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THE EFFECT OF DERIVATIVE TRADING ON VOLATILITY OF UNDERLYING STOCKS: EVIDENCE FROM THE NSE

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Abstract

The present study empirically investigates the effect of futures trading on volatility in Nifty as well as individual stocks by employing both symmetric and asymmetric GARCH models. The Daily closing price of Nifty index and twenty seven individual stocks are also collected from January 1, 1997 to February 28, 2008. The results of GARCH reveal that spot market volatility has declined after introduction of futures trading. In case of individual stocks, there has been a reduction in volatility of the individual stocks with the exception of seven stocks namely, ABB, CIPLA, ITC, ICICI, INFOSYS, RANBAXY and SIEMENS. Further, the introduction of futures trading has altered the asymmetric response behavior of spot price volatility as well as individual stock volatility. The study finally concludes that the introduction of the derivative contracts have improved the market efficiency and reduced the asymmetric information.

Keywords: *GARCH, GJR GARCH, Futures Trading and leverage Effects*

1. INTRODUCTION

It is an issue of interest as to how introduction of futures trading affects volatility of underlying stocks, have made the issue interesting for both exchanges and regulators. Introduction of futures trading might increase spot market volatility due to low transaction cost and high degree of leverage in futures market. The speculators in derivative market attempt to influence the spot index underlying futures contract, through excessive buying or selling of the underlying index constituents, the volatility of these stocks could increase. The excessive volatility in stock market significantly affects on risk-averse investor, corporate capital investment decisions, leverage decisions and consumption patterns .Therefore, it is important to study the impact of futures trading on individual stocks volatility which has considerable interest for regulator.

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The introduction of derivatives trading has received considerable attention. It has led to controversy over the effect of futures trading on volatility underlying assets. Some studies supported the argument that introduction of futures trading stabilizes spot market by decreasing its volatility. This is due to migration of speculative traders from spot to futures market. Futures' trading is expected to improve market efficiency and reduce informational asymmetries. The studies by Baldauf and Samtoni (1991) using the S&P 500 index in US, Darram (2000) using the FITSE Mid 250 contract in UK, Bologna (2002) using MIB 30 in Italy, and Raju and Kardnde (2003) using NSE 50 in India, support this view. They have shown a decline in the spot market volatility upon introduction of futures trading.

There are also studies which have supported that introduction of futures trading increased spot market volatility thereby destabilizing the market, as futures market promotes speculation and high degree of leverage. Harris (1989), Lee and Ohk (1992), have supported the destabilizing hypothesis. Thus, several of studies on introduction of futures trading on stock market volatility have been inconclusive. In the light of this background, the present study seeks to empirically investigate whether introduction of futures trading decreases or increases stock market volatility.

2. THE REVIEW OF LITERATURE

Pok and poshakwale (2004) examine the impact of the introduction of futures trading on spot market volatility using data from both the underlying and non-underlying stocks in the emerging Malaysian stock market. They employed GARCH to capture time varying volatility and volatility clustering phenomenon present in data. Their results show that the onset of futures trading increases spot market volatility and the flow of information to the spot market. Finally, the result shows that that the underlying stocks respond more too recent news, while the non-underlying stocks respond to more old news.

Golaka C Nath (2003) investigates behavior of stock Market volatility after introduction of derivatives by employing GARCH model. He considered 20 stocks randomly from the NIFTY and Junior NIFTY basket as well as benchmark indices themself. He observed that for most of the stocks, the volatility has come down in the post derivative period while for only few stocks in the sample) the volatility in the post derivatives has either remained more or less same or has increased marginally.

Dennis and Sim (1999) examine share price volatility with the introduction of individual share futures on the Sydney Futures Exchange by employing GARCH model. The results suggest that share futures trading has not had any significant effect on the volatility of the underlying share price for most stocks. In only a small number of shares are there evidence to suggest that share futures trading has had any effect. In cases where there is an effect, the results are mixed, with increased cash market volatility for two shares and decreased cash market volatility for one other share. Finally, they concluded that the impact of futures trading on cash

market volatility is no greater than, and in many cases less than, the impact of cash market trading itself.

Vipual (2006) investigates the effect of futures trading on volatility in Nifty as well as in individual stocks using data period between 1998 and 2004. He employed GARCH model to capture time varying nature of volatility and volatility clustering phenomena present in the data. The results show that introduction of derivatives trading has not destabilized the stock market. This is largely attributed to reduced persistence in the previous day's volatility. However, intraday unconditional volatility of equity increases. This contradiction is explained by increased correlation between prices of its constituent shares caused by arbitrage transaction in the cash market.

Harris (1989) examines the impact of S&P 500 index futures and options trading on the volatility of the firms' shares that comprise the S&P 500. He reported no significant difference in the volatility of the S&P 500 stocks *vis-vis* a control sample of 500 matching shares in the period 1975 through 1983 before the start of trade in index options and futures. However, he reported that after 1983, there is a statistically significant increase in the volatilities of firms in the S&P 500 index. However, the author suggested that the change in volatility is "economically" insignificant and that other factors could be responsible for the small increase.

Hodgson *et al.*, (1991) study the impact of All Ordinaries Share Index (AOI) futures on the Associated Australian Stock Exchanges over the All Ordinaries Share Index. The study spans for a period of six years from 1981 to 1987. Standard deviation of daily and weekly returns is estimated to measure the change in volatilities of the underlying Index. The results indicate that the introduction of futures and options trading has not affected the long-term volatility, which reinforces the findings of the previous U.S. studies. However, there was a problem of confounding variables such as floating of Australian dollar in late 1983, deregulation of stock exchanges, foreign bank ownership and mutual fund investment rules during 1984.

Figlewski (1981) examines impact of futures trading on Government National Mortgage Association (GNMA) market volatility. He found that the volatility of the GNMA security market is related to several factors, including futures trading. The amount of GNMA outstanding, which proxies for cash market liquidity, is found to lower cash market volatility, as does a lower average price for the GNMA. Futures trading were found to increase GNMA security volatility, and Figlewski (1978) suggested that the new traders in the GNMA market, because of the advent of futures trading, were likely to add noise to GNMA securities trading.

Edwards (1988) examines the volatility effects of the introduction of share futures on percentage daily changes in the level of the S&P 500 index. He reported that the day-to-day volatility of the S&P 500 from 1972 through 1987 does not support the hypothesis that the introduction of futures trading increased volatility in the stock market. In fact, he reported that volatility in the stock market decreased

after futures trading began, although he does not directly attribute the decrease to futures trading.

Chiang and Wang (2002) investigate the impact of inception of Taiwan Index futures trading on spot price volatility. They suggested that the trading of TAIEX futures had a major impact on spot price volatility, while the trading of MSCI Taiwan did not. They used GJR GARCH model to capture the asymmetric features in the data. The result shows that the increase in asymmetric response behavior following the beginning of the trading of two index futures reflects the fact that a major proportion of the investors in TSE is of non-institutional investors, generally un-informed and are inclined to over react to the bad news. Meanwhile, the introduction of the TAIEX futures trading is shown to improve the efficiency of information transmission from futures to spot markets.

The above literature gives a mixed result about the effect of futures on the volatility of the underlying market across the countries. Most of the studies are related to the developed countries like the US and UK. But, a very few studies have been conducted in developing countries like India. In this context, it gives rise to further research in this regard.

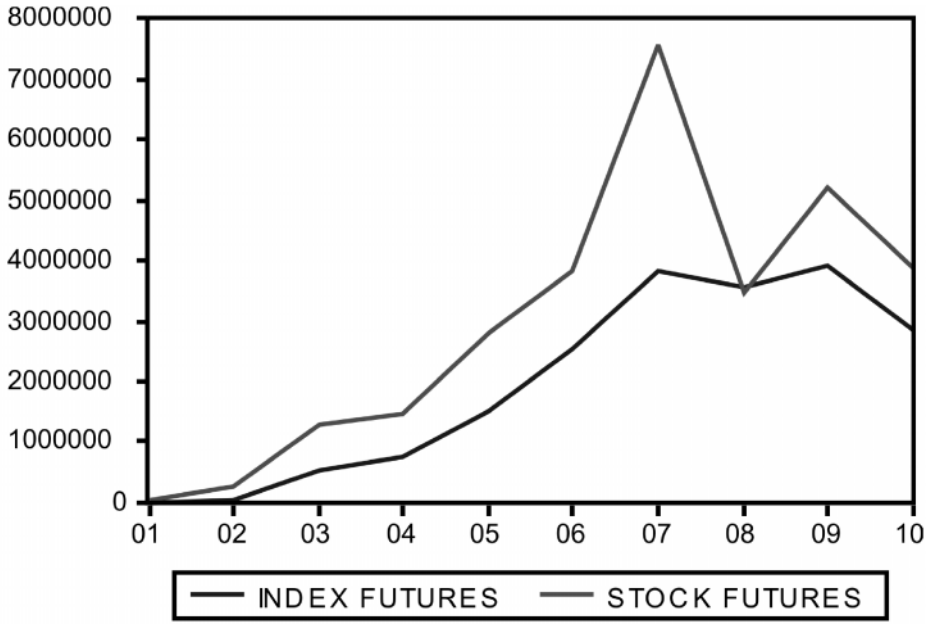
3. AN OVERVIEW OF THE NSE FUTURES MARKET

National stock exchange of India has introduced derivatives trading in June 2000 with the introduction of index futures followed by stock futures in November 2001. Since then, introduction of index futures and individual stocks have shown a tremendous growth. Currently, turnover in derivative products is much higher than the turnover in spot market. National Stock Exchange of India (NSE) has also emerged the fastest-growing bourse as the world's first largest derivative exchanges in terms of total traded volumes in 2007.

The total derivatives turnover was Rs 5477 crore in November 2001. Further, turnover of NSE's derivatives trading has increased to Rs 101925 crore in 2001-02 (daily average of Rs 410 crore) with stock futures accounting for Rs 51515 crore. Again, total derivatives turnover has increased in 2004-05 which was Rs 25, 46982 crore (Rs. 10107 crore of daily average) with stock futures trading for Rs 14,840 56 crore. As compared to the trading in stock futures in 2006 -07 at Rs. 38,30967 crore, has increased up to Rs 75,48563 crore in the comparable period of 2007-08- a rise of over 68 per cent. We can see growth of turnover in index futures and stock futures from figure and table 1.

However, index futures are becoming increasingly popular, and thus accounted for close to 45% of traded value in November 2007. The volume of index futures at NSE on 30 November 2001 was about Rs 21483 crore and the number of index futures contracts stood 10, 225 88. In 2007-08, the volume of index futures increased to Rs. 38, 206, 67 crore and that of contracts increased to 1, 565, 985, 79. Thus, derivatives contribute to faster growth in National Stock Exchange of India (NSE). Against this backdrop, it is important to study the effect of the futures introduction on spot market volatility.

Figure 1: Turnover in NSE Derivatives Market (Values in Crore Rupees)



Tabe 1
Turnover of NSE Derivatives Market

Year	*Index Futures*		*Stock Futures*		*Index Options*	
	No. of contracts	*Turnover (Rs. cr.)*	*No. of contracts*	*Turnover (Rs. cr.)*	*No. of contracts*	*Notional Turnover (Rs. cr.)*
2010-11	108453857	2847122.36	125571212	3887252.1	384835769	10790619.24
2009-10	178306889	3934388.67	145591240	5195246.6	341379523	8027964.20
2008-09	210428103	3570111.40	221577980	3479642.1	212088444	3731501.84
2007-08	156598579	3820667.27	203587952	7548563.2	55366038	1362110.88
2006-07	81487424	2539574	104955401	3830967	25157438	791906
2005-06	58537886	1513755	80905493	2791697	12935116	338469
2004-05	21635449	772147	47043066	1484056	3293558	121943
2003-04	17191668	554446	32368842	1305939	1732414	52816
2002-03	2126763	43952	10676843	286533	442241	9246
2001-02	1025588	21483	1957856	51515	175900	3765
2000-01	90580	2365	-	-		

Sources: NSE website

4. DATA AND METHODOLOGY

4.1. Data Description

The data for present study are obtained from National Stock Exchange of India (NSE). Daily closing prices of Nifty index and twenty seven individual stocks are collected for the period January 1, 1997 to February 28, 2008 to investigate the effect of index futures trading on the volatility of the Nifty. In all 27 individual stocks were selected out of 50 stocks, which formed the basis for introducing derivatives from time to time in the Indian stock market as underlying stocks. These individual stocks include ABB, ACC, BHEL, BPCL, CIPLA, DRREDDY, INFOSYS, GAIL**,** GRASIM, HDFC, HDFC BANK, HCLTECH, HEROHONDA, ICICI BANK**,** ITC, NATIONALU, M&M, ONGC, RANBAXY, RELIANCE, SAIL, SATYAM, SBI, SIEMNS, SUN PHARMA**,** TATAPOWER, and WIPRO. However, the study could not cover all individual stocks, because some of stocks were introduced as stocks futures very recently.

4.2. Methodology

To examine the effect of futures trading on volatility in Nifty as well as individual stocks, GARCH family techniques are employed. The GARCH family techniques are expected to capture time varying volatility, clustering volatility, leverage effects and mean reversion of present data. The main advantage of the GARCH model is that it makes the connection between information and volatility, since any changes in rate of information arrival into the market would also change the volatility in the market. Thus, unless information remains constant, which is hardly the case, volatility must be varying even on daily basis. The GARCH (1, 1) regression model is obtained by:

$$R_t = \Phi_0 + \Phi_1 R_{t-1} + \varepsilon_t \tag{1}$$

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

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} \tag{2}$$

where, R_t is log return conditional on past information, which is proxy by R_{t-1} and α_0, α_1 and β_1 are the parameters to be estimated. Ψ_{t-1} is the information set time t-$_1$, ε_t is the stochastic error conditional on Ψ_{t-1} and is assumed to normally distribution with zero mean and conditional (time varying) variance.

A dummy variable is introduced into conditional variance equation to check the effect of futures trading on volatility in Nifty as well as in individual stocks volatility.

$$R_t = \Phi_0 + \Phi_1 R_{t-1} + \varepsilon_t$$

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

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \gamma_1 DF \tag{3}$$

Where, DF is the dummy variable taking the value of the zero before futures introduction and 1 after the futures introduction. If the co-efficient of the dummy is negatively significant it indicates that the there is a decrease in the volatility associated with futures introduction. If the co-efficient is positively significant it indicates that there is increase in the volatility due to futures introduction.

The present study found that introduction of derivative trading has resulted in reduction in cash market volatility. Hence, we tried to investigate whether futures trading introduction is only factor responsible for reduction in volatility of NSE 50 or macro economic factors also affect market volatility. For this purpose, the study included return from a surrogate S & P 500(USA) index and BSE 200 into GARCH mean equation to control the additional factors affecting the market volatility. The following GARCH model is estimated.

$$R_t = \Phi_0 + \Phi_1 R_{t-1} + \theta_{1BSE200t-1} + \theta_{2\ s\ \&\ p\ 500\ t-1} + \varepsilon_t \quad (4)$$

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

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \gamma_1 DF \quad (5)$$

Where R_t is the spot price returns, the lagged S & P 500 index return is used to remove the effects of worldwide price movement on volatility of Nifty. For example, if the Indian market is influenced by US markets, this will be reflected through the lagged S & P 500 return. Here ε_t is the error in the conditional mean equation and Ψ_{t-1} is the set of information available at time t-1.

Finally, the study employs GJR GARCH model to investigate whether there is any change in asymmetric behavior of spot market volatility as well as individual stocks volatility after introduction of futures trading. The asymmetric behavior explains that bad news tends to have a larger impact on volatility than good news. Back (1976) attributes this behavior to the bad news which tends to drive down the stock price, there by increasing the leverage of the stock and causing the stock price to more volatile. Such an asymmetric impact of news on stock price volatility is referred as leverage effect. This leverage effect is captured by GJR GARCH model. The standard GRACH model assumes the bad news and the good news to have same effect on conditional volatility. However, GJR GARCH model developed by Glosten, Jagannathan and Runkle, (1993) showed how to allow for the effect of good news and bad news to have different effects on conditional volatility. The following GJR GARCH specification is estimated.

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \gamma_1 I_{t-1} \varepsilon_{t-1}^2 \quad (6)$$

where, $I_{t-1} = 1$ if $\varepsilon_{t-1} < 0$,

$= 0$ otherwise

5. EMPIRICAL RESULTS

The study conducted unit root tests to check the stationarity of the both Nifty and individual stocks by employing Augmented Dickey-Fuller (ADF) and Phillips–Perron

(PP) models. Table 1 presents the result of unit root test. The unit root test rejects null hypothesis for all the series, implying that Nifty and individual stocks series are stationary at first difference.

The descriptive statistics are given in Table 2 and 3 for Nifty series for both pre-futures and post-futures period. The results show that standard deviation has fallen from 0.01687 in the pre-futures period to 0.0145 in the post-futures period. That the values of kurtosis exceed more than three for Nifty series in both periods implies that distributions of Nifty returns are leptokurtic or tailed. The negative value of skewness for Nifty return indicates that the frequency distribution of returns series is negatively skewed during both the pre-futures as well as post-futures.

Table 2
Unit Root Test Statistics

Name of the stock	*ADF in First Difference*	*PP in First Difference*
Nifty Index	-21.765*	-698.50*
	(0.0000)	(0.0001)
BSE 200	20.594*	-615.62*
	(0.0000)	(0.0001)
S&P 500 (USA)	-19.915*	-938.54*
	(0.0000)	(0.0001)
ABB Ltd.	-19.176*	-1043.60*
	(0.0000)	(0.0001)
ACC Ltd	-21.176*	-832.32*
	(0.000)	(0.0001)
Bharat Heavy Electricals Ltd	-23.2978*	-629.35*
	(0.0000)	(0.0001)
BPCL	-24.006*	-814.07*
	(0.0000)	(0.0001)
CIPLA Ltd.	-22.136*	-870.4*
	(0.0000)	(0.0001)
Dr. Reddy's Laboratories Ltd.	-21.175*	-617.41*
	(0.0000)	(0.0001)
GAIL (India) Ltd.	-20.428*	-1170.64*
	(0.0000)	(0.0001)
GRASIM Ltd.	-20.085*	-748.07*
	(0.0000)	(0.0001)
HCL Technologies Ltd.	-21.125*	-510.78*
	(0.0000)	(0.0001)
HDFC Bank Ltd.	-22.051*	641.54*
	(0.0000)	(0.0001)
Hero Honda Motors Ltd.	-19.931*	-595.09*
	(0.0000)	(0.0001)

table 2 contd.

Name of the stock	*ADF in First Difference*	*PP in First Difference*
Housing Development Finance Corporation Ltd.	-25.394* (0.0000)	-1171.30* (0.0001)
I T C Ltd.	-20.398* (0.0000)	-452.01* (0.0001)
ICICI Bank Ltd.	-17.256 (0.0000)	-745.24 (0.0001)
Infosys Technologies Ltd.	-22.986* (0.0000)	-785.05* (0.0001)
Mahindra & Mahindra Ltd.	-22.882* (0.0000)	-627.62* (0.0001)
National Aluminum Co. Ltd.	-18.199* (0.0000)	-623.27* (0.0001)
Oil & Natural Gas Corporation Ltd.	-21.961* (0.0000)	-842.46* (0.0001)
Ranbaxy Laboratories Ltd.	-19.987* (0.0000)	-627.35* (0.0001)
Reliance Industries Ltd.	25.275* (0.0000)	-426.51* (0.0001)
Satyam Computer Services Ltd.	-20.594* (0.0000)	-266.39* (0.0001)
Siemens Ltd.	-22.166* (0.0000)	-608.879* (0.0001)
State Bank of India	-21.250* (0.0000)	-815.75* (0.0001)
Steel Authority of India Ltd.	-19.665* (0.0000)	-1502.57* (0.0001)
Sun Pharmaceutical Industries Ltd.	-20.611* (0.0001)	-847.14* (0.0001)
Tata Power Co. Ltd	-23.413* (0.0000)	-492.89* (0.0001)
Wipro Ltd	-26.523* (0.0000)	-490.73* (0.0001)

Note: Figures in parentheses are P value. *Indicates that unit root rejected null hypothesis at 1 % level of significance.

Table 2 and 3 also provide the descriptive statistics for all individual stocks both period pre-futures and post-futures. The daily mean returns for most of individual stocks are positive except in case of ACC, BHEL, BPCL, HCL, GRASAM and M& M during the pre-futures period. In case of post futures, the daily mean returns of 23 stocks are also positive, but returns of four stocks are negatively reported particularly stocks such as HEROHONDA, NATIONALU, SIEMENS and SAIL. The overall result shows that mean return of most of individual stocks has

Table 3
Descriptive Statistics on Nifty Index and Individual Stocks: Pre Futures Introduction

Name of the stock	*Mean*	*S-D*	*Skewness*	*kurtosis*	*J.B Test*
Nifty Index	0.00913	0.0168	-0.273	7.895	671.32
ABB Ltd.	0.00056	0.0257	-0.209	6.481	939.56
ACC Ltd	-0.00232	0.0834	-0.813	64.09	16498.71
Bharat Heavy Electricals Ltd	-0.00864	0.0365	0.03	3.62	16.02
BPCL	-0.00099	0.0433	-4.035	67.26	189029
CIPLA Ltd	0.00052	0.0454	-0.671	264.83	27872.2
Dr. Reddy's Laboratories Ltd.	0.00127	0.0412	-0.832	84.67	45306.54
GAIL (India) Ltd.	0.00066	0.0297	0.179	4.68	178.15
GRASIM Ltd.	-0.00022	0.0363	0.632	3.63	16.63
HCL Technologies Ltd.	-0.00385	0.0569	-2.646	33.05	29687.9
HDFC Bank Ltd.	0.00087	0.0276	0.318	5.16	350058
Hero Honda Motors Ltd.	0.00085	0.0237	-0.768	12.78	7458.2
HDFC	0.00156	0.0773	-0.364	738.41	219338
I T C Ltd.	0.00505	0.0387	0.008	4.64	108.74
ICICI Bank Ltd.	0.00241	0.0652	-0.022	89.23	875.26
Infosys Technologies Ltd.	0.00089	0.0501	-5.205	72.93	201224
Mahindra & Mahindra Ltd.	-0.00144	0.0365	-0.086	4.04	44.47
National Aluminum Co. Ltd.	0.00232	0.0134	0.777	9.56	68953.2
ONGC Ltd	0.00208	0.0296	0.448	6.22	522.41
Ranbaxy Laboratories Ltd.	0.00086	0.0375	-0.052	94.42	341913
Reliance Industries Ltd.	0.00046	0.0287	0.313	4.64	108.74
Satyam Computer Services Ltd.	0.00086	0.0724	0.0601	219.46	1906.17
Siemens Ltd.	0.00115	0.0284	0.049	5.63	533.59
State Bank of India	0.00224	0.0291	0.271	4.37	88.857
Steel Authority of India Ltd.	0.00087	0.0415	0.66	10.16	4739.27
Sun Pharmaceutical Industries Ltd.	0.00033	0.2011	-0.18	821.41	511845
Tata Power Co. Ltd	0.00079	0.0319	0.22	5.70	304.56
Wipro Ltd	0.00086	0.0612	-0.123	309.45	502378

increased marginally from pre to post futures period. The standard deviation of 20 individual stocks declined marginally in the post-futures period as compared to the pre-futures period. However, stocks such as ABB, CIPLA, ITC, ICICI, INFOSYS, RANBAXY and SIEMENS reported the highest standard deviation during the post-futures period.

The skewness, kurtosis and JB test statistic also have been reported in Table 2 and 3 The results show that the negative skewness coefficient for most of

individual stocks indicates that the frequency distribution of the return series is negatively skewed or longer tails to the left during both pre and post futures period. The kurtosis value exceeds more than three for most of individual stocks, implying that distributions of individual stocks returns are leptokurtic or tailed both period. Further, the JB test shows that assumption of normality is violated by log returns series of all stocks. The results of LB-Q, LB^2Q and LM tests are reported in table 4, which shows that squared residuals are auto correlated in almost all stocks, thus confirming the presence of ARCH effects in most of individual stocks.

Table 4
Descriptive Statistics on Nifty Index and Individual Stocks: Post Futures Introduction

Name of the stock	*Mean*	*S-D*	*Skewness*	*kurtosis*	*J.B Test*
Nifty Index	0.00062	0.0145	-0.875	9.26	3083.0
ABB Ltd.	0.00069	0.0612	-0.726	546.11	88939.36
ACC Ltd	0.00106	0.0225	-0.497	7.39	1342.75
Bharat Heavy Electricals Ltd	0.00173	0.0299	-0.714	178.99	2060076
BPCL	0.00062	0.0265	0.019	8.93	2321.35
CIPLA Ltd.	0.00076	0.0513	-23.59	690.21	313165.7
Dr. Reddy's Laboratories Ltd.	0.00099	0.0274	-10.65	273.96	484161.3
GAIL (India) Ltd.	0.00098	0.0286	-0.099	19.34	12394.44
GRASIM Ltd.	0.00145	0.0201	0.197	6.819	5892.36
HCL Technologies Ltd.	0.00038	0.0332	-0.078	167.93	14616.97
HDFC Bank Ltd.	0.00145	0.0227	0.314	21.82	16761.56
Hero Honda Motors Ltd.	-0.00097	0.0198	0.256	78.24	548.24
HDFC	0.00088	0.0276	-0.876	258.86	43471.81
I T C Ltd.	0.00075	0.0685	-35.25	134707	1208.63
ICICI Bank Ltd.	0.00758	0.0726	0.238	29.21	5689.27
Infosys Technologies Ltd.	0.00726	0.0631	-0.199	563.70	2085.59
M& M Ltd.	0.00013	0.0297	-0.791	185.71	2206.57
National Aluminum Ltd.	-0.00478	0.0128	-0.052	185.7	2206.51
ONGC.	0.0008	0.0254	-0.297	44.41	98232.2
Ranbaxy Laboratories Ltd.	0.00838	0.0496	0.946	272.43	482912.4
Reliance Industries Ltd	0.00141	0.0215	-1.697	28.18	4262.39
Satyam Computer Services Ltd.	0.00067	0.0323	-0.0076	134.54	115188.9
Siemens Ltd.	-0.0011	0.0728	-0.176	392.88	45927.59
State Bank of India	0.00149	0.0223	-0.411	7.09	1161.95
Steel Authority of India Ltd.	-0.00333	0.0358	0.436	6.62	157.06
Sun Pharmaceutical Industries Ltd.	0.00131	0.1965	-0.281	356.59	37456.01
Tata Power Co. Ltd	0.00147	0.0259	-0.512	13.425	7172.03.
Wipro Ltd	0.00073	0.0439	-0.174	344.73	62458.53

The results of GARCH are presented in Table 5. The empirical results show that all co-efficients in the conditional variance equation are significant at 1 percent level of significance including the dummy variable. The results show that the effect of introduction of index futures trading on Indian stock market may have affected per se the volatility of the Nifty. This is shown by the significance of the dummy variable. Further, the measures of the effect due the introduction of the futures trading (the value of the co-efficient γ) have negative sign, indicates that the onset of stock index futures results in diminished stock market volatility.

Table 5
Results of LB- Q and ARCH Test on Nifty Index and Individual Stocks

Name of the stock	*LB-Q(12)*	*$LB^2Q(12)$*	*LM(6)*
Nifty index	589.453	347.254	246.521
	(0.000)	(0.000)	(0.000)
ABB Ltd.	24.592	36.897	24.007
	(0.012)	(0.001)	(0.003)
ACC Ltd	26.145	36.004	42.564
	(0.003)	(0.000)	(0.000)
Bharat Heavy Electricals Ltd	40.599	8.783	57.852
	(0.000)	(0.942)	(0.000)
BPCL	28.688	32.342	24.235
	(0.000)	(0.000)	(0.0001)
CIPLA Ltd.	533.581	184.491	12.214
	(0.0000)	(0.000)	(0.235)
Dr. Reddy's Laboratories Ltd.	22.344	20.016	23.562
	(0.031)	(0.062)	(0.006)
GAIL (India) Ltd.	35.300	859.63	687.381
	(0.000)	(0.000)	(0.000)
GRASIM Ltd.	52.965	630.45	262.24
	(0.000)	(0.000)	(0.000)
HCL Technologies Ltd.	46.334	3.602	25.883
	(0.000)	(0.990)	(0.002)
HDFC Bank Ltd.	24.593	500.03	479.726
	(0.007)	(0.000)	(0.000)
Hero Honda Motors Ltd.	14.612	21.561	6.007
	(0.263)	(0.000)	(0.562)
Housing Development Finance Corporation Ltd.	4.499	2.362	17.576
	(0.975)	(0.996)	(0.253)
I T C Ltd.	12.261	0.0259	8.027
	(0.099)	(1.00)	(0.640)
ICICI Bank Ltd.	26.452	96.251	32.145
	(0.001)	(0.000)	(0.000)
Infosys Technologies Ltd.	12.554	23.032	16.013
	(0.402)	(0.001)	(0.020)

table 5 contd.

Name of the stock	*LB-Q(12)*	*$LB^2Q(12)$*	*LM(6)*
Mahindra & Mahindra Ltd.	48485	24.562	0.112
	(0.000)	(0.020)	(0.991)
National Aluminum Co. Ltd.	19.279	212.12	122.65
	(0.082)	(0.000)	(0.000)
Oil & Natural Gas Corporation Ltd.	28.051	28.252	14.225
	(0.000)	(0.000)	(0.127)
Ranbaxy Laboratories Ltd.	93.340	7.267	0.027
	(0.000)	(0.524)	(0.999)
Reliance Industries Ltd.	10.863	56.891	50.632
	(0.785)	(0.000)	(0.000)
Satyam Computer Services Ltd.	10.547	56.851	6.263
	(0.865)	(0.000)	(0.496)
Siemens Ltd.	29.106	40.986	0.067
	(0.003)	(0.000)	(0.999)
State Bank of India	44.194	758.235	261.331
	(0.000)	(0.000)	(0.000)
Steel Authority of India Ltd.	38.217	423.51	249.85
	(0.000)	(0.000)	(0.000)
Sun Pharmaceutical Industries Ltd.	599.96	98.457	1092.92
	(0.000)	(0.000)	(0.000)
Tata Power Co. Ltd	59.817	358.12	524.94
	(0.000)	(0.000)	(0.000)
Wipro Ltd	78.806	42.561	29.039
	(0.000)	(0.000)	(0.001)

Note: LB-Q (k) and LB2 -Q (k) are the portmanteau Ljung-Box Q test statistics for testing the

The present study examines whether futures trading is primarily responsible for reduction in volatility of Nifty or market wide factors affecting the stock market volatility (also see figures from 2 to 3). The empirical results reported in Table 6 show that the dummy co-efficient (-6.80) has taken negative value after adjusting for the market wide factors, and it is significant even though the magnitude of such effect has gone down considerably. Finally, the study concludes that futures trading has significant role in reducing volatility of the S&P CNX Nifty, but market wide factors do not affect volatility of the spot market.

The study also investigates the impact of stock futures on volatility of individual stocks. For this purpose a dummy variable is included in the GARCH conditional variance equation; for which D_t takes the value zero and one for pre and post futures period respectively. The dummy variable captures the effect of futures trading on volatility of individual stocks. The results of analysis reported in Table 7 show that coefficients of dummy variable for twenty individual stocks are negative and significant. It indicates that volatility of twenty individual stocks has marginally declined after introduction of futures trading. However, stocks such as ABB, CIPLA,

Figure 2: S & P CNX Nifty Returns

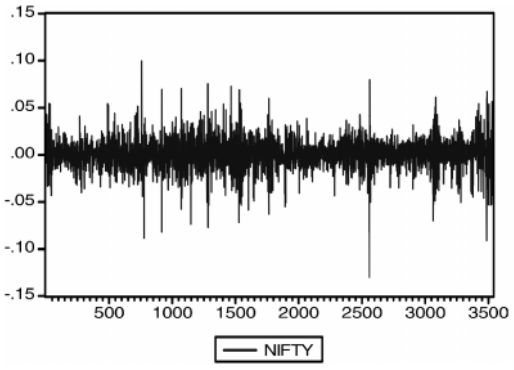


Figure 3: BSE 200 Returns

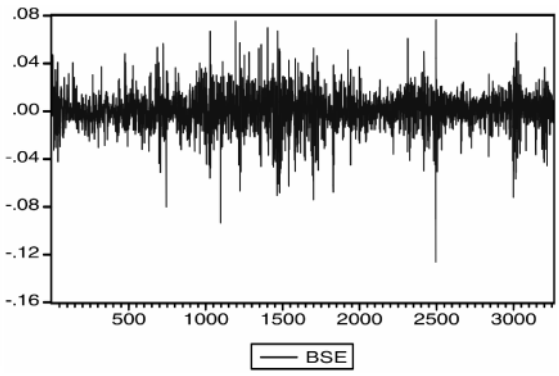
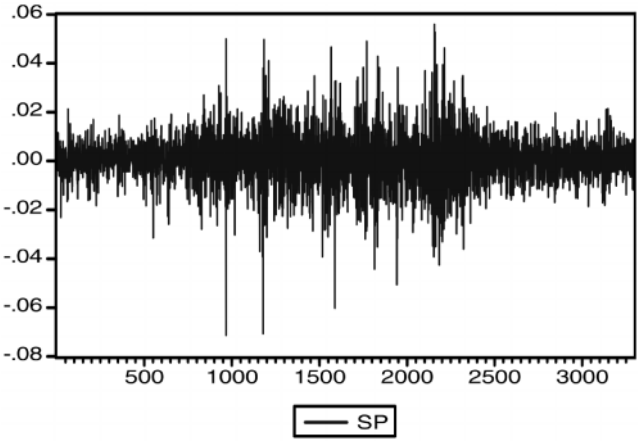


Figure 4: S & P 500 (US) Returns



ITC, ICICI, INFOSYS, RANBAXY and SIEMENS reports the higher volatility after introduction of futures trading. This is due to the fact that speculators might be participating heavily in these stocks.

Table 8 presents result of GJR GARCH model. It show that the estimated coefficient of asymmetry (γ) is positive and significant, indicating that asymmetric effects are present in the spot market, both during pre and post futures introduction. However, the coefficient of asymmetry is small in post futures compared to pre futures period. Overall, it can be said that introduction of derivative trading has had a negligible impact in resolving the asymmetric response of volatility to information in market.

The Table 9 and 10 provides result of GJR GARCH model for both pre and post futures period. The results show that the coefficients of asymmetry for most of individual stocks are found to be positive and significant except in the case of GAIL, ONGC, and SAIL specifically during pre futures period. In case of post futures

period, asymmetric effects are also present in the most of individual stocks. But, stocks such as ABB, BHEL, DRREEDY, HDFC, NATIONALU and RELIANCE are free from asymmetric effects.

6. CONCLUDING REMARKS

There has been a debate about how introduction of index futures trading influence cash market volatility. The moot question has been whether introduction of futures trading stabilizes or destabilizes stock market volatility. The results reveal that spot market volatility has declined after introduction of futures trading. In case of individual stocks, there has been a reduction in volatility of twenty individual stocks with the exception of ABB, CIPLA, ITC, ICICI, INFOSYS, RANBAXY and SIEMENS. Further, introduction of futures trading has altered the asymmetric response behavior both of spot price volatility as well individual stock volatility. Overall, introduction of futures markets improves the quality of information flowing to spot markets, and spot prices accordingly reflect more promptly changes that occur in demand and supply conditions. The finally results show that futures trading has significant role in reducing volatility of the S&P CNX Nifty, but market wide factors do not help to reduce the market volatility

Table 6
The Effect of Nifty Futures on Spot Price Volatility with GARCH (1, 1) Model

	Nifty Closing Returns	
Parameters	*Coefficients*	*Significance*
Constant	0.00415	7.534*
ARCH (1)	0.1291	16.484*
GARCH (1)	0.8227	93.968*
Dummy	-6.69E	-4.396*

* Indicates 1 % significance at 1 % level

Table 7
Controlling the Market Wide Factors GARCH (1, 1)

	Mean Equation	
Parameters	*Co-efficient*	*Significance*
constant	0.000827	3.634*
Nifty	0.133	7.013*
BSE 200	0.032	2.203*
S&P 500(US)	0.366	1.810*
	Variance Equation	
Constant	0.000164	7.753*
ARCH (1)	0.131	16.252*
GARCH (1)	0.822	97.244*
Dummy	-6.800	-4.310*

*Indicates significance at 1 per cent level

Table 8
Effect of Futures Trading on Individual Stocks Volatility with GARCH (1, 1) Model

Name of the stock	*Constant*	*ARCH(1)*	*GARCH(1)*	*Dummy*
ABB Ltd.	0.00019	0.027	0.430	0.81923
	(11.371)	(10.344)	(18.356)	(5.164)
ACC Ltd	0.00140	0.226	0.772	-1.00013
	(16.289)	(13.225)	(56.079)	(-16.625)
Bharat Heavy Electricals Ltd.	0.00042	0.522	0.393	-0.00273
	(10.144)	(19.101)	(13.220)	(-8.050)
BPCL	0.00055	0.424	0.319	-0.92796
	(12.379)	(24.360)	(12.008)	(-8.098)
CIPLA Ltd	0.00396	0.962	0.032	0.99137
	(142.913)	(12.554)	(12.008)	(14.627)
Dr. Reddy's Laboratories Ltd.	6.18E-05	0.131	0.530	-1.74326
	(5.622)	(5.343)	(7.937)	(-2.719)
GAIL (India) Ltd.	0.00374	0.152	0.805	-5.58045
	(8.856)	(13.865)	(64.640)	(-9.171)
GRASIM Ltd.	0.52261	0.090	0.882	-0.38475
	(12.567)	(11.592)	(103.572)	(-5.685)
HCL Technologies Ltd.	0.00374	0.151	0.849	-8.64071
	(6.531)	(8.588)	(72.067)	(-6.230)
HDFC Bank Ltd.	0.00485	0.229	0.719	-3.68054
	(9.585)	(20.956)	(50.641)	(-4.881)
Hero Honda Motors Ltd.	0.23185	0.272	0.561	-0.89417
	(5.704)	(6.642)	(13.641)	(-2.906)
Housing Development	0.00588	0.142	0.401	-0.00540
Finance Corporation Ltd.	(7.169)	(4.754)	(4.845)	(-7.719)
I T C Ltd.	0.00313	0.243	0.588	0.12558
	(7.637)	(12.686)	(28.321)	(2.561)
ICICI Bank Ltd.	0.00058	0.125	7.541	0.00546
	(6.487)	(9.856)	(29.471)	(5.875)
Infosys Technologies Ltd.	0.00056	0.201	0.746	1.86593
	(7.169)	(2.323)	(5.183)	(3.461)
Mahindra & Mahindra Ltd.	2.10824	0.107	0.710	-0.22014
	(4.611)	(5.041)	(13.790)	(-12.746)
National Aluminium Co. Ltd.	0.00011	0.146	0.809	-6.76251
	(4.031)	(12.812)	(68.002)	(-2.422)
Oil & Natural Gas Corporation Ltd.	0.00013	0.124	0.710	-1.90618
	(6.847)	(8.310)	(21.480)	(-0.261)
Ranbaxy Laboratories Ltd.	0.00179	0.165	0.153	0.94451
	(9.211)	(4.326)	(0.517)	(8.845)

table 8 contd.

Name of the stock	*Constant*	*ARCH(1)*	*GARCH(1)*	*Dummy*
Reliance Industries Ltd.	0.00179	0.287	0.517	-8.83631
	(9.614)	(26.337)	(19.887)	(-6.197)
Satyam Computer Services Ltd.	0.00128	0.835	0.081	-0.00059
	(13.782)	(42.633)	(3.138)	(-7.790)
Siemens Ltd.	0.29354	0.332	0.621	0.83063
	(5.956)	(10.841)	(38.046)	(2.815)
State Bank of India	3.35E-05	0.091	0.870	-1.43522
	(5.986)	(9.989)	(70.137)	(-4.117)
Steel Authority of India Ltd.	5.59E-05	0140	0.838	-1.2470
	(9.591)	(15.933)	(100.521)	(-1.594)
Sun Pharmaceutical Industries Ltd.	0.00417	0.264	0.708	-0.7155
	(3.320)	(12.768)	(77.256)	(3.226)
Tata Power Co. Ltd	6.32E-05	0.130	0.817	-3.5125
	(6.799)	(12.791)	(55.881)	(-5.236)
Wipro Ltd	0.00123	0.365	0.630	-0.00080
	(7.172)	(4.267)	(12.673)	(-4.491

Note: Figures in parentheses are t values

Table 9
The Asymmetric Effects of Futures Trading on Volatility of Nifty with GJR GARCH (1, 1)

		Pre Futures Introduction
Parameter	*Co-efficient*	*Significance*
α_0	0.0061	4.83*
α_1	0.0742	5.61*
β_1	0.8815	2.33*
γ_1	0.3907	7.62*
		Post Futures Introduction
α_0	2.0017	8.06*
α_1	0.1259	0.56*
β_1	0.7295	25.81*
γ_1	0.1294	8.82*

*indicates significance at 1 per cent level

Table 10
Result of GJR GARCH (1, 1) Model: Pre Futures Introduction

Name of the stock	*Constant*	*ARCH(1)*	*GARCH(1)*	*Leverage Effect (1)*
ABB Ltd.	0.00012	0.258	0.568	0.5684
	(10.567)	(8.247)	(18.415)	(3.435)
ACC Ltd	0.00026	0.1708	0.447	0.6172
	(5.310)	(3.285)	(14.949)	(11.164)
Bharat Heavy Electricals Ltd.	0.00021	0.024	0.750	0.0212
	(3.100)	(1.002)	(10.427)	(6.021)
BPCL	0.00861	0.316	0.603	0.0084
	(5.416)	(7.564)	(2.163)	(5.0487)
CIPLA Ltd.	0.00080	0.367	0.0632	0.4621
	(6.307)	(6.042)	(27.011)	(3.537)
Dr. Reddy's Laboratories Ltd.	0.00107	0.261	0.588	0.7450
	(2.637)	(7.461)	(4.113)	(7.455)
GAIL (India) Ltd.	3.45E-05	0.154	0.812	-0.0005
	(6.860)	(7.963)	(53.131)	(-0.301)
GRASIM Ltd.	7.79E-05	0.091	0.848	0.6150
	(3.436)	(3.015)	(26.614)	(4.991)
HCL Technologies Ltd.	0.00163	0.120	0.341	0.1131
	(4.476)	(1.360)	(2.371)	(3.097)
HDFC Bank Ltd.	3.45E-05	0.179	0.760	0.8812
	(8.326)	(7.586)	(46.660)	(2.863)
Hero Honda Motors Ltd.	0.00014	0.245	0.712	0.0785
	(5.236)	(4.268)	(56.873)	(2.874)
HDFC	0.00437	0.799	0.199	0.4932
	(3.257)	(2.698)	(2.597)	(2.0258)
I T C Ltd.	3.30E-05	0.068	0.889	0.8162
	(3.770)	(3.819)	(36.628)	(3.634)
ICICI Bank Ltd.	0.00025	0.178	6.987	0.0257
	(6.235)	(9.587)	(38.173)	(4.268)
Infosys Technologies Ltd.	0.51156	0.224	0.775	0.3654
	(4.229)	(11.274)	(68.720)	(3.075)
Mahindra & Mahindra Ltd.	0.000184	0.131	0.711	0.3260
	(3.683)	(3.223)	(10.800)	(2.675)
National Aluminum Co. Ltd.	0.00117	0.258	5.841	0.0741
	(8.794)	(7.589)	(41.457)	(3.457)
Oil & Natural Gas Corporation Ltd.	0.000373	0.148	0.840	-0.0004
	(5.819)	(7.100)	(50.703)	(-0.054)
Ranbaxy Laboratories Ltd.	0.000849	0.113	0.575	0.0011
	(1.253)	(1.235)	(1.754)	(4.020)
Reliance Industries Ltd.	8.29E-05	0.108	0.728	0.9382
	(4.882)	(0.374)	(18.514)	(3.195)

table 10 contd.

Name of the stock	*Constant*	*ARCH(1)*	*GARCH(1)*	*Leverage Effect (1)*
Satyam Computer Services Ltd.	0.000372	0.150	6.001	0.500
	(4.672)	(2.467)	(8.464)	(27.687)
Siemens Ltd.	0.000258	0.149	0.822	1.0104
	(6.261)	(8.715)	(64.800)	(6.582)
State Bank of India	0.005371	0.109	0.820	0.9209
	(3.875)	(3.650)	(24.390)	(4.632)
Steel Authority of India Ltd.	3.89E-05	0.127	0.869	-0.0692
	(8.300)	(14.686)	(127.43)	(-1.436)
Sun Pharmaceutical	5.75E-05	0.117	0.725	1.4615
Industries Ltd.	(9.557)	(5.057)	(143.66)	(30.901)
Tata Power Co. Ltd	0.000841	0.111	0.806	0.4130
	(3.761)	(4.817)	(22.974)	(9.266)
Wipro Ltd	0.000042	0.148	0.589	0.9514
	(4.267)	(2.661)	(12.613)	(3.662)

Note: Figures in parentheses are t value

Table 11
Result of GJR GARCH (1, 1) Model : Post Futures Introduction

Name of the stock	*Constant*	*ARCH(1)*	*GARCH(1)*	*Leverage Effect (1)*
ABB Ltd.	0.000122	0.049	0.593	-0.0002
	(0.823)	(0.095)	(1.204)	(-0.110)
ACC Ltd	0.000261	0.103	0.819	0.6842
	(4.990)	(7.356)	(42.791)	(3.333)
Bharat Heavy Electricals Ltd	0.000166	0.258	0.313	-0.0006
	(11.020)	(5.128)	(9.775)	(-0.211)
BPCL	2.56E-05	0.043	0.905	0.9494
	(5.359)	(4.528)	(89.230)	(3.826)
CIPLA Ltd.	6.55E-05	0.253	0.5431	0.3913
	(15.192)	(11.576)	(18.898)	(6.861)
Dr. Reddy's Laboratories Ltd.	0.000504	0.090	0.579	-0.0117
	(7.021)	(0.211)	(19.609)	(-0.267)
GAIL (India) Ltd.	4.56E-05	0.078	0.7893	0.5746
	(5.181)	(3.959)	(2.662)	(5.811)
GRASIM Ltd.	0.00266	0.124	0.799	0.4001
	(7.219)	(9.303)	(40.746)	(3.017)
HCL Technologies Ltd.	0.000384	0.948	0.046	0.9273
	(3.097)	(3.453)	(0.611)	(9.871)
HDFC Bank Ltd.	0.000101	0.110	0.571	0.862
	(3.097)	(3.144)	(11.951)	(7.251)

table 11 contd.

Name of the stock	*Constant*	*ARCH(1)*	*GARCH(1)*	*Leverage Effect (1)*
Hero Honda Motors Ltd.	0.00041	0.358	0.586	0.0587
	(5.241)	(6.221)	(29.251)	(4.235)
HDFC	0.000508	0.0215	0.584	-0.0237
	(0.607)	(1.421)	(0.860)	(-0.919)
I T C Ltd.	0.003049	0.116	0.568	0.9175
	(0.806)	(0.245)	(1.213)	(0.247)
ICICI Bank Ltd.	0.00051	0.257	0.524	0.0517
	(3.478)	(5.487)	(12.745)	(3.457)
Infosys Technologies Ltd.	0.00012	0.115	0.582	0.1178
	(0.903)	(5.831)	(1.282)	(4.6323)
Mahindra & Mahindra Ltd.	0.00010	0.225	0.915	0.0020
	(1.131)	(1.544)	(13.800)	(3.413)
National Aluminum Co. Ltd.	0.00897	0.157	0.752	-0.0001
	(5.741)	(9.256)	(24.783)	(-0.327)
Oil & Natural Gas Corporation Ltd.	0.000220	0.039	0.562	0.1139
	(4.750)	(1.656)	(6.226)	(7.0287)
Ranbaxy Laboratories Ltd.	0.000370	0.009	0.969	0.3004
	(12.482)	(2.632)	(51.962)	(6.010)
Reliance Industries Ltd.	0.00012	0.338	0.442	-0.0071
	(9.625)	(21.900)	(13.316)	(-0.237)
Satyam Computer Services Ltd.	0.00014	0.014	0.898	0.9115
	(1.711)	(2.955)	(14.947)	(2.333)
Siemens Ltd.	8.74E-05	0.275	0.529	0.0756
	(2.202)	(4.276)	(19.425)	(6.106)
State Bank of India	1.89E-05	0.066	0.875	0.4273
	(4.969)	(4.953)	(57.478)	(2.886)
Steel Authority of India Ltd.	0.00012	0.080	0.722	0.6950
	(2.306)	(2.066)	(8.641)	(2.075)
Sun Pharmaceutical Industries Ltd.	0.06206	0.064	0.585	0.0216
	(1.050)	(2.089)	(2.497)	(2.015)
Tata Power Co. Ltd	2.85E-05	0.128	0.800	0.1025
	(5.517)	(7.839)	(42.594)	(3.013)
Wipro Ltd	0.00125	0.142	0.728	0.9145
	(2.971)	(2.202)	(14.567)	(3.426)

Note: Figures in parentheses are t value

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