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Impact of Single Stock Futures Trading on Stock Price Volatility of Underlying Stocks: Empirical Evidence from Pakistan's Stock Market

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ABSTRACT

While 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 Single Stock Futures (SSFs) being relatively newer derivative products have not received much attention in the finance literature. Given the distinctive features 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. This paper examines the SSFs contract trading on the Karachi Stock Exchange and investigates the changes in the return volatility of the underlying stocks using an augmented GJR-GARCH model as well the more traditional measures of return volatility. Overall, we find mixed results for both the SSFs-listed stocks and the sample of control group stocks in terms of changes in volatility of daily stock returns in the post-futures periods using traditional measures of return volatility as well as the econometric investigations. Hence, indictments of single stock futures as having caused changes in the return volatility of the underlying stocks cannot be made.

KEY WORDS: Futures trading, SSF, Stock Volatility, Karachi Stock.

I. INTRODUCTION

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 body of empirical and theortical studies to settle the issue empirically and theoritically, though the empirical evidence has not been entirely conclusive and conflicting empirical results have been obtained as to whether stock index futures and/or options initiation can lead to any cahnges in the volatility of the underlying market/asset. Because of 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. Theoritically, what effect the trading of derivatives might have on the underlying market dependents largely on the assumptions that we make about the market participants. One of the key assumptions relates to the ability of the index futures to attract either the more informed or uninformed traders to the 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 price volatility of the underlying asset/market. One group of researchers and commentators asserts that futures trading have 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. Many authors, e.g., Anthony [1], Miller [2], Homes and Tomset [3] also suggest that market participants prefer trading in the derivatives markets as compared to the trading in the spot market, because of market frictions like transaction costs, capital requirements, etc. These factors are also mentioned by Faff and Hiller [4] to suggest that speculators have an incentive to migrate to the derivatives

[1] These are sometimes referred to as competing hypotheses

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market and move their "risky" deeds to the derivatives markets, thus causing some reduction in 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.

The other contrasting view opines that trading in the futures' market has led to higher levels of volatility in the underlying market[2]. Excessive and, perhaps, irrational speculative activities are mainly blamed for such an increased volatility in the stock market. [5, 6]. 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.

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[3]. 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 [7], most studies, which followed after, report a decrease in the price volatility of the underlying stocks in the spot market post-SSFs period. These studies mainly use an event study methodology comparing the volatility of the underlying in the post-SSFs versus the pre-SSFs period.

II. LITERATURE REVIEW

Majority of the studies on SSFs contracts have 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 at present there is little empirical research as SSF contracts are a relatively new financial innovation and have only been recently introduced in major markets around the world[4]. These empirical studies have not yet reached a consensus on the impact of SSFs trading on its effect on the stock price behavior and volatility aspects on the underlying asset markets. Early research studies (see, e.g., 7, 8, 9] report a decrease in the price volatility of the underlying stocks in the spot market post-futures period[5]. However, more recent work [10] shows that the foreign-listed SSFs contracts had a positive effect on the conditional volatility of the underlying domestic stocks.

Peat and McCorry [11] are the first authors who examined relation between SSFs listing and 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. However, in the following year, Lee and Tong [7] document a decrease (increase) in volatility (trading volumes) of underlying stocks in Australian market in the post-futures period. For this purpose, authors use parametric tests (t-test and F-test) and non-parametric test (Wilcoxon rank sum test) to examine changes in mean and variance of returns in 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 [9] examine the impact of SSF listing on the volatility of the underlying SSFs stocks in Australian market. Threshold Auto Regressive Conditional Heteroscedasticity (T-ARCH) model incorporating dummy variables for the two time 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 related to other market-

[2] It is sometimes called as destabilization hypothesis
[3] Presently, SSFs are traded in Australia, UK, South Africa, India, Malaysia, Hong Kong, and some other markets
[4] As compared to universal adoption of stock index futures, SSFs are traded relatively on a fewer exchanges.
[5] Peat and McCorry [11], 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.

wide factors or events. The beta risk change (and unconditional volatility change) coefficients in 5 (and 7) out of 10 cases, show a significant decline in volatility in the post SSF listing period.

Hung, Lee and So [10] used Golsten J & R-GARCH (1, 1) model to assess 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 model after decomposing them into expected (informationless) and unexpected (volume shocks) components using appropriated ARMA models. The study documents that the expected components of futures trading had a positive effect whereas the unexpected (informationless) component was found to have a negative effect (reduction in volatility) for the underlying domestics stocks.

Recently, Floros and Vougas [12] (2006) examined index futures trading and market volatility for indices in Greece over the period 1997-2001. The paper conducts empirical analysis in two stages. First, it uses dummy variable (taking value of 1 post-futures and 0 for pre-futures period) in the variance equation of various GARCH class of models. Second, the authors estimate these 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 et al. [13] examined feedback, autocorrelation, and behavior of price volatility of stocks subsequent to the introduction of trading in domestic and cross-border Universal Stock Futures (USFs) contracts on the LIFFE, employing the Santa and Wadhwani [14] heterogeneous trader model approach using asymmetric model of Golsten et al [15] 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 finds no sufficient evidence to suggest that USFs has contributed to the underlying stock market volatility. Dennis and Sim [8] find insignificant change in volatility for most of SSFs stocks for the Sydney Futures Exchange in the post SSF-period.

Most recently, Beer [16] evaluates a relation between the initial trading of SSFs contracts and price volatility of the stocks 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 [17] 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.

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 [18, 19, 20, 21], the nature of volatility in stock prices [20, 22]. However, despite the fact that single stock futures were first introduced on the Pakistan's stock market in 2001, a paper by Khan [23] is the first study to examine the volatility spill-overs from futures market to the underlying cash market using GARCH (1, 1) model and the Vector Autoregressive model to examine the lead-lag relationship between the two markets. Empirical results documents a unidirectional causality from spot to futures prices, no evidence that futures trading cause spot price volatility in the Pakistan's market. However, his paper does not include the analysis of volatility in the context of pre-versus-post futures trading. So, it is not clear whether price volatility for the underlying assets in the markt has actually undergone any chnages in the post-futures period. The paper examines only SSFs trading and the overall index return's volatility while this study looks at the volatility of the individual underlying stocks in the post futures period. Most recently a study by Khan and Hijazi [24] examined SSFs trading activity variables and the level of price volatility for the underlying stocks. The paper uses a sample of control group stocks in an attempt to differntiate the effects of the futures-trading from other market-wide changes. This study additionally considered 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 changes in volatility of the underlying stocks. The paper finds decreased spot price volatility for the SSFs stocks relative to a group of matching non-SSFs stocks.

This paper contributes to the literature on SSFs by examining a market that has received little attention of researchers. 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, India and South Africa. This study adds a Pakistani perspective to this growing, but relatively under-explored, area of research.

This study examines the behavior of stock returns volatility in the post-SSFs period in relation to the pre-SSFs period for the SSFs-listed stocks and a sample of non-SSFs 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 and the empirical findings 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.

The rest of the paper follows the following pattern. The second section discusses the methodology while next section presents the empirical results and the final section concludes the paper.

III. DATA AND METHODOLOGY

Trading in individual stock futures on the Karachi Stock Exchange commenced in July 2001. Beginning with 2001, SSFs were introduced for stocks in different phases and this processe continued till Febraury 2008 and by then, 46 stocks had SSFs traded on the Karachi Stock Exchange. The sample period of this study begins June 1, 1999 and ends June 30, 2008, two years before the launch of SSFs for each stock and two years after the launch of SSFs for that stock. The sample was screened using several criteria. If an SSFs contract was delisted for a stock during the two-year sample period that stock was not included in the sample. Second, a stock must also have daily price data for the whole sample period (two years pre- and two years post-SSFs period). Hence, those stocks were also excluded from the analysis that had SSFs introduced in February 2008 since they did not qualify the criteria of two years post-SSFs price data. There are 27 stocks out of 46 stocks that fulfill these criteria. The pre- and the post-SSF period for each individual stock; both SSFs-listed and the matching non-SSFs stock, was chosen on the basis of the listing date of SSFs contracts.

If this study finds that some changes in the volatility of the underlying stocks have occurred after SSFs trading initiation and these changes are because of some other market-wide or industry-specific factors and these factors have influenced the market as a whole then we may incorrectly attribute these changes to SSFs trading. We, therefore, also include a sample of non-SSFs stocks in our analysis and study the behavior of price volatility for these stocks. Following the methodology of Mckenzie et al [9], we select those stocks for the control group that were close to SSFs stocks in characteristics such as market capitalization, trading volume and the industry. The control sample consists of 20 non-futures listed stocks.

As a prelimenary analysis we use two measures of stock return volatility in this study. First is the variance of the daily returns for individual stocks and second is the Parkinson's [26] variance estimator, i.e., variance of High-Low intra-day returns[6].

$$HLR_{it}^2 = \frac{\left[\ln(P_{HT}) - \ln(P_{LT})\right]^2}{4\ln 2} \quad \text{----------(4.5)}$$

Where P_{HT} (P_{LT}) is the daily highest (lowest) price for stock i for day t. This simple analysis of the variances of the returns of SSFs-listed stocks is undertaken using the traditional F-test, Bartlett test and Wilcoxon Rank Sum Text. In the second phase we use Generalized Autoregressive Conditional Heteroscedasticity (GACH) model of return volatility both SSFs and non-SSFs stocks.

A. ECONOMETRIC MODELING:

Following Antoniou et al. [25], we test for the impact of SSFs trading on the volatility of each underlying stock using the augmented GJR-GRACH model with a dummy variable in the variance equation. The dummy variable takes on a value of 1 post-futures and 0 for pre-futures period. A positive

[6] These measures was also used by Edwards (1988), Robbani and Bhuyan [5], 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.

and significant dummy variable coefficient implies an increase in the level of stock's cash price volatility in the post-SSFs period, whereas a negative value of the coefficient suggests the opposite.

$$R_{i,t} = \phi_i + \varepsilon_{i,t} \quad -----(3)$$

$$\delta^2_{i,t} = \omega_i + \alpha\varepsilon^2_{t-1} + \gamma\varepsilon^2_{t-1}d_{t-1} + \beta\delta^2_{t-1} + cD_i \quad -----(4)$$

Where $R_{i,t}$ is daily stock returns for stock i, D_i is a dummy variable and is equal to one for post-futures period and zero for pre-futures period.

In the next stage, the paper re-estimates the GJR-model, this time without a dummy variable in the variance equation, for the pre-SSFs and the post-SSFs period for each underlying stock and then examines and compares the volatility parameters across the two sub-periods. The same procedure is also repeated for the matching non-SSFs stocks. GARCH model is estimated with the Marquardt algorithm, using the heteroscedasticity Consistent Covariance option[7].

B. Data Analysis:

B.1 Analysis of Pre-SSFs versus Post-SSFs stock returns volatility

Table 1—alternative measures of Volatility for sample of the futures listed stocks

	POST	PRE	F-test	Bartlett	POST	PRE	t-test	z-score	Mean	Mean	T-test	z-score
ACBL	0.8251	0.5623979	1.67	17.870	0.487	0.463	0.58	0.027	0.312	0.568	0.21	0.63
BAFL	1.1526	0.8279931	1.39	10.579	0.554	0.571	0.47	0.58	1.011	0.827	0.62	-0.68
BOP	0.85518	0.8170165	1.04	0.270	0.505	0.666	3.57*	-3.69*	0.843	0.834	0.09	1.06
DSFL	0.9564	10.384201	10.8	414.11	0.674	1.186	3.23*	-1.785	0.986	10.356	2.89*	-0.73
DGKC	0.7227	1.1158265	1.54	15.889	0.545	1.065	4.99*	-5.96*	0.723	1.007	2.05*	-2.60*
ENGRO	0.62901	1.9314047	3.07	105.24	0.425	0.714	3.16*	-3.31*	0.556	1.931	3.19*	-3.26*
FABL	0.87847	10.299469	11.7	496.29	0.542	0.566	0.48	0.162	0.863	10.278	1.64	2.04*
HUB	0.94305	2.4643331	2.61	78.142	0.401	0.785	3.79*	-5.26*	0.801	2.458	2.84*	-4.68*
IBFL	0.62597	2.2903451	3.65	183.45	0.517	0.826	4.18*	-3.91*	0.613	2.286	3.18*	-2.67*
KAPCO	0.30822	0.4656148	1.51	8.090	0.221	0.307	2.56*	-2.92*	0.2768	0.463	4.79*	11.92*
KESC	0.90634	1.1469845	1.26	6.784	0.865	0.887	0.257	0.126	0.89	1.146	1.49	-1.84
LUCK	0.71665	0.990213	1.38	8.835	0.562	0.77	2.93*	-1.629	0.717	0.994	1.79	-3.17*
MLCF	0.7504	1.4697578	1.95	37.32	0.581	1.171	5.27*	-5.69*	0.748	1.262	2.96*	-3.30*
MCB	0.76845	3.1549981	4.10	161.96	0.483	1.079	4.64*	-4.96*	0.746	3.146	2.99*	-1.82
NBP	0.5835	0.6504015	1.15	0.997	0.382	0.458	1.782	-3.48*	0.59	0.649	0.59	0.68
NML	1.10793	4.821297	4.35	175.03	0.711	1.304	3.25*	-2.08*	1.129	4.809	2.86*	0.44
OGDC	0.19646	0.5803291	2.95	38.781	0.125	0.48	5.51*	-7.04*	0.617	0.588	0.27	1.69
PIA	2.96863	6.0092651	2.02	42.703	1.289	0.91	3.08*	3.325*	2.426	5.998	1.98*	1.18
POIC	0.88013	1.0722324	1.28	4.772	0.718	0.848	2.62*	-1.96*	0.884	1.08	1.59	-0.25
POL	0.48075	0.659427	1.37	8.442	0.362	0.356	0.18	-1.522	0.483	1.146	1.09	-2.606
PSO	0.87015	2.1892489	2.56	72.089	0.44	0.56	1.27	1.414	0.831	2.185	2.24*	1.58
PTCL	0.69443	2.2275578	3.28	113.19	0.341	0.389	0.99	0.167	0.644	2.222	2.68*	-0.89
SNGP	0.96814	5.7974747	5.98	250.98	0.568	1.02	3.96*	-3.88*	0.84	5.781	3.06*	3.37*
SSGC	0.66124	2.5123272	3.79	210.50	0.525	0.526	0.02	0.503	0.67	2.819	2.47*	1.15
TELE	1.33896	0.9525346	1.46	11.727	0.932	0.827	1.46	1.287	1.353	0.951	1.58	1.88
UBL	0.9146	0.8941428	1.02	0.063	0.638	0.736	1.77	-1.41	0.918	0.904	0.16	-0.68

Table 1 shows F-test and Bartlet test results for 26 stocks across post and pre-SSF periods for the measures of return volatility. The results indicate that volatility—as measured by the daily stock returns variance—have decreased significantly for 20 out of 26 stocks after introducing the SSFs trading for those stocks on the Karachi Stock Exchange. The three stocks have return volatility inccreased significantly using F-test and Bartlet's test. The relative average decrease in volatility for all the 26 stocks is 60.5 percent in the post-SSFs period. In the similar vein, the average decrease (increase) in volatility for 21 (5) stocks is 71.6 (14.7) percent. Thus the prelimenary analysis point towards a reduction in return volatility for SSFs stocks in the post-SSFs period. This further warrants detailed econometric investigation, though. Next, we

[7] The same methodology was also used by Floros and Vougus, 2004

consider the volatility estimator suggested by Parkinson [26], reported in Table 1. These results are not much different to those found using the variance of close-to-close returns technique. The results show a decrease (increase) of volatility for 22 (4) out of 26 stocks, with 15(1) of them significant at 1 percent level using t-test and Wilcoxon Rank sum test. Again, the average decrease (increase) for the 22 (4) stocks is 58 (18.2) percent. Again, we observe a reduction in return volatility of the underlying SSFs stocks for 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.

Comparing the alternative volatility measures, one can notice some differences between the two volatility measures used in this study to compare the return volatility for the SSFs-listed stocks across the post- and the pre-futures periods. For instance, the Parkinson's [26] volatility estimator is smaller than the variance of the Close-to-Close prices. 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 between the two alternative measures of volatility and the conclusions are robust across the two measures of return volatility for the SSFs-listed stocks.

Similar to a procedure for SSFs-listed stocks, the two alternative measures of return volatility were also used 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 of market-wide and/or industry specific changes affecting majority of the stocks as a whole. The results for the two measures of return volatility for the sample of control group are reported in Table 2.

Table 2 tests for Alternative measures of return volatility for Control Group Stocks

	Variance Close-to-Close		F-test	Bartlett	Parkinson Estimator		t-test	z-score
	Post	Pre			Post	Pre		
ABL	0.621758	0.7217	1.161	1.002	0.672	1.005	0.87	1.39
ATKCMNT	0.81746	0.983319	1.203	4.102*	0.621	0.721	1.98*	-2.76*
ATKREF	0.876483	0.601398	1.457*	16.900*	0.55	0.428	2.43*	1.73
BKHB2001	0.541521	0.471397	1.149	1.992	0.237	0.203	0.97	3.93*
BKHB2006	1.416335	0.885767	1.599*	26.052*	0.255	0.399	4.80*	-5.10*
CHERTCM	0.79817	0.837148	1.049	0.273	0.463	0.503	0.94	0.56
CRESCNEX	0.7713	1.560659	2.023*	52.885*	0.39	1.106	5.54*	-4.94*
DAWOOD	0.713996	1.060393	1.485*	18.477*	0.192	0.138	1.29	6.54*
FECTO	0.660431	0.962284	1.457*	17.547*	0.504	0.471	0.82	1.73
FFC	0.397669	0.80519	2.025*	67.937*				
GARTON	0.873718	1.942992	2.224*	67.970*	0.274	0.804	3.61*	0.68
KHT2006	0.780052	1.225196	1.571*	25.189*	0.223	0.242	0.72	1.15
KOHNR2006	0.375102	0.385723	1.028	0.097	0.385	0.638	1.57	2.17*
KOHNOR2001	0.63317	0.949646	1.500*	17.439*	0.654	0.402	6.85*	-5.56*
PKDATA2004	0.794574	1.141066	1.436	15.701*	0.337	0.42	1.43	2.83*
PNSC	3.051859	5.123012	1.679*	28.537*	1.47	1.551	0.25	5.02*
SITARA	0.911467	0.490677	1.858*	46.293*	0.514	0.263	6.40*	6.01*
SONERI	0.816457	0.56993	1.433*	15.402*	0.328	0.311	0.54	2.03*
SSGC	0.828121	1.342651	1.621*	24.824*	0.506	0.965	3.16*	-2.64*
STRA2006	0.913529	0.490677	1.862	47.148*				
TELE	1.280347	1.976053	1.543*	20.001*	0.949	1.638	3.96*	-2.44*

The empirical results in terms of changes in return volatility in the two time periods and the statistical significance, are mixed across the two tables for return volatility measures. The number of stocks for which the return volatility has decreased, irrespective of the measure of volatility used, is more than half in the two tables. The significant decrease in return volatility are 12 (variance of Close-to-Close) and 5 (Parkinson estimator), respectively, using either t-test or the wilcoxon test. Interpreting these two tables collectively, one can see an observed reduction in the return volatility for more than half of stocks for the control group, though one can not conclude convincingly that the reduction in return volatility is universal for the stocks of the control group.

Looking 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.

B.2 Comparison of changes in return volatility for SSFs-listed and Control stocks

SSFs trading has been introduced in stages on the Karachi Stock Exchange. They were first introduced on July 1, 2001 (9 SSFs), the second on June 21, 2004, the third in September 21, 2004, the fourth time in February 20, 2006, and other stocks gradually introduced which are not part of this analysis as they do not fulfill some of the sample selection criteria. If we look at the observed changes in return volatility from pre-futures to the post-futures period for SSFs-listed and the matching non-SSFs listed sample of control stock, we observe that this reduction, irrespective of which measure of volatility we use, occurs for the period 2001-2003 for both SSFs-listed and the control sample stocks. This indicate that the observed reduction in return volatility for the SSFs-listed stocks may not be induced by the introduction of the SSFs trading for those stocks but it may an outcome of other market-wide or industry changes that has affected the overall market. If we analyze the overall market during 2002-04, in fact, it is the time period when the Karachi Stock Exchange experienced unprecedented growth in market capitalization, trading volume and new listings. The international magazine "Business Recorder" announced the Karachi Stock Exchange as the 'best performing' stock market of the world in 2002 where it registered an increase of 112% in the KSE-100 Index. The exchange was also ranked amongst the top 10 best performing markets of the world in 2003 and 2004, as the KSE-100 Index registered an increase of 65% and 39% respectively. Since then, however, the Karachi Stock Exchange has, in the past few years, witnessed excess volatility and today it is one of the most volatile regional markets. The same phenomenon was pointed out by Ahmad and Zaman [27] who found evidence of high levels of volatility and speculative activities in the market and in the various sectors.

C. Econometric Analysis

Table 3 Dummy variable GJR-GARCH model for adjusted returns series of SSFs-listed stocks

	ACBL	BAFL	BOP	DGKC	DSFL	ENGRO	FABL	FFC	HUBC	IBFL	KAPCO	KESC	MCB
Coefficient[a]	0.0763	0.00289	-0.00278	-0.0121	0.00018	0.0318	-0.00158	-0.024	0.0265	-0.0734	-0.0551	-0.13	-0.098
z-Statistic	5.27	9.078633	-0.299	-0.714	0.006	1.465	-0.509	-6.375	2.187	-3.539	-3.173	-5.952	-3.722
Prob.	0.000	0.000	0.765	0.475	0.995	0.143	0.611	0.000	0.029	0.000	0.002	0.000	0.000
	MLCF	NBP	NML	ODGC	PIA	POIC	POL	PSO	PTCL	SNGP	SSGC	TELE	UBL
Coefficient[a]	-0.0586	-0.0268	0.362	-0.0209	0.101	0.000726	-1.598	0.00504	0.00667	-0.0192	-0.0106	0.0416	-0.0679
z-Statistic	-2.076	-5.123	13.341	-2.036	3.822	0.051	-33.455	0.645	1.048	-2.781	-1.792	1.671	-2.266
Prob.	0.038	0.000	0.000	0.042	0.000	0.959	0.000	0.519	0.295	0.005	0.073	0.095	0.024

[a] Coefficient on Dummy variable. Also, coefficients are multiplied by 1000. This table reports results only for the coefficient on dummy variable for the augmented GJR-model for the adjusted returns series for each SSFs-underlying stock, with a dummy variable in the variance equation, which takes on a value of 1 post-futures and 0 for pre-futures. The model was applied for the whole sample; both pre and post-futures period.

This paper follows methodology of Antinio et al [25], outlined in the empirical methodology section, to examine if there are any changes in the level of stock return volatility for the SSFs stocks in the post-SSFs trading priod in the Pakistan's stock market. Table 3 contains results only for the dummy variable coefficient for this augmented GJR-GARCH (1, 1) model for each SSFs underlying stock. To make sure that the residuals from the dummy-variable regression are white noise, Ljung and Box [28] portmanteaus statistics was applied to the adjusted returns series for various lags of autocorrelations of the returns series for all the SSFs-listed and non-SSFs stocks, adjusted for the day-of-the-wee effects and serial correlations. Results show no evidence of linear temporal dependence in the (adjusted) returns series and are therefore, considered as 'news'.

It is evident from the Table 3 that the dumy coefficient is negative and significant at the five percent level for 12 stocks indicating relative reduction in volatility for these stocks in the post-SSFs period. Nevertheless, we also observe a measured increase in volatility for 11 stocks, as the sign of dummy variable coefficient is positive for these 11 stocks. However, the positive coefficient sign is statistically significant only for 5 stocks. Thus we observe a partial and limited reduction in the level of volatility for SSFs stocks in the Pakistan's market.

Table 4 Dummy variable GJR-GARCH model for adjusted returns series for control sample

	ALLIED	ATKCMNT	ATKREF	BKAHBIB	CHERAT	CRESCENT	DAWOOD	FECTO	GARTON	
Coefficient[a]	0.00933	-0.0438	-0.0118	-0.00859	0.0614	-0.357	-0.0556	-0.0723	-0.0327	
z-Statistic	0.203915	-1.470974	-0.779403	-0.524595	3.312925	-5.336249	-4.39701	-2.382616	-3.932724	
Prob.	0.838	0.141	0.436	0.600	0.001	0.000	0.000	0.017	0.000	
	KHNR06	**KOHAT**	**KOHINOOR**	**PAKDT01**	**PKDTA04**	**PNSC**	**SITARA**	**SONERI**	**SSGC**	**TELE**
Coefficient	-0.0024	-0.00951	-0.156	-0.0555	-0.686	-0.684	0.0618	0.0158	0.018	-0.0512
z-Statistic	-0.326966	-0.651368	-7.061088	-4.882059	-0.489	-4.960503	3.091273	1.299769	2.192739	-1.597037
Prob.	0.744	0.515	0.000	0.000	0.500	0.000	0.002	0.194	0.028	0.110

[a]Coefficient on Dummy variable. Also, coefficients are multiplied by 1000. This table reports results only for the coefficient on dummy variable for the augmented GJR-model for the adjusted returns series for each non-SSFs stock of a sample of control group, with a dummy variable in the variance equation, which takes on a value of 1 post-futures and 0 for pre-futures. The model was applied for the whole sample; both pre and post-futures period.

A similar procedure was also adopted for each of the control sample stocks (Table 4). As shown in the table, dummy variable coefficient is negative for 14 out of 19 stocks, with 7 of them statistically significant, whereas, 5 stocks have positive coefficient with three of them significant. Thus we also observe a decline of return volatility for many of the non-SSFs stocks, with some of them also registering an increase in return volatility. Hence, similar to empirical results for the SSFs-listed stocks, non-SSFs stocks also exhibit a mixed results for changes in return volatility. These empirical results reinforces the earlier conclusions that futures trading may have not had any universal impact on the volatility of the SSFs stocks and the changes in return volatility may be the outcome of other market wide changes.

IV. Conclusion

This paper investigates the possibility that SSFs trading may have had led to any changes in the return volatility of the SSFs stocks for the Pakistan's stock. The traditinal measures of volatility (variance of returns and Parkinson estimator) as well as the econometric specifications provide a mixed result for both the SSFs-listed and the non-SSFs stocks. There has been a reduction in the level of price volatility for many of these two groups of stocks. These results reinforce our conclusions that futures trading in the Pakistan's market may not have any universal impact on the volatility of the underlying stocks.

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