Volatility and Its Covariates: Evidence from Indian Stock Market

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Abstract: *Stock price Volatility is the source of risk in an investor's portfolio. Recent incidents in the financial markets across the world as well in India have shown that the Financial market volatility have wide scale repercussion on the economy as a whole. In this study, an attempt has been made to analyze the behavior of volatility in the Bombay Stock Exchange Index. The nature of volatility persistence, it's possible relationship with foreign institutional investment and the flow of unexpected news have been examined in this study. The results of the study suggest that there exist a substantial volatility clustering in case of BSE SENSEX. There is evidence for volatility persistence as well. Volatility can be attributed to the volatile foreign institutional investor funds' flow and news dissemination in the market. Signaling hypothesis holds good in the case of Indian stock market.*

Keywords: *Stock Index, Volatility Persistence, Asymmetric GARCH Models, Clustering, Leverage effect.*

I. INTRODUCTION

In the Indian stock market, volatility estimation is of prime importance as it determines the market movements and also has an impact. Financial market volatility is considered to have wide scale repercussion on the economy as a whole. In the backdrop of the global financial meltdown in 2008, volatility estimation has become essential for the policy makers, option traders and investors, since volatility forecasts are important for many financial decisions, such as implementation and evaluation of asset pricing theories and risk management. Volatility is the tradeoff between risk and expected return. An investor always intends to maximize expected return subject to risk constraint or minimize risk subject to return constraint. Volatility estimation plays important role in derivatives pricing and computation of value at risk in risk management. It is also important for determining the cost of capital, for evaluating direct investment and asset allocation decision. To estimate the nature of volatility in the stock market, it is very important to identify the factors that are inherent to the functioning of the equity market of a country.

Volatility estimation is very important from an investor's point of view. An investor is always interested in first two moments of stock price data viz. risk and return. The risk often is referred to as the volatility or the variance. The risk measure tends to be more complicated than the return. One reason for this is that the volatility does not tend to behave in a constant, stable way; instead large variations are commonly seen. Sometimes the volatility is more moderate, when other periods contain high volatility. Volatility is a measure of the intensity of unpredictable changes in asset returns and it is commonly time varying dependent. Volatility is a random variable that follows a stochastic process. Hence there is a necessity to understand the time path and nature of volatility of stock returns. The task of modeling volatility is to describe the historical pattern of volatility and forecast the future volatility pattern.

India on its path to liberalization has undertaken many reforms to develop the equity market. Some of the new policy reforms introduced in the Indian stock markets include introduction of trading in index futures in June 2000, trading in index options in June 2001, trading in options on individual securities in July 2001, introduction of VAR (value at risk)-based margin, and introduction of the T+2 settlement system from April, 2003. One of the most important policy issues of the government has always been with regard to the opening of the market to foreign institutional investment. FIIs can pull out their investment any time from the market, which causes ripples in the stock market. It results in a dampening effect in stock market and leads to wide scale fluctuation in stock market volatility. Trading volume is another most important factor in the stock market. The increase in trading volume results in increased volatility in the stock prices.

In many studies trading volume has been used as a proxy for the arrival of new information. In other words trading volume can give a good idea about how volatility is affected by the arrival of new information and help the investors to price their risk premium based on the power of its relationship with the volatility. This research paper attempts to throw light on the volatility pattern with reference to Indian stock market, analyze linkage between FIIs investment pattern and volatility and examine the relationship between trading volume and volatility. Section II highlights the literature review, section III lists data and methodology, and section IV concludes highlighting the policy implications and scope for future research.

II. LITERATURE REVIEW

Research studies have shown that various factors affect the volatility of stock returns and influence volatility persistence in the stock market worldwide. The following section lists some of the important studies below.

a) Volatility persistence

French et al (1987) examined the relationship between expected stock returns and volatility using two statistical approaches. They used daily returns to compute monthly volatility and then they decomposed the computed estimates into predictable and unpredictable component using ARIMA models. They observed that there is a strong negative relationship between excess holding period returns and unpredictable component of volatility.

Bekaert and Harvey (1997), Solnik et al. (1996), Bekaert and Urias (1999) argue that the correlation is not stable over time i.e. not only during the crisis but also for the whole period after 1987 crisis, the correlation between markets has been steadily on the rise.

Koutmos (1999) finds that the conditional variance of Asian stock markets is an asymmetric function of past innovations. Positive past returns are on average 1.4 times more persistent than negative past returns of an equal magnitude.

Pattanaik and Chatterjee (2000) analyzed excess returns and volatility pattern for equity market in India. Standard deviation had been used to estimate to estimate volatility. ARIMA model is used to analyze whether the predicted standard deviation track the actual standard deviations closely. The results show a negative risk return relation.

Patev and kanaryan (2003) examined the nature of the Central European stock market volatility before, during and after major emerging market crises. They analyze Central European Stock Index over the period April 30, 1996 – May 31, 2002. They have used ARCH, GARCH (1, 1) QGRACH models. They concluded that there is significant leverage effect in conditional variance and high volatility persistence. They used two symmetric and six asymmetric GARCH models for in-sample and out of- sample forecasting. Following a financial crisis, the negative return shocks have higher volatility than positive return shocks.

b) The Relationship between Liberalization, Foreign Institutional Investment and Volatility

Aggarwal, Inclan and Leal (1999) analyze volatility in emerging stock markets during 1985-95. Using an ICSS algorithm to identify the points of sudden changes in the variance of returns they examined the nature of events that cause large shifts in stock return volatility in these economies. After finding out the points of change they tracked the events that could have been the possible causes for those points. Aggarwal et al found that mostly local events like the Mexican crisis, peso crisis, and periods of hyper inflation in Latin America, stock market scandal cause jumps in the respective stock market volatility of the emerging markets. Only the "October 1987 Crash" was the only global event that affected the stock markets of the emerging countries.

Richards (1996) found no evidence in his study that stock market volatility is related to financial globalization. He used three different methodologies and two sets of data to estimate volatility of emerging markets. They concluded that emerging equity market returns have become less volatile in the recent periods of foreign participation. The opening of markets allows more investors to share a given amount of risk and should therefore reduce the volatility of returns.

Kim and Singal (1997) studied the behavior of stock prices following the opening of a stock market to foreigners or large foreign inflows in order to examine the benefits and risks associated with opening of stock markets. They found that there is no systematic effect of liberalization on stock market volatility. They estimated changes in the level and volatility of stock returns, inflation, and exchange rates around market openings. They found that stock returns increase immediately after market opening without a concomitant increase in volatility. Stock markets become more efficient as determined by testing the random walk hypothesis. They also saw that inflation seems to decrease after market opening as do the volatility of inflation and volatility of exchange rates.

Chakrabarti (2001) has examined in his research that following the Asian crisis and the bust of info-tech bubble internationally in 1998-99 the net FII has declined by US$ 61 million. But there was not much effect on the equity returns. This negative investment would possibly disturb the long-term relationship between FII and the other variables like equity returns, inflation, etc. has marked a regime shift in the determinants of FII after Asian crisis. The study found that in the pre-Asian crisis period any change in FII was found to have a positive impact on the equity returns. But in the post-Asian crisis period it was found the reverse relation that change in FII is mainly due to change in equity returns. Hence, any empirical exercise on FII has to take care of this fact.

Stanley Morgan (2002) has examined that FIIs have played a very important role in building up India's forex reserves, which have enabled a host of economic reforms. The Morgan Stanley report notes that FII strongly influence short-term market movements during bear markets. However, the correlation between returns and flows reduces during bull markets as other market participants raise their involvement reducing the

influence of FIIs. Research by Morgan Stanley shows that the correlation between foreign inflows and market returns is high during the bear phase.

Amita Batra (2004) in their paper examined the time variation in volatility in the Indian stock market during 1979-2003. Using monthly data and asymmetric GARCH methodology the paper identifies sudden shifts in stock price volatility and the nature of events that cause these shifts in volatility. The empirical analysis in the paper reveals that the period around the BOP crisis and the subsequent initiation of economic reforms in India is the most volatile period in the stock market. Sudden shifts in stock return volatility in India are more likely to be a consequence of major policy changes and any further incremental policy changes may have only a benign influence on stock return volatility. Stock return volatility in India seems to be influenced more by domestic political and economic events rather than by global events. A generalized reduction in stock market instability is observed in the post reform period in India.

Kaminsky and Schumkler (2001,2002) examine the time varying patterns of financial cycles before and after financial liberalization in 28 countries. Their results indicate that while financial liberalization may trigger financial excesses in the short-run it also triggers changes in institutions supporting a better functioning of financial markets. They observe a temporary volatility increase in the years immediately following liberalization in these countries.

Edwards et al (2003) analyze the behavior of stock prices in six emerging countries. They find that after financial liberalization Latin American markets are less unstable while the Asian economies, especially Korea, are in the process of recovering their stability.

Agarwal, Chakrabarti et al (2003) have found in their research that the equity return has a significant and positive impact on the FII. But given the huge volume of investments, foreign investors could play a role of market makers and book their profits, i.e., they can buy financial assets when the prices are declining thereby jacking-up the asset prices and sell when the asset prices are increasing. Hence, there is a possibility of bi-directional relationship between FII and the equity returns.

c) Trading volume and Calendar Anomalies

Tauchen and Pitts (1983) investigated the relationship between the variability of the daily price change and the volume of trading on speculative markets (90 day T-Bills futures market in Chicago mercantile exchange). According to them the variance of the daily price change and the mean daily trading volume depend upon three factors: (i) the average daily rate at which new information flows to the market; (ii) the extent to which traders disagree when they respond to new information; and (iii) the number of active traders in the market. Their work suggests that if the volume of trading is strongly trended over the sample period, then the results of a price variability-volume study can be very misleading. A sharp rise in the number of traders in the market can conceal most, and perhaps all of the relationship between the squared price change and the volume of trading. At a minimum, then, any variance-volume study should include preliminary tests for trend in the volume of trading. The finding of their paper was that price variability does not increase with the growth in the trading volume as the previous price variability-volume studies would suggest.

Timothy J. Brailsford (1994) did an empirical analysis of the relationship between trading volume and stock return volatility in the Australian market. They found that the relationship between price change and trading volume, irrespective of the direction of the price change, is significant across three alternative measures of daily trading volume for the aggregate market and individual stocks. Furthermore, they also found that the volume-price change slope for negative returns is smaller than the slope for positive returns, thereby supporting an asymmetric relationship. In the context of conditional variance their results were similar to the results of Lamoureux and Lastrapes [1990]. The findings show a reduction in the significance and magnitude of the conditional variance equation coefficients, and a reduction in the persistence of variance when trading volume is added as an exogenous variable. Hence, there is prima facie evidence that if trading volume proxies for the rate of information arrival, then ARCH effects and much of the persistence in variance can be explained.

Hendrik Bessembinder and Paul J. Seguin (1993) in their paper examined the relationship between trading volume and volatility for eight financial futures. According to them linking volatility to total volume do not explain the nature of volatility completely. It is only when volume is partitioned into expected and unexpected components; they found that unexpected volume shocks have a larger effect on volatility. Further, they found the relation to be asymmetric that is the impact of positive unexpected volume shocks on volatility is larger than the impact of negative shocks.

Vicent and Nieto (2004) in their study found that volatility is not much affected by the level of activity but more by the level of activity that is due to the unexpected part of its level. Unexpected trading volume had a significant effect on volatility. In the study the unexpected trading volume is used as a proxy for arrival of new information. This study re-examined the study done by Lamoureax, C.G., Lastrapes(1990) that analyzed the persistence of GARCH effects on the return of nine international stock exchange indices. The result in all markets shows that the inclusion of trading volume does not substantially reduce the persistence of conditional volatility.

Sunil Poshakwale (1996) in his study provides empirical evidence on weak form efficiency and the day of the week effect in Bombay Stock Exchange over a period of 1987-1994. The results provide evidence of day of the week effect and that the stock market is not weak form efficient. The weekend effect is evident as the returns achieved on Fridays are significantly higher compared to rest of the days of the week. According to the study the day of the week effect observed on the BSE pose interesting buy and hold strategy issues.

Kaushik Bhattacharya et al. (2002) finds evidence in favor of significant positive returns on non-reporting Thursday and Friday, in sharp contrast to the finding of significant positive returns only on non-reporting Monday by OLS procedure. Separate sub-period analyses reveal that there have been changes in daily Seasonality in both returns and volatility since the mid-1990s in the Indian capital market.

In light of the above literature review, the need for this study becomes evident. As mentioned in the literature, there is a relationship between trading volume and volatility and FIIs investments. A holistic model to examine these effects is required. This paper attempts to demystify the type and extent of relationship in Indian context which has not been studies widely in the previous literature. Hence this paper fills the gap by taking up this important topic for study. The objectives of this study are as follows:

1. To check whether volatility persistence has increased in the Indian Stock market from 1999 to 2009. This is done by dividing the sample period in two sub-periods. The first sub-period is from January 1999 to December 2004 and the second sub period is from January 2005 to December 2009.
2. To analyze the relationship between volatility and foreign institutional and compare it for the two periods.
3. To find the relationship between volatility and trading volume for the years June 2003 to December 2009. Earlier years was not taken in to the analysis due to lack of data.

III. DATA AND METHODOLOGY

Data has been taken from Bombay stock exchange index (BSE SENSEX) which represents stock market on India. Daily closing prices of the index have been taken for the period January 1999 to December 2009. The total sample consists of 2688 observations. Data on trading volume has been collected from Yahoo finance. Sample period for our analysis of the relationship between volatility and trading volume is from June 2003 to December 2009. Daily data on Foreign Institutional Investment in the equity market of India has been collected from the official website of Securities and Exchange Board of India (SEBI).

Closing price of the index has been used to calculate the daily returns of BSE index. The formula employed is:

$R_t = \log (P_t / P_{t-1}) * 100$

The Augmented Dickey Fuller test was done to test for the stationary conditions of the closing price of BSE, returns, FII and trading volume. Normality test were undertaken for the return series.

In view of the three objectives of the paper, the methodology used is illustrated below:

1) To check whether the nature of volatility has changed over the recent period of liberalization in India, the total sample period ranging from January 1999 to December 2009 has been divided into two periods. The first sub period is from January 1999 to December 2004 and the second sub period is from January 2004 to December 2009. Some of the important dimensions that have been looked in to are:

a) Volatility clustering: It says that the variance of speculative prices or asset returns is not constant over time. In fact asset prices are commonly characterized by volatility clustering that is large changes tend to be followed by large changes, of either sign, and small changes tend to be followed by small changes. In other words today's volatility shock will be allowed to persist, and can influence the volatility forecast for several periods.

b) Calendar Anomalies: Information accumulates during the period when financial markets are closed and is reflected in the price when the markets reopen. Variances are higher following weekends and holidays. This leads to the observation of daily seasonality in asset returns also known as the weekend effect and days-of-the-week effect.

c) Leverage Effect and Asymmetric impact on Volatility: Leverage effect refers that an unexpected drop on price (negative shock or bad news) has a larger impact on future volatility than an unexpected increase in price (good news or positive shocks) of same magnitude. Leverage is generally interpreted as an indicator of company's risk. If the leverage ratio increases, the company is considered more risky, and a higher degree of risk is associated with higher volatility. According to Black, leverage effect implies that negative surprises increases predictable volatility in asset markets more than positive surprises.

For all these dimensions of volatility Leverage GARCH model given by the GJR model (Glosten, Jaganathan and Runkle, 1993) has been used in this study . It is also known as T GARCH model which is based on the assumption that unexpected changes in the return of the index have different effects on the conditional variance of the asset returns. When there is good news this will contribute to the variance with the Co-efficient

α_1 and when there is a bad news this will contribute to the variance with the Co-efficient ($\alpha_1+\theta$). Calendar anomalies have been accounted by including day of the week dummies in the equation.

The mathematical formula of the model is the following one:

$\sigma_t^2 = \omega + \alpha_1 u_{t-1}^2 + \beta_1 \sigma_{t-1}^2 + \theta I_{t-1} u_{t-1}^2$

Where $I_{t-1} = 1$ if $u_{t-1} < 0$ and $I_{t-1} = 0$ otherwise …….T GARCH (1, 1)

If $\theta > 0$, we say that there is a leverage effect.

Bad news ($u_{t-1} < 0$) has an effect of ($\alpha_1+\theta$) u_{t-1}^2 on the variance.

Good news ($u_{t-1} \geq 0$) has an effect of $\alpha_1 u_{t-1}^2$ on the variance.

If $\theta < 0$, otherwise

2) To find the relationship between volatility and FII inflow, we have used the GARCH (1, 1) model for the two sub periods respectively. The GARCH (1, 1) model given by Bollerslev 1986 is based on the assumption that forecasts of variance changing in time depend on the lagged variance of the asset. An unexpected increase or decrease in the return at time *t* will generate an increase in the expected variability in the next period. The mathematical formula of the model is the following one:

$\sigma_t^2 = \omega + \alpha_1 u_{t-1}^2 + \beta_1 \sigma_{t-1}^2 + \beta_2 f$ II ch ……...GARCH (1, 1)

Where ω is the mean, u_{t-1}^2 as the news about volatility from the previous period (the ARCH term), σ_{t-1}^2 is the last period forecast variance (the GARCH term)

3) To find the relationship between trading volume, flow of new information and stock market volatility we have used the GARCH (1, 1) model for the period June2003 to Dec2009. In this part the trading volume has been divided into two parts. One part representing the volume of trade that is a part of normal trading activity and the other part of the trade which is done due to arrival of new information in the market.

The unexpected trading volume which is taken as a proxy for arrival of new information is calculated by:

$(\text{Unexpected value})_t = \text{Value}_t - E(\text{Value}_t | \text{Value}_{t-j}, j = 1, 2, \ldots)$

The paper uses ARMA (1, 1) model to forecast the expected value of the volume of trade. For the first forecast, the data for total volume was used corresponding to the first six months. From then on, the ARMA models are estimated using a moving window which drops the first value of the series and introduces one more piece of data corresponding to the following day. In this way, the expected volume is estimated from an ARMA model, always using information corresponding to the previous six months. The GARCH (1, 1) equation has been used to find the relationship between volatility and unexpected arrival of information. The equation is given as:

$h_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta h_{t-1}^2 + \varphi$ ExVol + ϕ UnexVol…….Garch(1,1)

IV. RESULTS

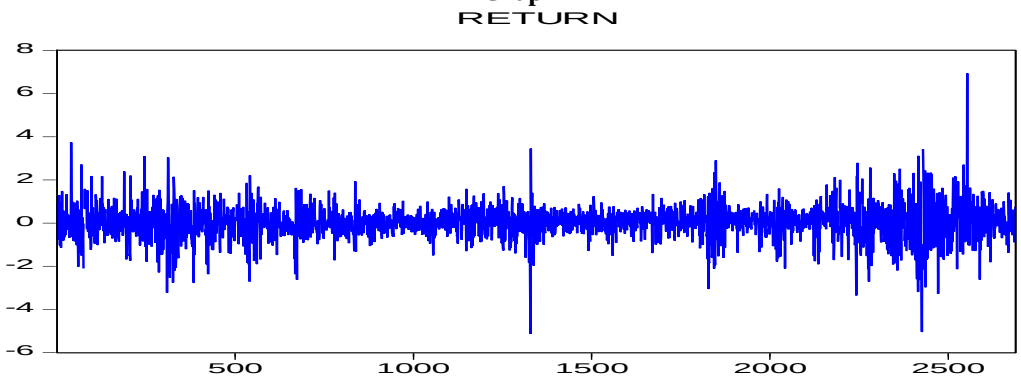
a. Descriptive Statistics

Table1

	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
RETURN (1999-2009)	0.027896	0.061253	6.944362	-5.12866	0.868298	-0.11072	8.415649
VOLUME	24383.16	21200	217600	13450	14239.48	4.611803	50.21951
FII	101.0631	48.05	5837.1	-3393.4	545.02	1.512985	22.53345
RETURN (1999-2004)	0.01568	0.049795	3.731222	-5.12866	0.740691	-0.3468	6.802603
RETURN (2005-2009)	0.039669	0.075023	6.944362	-5.03975	0.995905	-0.03616	9.199128

Descriptive statistics for index returns, FII and Trading volume have been shown in Table 1. In case of return for the whole period, the standard deviation is 0.86%, which can be termed as high volatility. More over we see that return has been more volatile in 2nd sub-period (0.99%) compared to the 1st sub period (0.74%). The mean return is also high for the 2nd sub period (0.039%) compared to the 1st sub period (0.015%). Kurtosis for the whole sample period as well as for both the sub periods is well above 3 implying non-normality and Negative skewness means that lot of observations gathered in left i.e. days with extreme losses are more. The daily return graph is given below showing the market has been quite volatile.

Graph1



Since the returns exhibits fat tailed distribution and also has negative skewness so it is necessary to test for normality. We use Anderson Darling Test, Shapiro-Wilk test and Kolmogorov-Smirvov. In all test statistics null hypothesis is data are from normal distribution.

Table2

Normality Test	
Test	Statistics
Anderson-Darling	13.703374***
Shapiro-Wilk	0.92159***
Kolmogorov-Smirvov	0.089177**

In all tests we are rejecting null hypothesis i.e. normality implying that returns are not normal (Table2). The Augmented Dickey fuller test for the stationary condition of the variables is given below (Table 3):

Table3

	Augmented Dickey-Fuller test statistic	Probability	Null hypothesis: unit root
VOLUME	-6.043926	0.0000	Rejected-Stationary
FII_IN_RS_CRORES	-13.21679	0.0000	Rejected-Stationary
RETURN	-48.03681	0.0001	Rejected-Stationary

A) Volatility Persistence

Stock return volatility is estimated using asymmetric GARCH (T-GARCH) methodology. As indicated by the normality tests, the stock returns do not follow a normal distribution. Asymmetric TGARCH model that allows for leptokurtosis and skewness is therefore considered appropriate to estimate volatility. The model can in addition capture the leverage and volatility clustering effects. The T- GARCH results for the whole sample period and the two sub periods are given in the table below:

Table4

	ARCH	GARCH	LEVERAGE EFFECT	MON	TUES	THURS	FRI
Full period	0.132165***	0.851484***	-0.177648***	0.006121	-0.1369	-0.03993	-0.04778
Sub-period 1 (1999-2004)	0.147847***	0.7784***	-0.210143***	0.048358***	-0.09989	-0.03572	-0.01624
Sub-period 2 (2005-2009)	0.125676***	0.862504***	-0.117783***	000184	-0.1492	-0.03216	-0.04474

*** Significant at 1%, 5%, 10% level

In Table 4 ‘α’ is the GARCH term that measures the impact of last period’s forecast variance. A positive α indicates volatility clustering implying that positive stock price changes are associated with further positive changes and vice versa. ‘β’ is the ARCH term that measures the effect of news about volatility from the previous period on current period volatility. ‘θ’ measures the leverage effect. Ideally θ is expected to be negative implying that bad news has a bigger impact on volatility than good news of the same magnitude. The sum of the ARCH-GARCH coefficients indicates the extent to which a volatility shock is persistent over time. A persistent volatility shock raises the asset price volatility.

The ARCH and GARCH terms are positive and significant at 1% significance level in all the models (Table 4). For the whole sample period the total sum of the ARCH and GARCH coefficients is 0.9536 which shows there is a high degree of persistence and long memory in conditional variance. However significant difference between the two sub periods can be seen. Where as in the 1st sub period the sum of the ARCH and GARCH term is 0.9262, in the 2nd sub period it is 0.988 which means there has been considerable rise in

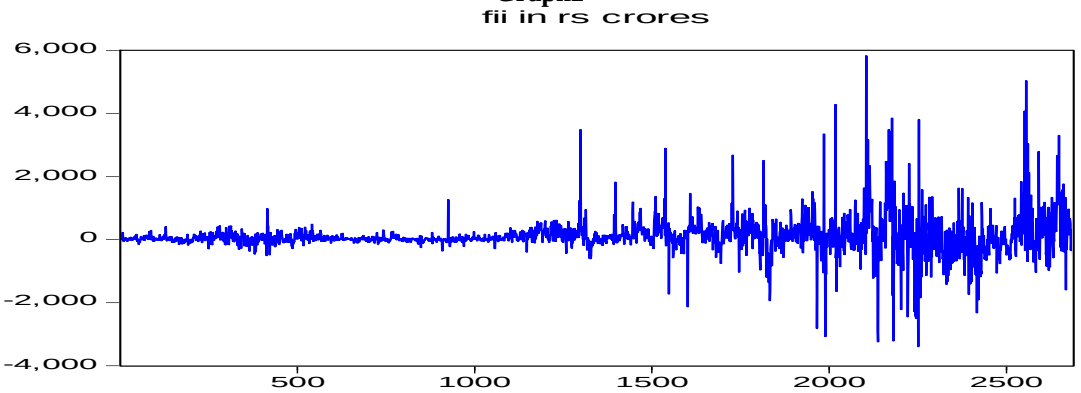
volatility persistence in the 2nd period. Thus it can be said that as India is getting more and more liberalized over the years the volatility persistence/ clustering is also increasing. In contrast we see that the leverage effect has been lower for the 2nd sub period.

With respect to calendar anomalies it can be seen that the effect of Monday to be positive and significant for the 1st sub period, however in the second sub period it did not have any significant effect.

b) Relationship between volatility and Foreign Institutional Investment

The GARCH (1, 1) result showing the relationship between volatility and FII flow for the whole sample period and the sub periods are given below along with the graph of the FII flow:

Graph2



From Graph 2 it is evident that the flow of FII has increased over the years and there has been much volatility in the investment market. We have taken the daily change in FII flow as an independent variable in our GARCH model. The results are:

Table5

	ARCH	GARCH	FIICH
Full period (1999-2009)	0.127987***	0.833982***	0.0037***
Sub-period 1 (1999-2004)	0.137784***	0.791858***	0.007
Sub-period 2 (2005-2009)	0.120491***	0.869225***	0.039***

*** Significant at 1%, 5%, 10% level

From Table 5 it can be seen that the coefficient of foreign institutional investment is significant for the whole sample period (1999-2009) and for the second sub period (2005-2009). However it is not significant for the first sub period (1999-2004). Thus it is evident that while in the first sub period, stock market volatility was not affected by change in the flow of foreign institutional investment, in the second sub period it has significantly and positively affected the volatility. It can also be seen from the graph that the volatility in the FII has increased over the years especially during the second sub period of our study. Thus we can say that as the flow and volatility of FII has increased over the years it has significantly contributed in increasing the volatility in the stock market.

c) Relationship between Volatility and Unexpected Flow of New Information:

For this purpose the unexpected portion of trading volume has been taken as a proxy for the arrival of new information. The aim is to find out whether unexpected arrival of information affects stock market volatility or not. Due to lack of data the time period is from June2003 to Dec 2009. The time path of trading volume in the market is given in Graph 3 shows and the results are given in Table 6 and Table 7.

Graph3

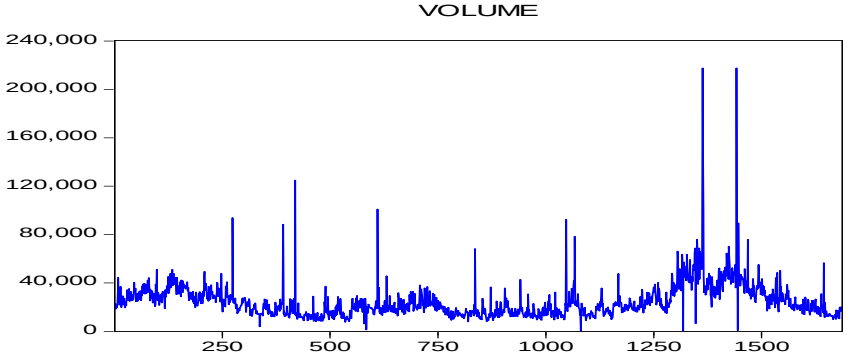


Table6

	ARCH	GARCH
June2003-Dec2009	0.135225***	0.852557***

*** Significant at 1%, 5%, 10% level

Table7

	ARCH	GARCH	EXPECTED	UNEXPECTED
June2003-Dec2009	0.108253***	0.832009***	0.00931***	0.0691**

*** Significant at 1%, 5%, 10% level

When Trading volume is not taken into account, volatility persistence given by the sum of the ARCH and GARCH coefficient is 0.987782 (Table 6). However when trading volume is considered as a significant factor affecting return volatility the coefficients are found to be significant and positive for both the expected and unexpected part of trading volume (Table7). However the effect of unexpected part representing flow of new information is more than the expected. For unexpected part the coefficient is 0.0691 where as for the expected part it 0.00931. Thus it can be observed that including trading volume explains better the nature of volatility. Another important point that can be observed from the result is that the inclusion of trading volume has reduced volatility persistence to 0.940262. This supports the findings of Timothy J. Brailsford (1994) in the Australian stock market.

V. CONCLUSION

This paper gives us a major insight to the nature of volatility of returns in the Indian stock market and helps us to understand how volatility has behaved over the years. From the results it can be inferred that volatility persistence has increased over the years of liberalization. In our study it can be seen that volatility persistence is much more during the period 2005-2009 than the period 199-2004. The paper also put forwards two major findings relating to the factors affecting volatility. It has been found that volatility in the flow of foreign institutional investment and unexpected trading volume representing arrivals of new information significantly contribute to the increase in volatility in the recent years. The result suggests that the huge inflow and outflow of foreign money in the equity market in India has precipitated in to the stock market and increased the volatility of stock return. Therefore incorporating these two factors becomes imperative in estimating volatility. It will help the both the government authorities and the investors in managing their policies and investment decisions in a better and efficient way.

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