THE IMPACT OF SINGLE STOCK FUTURES LISTING ON THE MARKETS FOR UNDERLYING STOCKS

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The impact of singe stock future trading in the stock exchange has been debated in the economic literature for a long time. The present study is aimed at the effects of the introduction of singe stock futures on the volatilities of the spot markets for these stocks. The study analyses whether the spot market volatility in a particular stock is influenced by the introduction of futures trading in such stock. The results show that the introduction of futures contract in individual stocks, per se, *has led to diminished stock volatility and no other factor seems to have systematically reduced it. The findings have been consistent with the theories proposing a well developed stock futures market for the efficient functioning of the spot market.*

I- Introduction

The issue of futures trading in individual stocks has been debated for a long time. Many a stock exchanges of the world, even in well developed financial markets, have refrained from introducing single stock futures in their stock exchanges due to the economic and social impact of futures trading in individual stocks. However, this instrument of derivative trading has been a favourite tool in the hands of market players in India.

The major opponents to the introduction of futures contract in individual stocks argue that the single stock futures contracts can be used to manipulate the market index, particularly when such stock posses higher weight in the construction of the market index. This can be easily done if the stock has lower float in the market. The futures market in individual stocks is shallow and concentrated. Any group of unscrupulous speculators can move the market as per the situation that suits them collectively. As compared to the option market, the cost efficient stock futures market attracts uninformed traders whose actions are likely to result in the increased stock volatility. Also, it is generally referred that the spot market is meant for the investor and the futures market is meant for the speculators.

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The futures market promotes speculation which in turn results in increased stock market volatility. All because of these and many other negative features of these derivative instruments, major stock exchanges of the world have not allowed trading in these instruments. In India too, the committee entrusted with the task of setting the path of derivatives market in India (L. C. Gupta Committee) has not recommended the introduction of single stock futures contracts in Indian bourses. Despite such recommendation, this instrument was introduced in both the heavyweight exchanges in India. And now the position is that the turnover in these instruments has not just surpassed the spot market turnover but also given a special status to the National Stock Exchange of India— No. 1 in the world (in terms of number of contracts traded during the calendar year 2006: World Federation of Exchanges).

The major proponents of these instruments argue that the futures market in the individual stocks plays an important role of price discovery in the spot market and the consequent reduction in the stock price volatility. Both the sets of arguments in favour and against the futures market in the individual stocks have some validity. It becomes a matter of inquisitiveness to explore this relationship empirically where both the possibilities of increased and decreased stock volatilities seems possible. However, most of the empirical work in this direction explores the area of Index Futures. Even the studies in the area of Index Futures have been inconclusive so far. As far as Stock Futures are concerned, there is lesser number of countries who have allowed stock futures trading in their exchanges when compared with countries with Index Futures trading. And most of these countries are the developing ones. A little above 15 exchanges have allowed stock futures trading out of more than 40 global exchanges (World Federation of Exchanges cited in Hukeri (2007)). So, not much of the studies are available on this topic around the world, what to talk about India.

This paper is among the first of its kind in the area of Single Stock Futures, particularly in Indian context which empirically analyses the impact of futures contract in individual stocks on the spot market volatility of the underlying stock. This paper tries to analyse the variability of certain stock prices over the period prior to the introduction of futures contracts in such securities. Such variability is compared with the period subsequent to the introduction of futures contracts in such securities. The study also tries to find out whether this impact can solely be attributed to the availability of futures contract or are there other factors responsible for the increased/decreased volatilities. The study also tries to comment upon the rate of absorption of new information; having a bearing on the nature of market efficiencies for such stock. The price formation of a security in a stock market is also affected by the additional flow of information on account of futures trading in such security.

This paper analyses the data obtained from the National Stock Exchange of India. In terms of the trading volume, NSE is bigger than its Indian rival Bombay Stock Exchange. The BSE is world's biggest stock exchange in terms of number of companies listed but is among the lowest ranked exchanges in terms of trading in the single stock futures-- contract-wise and turnover-wise. The NSE is a topmost stock exchange not only of India but also of the world in terms of turnover in single stock futures trading. There are only a selected number of countries in the world which have permitted futures trading in individual stocks in their stock exchanges. India is not only included in this club but also rank first among the members.

World over, the studies based on Index Futures applies a specified econometric modelling of the spot market. The few studies done outside India with respect to Single Stock Futures also replicates the same modelling for the spot market. Hence, this empirical study also uses the same econometric technique which is used by many authors studying the impact of introduction of Index Futures in the stock markets *i.e.* the Generalised Autoregressive Conditional Heteroscedasticity (GARCH) class of models.

This paper is divided into five sections, including the present section on introduction. The next section, Section II presents a brief review of the previous theoretical and empirical work done in this or the contiguous areas. Section III describes the data set picked up for the purpose of the analyses and introduces the econometric technique used in the paper for such analyses. Section IV discuses the empirical results obtained during the course of the study. The last section summarises the total discussion and concludes it.

II- Review of Literature

The effect of introduction of derivatives on the volatility of the spot markets and in turn, its role in stabilizing or destabilizing the spot markets has remained an active topic of analytic and empirical interest. The theoretical literature is, however, inconclusive on whether the introductions of derivative products lead to an increase or decrease in the spot market volatility (Bandivadekar & Ghosh).

One school of thought argues that the introduction of futures actually reduces the spot market volatility and thereby, stabilizes the market through increased flow of relevant information and improved investment choices at lower cost. Futures market attracts speculative market participants because of the high degree of leverage provided by these derivative instruments. Schwert (1990) shows that the transfer of speculative activity from the spot to the futures market may dampen spot market volatility. However, such transition into the futures market may also entice some uninformed participants who can add to the market volatilities with their lower information content when combined with the leverage used.

Another school of thought argues that the futures market, which attracts mostly speculation in the securities, creates undesirable "bubbles" which in turn results in destabilising the market for that security with increased volatility. Such "bubble" creation is further magnified by the shallowness in such futures market which is a notable feature of at least Indian Futures market. Ross (1989) demonstrates that, under conditions of no arbitrage, variance of price change must be equal to the variance of information flow and the futures trading increases the flow of information and provide 'news' for the purpose of the spot market. If such information is the result of unscrupulous speculative activity in the futures market then it will result into an unnecessary variation in the prices of the underlying securities. However, futures markets enhance the overall market depth, market liquidity and informativeness which necessitate the reduction in the market volatility.

The theoretical arguments to such debates have not been settled so far. These arguments can only be strengthened by the empirical evidences from various stock markets of the world to overshadow the other set of contradictory arguments.

Index Futures
Most of the stock markets have introduced Futures contracts in their stock markets and have experienced its impact on the spot markets. However, most of the stock exchanges, particularly in the developed countries, have introduced Index Futures only. They have, even USA, refrained from introducing Stock Futures in their stock exchanges because of its consequential impact on the underlying spot market and its further ramifications. Therefore, most of the studies in these developed countries are based on the impact of introduction of Index Futures.

So far as developed markets are concerned; in general, most of studies find little or no evidence of increased stock market volatility after the introduction of futures (Gupta and Kumar). Majority of the studies have been conducted in American stock markets [e.g. Stoll and Whaley (1987), Harris (1989), Damodaran (1990), etc.]. However, *inter alia*, Hodgson and Nicholls (1991) have studied the Australian stock market, Miller (1993) has studied the Japanese stock market, Antoniou and Holmes (1995) have studied the British stock market and Kan and Tang (1999) have studied the Hong Kong stock market. In a recent study, Bologna and Cavallo (2002) found that the introduction of index futures has actually reduced the stock price volatility in Italian stock market. It was unlike the findings of Antoniou and Holmes (1995) for London stock exchange.

In Indian context, Thenmozhi (2002) has shown that the introduction of index futures trading has reduced the volatility of spot Index returns. Gupta and Kumar (2002), Raju and Karande (2003) and Bandivadekar and Ghosh (2003) have also concluded the same. However, Shenbagaraman (2003) conclude with no significant impact on market volatility.

Stock Futures
As opposed to the Index Futures, it is quite convenient for manipulators to manipulate the spot markets with the usage of the Stock Futures. In the case of Index Futures, a manipulator has to take position in all the securities comprising the Index to exert influence on the underlying Index value. However, in the case of Stock Futures, it becomes quite easy for a manipulator to take position in a particular stock and exert influence on the underlying stock. This convenience is further magnified by the huge amount of leverage and

limited number of large participants in this market. Such Stock Futures contracts can also be used to manipulate the Index value if the underlying stock has a substantial weightage in the composition of Index and also has lower float in the market.

Among the countries that have allowed Stock Futures trading in their stock exchanges, there is an unusual lead by the developing countries in this area. Such exchanges are lead by the National Stock Exchange (NSE) of India and Johannesburg Stock Exchange (JSE) of South Africa. The NSE has an unusual dominance in Stock Futures segment. The spectacular growth of this segment of the derivatives market camouflages the related consequential issues like sustained volatility in spot market, shallowness of the market and increased concentration of trading. Such features are more likely to be present in developing markets and unfortunately, these are the markets who have allowed Stock Futures trading. This could prove to be fatal for such markets. India's position is also not different from this.

In India, the L.C. Gupta Committee (1997) appointed by the Securities and Exchange Board of India recommended the introduction of Index Futures in Indian stock markets but ruled out the introduction of Stock Futures in the Indian stock markets. Yet, the Stock Futures were introduced on the Indian stock exchanges in November 2001. All because of these negative features of Stock Futures, these instruments have been notoriously termed as architectural weakness of at least Indian stock market or have been allegedly held responsible for the increase in the respective commodity prices.

As regards to studying the impact of Stock Futures is concerned, not too many studies are available on this issue, particularly in Indian context. The reason perhaps had been that these instruments have not been allowed in major stock exchanges of the world. Peat and McCorry (1996) have studied the impact of introduction of individual share futures (ISF) in Sydney Futures Exchange of Australia. They concluded that the listing of stock futures contract is associated with a significant positive increase in trading volume in the underlying market, no significant change in the underlying price level and an increase in underlying volatility. McKenzie, Brailsford and Faff (2001) have also studied the introduction of ISF with respect to the prices of underlying securities in Australia. However, they found a general reduction in the systematic risk and unconditional volatility of individual stocks, a mixed response as to conditional volatility of individual stocks and a change in the market dynamics. But, this area has remained largely unexplored in India.

III. Market & Methodology

The Market and Data

This study is based on trading of single stock futures in the National Stock Exchange of India. More than 90 percent of trading in the derivative segment of Indian stock markets happens in this stock exchange. The volume of trade and the world leadership of this premier stock exchange of India in stock futures trading justify the rational for choosing NSE over other stock exchanges in India and around the world..

There is a gradual introduction of single stock futures trading in Indian stock markets. The trading of single stock futures is introduced in NSE from November 2001. From thereon, the list of securities for futures trading has been expanding day-by-day. The data used for the study consists of the securities which have firstly been allowed for futures trading on NSE. On 9th November, 2001 individual stock -futures were introduced on NSE in a set of 31 securities only. Out of these securities, only 22 securities can only be picked up for the study and the rest has to be dropped because either they have been dropped from the trading list itself or they had not been traded for the entire period covered by the study. The data was collected up to 30th April, 2007. Any attempt to collect data for further period had a restrictive implication for the selection the proxy securities to be used for segregating the impact of futures trading, ***per se***, from all other factors.

The data employed in the study consists of daily close prices of the stock market index *viz.* S&P CNX Nifty Index and the selected securities. The necessary data has been downloaded from the website of NSE—*www.nseindia.com*. The total period of approximately ten years (1996-2007) is covered in the study. This period is further divided into equal sub-periods of five years *i.e.* pre and post introduction of futures trading. It covers 1373 trading days before and after the introduction of stock futures on NSE with one additional entry to accommodate return computations at the beginning of the time series.

The securities chosen are the securities for which entire set of data was available and it remains traded in the futures' market for the period covered by the study. These securities are from different sectors of the economy *viz.* Aluminium, Automobiles, Banks, Cement & cement products, Cigarettes, Computer-Software, Electrical equipment, Housing finance, Pharmaceuticals, Power, Refineries, Tea & coffee and Telecom services.

To segregate the impact of futures trading *per se*, from all other factors affecting the prices of aforesaid securities we need to select another group of securities which are close substitutes of these securities, at least at an aggregate level. This is done for the purpose of providing a comparable base for the analysis. Thus, one more set of proxy securities is chosen from the market which is next best substitutes for the above securities *in toto.* The selection of such set of proxy securities was not an easy task as the number of potential proxy securities available to choose from was very limited. The reason for such limited number is that the more and more competing securities which are actively traded are introduced for futures trading. Thus, we are left with only a few securities which are large enough to be close substitute and also remain actively traded on the exchange during the period covered in the study. Therefore, the final selection of such securities was dependent upon three prime factors— Substitutability, Active trading and Period covered in the study.

Still the efforts have been made in this direction and the data is collected in respect of some proxy securities for the entire period taken for the study. These securities are also selected from different sectors of the economy and are also actively traded in the exchange. These sectors are—Banks, Computer-Software, Electrical equipment, Pharmaceuticals and Power. The securities so selected were only five in number because of the longer period chosen for the study. Another study done by the author with shorter period but larger set of such proxy securities has given the results which are not different from the results obtained here*.

The Model

Keeping in mind the scope of this study, the average return for each stock is modelled using Capital Asset Pricing Model for the selected period. Continuously compounded decimal returns have been computed for each security using the following equation:

$$R_t = \ln\left(\frac{P_t}{P_{t-1}}\right)$$

where P_t and P_{t-1} are the closing prices on day 't' and 't-1' respectively; R_t represents the return in relation to day 't'. The asset pricing model used is as follows:

$$R_{it} = \alpha_0 + \alpha_1 R_{mt} + \varepsilon_t$$

where R_{it} is the log price relative of the underlying stock 'i' at time 't'; R_{mt} is the log price relative of the stock market index—Nifty; and ε_t is the stochastic error term. The coefficient α_1 indicates the systematic risk of the security and the remaining return goes for the unsystematic risk held with the security.

The simple Ordinary Least Square estimation of the above regression equation will presume that given the value of R_{m}, the variance of ε_t is the same for all the observations *i.e.*

$$V(\varepsilon_t) = \sigma^2$$

Such a presumption is technically known as Homoscedasticity. Such constant variance for the day 't' can be estimated using the most recent 'n' observations, by the following equation:

$$\sigma_t^2 = \frac{1}{n-1}\sum_{i=1}^{n}(\varepsilon_{t-i} - \bar{\varepsilon})^2$$

Such presentation can be asymptotically rewritten as follows:

$$\sigma_t^2 = \frac{1}{n}\sum_{i=1}^{n}\varepsilon_{n-i}^2$$

whereby the mean error disappears on an average and above equation also become the unbiased estimate of the σ^2 for a large value of 'n'.

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* Narain, "The Impact of Futures Listing on the Markets for Underlying Stocks" (2007) a term paper submitted to Delhi University for the fulfilment of M.Phil. requirements.

The above stated representation with equal weight of $\frac{1}{n}$ can be presented in a more general form with varying weighting scheme as follows:

$$\sigma_t^2 = \sum_{i=1}^{n} \beta_i \varepsilon_{n-i}^2$$

where β_i is the amount of weight given to the observation 'i' days ago. Obviously, weights must sum to unity *i.e.*

$$\sum_{i=1}^{n} \beta_i = 1$$

An augmentation can also be done to give some weight to a long-run average variance rate. Thus, the augmented representation becomes—

$$\sigma_t^2 = \beta_0 V_L + \sum_{i=1}^{n} \beta_i \varepsilon_{n-i}^2$$

where β_0 is the weight given to the long-run variance rate V_L. Also, the total weights should sum to unity. So, we have—

$$\beta_0 + \sum_{i=1}^{n} \beta_i = 1$$

We can use any system of weighting the observations but, most plausible can be the system whereby we give more weight to recent data. By defining $\omega = \beta_0 V_L$, the augmented model can be presented as follows—

$$\sigma_t^2 = \omega + \sum_{i=1}^{n} \beta_i \varepsilon_{n-i}^2$$

The above model is well known as an Autoregressive Conditional Hetroscedasticity or ARCH (n) model, firstly suggested by Engle[*].

Following Antoniou and Holmes (1995), McKenzie *et al.* (2001) and Bologna and Cavallo (2002), the present study analyses the data within the framework of the Generalised Autoregressive Conditional Hetroscedasticity (GARCH). The GARCH model was proposed independently by Bollerslev[†] and Taylor[‡] as a generalised version of

[*] Engle, R. F., "Autoregressive Conditional Hetroscedasticity with Estimates of the Variance of the United Kingdom Inflation" (1982) *Econometrica.*

[†] Bollerslev, T., "Generalised Autoregressive Conditional Hetroscedasticity" (1986) *Journal of Econometrics.*

[‡] Taylor, S. J., "Modelling Financial Time Series" (1986) Wiley, Chichester.

Engle's (1982) Autoregressive Conditional Hetroscedasticity (ARCH) model. In the case of GARCH, we adopt another plausible system of weighting—the weights β_i decreases exponentially *i.e.*

$\beta_{i+1} = \lambda\beta_i$, where λ is a positive sub-unitary quantity.

With such a scheme of weighting, the general weighted equation

$$\sigma_t^2 = \sum_{i=1}^{n} \beta_i \varepsilon_{n-i}^2$$

becomes

$$\sigma_t^2 = \lambda\sigma_{t-1}^2 + (1-\lambda)\varepsilon_{t-1}^2$$

If we also take into account the long-run average variance rate then, the above equation is turned into what is known as Generalised Autoregressive Conditional Hetroscedasticity model:

$$\sigma_t^2 = \beta_0 V_L + \beta_1 \varepsilon_{t-1}^2 + \gamma\sigma_{t-1}^2$$

where total weights should sum to unity *i.e.*

$$\beta_0 + \beta_1 + \gamma = 1$$

Once again setting $\omega = \beta_0 V_L$, the above can be written as—

$$\sigma_t^2 = \omega + \beta_1 \varepsilon_{t-1}^2 + \beta_2 \sigma_{t-1}^2$$

This is the form of the GARCH model denoted as GARCH (1,1) which is generally used for the purpose of estimating the parameters. The (1,1) scheme tells the subscript notation of ε^2 and σ^2 in the equation, respectively. For a stable GARCH (1,1) process we need $\beta_1+\beta_2<1$. When the sum of β_1 and β_2 is less than one the model has finite unconditional variance. We can get the value of long-run variance rate after estimating the parameters, by using $\omega/(1-\beta_1-\beta_2)$.

The parameter estimation can be done by the method known as *maximum likelihood method*, Engle (1982) has suggested that the coefficients estimates obtained by maximising the likelihood function will be not only unbiased but also consistently more efficient than the estimates obtainable using Ordinary Least Squares. The likelihood measure of such GARCH process is—

$$\sum_{i=1}^{n}\left[-\ln\{\mathrm{var}(\varepsilon_i)\} - \frac{\varepsilon_i^2}{\mathrm{var}(\varepsilon_i)}\right]$$

We need to search iteratively to find the parameters in the model that maximise the above expression. For such purposes we can take the help of special algorithms like Levenberg-Marquardt, Gauss-Newton or Berndt-Hall-Hall-Hausman.

The Methodology
The GARCH (1,1) framework has been extensively found to be the most parsimonious representation of the conditional variance that best fits many financial time series* and thus, the same has been adapted to model stock return volatility. The model specifications for the study are as follows:

$$R_{it} = \alpha_0 + \alpha_1 R_{mt} + \alpha_2 D + \alpha_3 R_{mt} D + \varepsilon_t$$

$$\varepsilon_t / \varepsilon_{t-1} \sim N(0, \sigma_t^2)$$

$$\sigma_t^2 = \omega + \beta_1 \varepsilon_{t-1}^2 + \beta_2 \sigma_{t-1}^2 + \delta D$$

where R_{it} is the log price relative of the underlying stock 'i' at time 't'; R_{mt} is the log price relative of the stock market index; and ε_t is the stochastic error term which is now conditional upon the previous error term and is assumed to be normally distributed. The intercept and the slope dummy introduced in the augmented average return model are used to infer any change in the return during the post-futures period due to the introduction of futures trading in the security. As regards the conditional variance term σ^2, following Bologna and Cavallo (2002), it has been augmented with a dummy variable D which takes the value 'zero' for the pre-stock-futures period and 'one' for the post-stock-futures period. The direction and magnitude of the coefficient of this dummy variable, δ, is used to infer whether the introduction of futures could be related to any change in the volatility of the spot market for the security under consideration. The coefficient β_1 could be interpreted as a 'news', while β_2 could be defined as 'old news' coefficient. The coefficient β_1 measures the relative speed with which information is incorporated in stock prices due to stock futures trading. The coefficient β_2 measures the relative extent of the role played by the 'old news' due to stock futures trading. These coefficients have significance for the information efficiency of the stock markets.

It is possible that the factors other than the introduction of futures trading may affect the dynamics of the market, affecting all the tradable securities simultaneously. Our tests may erroneously attribute such a change, if at all, to the event of introduction of single

* Bollerslev, *op. cit.*

stock futures. Thus, it is imperative to study the behaviour of similar stocks that did not have futures' listing. For this purpose, a group of securities has already been selected which resembles the securities under study in the most similar attributes. However, the selection of such securities was not an easy task as most of the actively traded securities have already been listed for futures trading. The inclusion of non-active. securities could have serious distortions for the findings. It is more likely that there is no contribution to the volatility during the period of deferred trading and a sudden bump in the volatility of prices of the non-active stock just after the period of deferred trading.

This group of securities has been analysed simultaneously by converting their individual prices into a "Proxy Index" with equal weights. Thus, the behaviour of the stocks' returns is adjusted for exposition to additional factors which may affect market sensitivity and volatility of returns. So, another set of analysis has been conducted by taking into account the return on such proxy index as another exogenous explanatory variable in the. previous equation. The model, therefore, takes the following shape in another set of analysis—

$$R_{it} = \alpha_0 + \alpha_1 R_{mt} + \alpha_2 D + \alpha_3 R_{mt} D + \alpha_4 R_{pt} + \varepsilon_t$$

$$\varepsilon_t / \varepsilon_{t-1} \sim N\left(0, \sigma_t^2\right)$$

$$\sigma_t^2 = \omega + \beta_1 \varepsilon_{t-1}^2 + \beta_2 \sigma_{t-1}^2 + \delta D$$

where all other coefficients have previously been defined except for R_{pt} which means continuously compounded decimal returns on the proxy index at time 't'.

The Hypotheses

The study tries to tests the following major hypotheses:

1. The introduction of futures trading in the stock, *per se*, has affected the sensitivity of the stock return to market-wide movements. Thus, in statistical terms:

$$H_0 : \alpha_3 = 0$$

$$H_a : \alpha_3 \neq 0$$

2. The introduction of futures trading in the stock has affected the unconditional volatility in the spot prices of that stock in the post-introduction period. Thus, in statistical terms:

$$H_0 : \delta = 0$$
$$H_a : \delta \neq 0$$

where the coefficients to be tested has already been defined in the previous sub-section itself.

IV. Results and Discussion

Each individual stock return series is modelled using the augmented CAPM equation discussed in the previous section with the conditional variance described to follow the GARCH (1,1) process. The Marquardt optimisation algorithm is employed to obtain the coefficients of the model. The data is processed with the help of Eviews software. The results of the regression are reported in Table I as follows—

Table-I

The hypothesised coefficients and their respective significance

S. No.	Security	α_3	δ
1	ACC	0.0621793	-0.0002032**
2	AMBUJA	-0.0377090	0.0022884**
3	BAJAJ	-0.0267328	-0.0000906**
4	BHEL	-0.0916963	-0.0000458**
5	BPCL	0.1284838**	-0.0001456**
6	CIPLA	-1.2675077**	0.0000168*
7	DRREDDY	-0.3607248**	-0.0001310
8	GRASIM	0.1725827**	-0.0000023**
9	HDFC	0.1048214	-0.0011442**
10	HINDALCO	0.6106325**	-0.0000279
11	HLL	-0.0538314	0.0000035
12	HPCL	0.3041767**	0.0000006
13	INFOSYS	-0.5213376**	0.0010002**
14	ITC	-0.2554106	0.0025556**
15	M&M	0.1832421**	0.0000644**
16	MTNL	-0.1014569*	-0.0000039
17	RANBAXY	0.6015651**	-0.0000075
18	RELIANCE	-0.1778501**	-0.0001279**
19	SATYAM	0.1226612	-0.0002438**
20	SBI	-0.0361711	-0.0000052**
21	TATAPOWER	0.1796876**	-0.0000186**
22	TATATEA	-0.0971084*	-0.0000129**

(Note: **--'significant at 1%' and *--'significant at 5 %')

As can be observed from the above table, the majority of the securities have been affected by the fact that the futures trading had been allowed in such securities. In majority of the cases the null hypotheses can not be accepted; implying that the introduction of futures trading has statistically affected their spot market behaviour. As far as their market sensitivity is concerned, a definite impact can not be traced with respect to only forty-percent of the securities.

However, as far as their volatility is concerned, a definite impact can not be traced with respect to less than thirty-percent of the selected stocks only.

The results of the regression, taking into account the effect on the comparable set of securities, are reported in the Table II as follows—

Table-II
The revised hypothesised coefficients and their respective significance

S. No.	Security	α_3	δ
1	ACC	0.0845701	-0.0002138**
2	AMBUJA	-0.0330117	0.0019995**
3	BAJAJ	-0.0243585	-0.0000882**
4	BHEL	-0.0851630	-0.0000467**
5	BPCL	0.1475527**	-0.0001442**
6	CIPLA	0.9846599**	0.0000048
7	DRREDDY	-0.3301283**	-0.0000313
8	GRASIM	0.1791656**	-0.0000023**
9	HDFC	0.1133485	-0.0011046**
10	HINDALCO	1.0959940**	-0.0000086
11	HLL	-0.0460178	0.0000033
12	HPCL	0.3091820**	0.0000005
13	INFOSYS	-0.2641928**	-0.0000317
14	ITC	-0.2869742	0.0025700**
15	M&M	0.1936213**	0.0000634**
16	MTNL	-0.1020344*	-0.0000039
17	RANBAXY	0.6299780**	-0.0000052
18	RELIANCE	-0.1915221**	-0.0001269**
19	SATYAM	0.2773701**	-0.0003413**
20	SBI	-0.0334212	-0.0000053**
21	TATAPOWER	0.1974656**	-0.0000208**
22	TATATEA	-0.0787712*	-0.0000142**

(Note: **--'significant at 1%' and *--'significant at 5 %')

As can be observed from the above table, the results obtained in the previous paragraph are not materially altered by the inclusion of the proxy regressor to account for the factors other than the listing of the futures. The majority of the securities have been affected by the introduction of the futures trading in such securities.

The empirical results obtained are summarised in the following tables for better analytical understanding of Table I and II at a single glance:

Table- 1.
The summary results of α_3 coefficients

	Positive sign	Negative sign	Total
Statistically significant @ 5%	7(9)	6(5)	13(14)
Statistically not-significant	3(2)	6(6)	9(8)
Total	10(11)	12(11)	**22**

Table-2.
The summary results of δ coefficients

	Positive sign	Negative sign	Total
Statistically significant @ 5%	5(3)	11(11)	16(14)
Statistically not-significant	2(3)	4(5)	6(8)
Total	7(6)	15(16)	**22**

(Figures in bracket shows the summary of Table II)

Clearly, the trend is in favour of a significant impact on the relevant stock on the onset of its futures trading. The modes also tell that the stock futures trading have raised the beta sensitivity of the relevant stock together with a reduction in the long-run average volatility of the stock.

Considering the average return equation used, the market sensitivity or the beta risk estimates are represented by α_1 coefficients (pre-futures' listing beta risk estimate) and α_3 (post-futures' listing increment to the beta risk estimate of α_1). When we consider the sign and the statistical significance of the α_3 coefficients, we find that in the case of 7 securities (9 after considering the control portfolio of similar but non-futures stocks) there has been a significant increase in beta risk in the post-futures' listing period and an increase, albeit insignificant, in further three cases. This shows that the securities have become more responsive to the market-wide or herd movements in the stock market. Therefore, the structure of the market system has gained its determinative powers to ascertain the returns on these stocks after the post-futures' listing period. This also implies a stronger applicability of the CAPM model in respect of these securities and consequently it has become easier to forecast stock returns on the basis of the market returns. However, 6 securities (5 after considering the control portfolio of similar but non-futures stocks) have shown a significant decline in their beta risks.

When we consider the variance equation, the changes, occurring in the period after the listing of futures, in the unconditional volatility (or the long-run average volatility) is captured by the δ coefficient. 15 (16 after considering the control portfolio of similar securities) of the 22 securities reveal a negative coefficient which is significant in all except four (five) cases, thereby supporting a direct decline in the volatility in the post-introduction period. Of the remaining seven cases, only five of them are significantly positive.

If we analyse these results in terms of sectors then we reveal that none of the sector (wherever more than one security were included) has shown any trend, positive or negative, either in terms of their beta sensitivity or in terms of the unconditional volatility. One security, HLL, has not shown any significant trend neither in terms of beta sensitivity nor in terms of its unconditional volatility even after considering the control portfolio analysis. It is interesting to note that this security is the only security included in the study which is sectorally diversified.

The security-wise analysis can be done on the basis of the charts appended to the study. Only one stock, Cipla, has significantly responded to the factors other than the onset of futures trading *i.e.* the significant reduction in the beta sensitivity was due to some factors other than the onset of futures trading in this stock, otherwise there was a significant increase in the beta sensitivity of the stock. In the case of Satyam, the exclusion of such factors results in the significance of the change in beta sensitivity. Barring these two cases, the set of control portfolio of similar but non-futures securities has not been able to affect the results as to beta sensitivity of stocks. The largest increase in the beta sensitivity has occurred in the case of Hindalco. The present study empirically supplements to the unsettled debate of the optimal level of beta sensitivity and thus, does not purport any hypothesis of the, good or bad, consequences of reduced or increased beta sensitivity.

However, if we study the volatility of various stocks then we again find two stocks have been affected by the exclusion of such factors. In the case of Cipla, an increase in the unconditional volatility, significant at 5 % level of significance has been turned into non-significant at this level. But in the case of Infosys, a statistically significant increase in its unconditional volatility is turned into non-significant fall in its unconditional volatility. Again barring these two cases, the set of control portfolio of similar but non-futures securities has not been able to affect the results as to long-run average volatility of the stocks. The largest fall in the unconditional volatility has happened in the case of HDFC taking into account the equation—$\omega/(1-\beta_1-\beta_2)$, wherever the sum of β_1 and β_2 is less than one. However, the largest change in the unconditional volatility was an increase which happened in the case of ITC taking into account the equation—$\omega/(1-\beta_1-\beta_2)$, wherever the sum of β_1 and β_2 is less than one.

V. Summary and Conclusions

This paper tries to analyse some of the earliest securities allowed for futures trading in National Stock Exchange of India using GARCH technique with respect to their consequential volatility. The results show that the 50 % of the securities had a significant fall in their volatility in the post-futures period. Only 13 % percent of the securities had a significant increase in the post-futures volatility. At the outset it can only be said that the futures trading had a significant impact on the volatility parameter of those securities in which stock futures were allowed in the stock market of India. These results, however, has not been able to confirm the results of previous study done by the author whereby more than 87 % percent of the securities had a significant fall in their unconditional volatilities in post-futures periods and no security was found to report a significant increase in their unconditional volatility in post-futures period. This result does not fully confirm the hypothesis that the futures contract has a stabilising effect on the spot market of the underlying stock.

As one is aware of the fact that many factors other than the onset of futures contract in the specific stock may affect the stock's volatility and that the futures effect may not be the sole influencing factor. The change in the unconditional volatility may be the outcome of the internal or the external factors. There could be changes in the structural factors (*e.g.* demutualisation of stock exchanges, creation of stock option market, etc.) which may contribute to increase the efficiency of the market and thus making it substantially more mature and hence less volatile. Some external factors like growing integration of Indian stock markets with Asian and western stock markets may also bring Indian stock market in line with their own momentum. To carve out the analytical content out of such confounded data series, an attempt is made by adjusting the GARCH model using returns on the proxy index of control portfolio. The results of this estimate do not materially alter the findings.

The study also analyses the applicability of CAPM model in the context of revised volatility of these securities as the consequence of the introduction of futures contract in these securities. It was basically the augmented CAPM model which was moulded on the lines of GARCH class of models. The findings show that the onset of futures trading had a significant impact on the market sensitivity of the returns on these securities with respect to the market returns. However, in this case too, the study does not confirm the previous findings of significant increase in the beta factors of such securities.
In conclusion it can be argued that the stock futures contribute to the broad market features of the underlying securities and thus, it is a relevant constituent of the market efficiency of the stock markets in India, at least for the National Stock Exchange. If the theoretical arguments of enhanced social welfare as a result of the enhanced market efficiency, greater depth and width in the market, is accepted, then we need to consider the role played by the stock futures market in that context.

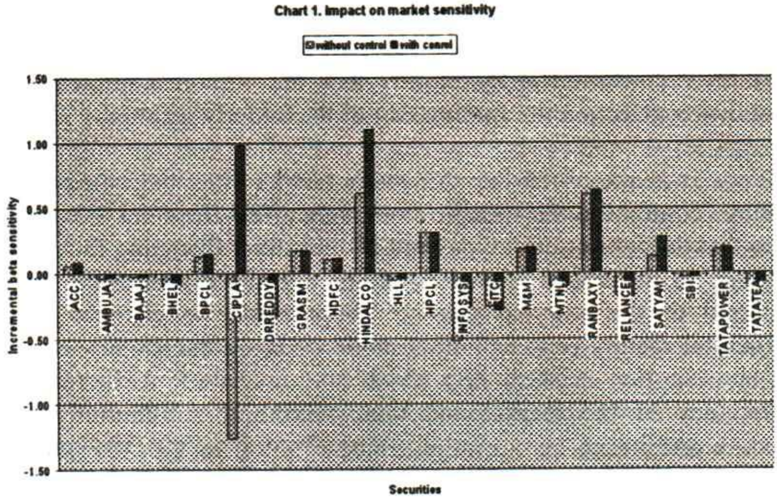
Chart 1. Impact on market sensitivity
without control with conrol
Incremental beta sensitivity
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
ACC
AMBUJA
BAJAJ
BHEL
BPCL
CIPLA
DRREDDY
GRASIM
HDFC
HINDALCO
HLL
HPCL
INFOSYS
ITC
M&M
MTNL
RANBAXY
RELIANCE
SATYAM
SBI
TATAPOWER
TATATEA
Securities

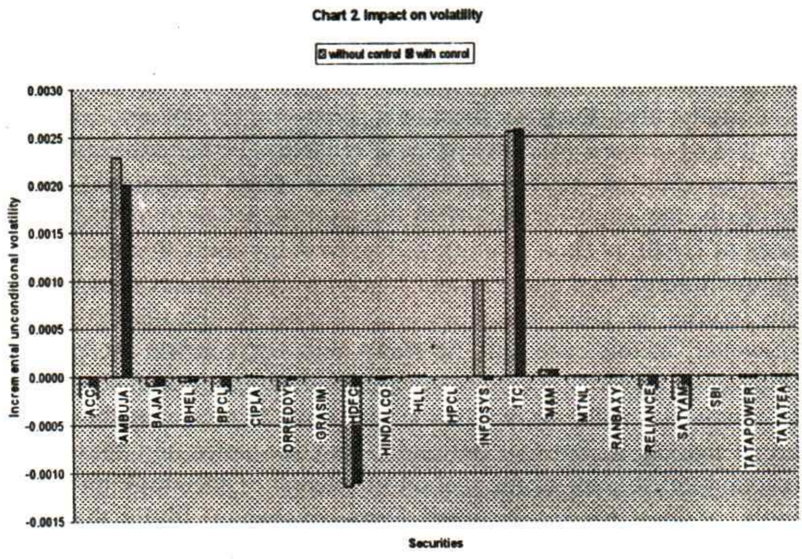
Chart 2. Impact on volatility
without control with conrol
Incremental unconditional volatility
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
-0.0005
-0.0010
-0.0015
ACC
AMBUJA
BAJAJ
BHEL
BPCL
CIPLA
DRREDDY
GRASIM
HDFC
HINDALCO
HLL
HPCL
INFOSYS
ITC
M&M
MTNL
RANBAXY
RELIANCE
SATYAM
SBI
TATAPOWER
TATATEA
Securities

Details of the Stocks

S. No.	Name of the Company	Code	Industry Classification	Derivative Status
1	Associated Cement Co. Ltd.	ACC	CEMENT AND CEMENT PRODUCTS	Y
2	Bajaj Auto Ltd.	BAJAJ AUTO	AUTOMOBILES - 2 AND 3 WHEELERS	Y
3	Bharat Heavy Electricals Ltd.	BHEL	ELECTRICAL EQUIPMENT	Y
4	Bharat Petroleum Corporation Ltd.	BPCL	REFINERIES	Y
5	Cipla Ltd.	CIPLA	PHARMACEUTICALS	Y
6	Dr. Reddy's Laboratories Ltd.	DRREDDY	PHARMACEUTICALS	Y
7	E.Merck (India) Ltd	EMERCK	PHARMACEUTICALS	N
8	Gujarat Industries Power Co. Ltd	GIPCL	POWER	N
9	Grasim Industries Ltd.	GRASIM	CEMENT AND CEMENT PRODUCTS	Y
10	Gujarat Ambuja Cement Ltd.	GUJAM BCEM	CEMENT AND CEMENT PRODUCTS	Y
11	Housing Development Finance Corporation Ltd.	HDFC	FINANCE - HOUSING	Y
12	Hindalco Industries Ltd.	HINDALCO	ALUMINIUM	Y
13	Hindustan Lever Ltd.	HINDLEVER	DIVERSIFIED	Y
14	Hindustan Petroleum Corporation Ltd.	HINDPETRO	REFINERIES	Y
15	Infosys Technologies Ltd.	INFOSYSTC H	COMPUTERS - SOFTWARE	Y
16	ITC Ltd.	ITC	CIGARETTES	Y
17	Karur Vysya Bank Ltd	KARURVYS YA	BANKS	N
18	Mahindra & Mahindra Ltd.	M&M	AUTOMOBILES - 4 WHEELERS	Y

19	Mahanagar Telephone Nigam Ltd.	MTNL	TELECOMMUNICATI ON - SERVICES	Y
20	Ranbaxy Laboratories Ltd.	RANBAXY	PHARMACEUTICALS	Y
21	Reliance Industries Ltd.	RELIANCE	REFINERIES	Y
22	Rolta India Ltd.	ROLTA	COMPUTERS - SOFTWARE	N
23	Satyam Computer Services Ltd.	SATYAMCO MP	COMPUTERS - SOFTWARE	Y
24	State Bank of India	SBIN	BANKS	Y
25	Tata Power Co. Ltd.	TATAPOWE R	POWER	Y
26	Tata Tea Ltd.	TATATEA	TEA AND COFFEE	Y
27	Thermax Ltd	THERMAX	ELECTRICAL EQUIPMENT	N

(Y: Stock Futures available N: Stock Futures not available)

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