	KSE	D1*KSE	D2*KSE	D1*D2*KSE	AR (1)	AR(2)
AKBL	-0.2844	-0.2139	0.3973	1.5164	-0.6908	-0.6148	0.6149		
t-Statistic	-0.8322	-0.5639	0.6243	7.1424*	-2.2921*	-1.5183	1.2549		
BAFL	-0.2862	0.2274	0.6279	0.9503	0.1386	0.0693	0.2463		
t-Statistic	-0.8755	0.6273	1.0573	6.6027*	0.4082	0.2710	0.5376		
BOP	-0.1548	0.2214	0.2128	2.0010	-0.8110	-0.4021	0.4131		
t-Statistic	-0.4729	0.6069	0.3523	9.8804*	-2.8429*	-1.0365	0.8835		
DSFL	0.2411	0.0550	-0.9240	1.3885	-0.2527	0.1906	-0.1403	0.1014	-0.1368
t-Statistic	0.9174	0.1832	-1.7892**	9.1004*	-1.0462	0.6225	-0.3424	1.9975*	-2.6918*
DGKC	0.7721	-0.2102	-0.3784	1.5017	-0.7828	-0.0623	0.6071		
t-Statistic	2.4587*	-0.6153	-0.6568	10.1048*	-3.3686*	-0.2348	1.6960**		
ENGRO	-0.0053	-0.0038	0.0154	0.0147	-0.0044	-0.0068	0.0094		
t-Statistic	-1.9661*	-1.1919	2.8367*	8.9250*	-1.7851**	-2.0691*	2.2640*		
								AR(14)	AR(28)
FABL	-0.7232	-1.4874	2.6690	-0.0885	1.3034**	-1.7869	1.7165	-0.6221	-0.2736
t-Statistic	-0.7030	-1.3326	1.3471	-0.1542	1.7743	-1.5149	1.1580	-12.2307*	-5.3840*
HUBC	-0.0717	-0.0089	-0.2582	1.5128	-0.4247	-0.3537	0.1998		
t-Statistic	-0.3387	-0.0361	-0.6106	11.9476*	-2.1468*	-1.4097	0.6031		
IBLF	0.0320	-0.6809	0.8157	1.2183	-0.4327	-0.4258	0.5360		
t-Statistic	0.0993	-2.0395*	1.3529	7.6499*	-1.5366	-1.5750	1.2489		
								AR(1)	
KAPCO	-0.0616	0.0772	-0.1773	0.6309	-0.2092	0.1826	-0.1692	0.0521	
t-Statistic	-0.2399	0.2628	-0.3785	5.2317*	-0.7860	0.8005	-0.4524	1.0069	
KESC	-0.2530	-0.1311	0.3041	1.0047	-0.1102	-0.2216	0.2631		
t-Statistic	-0.6117	-0.2859	0.4048	5.5184*	-0.2567	-0.6852	0.4540		
LUCK	0.5654	-0.3015	0.1568	1.5010	-0.9296	-0.0594	0.5307	0.0983	
t-Statistic	1.4822	-0.7510	0.2328	8.4634*	-3.3699*	-0.1888	1.2341	1.9147	

MLCF	0.2780	-0.1090	-0.1895	1.4890	-0.6866	-0.0010	0.2850	0.0665	
t-Statistic	0.7684	-0.2813	-0.2945	8.7343*	-2.5934*	-0.0033	0.7072	1.3038	
MCB	0.3858	-0.4543	-0.2458	0.2481	0.4792	-0.1518	0.5338		
t-Statistic	1.7055**	-2.0308*	-0.5741	4.0246**	2.8267**	-1.5327	2.1332*		
NBP	0.8393	0.0195	-0.2684	1.3405	-0.8110	-0.2608	0.9518		
t-Statistic	2.7218*	0.0574	-0.4716	9.0741*	-3.5594*	-0.9886	2.6982*		
								AR(2)	AR(3)
NML	0.1534	-0.2965	0.2488	1.4904	-0.2473	-0.0667	0.4174	-0.1070	0.0095
t-Statistic	0.4660	-0.7702	0.3736	7.8009*	-0.8144	-0.1707	0.8068	-2.1212*	0.1885
								AR(5)	AR(15)
OGDC	-0.1707	0.0341	-0.1041	1.3011	0.0577	0.0186	-0.2726	0.1595	-0.2002
t-Statistic	-0.5690	0.0940	-0.1850	7.1907*	0.2367	0.0502	-0.6415	2.7420*	-3.3381*
								AR(1)	
PIA	0.3295	-0.9519	0.0009	1.2770	0.1954	-0.7342	0.5788	-0.0990	
t-Statistic	0.8457	-2.1658*	0.0011	5.7073*	0.5379	-1.6329**	0.9568	-1.9611*	
								AR(1)	AR(2)
POIC	-0.4290	0.5126	-0.2112	0.9326	0.6205	0.1547	-0.4912	0.1360	0.1175
t-Statistic	-1.1165	1.2328	-0.3282	5.4317*	1.6808**	0.5175	-0.9459	2.6921*	2.3371*
POL	0.6063	0.1725	-0.2407	1.2412	-0.7616	0.1824	0.4230		
t-Statistic	1.2598	0.3239	-0.2689	5.3326*	-2.1642*	0.4389	0.7657		
								AR(20)	
PSO	-0.3970	0.2756	0.0637	0.8585	0.6735	0.5398	-0.6579	-0.1437	
t-Statistic	-1.8792**	1.1877	0.1528	7.4904*	3.5964*	2.2842*	-2.0655*	-2.8650*	
PTCL	-0.3488	0.0990	-0.2079	1.1142	0.3579	0.3302	-0.8795		
t-Statistic	-2.2598*	0.5553	-0.6786	12.6842*	2.5742*	1.8427**	-3.6936*		
SNGP	-0.3861	-0.0625	0.8282	1.4598	-0.0697	0.1635	-0.2126	-0.0896	
t-Statistic	-1.6012	-0.2288	1.7456*	10.4456*	-0.3070	0.5843	-0.5638	-1.7735**	
SSGC	0.2141	-0.0869	-0.0532	1.2272	-0.2525	0.0805	0.1789	0.1684	-0.0974
t-Statistic	0.6876	-0.2424	-0.0918	7.7550*	-0.9577	0.2873	0.4542	3.2899*	-1.9231*
TELE	0.0934	-0.1146	-0.0850	1.0795	-0.1992	0.1011	0.0487	0.1106	-0.1125
t-Statistic	0.2521	-0.2756	-0.1214	4.6382	-0.5973	0.2291	0.0902	2.1782*	-2.2156*
UNION	0.6186	0.0105	0.2374	1.2031	-0.7115	-0.7877	1.4124	0.1936	-0.0169
t-Statistic	1.6063	0.0261	0.3592	5.1373*	-2.1611*	-1.8636**	2.6884*	3.7936*	-0.3329

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ANNEXURE XIII GARCH MODEL RESULTS FOR 100-DAY OBSERVATIONS FOR SSFs-LISTED STOCKS FOR POST-FUTUDRES PERIOD

		KSE	C	AR(1)	MA(1)		C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)
DSFL		1.493964	-0.48057				0.382678	-0.12827	-0.01985	1.054426
Std. Error		0.102864	0.232736				0.211103	0.060815	0.127689	0.045809
z-Statistic		12.14697	-2.29295				4.265148	-1.94774	-0.324	27.48427
Prob.		0.000	0.022				0.000	0.051	0.746	0.000
ACBL			0.215595				1.897145	0.561575	-0.41342	0.333538
Std. Error			0.221536				1.311102	0.482198	0.495389	0.348836
z-Statistic			0.973181				1.446985	1.164614	-0.83455	0.956146
Prob.			0.331				0.148	0.244	0.404	0.339
BAFL		1.281208	-0.11449				0.273443	0.029135	0.731667	0.601248
Std. Error		0.087633	0.129756				0.204862	0.081024	0.352975	0.17253
z-Statistic		14.62011	-0.88232				1.334767	0.359581	2.072856	3.484895
Prob.		0.000	0.378				0.182	0.719	0.038	0.001
BOP		0.010613	0.002419				1.85E-05	0.153521	-0.06967	0.782575
Std. Error		0.000862	0.001463				1.39E-05	0.111245	0.120434	0.121432
z-Statistic		12.31369	1.653066				1.330609	1.380025	-0.57847	6.444575
Prob.		0.000	0.098				0.183	0.168	0.563	0.000
DGKC			0.542456				0.694056	0.152818	-0.087	0.76044
Std. Error			0.239344				0.997079	0.222138	0.248318	0.28397
z-Statistic			2.266429				0.696089	0.687941	-0.35037	2.677887
Prob.			0.023				0.486	0.492	0.726	0.007
ENGRO			0.127855				0.4319	0.541876	0.083093	0.35189
Std. Error			0.128467				0.215569	0.264628	0.387602	0.123587
z-Statistic			0.995236				2.00353	2.047691	0.214376	2.847308
Prob.			0.320				0.045	0.041	0.830	0.004

ANNEXURE XIII --CONTINUED

		KSE	C	AR(1)	MA(1)		C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)
FABL			0.070229				1.359618	0.565835	-0.50433	0.562399
z-Statistic			0.27845				1.364416	1.545083	-1.40831	2.65908
Prob.			0.781				0.172	0.122	0.159	0.008
HUBC			0.255919				0.790833	0.881574	-0.91654	0.384735
Std. Error			0.151983				0.075634	0.256963	0.245147	0.080133
z-Statistic			1.683867				10.45611	3.430747	-3.73873	4.801175
Prob.			0.092				0.000	0.001	0.000	0.000
IBFL			0.062011				0.739089	0.320721	-0.22909	0.63126
Std. Error			0.205127				0.617229	0.206957	0.254722	0.180199
z-Statistic			0.302306				1.197429	1.549702	-0.89937	3.50312
Prob.			0.762				0.231	0.121	0.369	0.001
KAPCO			0.111231	-0.19054			0.776669	0.466248	0.476314	0.238436
Std. Error			0.088787	0.110779			0.152129	0.240834	0.437341	0.099469
z-Statistic			1.252783	-1.71998			5.10535	1.93597	1.089113	2.397095
Prob.			0.210	0.085			0.000	0.053	0.276	0.017
KESC			-0.0646	-0.38497			3.439713	0.420789	-0.28632	0.251595
Std. Error			0.162711	0.11324			1.624146	0.334732	0.416498	0.307162
z-Statistic			-0.39701	-3.39963			2.11786	1.257091	-0.68744	0.819096
Prob.			0.691	0.001			0.034	0.209	0.492	0.413
LUCK			0.252901	0.89319	-0.84974		0.196678	0.347988	-0.10507	0.692073
Std. Error			0.285436	0.172287	0.198014		0.21073	0.223332	0.381199	0.139879
z-Statistic			0.886016	5.184322	-4.29131		0.933318	1.558167	-0.27564	4.947665
Prob.			0.376	0.000	0.000		0.351	0.119	0.783	0.000
MLCF		1.05323	0.09972				0.371252	0.211786	0.181305	0.681147
z-Statistic		5.850104	0.513943				1.041376	1.749142	0.514495	4.057072
Prob.		0.000	0.607				0.298	0.080	0.607	0.000

ANNEXURE XIII --CONTINUED

		KSE	C	MA(2)			C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)
NBP			0.358794		0.109948		0.177354	0.269022	-0.21105	0.779986
z-Statistic			1.705126		1.133554		1.084976	1.513815	-1.18401	7.308164
Prob.			0.088		0.257		0.278	0.130	0.236	0.000
NML			-0.31904	-0.72083	0.930578		5.515342	0.185501	0.296906	0.131378
Std. Error			0.360431	0.150388	0.072216		3.711431	0.276806	0.461315	0.427786
z-Statistic			-0.88517	-4.79316	12.88607		1.486042	0.670147	0.643607	0.307112
Prob.			0.376	0.000	0.000		0.137	0.503	0.520	0.759
OGDC		1.234186	-0.16088				0.136985	-0.02683	0.202178	0.805376
Std. Error		0.090374	0.114373				0.114699	0.077716	0.184427	0.144924
z-Statistic		13.6565	-1.40661				1.194308	-0.3452	1.09625	5.557235
Prob.		0.000	0.160				0.232	0.730	0.273	0.000
			C				C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)
PIA			-0.05011				2.343114	-0.0947	0.428848	0.76571
Std. Error			0.334434				0.762391	0.02157	0.19115	0.103468
z-Statistic			-0.14984				3.073377	-4.39015	2.243514	7.400462
Prob.			0.881				0.002	0.000	0.025	0.000
			C				C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)
POIC			-0.20886				2.165404	0.344268	-0.30741	0.509491
Std. Error			0.278341				1.732555	0.194288	0.234787	0.261065
z-Statistic			-0.75036				1.249833	1.771948	-1.30933	1.951584
Prob.			0.453				0.211	0.076	0.190	0.051
			C				C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)
POL			0.373111				0.371686	0.135476	0.141795	0.68979
z-Statistic			2.098499				1.416413	1.112478	0.80053	5.144202
Prob.			0.036				0.157	0.266	0.423	0.000

ANNEXURE XIII --CONTINUED

		KSE	C	MA(2)			C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)
PSO			0.152648	-0.26177			4.405401	0.398348	0.020777	0.070915
Std. Error			0.199736	0.089827			2.343477	0.308698	0.470018	0.298969
z-Statistic			0.764251	-2.91418			1.879856	1.290412	0.044206	0.2372
Prob.			0.445	0.004			0.060	0.197	0.965	0.813
			C				C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)
PTCL			0.319206				1.096831	0.68357	-0.73944	0.640245
Std. Error			0.222618				0.474831	0.253944	0.254413	0.116212
z-Statistic			1.433877				2.309939	2.691815	-2.90643	5.509274
Prob.			0.152				0.021	0.007	0.004	0.000
SNGP		1.188035	-0.11095				0.358949	0.111866	-0.03644	0.792237
Std. Error		0.144004	0.178132				0.485579	0.149147	0.159094	0.215199
z-Statistic		8.250045	-0.62283				0.739219	0.750038	-0.22902	3.68142
Prob.		0.000	0.533				0.460	0.453	0.819	0.000
SSGC			0.034845		0.200371		7.71698	0.791391	-0.75037	0.030738
Std. Error			0.440016		0.110796		4.733371	0.657046	0.637168	0.429598
z-Statistic			0.079189		1.808476		1.630335	1.204469	-1.17766	0.071551
Prob.			0.937		0.071		0.103	0.228	0.239	0.943
UBL			0.03				0.026035	0.685656	-0.40484	0.624021
Std. Error			0.145736				0.036138	0.202512	0.290963	0.067043
z-Statistic			0.205851				0.72044	3.385761	-1.39139	9.307775
Prob.			0.837				0.471	0.001	0.164	0.000
TELE		1.072567	-0.45619				1.496089	-0.10821	0.834154	0.635976
Std. Error		0.077188	0.208173				0.657382	0.022817	0.377342	0.126305
z-Statistic		13.89553	-2.19142				2.275828	-4.74257	2.210604	5.03526
Prob.		0.000	0.028				0.023	0.000	0.027	0.000

ANNEXURE XIV Ljung-Box Q statistics for residuals using the GRJ-GARCH Model for SSFs-listed underlying stocks

	ACBL	**BOP**	**DSFL**	**DGKC**	**ENGRO**	**FABL**	**HUB**
L-B Q Stat (36)	38.671		36.471	36.285	28.225	57.91	37.23
Probability value	0.35		0.269	0.455	0.819	0.012	0.415
Durbin-Watson stat	1.995947	2.287243	1.869867	2.125087	1.99284	1.643604	2.328134
	NBP	**NML**	**OGDC**	**PIA**	**POL**	**PSO**	**SNGPL**
L-B Q Stat (36)	32.807	30.227	18.947	41.624	36.67	18.35	
Probability value	0.574	0.653	0.991	0.239	0.438	0.991	
Durbin-Watson stat	1.94621	1.795712	1.975678	1.893855	2.305362	1.822752	
	LUCK	**MLCF**	**MCB**	**UBL**	**SSGC**	**IBFL**	
L-B Q Stat (36)	40.169	**40.49**	45.3488	45.257	33.863	41.65149	
Probability value	0.216	**0.279**	0.31248	0.139	0.523	0.64329	
Durbin-Watson stat	2.096257	1.749969	1.959965	2.01	1.976389	2.010085	
	TELE	**POIC**	**BAFL**	**KAPCO**	**KESC**	**PTCL**	BFL
L-B Q Stat (36)	40.08878	29.917	32.60953	39.802	24.804	48.608	44.71936
Probability value	0.63168	0.752	0.81968	0.305	0.9	0.098	0.09016
Durbin-Watson stat	1.968939	2.009121	2.029212	1.957975	1.918981	1.9069	1.59417

ANNEXURE XV GARCH MODEL RESULTS FOR 100-DAY OBSERVATIONS FOR SSFs-LISTED STOCKS FOR PRE-FUTUDRES PERIOD

	KSE	C	AR(1)	MA(1)		C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)
DSFL		-0.14796	-0.40511	0.417673		0.647855	-0.19896	0.006172	1.049537
Std. Error		0.242297	1.112226	1.13771		0.165667	0.035178	0.070875	0.047276
z-Statistic		-0.61065	-0.36423	0.367118		3.91059	-5.65579	0.08708	22.20014
Prob.		0.541	0.716	0.714		0.000	0.000	0.931	0.000
ACBL	1.327996	0.226298				0.518739	0.02592	0.163526	0.767145
Std. Error	0.19683	0.205122				0.7134	0.083609	0.196423	0.299831
z-Statistic	6.746925	1.103237				0.727136	0.310016	0.83252	2.558596
Prob.	0.000	0.270				0.467	0.757	0.405	0.011
BAFL		0.547934				0.50391	0.252909	-0.11367	0.698256
Std. Error		0.209826				0.608698	0.191563	0.238287	0.196623
z-Statistic		2.611375				0.82785	1.32024	-0.47702	3.551246
Prob.		0.009				0.408	0.187	0.633	0.000
	BOPKSE	C	AR(3)	MA(7)		C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)
BOP	1.683402	0.304433	0.330525	-0.23137		0.738915	0.149028	-0.48526	0.754496
Std. Error	0.147007	0.222121	0.085572	0.092524		0.324501	0.104711	0.124503	0.146957
z-Statistic	11.451	1.371	3.863	-2.501		2.277	1.423	-3.898	5.134
Prob.	0	0.1705	0.0001	0.0124		0.0228	0.1547	0.0001	0
DGKC		0.380858				0.38453	0.159791	0.08061	0.71474
Std. Error		0.209242				0.464076	0.16327	0.17262	0.158844
z-Statistic		1.820175				0.828593	0.978694	0.466978	4.499622
Prob.		0.069				0.407	0.328	0.641	0.000

ANNEXURE XV --CONTINUED

	KSE	C	AR(1)	MA(1)		C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)
ENGRO	0.76105	-0.10585				0.503258	0.129204	4.364359	0.087937
Std. Error	0.086553	0.087203				0.196625	0.154386	1.178266	0.039751
z-Statistic	8.792847	-1.21388				2.559479	0.83689	3.704053	2.212156
Prob.	0.000	0.225				0.011	0.403	0.000	0.027
FABL		-0.42447	-0.07101			251.7083	0.041899	-0.0735	0.562722
Std. Error		2.726524	0.027934			305.9595	0.112473	0.135738	0.529467
z-Statistic		-0.15568	-2.54212			0.822685	0.372525	-0.54145	1.062809
Prob.		0.876	0.011			0.411	0.710	0.588	0.288
HUBC		-0.19725				0.597469	0.572884	1.687586	0.075297
Std. Error		0.130376				0.236486	0.239634	0.889392	0.071651
z-Statistic		-1.51291				2.526444	2.390664	1.89746	1.050885
Prob.		0.130				0.012	0.017	0.058	0.293
IBFL		-0.64386				3.738698	0.062588	1.554438	0.145287
Std. Error		0.276075				1.185625	0.10412	0.651422	0.096928
z-Statistic		-2.33219				3.153357	0.601116	2.386224	1.498912
Prob.		0.020				0.002	0.548	0.017	0.134
		KAPCOKSE	C	AR(4)		C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)
KAPCO		0.39466	-0.08116	0.095898		1.003916	2.729655	-2.01862	0.014585
Std. Error		0.124118	0.186445	0.053712		0.227169	0.824868	1.011185	0.026872
z-Statistic		3.179704	-0.43532	1.785425		4.419257	3.309202	-1.99629	0.542748
Prob.		0.002	0.663	0.074		0.000	0.001	0.046	0.587
KESC		-0.2196				3.681294	1.163583	0.788954	-0.0006
Std. Error		0.273321				1.288959	0.317467	0.965221	0.047027
z-Statistic		-0.80346				2.856021	3.665208	0.817382	-0.01266
Prob.		0.422				0.004	0.000	0.414	0.990

ANNEXURE XV --CONTINUED

	KSE	C	AR(1)	MA(1)		C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)
LUCK		1.105244	0.42667			1.775291	0.024502	0.229258	0.554892
Std. Error		0.354328	0.348337			1.80495	0.064056	0.298205	0.400816
z-Statistic		3.119268	1.224877			0.983568	0.382514	0.768795	1.384404
Prob.		0.002	0.221			0.325	0.702	0.442	0.166
MLCF		0.5174				1.210144	0.046148	0.178029	0.616677
Std. Error		0.237589				1.314637	0.098023	0.232322	0.345182
z-Statistic		2.17771				0.920516	0.470785	0.7663	1.78653
Prob.		0.029				0.357	0.638	0.444	0.074
MCB		-0.22843	0.112153			3.360649	-4.66E-05	-0.07933	0.552718
Std. Error		0.390887	0.064382			4.244016	0.189222	0.189828	0.592758
z-Statistic		-0.58438	1.742			0.791856	-0.00025	-0.41791	0.932452
Prob.		0.559	0.082			0.428	1.000	0.676	0.351
NBP		0.293239				0.724651	0.932612	-1.01253	0.547953
Std. Error		0.188469				0.190389	0.265166	0.280116	0.055071
z-Statistic		1.555898				3.806151	3.517091	-3.61466	9.949976
Prob.		0.120				0.000	0.000	0.000	0.000
NML		1.455282	-0.32459	-0.25022		1.659646	0.28519	-0.30132	0.383734
Std. Error		0.211367	0.16812	0.13385		1.375093	0.071843	0.084672	0.444311
z-Statistic		6.885089	-1.93071	-1.86939		1.206934	3.969648	-3.55863	0.863661
Prob.		0.000	0.054	0.062		0.228	0.000	0.000	0.388
OGDC		1.357933	0.037474			0.091042	0.179151	0.232577	0.674541
Std. Error		0.118288	0.121114			0.114117	0.155316	0.320536	0.165053
z-Statistic		11.4799	0.309407			0.797799	1.153465	0.725587	4.086823
Prob.		0.000	0.757			0.425	0.249	0.468	0.000

ANNEXURE XV --CONTINUED

	KSE	C	AR(1)	MA(1)		C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)
PIA		1.369985	-0.30861	-0.44099		1.182972	0.152422	-0.14352	0.714263
Std. Error		0.243326	0.177227	0.109228		1.05281	0.151842	0.164565	0.234382
z-Statistic		5.630249	-1.74131	-4.03727		1.123633	1.003816	-0.87214	3.047433
Prob.		0.000	0.082	0.000		0.261	0.316	0.383	0.002
POIC		0.937111	0.210252			2.275999	0.346815	-0.10638	0.426289
Std. Error		0.324938	0.309714			2.709808	0.460739	0.435611	0.50724
z-Statistic		2.883972	0.678858			0.839911	0.752737	-0.2442	0.840409
Prob.		0.004	0.497			0.401	0.452	0.807	0.401
POL		0.037144				0.876849	0.533378	0.671717	0.116658
Std. Error		0.118262				0.266026	0.277043	0.541358	0.110373
z-Statistic		0.31408				3.296104	1.925257	1.240802	1.056944
Prob.		0.754				0.001	0.054	0.215	0.291
PSO		0.036955				0.80246	0.805428	-0.47399	0.363065
Std. Error		0.153404				0.350248	0.435552	0.381475	0.159731
z-Statistic		0.240899				2.291123	1.849213	-1.2425	2.272978
Prob.		0.810				0.022	0.064	0.214	0.023
PTCL		1.302808	-0.09719			0.012636	-0.21067	0.263076	1.060004
Std. Error		0.046478	0.069242			0.01069	0.047204	0.090982	0.045169
z-Statistic		28.03047	-1.40359			1.182106	-4.46288	2.89152	23.46755
Prob.		0.000	0.160			0.237	0.000	0.004	0.000
SNGP		1.441932	-0.15691			1.845716	-0.25106	0.237433	0.705863
Std. Error		0.330603	0.314548			1.437877	0.201053	0.194391	0.257714
z-Statistic		4.361523	-0.49885			1.28364	-1.24874	1.22142	2.738939
Prob.		0.000	0.618			0.199	0.212	0.222	0.006

ANNEXURE XV --CONTINUED

		C	AR (1)	MA (1)		C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)
SSGC		0.311824				0.336553	-0.15412	0.221111	0.984201
Std. Error		0.194706				0.104655	0.038458	0.082968	0.046721
z-Statistic		1.601512				3.215831	-4.00753	2.665026	21.06547
Prob.		0.109				0.001	0.000	0.008	0.000
TELE		-0.21749				0.003339	-0.08487	0.099786	1.066161
Std. Error		0.226918				0.068167	0.056498	0.139278	0.055076
z-Statistic		-0.95847				0.048984	-1.50209	0.716451	19.35784
Prob.		0.338				0.961	0.133	0.474	0.000
UBL		0.125559	0.082053			0.156492	-0.1742	0.339811	1.045282
Std. Error		0.282058	0.115642			0.171677	0.046169	0.154633	0.048971
z-Statistic		0.445156	0.709548			0.911552	-3.77309	2.197535	21.34508
Prob.		0.656	0.478			0.362	0.000	0.028	0.000

ANNEXURE XVI GARCH MODEL RESULTS FOR 200-DAY OBSERVATIONS FOR SSFs-LISTED STOCKS FOR POST-FUTUDRES PERIOD

		KSE	C	AR (1)	MA(1)		C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)
ACBL		1.010434	-0.11051		-0.24884		0.774434	0.092118	3.554895	0.236305
Std. Error		0.046714	0.086742		0.063795		0.244484	0.083412	0.975588	0.075834
z-Statistic		21.63034	-1.27399		-3.90058		3.167622	1.10438	3.643847	3.116084
Prob.		0.000	0.2027		0.0001		0.0015	0.2694	0.0003	0.0018
BAFL		1.214311	-0.0716				0.006286	-0.01426	-0.01514	1.026989
Std. Error		0.138196	0.192574				0.012816	0.004149	0.007376	0.004222
z-Statistic		8.78687	-0.3718				0.490488	-3.43654	-2.05282	243.2208
Prob.		0.000	0.71				0.6238	0.0006	0.0401	0
		KSE	C	AR(5)			C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)
DSFL		1.224043	-0.29261	0.114675			0.756237	0.203528	0.776901	0.402274
Std. Error		0.0826	0.142874	0.059309			0.336065	0.066783	0.327307	0.128261
z-Statistic		14.81889	-2.048	1.933506			2.250271	3.047602	2.373619	3.13636
Prob.		0.000	0.0406	0.0532			0.0244	0.0023	0.0176	0.0017
DGKC			0.453034				0.53643	0.163684	-0.05284	0.808623
Std. Error			0.191482				0.392006	0.075318	0.11159	0.070291
z-Statistic			2.365932				1.368421	2.17324	-0.47353	11.50397
Prob.			0.018				0.1712	0.0298	0.6358	0.000
ENGRO		0.008306	-0.00277				2.75E-05	0.015993	1.240898	0.548344
Std. Error		0.000444	0.000765				8.21E-06	0.051066	0.296426	0.064886
z-Statistic		18.69427	-3.61777				3.348683	0.313181	4.186195	8.450866
Prob.		0.000	0.0003				0.0008	0.7541	0.000	0.000
			C	AR(5)	MA(5)		C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)
FABL			0.009899	0.466544	-0.49039		0.73112	0.519635	-0.53415	0.74196
Std. Error			0.19504	0.202234	0.207129		0.41394	0.185529	0.171514	0.09595
z-Statistic			0.050753	2.306955	-2.36757		1.766247	2.800824	-3.1143	7.732808
Prob.			0.9595	0.0211	0.0179		0.0774	0.0051	0.0018	0

ANNEXURE XVI-- CONTINUED

		KSE	C	AR (1)	MA(1)		C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)
HUBC			0.259831	-0.07499			0.553037	0.575045	-0.11972	0.486153
Std. Error			0.105146	0.107649			0.179958	0.130304	0.229765	0.075725
z-Statistic			2.471158	-0.6966			3.073137	4.413104	-0.52106	6.419997
Prob.			0.0135	0.4861			0.0021	0	0.6023	0
IBLF			0.211339				0.929476	0.184953	-0.09354	0.64757
Std. Error			0.148346				0.551964	0.096301	0.124763	0.164964
z-Statistic			1.424634				1.683945	1.920566	-0.74973	3.925527
Prob.			0.1543				0.0922	0.0548	0.4534	0.0001
KAPCO			0.083904				0.553002	0.430071	0.274176	0.328311
Std. Error			0.07258				0.102172	0.154144	0.239259	0.096344
z-Statistic			1.156014				5.412442	2.790068	1.145937	3.407713
Prob.			0.2477				0	0.0053	0.2518	0.0007
			C	AR(1)	AR(2)		C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)
KESC			-0.16959	-0.26659	-0.16336		2.618621	0.280621	0.209751	0.200827
Std. Error			0.113047	0.084337	0.081885		0.975949	0.151936	0.29141	0.222237
z-Statistic			-1.50013	-3.16107	-1.99493		2.683154	1.84697	0.719779	0.903662
Prob.			0.1336	0.0016	0.0461		0.0073	0.0648	0.4717	0.3662
			C				C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)
LUCK			0.204871				0.239298	0.27031	-0.00478	0.753588
Std. Error			0.160889				0.138113	0.08911	0.148656	0.063131
z-Statistic			1.273362				1.73263	3.033438	-0.03216	11.93681
Prob.			0.2029				0.0832	0.0024	0.9743	0
			C	AR(2)			C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)
MLCF			0.223321	-0.20745			0.433783	0.012487	0.154913	0.858372
Std. Error			0.155286	0.077152			0.361406	0.053866	0.108038	0.082616
z-Statistic			1.438125	-2.68881			1.200265	0.231817	1.433875	10.38985
Prob.			0.1504	0.0072			0.23	0.8167	0.1516	0

ANNEXURE XVI CONTINUED

		KSE	C	AR (1)	MA(1)		C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)
MCB			0.15832				2.204975	0.47925	0.03896	0.243445
Std. Error			0.168076				0.577113	0.208433	0.292632	0.145585
z-Statistic			0.941954				3.8207	2.2993	0.133138	1.672184
Prob.			0.3462				0.0001	0.0215	0.8941	0.0945
NBP			0.633722				1.464469	0.167489	0.486374	0.430468
Std. Error			0.155025				0.573876	0.105126	0.251651	0.115594
z-Statistic			4.087878				2.551892	1.593225	1.932729	3.723959
Prob.			0.000				0.0107	0.1111	0.0533	0.0002
		KSE	C	AR(1)	MA(1)		C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)
NML		1.345371	-0.16256	-0.58584	0.831066		6.158635	0.441882	-0.2929	-0.2021
Std. Error		0.137767	0.208407	0.104273	0.061361		1.157934	0.207046	0.218326	0.101379
z-Statistic		9.765562	-0.78003	-5.61839	13.54397		5.318642	2.134218	-1.34155	-1.99349
Prob.		0.000	0.4354	0.000	0.000		0.000	0.0328	0.1797	0.0462
			C				C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)
OGDC			0.243227				0.390429	0.157008	0.109113	0.750173
Std. Error			0.162937				0.242679	0.097658	0.138693	0.081291
z-Statistic			1.492763				1.608831	1.60774	0.786726	9.22828
Prob.			0.1355				0.1077	0.1079	0.4314	0
OGDC			0.403794				0.8825	0.101227	0.102336	0.806428
Std. Error			0.271984				0.6001	0.063798	0.120918	0.093412
z-Statistic			1.484624				1.470589	1.586686	0.84633	8.63303
Prob.			0.1376				0.1414	0.1126	0.3974	0
POIC			-0.00115				0.923172	0.248067	-0.12351	0.719178
Std. Error			0.208148				0.728251	0.110577	0.114035	0.092392
z-Statistic			-0.00552				1.267655	2.243394	-1.08304	7.783982
Prob.			0.9956				0.2049	0.0249	0.2788	0

ANNEXURE XVI CONTINUED

		KSE	C	AR (1)	MA(1)		C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)
POL			0.271051				0.173373	0.004913	0.18843	0.890792
Std. Error			0.145277				0.091586	0.051968	0.084783	0.03636
z-Statistic			1.865749				1.893009	0.094532	2.222507	24.49934
Prob.			0.0621				0.0584	0.9247	0.0262	0.000
PSO			0.215819	-0.24382			1.034751	0.329343	0.239567	0.46817
Std. Error			0.120861	0.08001			0.514895	0.1539	0.267426	0.139698
z-Statistic			1.785677	-3.04738			2.009636	2.139982	0.895824	3.351292
Prob.			0.0742	0.0023			0.0445	0.0324	0.3703	0.0008
			C	MA(2)			C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)
PTCL			0.351412	-0.22789			0.521031	0.519981	0.037115	0.500949
Std. Error			0.092614	0.101997			0.246998	0.144959	0.227023	0.087927
z-Statistic			3.794387	-2.23429			2.109457	3.587088	0.163486	5.697319
Prob.			0.0001	0.0255			0.0349	0.0003	0.8701	0
SNGP			0.313155				2.330049	0.51168	0.057803	0.06316
Std. Error			0.131276				0.629646	0.213178	0.321198	0.129443
z-Statistic			2.385471				3.700569	2.400244	0.179961	0.48794
Prob.			0.0171				0.0002	0.0164	0.8572	0.6256
		KSE	C	AR(1)			C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)
SSGC		1.154211	-0.05798	0.194541			0.456542	0.020262	0.070513	0.839959
Std. Error		0.092631	0.188013	0.082001			0.400073	0.052565	0.087379	0.124042
z-Statistic		12.46029	-0.30838	2.372426			1.141145	0.385477	0.806978	6.771593
Prob.		0.000	0.7578	0.0177			0.2538	0.6999	0.4197	0.000

ANNEXURE XVI CONTINUED

		KSE	C	AR (1)	MA(1)		C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)
TELE			0.050847				3.74139	0.216562	0.032042	0.501731
Std. Error			0.258933				2.712949	0.137297	0.187988	0.25364
z-Statistic			0.196371				1.379086	1.577332	0.170448	1.978121
Prob.			0.8443				0.1679	0.1147	0.8647	0.0479
			C				C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)
UBL			0.316358				3.210905	0.677538	0.197111	0.002974
Std. Error			0.160284				0.536217	0.345151	0.373483	0.048321
z-Statistic			1.973733				5.988067	1.963018	0.527762	0.061556
Prob.			0.0484				0.000	0.0496	0.5977	0.9509
BOP		1.17718	0.052441				1.241648	0.242246	1.751666	0.088795
Std. Error		0.035414	0.122336				0.238816	0.10834	0.360785	0.079952
z-Statistic		33.24033	0.428662				5.19918	2.23598	4.855157	1.110604
Prob.		0.000	0.6682				0.000	0.0254	0.000	0.2667

ANNEXURE XVI I GARCH MODEL RESULTS FOR 200-DAY OBSERVATIONS FOR SSFs-LISTED STOCKS FOR PRE-FUTUDRES PERIOD

	KSE	C	AR(1)	MA(1)		C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)
ACBL		0.39203				0.288378	0.106197	-0.15053	0.914021
Std. Error		0.161766				0.138671	0.046458	0.051011	0.045762
z-Statistic		2.423442				2.079577	2.285883	-2.9509	19.97339
Prob.		0.0154				0.0376	0.0223	0.0032	0
BAFL		0.219466				1.210216	0.372233	-0.02304	0.455359
Std. Error		0.152168				0.665919	0.204182	0.24229	0.188468
z-Statistic		1.44226				1.817362	1.82304	-0.09507	2.416106
Prob.		0.1492				0.0692	0.0683	0.9243	0.0157
DSFL		-0.20182				0.920359	0.101792	-0.14325	0.796743
Std. Error		0.173754				0.497917	0.045807	0.072258	0.103484
z-Statistic		-1.16151				1.848417	2.222182	-1.98243	7.699211
Prob.		0.2454				0.0645	0.0263	0.0474	0
DGKC	1.498648	-0.02262				0.290879	0.133743	0.008226	0.797971
Std. Error	0.108282	0.139709				0.27947	0.100202	0.127416	0.123042
z-Statistic	13.84023	-0.16193				1.040824	1.334738	0.06456	6.485337
Prob.	0	0.8714				0.298	0.182	0.9485	0
ENGRO	0.008981	-0.00063				6.79E-05	0.353356	2.221157	0.173792
Std. Error	0.000541	0.000877				1.90E-05	0.134279	0.423882	0.071247
z-Statistic	16.58707	-0.71449				3.583365	2.631503	5.240033	2.439277
Prob.	0	0.4749				0.0003	0.0085	0	0.0147
FABL	0.539116	-0.34374				1.044342	0.444295	103.073	0.141644
Std. Error	0.070265	0.07816				0.339685	0.195272	21.02066	0.016131
z-Statistic	7.672594	-4.39789				3.074444	2.275263	4.903414	8.78061
Prob.	0	0				0.0021	0.0229	0	0

ANNEXURE XVII CONTINUED

	KSE	C	AR(1)	MA(1)		C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)
HUBC	1.15716	0.056394				0.446325	0.32565	-0.12812	0.618191
Std. Error	0.075563	0.109762				0.209345	0.106646	0.122957	0.1365
z-Statistic	15.31376	0.513779				2.132006	3.053553	-1.04202	4.528875
Prob.	0	0.6074				0.033	0.0023	0.2974	0
IBFL		-0.4875	-0.14328			2.70532	0.10291	3.260365	0.042312
Std. Error		0.122952	0.071037			0.419258	0.103448	0.545099	0.032409
z-Statistic		-3.965	-2.01704			6.452637	0.994802	5.98123	1.305548
Prob.		0.0001	0.0437			0	0.3198	0	0.1917
KAPCO	0.592247	-0.11732		-0.26877		0.053266	0.667803	0.01089	0.578815
Std. Error	0.06075	0.06082		0.057556		0.044016	0.106303	0.239658	0.059356
z-Statistic	9.74893	-1.92892		-4.66975		1.21016	6.282069	0.04544	9.751611
Prob.	0	0.0537		0		0.2262	0	0.9638	0
KESC	0.710124	-0.40227				3.411345	0.437662	0.636761	0.2039
Std. Error	0.141769	0.226532				1.032839	0.124067	0.37501	0.090557
z-Statistic	5.009032	-1.77577				3.302881	3.527624	1.697985	2.251626
Prob.	0	0.0758				0.001	0.0004	0.0895	0.0243
LUCK	1.591855	0.130116				0.407326	0.083998	-0.13877	0.902091
Std. Error	0.128345	0.170943				0.38006	0.04846	0.064883	0.081061
z-Statistic	12.40294	0.761168				1.071742	1.733352	-2.1387	11.1286
Prob.	0	0.4466				0.2838	0.083	0.0325	0
MLCF	1.364229	0.078134				0.478513	0.053657	0.240378	0.779644
Std. Error	0.123669	0.166892				0.411031	0.047064	0.143783	0.1045
z-Statistic	11.03129	0.468171				1.164177	1.140106	1.671816	7.460684
Prob.	0	0.6397				0.2444	0.2542	0.0946	0

ANNEXURE XVII CONTINUED

	KSE	C	AR(1)	MA(1)		C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)
MCB	1.094728	-0.00379				0.833949	0.174964	-0.21257	0.781152
Std. Error	0.121955	0.177359				0.308859	0.055965	0.058598	0.080158
z-Statistic	8.976484	-0.02138				2.7001	3.126336	-3.62754	9.745139
Prob.	0	0.9829				0.0069	0.0018	0.0003	0
NBP	1.013659	0.040024				0.863354	0.917316	0.374339	0.091679
Std. Error	0.050939	0.103917				0.160344	0.188105	0.522185	0.046106
z-Statistic	19.89955	0.38515				5.384396	4.87661	0.716871	1.988454
Prob.	0	0.7001				0	0	0.4735	0.0468
NML		-0.10286				1.516762	0.684969	-0.71233	0.576145
Std. Error		0.166983				0.385223	0.106899	0.109072	0.06467
z-Statistic		-0.61597				3.937364	6.407638	-6.5308	8.908927
Prob.		0.5379				0.0001	0	0	0
OGDC		0.244188				0.196423	0.06368	0.11807	0.866887
Std. Error		0.19006				0.165573	0.055423	0.08182	0.067538
z-Statistic		1.284793				1.186324	1.148983	1.44304	12.83561
Prob.		0.1989				0.2355	0.2506	0.149	0
PIA		-0.3696	-0.17636			2.846085	0.209498	0.5525	0.385434
Std. Error		0.179876	0.073327			0.998009	0.108389	0.218016	0.115679
z-Statistic		-2.05477	-2.40505			2.851764	1.932838	2.534215	3.331918
Prob.		0.0399	0.0162			0.0043	0.0533	0.0113	0.0009
POIC	0.838585	-0.05003				1.041048	0.362645	-0.01367	0.460439
Std. Error	0.082601	0.149129				0.629103	0.207632	0.266166	0.218678
z-Statistic	10.15221	-0.33548				1.654813	1.746573	-0.05136	2.105561
Prob.	0	0.7373				0.098	0.0807	0.959	0.0352

ANNEXURE XVII CONTINUED

	KSE	C	AR(1)	MA(1)		C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)
POL		-0.06475				0.950393	0.191048	3.137236	0.355691
Std. Error		0.115196				0.276117	0.088671	0.358493	0.050549
z-Statistic		-0.56211				3.441997	2.154578	8.751167	7.036528
Prob.		0.574				0.0006	0.0312	0	0
PSO	0.911108	-0.14302				0.092079	0.503377	-0.21531	0.636213
Std. Error	0.05905	0.070402				0.045173	0.135419	0.135013	0.052241
z-Statistic	15.42939	-2.03142				2.038351	3.717176	-1.59471	12.1784
Prob.	0	0.0422				0.0415	0.0002	0.1108	0
PTCL		-0.15083				0.207308	0.241208	-0.20964	0.806141
Std. Error		0.106029				0.107121	0.084165	0.094085	0.071913
z-Statistic		-1.42249				1.935267	2.865901	-2.22821	11.20995
Prob.		0.1549				0.053	0.0042	0.0259	0
SNGP	1.560332	-0.15224		-0.17527		1.136887	0.046025	-0.06381	0.711704
Std. Error	0.142212	0.155143		0.116948		1.115392	0.143702	0.149423	0.27975
z-Statistic	10.97185	-0.98128		-1.49872		1.019272	0.320278	-0.42701	2.544074
Prob.	0	0.3265		0.1339		0.3081	0.7488	0.6694	0.011
			AR(1)	AR(2)					
SSGC		0.088591	0.254593	-0.16674		3.296822	0.071885	0.477624	0.332251
Std. Error		0.222705	0.078186	0.073294		1.421038	0.085975	0.281242	0.236784
z-Statistic		0.397797	3.256228	-2.27497		2.320009	0.836112	1.698267	1.403183
Prob.		0.6908	0.0011	0.0229		0.0203	0.4031	0.0895	0.1606
TELE	1.038312	-0.31366				0.121499	0.072419	0.481799	0.774057
z-Statistic	9.031953	-2.66225				1.250804	1.222901	2.396296	9.671632
Prob.	0	0.0078				0.211	0.2214	0.0166	0
UBL		0.296712	0.162689			2.808946	0.087057	0.330938	0.398396
z-Statistic		1.28261	2.033623			2.15613	1.052567	1.643401	1.685428
Prob.		0.1996	0.042			0.0311	0.2925	0.1003	0.0919

ANNEXURE XVIII GARCH MODEL RESULTS FOR 500-DAY OBSERVATIONS FOR SSFs-LISTED STOCKS FOR POST-FUTUDRES PERIOD

	KSE	C		C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)	AR(1)	MA(1)			
BOP	1.140713	-0.00062		8.22E-05	1.184419	-0.44608	0.355034					
Z-Stat	30.03617	-1.13099		7.161183	7.172625	-2.69314	6.945234					
Prob.	0.000	0.258		0.000	0.000	0.007	0.000					
DEWAN	0.324542	0.000508		0.00014	0.205384	0.231058	0.568224					
Z-Stat	6.208898	0.448832		4.649542	3.092928	1.735622	9.327411					
Prob.	0.000	0.654		0.000	0.002	0.083	0.000					
DGKC	1.266103	-0.00037		3.10E-05	0.154808	0.291719	0.682042					
Z-Stat	20.52307	-0.38016		2.527299	2.382468	3.270456	10.77817					
Prob.	0.000	0.704		0.012	0.017	0.001	0.000					
ENGRO	0.934852	-0.00219		2.44E-05	0.349456	0.307206	0.568866		-0.08501			
Z-Stat	27.58553	-3.88862		4.528763	8.142051	2.888122	17.27593		-2.01521			
Prob.	0.000	0.000		0.000	0.000	0.004	0.000		0.044			
FABL	1.028507	-0.00036		3.49E-05	0.342362	-0.2715	0.765451		0.120681			
Z-Stat	20.10684	-0.35238		3.477778	5.449952	-3.99251	22.00552		2.169992			
Prob.	0.000	0.725		0.001	0.000	0.000	0.000		0.030			
HUBC	1.166583	-0.00145		4.26E-07	0.005143	-0.01388	1.005521					
Z-Stat	28.55436	-1.56173		1.179737	1.870867	-3.67332	422.9867					
Prob.	0.000	0.118		0.238	0.061	0.000	0.000					
IBFL	1.066805	-0.00061		0.000268	0.087953	0.07311						
Z-Stat	24.62656	-0.73498		18.04576	1.959235	0.747331						
Prob.	0.000	0.462		0.000	0.050	0.455						

ANNEXURE XVIII—CONTINUED

	KSE	C		C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)	AR(1)	MA(1)			
LUCK	0.901385	2.13E-05		3.20E-05	0.134646	-0.022	0.821369					
Z-Stat	14.36537	0.018151		2.562094	3.1595	-0.3519	19.41825					
Prob.	0.000	0.986		0.010	0.002	0.725	0.000					
MLCF	9.584131	-0.00246		0.000372	0.122917	0.093799						
Z-Stat	15.22022	-1.9452		20.01816	1.62411	0.723547						
Prob.	0.000	0.052		0.000	0.104	0.469						
MCB	1.05463	-0.00117		0.000182	0.159786	0.603549	0.198636	-0.88045	0.84988			
Z-Stat	34.91247	-1.55883		7.576768	2.776132	3.781372	2.394102	-4.64865	4.10693			
Prob.	0.000	0.119		0.000	0.006	0.000	0.017	0.000	0.000			
NBP	0.000922	0.82671		2.69E-05	0.337296	0.660664	0.469363	-0.60772	0.449051	-0.13092	0.663621	-0.51643
	1.614821	23.99964		2.743516	3.097874	3.432591	7.020213	-15.6016	10.0214	-3.92963	30.68497	-12.1778
	0.106	0.000		0.006	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000
NML	1.46667	-0.00226		5.36E-05	0.025572	0.124697	0.825423		0.118612			
	20.01227	-1.90655		2.400968	1.225351	1.993866	12.96774		2.398602			
	0.000	0.057		0.016	0.220	0.046	0.000		0.017			
OGDC	1.131404	-4.98E-05		1.54E-05	0.402187	0.309422	0.520238		0.147107			
	34.87345	-0.08588		4.568501	5.177425	1.629277	9.943711		2.11174			
	0.000	0.932		0.000	0.000	0.103	0.000		0.035			

ANNEXURE XVIII—CONTINUED

	KSE	C		C	ARCH(1)	(RESID<0)*ARCH(1)	GARCH(1)	AR(1)	MA(1)			
PIA	1.829431	-0.00216		1.76E-05	0.155621	0.147129	0.824594	0.709108	-0.81781			
	30.86382	-2.32318		1.478471	4.39255	2.429661	29.40545	5.663196	-8.21232			
	0.000	0.020		0.139	0.000	0.015	0.000	0.000	0.000			
POL	0.800385	0.000321		4.79E-06	0.052914	0.240479	0.847132		-0.12524			
	21.58162	0.584585		2.512265	2.905108	3.87327	33.88202		-2.06668			
	0.000	0.559		0.012	0.004	0.000	0.000		0.039			
PSO	1.27131	-0.0009		5.91E-05	0.530452	-0.37388	0.549779					
	31.78152	-1.12927		6.033317	7.12239	-4.52333	13.1193					
	0.000	0.259		0.000	0.000	0.000	0.000					
PTCL	1.255624	-0.00123		1.54E-05	0.46819	0.578212	0.440815	0.915715	-0.95052			
	59.20086	-5.22229		4.307089	7.512395	3.745273	8.344992	25.84581	-37.7537			
	0.000	0.000		0.000	0.000	0.000	0.000	0.000	0.000			
SSGC	1.068401	-0.00148		1.14E-05	0.116707	0.071509	0.82841					
	25.52041	-2.20955		2.432309	4.250728	1.606153	30.5827					
	0.000	0.027		0.015	0.000	0.108	0.000					
SNGP	1.319175	-0.00076		7.53E-05	0.184363	0.993232	0.34699	-0.60727	0.486707			
	40.69976	-1.32326		6.4121	2.834427	4.767858	5.816809	-3.43067	2.323211			
	0.000	0.186		0.000	0.005	0.000	0.000	0.001	0.020			
TELE	0.931408	-0.00469		0.000408	0.356995	1.628667			0.08871			
	20.30093	-3.77269		9.880923	3.599009	7.882125			1.894843			
	0.000	0.000		0.000	0.000	0.000			0.058			

ANNEXURE XIX SYSTEMATIC RISK ESTIMATES FOR CONTROL GROUP STOCKS 6 MONTHS TIME USING VARYING MARKET MODEL APPROACH

	C	D1	D2	D1*D2	KSE	D1*KSE	D2*KSE	D1*D2*KSE	AR(1)	
BANKALHABIB	-0.001824	0.013049	0.001927	-0.012299	0.869219	-0.880257	-0.07015	0.07857		
Std. Error	0.005865	0.008296	0.008765	0.012535	0.635616	0.635636	0.90901	0.909041		
t-Statistic	-0.310998	1.572936	0.219875	-0.981204	1.367522	-1.384844	-0.077172	0.086432		
Prob.	0.7561	0.1174	0.8262	0.3277	0.1731	0.1677	0.9386	0.9312		
CRESENT	0.000505	-0.002748	0.000155	0.010348	1.064313	-1.058491	0.851916	-0.856716	-0.20386	
Std. Error	0.006091	0.008428	0.009505	0.013423	0.680045	0.680001	0.956604	0.956649	0.074037	
t-Statistic	0.0829	-0.326008	0.016319	0.770873	1.565063	-1.556601	0.890563	-0.895539	-2.75344	
Prob.	0.934	0.7448	0.987	0.4417	0.1192	0.1212	0.3743	0.3716	0.0065	
DAWOOD	-0.000159	-0.009326	-0.001999	0.019154	0.575274	-0.562645	-0.634518	0.632549		
Std. Error	0.006865	0.009711	0.01026	0.014672	0.744018	0.744041	1.064038	1.064074		
t-Statistic	-0.023104	-0.960385	-0.194827	1.305482	0.773199	-0.756202	-0.596331	0.59446		
Prob.	0.9816	0.3381	0.8457	0.1933	0.4404	0.4505	0.5517	0.5529		
GARTON	0.000178	0.004546	0.005305	-0.00818	0.012492	-0.009769	0.430078	-0.427282	0.127131	
Std. Error	0.006035	0.008642	0.008634	0.012477	0.634476	0.634493	0.911627	0.911654	0.074279	
t-Statistic	0.029478	0.526001	0.614404	-0.655615	0.019689	-0.015396	0.471769	-0.468688	1.711532	
Prob.	0.9765	0.5995	0.5397	0.5129	0.9843	0.9877	0.6376	0.6398	0.0886	
									AR(3)	
KOHINOOR	-0.002912	-4.13E-05	0.006593	-0.001037	0.765915	-0.753806	0.04163	-0.043225	-0.13793	
Std. Error	0.004371	0.006143	0.006598	0.009482	0.488163	0.488212	0.702336	0.702409	0.073104	
t-Statistic	-0.666184	-0.006724	0.999237	-0.109373	1.568974	-1.544013	0.059274	-0.061538	-1.88668	
Prob.	0.5061	0.9946	0.319	0.913	0.1183	0.1243	0.9528	0.951	0.0607	

ANNEXURE XIX—CONTINUED

	C	D1	D2	D1*D2	KSE2001	D1*KSE2001	D2*KSE2001	D1*D2*KSE2	AR(4)	AR(6)
PKDT2001POST	-0.006372	0.008855	0.004783	0.007867	0.337405	-0.333757	-0.044542	0.059811	-0.19269	-0.24056
Std. Error	0.004875	0.006773	0.007738	0.01124	0.553158	0.553191	0.818134	0.818117	0.071236	0.073579
t-Statistic	-1.307133	1.307319	0.618159	0.699923	0.60996	-0.60333	-0.054443	0.073108	-2.70495	-3.26946
Prob.	0.1928	0.1927	0.5372	0.4849	0.5426	0.547	0.9566	0.9418	0.0075	0.0013
									AR(13)	
PNSC	-0.005331	0.010213	0.025875	-0.026963	1.036422	-1.025681	1.859908	-1.851357	-0.2319	
Std. Error	0.008885	0.012374	0.013381	0.019748	0.98843	0.98818	1.426055	1.426179	0.079101	
t-Statistic	-0.600058	0.825404	1.933723	-1.36536	1.048554	-1.03795	1.304233	-1.298123	-2.93166	
Prob.	0.5492	0.4102	0.0547	0.1739	0.2958	0.3007	0.1938	0.1959	0.0038	
									AR(1)	
SSGC	-0.002559	0.003479	0.002303	-0.008823	1.201494	-1.190443	-0.358018	0.349619	0.130266	
Std. Error	0.003448	0.004951	0.004927	0.00711	0.362327	0.362337	0.520698	0.520712	0.072512	
t-Statistic	-0.742192	0.702573	0.467342	-1.240847	3.316048	-3.285457	-0.687573	0.671425	1.796479	
Prob.	0.4589	0.4832	0.6408	0.2162	0.0011	0.0012	0.4926	0.5028	0.074	
									AR(1)	AR(4)
TELE	-0.001605	-0.001415	0.006707	-0.004915	1.418409	-1.407495	1.098583	-1.10351	0.117235	-0.24211
Std. Error	0.004789	0.00667	0.007152	0.010215	0.526447	0.526444	0.780885	0.780898	0.070868	0.071151
t-Statistic	-0.33511	-0.212161	0.937786	-0.481111	2.694303	-2.673589	1.406843	-1.413131	1.654264	-3.40267
Prob.	0.7379	0.8322	0.3496	0.631	0.0077	0.0082	0.1611	0.1593	0.0998	0.0008
ATK CMNT	0.002737	-0.002535	-0.004012	-0.00111	1.18312	-0.032208	0.001546	-0.456013	0.095584	
Std. Error	0.005744	0.008455	0.008258	0.011959	0.669448	0.793389	0.891451	1.036134	0.074427	
t-Statistic	0.476573	-0.299798	-0.485817	-0.092802	1.767307	-0.040595	0.001735	-0.44011	1.284262	
Prob.	0.6342	0.7647	0.6277	0.9262	0.0788	0.9677	0.9986	0.6604	0.2006	

ANNEXURE XIX—CONTINUED

	C	D1	D2	D1*D2	KSE2004	D1*KSE2004	D2*KSE2004	D1*D2*KSE2	AR(1)	AR(2)
ATKREF	0.004631	-0.008005	-0.002706	0.001884	-0.23939	1.257804	0.994661	-1.033622		
Std. Error	0.004445	0.00661	0.006677	0.009661	0.534049	0.63802	0.700765	0.817338		
t-Statistic	1.0419	-1.211037	-0.405248	0.19502	-0.44826	1.971417	1.419394	-1.26462		
Prob.	0.2988	0.2274	0.6857	0.8456	0.6545	0.0501	0.1574	0.2075		
CHRT CMNT	0.004214	-0.002561	-0.0049	0.001178	0.957745	-0.436349	0.112471	0.183018	0.161013	0.095142
Std. Error	0.005195	0.00764	0.007008	0.010176	0.566116	0.674254	0.758694	0.89441	0.074706	0.074012
t-Statistic	0.81103	-0.335184	-0.699224	0.11577	1.691783	-0.647158	0.148243	0.204624	2.155289	1.285507
Prob.	0.4184	0.7379	0.4853	0.908	0.0923	0.5183	0.8823	0.8381	0.0324	0.2002
PKDT2004	0.00256	-0.004412	-0.000963	0.009706	0.481777	-0.159814	-0.003204	0.241408		
Std. Error	0.00536	0.007971	0.008052	0.011651	0.644026	0.769407	0.845072	0.985651		
t-Statistic	0.477632	-0.553427	-0.119552	0.83307	0.748072	-0.207711	-0.003792	0.244922		
Prob.	0.6335	0.5806	0.905	0.4058	0.4553	0.8357	0.997	0.8068		
SONERI	-0.000103	0.004257	-0.000141	-0.002735	0.676985	-1.150062	-0.309299	1.402562		
Std. Error	0.00701	0.010425	0.01053	0.015236	0.84223	1.006198	1.105151	1.288994		
t-Statistic	-0.014638	0.408325	-0.013352	-0.179497	0.8038	-1.142977	-0.279871	1.088106		
Prob.	0.9883	0.6835	0.9894	0.8577	0.4225	0.2545	0.7799	0.2779		
									AR(1)	AR(5)
ALLIED	0.010001	-0.006336	0.003258	-0.008277	-0.14091	0.830213	1.048807	-1.265039	0.323333	-0.17237
Std. Error	0.004564	0.006329	0.006429	0.008802	0.454714	0.564148	0.691796	0.83139	0.069583	0.069579
t-Statistic	2.191418	-1.000999	0.506787	-0.940398	-0.3099	1.471624	1.516063	-1.521595	4.646746	-2.47736
Prob.	0.0297	0.3181	0.6129	0.3482	0.757	0.1428	0.1312	0.1298	0	0.0141

ANNEXURE XIX—CONTINUED

	C	D1	D2	D1*D2	KSE2006	D1*KSE2006	D2*KSE2006	D1*D2*KSE	AR(1)	AR(2)
FECTO	0.001922	-0.007359	0.019866	-0.014057	1.423362	-0.595523	-0.457587	0.256543		
Std. Error	0.004918	0.006763	0.007709	0.010284	0.51298	0.643422	0.712018	0.863425		
t-Statistic	0.39075	-1.088209	2.576985	-1.366862	2.774691	-0.925557	-0.642662	0.297122		
Prob.	0.6964	0.2779	0.0107	0.1733	0.0061	0.3558	0.5212	0.7667		
BNKALHBIB	0.009256	-0.005579	-0.01765	0.003397	0.055204	-0.159787	-0.058408	-1.104098		
Std. Error	0.007322	0.010069	0.011477	0.015311	0.763747	0.957954	1.060084	1.285505		
t-Statistic	1.264083	-0.554088	-1.537788	0.221854	0.07228	-0.1668	-0.055098	-0.858882		
Prob.	0.2077	0.5802	0.1257	0.8247	0.9425	0.8677	0.9561	0.3915		
KOHTCMNT	0.002971	-0.003962	0.022042	-0.021193	1.271038	-0.617235	3.788562	-3.740529	0.227579	-0.21141
Std. Error	0.006264	0.008509	0.009255	0.012397	0.66049	0.8092	0.93293	1.109699	0.072685	0.071142
t-Statistic	0.474286	-0.465629	2.381634	-1.70956	1.924386	-0.762771	4.060931	-3.37076	3.131042	-2.9716
Prob.	0.6358	0.642	0.0182	0.089	0.0558	0.4466	0.0001	0.0009	0.002	0.0033
KOHNOOR2006	-0.002171	-0.00214	0.009447	-0.007544	0.609582	0.083978	0.429625	-0.661038		
Std. Error	0.003743	0.005147	0.005867	0.007827	0.390445	0.489727	0.541938	0.657179		
t-Statistic	-0.580065	-0.415663	1.610075	-0.963768	1.56125	0.171479	0.792756	-1.005873		
Prob.	0.5626	0.6781	0.109	0.3364	0.1201	0.864	0.4289	0.3157		
SITARA	0.007129	-0.00405	-0.005999	0.004614	-0.54051	1.089795	0.908728	-0.87693	0.122104	
Std. Error	0.005516	0.007585	0.008155	0.010866	0.560683	0.697994	0.801876	0.965802	0.072156	
t-Statistic	1.292367	-0.533982	-0.735637	0.42464	-0.96401	1.561324	1.133253	-0.907982	1.692214	
Prob.	0.1978	0.594	0.4629	0.6716	0.3363	0.1201	0.2585	0.365	0.0922	

ANNEXURE XX SYSTEMATIC RISK ESTIMATES FOR CONTROL GROUP STOCKS 1-YEAR TIME USING VARYING MARKET MODEL APPROACH

	C	D1	D2	D1*D2	KSE2001	D1*KSE	D2*KSE1	D1*D2*KSE1	AR(1)	
BNKHB2001	0.000552	0.00474	-0.002	-0.0002	0.258822	-0.26176	-0.0836	0.0876		
Std. Error	0.003394	0.0047	0.00508	0.00733	0.275401	0.275411	0.434196	0.43421		
t-Statistic	0.16269	1.0087	-0.3918	-0.0283	0.9398	-0.95045	-0.19254	0.20175		
Prob.	0.8708	0.3137	0.6954	0.9774	0.3479	0.3425	0.8474	0.8402		
CRESENT	0.004668	-0.00401	-0.0063	0.01422	0.768204	-0.76845	0.510837	-0.50696	-0.1141	
t-Statistic	1.140818	-0.71164	-0.9978	1.57108	2.261204	-2.26184	0.96199	-0.95465	-2.212	
Prob.	0.2546	0.4771	0.319	0.117	0.0243	0.0243	0.3367	0.3403	0.0275	
DAWOOD	0.002781	-0.00536	-0.0053	0.01033	0.348233	-0.34023	-0.11191	0.11004		
Std. Error	0.004217	0.00584	0.00632	0.0091	0.342192	0.342205	0.539499	0.53952		
t-Statistic	0.659508	-0.91669	-0.8335	1.13507	1.017651	-0.99422	-0.20744	0.20396		
Prob.	0.51	0.3599	0.4051	0.257	0.3095	0.3207	0.8358	0.8385		
KOHNOOR	-0.00403	0.005	0.00432	-0.0031	0.72012	-0.71191	-0.19455	0.19461	-0.0987	
Std. Error	0.003342	0.0046	0.00513	0.00737	0.278064	0.27808	0.432213	0.43223	0.05085	
t-Statistic	-1.20565	1.08607	0.84199	-0.4135	2.589765	-2.5601	-0.45013	0.45025	-1.9416	
Prob.	0.2287	0.2781	0.4003	0.6795	0.01	0.0108	0.6529	0.6528	0.0529	
GARTON	0.015624	-0.01268	-0.0139	0.01066	-1.40353	1.406088	2.029709	-2.02694	-0.1142	
t-Statistic	3.150314	-1.86145	-1.821	0.97016	-3.41645	3.422545	3.164247	-3.15983	-2.2509	
Prob.	0.0018	0.0634	0.0694	0.3326	0.0007	0.0007	0.0017	0.0017	0.0249	

ANNEXURE XX--CONTINUED

	C	D1	D2	D1*D2	KSE2001	D1*KSE	D2*KSE1	D1*D2*KSE1	AR(1)	
PKDT2001	0.00374	-0.00631	-0.0126	0.02094	-0.32094	0.33199	0.251999	-0.24937	-0.2101	
Std. Error	0.00578	0.0079	0.00904	0.01297	0.486674	0.486691	0.75349	0.75352	0.04955	
t-Statistic	0.64697	-0.79931	-1.3947	1.61455	-0.65945	0.682137	0.334442	-0.33094	-4.2407	
Prob.	0.518	0.4246	0.1639	0.1072	0.51	0.4956	0.7382	0.7409	0	
PNSC	-0.00528	0.01596	0.00603	-0.0176	1.344122	-1.33306	-0.58667	0.5896		
Std. Error	0.007968	0.01104	0.01194	0.0172	0.646567	0.64659	1.019374	1.0194		
t-Statistic	-0.6622	1.44581	0.50521	-1.0227	2.078859	-2.06168	-0.57552	0.57838		
Prob.	0.5082	0.149	0.6137	0.3071	0.0383	0.0399	0.5653	0.5633		
SSGC	-0.00179	-0.00028	0.00177	-0.0038	0.89495	-0.88179	0.188001	-0.19196		
Std. Error	0.00253	0.00351	0.00379	0.00546	0.205293	0.2053	0.323663	0.32367		
t-Statistic	-0.70808	-0.07956	0.46708	-0.7025	4.359391	-4.29513	0.580854	-0.59306		
Prob.	0.4793	0.9366	0.6407	0.4828	0	0	0.5617	0.5535		
									AR(4)	
TELE	-0.00046	-0.00277	-0.0048	0.01218	1.389626	-1.37565	-0.15332	0.15404	-0.1469	
Std. Error	0.003363	0.00466	0.00525	0.00761	0.273108	0.273126	0.434042	0.43406	0.05155	
t-Statistic	-0.13712	-0.59469	-0.9044	1.60145	5.088193	-5.03669	-0.35324	0.35488	-2.85	
Prob.	0.891	0.5524	0.3664	0.1101	0	0	0.7241	0.7229	0.0046	
ATKCMENT	-0.00018	-0.00105	-0.0005	-0.0018	1.397716	-0.45251	-0.12269	-0.30054		
Std. Error	0.003415	0.00507	0.00544	0.00776	0.275154	0.398006	0.387495	0.53612		
t-Statistic	-0.05114	-0.20662	-0.0914	-0.2341	5.079753	-1.13694	-0.31662	-0.56058		
Prob.	0.9592	0.8364	0.9272	0.815	0	0.2563	0.7517	0.5754		

ANNEXURE XX--CONTINUED

	C	D1	D2	D1*D2	KSE2001	D1*KSE	D2*KSE1	D1*D2*KSE1	AR(1)	AR(9)
ATKREF	-0.00087	0.00105	0.00427	-0.0029	0.504999	0.180212	0.372262	0.0548	0.09092	-0.1101
Std. Error	0.002948	0.00442	0.00464	0.00663	0.23595	0.346136	0.338163	0.4763	0.05218	0.0514
t-Statistic	-0.29467	0.238	0.91992	-0.44	2.140279	0.520638	1.100834	0.11505	1.74241	-2.1418
Prob.	0.7684	0.812	0.3582	0.6602	0.033	0.6029	0.2717	0.9085	0.0822	0.0328
									AR(10)	
CHERTCEMNT	0.004087	-0.00283	-0.0062	0.00633	1.159712	-0.64506	0.118373	0.26961	-0.1835	
Std. Error	0.003158	0.00478	0.00528	0.0077	0.264803	0.387448	0.374163	0.52695	0.05199	
t-Statistic	1.294003	-0.59146	-1.1797	0.82206	4.379519	-1.66491	0.316367	0.51164	-3.5298	
Prob.	0.1964	0.5546	0.2389	0.4116	0	0.0968	0.7519	0.6092	0.0005	
PKDTA2004	0.001263	-0.00326	-0.0006	0.00151	0.795225	0.064724	0.147357	-0.648		
Std. Error	0.003926	0.00582	0.00626	0.00892	0.316315	0.457544	0.44546	0.61632		
t-Statistic	0.321706	-0.55915	-0.1003	0.16889	2.514029	0.141459	0.330797	-1.05139		
Prob.	0.7478	0.5764	0.9201	0.866	0.0123	0.8876	0.741	0.2937		
									AR(1)	
SONERI	0.001325	0.00382	0.00333	-0.0084	0.572563	-0.65183	0.259316	0.36606	0.08656	
Std. Error	0.003935	0.00585	0.00604	0.00864	0.307632	0.446842	0.439477	0.61428	0.05135	
t-Statistic	0.33683	0.65389	0.55051	-0.972	1.861193	-1.45874	0.590056	0.59592	1.68565	
Prob.	0.7364	0.5136	0.5823	0.3316	0.0635	0.1454	0.5555	0.5516	0.0927	
BNKALHBIB	0.007099	-0.00651	-0.0063	-0.0021	0.31646	-0.26936	0.326665	-1.28498		
Std. Error	0.003944	0.00557	0.00593	0.00821	0.267022	0.452723	0.370134	0.58583		
t-Statistic	1.799743	-1.16858	-1.0703	-0.2532	1.185148	-0.59499	0.882557	-2.19343		
Prob.	0.0727	0.2433	0.2852	0.8003	0.2367	0.5522	0.378	0.0289		

ANNEXURE XX--CONTINUED

	C	D1	D2	D1*D2	KSE2001	D1*KSE	D2*KSE1	D1*D2*KSE1	AR(1)	
FECTO	0.004861	-0.00715	0.00734	-0.0051	0.572539	0.115283	0.497111	-0.49125		
Std. Error	0.003313	0.00468	0.00498	0.00689	0.224302	0.380294	0.310918	0.49211		
t-Statistic	1.467045	-1.52822	1.47355	-0.7452	2.552532	0.303142	1.598846	-0.99826		
Prob.	0.1432	0.1273	0.1414	0.4566	0.0111	0.7619	0.1107	0.3188		
KOHTCMNT		0.000145	0.00564	-0.0064		0.99977	1.253736	-1.34872	0.089662	
Std. Error		0.004244	0.00478	0.00761		0.38334	0.27704	0.558408	0.051394	
t-Statistic		0.034073	1.17839	-0.8354		2.60803	4.525469	-2.4153	1.744587	
Prob.		0.9728	0.2394	0.404		0.0095	0	0.0162	0.0818	
KHNR2006		-0.00174	0.00292	-0.0017		0.80183	0.668701	-0.72691		
Std. Error		0.002812	0.00316	0.00515		0.2615	0.183338	0.372971		
t-Statistic		-0.61738	0.92201	-0.3373		3.06627	3.647371	-1.94896		
Prob.		0.5373	0.3571	0.7361		0.0023	0.0003	0.052		
SITAR		0.005646	0.00087	-0.0051		0.54175	0.509323	-0.11855		
Std. Error		0.003632	0.00409	0.00665		0.33772	0.236777	0.481683		
t-Statistic		1.554388	0.21327	-0.7698		1.60413	2.151071	-0.24613		
Prob.		0.1209	0.8312	0.4419		0.1095	0.0321	0.8057		
ALLIED		0.004818	0.00509	-0.0117		0.68713	0.746138	-0.52711	0.274118	
Std. Error		0.003307	0.00521	0.00663		0.27427	0.454612	0.578175	0.056107	
t-Statistic		1.456788	0.9778	-1.7695		2.50529	1.641262	-0.91168	4.885624	
Prob.		0.1462	0.329	0.0778		0.0128	0.1018	0.3627	0.000	