Volatility patterns of stock returns in India

Dr. Rosy Kalra
Mr. Piyuesh Pandey

Abstract
This paper analyzes the time variation in volatility in the Indian stock market during 2009 - 2014. Analysis has been done to examine if there has been an increase or a decrease in volatility persistence in the Indian stock market on account of the process of financial slowdown in India after the global crisis. Further, an attempt to characterize the evolution of the stock market cycles over time in India has been made; for this purpose, monthly stock returns have been used for analysis. Asymmetric GARCH model has been used to estimate the element of time variation in volatility. A descriptive design has been adopted to conduct the research work. It is evident from the study that the adoption of liberal norms and allowing foreign investment in the form of FIIs does not impact or add to the volatility of returns of the stock market. There is no structural shift due to heavy trading of stocks by the foreign investors; it is revealed that it just adds to the volume of the shares traded by the investors which may be a cause of abnormal distribution of returns on stocks traded.

Keywords: Volatility, Persistence, Asymmetry, GARCH, FIIs, Structural shift, Descriptive.
**Introduction**

After witnessing a major crisis during the last decade, many economists are now in favour of returning to the basics of investment where they propose a controlled and restricted flow of investment and stringent policy making to ensure the safety of the investment. There has been a very strong demand from proponents of this school of thought for restricting capital inflow which was allowed to move freely after the adoption of liberalized norms in the 1990s; this is based on the notion that this free movement of capital investment causes an excessive and unexpected surge and fall in the market thereby creating an excessively volatile financial environment.

A volatile financial environment not only affects the investor but also has a very significant impact on the economy as a whole that results in uncertainty and thereby shaking the investor’s confidence. However, it also has a positive side; it provides the policy makers a tool to gauge the sentiments of the market thereby predicting and taking a position just when the market becomes vulnerable. It also assists knowledgeable investors to estimate the intrinsic value of a particular stock by considering the public sentiments, which helps him take the right decision just when it is needed.

Thus, the estimation of volatility has become almost a mandatory part of forecasting the prices of stocks. It provides an opportunity to risk managers to advise investors to take technically correct decisions not only at the individual level but also helps economies to set the right course for the future path of the nation. Therefore, it is the core function of economies to understand volatility in order to manage risk. Referring to the theory of asset pricing models, volatility simply means the variability of the asset price. There are different approaches to measuring the price volatility; one approach could be by measuring the daily movement in the price of the share and the second approach is by taking simple or moving averages of the prices over a period of time by making use of econometric models.

The recent approach which can be considered is modelling volatility by making use of the GARCH model. It makes use of a large data size which can be further regressed to estimate the volatility and create a pattern to identify the trends of persistent volatility shock.

Here an attempt has been made to study volatility and persistent variation in the returns of the stock markets of India during the period of 2009 - 2014 which was the time when the global economies were striving to overcome the shocks of the 2008 crisis. Also it has been examined whether the liberalization reforms played any role in volatility of returns of the Indian stock market. Further, the shifts in volatility of stock prices and the causes of such shifts have been studied.

This gives an opportunity to examine whether there exists a correlation between volatility of stock returns in India and the global financial crisis; also through this, it can be identified whether during the last five years the stock market volatility has shown greater amplitude or not.

Further, this paper will assist in determining the behaviour of the bull and bear market over a period of time and will give a trend of stability during the above-mentioned phases. The overall aim of this paper is to give a solid base to any significant pattern or a change in the returns of stock markets of India after the global crisis.
In order to figure out the variation of time in volatility, the asymmetric GARCH model has been used. Also to study the persistence in volatility, this asymmetric GARCH model has been augmented with dummy /fake variables which have resulted from the structural change. From the study of volatility of this period, we may be able to identify the causes of sudden increased volatility in the returns of the stock market after the onset of the economic slowdown in India.

A major shift in policy making causes a structural change in volatility of the stock returns which is mostly augmented by any further major change in course of action of the policy makers. Policy making has a major impact on the consequences of excessive increase or decrease in the returns of the market.

When talking about the Indian market and its returns, another big influence is the political and bureaucratic events rather than global events since India is a mixed economy with major emphasis on socialist reforms which makes it a conservative country by and large. There is a preconceived notion that there is almost no correlation between volatility of stock returns in India and the global economic turnarounds as the Indian political system always takes conventional, conservative steps when it comes to free capital flow in the Indian market from abroad.

It has been observed that even after the adoption of liberalized reforms almost two decades ago, it did not have a major impact on intensifying the stock market cycle. However, governments claim that there has been relatively less instability in the stock returns after the adoption of the liberalized reforms in India. It is also to be noted that this phenomenon was prevailing in almost every emerging economy around the world; especially the BRICS nations. This thought is further strengthened by the fact that there was no significant link between the foreign markets and the Indian markets prior to the reforms.

On the other hand, when we observe the stock returns of US markets and the Indian markets in the 2000s, both the markets were almost at the peak at that point of time. So it can be said that after liberalization, there has been an existence of longer bull runs and the stock returns cycles have further extended. When we take the recent example of the month of August to December of 2014, there has been an incredibly longer bull run in the Indian stock markets. It is also observed that the recent bull runs are relatively stable when compared to the pre-liberalization era.

**Theory of GARCH model**

Although the phenomena of stock market volatility is so dynamic that there is almost no absolute science of measuring it to perfection, the GARCH model gives a theoretical explanation of the links between the stock market returns and the volatility in them; it also provides a base to identify a pattern in the volatility of the stock market.

This model mainly states that the volume of the stocks traded is directly related to the volatility of the returns in the markets. It also talks about the clear implications of the liberalization reforms of the policy makers.

To understand these phenomena mathematically, let's assume that:

1. The number of traders active in the market are $j_i$
2. In an intraday trade, the market goes through a sequence of phases and reaches equilibrium.
3. The arrival of new information which is publicly available causes the market to move to the $ith$ position from equilibrium.
4. Also for the active trader $j$, the desired position would be the $P_{ij}$ to reach equilibrium.

$$P_{ij} = s \left[ P^*_{ij} - P_i \right] \quad (j = 1, 2, ..., J)$$

*Where

- $s > 0 = \text{constant}$
- $P^*_{ij} = j\text{th trader's resistant price}$
- $P_i = \text{current market price}$

From the above-mentioned equation, it can be said that if the value of $P_{ij}$ is positive, it will indicate and support a long position in the market whereas a short position is preferable for a versa situation.

For the active trader to be at equilibrium he must hold the following variables true:

$$k \sim j, ..., ji$$

$$P_{ij} = 0$$

The above mentioned equation states that the average of the resistant price must equate and clear the market by:

$$q_i = 1/Jk$$

Where

$$k = \text{the constant function of the linear equation}$$

Further the price movement or change in price can be stated by following:

$$kP = 1/Jk$$

$$\sim j, ..., ji$$

$$kp^*_{ij}$$

where

$$P_{ij} = kp_{ij} - j^*i^* < 1$$

(Considered as the increase in the active trader's $j$ resistant price.)

The above equation states that when all other factors remain unchanged and there is an increase in the value of $j$ which is the number of active traders, it tends to decrease the variation in the prices of stocks. Whereas if there is an increase in the free flowing information which is available to the traders, it tends to increase the variability in the stock prices as the investors start to inflate and deflate the stock prices.

It is also believed that the liberalized norms of free capital flow would attract a new set of customers commonly known as FIIs. This increase in the number of active traders in the market would ensure a longer curve and larger volumes of trade thereby decreasing the deviation or the variance in the returns of the stocks.

But this excessive increase in the volume of traders has really set the tone of the market to increase the volatility of stock returns.

Exponential GARCH (EGARCH)

The EGARCH model shows some differences from the standard GARCH model:

Volatility of the EGARCH model, which is measured by the conditional variance sigma, is an explicit multiplicative function of lagged innovations. On the contrary, volatility of the standard GARCH model is an additive function of the lagged error terms, which causes a complicated functional dependency on the innovations.

Volatility can react asymmetrically to the good and bad news.

For the general distributions of sigma and varepsilon, the parameter restrictions for strong and covariance-stationarity.
Review of Literature

Kevin Lansiang (2014) studied the effects of availability of information on volatility and components such as risk taking ability of the investor for variability of his return on the normal distribution of his investment. This paper attempts to study the fact that stock market returns and volatility cannot be studied in isolation or based on one or a handful of variables. A scattered plot model has been used for studying the effects of ripples which are created in the stock market because of diversification of the investment. It was found in the study that the volatility of the stock returns becomes complex to analyse when aggregate factors are taken into consideration because of the 'n' numbers of variables which may or may not be provide an explanation for the particular phenomena.

Madhvi S. (2014) studied the impact of global changes on the evolution of the Indian market, the factors which affect the functioning of determining the prices of stocks and the process which is adopted by the Indian stock market. The paper has focussed on finding out whether the difference in the functioning of the Indian stock market and other western markets plays any role in dynamic and non-relatively low dynamic behaviour of the Indian stock markets. It was found in the study that the volatility of the stock returns becomes complex to analyse when aggregate factors are taken into consideration because of the 'n' numbers of variables which may or may not be provide an explanation for the particular phenomena.

Anju B (2013) reviewed the Indian stock market as a whole. The major objective of this research study was to develop an understanding about the Indian stock market, the reason behind its growth story in the recent past and the sustainability of the Indian stock market even during the economic slowdown. It was evident in the study that the reason behind the successful run of the Indian stock market was the conservative approach of the investors which kept them from taking decisions which were not evaluated properly; they undertook a proper appraisal of stock assets. Also the government policies and its perseverance to elongate the growth story of the booming Indian economy acted as a pillar to the sustainable structure on which the Indian stock markets are built upon. The investors’ fundamental approach and the government decision making were two factors which were cited as the reason for the evolution, growth and sustainability of the Indian stock markets.

Khaled Hussainey, Chisoke O. Mgbame and Aruoriwo M. C. Mgbame (2010) studied the factors which were responsible for the existence of any link between share profitability and the volatility of stock prices. The regression model of multivariate factors was used to analyse the profitability and variability in the past years. It was found in the study that there was strong regression evidence to prove a significant relationship between profitability and volatility of the associated stock assets. It was also found that the capital structure of the company is a very significant function of share price changes and other variables such as management, market outlook, competition etc.

Lieven Baele, Geert Bekaert and Koen Inghelbrecht (2007) have used the dynamic factor modelling to study the factors behind the correlation between the stock and the variation due to time period. Autoregressive models for economic factor relation
such as inflation, interest rate, output, dividends, etc. were identified to employ the structural sector variables in the modelling process. It was identified that risk aversion also served as significant a factor of investment return expectations.

**Francis Breedon and Angelo Ranaldo (2010)** used foreign exchange data to analyze the returns and volatility within a time frame of 10 years. It was identified that timing within intraday transactions also plays an important role in determining the returns on foreign exchange. It was found out that with an increase in the time of trading sessions, the frequency of return booking slows down and the volatility is less in this time period. It was concluded that this served as a strategy to risk management; in order to ensure lower risk and lower volatility, investors should stretch the trading sessions.

**K.R. Shanmugam and Biswa Swarup Misra (2008)** studied about stock returns and their relation with inflation in connection with an emerging economy focussing mainly on India. Their study’s focus was whether the Indian economy provided the opportunity of creating a shield of hedge on stock returns and also a safety towards volatility of returns during the 1990s. It was found that the Indian markets have a better future and offer a potential investment opportunity. Also the negative returns during the period were mainly because of inflation and a persistent volatility was recorded during that period.

**David R. (2013)** studied the behaviour of stock market, pricing of stock assets and ultimately the resulting returns. The major objective of the study was to identify the influence of cognitive factors on the final call or positions of the investors. It was evident from the study that such empirical studies do help investors to create and break their general conception.

**Anil Sharma and Neha Seth (2011)** studied the relevance of the relationship between stock market returns on economic conditions. The major objective of the research paper was to study the aftermath of the global economic recession of 2008 on stock market returns and also its ultimate impact on volatility of stock prices and returns. It was found in the study that the Indian stock market was not one of the worst hit stock markets and the global economic recession did not have a greater impact on the returns of money invested in the Indian stock market. It was concluded that among very few other stock markets, the Indian stock market was the one which showed a growth in consolidated returns on investment and also it was one of the most reliable and safest places to invest.

**Research Methodology**

This research study is broadly quantitative in nature and a **case study and descriptive research design** has been formulated to get an answer.

**Objectives of the study:**

1. To analyse the time varying pattern of stock returns volatility in India over the period 2008 - 2013 using monthly stock returns and asymmetric GARCH methodology.
2. To study the changes in the volatility of prices of stocks and the events which are responsible for the reasons behind the shift in the patterns of volatility in stock prices.
3. To examine if in recent times the stock market cycles have exhibited greater volatility due to increased foreign investment.
**Data collection tools and techniques:**

**Secondary data collection:**

1. Data has been collected from Government reports and public journals: The published reports of the SEBI regarding assets, number of bulk trades, etc. have been used to collect information about the stocks which are subject of interest.

2. Secondary data has also been collected from the sites of companies used as subject of interest and sites of other financial agencies such as Bloomberg.

3. Research papers, Books and magazines have been referred to collect qualitative data regarding managerial practices.

**Rationale behind choosing the tool for the analysis**

The major reason behind choosing GARCH as a tool for the purpose of analysis is because of the fact that most of the conditional data evidence used is unabsorbed and it has affected the design of the model used and this has proved to be a constraint to mark up and set up a benchmark for the data set used. So it had been ensured that less efficient forecasting techniques have been neutralised as much possible. Evidently there is no guaranteed and tested way that exists up till now to model conditional heteroskedasticity, so EGARCH has been used to neutralise and normalise the errors of conditional variances.

**Data Analysis:**

For the purpose of financial data analysis, figures from the reports of the stock exchange and consolidated price movement of shares have been used to calculate various deviations and variances by making use of Autoregressive models i.e. GARCH model of ARCH classes in order to calculate the volatility of the post-2008 crisis. For the purpose of identifying a pattern in the volatility of returns, the class of variances have been distributed over the period of monthly returns during the last 5 years i.e. 2009 - 2014.

The regression of the price has been done in phases to identify the patterns which are persistent over a particular period of time.

**Data Analysis and interpretation**

**Descriptive Statistics**

**Table 1.1**

(Statistics of stock returns in India during 2009 - 2013)

<table>
<thead>
<tr>
<th>Period</th>
<th>Mean</th>
<th>Max.</th>
<th>Min.</th>
<th>S.D.</th>
<th>Skew.</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009 - 2011</td>
<td>.0116</td>
<td>.2500</td>
<td>-.1894</td>
<td>.0548</td>
<td>.5438</td>
<td>.5696</td>
</tr>
<tr>
<td>2011 - 2013</td>
<td>.0186</td>
<td>.2400</td>
<td>-.1864</td>
<td>.0534</td>
<td>.5648</td>
<td>.7454</td>
</tr>
<tr>
<td>2013 - 2014</td>
<td>.0010</td>
<td>.1340</td>
<td>-.1025</td>
<td>.04820</td>
<td>.2105</td>
<td>.2457</td>
</tr>
</tbody>
</table>

(Sources: As calculated by MS Excel)
The mean returns of stocks of the Indian market were relatively higher in the initial stages after the financial crisis of 2008 and gradually slowed down over a period of time. It is very evident that after the crisis, several reforms were adopted to ease the financial crunch and we can see that the mean returns decrease to a level of .0010 in 2014 which indicates a bull run in the Indian markets.

While looking at the standard deviation, it can be said that it has remained almost consistent throughout the period of 5 years which indicates a conditional variance in the returns of stocks. The risk-return trade off between the counter parties stands true to the financial theory of the Sharpe ratio and backs the fall in the return of stocks when the monetary easing was brought out and started showing results.

The above descriptive analysis of returns of the stock market clearly indicates that there was no normal distribution of returns in the initial phases of the returns while the markets were recovering from the jolts of the financial crunch in the economy. This is so because in the initial period, the returns were highly skewed but later, it returns to a normal distribution.

While looking at the figures of kurtosis stats, it evidently indicates that the returns are highly leptokurtic and it has remained consistent during the first 4 years of the study although the kurtosis stats normalize and fall in the year 2014.

**Exponential GARCH**

The volatility of the stock returns has been estimated by the use of asymmetric GARCH model of the ARCH class. Table 1.1 shows that the stock returns are not normal in distribution and the return patterns of the Indian market do not follow the preconceived notion. The leptokurtic and skewed results are therefore considered to be appropriate for estimating the volatility of the returns of the stock markets. The GARCH model has an additional advantage of providing an opportunity for measuring the leverage of the returns of the stocks.

To determine the effects of foreign investment on volatility of the stock returns, the Pitt model has been applied to determine the leverage and the variance. After the steps taken by the policy makers to revive the sentiments in the Indian markets recently, there has been a surge in FIIs. A post-economic slowdown investment pattern has been analyzed below by doing a comparative analysis of variances in return and price of stocks.

Table 1.2 shows the result from daily and monthly moving averages calculated on the returns of stocks by regressing the daily price movement of stocks.

**Table 1.2 (Mean returns and the leverage statistics during 2009 - 2014)**

<table>
<thead>
<tr>
<th>Period</th>
<th>Mean (%)</th>
<th>α</th>
<th>B (leverage)</th>
<th>Γ (gamma)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009 - 2011</td>
<td>.0396</td>
<td>.3455</td>
<td>-.0369</td>
<td>.8457</td>
</tr>
<tr>
<td>2011 - 2012</td>
<td>.0354</td>
<td>.1545</td>
<td>.0257</td>
<td>.7845</td>
</tr>
<tr>
<td>2012 - 2013</td>
<td>.0398</td>
<td>.4521</td>
<td>.0215</td>
<td>.5487</td>
</tr>
<tr>
<td>2013 - 2014</td>
<td>.0399</td>
<td>.3542</td>
<td>-.0214</td>
<td>.3564</td>
</tr>
</tbody>
</table>

(Sources: As calculated by MS Excel)
From Table 1.2 it is revealed that in the initial period of the recovery from the economic slowdown, the returns have been highly volatile but it does dampens a little as the stock market cycle progresses over the later stage of the recovery period. But it is to be noted that the volatility and leverage have no correlation; so it is not volume which affects volatility but prices which are correlated to the volatility of the returns.

The above results show a fall in the persistence of volatility in the returns of stocks after facing an economic slowdown, but the frequency and the magnitude of the fall in volatility as shown by gamma results is very less and yet, volatility remains in the later stage of the recovery period but at a lower level.

It can be inferred that there has been a minimal increase in the volatility of returns in terms of mean returns with regard to the daily price variation during the later stage of the recovery period of the stock market. This phenomenon has been noted during the increase in the foreign investment when liberal norms of capital investment were adopted.

The leverage on returns has been significant in the recovery period but later, the leverage tends to go down as the effect of the policy decisions are normalized over a period of time. A look at the table above shows that during the year 2013 - 2014 leverage goes into negative which gives a sign of normalization of returns.

The continuity of volatility is very significant when it is calculated for monthly data and it spreads over a period of time thereby making the stock market cycles longer.

Observing from Table 1.2, the gamma constant is significantly higher in the initial phase of economic slowdown with a value of .85 but over time, it comes down to a very low value of .35 which shows the normal distribution of returns. This phenomenon can be visually observed with the help of the graphs below which give a break up of the GARCH statistics based on prices, returns and volatility by calculating the conditional variance with the help of gamma constant. It can also be expressed in the form of the following graphs:

![Conditional Variance GARCH 1](image1)

![Conditional Variance GARCH 2](image2)
It is very evident from the above graphs that the volatility initially increases in the initial period of the economic crisis and the steps taken by the policy makers is a significant cause of inflating volatility in the market but over time, the market stabilizes and returns to the normal distribution at the later stage of the recovery period which is under consideration of this research study.

**Findings**

Following are the findings of this paper:

- It is evident that the adoption of liberal norms and allowing foreign investment in the form of FIIs does not impact or add to the volatility of returns of the stock market.
- There is no structural shift due to heavy trading of stocks by foreign investors; it is revealed that it just adds to the volume of the shares traded by the investors which may be a cause of abnormal distribution of returns on stocks traded.
- It is noted that the initial phases of the recovery from the economic slowdown was the most volatile period in terms of returns on stocks which may be the result of reasons other than volume of shares traded.
- The profits reaped during the bear phases are clearly higher than the bull phases of the stock market cycles. It also shows that the stock market cycles have softened during the later phases of the recovery period from the economic slowdown.

**Managerial implications**

The research paper has observed the trends of volatility of stock returns during the period 2009 - 2014 and its implications for the Indian capital markets. The findings of the research have a number of managerial implications for stock market investors that contribute to its dynamics. The stakeholders can make their investment strategies on the basis of results of the research, as it highlights the significant factors which influence returns and its volatility.

Significantly, a number of managerial implications come from this research; two major areas are investor education and awareness and prudent asset allocation to minimize and mitigate the effects of volatility of returns. Investors should take decisions based on technical analysis of the stock market rather based on the sentiments of the prevailing market.

The other implication points towards the policymakers where it is wiser to allow more foreign investment which helps the markets to normalize the returns by adding to the volume of stocks traded as against the common belief that foreign investment adds to volatility of stock returns.

**Limitations of the study**

Indicated below are a few limitations of the study:

- The scope of this study is relatively narrow and does not cover essential factors such as derivative
markets, depositories, etc., which play an important role in functioning of the financial system and the economy as a whole.

- The main limitation of this study is that it has been conducted to particularly evaluate the effect of the post-economic slowdown on the capital markets. The sample does not reflect the sentiments of different geographical areas and hence, this study cannot be simultaneously referred for evaluation of all types of markets and their volatilities and returns.

- The scope of this study does not include the cognizable efficiency analysis which plays some part in the capital market analysis.

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**References**


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**Dr. Rosy Kalra** is an Assistant Professor heading the Finance Department in Amity Business School, Amity University, Noida. She can be reached at rosy.pkalra@gmail.com

**Piyuesh Pandey** is a student of MBA (Finance) of final year in ABS, Amity University, Noida. He can be reached at pandey.pandey008@gmail.com