International Events & Volatility in Indian Stock Markets: A GARCH Model Study

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ABSTRACT

A very crucial role is played by the stock markets in the financial system of a country. Stock markets somewhere represent the health of the economy. There are various factors which fluctuate the stock markets. The Indian economy plays an important role in the global economy. In the present era Foreign Institutional Investors (FIIs), Foreign Direct Investment (FDI) & reforms in the market are increasing the market inflows and outflows. The international funds move from one market to another market. The stock markets are affected to a large extent by the global factors and events. The stock markets are represented in the present analysis by BSE Sensex. The paper explores the impact of international events on the stock market volatility in India. The various GARCH models have been used in the research work of the paper to analyze the impact of international events on the stock market volatility in India.

Key Words: E-GARCH, GARCH, Leverage, Sensex T-GARCH, Volatility.

INTRODUCTION

In the financial system of a country a crucial role is played by the stock markets. There are large number of economic and non-economic factors which influence the stock markets. The economic health of a country is checked through the capital markets. The fund houses provide the funds to the markets for a larger period of time. There are a large number of inside and outside factors which affect the working of the stock markets. In the global scenario the funds move from one country to another. The markets which are attractive from investment point of view the investment is more in those international markets. Other international markets where the future is not bright the funds are withdrawn from those markets. In the global scenario the markets are interwoven. The positive or negative news in one market surely affects the working of the other stock market. The Indian economy has undergone a drastic change since 1991 as the economic reforms were initiated in India at that time. Since then, India has become an attractive investment destination for the investors. So, the present research paper analysis the impact of various international events which generate the volatility in the stock markets in India.

REVIEW OF LITERATURE

The volatility of the stock markets cannot be explored without the analysis of the empirical studies on the matter. Various studies have been done in developed markets but the developing markets are exploring new horizons in this area. Global events have a linkage with the stock market's volatility in India. The present research paper covers a brief literature review as below:

Bahng, Joshvas W (2005) in the research paper analyzed the Indian stock market interdependence along with the emerging international markets in Asia. It was explored that BSE Sensex is affected by MSCI Asian Index or not. It was found that there is an impact of Asian markets on the fluctuations of Indian stock market.

Agarwal, Gaurav (2007) in the research paper analyzed whether monetary policy declaration is worth impacting the stock market or not. On the CNX Nifty an event study was performed to make the analysis of the impact of monetary policy on the stock markets. It was explored that monetary policy announcement is a vital information for the stock markets in India. Although it was not found to be of the form of semi strong nature during the analysis period.

Ahmed, Shahid (2008) in his study examined a crucial linkage in between the stock prices and important economic factors in India. The Granger Causality test and Cointegration analysis were made to explore the results. It was found that variable performance is not the single factor to drive the economy.

Bansal, Anand, J.S Pasricha (2009) observed in the study the effect of foreign institutional investors on stock market performance in India. It was found that there seem no important variations in the Indian stock market returns

Mishra et al. (2010) examined the impact of negative global news on volatility of the Indian stock market during 2006 to 2009.The daily observations of S&P CNX Nifty were considered in the study. The GARCH family models i.e., T-GARCH and E-GARCH were used in the analysis.

NEED OF THE PRESENT STUDY

In the stock markets the volatility is always a hot topic. The investors are keen to invest or withdraw the funds from the markets keeping in mind the volatility in the stock market. The volatility is associated with the risk. But its always said that higher risk means higher reward. There is no doubt that daily a large number of crucial events make the stock markets volatile in Nature. These events may have short term or long-term impact on the stock markets. In the present era the stock markets throughout the world are very much related and news in one market can dominate the working of another stock market. In the present research paper, the focus is on the stock market volatility keeping in mind certain specific international events.

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OBJECTIVES OF THE STUDY

The purpose of the research paper is to explore the volatility in Indian stock markets due to international events. The problem has been divided into two main objectives:
1. To study the volatility in the Indian stock market due to the impact of various international events.
2. To explore the effect of leverage in the Indian stock market due to the impact of international events.

HYPOTHESIS OF THE STUDY

1. H0: There is no significant impact of international events on the stock market volatility in India.
   H1: There is a significant impact of international events on the stock market volatility in India.
2. H0: Leverage effect is present in the Indian stock market due to international events.
   H1: Leverage effect is not present in the Indian stock market due to international events

For a best GARCH model assumptions are as follows:
1. H0: There is no serial correlation in the residuals.
   H1: There is a serial correlation in the residuals.

2. H0: There exists no ARCH effect.
   H1: There exists an ARCH effect.

The null hypothesis is expected in a best model.

In case of ARCH effect or serial correlation if the P-value is more than 5% it is an indicator that we are not in a position to reject the null hypothesis i.e., null hypothesis has to be accepted which indicates the absence of ARCH effect or serial correlation in the model.

RESEARCH METHODOLOGY

The research paper is analytical in nature and explored the impact of international events on the Indian stock markets. Volatility is also very much important in the market as it controls the nerve of the market. Surely the stock markets are affected by different type of information but generally the impact of negative information is seen more in case of stock

markets volatility. Here in the study BSE Sensex is used as a proxy for the stock markets and treated as dependent variable. Whereas the various international events are treated as dependent variable. The observations are made in between the year 2000 to 2017.The Sensex data is gathered from official website of Bombay Stock Exchange. Whereas various international events data is gathered from secondary sources like newspapers, magazines and Wikipedia etc.First of all, BSE Sensex returns series are tested for stationarity. Here in the study the daily data of BSE Sensex has been used. To measure the volatility of the Sensex returns due to international events GARCH family models are used. Which are GARCH (1,1), E-GARCH (1,1) & T-GARCH (1,1). It was found that at the level BSE Sensex returns are not stationary. So, values are converted to log values. As the BSE Sensex return series are not stationary at level, the series are converted to first difference. Now the series are being converted to stationarity. The GARCH family models can be applied on the data after conversion into stationarity. Event study has been performed to analyze the impact of international events on the stock market volatility in India and to explore the leverage effect in the study.100 days are taken as estimation period before the event. Event window is considered 15 days before and 15 days after the event i.e., event window is of 31 days in total. Dummy variable 1 is used for the date of occurrence of international event. First of all, the daily BSE Sensex returns are converted to the logarithmic values and further the logarithmic differences are used. The stock market returns data equation conversion is as follows:

$$Rt = (LnPt - LnPt - 1)X100$$

Where, Rt is return during the period t, daily stock prices (closing) are represented at the time t & t-1 by P_t& P_{t-1}

31 days. Dummy variable 1 is used for the date of announcement of the election result.

The stock markets in India affected by a large number of international events. Some of the important international events during 2000 to 2017 are listed in the table 1 as below:

Table 1: Important International Events in between years 2000-2017

Date	International Event
2001 (11 Sept)	September 11 Attacks, Economic Effects
2002 (09 Oct.)	2002, Downturn in Stock Market
2007 (27 Feb)	2007, Bubble in Chinese Stock Market
2007 (11 Oct.)	2007-09, U.S. Bear Market
2008 (16 Sept.)	Financial Crisis in 2007-08
22009 (27 Nov.)	Debt Standstill 2009 of Dubai
2010 (27 April)	European Sovereign Debt Crisis
2010 (06 May)	2010 Flash Crash
2011 (06 May)	August 2011 Stock markets Fall
2015 (12 June)	Crash of Stock Market in China (2015-16)
2015 (18 Aug)	Sell off the Stock Market (2015-16)

Source: Wikipedia

DESCRIPTIVE STATISTICS

The table 2 shows the results of descriptive statistics of Sensex returns during the year 2000 to 2017. It was found that mean is maximum in case of international events of 2017 (11th Oct.). The standard deviation was found to be highest in case of 2009 (27th Nov.) international event Sensex return series. The different series have skewness of positive & negative nature which indicates for the series long left and right tail. It was found that Kurtosis for all the series of Sensex is greater than 3 & its positive. Hence it was an indication that in case of all the variables there is an existence of leptokurtic distribution as compared to normal distribution.

Table 2: BSE Sensex Returns Descriptive Statistics during years 2000-01 to 2017-18

(International Events)

	Mean	**Med.**	**Std. Dev.**	**Kurtosis**	**Skew**	**Min**	**Max**
2001 (11 Sept)	-0.003	-0.002	0.019	4.39	-0.48	-0.06	0.051
2002 (9 Oct)	-0.0011	-0.0004	0.011	4.445	0.253	-0.030	0.04
2007 (27 Feb)	0.001	0.0020	0.012	4.729	-0.717	-0.041	0.037
2008 (16 Sept)	-0.0024	-0.003	0.024	3.061	0.045	-0.062	0.06
2007 (11 Oct)	0.003	0.002	0.015	5.174	-0.341	-0.05	0.05
2009 (27 Nov)	0.0003	0.0011	0.03	48.40	-3.773	-0.27	0.160
2010 (27 April)	0.00002	0.0003	0.0110	0.145	4.038	-0.031	0.033
2010 (6 May)	0.0003	0.0002	0.012	3.936	0.0300	-0.031	0.033
2011 (6 May)	-0.001	-0.001	0.012	2.78	0.033	-0.031	0.03
2015 (12 June)	-0.0001	-0.000	0.010	3.662	-0.424	-0.03	0.03
2015 (18 aug)	-0.001	-0.001	0.011	7.453	-1.149	-0.061	0.026

ANALYSIS OF SENSEX RETRNS (GARCH MODEL) FOR INTERNATIPONAL EVENTS

It was found that that in the equation of variance for the table 3 ARCH is significant. ARCH(α) is significant it means that previous day returns is in a position to affect present day return. For the international event of 2001 (11th Sept.) dummy or external shock is found to be significant. In case of GARCH (1,1) estimate of the parameter (β) is significant statistically. It means that volatility on previous day can impact volatility today. The results of asymmetric E-GARCH (1,1) explained that estimates of parameter (δ) found to be statistically significant. Which shows the presence of leverage effect in the model. The results of T-GARCH (1,1) explained that estimates of parameter (γ) found to be more than zero and statistically significant. Which shows the presence of leverage effect in the model. Which means that It was found that GARCH model tests of diagnosis through AIC, SIC and Residual Tests are appropriately quantified.

Table 3: Sensex Returns GARCH (1,1) Models Analysis 2001 (11 Sept) International Event

	GARCH		E GARCH		T-GARCH	
Mean Eqn.						
Φ_1	-0.001	0.21	-0.003	0.000	-0.002	0.078
Variance Equation						
ω	0.00	0.40	-0.212	0.000	0.000	0.000
α	0.15	0.01	-0.084	0.10	-0.16	0.01
β	0.81	0.00	0.966	0.00	0.70	0.00
γ					0.68	0.00
δ			-0.19	0.00		
Dummy	0.000	0.025				
AIC	-5.34		-5.50		-5.432	
SIC	-5.28		-5.38		-5.31	
RESIDUAL TESTS						
Q (12) Stats	**10.90 (0.54)**		**11.63 (0.48)**		**12.02(0.44)**	
Q^{12} Stats	**16.61 (0.17)**		**18.61 (0.10)**		**14.57 (0.27)**	
ARCH LM TESTS						
Lag 5	0.06 (0.45)		0.062 (0.47)		-0.017 (0.85)	
Lag 10	0.07 (0.44)		0.014 (0.87)		-0.031 (0.724)	

It was found that in the equation of variance for the table 4 ARCH (α) is not significant for the international event of 2002 (09 Dec.) dummy or external shock is not found to be significant. In case of GARCH (1,1) estimate of the parameter (β) is significant statistically. The results of asymmetric E-GARCH (1,1) explained that estimates of parameter (δ) found to be statistically significant. The results of T-GARCH (1,1) explained that estimates of parameter (γ) found to be more than zero and statistically significant. It was found that GARCH model tests of diagnosis through AIC, SIC and Residual Tests are appropriately quantified.

Table 4: Sensex Returns GARCH (1,1) Models Analysis 2002 (09 Dec) International Event

α	0.22	0.11	-0.12	0.35	-0.051	0.33
β	0.55	0.08	-0.66	0.01	0.81	0.00
γ					0.33	0.01
δ			-0.24	0.00		
Dummy	0.000	0.38				

It was found that in the equation of variance for the table 5 ARCH (α) is significant for the international event of 2007 (27 Feb..) dummy or external shock is not found to be significant. In case of GARCH (1,1) estimate of the parameter (β) is significant statistically. The results of asymmetric E-GARCH (1,1) explained that estimates of parameter (δ) found to be statistically significant. The results of T-GARCH (1,1) explained that estimates of parameter (γ) found to be more than zero and statistically significant. It was found that GARCH model tests of diagnosis through AIC, SIC and Residual Tests are appropriately quantified.

Table 5: Sensex Returns GARCH (1,1) Models Analysis 2007 (27 Feb.) International Event

α	0.15	0.05	-0.25	0.001	-0.202	0.00
β	0.61	0.00	0.85	0.00	1.02	0.00
γ					0.24	0.00
δ			-0.42	0.00		
Dummy	0.00	0.17				

It was found that in the equation of variance for the table 6 ARCH (α) is significant for the international event of 2007 (11 Oct..) dummy or external shock is found to be significant. In case of GARCH (1,1) estimate of the parameter (β) is significant statistically. The results of asymmetric E-GARCH (1,1) explained that estimates of parameter (δ) found not to be statistically significant. The results of T-GARCH (1,1) explained that estimates of parameter (γ) found to be more than zero and statistically significant. It was found that GARCH model tests of diagnosis through AIC, SIC and Residual Tests are appropriately quantified.

Table 6: Sensex Returns GARCH (1,1) Models Analysis 2007 (11 Oct.) International Event

ω	0.1001	0.04	0.1176	0.015	-0.172	0.0002
α	0.770	0.00	-0.831	0.0000	0.822	0.000
β					0.332	0.000
γ			-0.040	0.53		
δ	0.000072	0.030				

It was found that in the equation of variance for the table 7 ARCH (α) is not significant for the international event of 2008 (16 Sept.) dummy or external shock is found to be significant. In case of GARCH (1,1) estimate of the parameter (β) is significant statistically. The results of asymmetric E-GARCH (1,1) explained that estimates of parameter (δ) found to be statistically significant. The results of T-GARCH (1,1) explained that estimates of parameter (γ) found to be more than zero and statistically significant. It was found that GARCH model tests of diagnosis through AIC, SIC and Residual Tests are appropriately quantified.

Table 7: Sensex Returns GARCH (1,1) Models Analysis 2008 (16 Sept.) International Event

ω	0.102	0.000	0.202	0.000	-0.06	0.16
α	0.89	0.000	0.98	0.000	0.91	0.00
β					0.29	0.01
γ			-0.08	0.000		
δ	0.000	0.072				

It was found that in the equation of variance for the table 8 ARCH (α) is significant for the international event of 2009 (27 Nov.) dummy or external shock is found to be significant. In case of GARCH (1,1) estimate of the parameter (β) is significant statistically. The results of asymmetric E-GARCH (1,1) explained that estimates of parameter (δ) found not to be statistically significant. The results of T-GARCH (1,1) explained that estimates of parameter (γ) found to be more than zero and not statistically significant. It was found that GARCH model tests of diagnosis through AIC, SIC and Residual Tests are appropriately quantified.

Table 8: Sensex Returns GARCH (1,1) Models Analysis 2009 (27 Nov.) International Event

ω	0.0282	0.742	0.0339	0.764	-0.0528	0.0014
α	0.4973	0.003	0.868	0.000	0.4671	0.0003
β					0.0115	0.725
γ			0.204	0.05		
δ	-0.000082	0.010	s			

It was found that in the equation of variance for the table 9 ARCH (α) is significant for the international event of 2010 (27 April) dummy or external shock is not found to be significant. In case of GARCH (1,1) estimate of the parameter (β) is significant statistically. The results of asymmetric E-GARCH (1,1) explained that estimates of parameter (δ) found to be statistically significant. The results of T-GARCH (1,1) explained that estimates of parameter (γ) found to be more than zero and statistically significant. It was found that GARCH model tests of diagnosis through AIC, SIC and Residual Tests are appropriately quantified.

Table 9: Sensex Returns GARCH (1,1) Models Analysis 2010 (27 April) International Event

ω	0.073	0.316	-0.050	0.340	-0.098	0.0002
α	0.7789	0.008	0.91712	0.000	0.882	0.000
β					0.3225	0.0003
γ			-0.248	0.000		
δ	0.00000154	0.812				

It was found that in the equation of variance for the table 10 that ARCH (α) is significant for the international event of 2010 (06 May) dummy or external shock is not found to be significant. In case of GARCH (1,1) estimate of the parameter (β) is significant statistically. The results of asymmetric E-GARCH (1,1) explained that estimates of parameter (δ) found to be statistically significant. The results of T-GARCH (1,1) explained that estimates of parameter (γ) found to be more than zero and statistically significant. It was found that GARCH model tests of diagnosis through AIC, SIC and Residual Tests are appropriately quantified.

Table 10: Sensex Returns GARCH (1,1) Models Analysis 2010 (06 May) International Event

ω	0.0732	0.180	-0.059	0.251	-0.093	0.0004
α	0.8128	0.000	0.917	0.000	0.889	0.000
β					0.303	0.001
γ			-0.239	0.0010		
D	0.0000115	0.415				

It was found that in the equation of variance for the table 11 that ARCH (α) not is significant for the international event of 2011 (06 May) dummy or external shock is not found to be significant. In case of GARCH (1,1) estimate of the parameter (β) is significant statistically. The results of asymmetric E-GARCH (1,1) explained that estimates of parameter (δ) found to be statistically significant. The results of T-GARCH (1,1) explained that estimates of parameter (γ) found to be more than zero and not statistically significant. It was found that GARCH model tests of diagnosis through AIC, SIC and Residual Tests are appropriately quantified.

Table 11: Sensex Returns GARCH (1,1) Models Analysis 2011 (06 May) International Event

ω	-0.115	0.156	-0.133	0.45	-0.1483	0.0203
α	0.8005	0.000	0.7615	0.00	0.758	0.0001
β					0.243	0.066
γ			-0.239	0.016		
D	-0.0000156	0.194				

It was found that in the equation of variance for the table 12 that ARCH (α) not is significant for the international event of 2015 (12 June) dummy or external shock is not found to be significant. In case of GARCH (1,1) estimate of the parameter (β) is not significant statistically. The results of asymmetric E-GARCH (1,1) explained that estimates of parameter (δ) found not to be statistically significant. The results of T-GARCH (1,1) explained that estimates of parameter (γ) found to be more than zero and not statistically significant. It was found that GARCH model tests of diagnosis through AIC, SIC and Residual Tests are appropriately quantified.

Table 12: Sensex Returns GARCH (1,1) Models Analysis 2015 (12 June) International Event

ω	-0.10	0.000	-0.40	0.003	-0.143	0.08
α	1.03	0.00	-0.52	0.06	-0.32	0.41
β					0.05	0.51
γ			0.04	0.70		
D	0.000	0.071				

It was found that in the equation of variance for the table 13 that ARCH (α) is significant for the international event of 2015 (08 Aug) dummy or external shock is not found to be significant. In case of GARCH (1,1) estimate of the parameter (β) is significant statistically. The results of asymmetric E-GARCH (1,1) explained that estimates of parameter (δ) found not to be statistically significant. The results of T-GARCH (1,1) explained that estimates of parameter (γ) found to be more than zero and statistically significant. It was found that GARCH model tests of diagnosis through AIC, SIC and Residual Tests are appropriately quantified.

Table 13: Sensex Returns GARCH (1,1) Models Analysis 2015 (8 August) International Event

ω	-0.015	0.527	-0.39	0.01	-0.122	0.000
α	0.91	0.000	-0.293	0.382	0.993	0.000
β					0.14	0.003
γ			-0.07	0.52		
D	0.000	0.09				

FINDINGS & DISCUSSIONS OF THE STUDIES

For the equation of variance, the results of ARCH show that it is significant i.e., BSE Sensex earlier day's return affects present day's returns of BSE Sensex volatility for the international day event of 2001 (11 Sept.), 2007 (27 Feb.),2007 (11 Oct.),2008 (16 Sept.,2009 (27 Nov.),2010 (27 April,2015 (12 June). ARCH was not found to be significant in case of global events 2002 (9 Dec.), 2010 (6 May), 2011 (6 May) and 2015 (08 Aug.). GARCH is found to be statistically significant which is an indication that volatility of returns of BSE Sensex (i.e., GARCH) is in a position to impact volatility in the returns series of BSE Sensex in case of international events of 2001 (11 Sept.), 2007 (27 Feb.), 2007 (11 Oct.), 2008 (16 Sept.), 2009 (27 Nov.), 2010 (27 April),2010 (6 May), 2011 (6 May), 2015 (12 June) and 2015 (08 Aug.).Dummy was significant means international event or outside shock could influence BSE Sensex return volatility in case of international events of 2001 (11 Sept.),2007 (11 Oct.), 2008 (16 Sept.), 2009 (27 Nov.). Dummies for other international events were not significant. Asymmetric E GARCH (1,1) model estimates showed that the outcome of leverage was significant statistically with a negative sign in case of international events of 2001. (11 Sept.), 2002 (9 Dec.), 2007 (27 Feb.), 2008 (16 Sept.),2010 (27 April), 2010 6 May), 2011 (6 May). For other international events the E GARCH (1,1) model was not significant. T-GARCH (1,1) outcomes were significant and estimation criterion was more than zero which showed the presence of leverage effect in the model for the international events of 2001 (11 Sept), 2002 (9 Dec.), 2007 (27 Feb.), 2007 (11 Oct.), 2008 (16 Sept.), 2010 (27 April),   2010 (6 May), 2011 (6 May) and 2015 (8 Aug.). For other international events the GARCH model was not significant. The test results were found to be properly stated for all the GARCH models.

SCOPE FOR FUTURE STUDIES

The stock markets are affected by a larger number of crucial events and factors. The present study is restricted to the selective international events. Other crucial events may be covered in the future studies. Various emerging econometric models can be used in the future studies. The data of other stock exchanges can be the part of the future studies.

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