Stock Futures Introduction Its Impact on Indian Spot Market

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2008

Stock Futures Introduction & Its Impact on Indian Spot Market

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Abstract

Futures have been introduced to cater the needs of investors and fill up the existing gaps in stock market. Studies show that, in the long-run, futures introduction does *not* have any effect on the spot market; however, in the short-run volatility in the spot market *increases*; Paudyal *et al.* (2005). Harris (1989) finds that increased volatility in the spot market is not solely due to the futures introduction. Alexakis (2007) substantiates the stability of indices after futures introduction.

This study is set about to understand the impact of stock futures introduction on the Indian spot market. We consider a small sample of 20 scrips, segregated as small and large caps, listed on NSE for the period August 2005 to May 2008. Using Hoadley Options, volatility modeled by GARCH (1, 1) is estimated. Considering both *volume* and *volatility*, mixed evidences are witnessed. Futures introduction has some destabilizing effect on large caps. For small caps, marginal increase in volatility is accompanied by large increase in volume, thereby, improving the liquidity of the scrips.

Key Words: Stock futures, Spot market, Stock price, Volatility, Traded volume, GARCH.

JEL Classification: C32, G14.

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I. Introduction

Stock price volatility plays a crucial role in the stock market. Investment decisions are governed significantly by this volatility apart from other *interdependent* factors like price, volume traded, stock liquidity, among many others. Several new instruments have been introduced in the recent past to cater the needs of investors and fill up the existing gaps in stock market. Futures being one of such instruments, act as a tool to hedge the risk associated particularly with an equity portfolio. Introduction of futures have revolutionized the nature of trading on stock exchanges. Not only investment decisions regarding portfolio composition in the spot market, but also, timing of the transactions depend significantly on existing scenario in the futures market. This linkage can also be attributed to the presence of arbitragers — those who liquidate positions in one market and take comparable positions in another at relatively better prices. How the association of these two markets affects each of them continues to remain an interesting area of research in economics and finance. Some researchers have examined the interrelation between the spot and futures market of various stock exchanges worldwide. Broadly, the literature so far portray three different views: first, futures introduction have made the spot market more volatile, owing to highly levered and speculative market participants, see Edwards (1988); the second view puts forward that there is no significant impact on the spot market due to futures introduction, see Hodgson *et al*. (1991) and Paudyal *et al*. (2005). Harris (1989) comparing daily volatility of S&P 500 pre and post- futures introduction, found that spot market volatility has increased. But, using index with no futures traded as the control group, Harris (*ibid*.) concluded that increase in volatility has been a common phenomenon and cannot be attributed to futures introduction. Lastly, empirical research on post-futures introduction has also shown the stabilizing effect attributed to decreased volatility in the spot market, Kamara *et al*. (1992), Alexakis (2007). Subsequently, Chan *et al*. (1991) studied S&P 500 and some other major market index futures and found that strong inter-market dependence exists between the two markets. In a similar line of arguments, Thenmozhi (2002) illustrates that introduction of NSE 50 futures have decreased the volatility of NSE 50 index. Interestingly, another study by Shenbagaraman (2003) with same objective finds that there is no evidence of linkage between trading activity variables in futures market and spot market volatility.

The gamut of literature shows that all these studies have been done at the indices level. Thus, how the individual scrips have been affected, still remains unexplored. This study therefore, attempts to illustrate the impact on volatility and volume traded of the stocks with the introduction of their respective futures. It also attempts to throw light on whether the impact has been same for both large and small caps. The itinerary of rest of the paper is as follows. Section II discusses Data and Variables followed by Section III which highlights the research methodology. Empirical findings are mentioned in Section IV and lastly, concluding remarks are provided in Section V.

II. Data and Variables

Data for this study have been taken from Technical Trends database using Meta Stock Professional 8.0 as front end. Though futures and options segment of NSE started operating in 2001 but since then the market scenario has changed significantly. Therefore, for evaluating the post futures introduction effect, most recent data have been considered. In total, 26 stocks' futures were launched on 29th December, 2006. From December 2006 to May 2008, 18 months have lapsed, hence we study 18 months before the introduction and 18 months after the futures introduction. The *pre* futures introduction period spans from 19th August 2005 to 28th December 2006 and *post* futures introduction period ranges from 29th December 2006 to 14th May 2008. Data inconsistency arising out of circuit breakers implemented by NSE trading system provides us with only 22 scrips.[1] However, in the selected sample, two stocks started trading only after 2005. So, due to data unavailability, the sample further reduces to 20 scrips. Depending on the market capitalization, the scrips are distinguished as large caps and small caps, ratio being 9:11 in this study.

This study confines itself to understand how stock price volatility and traded volume of scrips change after futures introduction. Volatility is the uncertainty arising out of share price fluctuations. Stock price considered is the daily closing price, which is final settlement price of stocks at the end of trading session. Daily traded volume denotes number of trades that happen for the stock in a single day. Higher volume implies that investors are more interested in the stock, and thus it is likely to experience more price fluctuations and vice versa.

[1] Circuit breaker refers to the measures used by stock exchanges during large sell-offs to avert panic selling.

III. Methodology

The extant literature provides us with two volatility measures viz., Standard Deviation and GARCH Estimation. The GARCH model was originally developed by Bollerslev (1986) on the lines of ARCH model given by Engle (1979) for estimation of volatility. The price return series exhibit few unique characteristics about volatility. First, *volatility clustering*: volatility remains high for certain period and low for another. Then, it is *stationary* i.e. it has finite mean and variance. Lastly, it exhibits *leverage effect*: different reaction to price increase and decrease.[2] GARCH model provides better volatility estimates than standard deviation because it is designed to accommodate these unique properties of volatility. Moreover, existing studies show that GARCH (1, 1) provides most robust estimates than any other model. See, Lunde and Hansen (2005).

Tsay *et al.* (2005) reports a sequential procedure to specify any volatility model over return series. We adopt the same procedure to check the validity of GARCH (1, 1) over the return series. Mathematically, standardized returns are calculated as:

$$r_t = \ln\left(\frac{P_t}{P_{t-1}}\right)\times 100 + 1$$

where r_t is the return on the stock and P_t is the daily closing price at time t.

Mean equation is then specified by testing for serial dependence in the return series. To test for serial dependence, Ljung – Box statistic [Q (m)] is calculated. 'm' is the number of lag(s) in return series in which the dependency is observed. If the Q statistic is greater than the critical value of χ^2 (m df) at α (0.05) significance level, data exhibit serial dependency. Therefore, the Mean equation obtained is:

$$r_t = \mu + \sum_{i=1}^{m} \phi_i r_{t-i} + a_t$$

where r_t is the return on the stock and a_t is residual of the mean equation at time t.

[2] Mandelbrot (1963), Fama (1965), Bollerslev (1986) document the presence of mentioned volatility characteristics in the stock returns.

Lastly, squared residuals $\{a_t^2\}$ of the *mean equation* are obtained to test for ARCH effect. We again calculate Ljung-Box statisitcs [Q (*m*)] of the $\{a_t^2\}$ series to test for ARCH effect. SPSS software (12.0) has been used to plot the ACF graphs. Finally, *Volatility Model* is specified and joint estimation of mean and volatility equation is carried out to estimate the parameters. As discussed earlier that GARCH (1, 1) is well suited for robust statistical estimates, it is specified as:

$$a_t = \sigma_t \varepsilon_t, \qquad \sigma_t^2 = \omega + \alpha a_{t-1}^2 + \beta \sigma_{t-1}^2 \qquad \textit{Variance equation}$$

$$0 \le \alpha, \quad \beta \le 1, \quad \alpha + \beta \langle 1 \qquad \textit{Constraints}$$

where σ_t is the volatility of return series and $\{\varepsilon_t\}$ is a sequence of *iid* random variables with zero mean and unit variance.

The estimation of above parameters is done through Maximum Likelihood method since OLS fails to give robust estimates in presence of heteroskedasticity in the data. Hoadley Options software has been used to provide volatility estimates and parameter estimates of GARCH (1, 1) model.

IV. Statistical Analysis

Based on date of futures introduction, data have been segregated in two sets, namely, *pre* futures introduction and *post* futures introduction. Descriptive statistics are reported for these two sets separately over each of the 20 scrips. Since the study captures the impact on both price and volume traded, separate analysis is done for the two. The results are provided in Appendix I and Appendix II, respectively.

IV.1 Descriptive Statistics of Price Returns

The volatility estimation method incorporates use of maximum likelihood process. This process can be applied only to normalized data. Through the skewness and kurtosis figures of the return series, it can be satisfactorily assumed that maximum number of scrips follows the normal distribution. See, Appendix I. Summary statistics reveal that the population can be assumed to be *normally* distributed. We also observe the *Gaussian distribution* of return series from the equality of mean and median. However, some of the scrips show slight deviation from normality.

While estimating the volatility using standard deviation, it was found that for nearly 55% of the scrips, volatility has increased. However, comparing the value in *pre* and *post* futures introduction period, we find that there is no significant difference. Considering the entire sample in totality, we observe that nearly 60% of the firms have higher returns than the average. However, the figure reduces to 45% in the *post* futures introduction period. Infact, the average return has also decreased by 6%. See, Table 1 below.

Table 1: Summary Statistics of Stock Price Returns

	Pre Futures Introduction	Post Futures Introduction
Mean	1.14	1.07
Std Error	0.04	0.04
Median	0.97	0.98
Std Deviation	3.28	3.52
Kurtosis	4.60	6.89
Skewness	0.34	–0.29
No. of Stocks	20	20

The market volatility when crudely estimated by the combined standard deviation of these twenty firms has increased by 7%. In the *pre* futures introduction period, 11 scrips are seen to be more volatile than the market. The figure reduces to 8 in the *post* futures introduction period.

IV.2 Descriptive Statistics of Volume Traded

Comparing volume traded in *pre* futures and *post* futures introduction period we find that for a large number of scrips it has decreased. See, Appendix II. Amongst the small caps, nearly 60% have witnessed increase in the volume traded. But for the large caps, number of scrips experiencing increase and/or decrease is same. Moreover, in large caps segment, one group of firms witnessing decrease in volume has experienced a large reduction in traded volume. While for the other group of large scrips, there has been a slight increase in traded volume.

The stark contrast is observed for small caps. In the *post* futures introduction period, for one set of small scrips there has been a marginal decrease in traded volume. But for the other set of small caps, significant increase is experienced in traded volume.

IV.3 Empirical Analysis

The volatility model is estimated separately for each of the 20 scrips. After checking for serial dependence in the price return series for each of the 20 scrips, we find that largely scrips have dependence at lag one. Refer to Table 2. The 'mean equation' for this study is represented by

$$r_{it} = \mu_i + \phi_{i,1} r_{i,t-1} + a_{it} \; ; \; i \in (1, 20) \qquad \textit{Mean Equation}$$

The residuals of each of the twenty mean equations are tested separately for the presence of ARCH effect. The ACF plots for a selected few are shown in Appendix III.[3] At 5% significance level the *null hypothesis* is *rejected* for the maximum number of scrips. This supports the suitability of GARCH (1, 1) model for our selected data.

Table 2: Ljung – Box Statistic [Q (1)]: The ARCH Effect

	Pre Futures Introduction	**Post Futures Introduction**
Aban	9.29	3.30
Amtek	9.77	3.02
Bajaj	28.25	93.67
Balram	7.80	20.07
Bata	35.25	19.19
Bombdyeing	17.99	11.59
Crompgreav	24.73	6.69
GDL	88.92	30.28
GTL	0.11	0.01
Gujrakali	9.89	92.96
HCC	10.06	8.66
JSW	7.85	23.10
Kotak	43.63	15.40
Lupin	8.23	8.17
Mcdowell	6.92	19.00
Nagar	34.92	1.38
Sesagoa	16.91	1.40
TTML	2.59	66.06
Ultracemco	9.92	2.63
Voltas	6.92	16.28

Critical value of χ^2 (1 *df*) = 3.84 (5 %)

After Testing for ARCH effect, volatility is estimated for both *pre* & *post* futures introduction period by performing joint estimation of *mean equation* and *variance equation*. Results for the same are provided in Table 3.

[3] The other ACF plots are available on request from the authors.

Table 3: Current Volatility: GARCH (1, 1) Estimates

	Pre Futures Volatility	Post Futures Volatility
Aban	0.47	0.45
Amtek	0.34	0.25
Bajaj	0.49	0.53
Balram	0.44	0.60
Bata	0.44	0.44
Bombdyeing	0.50	0.66
Crompgreav	0.37	0.42
GDL	0.54	0.43
GTL	0.43	0.36
Gujrakali	0.58	0.44
HCC	0.43	0.54
JSW	0.44	0.51
Kotak	0.42	0.55
Lupin	0.30	0.32
Mcdowell	0.37	0.44
Nagar	0.45	0.52
Sesagoa	0.43	0.60
TTML	0.52	0.54
Ultracemco	0.34	0.39
Voltas	0.51	0.45
Mean	**0.44**	**0.47**

We observe that nearly 70% of the firms have experienced increase in stock price volatility implying that *after the futures introduction price uncertainty has increased* in the stock market. Considering the average volatility, it can be said that market volatility has increased by nearly 7% after futures introduction. Moreover, we observe that 65 % of the small cap firms have witnessed increase in volatility, whereas among the large caps, 80% of them have experienced volatility increase. Furthermore, we obtain the average volatility for the large and small caps separately for *pre* and *post* futures introduction. For large caps, percentage change in volatility is nearly 15%, but for small caps it is comparatively much less (approximately 1.6%).

Table 4: Market Segments Volatility

	Pre Futures Introduction	Post Futures Introduction	No. of firms	% Change
Large Caps	0.41	0.47	9	15.6
Small Caps	0.46	0.47	11	1.6

V. Conclusion

This is a preliminary study aimed at exploring how stock futures introduction has affected the underlying scrips in the spot market. Using GARCH (1, 1) for volatility estimation, it is found that volatility increases after futures introduction. In other words, stock futures introduction has some *destabilizing effect* over its underlying scrip. Moreover, selected sample of scrips are segmented as large cap and small cap firms, depending on their market capitalization, in the ratio of 9:11. The number of large caps experiencing increased volatility is higher than the number of small caps. Moreover, on an average, large caps have undergone greater change in volatility as compared to their smaller counterparts. At the same time, small caps have also experienced significant increase in traded volume. For the small caps large increase in traded volume and marginal increase in volatility imply that investors have become more interested in these firms after the futures introduction than before. However, among the large caps, one segment experiences a significant decline while the other segment shows slight increase in traded volume. This may be interpreted as a destabilizing effect on large caps, given high stock price volatility and reduction in traded volumes after futures introduction. But, since an equal number of large caps have also experienced increase in volatility, further studies are required to substantiate the above results.

In order to maintain consistency, we used a common volatility estimation method for all the scrips. This neglects the possibility of obtaining better volatility estimates for scrips in the cases where GARCH is not so suitable. This study does not claim to have incorporated all the relevant variables as possible determinants of impact of futures introduction on the spot market. This is left for immediate future research. Once such important variables are (empirically) identified, volatility forecasting model can be built.

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Appendix I: Descriptive Statistics of Price Returns

Table 1: Pre Futures Introduction							
	Mean	Std Error	Median	Std Deviation	Kurtosis	Skewness	Count
Aban	1.28	0.18	0.96	3.32	2.68	0.66	341
Amtek	1.15	0.15	1.00	2.75	6.35	0.62	341
Bajaj	1.01	0.21	1.02	3.89	3.31	0.37	341
Balram	0.99	0.18	0.77	3.27	1.18	0.08	341
Bata	1.09	0.20	0.80	3.69	7.84	-0.28	341
Bombdyeing	1.15	0.23	1.05	4.18	3.54	0.44	341
Crompgreav	1.25	0.15	1.27	2.81	0.68	0.06	341
GDL	1.01	0.19	0.97	3.54	6.46	-0.24	341
GTL	1.09	0.19	1.09	3.42	7.10	-0.01	341
Gujrakali	1.00	0.19	0.67	3.57	6.22	1.19	341
HCC	1.18	0.18	1.10	3.29	1.21	0.22	341
JSW	1.09	0.16	1.02	3.01	2.25	0.45	341
Kotak	1.20	0.18	0.98	3.24	9.15	0.26	341
Lupin	1.15	0.13	1.02	2.38	3.63	-0.08	341
Mcdowell	1.29	0.17	0.91	3.18	2.50	0.55	341
Nagar	1.20	0.18	1.18	3.38	1.48	-0.17	341
Sesagoa	1.20	0.19	0.98	3.59	4.02	0.52	341
TTML	0.86	0.14	0.64	2.50	9.28	1.52	341
Ultracemco	1.28	0.14	1.26	2.61	2.22	0.40	341
Voltas	1.35	0.18	1.00	3.31	1.22	0.66	341

Table 2: Post Futures Introduction							
	Mean	Std Error	Median	Std Deviation	Kurtosis	Skewness	Count
Aban	1.30	0.18	1.11	3.30	5.78	-0.35	341
Amtek	0.94	0.13	0.96	2.45	2.89	0.37	341
Bajaj	1.01	0.28	0.97	5.22	9.63	-0.79	341
Balram	1.04	0.25	0.87	4.59	4.58	0.28	341
Bata	0.95	0.20	0.74	3.66	8.15	-0.79	341
Bombdyeing	1.07	0.21	1.07	3.82	3.58	0.19	341
Crompgreav	1.03	0.16	0.92	3.05	0.43	0.13	341
GDL	0.84	0.18	0.71	3.30	6.94	-0.60	341
GTL	1.18	0.13	1.02	2.36	6.32	1.31	341
Gujrakali	1.05	0.19	0.86	3.45	6.29	-0.52	341
HCC	0.97	0.21	0.97	3.97	2.11	-0.21	341
JSW	1.29	0.19	1.43	3.46	2.14	-0.35	341
Kotak	1.19	0.19	1.34	3.54	2.22	-0.27	341
Lupin	0.98	0.12	0.91	2.16	0.89	0.17	341
Mcdowell	1.18	0.19	0.99	3.42	1.99	0.55	341
Nagar	0.99	0.20	0.70	3.60	3.54	-0.47	341
Sesagoa	1.32	0.19	1.10	3.46	10.65	-0.95	341
TTML	1.18	0.22	1.00	4.07	6.22	-0.28	341
Ultracemco	0.86	0.14	0.84	2.62	1.36	-0.03	341
Voltas	1.13	0.19	1.14	3.44	2.97	-0.32	341

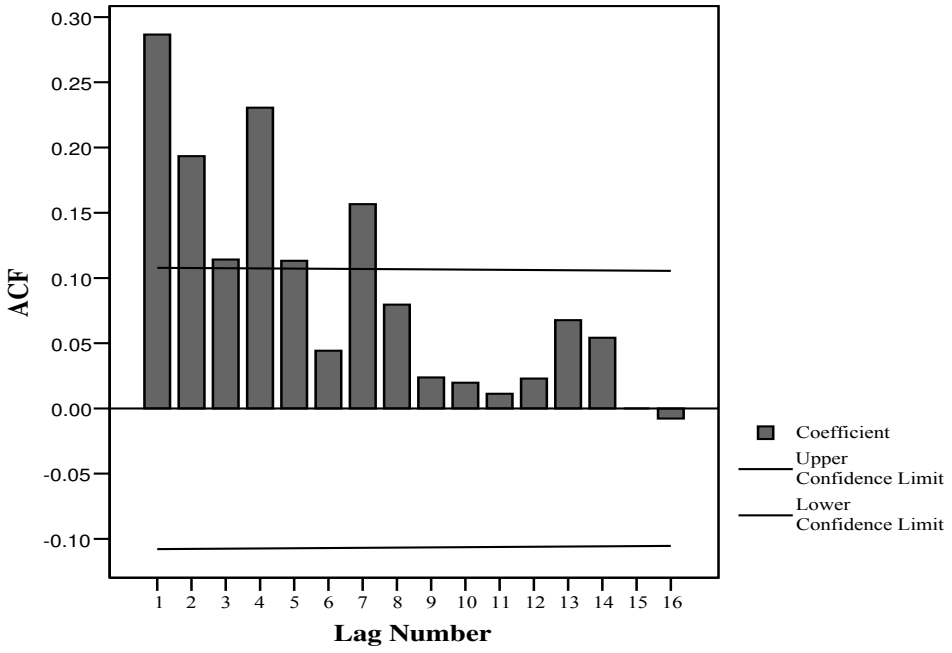
Appendix II: Descriptive Statistics of Volume Traded

Table 1: Pre Futures Introduction							
	Mean	Std Error	Median	Std Deviation	Kurtosis	Skewness	Count
Aban	63105	4518.0	34886	83429.9	14.72	3.36	341
Amtek	200623	16476.7	122288	304261.4	63.31	6.70	341
Bajaj	1145921	52286.6	896366	965533.6	5.27	1.87	341
Balram	2308806	137601.6	1488742	2540976.0	8.48	2.63	341
Bata	750530	41141.0	480928	759717.3	13.14	3.07	341
Bombdyeing	810327	48485.9	509863	895348.9	3.82	1.77	341
Crompgreav	474988	22078.2	340053	407699.9	5.87	2.14	341
GDL	629663	39805.5	368822	735055.2	9.71	2.80	341
GTL	1179941	100517.6	548838	1856176.5	22.17	4.17	341
Gujrakali	447833	45694.4	211312	843801.9	57.18	6.51	341
HCC	787316	39227.8	566979	724388.3	4.79	2.03	341
JSW	200623	16476.7	122288	304261.4	63.31	6.70	341
Kotak	265494	17136.1	166790	316437.9	21.06	3.88	341
Lupin	89692	4852.0	62360	89597.5	14.22	3.10	341
Mcdowell	849981	57943.7	534257	1069999.6	18.61	3.77	341
Nagar	1029976	46089.2	783214	851091.8	12.95	2.78	341
Sesagoa	328372	27515.3	195428	508102.3	62.81	6.50	341
TTML	4287138	245492.9	2902083	4533316.8	22.34	4.02	341
Ultracemco	79356	3182.3	61663	58764.9	1.53	1.35	341
Voltas	1571158	107708.4	915830	1988963.1	19.71	3.77	341

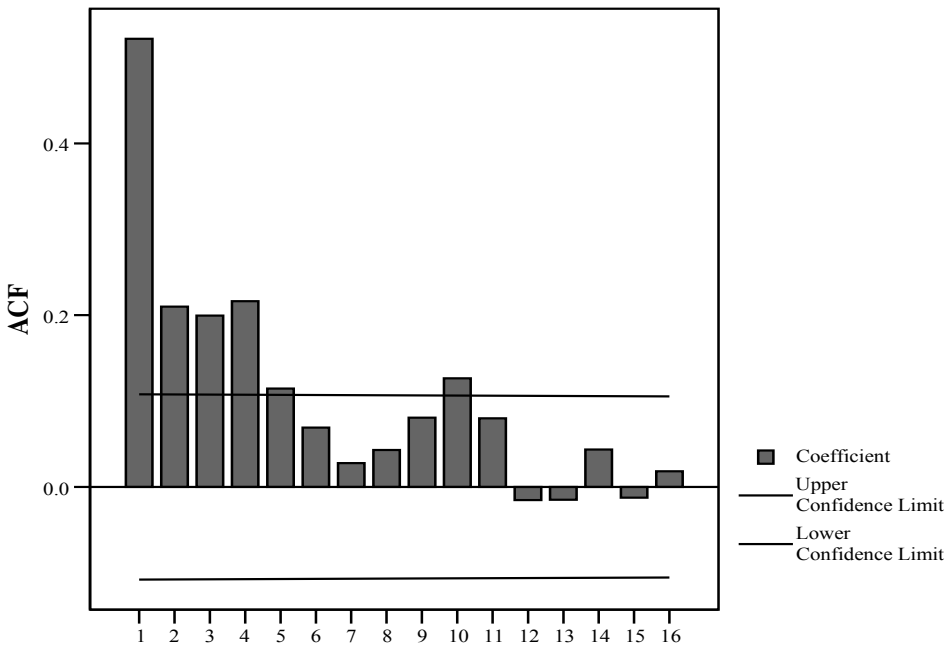
Table 2: Post Futures Introduction							
	Mean	Std Error	Median	Std Deviation	Kurtosis	Skewness	Count
Aban	127113	4996.4	106318	92265.3	9.27	2.36	341
Amtek	191288	11367.4	123153	209912.6	26.31	3.86	341
Bajaj	2431243	100984.4	1889236	1864796.7	3.70	1.68	341
Balram	4732694	209510.2	3731972	3868853.5	10.61	2.54	341
Bata	365742	20019.6	246177	369685.9	11.02	2.97	341
Bombdyeing	339260	21323.9	219589	393770.8	15.94	3.52	341
Crompgreav	618732	22875.6	522790	422424.7	4.79	1.95	341
GDL	591242	36691.7	376449	677556.5	17.76	3.55	341
GTL	696699	57481.7	410939	1061466.9	62.40	6.40	341
Gujrakali	303254	19952.5	176827	368445.9	22.14	3.82	341
HCC	2072103	84833.1	1580847	1566543.1	7.33	2.26	341
JSW	191288	11367.4	123153	209912.6	26.31	3.86	341
Kotak	757572	25193.5	669808	465227.5	4.43	1.65	341
Lupin	154342	8366.9	103486	154504.5	7.85	2.39	341
Mcdowell	360463	22271.5	236564	411270.2	30.31	4.65	341
Nagar	955800	43002.0	762952	794083.0	19.01	3.54	341
Sesagoa	283105	16598.3	194115	306507.0	9.57	2.67	341
TTML	20546978	1032922.7	15197410	19074142.0	6.97	2.27	341
Ultracemco	87544	4312.7	61566	79638.4	4.38	1.99	341
Voltas	1549599	71908.8	1132560	1327881.0	10.59	2.60	341

Appendix III: ARCH Effect

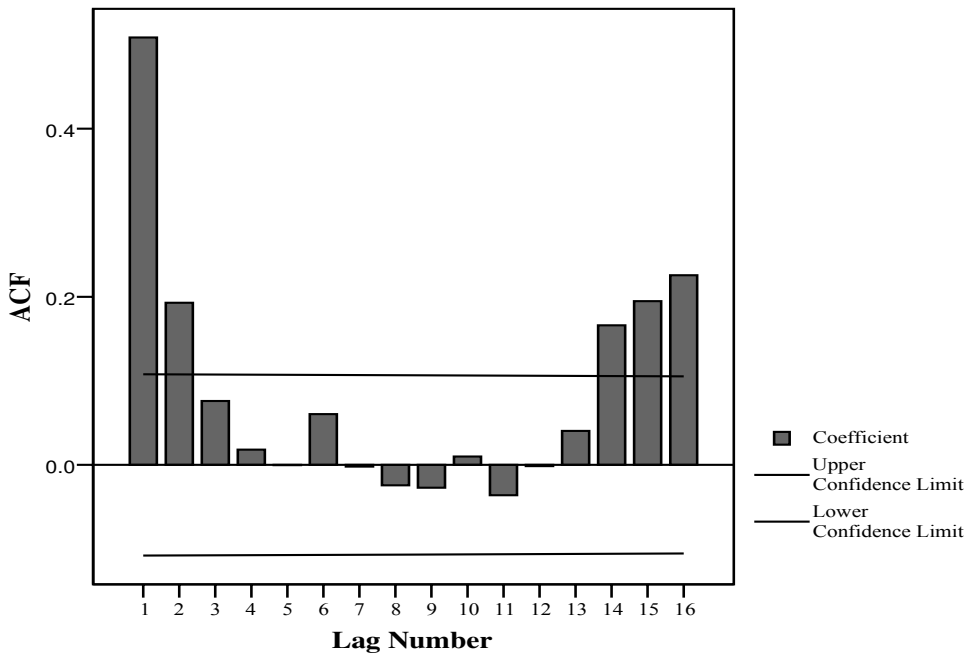
Graph 1.1- Bajaj Pre Futures Introduction



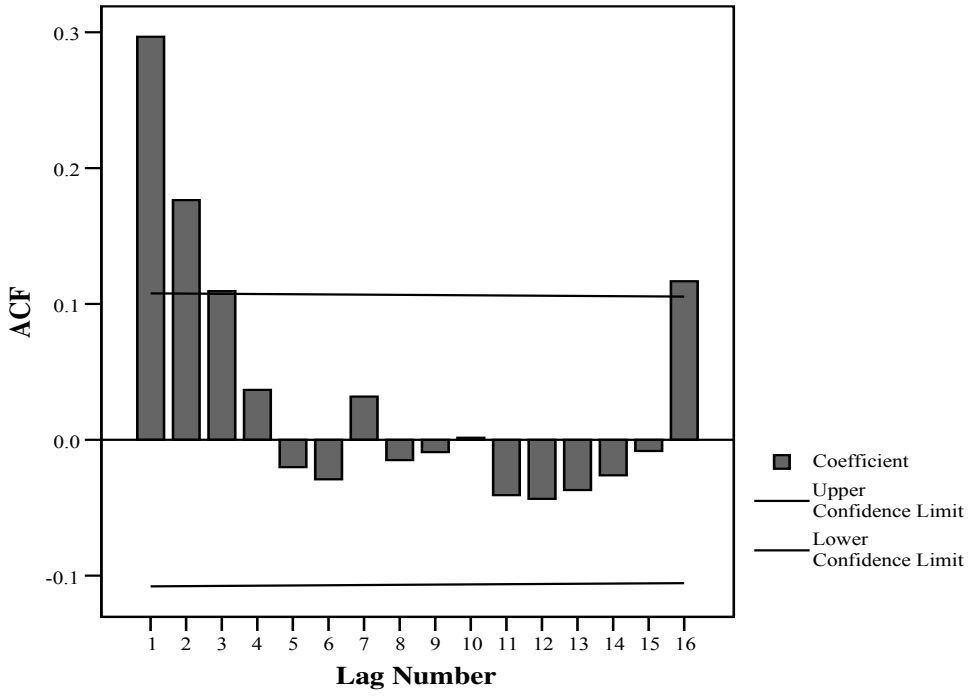
Graph 1.2 - Bajaj Post Futures Introduction



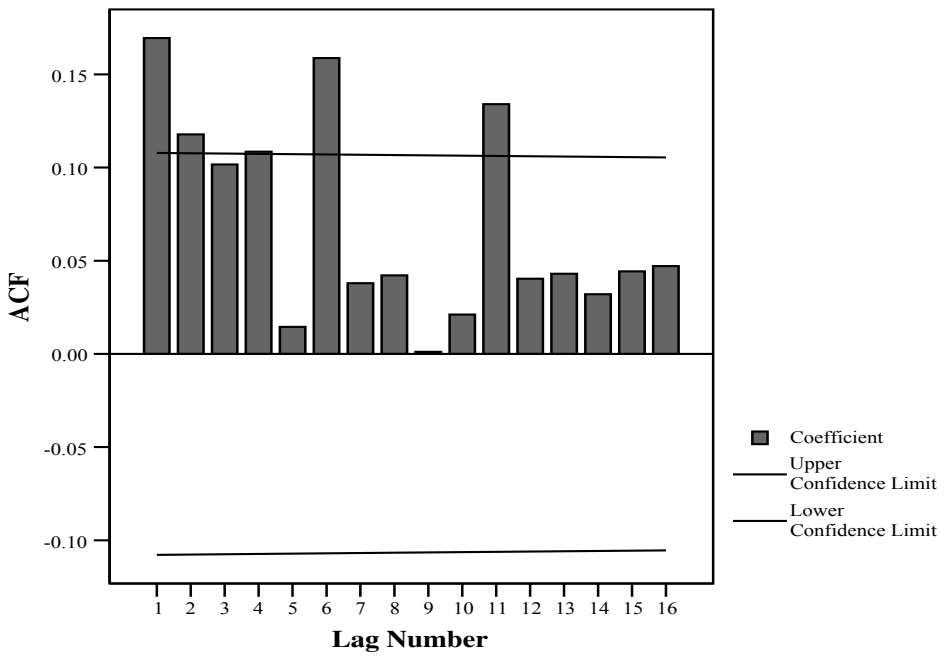
Graph 2.1 - GDL Pre Futures Introduction



Graph 2.2 - GDL Post Futures Introduction



Graph 3.1 - Gujrat Alkali Pre Futures Introduction



Graph 3.2 - Gujrat Alkali Post Futures Introduction