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# Does the Introduction of Stock Index Futures Reduce the Stock Market Volatility

**Mamta Singh**

***Abstract***

*Traditional econometric models assume a constant one period forecast variance. However, many financial time series display volatility clustering, that is, autoregressive conditional heteroscedasticity (ARCH). The aim of this paper is to estimate conditional volatility models in an effort to capture the salient features of stock market volatility in India and evaluate the models in terms of out-of sample forecast accuracy. The paper also investigates whether there is any change in volatility after the introduction of futures. The estimation of volatility is made at the macro level on a major market index, namely, S&P CNX Nifty. In addition, 50 individual companies' share prices currently included in S&P CNX Nifty are used to examine the heteroscedastic behaviour of the Indian stock market at the micro level. The volatility is estimated by fitting different models to the market indices by dividing the study duration into two different time period's, one pre-future and another post-futures -:*

- *Historical moving average model*
- *Standard Generalized autoregressive conditional heterosedasticity GARCH (1, 1) model.*

*The paper found*

- *A strong evidence of time-varying volatility.*
- *A tendency of the periods of high and low volatility to cluster.*
- *A high persistence and predictability of volatility.*

After futures trading has been introduced in all main stock exchanges, the economic literature intensified the debate on the economic and social impact of futures and options trading.

The main argument against futures trading maintains that futures market increases stock market volatility. Support to this argument is based on the observation that, because of their high degree of leverage, futures markets are likely to attract uninformed traders. The lower level of information of futures traders with respect to cash market traders is likely to increase the asset volatility. Another point against futures trading concedes that futures market promote speculation, with the consequence of an increase in the stock market volatility.

The opposite current of literature claims that futures markets play an important role of price discovery, and have a beneficial effect on the underlying cash markets. Both the arguments against and in favor of futures market trading have some validity, and both the reduction in volatility and the increase in volatility outcomes seem to be possible.

The issue of whether and how futures markets affect underlying spot markets has also, then been analyzed empirically. However, the results of this empirical literature are still controversial. Moreover, studies that found evidence of a decrease of market volatility consequent to futures introduction, do not further investigate this effect.

The purpose of this paper is to produce a marginal contribution to this literature by analyzing the effect of futures introduction on the stock market volatility in more detail. In particular, the paper concentrates on two issues: First, an analysis of whether the impact on volatility is entirely due to the introduction of futures trading introduction or if otherwise it can be attributed to other market factors. Second, the study tries to determine if the time the impact on volatility occurs corresponds to the date of introduction of the futures trading.

Most empirical studies test the impact of futures market introduction on futures market volatility using as a breakpoint the date of futures introduction. However, even if the change in volatility is entirely due to futures trading, the effect on volatility might be with a lag reasonable. This paper analyses the Indian stock market. Most of the research done until now relates to the USA and only a small number of recent studies analyses the UK market and very few studies some to other countries.

For the empirical analysis the econometric technique employed in most previous studies is used, that is the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) class of models.

## THEORETICAL FRAMEWORK

Two main bodies of theories exist in the literature about the relationship between futures markets and underlying spot markets. The first group of researches supports the argument that futures trading destabilize the underlying spot market by increasing its volatility. The presence of uninformed traders in the derivatives market is, according to a Cox (1976), the main cause of destabilization of the underlying cash market. Essentially the same argument has been proposed by Finglewski (1981), who asserted that a lower level of information of futures traders, compared with that of cash market participants results in increased cash market volatility.

Stein (1987) came to the same conclusion stating that futures markets attract uninformed traders because of their high degree of leverage; the activity of those traders reduces the information content of prices and increases spot market volatility. More or less the same argument is proposed by Cagan (1981).

There is a voluminous body of literature that examines the effect of futures trading on the volatility of underlying assets for US markets. For instance, the results of Edwards (1988a, 1988b) indicate that stock market volatility for the S&P 500 index decreased following the introduction of a stock index futures contract. Other studies find that there is an insignificant or no relationship between the introduction of a futures contract or the level of activity in the futures contract and stock market volatility for the S&P 500 (Becketti and Roberts 1990; Santoni 1987; Smith 1989). Baldauf and Santoni (1991) also test whether S&P 500 volatility increased since the introduction of futures trading and programme trading, and report **no increase in volatility from trading on derivative contracts**. Furthermore, Harris (1989) suggests that other phenomena, such as, growth in foreign ownership of equities, could account for changes in volatility. In an early study, Froewiss (1978) investigates the market for the US Government National Mortgage Association (GNMA) certificates and find that **spot price volatility has not been influenced by the introduction of futures trading**. Bhattacharya et al. (1986), using a different methodology than Froewiss, also finds no change in spot volatility since the initiation of futures trading in the market for GNMA certificates.

In studies that examine other capital markets, Chiang and Wang (2002) find that the trading of TAIEX futures has a major impact on spot price volatility while the trading of the Morgan Stanley Capital Interntional (MSCI) Taiwan futures does not, and Yo (2001) finds no significant changes in the Hong Kong underlying markets. Lee and Ohk (1992) examine the effect of trading in stock index futures on stock return volatility in Australia, Hong Kong, Japan and the UK, and report no significant increase in Australia and Hong Kong, but a significant one in the rest of the markets.

As regards other underlying assets, Antoniou and Foster (1992) examine the effect of the introduction of a futures contract for Brent Crude Oil on the price volatility in the spot market. Their results reveal no apparent change, and imply that the introduction of a futures market improves the quality of information flowing to the spot markets. Edison et al. (1999) finds an abnormal increase in volatility for three consecutive weeks following the introduction of futures to crude oil prices, but no increase (due to futures trading) in the long term. Santos (2002), in a study for US grain prices, argues that the evolution of futures markets is the principal reason why commodity spot price volatility diminished.

According to Schwarz and Laatsch (1991), futures markets are an important means of price discovery in spot markets. Powers (1970) argued that futures markets increase the overall market depth and informative ness. Stroll and Whaley (1988) stated that futures markets enhance market efficiency. The model proposed by Danthine (1978) implies that futures trading increases market depth and reduces spot market volatility. Bray (1981) and Kyle (1985) presented alternative models asserting that futures trading lower the volatility of the underlying market.

Since the proposed logical arguments both support and reject the proposition of futures markets having a destabilizing effect on spot markets, it is self-evident that the theoretical debate on how futures markets affect underlying stock markets still remains rather inconclusive. Thus the uncertainty of the existent theoretical literature implies that the issue of whether and how futures markets affect underlying spot markets remains mainly an empirical one.

## EMPIRICAL LITERATURE

Although many studies have been carried out trying to understand whether futures markets destabilize cash markets or not, the findings are still not in agreement. In other words even empirical researches leave uncertainties, although more recent studies seem to present some common results indicating, to a certain extent, similar conclusions. Earlier studies on financial futures investigated the impact of Government National Mortgage Association (GNMA) futures on the volatility of the GNMA cash market. Whereas Froewiss (1978) found that weekly spot price volatility was not affected by the introduction of futures, Finglewski (1981) concluded that GNMA futures trading have led to increased monthly volatility for the spot market. Simpson and Ireland (1982) as well as Corgel and Gay (1984) proposed results in line with those of Froewiss. In other words they both concluded that **futures did not affect spot market volatility**.

Following these early researches other studies have been done on financial futures, and many of them argued that futures trading somehow increased spot market volatility. More recently, studies concerning the specific relationship between stock index futures markets and underlying stock markets have been produced. Edwards (1988a, b) found decreased stock market volatility for the S&P500 after the introduction of the stock index futures contract. Santoni (1987) suggested that an increase in the S&P500 futures contract trading volume does not increase the volatility of the underlying index and Smith (1989) reported that the S&P500 futures volume had no effect on the volatility of the index returns.

Becketti and Roberts (1990) found little or no relationship between the stock market volatility and either the introduction of, or the level of activity in, the S&P500 stock index futures market, whereas previously Harris (1989) argued that the conclusion of index futures trading increasing spot market volatility can be only occasional. Again, about the S&P500, Schwert (1990) reported that when the volatility on the S&P500 index is high, stock index futures and spot market volumes are also high. Hodgson and Des Nicholls (1991) concluded that stock index futures trading did not affect the long-term volatility of the Australian Stock Exchange but left unanswered the question for the short-term volatility. Bessembinder and Seguin (1992) found evidence that unexpected S&P500 futures trading were positively related to spot market volatility but the relationship between spot market volatility and expected futures volume was negative.

Darrat and Rahaman (1995) concluded that S&P500 futures volume did not affect spot market volatility. Anotoniou and Holmes (1995) suggested, for the London Stock Exchange, an increased volatility following the introduction of the FTSE100 index futures contract. Brown- Hruska and Kuserk (1995) showed for the S&P500 that higher levels of futures volume relative to cash market trading could be associated with lower spot market volatility. Board et al. (1997) found that contemporaneous futures market trading had no effect on spot market volatility but lagged futures volume has been found to have a small positive effect. Bologna (1999) showed that the introduction of stock index futures trading in the Indian Stock Exchange has led to diminished volatility and that lagged futures volume is inversely related to stock market conditional volatility. Altay-Salih and Kurtas (1998) found that seventeen out of the twenty-four different indexes analyzed presented lower long run volatility after the introduction of futures contracts.

## STOCK MARKET VOLATILITY

Volatility is the most basic statistical risk measure. It can be used to measure the market risk of a single instrument or an entire portfolio of instruments. While volatility can be expressed in different ways, statistically, volatility of a random variable is its standard deviation. In day-to-day practice, volatility is calculated for all sorts of random financial variables such as stock returns, interest rates, the market value of a portfolio, etc. Stock return volatility measures the random variability of the stock returns. Simply put, stock return volatility is the variation of the stock returns over time. More specifically, it is the standard deviation of daily stock returns around the mean value and the stock market volatility is the return volatility of the aggregate market portfolio.

Volatility of stock returns has been mainly studied in the developed economies. After the seminal work of Engle (1982) on the Autoregressive Conditional Heteroscedasticity (ARCH) model and its generalized form (GARCH) by Bollerslev (1986), much of the empirical work has used these models and their extensions (see, for example, French, Schwert and Stambaugh 1987; Akgiray, 1989; Connolly, 1989; Ballie and DeGennaro, 1990; Lamoureux and Lastrapes, 1990; Corhay and Tourani, 1994; Geyer, 1994; Nicholls and Tonuri, 1995; Booth, Martikainen and Tse, 1997; de Lima, 1998; and Sakata and White, 1998).

There is relatively less empirical research on stock return volatility in the emerging markets. In the Indian context, Roy and Karmakar (1995) focused on the measurement of the average level of volatility as the sample standard deviation and examined whether volatility has increased in the early 1990s; Goyal (1995) used conditional volatility estimates as suggested by Schwert (1989) to study the nature and trend of stock return volatility and the impact of carry forward system on the level of volatility; Reddy (1997-98) analysed the effects of market microstructure, e.g., establishment of the National Stock Exchange (NSE) and the introduction of Bombay Stock Exchange Online Trading (BOLT) system on the stock return volatility measured as the sample standard deviation of the closing prices; Kaur (2002) analysed the extent and pattern of stock return volatility during 1990- 2000 and examined the effect of company size, day-of-the- week, and FII investments on volatility measured as the sample standard deviation.

ARCH/GARCH models have been used by Thomas (1995, 1998), Pattanaik and Chatterjee (2000) and Kaur (2002) to model volatility in the Indian financial markets. Shenbagaraman (2003) examined the impact of introduction of index futures and options on the volatility of underlying stock index using a GARCH model. Kumar and Mukhopadhyay (2002) applied the GARCH models to examine the co-movement and volatility transmission between the US and Indian stock markets.

This paper empirically investigates the change of volatility in the Indian stock market during 1996-2004 after introduction of futures. The stock market volatility in India provides the evidence on its main characteristic features with the help of econometric techniques and employing GARCH models.

We have examined the following issues with respect to the Indian stock market for the period June 1996 - May 2004:

- Is there any change in volatility of Indian stock market after the introduction of futures?
- We checked whether this change in volatility is due to introduction of futures or due to other reasons.

**Volatility forecasting models**

Before discussing specific volatility forecasting models the question of how to approximate volatility, which is an unobservable variable, needs to be addressed. Given daily return data, the sample standard deviation over a time interval spanning the $h$ trading days $T+1, \ldots T+h$, i.e.

$$V_{T+1,T+h} = \sqrt{\frac{1}{h-1}\sum_{i=1}^{h}(r_{T+i} - r_{T+i})^2}$$

is commonly used as the estimate of this period's average volatility. Here, rt denotes the asset return for trading day $t$; $r_T = \frac{1}{h}\sum_{i=1}^{h} r_{t+1}$ and is the average return over this period. Assuming 252 trading days per year, $V_{T+1T+H}\sqrt{252}$ represents the annualized average volatility. Below, we will use $V_{T+1,T+h}$ as the true future average volatility over interval $[T+1, T+h]$. We investigate eight alternative approaches to forecasting stock market volatility.

Two of them, the moving average and the random walk model, use information about past returns in a rather naive manner. We also consider a standard GARCH (1,1) model; a modified GARCH (1,1) model taking weekend and holiday effects into account; an autoregressive model for squared past returns; implied volatility (IV) information; a GARCH (1,1) model combined with IV information; and, finally, we consider combined forecasts, following the lines of Granger and Ramanathan (1984). The remainder of this section briefly summarizes these eight approaches.

**Historical Moving Average Model**

A widely used estimator for future volatility is the square root of a moving average of past squared returns. If we adjust for mean returns, the volatility forecast is given by the sample standard deviation

$$V_{T+1,T+h} = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}(r_{T-i} - r_T)^2}$$

We choose a window length of one calendar year, i.e. N = 252 trading days.

**Standard GARCH (1, 1) Model**

The autoregressive conditional heterosedasticity (ARCH) models introduced by Engle (1982) and their generalization, the so-called GARCH models (Bollerslev, 1986) (see also Bollerslev *et al.*, 1992, 1994) have been the most commonly employed class of time series models in the recent finance literature. These models have been very successful in describing the behaviour of financial return data. Their appeal comes from the fact that they can capture both volatility clustering and unconditional return distributions with heavy tails - two stylized facts associated with financial return data. The estimation of a GARCH model involves the joint estimation of a mean and a conditional variance equation. For the forecast comparison we found a GARCH (1, 1) model combined with an AR (1) model for the mean to be appropriate.

The GARCH (1, 1) framework has been extensively found to be the most parsimonious representation of conditional variance that best fits many financial time series. In this work alternative representation of volatility was tested in order to find the best specification.

Then employing the auto-regressive conditional heteroscedasticity (ARCH) family of models in order to examine the behaviour of spot volatility before and after the introduction of futures trading. The ARCH process accounts for the difference between the unconditional and the conditional variance of a stochastic process (Engle 1982). The process allows the conditional variance to vary over time, leaving the unconditional variance constant. In the ARCH (*q*) model the conditional variance is a function of past squared innovations (*ut*) in the mean of some other stochastic process:

$$Y_t = \beta' \chi_1 + u_t \quad (1)$$

$$u_1 \mid \Omega_{t-1} \sim N(0, h_t) \quad (2)$$

$$h_1^2 = \omega + \sum_{i=1}^{q} a_i u_{t-i}^2 \quad (3)$$

In equations (1) to (3) $\chi_t$ is a vector including the information set $\Omega_{t-1}, u_t$ is a random error, and $h_t^2$ is the conditional volatility of the stochastic process $y^t$.

A more general process is the generalized ARCH (GARCH) process (Bollerslev 1986) that is able to account for empirical features of the data such as leptokurtosis, skewness and volatility clustering. In the GARCH (*q, p*) model, the conditional volatility is specified as in (3), with the addition of its past squared values, as in equation (4):

$$h_t^2 = \omega + \sum_{i=1}^{q} a_i u_{t-i}^2 + \sum_{i=1}^{p} c_i h_{t-1}^2 \quad (4)$$

For a well-defined GARCH $(q, p)$ the restrictions: $\omega > 0, a_i \geq 0 c_i \geq 0$ must be imposed. Equation (4) is used in this paper to capture the effect of a time-varying variance. In (4) the coefficient of the squared error term ($a$) captures the extent to which past news causes volatility today, that is, the existence of volatility clustering in the data. The sum $(a + c)$ measures volatility persistence and as it approaches unity the persistence of shocks to volatility becomes greater. If $(a + c) = 1$, any shock to volatility is permanent, the unconditional variance is infinite and the process is called an I-GARCH process (integrated in variance process) [Engle and Bollerslev 1986]).

In this case volatility persistence is permanent and past volatility is significant in predicting future volatility over all finite horizons. If the sum $(a+ c)$ is greater than 1 then volatility is explosive, that is, a shock to volatility, this period will result in even greater volatility during the next period (Chou 1988). It is a well-documented result in the literature that most financial time series follow a GARCH (1, 1) process; thus, this article employs a GARCH (1, 1) model for the empirical testing.

Next, we also test for structural shifts in unpredictable return variance, that is, we examine whether the unconditional variance is non-stationary. To test for structural shifts in the unconditional variance, we include a dummy variable in the variance equation of the standard GARCH (1,1) model:

$$h_t^2 = \omega + \gamma_1 DUMMY_F + a_1 u_{t-1}^2 + c_1 h_{t-1}^2 \qquad (5)$$

In equation (5) $DUMMY_F$ is a dummy variable that takes the value of 0 for the period before the introduction of futures contracts and 1 for the period after the introduction of futures contracts. In other words, the sign and statistical significance of the dummy variable coefficient will provide important information in order to determine whether the introduction of the index futures contract is related to any change in spot volatility. For example, if $\gamma_1$ is statistically significant, this implies that the introduction of futures trading had a significant effect on spot volatility. In addition, a positive sign on $\gamma_1$ implies that volatility is increased, while a negative sign implies that volatility is decreased following the introduction of futures trading.

## DATABASE

### Period of Study

The study spans the period 3rd June 1996 through 31st May 2004. Besides being the most recent period, major changes were brought about in the structure and functioning of the Indian stock markets during these eight years. In the wake of the scam of 1992 and the information, communication, and entertainment (ICE) meltdown of 2001, major regulatory activities took place. For example, Dematerialization of shares and hence 'paperless trading' begun in 1997 was made compulsory in January 1999, rolling settlements were introduced in December 1999 in a limited manner, index-based futures were introduced in June 2000 and index options in June 2001, and carry forward of trades was abolished from 2nd July 2001. It is, therefore, important to study the nature of stock market volatility during these years.

The daily stock price data on Nifty has been taken from PROWESS, the online database maintained by the Centre for Monitoring of Indian Economy (CMIE). Daily closing prices have been taken for the indices for the period of study. These prices have been adjusted for bonus and right issues.

Daily stock prices have been converted to daily returns. The present study uses the logarithmic difference of prices of two successive periods for the calculation of rate of return. The logarithmic difference is symmetric between up and down movements and is expressed in percentage terms for ease of comparability with the straightforward idea of a percentage change.

### The Sample

The stock market indices are fairly representative of the various industry sectors and trading activity mostly revolves around the stocks comprising these indices. Thus, the sample population of the study consists of the most prominent domestic market indices, viz. Nifty indices to represent the Indian market.

The sample data used here consists of two sets. The first set comprise of the Index Closing of S&P CNX Nifty from 3$^{rd}$ June 1996 to 6$^{th}$ June 2000 before introduction of futures in India. The second set comprise of the Index Closing of S&P CNX Nifty from 6$^{th}$ June 2000 to 31$^{st}$ May 2004 after introduction of futures in India. Thus, there are 2 sub-samples in the data set with about 1000 observations per sub-sample. The choice of these sub-sample periods has been guided by the ready availability of price data with the author.

These indexes have been used in order to test whether the changes in volatility should be attributed to market factors rather than to the stock index futures introduction. The NSE index has been chosen as representative of the behavior of the overall Indian market.

## DESCRIPTIVE INDEX STATISTICS

**Table 1** presents descriptive statistics for the Index futures for two periods- before the introduction of futures trading (the pre-futures period) and after the introduction of futures trading (the post-futures period). Statistics for the full sample period are also reported.

The average of the Index Closing *Pt* of both and combined sample is positive implying the fact that price series have increased over the period.

The statistics show that returns are positively skewed although the skewness statistics are not large. The positive skewness implies that the return distributions of the shares traded in our markets have a higher probability of earning positive returns. The value of the kurtosis is less than 3 in both the series, meaning that they have a lower tail than the standard normal distribution.

**Table 1: Descriptive Statistics of Index Closing**

| | Full Sample | Pre-futures | Post-futures |
|---|---|---|---|
| Mean | 1176.644 | 1118.78 | 1234.508 |
| Standard Error | 5.559809 | 6.813135 | 8.401538 |
| Median | 1102.875 | 1069.765 | 1135.175 |
| Mode | 1085 | 1168.4 | 1067 |
| Standard Deviation | 248.6422 | 215.4502 | 265.68 |
| Sample Variance | 61822.96 | 46418.8 | 70585.85 |
| Kurtosis | 0.761093 | 0.189676 | 0.351367 |
| Skewness | 1.122863 | 0.902228 | 1.138255 |
| Range | 1194 | 967.85 | 1127.95 |
| Minimum | 788.15 | 788.15 | 854.2 |
| Maximum | 1982.15 | 1756 | 1982.15 |
| Sum | 2353288 | 1118780 | 1234508 |
| Count | 2000 | 1000 | 1000 |
| Largest(1) | 1982.15 | 1756 | 1982.15 |
| Smallest(1) | 788.15 | 788.15 | 854.2 |
| Confidence Level (95.0%) | 10.90363 | 13.36971 | 16.48671 |

## METHODOLOGICAL ISSUES

As specified earlier, the relationship between stock index futures trading and spot price volatility for the National Stock Exchange is examined addressing three precise issues:

- Does the existence of stock index futures affect the volatility of the cash stock market, and how?
- If the 'futures effect' exists, is it immediate?
- Is the futures introduction the only cause for a change in the cash market volatility?

The third issue is particularly relevant, considering that often it is the high volatility of the cash market itself to motivate the introduction of futures trading. Nevertheless, some policy regulators claimed that stock index futures had increased stock markets volatility (NYSE, 1990). To deal with these issues the study proceeded as follows:

- The impact of futures trading on volatility were tested amending the variance equation of the GARCH model with a dummy variable which takes values zero for the pre-futures period and one for the post futures period.
- A rolling estimation of the GARCH model (without the dummy) was implemented in order to test whether the time of the change in volatility corresponds to the day of the introduction of futures trading.

## RESULTS

### Estimates of Market Volatility

In this section, we aim to fit an appropriate GARCH model to estimate the conditional market volatility based on S&P CNX Nifty. We first discuss the properties of daily market returns and then investigate the volatility clustering. If volatility clustering is confirmed, we estimate the GARCH (1, 1) to the data sets and subsequently the diagnostic checking on the fit. Finally, we examine if there is any volatility shifting in the market over the period.

If *Pt* is the closing level of Sensex on date *Pt* and *Pt-1* is the same for its previous business day, i.e., omitting intervening weekend or stock exchange holidays, then the one day return on the market portfolio is calculated as:

$Rt = \log (Pt / Pt\text{-}1)$

## Properties of Market Returns

Table 2 presents descriptive statistics for the Index futures for two periods-before the introduction of futures trading (the pre-futures period) and after the introduction of futures trading (the post-futures period). Statistics for the full sample period are also reported.

The average of the returns *Rt* of both and combined sample is positive implying the fact that price series have increased over the period.

Note that the standard deviation (an estimate of the total risk or the uncertainty) of the return series is significantly decreased in the post-futures period (for example, reduced from 0.018358 to 0.015197). This seems to suggest that volatility per se is significantly reduced in spot markets following the onset of futures trading.

The statistics show that returns are negatively skewed for full and second sample although the skewness statistics are not large. The negative skewness implies that the return distributions of the shares traded in our markets have a higher probability of earning negative returns over the period. The statistics for first sample shows that returns are positively skewed although the skewness statistics are not large. The positive skewness implies that the return distributions of the shares traded in our markets have a higher probability of earning positive returns.

The value of the kurtosis is greater than 3 in the series, meaning that they have a heavier tail than the standard normal distribution. The daily stock returns are, thus, not normally distributed.

**Table 2: Descriptive Statistics of Daily Returns Rt**

| | Full sample | First sample Before | Second sample After |
|---|---|---|---|
| Mean | 0.000143 | 0.000249 | 3.66E-05 |
| Standard Error | 0.000377 | 0.000581 | 0.000481 |
| Median | 0.000597 | 0.000221 | 0.000976 |
| Mode | 0 | 0.00738 | 0 |
| Standard Deviation | 0.016848 | 0.018358 | 0.015197 |
| Sample Variance | 0.000284 | 0.000337 | 0.000231 |
| Kurtosis | 4.827815 | 3.095638 | 7.706966 |
| Skewness | -0.31533 | 0.057321 | -0.97139 |
| Range | 0.229878 | 0.187744 | 0.21023 |
| Minimum | -0.13054 | -0.0884 | -0.13054 |
| Maximum | 0.099339 | 0.099339 | 0.079691 |
| Sum | 0.285099 | 0.248547 | 0.036552 |
| Count | 1998 | 999 | 999 |
| Confidence Level (95.0%) | 0.000739 | 0.00114 | 0.000943 |

**Figure 1**(given below) shows Daily Returns on NSE Nifty (1996-2004) for the Index futures for two periods- before the introduction of futures trading (the pre-futures period) and after the introduction of futures trading (the post-futures period). Graph for the full sample period is shown by dividing it into two halves. The movement of returns is shown such that we can see that the fluctuations in the return series are significantly decreased in the post-futures period. This seems to suggest that volatility per se is significantly reduced in spot markets following the onset of futures trading.

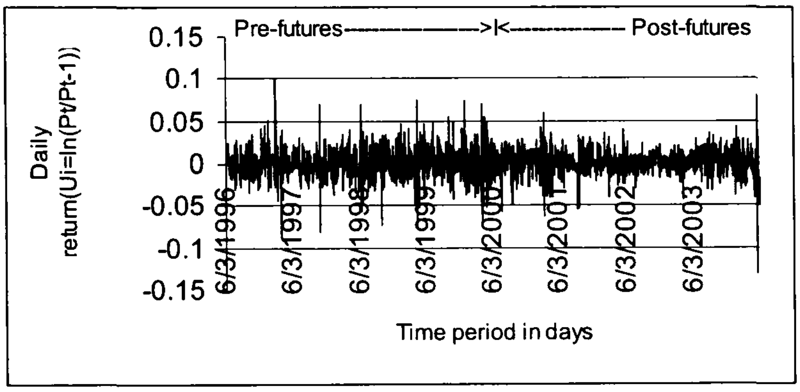


Figure 1: Daily Returns on NSE Nifty (1996-2004)

### Historical moving average model

The results of the Historical moving average model presented in **Table 3** shows that the volatility has decreased from 0.29143 to 0.241238 per annum (5% reduction) in the post-futures period. This seems to suggest that volatility per se is significantly reduced in spot markets following the onset of futures trading. The results so far do not seem to suggest any indication that the introduction of futures trading has effect on the volatility of the underlying market or not.

| Table 3 | Historical moving average model | Pre-futures | Post-futures |
|---|---|---|---|
| | Sigma (volatility per day) | 0.018358 | 0.015197 |
| | Volatility per annum | 0.29143 | 0.241238 |
| | Std error | 0.00652 | 0.005397 |

### Standard GARCH (1, 1) model

$$h_t^2 = \omega + a_l u_{t-i}^2 + c_l h_{t-i}^2$$

The results from the GARCH (1, 1) model without Dummy are reported in **Table 4**.The results indicate that the coefficient $\alpha_1$ is slightly increased and $c_1$ is slightly reduced for the post-futures period. However, it is crucial to determine whether any perceived differences on the coefficients are indeed statistically significant.

Furthermore, the sum $\alpha_1$+$c_1$, which measures volatility persistence, is always less that unity for both periods.

The results of the Standard GARCH (1, 1) model presented in **Table 4** shows that the volatility has decreased from 0.295046 to 0.241376 per annum (5.4% reduction) in the post-futures period. This seems to suggest that volatility per se is significantly reduced in spot markets following the onset of futures trading. The results so far do not seem to suggest any indication that the introduction of futures trading has effect on the volatility of the underlying market or not.

| Table 4 | Garch without dummy | *Pre-futures* | Post-futures |
|---|---|---|---|
| | $\omega$ | 0.000025 | 0.000021 |
| | $\alpha_1$ | 0.059704 | 0.204381 |
| | $c_1$ | 0.868055 | 0.705009 |
| | $\alpha_1 + c_1$ | 0.927784 | 0.909411 |
| | VL (long term variance rate) | 0.000345 | 0.000231 |
| | Volatility per day | 0.018586 | 0.015205 |
| | Volatility per year | 0.295046 | 0.241376 |
| | Volatility per year (%) | 29.50458 | 24.13764 |

## Standard GARCH (1, 1) model with a Dummy variable

$$h_t^2 = \omega + a_1 u_{t-i}^2 + c_1 h_{t-i}^2 + DUMMY_F$$

The results from testing for structural shifts (equation [5]) are presented in **Table 5** and indicate that the coefficient on the dummy variable is statistically significant at the 5 per cent level and zero. This seems to suggest that the introduction of index futures in the NSE is not affecting spot return volatility (statistical significance of the coefficient). In fact, it appears that volatility is reduced in the post-futures period so there might be some other reason.

**Table 5: Garch with Dummy**

| | |
|---|---|
| $\omega$ | 0.0000134 |
| Dummy | 0 |
| $\alpha_1$ | 0.116841 |
| $c_1$ | 0.84244 |
| $\alpha_1 + c_1$ | 0.959295 |
| VL (long term variance rate) | 0.00033 |
| Volatility per day | 0.018168 |
| Volatility per year | 0.28841 |
| Volatility per year (%) | 28.84096 |

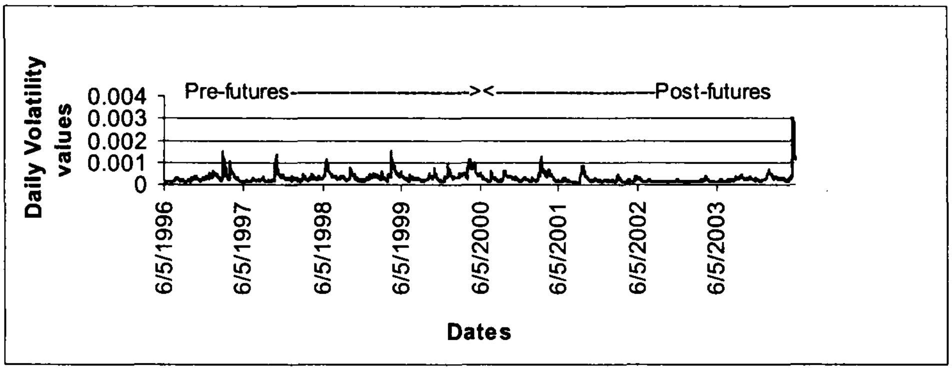


Figure 2: GARCH variance series with dummy before and after the introduction of Nifty stock index futures (1996-2004)

## Two important issues: Asymmetric response and isolating the futures effect

The results so far seem to suggest that the introduction of futures trading has no effect on the volatility of the underlying market. However, two issues rise at this point. First, although the methodology discussed earlier has often been employed in previous studies, it may produce biased results if prices respond asymmetrically to news (that is, when the conditional variance is not an even function of past disturbances). An asymmetric response to information is a situation where a price fall results in greater volatility than does a price increase of similar magnitude. That is, the standard GARCH model assumes a symmetric response to news.

Second, we need to think whether the effect detected is solely attributable to the introduction of futures contracts or whether it is also due to other changes in the environment during the period examined. For example, many events took place in the 1990s that affected the volatility of international markets, for example, the Asian and Russian crises. Thus, it is crucial to separate volatility arising from other factors and volatility that is specific to futures trading.

## Trading volume of the futures contracts

Another important issue that must be investigated at this point is whether there exists any link between futures trading activity and spot volatility. For example, we detect no effect or a small reduction in volatility following the introduction of futures contracts. If the trading in futures contracts is the cause of this reduction, then we should find that the greater the futures trading activity the greater the reduction in volatility (at least in the first months). In order to investigate the relationship between spot volatility and futures trading activity for the first months after the introduction of futures contracts we augment with a trading activity variable as follows:

The results indicate that neither current nor lagged futures trading activity is statistically significant in the volatility equation. The implication is that activity in futures contracts has no detectable effect in spot volatility. Summing up, the change in volatility was found but that was not because of futures, there are some other possible reasons for this change

## CONCLUSION

The concept of a futures transaction as a hedge for unforeseen future events is not new in monetary economics. However, modern times have witnessed the presence of organized exchanges where standardized futures contracts are traded on a daily and worldwide basis by large numbers of sophisticated investors. As a result, the markets for these financial instruments have grown dramatically in size and typically attract speculators. To the extent that spot and futures prices are linked by arbitrage the transactions of investors in the futures markets may create a spillover effect where futures volatility spills over to the underlying markets. Thus, an important question is whether the introduction of a futures contract stabilizes or destabilizes the cash market of the underlying asset.

The empirical research on this issue has generated controversial results; nevertheless, it has concentrated mainly on large capitalization equity markets and few studies examine smaller and emerging equity markets. This article attempts to partly address this gap in the literature and empirically investigates whether spot volatility of the S&P CNX Nifty index has been affected since the introduction of a futures contract. In this paper the GARCH technique was used to analyze the relationship between stock index futures and corresponding stock market volatility for the National Stock Exchange. The results support the hypothesis that the Futures contract has a stabilizing effect on the underlying stock market. The finding that unconditional volatility in the post-futures period was lower than that in the pre-future period considered also supports this result, already pointed out in previous research. However, one is aware of the fact that many factors other than stock index futures may affect stock market volatility and that the futures effect might not be instantaneous.

To analyze the presence of factors other than stock index futures introduction as determining the decrease in volatility in the post futures period a GARCH model was estimated, adjusting the stock index returns equation for market factors. Results of this estimate still do not allow rejecting the hypothesis that futures trading had a prevalent effect in reducing the stock market volatility. Hence, we can exclude that market factors had a significant effect in determining the level of volatility of the National Stock Exchange.

In order to answer the question relative to the possible presence of time lags of the futures impact on the underlying stock market volatility, with respect to the time of the introduction, the GARCH model was estimated recursively using a rolling window. The pattern of the estimated coefficients of the conditional variance equation shows a clear break around the date of futures introduction. At that moment in time coefficients start to converge, reaching a full convergence once the sample of the rolling window includes only observations from the post-futures period. This evidence confirms that the effect of futures introduction on conditional volatility estimates is immediate. Hence, it can be concluded that strengthening the hypothesis that stock index futures introduction had, at least for the National Stock Exchange, a positive effect on the underlying market volatility, making it lower. Moreover this effect was immediate. In other words, the onset of Index futures contract contributed substantially to make the underlying cash market less volatile than in the past, and this beneficial effect occurred without delay from the date at which trading began.

In conclusion it is argued that the existence of stock index futures, at least for the National Stock Exchange, by reducing the underlying market volatility, contributes to increase in market efficiency. Given the positive relationship between market efficiency and public welfare this also implies a non-secondary effect: a public welfare increase. This argument, in theory extensible to any other futures market, is consistent with those theories stating that futures improve the efficiency, enhance the depth and reduce the volatility of the underlying market.

## IMPLICATIONS

One of the objectives of the various GARCH models is to provide good forecasts of volatility which can then be used for a variety of purposes including portfolio allocation, performance measurement, option valuation, etc. Investors seeking to avoid risk, for example, may choose to adjust their portfolios by reducing their commitments to assets whose volatilities are predicted to increase or by using more sophisticated dynamic diversification approaches to hedge predicted volatility increase. In a market in which such strategies operate, equilibrium asset prices should respond to forecasts of volatility as well as to the risk aversion of investors. Again, recognizing that portfolio is generally the ratio of the covariance of an individual share with the market to the variance of the market suggests that covariance and betas are possibly forecastable in the same way as variances are forecastable.

There are, thus, several reasons for the future researchers to be interested in multivariate GARCH processes that model not only variances but also covariance. Time-varying conditional volatility model may also be used to estimate VaR more appropriately. Moreover, it is well known that option prices as computed by the Black-Scholes formula depend upon the variance of the underlying asset. In the Black-Scholes framework, this variance is assumed to be constant and hence its estimation is simple. Many practitioners believe that the Black-Scholes framework provides a good approximation but that it must have up-to-date variance estimates, even possibly the implied volatilities from some other contract or previous trade. The conditional variance forms a good estimate for pricing options. Finally, given the anticipated high growth of the economy and increasing interest of foreign investors towards the country, it is important to understand the pattern of stock market volatility in India, which is time-varying, persistent, and predictable. This may help diversify international portfolios and formulate hedging strategies.

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