Gains and Costs Associated With Introduction of Equity Derivatives: Empirical Evidence from Pakistan

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Abstract

While voluminous body of literature exists on the stock index futures contracts and their relationship with the underlying asset market in terms of price volatility dynamics and lead-lag relationships between the two markets, Single Stock Futures (SSFs) are a relatively newer financial innovation in the derivatives market and have not received due attention of researchers for their impact on the underlying asset market, particularly in emerging markets. In this study, we examine the impact of trading of SSFs contracts on respective underlying stocks' market efficiency and stock price volatility in Pakistan's market. For this purpose, an event study and matching sample approach was used for a sample of SSFs and relatively matched Non-SSFs stocks. Overall, it is observed that introduction of SSFs had no significant impact on the market efficiency and volatility of SSFs underlying stocks and Non-SSFs stocks, as the results provides no consistent patterns in terms of changes in volatility and market efficiency post-futures periods. These results are consistent with some of the earlier studies that derivatives markets have, at least, no destabilizing effect on the underlying asset market.

1 Introduction

Financial derivatives contracts are leveraged financial products and have different features than spot market trading mechanism. The primary objective of introduction of the derivatives market is to provide investors with an opportunity to hedge the risk (i.e. transfer of risk among the players assuming different roles in the economy) and increase the liquidity of the market thus for increasing the market efficiency. The issue of impact of derivatives trading in empirical financial research is the most recurring theme since their introduction in 1970's. A large number of theoretical and empirical studies have been conducted to check its impact on different aspects of the underlying stock markets. Different simple and complex approaches have been used to answer whether derivatives trading stabilize or destabilize the underlying spot markets. One explanation of the destabilization hypothesis is that derivatives trading activity provides additional route for transmission and reflection of information in spot market prices and, in result, lead to an increase in the spot market volatility which could be the consequence of frequent and more rapidly processed information arrival. The relationship of these financial instruments with price volatility has been the area of interest for academicians, practitioners and regulators alike.

One way to evaluate derivates impact is to first identify the users of derivatives and their intentions to enter in the derivatives trading activity. Hedgers, speculators and arbitragers are the three broad categories of participants in the derivatives markets. Since futures encourage speculative activity, a concern about futures' inherent ability to attract speculators, who then destabilize the spot market, has always been a point of debate, both at the theoretical and empirical level. This debate was intensified in Pakistani market, after the 2005 market crash, and futures were blamed for the hyper volatility persisted in the market. So, it became necessary to study the impact of SSFs on spot market volatility, liquidity and market efficiency, and identification of any causal link among the futures market and underlying spot market. SSFs were introduced in KSE, most traded local bourse of Pakistan, on 1st July, 2001. Initially, one month SSFs were launched. In the beginning, SSFs constituted a very small fraction of overall spot market volume and value. However, late in the year 2004 and early part of 2005, SSFs traded activity stimulated, and for a short span of time, it constituted almost 40% of the spot market volume. But, later, due to weak infrastructure and risk management measures, market could not sustain the ever increasing leverage position in the stock market, which led to stock market crash in the year 2005. After the stock market crisis, several risk management measures were taken to reduce inherent risk, and trading in 18 stocks were resumed on 27th July 2009, with reformed features, improved risk management regime. So, there was a need to assess new situation, still under transition, which has gathered enough experience till now.

The aim of this study is to identify, whether resumption of SSFs contracts trading has led to an improvement in the spot market functioning in terms of depth, market efficiency and volatility (tradeoff between gains and loss). As Cox (1976) and Ross (1989) argues that as new information quickly adjust to the future prices, and through arbitrage mechanism, if information is transferred to spot market, then spot market volatility and market efficiency would increase simultaneously. To observe, and achieve the above mentioned objective, the study answers specifically the following questions.
Has the resumption of SSFs trading in Pakistan imparted significant change in the volatility of the underlying spot market stock prices; and simultaneously, whether there is a significant change in the degree of market efficiency?

2 Literature Review and Overview of the Pakistani Market

Although Ross (1976) and Hakansson (1982) had proposed in their respective theories, that value of a stock should be influenced by the introduction of its own derivatives, still, until 1990s, Single Stock Futures contracts were not traded. In the 1990s decade, Single Stock Futures were first initiated in Australia and Hong Kong. Since then, it has been introduced in several other countries e.g. UK, USA, South Africa, India, Hong Kong and Malaysia etc. Explicitly, introduction of derivatives counterparts improve the market/ trading efficiency of the underlying stock, by completing the market. Research to date is evident that impact of introduction of Single stock futures' contracts range from benign to a positive effect on the underlying stocks. Several studies across the different markets, on impact of introduction of derivatives trading on different aspects, reported diverse set of results. The reasons for varying results depend on the geographical locations, methodology employed, data used for analysis, and period used for study the impact.

Sung, Taek, Jong (2004) used event study and matching sample principle approach to study impact of index futures on spot price volatility and market efficiency for Korean market, using data of KOSPI 200 constituent and non-KOSPI 200 stocks, and conclude that introduction of index futures brought significant increase in the market efficiency and spot price volatility, simultaneously. The study also reported that non KOSPI 200 stocks experienced higher spot price volatility and lower market efficiency than KOSPI 200 index stocks. They also found the volatility spill over from futures traded stocks to non-futures traded stocks. Sathya (2009) investigated the impact of NSE Nifty index futures trading initiation in Indian Stock market, and suggested that equity trading is associated with short run cost (decrease in market/ trading efficiency and gains (i.e. stabilization) in the equity market).

First category of studies, among many, as by Damodaran (1990), Lockwood and Linn (1990), Shwert (1990) and Harris (1989) suggested that introduction of derivatives trading in S&P 500 stock index implied increase in the volatility of spot returns. On the other hand, second category of studies, as by Brown Hruska and Kuserk (1995) and Santoni (1987) depicted negative relationship between trading volume of S&P 500 and volatility of S&P 500 index returns. They further argued that, increase in futures' trading activity stabilized the spot market by reducing the variation in stock returns. Nath (2003) studied the impact of introduction of futures on S&P CNX NIFTY and S&P CNEX NIFTY JUNIOR by using the static and conditional variance approaches, and concluded that volatility in the post period declined. Johannes Scheepers De Beer (2008) studied price, volume and volatility change due to introduction of SSFs in 38 companies on South African stock market, using GARCH model, and concluded insignificant impact on prices, increased volume, and reduced spot market volatility. The third category of Studies, for example by Board, Sandman and Sutcliffe (2001) Darrat and Rahman (1995), Bachetti and Robers (1990), Smith (1989), Conrad (1989), Grossman (1988) and Edwards (1988a, 1988b) found an insignificant impact of futures' introduction on spot market in their respective studies. Illuecea and Lafuented conducted their study on Spanish stock market. They used intra-day hourly return data to check the hypothesis of relationship between introduction of index futures and spot market volatility. Their results did not support any relationship between index futures and spot market volatility. Bessimender and Seguin (1992) has segregated the futures trading activity into expected and unexpected components and has empirically proved that there is a statistically significant negative relationship between expected trading activity and volatility, but statistically significant positive relationship between stock market volatility and expected futures' trading activity of S&P futures' index. Darrat, Rahman and Zhong (2002) used an asymmetric model EGARCH to conclude that introduction of index futures may not be responsible for excess volatility in the spot market. A study conducted by Kyriacou and Sarno (1999) for FTSE 100 index, bi-furcated the futures volume into contemporaneous and lagged futures' component, and concluded that both components have significant impact on variation in spot market.

Jochum and Kodres (1998) conducted multi countries (i.e. Australia, Brazil, Hungary and Mexico) analysis to identify the impact of futures' trading and found that futures trading activity has insignificant impact on spot market volatility. Rahman (2001) reported, while using GARCH model to check the impact of index futures on DJIA, that there was no structural change due to introduction of index futures. Another study by Lee and Ohk (1992) examined the impact of futures introduction on SIMEX, found that introduction of Nikkei 225 induced increase in spot market volatility. Chang, Cheng, and Pinegar (1999) applied several tests to check the volatility of portfolio of stocks after introduction of Nikkei futures trading on OSE and SIMEX, and concluded insignificant increase of volatility on OSE, but not on SIMEX. Gullen and Mayhew (2000) conducted a multi countries analysis to identify the impact of futures contracts, particularly, the force of expected futures' volume on spot market volatility in 25 countries. Results were negative effect for Australia and United Kingdom, positive for Denmark, Germany and Hong Kong, and neutral for remaining countries. Ruchika, Saroj, Sheeba (2010) used five derivatives and non-derivatives stocks, each listed on S & P CNX Nifty, to compare the results about introduction of derivatives trading. They used dummy variable in the GARCH model, and reported evidence of insignificant change in volatility.

Regarding Pakistan's market, there is little work done on impact of futures introduction on different aspects of spot market. In Pakistani Context, study conducted by Khan and Hijazi (2009), report that introduction of SSFs have led to significant decrease in underlying spot market stock returns and decrease in volatility. Khan (2006), report that futures trading should not be blamed for increased spot market volatility in the year 2005, which led to market crash in KSE. Using (VECM) for causality and feedback relationship, he argued, that information incorporation in spot prices explains the future prices and not the vice versa. This study focused on the value and role of equity trading on volatility of Pakistan's stock market with the emphasis on capability of derivatives in predicting the spot prices. Using GARCH model to study the volatility in the corresponding spot and futures markets and the relationship of volatility amongst them, empirical results showed that spot prices lead the future prices in incorporation of information arrival. Most recently, Khan, Shah and Abbas (2011) examine the SSFs contracts trading for the stock price volatility of the underlying stocks using the augment GJR-GARCH model and the more traditional measures of volatility. The study finds no consistent pattern for changes in volatility for the underlying SSFs stocks in the post-futures trading period and concludes that the futures trading has not led to the destabilization of the market in terms of an increase in the spot price volatility post-futures period.

Overall, all the three papers on the Pakistan's market has not provided any convincing evidence of whether SSFs trading can have any negative impacts on the price volatility of the underlying stocks. On empirical and theoretical level, the outcome of the increased interest in futures markets is still unresolved. This study provides additional empirical evidence and also contributes to the literature in different aspects. An important dimension that had never been discussed before is the importance of underlying distribution while measuring volatility in the equity derivatives. A number of studies have shown underlying error distribution to be Non-normal, but still models and tests are used which assume it to be normal. Also, some studies have been performed in Pakistani market context when the equity derivatives were first introduced, but, here the data has been used for resumption period with modified contract specification and expected more informed trader in the market than before. The outcomes of this study are important to regulators and officials in improving contract specifications and trading mechanism for derivatives contracts, which would lead to enhancement of derivatives as a better risk management tool.

2.1 Testable hypothesis

On the basis of the theoretical discussions and empirical findings in the previous section, following hypotheses are developed and tested in this study.
H_1: Introduction of SSFs has changed the spot market volatility of underlying SSFs stocks
H_2: Introduction of SSFs has changed the market/ trading efficiency of underlying SSFs stocks
The above two hypotheses will be tested against null hypotheses of no change in the underlying stock market volatility and market/ trading efficiency, using simple inferential tests as well as advanced econometric models and specifications.

2.2 Evolution of Financing Instruments in Pakistan

Pakistan's equity market has had one unique financing instrument known as "Badla" financing in regional parlance. In Pakistan, it was introduced in 1994. "Badla" system allows carry forward of any open position from one settlement date to the next. To avail such a facility of carrying forward its position, "financee" has to pay compensation, known as "Badla rate". This rate is determined through prevailing forces of demand and supply in the market, which are independent of stock and type of investing party. The "Financier" keeps shares as collateral till settlement of the transaction. Badla" has a feature of futures markets, because settlements are done in future, so it superimposes the attribute of derivatives markets over the spot market. While facilitating "financee", the "financier" is open to the elements of counterparty risk, and, since the clearing house is not responsible for this type of transactions, there seems no way to manage this risk involving transactions and settlement dates. Such counterparty risks are the reason for "Badla rates" higher than normal risk free rates. This counter party risk is fatal, and has been the reason market crash in both Pakistan and India. For instance, in May 2000, numerous brokerage firms in KSE defaulted, because stock prices fell significantly, and borrowers could not clear their settlements. Conversely, due to the involvement of counter party risks, regulatory authorities of Pakistan and India[1] tried to evict this instrument from their respective equity markets, a number of times. In Pakistan, to protect the interest of investors and ensure effective

[1] Badla was initially banned in India in March 1994 with the expectation to replace it with futures and options. However this was not materialized and badla was legalized in 1996, and, finally banned in 2001 following the introduction of futures contracts in 2000 (Rajwari, 2001)

risk management, SECP initiated in 2003 a planned and timed phase-out of this traditional financing instrument and to replace it with alternative modes of financing, and was finally replaced in 2006 with official automated financing named Continuous financing systems (CFS) to ensure stability in the market. Though similar in nature to the traditional COT, with major differences being the continuous trade system unlike COT, with the investor now had to settle the rollover trade during market hours while in COT it used to happen in the end of the session, which could lead to an increased risk factor, if funds were not available wasat it was a

Apart from "Badla financing", KSE microstructure is almost same as any other developed market around the globe. Trading mechanism at KSE is fully automated, by means of Karachi automated transfer system (KATS), and is order driven (e.g. market order and limit order). Inherent counter party risk in "Badla financing", has caused several debt crisis, over the period of time. At an instance, in May 2000, continuous decline in the market made the investors unable to clear their payments which lead market brokers to default. As "Badla financing" can aggravate the deteriorating condition in the market, due to its inherent inability to handle counter party risk, KSE had to face another payment crash in March 2005. A task force was setup to scrutinize the unprecedented decline in the market, which reported, "Badla" instrument as the prime reason for such an unparallel decline. The recent crisis in KSE, which could be surely attributed to "Badla", occurred in May 2000, September 2001, May 2002, March 2005, and June 2006. In response to this entire crisis, several attempts were made to eradicate "Badla Financing", although it was highly supported by brokers. In 2005, "Badla financing" was automated, and was renamed as CFS and later CFS MK-II. The ultimate abolition of this mechanism in KSE took place in May 2009.

Derivatives are considered as instruments for shifting risk from one to another party, who intends to bear the risk of loss in hope of making profit (Bodla and Jindal, 2006). Specifically, future Contract is an agreement between buyer and a seller to commit to buy or sell a specific commodity, stock or currency on a predetermined rate at a predetermined price. Futures derive their value from the underlying security. Studies have shown that trading in derivatives effect their underlying asset or market.

In Pakistan, SSFs were first introduced on July 1, 2001, when 10 eligible scrips in KSE were allowed to have SSFs contracts. To begin with, one month deliverable SSFs were launched. After 11 years, the derivatives market in Pakistan is still underdeveloped when compared to neighboring Indian Market. In India ETD's were simultaneously launched at the two most traded exchanges i.e. National Stock exchange (NSE) and Bombay Stock Exchange (BSE) on 9th and 12th June 2000, respectively. Initially, S&P CNX Nifty Index (Nifty), BSE Sensitive Index (Sensex) were the indexes in which index future contracts were launched. The trading volume rose significantly, since then.

Later on, SSFs in a number of other stocks were also introduced. During the market turmoil and afterwards in the year 2008, the Securities and Exchange Commission of Pakistan (SECP) had decided to discontinue Continuous Funding

System (CFS Mk-II) and SSFs products at the Karachi Stock Exchange, on the recommendations of the CFS MK II review committee. On July 27, 2009, the futures in 18 most liquid stocks were set to resume trading. Our Study is aimed at examining the impact of the SSFs on changes in volatility and market/ trading efficiency for the underlying stocks for this resumption event. The study examines, in this case, the introduction of financial futures on volatility and market efficiency.

3 Data & Methodology

Two different approaches are extensively used to incarcerate the impact of introduction of derivatives trading on underlying stocks' volatility and market efficiency. First approach was introduced by Harris (1989), which compares the degree of volatility and market efficiency between pre and post period of the underlying event. And, second approach used by Faff, Mckenzie and Brailsford (2002), which is aimed at cross-sectional comparison of the degree of volatility and market efficiency between the SSFs traded and Non-SSFs traded stocks. Despite the fact that, both approaches have mechanical compensation over one another, they need to congregate several circumstances to be consistent. The underlying study employs both approaches to take care of robustness and differences in potential cross-sectional factors. Following econometric models are used to empirically prove the hypothesis of the study.

3.1 Market Efficiency Model

Cox (1976), empirically established the results consistent with increased information from futures trading activity. He concluded that market prices provide more accurate signals for investments when there is futures trading in a commodity. Further, he argues that if futures prices adjust rapidly after the arrival of new information, and if through arbitrage mechanism, this process is transferred to spot market, then spot market efficiency and volatility would increase simultaneously. Ross (1989), under the assumption of arbitrage free economy, concluded that price volatility is directly proportional to the rate of new information arriving to the market. Brorsen (1991) extended the argument of Brorsen, Oellermen, and Farris (1989), that futures market effects spot markets to adjust to new information more speedily, which results in price volatility in the short run perspective. From the above studies, it can be hypothesized that, if futures trading provides an anvenue for information transmission, and also if, the same information is reflected quickly in the spot prices, then as a result spot price volatility would increase.

Brorsen (1991) developed a theoretical relationship between market frictions in futures markets and underlying spot price volatility. He empirically proved that if market frictions are reduced, market efficiency and volatility of short run spot returns would increase simultaneously. He used S & P 500 index data to analytically prove this theoretical relationship across two events (deregulation of Brokerage commission in 1975 & S & P futures contracts introduction in 1982). Results affirmed the hypotheses of the gains (improvement of market efficiency) and costs (destabilization in the form of volatility increase). He concluded, that short run stability in the form of reduction of volatility could be achieved, if market frictions (e.g. futures margins or market traders' transaction costs) are increased.

Since, there exist more market frictions in less developed stock markets, the hypothetical relationship between market frictions and stability should be more evident in such markets. Although, equilibrium prices follow a random walk, still spot prices may not converge quickly to the equilibrium prices, due to market frictions such as market regulations and transaction costs etc. So, it can be concluded that price adjustment on new information arrival follow a partial adjustment process instead of instantaneous adjustments. Brorsen (1991), Brorsen, Oellermann, and Farris (1989) formulated the association between the spot prices ($\emptyset_t$) and equilibrium prices ($\emptyset_t^*$) and expressed in the following partial adjustment process model:

$$\Delta\emptyset_t = \emptyset_t - \emptyset_{t-1} = \gamma(\emptyset_t^* - \emptyset_{t-1}) \ldots\ldots (3.1)$$
$$\emptyset_t^* = \emptyset_{t-1}^* + \mu_t \qquad \mu_t \sim \text{WN}(0,\sigma_\mu^2) \ldots\ldots (3.2)$$

Here, prices are measured using logarithms, ($\Delta\emptyset_t$) represents the price change, (μ_t) is an uncorrelated disturbance term, and gamma (γ) is a constant, which takes any value between 0 and 1, and it represents the rate of speed of actual prices reaching the equilibrium prices. Price adjustments are immediate, when γ takes the value "1", otherwise not. As γ decreases with increase in market frictions, it can be considered as a measure of market efficiency of a stock.

Autoregressive model of the order "1" for stock returns (R_t), or price changes ($\Delta\emptyset_t$), can be rearranged in the following manner:

$$\Delta\emptyset_t = R_t = (1-\gamma)R_{r-1} + \gamma U_t \ldots\ldots (3.3)$$

Here, Rt_{-1} and μ_t are independent of each other, and unconditional variance of R_t and Rt_{-1} are same, and variation in R_t can be formulated as follows:

$$Var(R_t) = \left[\frac{\gamma}{2-\gamma}\right] Var(U_t) \ldots\ldots (3.4)$$

Since, Var(μ_t) is the variation in equilibrium prices, and has previously been used as a measure of information flow in the stock market in a number of prior studies (Bae and Jo, 1999; Jones, Kaul, and Lipson, 1994; Ross, 1989; Skinner, 1989). Brorsen (1991) proposed that variance of equilibrium prices can be best estimated by measuring variation in weekly or monthly price changes.

The first order partial derivative of Var(R_t) with respect to γ could be represented as follows:

$$\frac{\delta \text{Var(Rt)}}{\delta\gamma} = \left[\frac{2}{(2-\gamma)^2}\right] \text{Var}(\mu_t) \ldots\ldots (3.5)$$

Equation (3.5) illustrates a positive relationship between market efficiency and spot price volatility, that is, as market efficiency increases, simultaneously, so does the spot market volatility of the underlying stock. It also implies that, as market frictions are reduced, or, equivalently, efficiency of the trading system improves, the spot price volatility also shows an upward trend. Several prior studies (Cohen et al, 1986; Scholes and Williams, 1977; Schwartz and Whitcomb, 1977) suggested that the market efficiency is related to the prevailing market frictions in the market. However, due to different firm or industry specific factors, the impact of market frictions could be different on underlying stocks.

Studies by Cox (1976) and Brorsen (1991) conclude that there are lesser market frictions in futures markets as compared to spot markets. Furthermore, futures prices adjust swiftly to the new information, and, if, the new information impact is transferred from future to spot market by arbitrage scheme, then the spot market frictions would also be reduced due to this inherent ability of future markets. So, it could be said that, ETD's helps improve the market efficiency of the spot market. So, from the discussion above, it could be hypothesized that, futures introduction in KSE would help improve the market efficiency of the underlying stocks. Also, from the positive relationship observed, indicates that spot market volatility would also increase.

After calculation of DME for each stock in pre and post periods separately, paired sample t-test will be used to examine the overall significance of the change, if any.

3.2 Volatility Model

The Exponential GARCH (EGARCH) model was introduced by Nelson (1991). It is an extension of GARCH model, because it also accounts for asymmetric effect induced by negative and positive shocks, in an econometric volatility model. Nelson's EGARCH model is expressed as follows:

Let Y_t represents the closing price at time "t", which assumes values t=1, 2, 3….T. The rate of return can be calculated as:

$$R_t = \log(Y_t/Y_{t-1}) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.6)$$

Here, R_t is the rate of return of the holding period from time "t" to "t-1".
For the subject study, The ARMA (k, l)-EGARCH model could be presented as follows:

$$R_t = \phi_0 + \sum_{i=1}^{k} \phi_{t-i} R_{t-i} + \sum_{j=1}^{l} \theta_{t-j} \varepsilon_{t-j} + \varepsilon_t ----------------------(3.7)$$

$$ln\sigma_t^2 = \omega + \sum_{j=1}^{p} \beta_j \sigma_{t-j}^2 + \sum_{i=1}^{q} (\alpha_i |\eta_{t-i} - E(\eta_{t-i})| + \gamma_i \eta_{t-i}) + \phi dummy ----- (3.8)$$

Here, $\eta_t = \dfrac{\varepsilon_t}{\sigma_t}$ is the standardized normal residual series.

Positivity constraints are taken care of, using logarithmic expression of the model, and it also establishes the argument that leverage effect is exponential instead of quadratic nature. The asymmetric effect is incorporated in the model using the term

$\alpha_i|\eta_{t-i} - E(\eta_{t-i})| + \gamma_i(\eta_{t-i})$. This term is function of sign and magnitude of the variable η_t. One another advantage of this model is that, unlike other asymmetric models, it does not require stationarity constraints.

3.3 Underlying Error Distribution

During formulation of ARCH process, Engle (1982) assumed that the error term follows Gaussian distribution. Bollerslev (1986), while extending ARCH to GARCH, also assumed the same. These models are estimated using Maximum Likelihood (ML) approach. ML interprets the probability density as a function of parameters set, which are conditional on a sample outcome's set. The said function is also called Maximum Likelihood function (hereafter QML). Although, Gaussian distribution is widely used in parametric analysis, it fails to describe the fat tails in the stock returns, which seems quite evident from the excess skewness and kurtosis of the returns distribution. Weiss (1986) and Bollerslev and Wooldridge (1992) proved that under normality assumption, QML is consistent, only if conditional mean and conditional variance are specified correctly, and found it to be robust when distribution of error term departs from normality. Engle and Gonzalez-Rivera (1991), are of the view, that although QML is consistent but inefficient for Non-Gaussian distribution and the degree of inefficiency increases with the degree of departure from Gaussian distribution. Obviously, underlying error distribution plays a great role in the estimation of any model, so great concern is now being showed, for the due consideration of underlying error distribution. Also, it may be expected that excess skewness and kurtosis displayed by the residuals of conditional heteroscedastic models could be reduced by using more appropriate distribution. Here, other probability density functions, such as Student's t distribution suggested by Bollerslev (1987), and Generalized Error Distribution (GED) by Nelson (1991) alongside Gaussian distribution, are being used in this study to take tail thickness into account.

3.3.1 Standardized Student's t Distribution

Probability Density Function (PDF) proposed by Bollerslev (1987) for the standardized student's t distribution with $\upsilon > 2$ degree of freedom is as follows:

$$f(\eta_t) = \frac{\Gamma((\upsilon+1)/2)}{\Gamma(\upsilon/2)\sqrt{\pi(\upsilon-2)}}(1+\frac{\eta_t^2}{\upsilon-2})^{-\frac{\upsilon+1}{2}} \text{--------------------} (3.9)$$

Here, $\Gamma(.)$ represents the gamma function. The number of parameters to be estimated is represented by the degree of freedom. The student's t distribution is symmetric around mean value "0" and for $\upsilon > 4$, the conditional kurtosis is exactly equals to $3(\upsilon-2)(\upsilon-4)^{-1}$ which is obviously more than the kurtosis value of a normal distribution i.e. 3. For $\upsilon \to \infty$, the PDF of student's t distribution converges to the PDF of a standard normal distribution.

3.3.2 Generalized Error Distribution

Nelson (1991) proposed the use of GED for stock returns with extra kurtosis; (Probability Density Function) PDF of GED could be expressed as follows:

$$f(\eta_t) = \frac{\upsilon \exp(-0.5|\eta_t / \lambda|^{\upsilon})}{2^{(1+\frac{1}{\upsilon})}\Gamma(\upsilon^{-1})\lambda} \qquad \upsilon > 0 \text{------------------------} (3.10)$$

Here, υ is the shape parameter, which governs the peakedness and fat tail of the PDF with underlying constraint of $\upsilon > 0$, and $\lambda \equiv \left[2^{(-2/\upsilon)}\Gamma(1/\upsilon)/\Gamma(3/\upsilon)\right]^{1/2}$ is the skewness parameter with -1<λ<1. For $\upsilon = 2$, η_t follows a standard normal distribution. For $\upsilon < 2$, PDF shows thick tails than standard normal distribution (e.g. If, $\upsilon = 1$, η_t is double exponentially distributed). On the other hand, if $\upsilon > 2$, PDF of η_t has thinner tails than standard normal distribution (e.g. if, then PDF of η_t follows uniform distribution in the interval of ($-\sqrt{3}$, $\sqrt{3}$). The conditional kurtosis could be expressed as $(\Gamma(1/\upsilon)\Gamma(5/\upsilon))/(\Gamma(1/\upsilon))^2$.

It has been observed that PDF choice has a particular impact on some models, such as in EGARCH model used in this study, the term $E|\eta_t|$, surely depends upon the PDF.
For normal distribution:

$$E(\eta_{t-i}) = \sqrt{\frac{2}{\pi}} \text{----------------------------------} (3.11)$$

For student's t distribution:

$$E(|\eta_{t-i}|) = \frac{2\Gamma(\frac{1+\upsilon}{2})^2\sqrt{(\upsilon-2)}}{1+\sqrt{\pi}(\upsilon-1)\Gamma(\upsilon/2)} \text{-------------------------} (3.12)$$

For Generalized Error Distribution:

$$E(|\eta_{t-i}|) = \lambda 2^{1/\upsilon}\frac{\Gamma(2/\upsilon)}{\Gamma(1/\upsilon)} \text{----------------------------} (3.13)$$

Several financial time series share following three common characteristics, often called "stylized facts". First, Volatility clustering i.e. small variations has a tendency to be followed by small variations and large variations have a propensity to be followed by large variations (Mandlebrot, 1963). Second, quite often, distribution of financial time series is leptokurtic. Excess kurtosis is more than zero, which is zero for a standard normal distribution (Mandlebrot, 1963; Fama, 1965). Third, negative shocks induce more volatility in the stock prices than the positive shocks of same magnitude, known as "leverage-effect" or asymmetric response to good and bad news Black (1976).

GARCH family of models does not entirely incarcerate the fat tails characteristic of high frequency series of financial data. This has obviously led the academicians and practitioners to a new direction i.e. use of non-normal distributions, to improved modeling of excess kurtosis. Bollerslev (1987), Baillie and Bollerslev (1989), Kaiser (1996) and Beine, Laurent and lecourt (2000), suggested the use of student's t distribution. On the other hand, Nelson (1991), and Kaiser (1996) recommend generalized error distribution for such an instance, on hand.

This study aims to take care of the above three characteristics of the financial time series by using (1) Autoregressive conditional heteroskedasticity model; (2) respective underlying distribution; and (3) EGARCH model. Finally, Z-test will be used to compare the proportions of simultaneous increase or decrease of DME and volatility.

3.4 Data Description

In Pakistan SSFs were introduced on 10th July, 2001, when derivatives trading in 10 stocks was initiated. The number of SSFs listed stocks kept on increasing and decreasing based on the eligibility criteria regulated by Securities and Exchange Commission of Pakistan. In a response to Global economic crisis, SSFs trading was discontinued for a few months, which were again resumed on July 27, 2009 in 18 stocks, renewing the availability of margin financing with introduction of index based stock market and modified trading halts via widening circuit breakers. The sample period is comprised of the resumption episode. One year daily closing prices' observations on each side of the event date are used to examine the effect of the introduction of SSFs contracts. The data is collected from online database of "Business Recorder", a premier daily business newspaper.

4: Analysis & Discussion

Market efficiency model:

Results for the market efficiency model are reported in Table 1, using the partial adjustment process model (equation 3.1). The table reports that degree of market efficiency "γ" for each stock is calculated for pre and post periods for both SSFs and Non SSFs. Comparison of "γ" reveals that out of eighteen SSFs, market efficiency has increased for 10 stocks, while it has decreased in the remaining eight stocks. On the other hand, application of similar approach to non-SSFs, resulted an increase in seven stocks, and decrease is observed in remaining nine stocks. Table 1B reports comparison between degree of market efficiency for pre and post periods. Paired sample t test showed insignificant difference between pre and post periods for both SSFs and non-SSFs. On the other hand, volatility is measured using ARIMA-EGARCH model (3.7 & 3.8), underlying different distributional assumptions for both SSFs and NONSSFs.

Table 2 reports descriptive statistics for SSFs and Non-SSFs. Skewness and kurtosis are presented along with Jarque Berra (JB) and Augumented Dicky Fuller

(ADF) tests, which are used to examine the normality and stationarity of the underlying stock returns distribution. The skewness, kurtosis and JB report that null hypothesis of normality of underlying distribution has rejected or not in each case. The aforementioned tables also indicate the absence of unit root in each return series using ADF test. Box and Jenkins methodology was used for for selection of mean equation ARIMA-EGARCH model. Several provisional equations with varying ARMA orders have been estimated, depending upon the autocorrelation function (ACF) and partial autocorrelation function (PACF). For each stock, ARMA equations with least Akaike information criterion (AIC) and Schwarz's Bayesian information criterion (SIC) are selected for later incorporation in ARMA-EGARCH model to measure volatility change. In addition, skewness, kurtosis, Jarque Berra test and ARCH effect were examined for further analysis of normality and heteroscdasticity effect.

Finally, ARIMA-EGARCH model (equations 3.7 & 3.8) is applied with dummy variable assuming value "1" for pre and value "0" for post period, on each stock, using normal, GED, and t distribution, which ever fitted the best on the basis of JB, skewness and kurtosis. Results are shown in Table 3 and 4. For SSFs, an insignificant increase is observed for 15 stocks while an insignificant decrease is seen in remaining three SSFs stocks. Moreover, for Non-SSFs, an insignificant increase is evident in case of 11 stocks and significant increase in only one stocks while insignificant decrease in remaining four Non-SSFs stocks.

So, it may be interpreted that an insignificant change has been observed, both, in DME and volatility. Furthermore, Z test is used to check that whether proportion of simultaneously DME and volatility is different from simultaneously decreasing DME and volatility. Tables 5 and 6 report that, for SSFs, the proportion of stocks with increasing DME and volatility are significantly different (greater) than the ones with decreasing DME and volatility at 10% level of significance. The same test resulted in an insignificant difference for Non-SSFs.

5: Conclusion

This study examines the impact of introduction of equity trading in Pakistan on market efficiency and price volatility of underlying stocks. Using various econometric specifications and models, our empirical results fails to find any consistent patterns in terms of changes in stock price volatility and market efficiency for the underlying SSFs stocks in the post futures period. We also employ a control sample methodology to examine whether events other than the trading in the futures contract can explain price volatility and efficiency dynamics of the stocks. Results also fail to report any consistent pattern in the price volatility and efficiency of non-SSFs stocks. These results are consistent with some of the earlier studies that derivatives trading may not necessarily be associated with the destabilization of the underlying asset market.

Table 1: DEGREE OF MARKET EFFICIENCY FOR SSFs and Non-SSFs

	Degree of Market Efficiency					Degree of Market Efficiency		
SCRIP	BEFORE	AFTER	INC/(DEC)		SCRIP	BEFORE	AFTER	INC/(DEC)
OGDC	1.875	1.896	0.02137		ABL	1.893	1.961	0.06759
MCB	1.895	1.925	0.02974		APL	1.99	1.948	-0.04216
PPL	1.932	1.912	-0.01963		ARL	1.855	1.89	0.03488
HUBCO	1.914	1.952	0.03755		DHC	1.899	1.746	-0.1433
PSO	1.904	1.904	-0.00004		EFU	1.895	1.931	0.03541
POL	1.845	1.912	0.06758		FCCL	1.965	1.943	-0.02263
NBP	1.836	1.883	0.04618		HBL	1.895	1.935	0.04069
UBL	1.93	1.906	-0.02462		MGCL	1.794	1.821	0.0266
EC	1.753	1.943	0.1897		MLCF	1.922	1.945	0.02328
DGKC	1.901	1.897	-0.00373		NRL	1.879	1.924	0.04513
PTCL	1.935	1.875	-0.06037		BAHL	1.932	1.899	-0.03362
BAF	1.927	1.962	0.03501		ACBL	1.979	1.872	-0.10692
FFBQ	1.983	1.907	-0.07538		KTM	1.954	1.955	-0.00131
LUCK	1.887	1.886	-0.00009		KAPC	1.901	1.853	-0.04759
NM	1.906	1.847	-0.0592		TELE	1.966	1.966	-0.11264
AJI	1.903	1.962	0.05973		NCL	1.936	1.875	-0.06101
FFC	1.939	1.968	0.02926					
AN	1.745	1.903	0.1575					

Table 1B: Paired Sample T Test for Pre to Post Degree of Market Efficiency Change

Category	Exact Significance (two-tailed)
SSFS	2.1098
Non-SSFS	2.1314

Table 2: Descriptive statistics for SSFs and Non-SSFs stocks

Panel A: Descriptive statistics for SSFs					**Panel B: Descriptive statistics for Non-SSFs**				
SCRIP	Sk	KT	JB	ADF	SCRIP	Sk	KT	JB	ADF
OGDC	-0.32554	2.873254	0.209805	-12.4669*	ABL	-0.2625	3.0211	2.8535	-13.3071*
MCB	-0.154395	2.381254	4.9438***	-13.6362*	APL	0.1652	81.4152	63540.26*	-18.0055*
PPL	-1.677695	15.19358	1652.735*	-17.0239*	ARL	-0.1526	2.0358	10.5683*	-12.1561*
HUBCO	0.095563	4.456982	22.31304*	-15.1798*	DHC	0.0549	2.4916	2.7953	-12.1904*
PSO	0.147066	2.550685	2.980098	-14.2804*	EFU	-0.0481	2.0631	9.1661**	-11.7300*
POL	0.138458	2.416299	4.313023	-14.0836*	FCCL	0.3725	6.6229	141.3641*	-18.03002*
NBP	-1.260473	11.12095	747.1521*	-13.7522*	HBL	-1.2601	11.8496	874.8940*	-15.0500*
UBL	-0.039292	2.531193	2.334877	-14.5948*	MGCL	-8.7403	114.1234	130757.8*	-13.8483*
EC	0.27347	3.111065	3.218608	-12.6299*	MLCF	0.5801	6.9346	173.8759*	-17.0440*
DGKC	-0.10744	2.166987	7.64755**	-13.1086*	NRL	0.174	2.6543	2.4861	-11.9650*
PTCL	0.1528	3.076405	1.025373	-13.1244*	BAHL	5.3597	61.7473	36850.25*	-17.0949*
BAF	0.291715	3.302951	4.465763	-14.9085*	ACBL	-0.8461	8.8369	381.6455*	-15.3538*
FFBQ	-0.320218	5.128466	51.0521*	-17.7165*	KTM	0.6371	4.6822	46.0182*	-17.3644*
LUCK	-0.104442	2.391584	4.275965	-13.6604*	KAPC	0.0568	4.1279	13.2787*	-15.4637*
NM	-0.145648	2.051902	10.16534*	-14.7131*	TEL	0.1584	12.9416	1022.3390*	-18.3480*
AJI	-0.216157	2.267449	7.47644**	-12.8236*	NCL	0.11090	2.86462	0.697779	-14.86816*
FFC	-2.892661	25.4679	5562.188*	-13.9002*					
AN	-0.247365	2.694462	3.493817	-11.9587*					

Note: ***, **, *** represents significance at 1%, 5% and 10% respectively**

Table 3: ARIMA-EGARCH MODEL FOR SSFs:

	OGDC	MCB	PPL	HUBCO	PSO	POL	NBP	UBL	EC
AR		0.114533(1)**	0.771633(1)*	-0.16435(3)**	0.016453(19)	0.72499(28)*	0.04636(1)	-.15168(14)*	0.13325(1)** *
				-0.02455(17)				0.100435	0.137716(10)**
				0.11032(18)**					-.11064(17)**
									-.13792(29)*
MA	0.172821(1)*		-0.78882(1)*			-.67475(28)*			
	-0.13649(23)**								
ω	-6.99E-01	-0.01194	-0.26025	-1.26582	-0.67348	0.226795**	-0.10636*	-0.06303	-2.63649***
β	0.1277	-0.0443	0.165277***	0.29373**	0.208451**	-0.05629*	-0.02538**	-0.02402	0.49329*
α	0.011194	0.031145	0.106754**	0.067343	-0.00564	0.949092	0.056622**	0.06523	0.073967
γ	0.939111*	0.995391*	0.985529*	0.893942*	0.946693*	1.000605*	0.986445*	0.991525*	0.76614*
Dum	0.025405	0.002263	-0.00807	0.020609	0.009692	0.002856	0.00154	0.006801	0.148475
Dist	Normal	Normal	GED	GED	Normal	Normal	GED	Normal	Normal
	DGKC	PTCL	BAF	FFBQ	LUCK	NM	AJI	FFC	AN
AR		0.092912(1)	0.096685(22***	-0.59651***	0.121457(1)**	0.158186(7)**		0.013708(1)	0.129226***
		-0.15015(3)**				-0.12732(26)***		-0.13623(4)*	
		0.214805(7)*						-0.04334(5)	
								-0.07525(8)	
MA	0.189049(1)*		-0.20844(9)*	0.528285			0.238619(1)*		
			-0.09569(18)***				-0.1125(21)**		
							-0.18849(23)*		
ω	-0.12875	-0.23007*	-0.06454	-0.24189	0.038815	-0.74745	-4.69854	-1.07655***	-3.33112
β	-0.05236	-0.11272*	-0.03289	0.081865	-0.00629	0.153171	0.339896	0.202964	0.335041
α	-0.03981	0.096733**	0.101677*	0.17267*	0.04361	0.024043	-0.04209	0.212384**	-0.0644
γ	0.98224*	0.966118*	0.991345*	0.980359*	1.003706*	0.929444*	0.508973	0.911948*	0.66189
Dum	0.026055	0.020546*	0.013844	0.008368	-0.01344	-0.00454	0.370167	0.122625	0.302411
Dist	Normal	Normal	Norma	GED	Normal	Students' t	Students' t	GED	Normal

Table 4: ARIMA-EGARCH MODEL FOR NONSSFs:

	ABL	APL	ARL	BAHL	EFU	FCCL	HBL	MGCL
AR	-0.0632(14)			-0.0700(6)**	0.2013(1)*	-0.2104(1)*	0.1279(1)***	0.6113(1)*
	-0.1250(20)			0.0678(11)**	-0.1280(4)***	-0.1635(2)*		
				-0.0903(13)*		0.1442(15)*		
				-0.0606(14)***		-0.1237(23)*		
MA		-0.0698(1)***	0.1985(1)**		-0.2488(16)*			-0.2698(1)**
ω	-0.7001***	-1.2032***	-5.6394	-6.3755*	-0.2913***	-15.7605*	-10.5293*	-5.347318
β	0.2840**	0.3384*	0.4101	0.8527*	0.0356	-0.1646	0.5537*	0.2483
α	0.0559	-0.0017	0.0442	-0.2765**	0.0569	-0.0266	0.1391	-0.0171
γ	0.9496*	0.8965*	0.4026	0.3854**	0.9685*	-0.7289***	-0.1061	0.3763
Dum	-0.0082	0.1018	0.2325	-0.1402	-0.0092	1.4878**	0.5312	0.0425
Dist	Normal	GED	Students' t	GED	Normal	GED	GED	GED
	MLCF	NRL	DHC	ACBL	KTM	KAPC	TELE	NCL
AR		0.1110(1)	0.1179(1)***	-0.1082(4)		0.0847(10***		-0.09129(21)
		-0.1826(2)**		0.0012(22)				-0.08523(25)
		0.0597(13)						
		0.1623(24)*						
MA	0.0551(1)				-0.0784(30)		-0.2174(1)*	
							-0.0104(26)	
ω	-0.324	-1.4296	-1.3300*	-0.5298***	-1.73861**	-3.3499	-0.7355**	-1.801833
β	0.0453	0.2355***	0.5368*	0.1953***	0.284487***	0.4781***	0.3112**	0.330684**
α	0.0692	0.0112	0.1162	0.1294**	0.225197**	-0.0466	0.1346	-0.03184
γ	0.9684*	0.8708*	0.8980*	0.9608*	0.808448*	0.7008*	0.9337*	0.811708*
Dum	0.0333	0.0584	-0.0598	0.0056	0.049501	0.0772	0.0482	0.015306
Dist	GED	Normal	Normal	GED	GED	GED	GE	Normal

Table 5: Simultaneously increasing and decreasing Volatility and DME

VOL & DME	SSFs (No.)	NON-SSFs (No.)
Increased	10	6
Decreased	3	2
Opposite	5	8
Total	18	16

Table 6: Comparison of simultaneously increasing and decreasing Volatility and DME

		Category	N	Observed Prop.	Test Prop.	Exact Sig. (2-tailed)
SSFs	Group 1	1.00	10	.77	.50	.092*
	Group 2	0.00	3	.23		
	Total		13	1.00		
NONSSFs	Group 1	1.00	6	.75	.50	.289
	Group 2	0.00	2	.25		
	Total		8	1.00		

*, **, *** represents significance at 10%, 5% and 1% respectively

Annexure-I: Contract Specifications of Deliverable Future Contracts

Contract Size	500 Shares
Position Limits	As prescribed under Regulations Governing Risk Management of Karachi Stock Exchange, as amended from time to time
Daily Price Limits	As provided under Regulations Governing Risk Management of the Exchange
Contract Period	1 calendar month
Opening of Contract	Monday preceding the last Friday of the month, if Monday is not a trading day, then immediate next trading day
Overlapping Period	Maximum Five Days (not less than two days).
Expiration Date/ Last trading day	Last Friday of the calendar month, if last Friday is not a trading day, then immediate preceding trading day
Settlement	T+2 settlements falling immediate after the close of contract
Depository of underlying security	Central Depository Company of Pakistan Limited

Source: "Regulations Governing Deliverable Futures Contract of the Karachi Stock Exchange (Guarantee) Limited", as amended on June 06, 2011.

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