REPERCUSSION OF FUTURES TRADING ON SPOT MARKET: EVIDENCE FROM INDIA

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ABSTRACT

This paper examines the repercussions on the underlying spot market volatility due to the introduction of futures market in India for the period from January 1, 1995 to December 31, 2011. The overall sample size consists of 4053 observations of S&P CNX Nifty, S&P CNX Nifty Junior and S&P CNX 500. The dataset for the analysis divided into pre and post futures, respectively. The pre-futures period consists of 1168 observations spanning from January 1, 1995 to June 12, 2000 and the post-futures period is from June 13, 2000 to December 31, 2011, because derivatives market was introduced in India on June 12, 2000. To measure the volatility of the stock market, the GARCH (1,1) Model under Maximum Likelihood Estimation and Chow Break Point were used by examining Z-statistic and Log Likelihood Ratio. In addition to that, the stock market volatility was investigated by using day of the week effect which existed in pre-futures period and not present in post-futures period. The result of the study indicates that there is a significant decrease in the domestic market volatility. It is mainly due to the influence of global factors on the underlying spot market. Therefore, the study concluded that the index futures are playing a very significant role in mitigating the volatility of the market and has contributed towards increased market efficiency. Finally, the spill over in the futures market lead to spot market, thereby making the spot market unstable.

Keywords: Returns, GARCH Model, Chow Break Point test, Volatility, Efficiency

INTRODUCTION

The Indian capital market has witnessed a major transformation and structural reforms during the past one decade, in the wake of liberalization and globalization. The financial sector reforms attracted the academicians, researchers and practitioners to learn more about derivatives and derivatives markets operations and their implications. The initiatives taken by the regulatory authority mainly emphasized on the objectives such as improving market efficiency, enhancing transparency, checking unfair trade practices, and bringing the Indian capital market up to international standards. As a result of these reforms, numerous changes have been inculcated in the operations of the secondary markets such as automated online trading, reduction in the settlement period and providing more opportunities for foreign portfolio investors and the like. In addition to these developments, the Indian market is being considered to be one of the emerging markets in the world, which has introduced derivative products in line with the other developed counterparts, facilitating risk management to investors.

The future market trading in Indian financial markets was introduced in June 2000 and options index was commenced from June 2001. Subsequently, the options and futures on individual securities trading were commenced from July 2001 and November 2001, respectively. Moreover, both futures and options trading on S&P CNX 100 and Nifty Junior indices have been started from 1st June, 2007 in National Stock Exchange (NSE). The derivatives trading have grown rapidly in recent times and witness maximum trading volume in futures and options segments at National Stock Exchange. The derivatives trading provides important economic functions such as price discovery, portfolio diversification and opportunity for market participants to hedge against the risk of adverse price movements. Hence, the introduction of derivatives market makes a significant influence on corresponding spot markets. The movements of the spot market price have been largely influenced by speculation, hedging, and arbitrage activity of futures and options markets. Therefore, the debate on the impact of derivatives trading on spot market volatility has become increasingly important research issue among academicians, regulators and investors alike.

The main objectives of our study is to probes into the repercussions on the underlying spot market volatility due to the introduction of the derivatives in Indian stock market by using day of the effect. From the theoretical point of view, the impacts of derivatives trading on volatility of underlying spot markets are still controversial. One view is that, the introduction of derivatives market increases spot market volatility due to the fact that high degree of leverage benefits and low transaction costs in derivatives market are likely to attract larger uninformed traders. The lower level of information of derivatives traders with respect to spot market traders is likely to increase the spot market volatility. One of the main limitations of the earlier analyses on the impact of underlying spot market volatility is that they are all performed by GARCH (p,q) model. Meanwhile, the results from S&P CNX nifty spot market will be interesting for several reasons. First, the noise trading is the cause of asymmetric responses, which was not significantly affected by such market participants. Second, the introduction of futures and options trading has enhanced the speed and quality of information flowing in spot market. Furthermore, the world's capital markets have integrated and developed in recent years, studies on S&P CNX Nifty security markets have been spare quantitatively. The Empirical results from these markets are of great importance for the increasing group of people, who are planning to operate in futures and options segments of capital markets in the future.
Conversely, the introduction of derivatives trading reduces the spot market volatility because of low cost contingent strategies and high degree of leverage benefits in derivatives market attracts larger speculative traders from a spot market to a more regulated futures and options market segments. This makes the spot market less volatile through reducing the amount of noise trading. The proponents of 'market completion' hypothesis argues that derivatives trading helps in price discovery, improve the overall market depth, enhance market efficiency, increase market liquidity and ultimately reduces informational asymmetries and therefore compress spot market volatility. We present a brief review of antecedent literature in Section 2. Section 3 introduces the data and sample size conducted in this study. Section 4 describes brief discussion about Econometric methodological issues concerning to the repercussions on the underlying spot market volatility due to the introduction of the derivatives in Indian stock market by using day of the effect for pre and post period, while Section 5 incorporates the data used and validity of the assumptions made about the model. Finally, Section 7 summarizes and concludes.

REVIEW OF LITERATURE

Though there is a vast amount of literature focusing on the impact of derivative trading on spot market volatility in developed markets. Figlewski (1981) studied the impact of futures trading on Government National Mortgage Association (GNMA) by using standard deviations of the returns and concludes that the volatility of underlying asset were increased after the introduction of futures markets. The introduction of futures trading has not induced any change in spot market volatility in the long-run, but the futures markets induced short-run volatility on the expiration days of futures contracts Edwards (1988). Harris (1989) examined the volatility effects for pre-futures and post futures and suggests the increase in volatility was a common phenomenon in different markets and index futures may not be the cause. Bessembinder and Seguin (1992) examined the dynamic relationship between futures trading activity and spot market volatility for United States. Kamara et.al (1992) investigated the impact of futures trading on spot market and indicates the volatility of daily returns in post futures period was higher than the pre futures period. Antoniou and Holmes (1995) found that the introduction of stock index futures caused an increase in spot market volatility in the short run while there was no significant change in long run. Butterworth (2000) found no significant change in the volatility of FTSE-250 index after onset of futures trading. Board, Sandmann and Surcliffe (2001) investigate the regulatory concern and the results of other papers, contemporaneous information less futures market trading has no significant effect on spot market volatility.

Several studies, both theoretical and empirical analyze the relationship between the spot and futures markets. The early study by Similarly, Kawaller et al. (1987) use minute to minute data on the S&P 500 spot and futures contract and prove that futures lead the cash index by 20-45 minutes. Herbst, McCormack and West (1987) examine the lead lag relationship between the spot and futures markets for S&P 500 and VLCI indices. They find that for S&P 500 the lead is between zero and eight minutes, while for VLCI the lead is up to sixteen minutes. Stoll and Whaley (1990) find that S&P 500 and MM index futures returns lead the stock market returns by about 5 minutes. Similarly, Cheung and Ng (1990) analyze price changes over fifteen minute periods for the S&P 500 index using a GARCH model. Chan, Chan, and Karolyi (1991) use a bivariate GARCH model and find that S&P 500 futures returns lead spot returns by about five minutes. Abhyankar (1995) observed that futures market leads spot market returns during the period of high volatility. Turkington and Walsh (1999) examine the high frequency relationship between SPI futures and AOI in Australia and evidenced bidirectional causality between the two series. Kavussanos and Nomikos (2003) investigated the casual relationship between futures and spot prices in the freight futures market and found that futures price tend to discover new information more rapidly than spot prices.

Thus the empirical works on derivatives market has grown manifold in recent years at national and international level. Bansal, Pruitt and Wei (1989) and Skinner (1989) found that option trading reduces the volatility of underlying spot markets by employing ARIMA model and reveals that active futures market trading are associated with decreased rather than increased volatility of the spot market by enhancing the liquidity and depth of the spot markets. Similarly the studies by Chatrath, Arjun, Ramchander and Song (1995) indicate that S&P 100 options market has a stabilizing effect on the underlying index. Phil Holmes (1996) examined the relationship between futures trading activities and stock market volatility in UK stock market and observed the inception of futures trading has a beneficial impact on underlying spot market. Furthermore, the recent studies of Bologna and Cavallo (2002) for Italy. Thenmozhi (2002), Nath (2003), Raju and Karande (2003), Singh and Bhatia (2006) used the GARCH (1,1) model to study the effect of futures trading on the spot market volatility for India and Goodfellow and Salm (2008) for Poland have found that the onset of stock index futures trading had decreased the volatility of underlying spot market. In contrast, there exists a little work on the repercussion of futures trading on underlying spot market volatility by using day-of-the-week end effect. To shed light on this issue, we employ GARCH (1,1) model to examine the repercussion of futures trading

on underlying spot market volatility for pre and post futures periods by using a dummy variables. Apart from that, we also examined the day-of-the-week end effect by using a dummy variable on both the mean and variance equation. The present research study is helpful to test the market efficiency, market setting, anomalies in investor behavior and its applicability for the futures markets. An exhaustive literature review has been carried to identify the gap for the sake of sake of clarity and simplicity

DATA & METHODOLOGY

The dataset comprises of daily stock returns for the period from October 4, 1995 to December 31, 2011 for S&P CNX Nifty, S&P CNX Nifty Junior and S&P 500 to analyze the repercussion of futures trading on spot market volatility. Apart from this, the study also considered day-of-the-week end effect by including dummy variable to measure the return and volatility of the series by employing GARCH (1,1) model and Chow Break Point test was used to compare the structural changes in volatility during pre and post period. The pre and post future period consists from 4th October 1995 to 12th June 2000 and 13th June 2000 to 31st December 2011, respectively. The data was retrieved from NSE (National Stock Exchange) and the contract specifications and trading details are available from their website. The reason for distributing pre and post is introduction of derivatives took place in June 12, 2000. The S&P CNX Nifty is a well diversified stock index comprises of 50 most liquid stocks accounting for 23 sectors of the economy. The CNX Nifty Junior index returns are used as a proxy for domestic market market-wide factors and the S&P 500 index returns are used as a proxy for global market-wide factors. The closing price indices were converted to daily compounded return by taking the log difference as $R_t = \log (P_t/P_{t-1})$, where P_t represents the value of index at time t. S & P CNX Nifty is owned and managed by India Index Services and products Limited (IISL), which is a joint venture of NSE and CRISIL. All the observations are transformed into natural logarithms so that the price changes in returns prevent the non-stationary of the price level series approximate the price volatility.

The Engle (1982) Autoregressive Conditional Heteroscedasticity (ARCH) model is the most extensively used time-series models in the finance literature. The ARCH model suggests that the variance of residuals at time *t* depends on the squared error terms from past periods. The residual term ε_{it} is conditionally normally distributed and serially uncorrelated. The strength of the ARCH technique is that it uses the established and well specified models for economic variables; the conditional mean and conditional variance are the only two main specifications. A useful generalization of this model is the GARCH parameterization. Bollerslev (1986) extended Engle's ARCH model to the GARCH model and it is based on the assumption that forecasts of time varying variance depend on the lagged variance of the asset. The GARCH model specification is found to be more appropriate than the standard statistical models, because it is consistent with return distribution, which is leptokurtic and it allows long-run memory in the variance of the conditional return distributions. The relationship between information, underlying spot market volatility and repercussion on futures trading has to be expressed with the following equation:

$$R_t = \beta_0 + \beta_1 R(NiftyJr)_{t-1} + \beta_2 R(S\ \&\ P500)_{t-1} + \sum_{i=t}^{5} \beta_3 Day + e_t$$

$$\varepsilon_t \mid I_{t-1}\ N(0, h_t),$$

$$h_t = \alpha_0 + \sum_{i=1}^{p} \alpha_1 h_{t-1} + \sum_{j=1}^{q} \alpha_2 u_{t-1}^2 + \alpha_3 D_F$$

Where, R_t and h_t refers to the spot returns of the S&P Nifty Index at time't' and conditional volatility, respectively . The β_1 refers to Nifty Junior Index is the daily changes in natural log prices for a proxy variable to capture market wide volatility. The global market wide factors are denoted by β_2, which is the lagged S&P 500 index and the introduction of day-of-the-week dummy variables to Monday, Tuesday, Wednesday, Thursday and Friday effect, respectively. The proxy variables remove market-wide influences, world market influences and day-of-the-week effect, the error captures the repercussion of specific factors towards the introduction of derivatives in underlying spot markets. In the conditional variance equation, the dummy variables from Tuesday, Wednesday, Thursday and Friday was included to measure the market volatility and persistent of information towards market shocks over the period of time.

In order to measure the distributed properties between the two phases like pre-futures and post-futures, we employed Chow Break Point test to estimate the parameter stability in the mean equation, by assuming constant unconditional variance. The chow break point test is calculated as follows:

$$F = [(SSE_r - SSE_f)/m][SSE_f/(T-2m-k-1)]$$

Where, SSE_r stands for the sum of squared residuals of the restricted regression, SSE_f are the sum of squared residuals of the unrestricted equation. Finally *T* and *m* refers to number of observations and their optimal lag structure respectively. The repercussion of futures trading on spot market volatility is examine first by testing for ARCH effect in the time series and again tested by using GARCH model by including dummy variable and compared by developing separate GARCH model. The information efficiency is tested using unconditional variance, persistence of volatility and by testing the structural change in the pre and post period using Chow Break Point test.

RESULT & DISCUSSION

The marginal decline in volatility of Nifty, Nifty Junior and S&P 500 were explained in cannot be ascribed to the repercussion on future trading on spot market volatility are based on the assumption of constant variance. The assumption will have a significant inference to the volatility has to be measured and compared using a model capturing the time varying variance. The maximum likelihood estimation of GARCH (1,1) model of the Nifty returns from October 1995 to December 2011 is estimated for the present of any ARCH/GARCH effects, and it is implicated that heteroscedasticity is present in the model since ARCH/GARCH terms are significant are presented in Table: 1. The analysis shows that both market-wide factor and world market factor, as represented by Nifty Junior returns and lagged S&P 500 returns, are found to be significant factors in explaining the Nifty returns. In the mean equation, the dummy variable for Wednesday was statistically significant at 1 per cent level. But all the other days were observed with insignificant effect. Here, $\alpha_1$coefficient was indicated with 0.15616 and α_2 is 0.788804, which suggests that the past conditional variance has greater impact on spot market volatility than the recent news.

Table: 1 Maximum Likelihood Estimates for the GARCH (1,1) Model

Parameters	Coefficient
β_0 Intercept	0.003891 (0.6104)
β_1 Nifty Junior Returns	-0.01620 (- 1.860)
β_2 S & P 500 Returns	0.011514 (0.7202)
β_3 Tuesday Dummy	-0.000410 (-0.430)
β_4 Wednesday Dummy	0.002876* (3.250)
β_5 Thursday Dummy	-0.001989 (-2.350)
β_6 Friday Dummy	-0.000383 (-0.420)
α_0	0.413347* (18.46)
α_1	0.15616* (4.8702)
α_2	0.788804* (5.740)
Unconditional Variance	0.719023
Persistence of Volatility	0.02314

Note: Figures in the parenthesis report z-Statistics. * & b significance at the 0.01 & 0.05 per cent level respectively.

The Figure: 1 to 4 demonstrates that the model is able to clearly capture the temporary increase in the volatility leading up to the introduction of the futures contracts in the first one year of October 1995 to December 2012. Further, one can observe that volatility during post-futures is higher than pre-futures except for a few spikes in the initial and fag end of post future period. However, it would be better to examine more empirically whether the spot index value has changed before and after the introduction of futures.

Figure: 1 ARCH Effect for S&P Nifty from October 1995 to December 2011

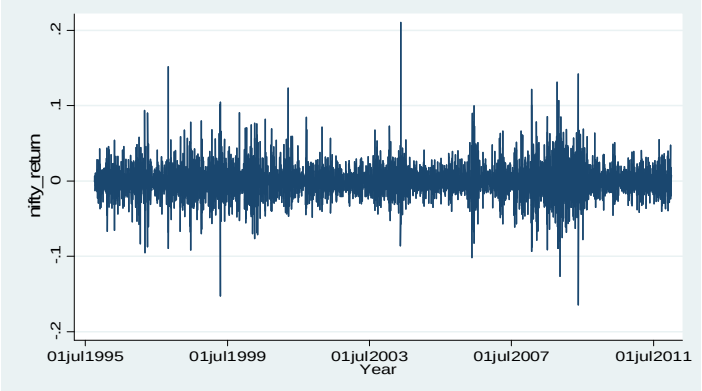


Figure: 2ARCH Effect for S&P Nifty Jr from October 1995 to December 2011

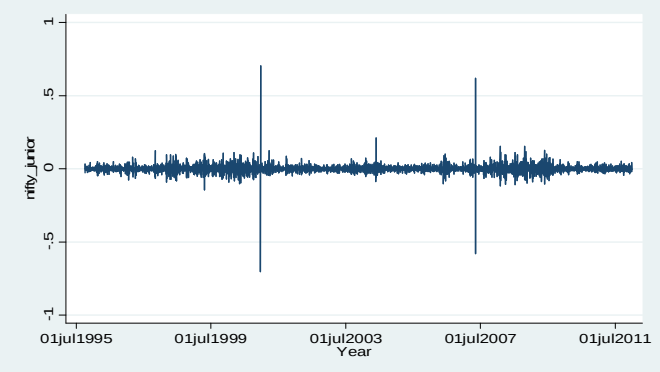


Figure: 3 ARCH Effect for S&P 500 from October 1995 to December 2011

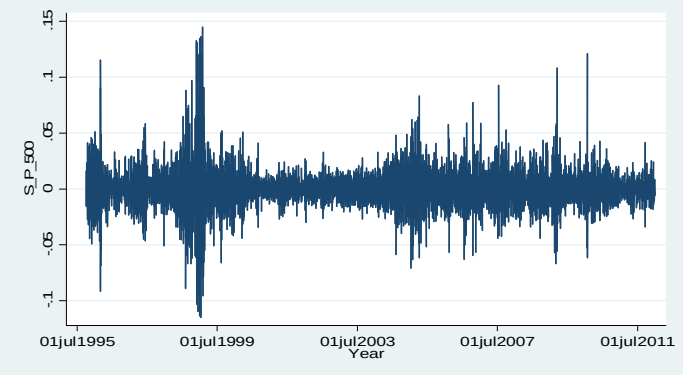
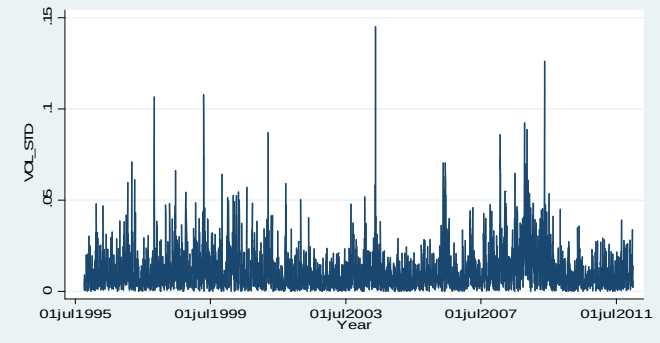


Figure 4: Volatility for Nifty Returns from October 1995 to December 2011



The GRACH (1, 1) model was augmented with the dummy variable D_F that takes value zero for the pre-futures period and one for the post-futures period. This dummy permits to determine whether the inception of Nifty futures contract be associated with any transformation in the volatility of the spot market. The results presented in Table: 2 show that the co-efficient of Nifty Junior return and S&P 500 are not significant at the 5 per cent level. In addition, the measure of the effect due to the introduction of stock index futures is make a significant impact on the commencement of stock index futures resulted in increasing stock volatility marginally. This preliminary finding does not accept the hypothesis that the introduction of stock index futures has no effect on underlying spot market volatility. In GARCH (1,1) model α_1 with 0.15616 and α_2 at 0.748804, respectively. The data seems to suggest that past conditional variance has a considerably impact on spot market returns than recent news proclamation.

Table: 2 Estimates for the GARCH (1,1) Model with Future Dummy

Parameters	Coefficient
β_0 Intercept	0.00308 (0.43021)
β_1 Nifty Junior Returns	- 0.01669(- 1.860)
β_2 S & P 500 Returns	0.011496 (0.7202)
β_3 Tuesday Dummy	-0.000410 (-0.430)
β_4 Wednesday Dummy	0.002714* (3.250)
β_5 Thursday Dummy	-0.002689* (4.085)
β_6 Friday Dummy	-0.005471 (-0.854)
α_0	0.413347* (18.46)
α_1	0.15616* (4.8702)
α_2	0.748804* (5.740)
Unconditional Variance	0.719023
Persistence of Volatility	0.02314

Note: Figures in the parenthesis report z-Statistics. * & b significance at the 0.01 & 0.05 per cent level respectively.

In order to inspect the phenomenal structural changes of facilities such as installation of an electronic trading system, margin trading, dematerialization of stocks etc., and its impact on the efficiency of the market and thereby lessening the volatility, two GRACH (1,1) models, one for the pre-futures period and the other for the post-futures period, have been employed to observe how the estimate of the GARCH coefficients change from one period to another. The Table: 3 illustrate the estimates of two GRACH (1, 1) models, one for the pre-futures period and the other for the post-futures period. The first aspect to be inspected is whether the introduction of index futures has led to a change in the nature of volatility by examining the change in unconditional variance. The increase of α0 post futures together with the changes in α1 and α2 indicates that there has been an increase in the unconditional variance. The unconditional variance is 0.589815 pre-futures and 0.912926 post-futures which exhibits that the spot market volatility has increase after the introduction of stock index futures in the Indian stock market.

The information efficiency in the pre and post derivatives period has been evaluated by examine the effect of α_1 and α_2, examining the persistence of volatility and change in the β_4, β_5 and day-of-the week. The value of α_1 in the pre-futures is 0.282518, whereas it has decreased in post futures to 0.101711, suggesting a decrease in volatility. α_1 is the coefficient relating to the lagged squared error term. In the context of this analysis, the lagged error term relates to the changes in the spot price on the previous day that is attributable to market-specific factors, i.e., non-market-wide factors. Assuming that markets are well-organized, these price changes are due to the influx of information in the market that are specific to pricing of Nifty. The less non significant α_1 in post-futures indicates that absence of ARCH effect after introduction of futures trading. α_2 has gone up in the post futures considerably indicates the absence of information efficiency. This result indicates that the information efficiency has declined. However, there are other parameters which have been tested to find out the actual impact of introduction of futures on the informational efficiency.

Thus, it is imperative to look at other factors indicating increased market efficiency in the post futures period. The persistence of volatility has dropped marginally from 0.02492 in the pre-futures to 0.022448 in the post-futures period. The results show that this information effect has come down slightly after the introduction of index futures. These signals indicate that increased market efficiency is observed in the post-futures period. It may also be observed that there is a change in day-of-the-week effect amongst the pre and post-futures periods in terms of the absence of Tuesday and Friday effect in the post-futures period. There is no day-of-the-week effect post-futures. The reduction in of coefficients of β_1 from - 0.085249 in the pre-futures period to - 0.004339 in the post-futures and β_2 from 0.021216 in the pre-futures period to 0.012066 in the post-futures period indicates that there is change in the global market effect and domestic factor effect in the post-futures period. Therefore, it can be inferred that as there is a decline in the value of both these indices in the post-futures period, it indicates that the strength of the relationship between Nifty returns with Nifty Junior and S&P 500 returns has reduced. Thus, the futures introduction has an impact on the spot market volatility and it has increased in the post-futures period.

Table 3: Estimates for the GARCH (1, 1) Model Pre Future Dummy

Particulars	Pre Futures	Post Futures
C	0.00095 (-0.698)	-0.00046 (0.6643)
$\beta R_{Nifty\ Juniort-1}$	-0.0852 (-3.152)	-0.00433 (-0.429)
$\beta R_{S\&P500t-1}$	0.02121 (-0.882)	0.01206 (0.5976)
βT_{Dummy}	-0.0003 (5.2412)	0.00029 (0.2781)
βW_{Dummy}	0.00989 (5.2487)	0.00095 (0.9731)
βTh_{Dummy}	- 0.0063 (-3.771)	-0.00319 (-0.331)
βF_{Dummy}	0.00254 (1.2983)	-0.00072 (-0.748)
C	0.37570 (8.1521)	0.45335 (16.369)
α	0.28251 (6.2453)	0.10171 (2.4932)
β	-0.0804 (-1.1276)	0.40169 (7.8614)
Unconditional Variance	0.589815	0.912926
Persistence of Volatility	0.024928	0.022448

Note: Figures in the parenthesis report z-Statistics. * & b significance at the 0.01 & 0.05 per cent level respectively.

To investigate the structural change in the mean equation pre and post futures introduction, we employed Chow Break Point test on futures to test the parameter stability in the mean equation, assuming constant unconditional variance and envisaged in Table: 4. The Chow Break Point is a formal test to evaluate the stability of the regression co-efficient. The derivatives trading in India was introduced in June 12, 2000. The F-statistic and log likelihood ratio are highly significant at 5 % level. This suggests that there is a structural change, as the coefficients are not the same before and after futures introduction. Thus, it is very much oblivious that the introduction of futures has brought forth a structural change

Table 4: Chow Break Point Test on Futures

F- Statistics	6.1362	Probability	0.00000
Log Likelihood Ratio	48.987	Probability	0.00000

CONCLUSION

This paper examines the repercussions of futures trading on spot market volatility for the period spanning from 1st October 1995 to 31st December 2011 by using the methodology GARCH (1,1) model for pre and post futures trading. The Chow Break Point test also used in this study to identify the structural breaks in the Indian stock market. The result of GARCH (1,1) model augmented with the dummy variable that takes value zero for the pre-futures period and one for the post-futures period. This dummy permits to determine whether the inception of Nifty futures contract be associated with any transformation in the volatility of the spot market. In order to inspect the phenomenal structural changes of facilities such as installation of an electronic trading system, margin trading, dematerialization of stocks etc., and its impact on the efficiency of the market and thereby lessening the volatility, two GRACH (1,1) models, one for the pre-futures period and the other for the post-futures period, have been employed to observe how the estimate of the GARCH coefficients change from one period to another. Our study can be concluded that the index futures are playing a very important role in mitigating the volatility in the Indian stock market and contributed towards increased market efficiency. However, when unexpected volatility is observed in the futures market, the regulators should take necessary steps to curbs the volatility. Otherwise, the excess volatility in the futures market will spill over to spot market, thereby making the spot market unstable.

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