Global Financial Crisis And Stock Return Volatility In India

***P. K. Mishra**
****K. B. Das**
*****B. B. Pradhan**

INTRODUCTION

In recent years, there has been a lot of noise in the media about stock market volatility. Market volatility has drastically increased in recent days and emerging as well as mature economies have been passing through a turbulent period, as reflected in all financial markets and asset classes. In the last year, we had been bombarded by media coverage of the financial crisis in US (the credit crisis, bankruptcies of US financial institutions, the bailout plan, etc.) which had added to this volatility. Market volatility had spiked, and political nations experienced turbulence that spilled over to all capital markets. The global economic slowdown, the US real estate decline, the credit crisis and the reversal in the resource trend created a great deal of turbulence and worry in the capital markets. Financial institutions and other companies around the world have been affected by volatility in the share and property markets.Shares and properties have been the asset types most affected by the recent market volatility. They are known as growth assets, and whilst they are inclined to a higher amount of risk compared to defensive asset types such as cash or fixed interest, they are also known for delivering higher returns over the long term. The relationship between risk and return cannot be avoided. The higher the risk, the higher the potential return.

The term 'volatility' has several definitions ranging in scope from the scientific to the emotional. The media often uses this term as a proxy for "a market that is going down a lot in a quick hurry." The American Heritage Dictionary defines volatility in two ways: (i) *the property of changing readily from a solid to a vapour and (ii) tending to vary often or widely, as in price.*

While the first may be perfectly acceptable in the scientific setting, using such a definition in an investment context would certainly create anxiety for an investor. The second definition is more financial "friendly" and is more positive than the first. In simple words, volatility is the degree to which asset prices tend to fluctuate. It is the variability or randomness of asset prices. Volatility is often described as the rate and magnitude of changes in prices and in finance often referred to as risk. Stock market volatility, a barometer of uncertainty or risk, measures the size and frequency of fluctuations in a broad stock market price index. Usually, volatility is gauged by the standard deviation of price changes at fixed intervals in a given period. That is, volatility is low if price changes are clustered near their mean and is high if price changes are widely dispersed.

The volatility of developed and emerging stock markets have been studied comprehensively since the 1987 stock market crash and in the aftermath of East Asian financial crisis. Again, this study has become imperative in recent days scepticism of recession. The objective of this paper is to examine the volatility of Indian stock market as has been originated from the global economic turbulence.

Over the last decade or so, there has been a paradigm shift in the Indian capital market. The Indian market is no longer isolated from the global economic events. India has witnessed bouts of volatility in its market. Some of which have had their origin in global events. The recent sub-prime crisis and news of recession emerging from the US are examples of how events which are international, can cause volatility in Indian capital market. Besides, inflation rates, global energy prices, exchange rate fluctuations, etc. are witnessing constant changes in the recent years. These are affecting the volatility of the capital market. It is the belief of market analysts, researchers and academicians that two main factors have influenced Indian stock markets, namely, the credit crisis in the US, and the fear of the US recession. These factors have caused some investors to sell more assets than usual, which has resulted in lower share prices and increased market volatility. Thus, stock price indices can be used and have been used around the world for measuring

**Senior Lecturer In Economics,* Siksha O Anusandhan University, Bhubaneswar. Email : pkmishra1974@gmail.com
***Professor*, Department of A& A Economics, Utkal University, Bhubaneswar. Email : drkbdas@gmail.com
****Professor and Registrar*, Siksha O Anusandhan University, Bhubaneswar. Email : registrar@soauniversity.ac.in

volatility of stock returns.

LITERATURE REVIEW

A number of studies have been carried out to measure the volatility of the stock market. Though there have been a few studies done related to this area, most of the studies have been done on developed markets and few have been done on the Indian market, especially taking into consideration the recent global economic recession. After reviewing the past studies, it has been felt that there is a need to measure the extent of volatility and also to study the behaviour of this volatility during March, 2006 to March, 2009.

Deb, Vuyyuri and Roy (2003) model the monthly volatility of market indices (Sensex & S&PCNX-Nifty) of Indian capital markets using eight different univariate models. Out-of-sample forecasting performance of these models has been evaluated using different symmetric, as well as asymmetric loss functions. The GARCH (1, 1) model has been found to be the overall superior model based on most of the symmetric loss functions, though ARCH has been found to be better than the other models for investors who are more concerned about under predictions than over predictions.

Raju and Karande (2003) study price discovery and volatility in the context of introduction of Nifty futures at the National Stock Exchange (NSE) in June 2000. Co-integration and GARCH techniques are used to study price discovery and volatility respectively. The major findings are that the futures market (and not the spot market) responds to deviations from equilibrium; price discovery occurs in both the futures and the spot market, especially in the latter half of the study period. The results also show that volatility in the spot market has come down after the introduction of stock index futures.

Batra (2004) examines the economic significance of changes in the pattern of stock market volatility in India during 1979-2003. The analysis reveals that the period around the BOP crisis and the initiation of economic reforms in India is the most volatile period in the stock market.

Seth and Saloni (2005) examine the volatility of common stock from the period 1980 to 2003. The study concludes that the stock market returns follow a deterministic path implying that stock returns oscillate between excess and under return, passing through the mean stock return. Hence, the acceptable limits of volatility for the decision making of investors, depending on the type of investors can be made.

Padhi (2005) explains the stock market volatility at the individual script level and at the aggregate indices level. The empirical analysis has been done by using ARCH, GARCH model and ARCH in Mean model and it is based on daily data for the time period from January 1990 to November 2004. The analysis reveals the same trend of volatility in the case of aggregate indices and five different sectors such as electrical, machinery, mining, non-metallic and power plant sector. The GARCH (1, 1) model is persistent for all the five aggregate indices and individual company.

Karmakar (2006) measures the volatility of daily stock return in the Indian stock market over the period of 1961 to 2005. Using GARCH model, he found strong evidence of time varying volatility. He also used the TARCH model to test the asymmetric volatility effect and the result suggests the asymmetry in volatility.

Rao, Kanagaraj and Tripathy (2008) attempt to determine the impact of individual stock futures on the underlying stock market volatility in India by applying both GARCH and ARCH model for a period of seven years from June 1999 to July 2006. This study includes stock of 10 companies i.e Reliance, SBI, TISCO, ACC, MTNL, TATA Power, TATA Tea, BHEL, MAHINDRA & MAHINDRA and ITC. The results suggest that stock future derivatives are not responsible for increase or decrease in spot market volatility and conclude that there could be other market factors that have helped the increase in Nifty volatility.

Mahajan and Singh (2008) examine the empirical relationship between return, volume, and volatility in Indian stock market using GARCH (1, 1) and EGARCH (1, 1) estimated for Nifty index.

Rao and Tripathy (2008) examine the volatility of Nifty to understand the behaviour of the Indian stock market. This study explores the daily nifty movements as well as wide range of economic events from 1991 to 2008 and the results show that the stock market volatility was highest during some years. This volatility is studied further in detail to find the logical reasons for the excessive or under returns on the specific day for the market. The study concludes that the market would react very sharply to economic, political and policy issues.

As is evident from the survey of literature discussed above, the issue of changes in volatility of stock returns in emerging markets has received considerable attention in recent years. The reason for this enormous interest is that volatility is used as a measure of risk. The market participants also need this measure for several reasons. It is needed

as an input in portfolio management. It is indispensable in the pricing of options. Furthermore, in the process of predicting asset return series and forecasting confidence intervals, the use of volatility measure is crucial. Campbell et al. (2001) finds that stock market volatility has significant forecasting power for real gross domestic product (GDP) growth. These results are not a surprise. When volatility increases, investors require a higher risk premium to hold stocks. As a result, stock prices fall and the cost of capital rises, which in turn reduces investment and output. Therefore, the issue of volatility and risk has become increasingly important in recent times to financial practitioners, market participants, regulators and researchers. In this context, the present study has been carried out to understand the volatility behaviour of the Indian stock markets for a period of 2006 to 2009.

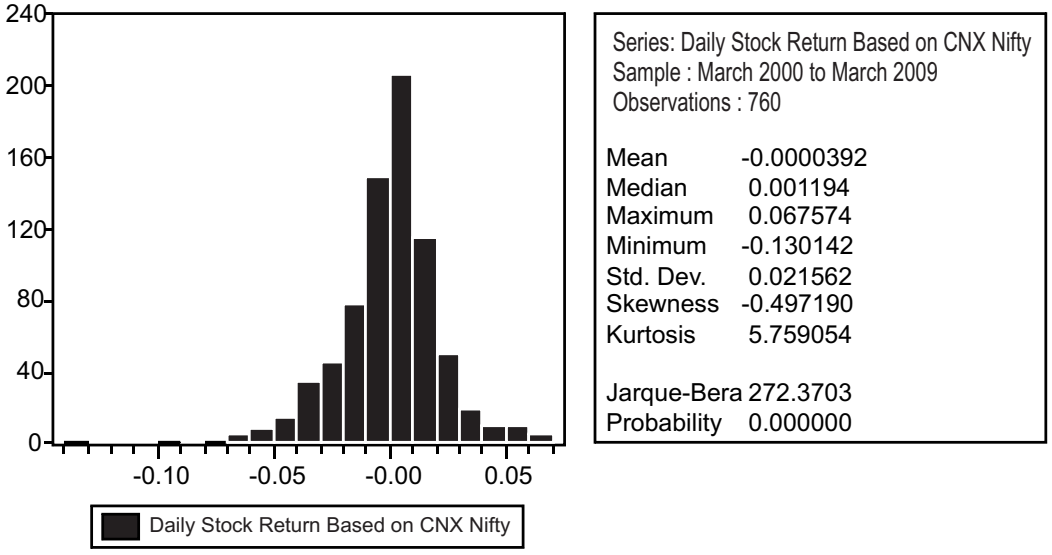
DATA AND EMPIRICAL ANALYSIS

The study has been conducted for the period from 2006:03 to 2009:03 so as to incorporate the flow of bad news from global events, thereby analysing their effects on stock market volatility in India. The study uses the daily data on stock returns on S&P CNX Nifty. The data are collected from the RBI database. The econometric estimations of the GARCH class models are performed to cater to the needs of the study.

To the requirement of volatility modelling, the daily closing prices of the CNX Nifty are used to arrive at the daily stock return data ignoring the days when there was no trading. The price changes are calculated from the last day the market was open. Daily stock returns (R_t) are calculated **by the log difference change in the price index:** $R_t = \log\left(\frac{I_t}{I_{t-1}}\right)$

where (R_t) is the daily stock return at time 't' and I_t and I_{t-1} are the closing value of the Nifty at time 't' and 't-1' respectively. The Fig. 1 summarizes the descriptive statistics relating to the Nifty based stock returns in India. The basic statistics indicates that the mean (0.0000392) is close to zero, relative to the standard deviation (0.021562). The return series is negatively skewed for the sample period. The most interesting feature is the kurtosis, which measures the magnitude of the extremes. It is greater than three. And, it suggests that the return series has fatter tails than the normal distribution. That is, the probability of extreme returns that has been observed empirically is higher than the probability of extreme returns under the normal distribution. This feature is referred to as Lepto-kurtosis, or simply 'fat tails'. The daily stock returns are thus not normally distributed - a conclusion which is confirmed by the Jarque-Bera (JB) test.

Fig.-1: Descriptive Statistics on Daily Stock Returns Based on CNX Nifty



Then, for volatility estimation, the GARCH (1, 1) model [4] is used. The model for daily stock return is specified as under:

[4] The GARCH model was introduced by Bollerslev (1986).

Mean Equation: $R_t = c + \varepsilon_t$

Variance Equation: $\sigma^2_t = \omega + \alpha_1 \varepsilon^2_{t-1} + \beta_1 \sigma^2_{t-1}$

Since σ^2_t is the one-period ahead forecast variance based on past information, it is called the conditional variance. The above specified conditional variance equation is a function of three terms: a constant term (ω), news about volatility from the previous period, measured as the lag of the squared residual from the mean equation (ε^2_{t-1}) and the last period's forecast variance (σ^2_{t-1}). The GARCH (1, 1) model assumes that the effect of a return shock on current volatility declines geometrically over time. This model is consistent with the volatility clustering, where large changes in stock returns are likely to be followed by further large changes.

Table-1: Garch (1, 1) Estimates Of Daily Stock Returns

	Coefficient	Std. Error	z-Statistic	Prob.
C	0.001586	0.000608	2.608525	0.0091
Variance Equation				
ω	1.12E-05	2.56E-06	4.392280	0.0000
α_1	0.165045	0.020880	7.904651	0.0000
β_1	0.820762	0.019955	41.13149	0.0000

It is clear that the bulk of the information comes from the previous day's forecast (around 82%). The new information changes this a little and the long run average variance has a very small effect.

Fig.-2 (a): Daily closing Stock Prices and Returns Based on Nifty (March 2006 to March 2009)

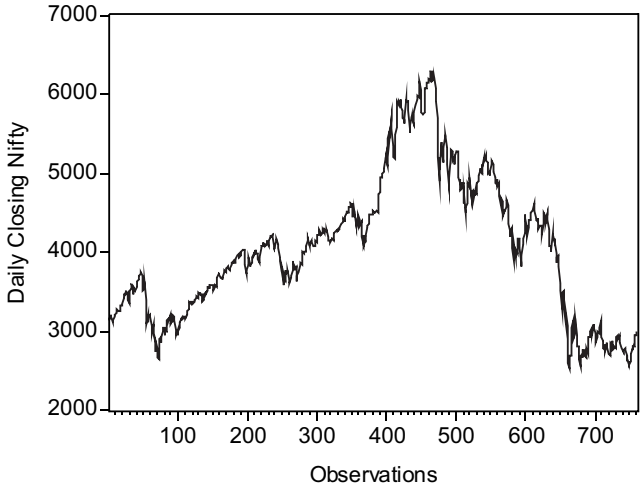
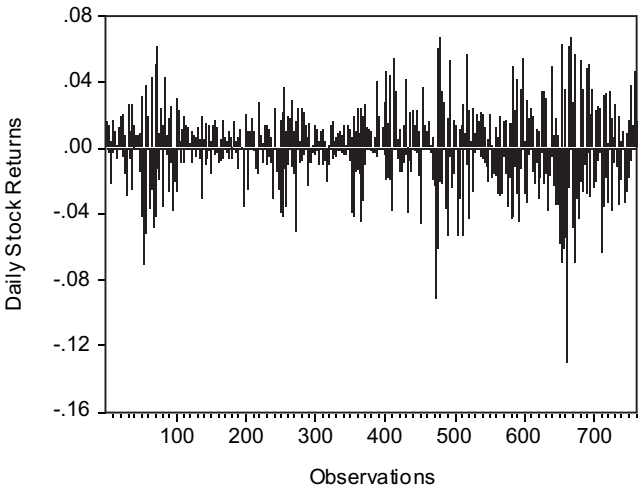


Fig.-2 (b): Daily Stock Returns Based on Nifty (March 2006 to March 2009)



It is very apparent from Fig. 2(b) that the amplitude of the daily stock returns is changing. The magnitude of the changes is sometimes large and sometimes small. This is the effect that GARCH is designed to measure and that we call volatility clustering. There is another interesting feature in the fig.-2 -that the volatility is higher when prices are falling than when prices are rising. It means that the negative returns are more likely to be associated with greater volatility than positive returns. This is called asymmetric volatility effect.

The time varying stock return volatility as captured by GARCH (1, 1) model does not say about whether good news or bad news that increases volatility. This aspect of volatility modelling is captured by Threshold GARCH (TGARCH) model as developed independently by Glosten, Jaganathan, and Runkle (1993) and Zakoian (1994).

The specification for conditional variance in Threshold GARCH (1, 1) model is:

$\sigma^2_t = \omega + (\alpha + \gamma I_{t-1})\varepsilon^2_{t-1} + \beta\sigma^2_{t-1}$

Here, the dummy variable I_{t-1} is an indicator for negative innovations and is defined by: I_{t-1} =1, if ε_{t-1}<0 and I_{t-1}=0 if ε_{t-1} ≥0. In this model, good news, ε_{t-1}>0, and bad news, ε_{t-1}<0, have differential effects on the conditional variance; good news has an impact of α, while bad news has an impact of $\alpha+\gamma$. If γ >0, then bad news increases volatility, and we say that there is a leverage effect. If $\gamma \neq 0$, the news impact is asymmetric.

Table-2: T-Garch (1, 1) Estimates Of Daily Stock Returns

	Coefficient	Std. Error	z-Statistic	Prob.
C	0.001020	0.000588	1.733348	0.0830
Variance Equation				
C	1.56E-05	2.67E-06	5.851812	0.0000
ARCH(1)	0.027518	0.025575	1.075968	0.2819
RESID(-1)^2*(RESID(-1)<0)	0.239766	0.041046	5.841395	0.0000
GARCH(1)	0.813429	0.021260	38.26069	0.0000

It shows that the good news has an impact of 0.0275 magnitudes and the bad news has an impact of 0.027518+0.239766= 0.267284 magnitudes. Thus, it can be said that in the Indian stock markets, the bad news increases the return volatility substantially. In recent time, the bad news has been originated from US sub-prime crisis, economic failure of globally reputed financial institutions, and large scale selling of stocks by FIIs in Indian stock markets. All these have made the Indian stock market environment gloomy and investment scenario scary.

Another aspect of this study is the short-term and/or long-term behaviour of stock return volatility. Thus, this part investigates the volatility spill over effects of the US sub-prime crisis on the Indian stock markets using the Component GARCH (CGARCH) model, which is a restricted GARCH model of Engle and Lee (1993), designed to capture the long-term or short-term component of the global financial shock to the Indian stock markets. The component-GARCH model is stated below:

$R_t = c + \varepsilon_t$

$= q_1 + \alpha(\varepsilon^2_{t-1} - q_{t-1}) + \beta(\sigma^2_t - q_{t-1})$

$q_1 = \omega + \rho(q_{t-1} - \omega) + \phi(\varepsilon^2_{t-1} - \sigma^2_{t-1})$

Here, σ^2_t is the volatility, *c* is the mean of the process, and q_t is the permanent or trend component in the conditional variance that captures the idea of time-varying long-term volatility with the speed of mean reversion determined by ρ. Typically ρ is between 0.9 and 1, so approach the unconditional variance very slowly. For ρ = 1, the long-term

Table-3: C-Garch (1, 1) Estimates Of Daily Stock Returns

	Coefficient	Std. Error	z-Statistic	Prob.
C	0.001611	0.000620	2.597483	0.0094
Variance Equation				
ω	0.000764	0.000542	1.411161	0.1582
ρ	0.983671	0.013322	73.84009	0.0000
ϕ	0.174812	0.024745	7.064514	0.0000
α	-0.029482	0.041543	-0.709670	0.4779
β	0.269877	1.566742	0.172254	0.8632

volatility process is integrated. The forecasting error term ($\varepsilon^2_{t-1} - \sigma^2_{t-1}$) is the zero-mean and serial uncorrelated, which drives the evolution of the permanent component. The difference between σ^2_t and q_t represents the transitory component of the conditional variance that dies out with time. Thus, the long-run movement of asset return volatility is dominated by the current expectation of the permanent trend given $\alpha + \beta < 1$. The results of component GARCH model are presented in Table-3. The variables in the transitory equation will have an impact on the short run movements in volatility, while the variables in the permanent equation will affect the long run level of volatility. The value of α (-0.0294) indicates the negative significant initial impact of a shock to the transitory component, and β (0.2698) indicates the positive and significant degree of memory in the transitory component. The sum value of α and β (0.24039) provides the persistence of transitory shocks. The higher value of ρ (0.9836) shows the trend persistence. High trend persistence, low transitory volatility, and slower mean reversion in the long-run are thus, represented.

CONCLUSION

This paper, therefore, studied the volatility of Indian stock markets, taking into account the National Stock Exchange as the role model. The study by employing GARCH, T-GARCH and C-GARCH models provides the evidence of high persistence of time varying volatility, its asymmetric effects, and low transitory volatility due to crisis shock and leaves the application of the result in the field of volatility forecasting as an issue for future study. This volatility behaviour of Indian capital market may be due to recent global financial slowdown that originated from US sub-prime crisis.

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