

Contagion And Global Financial Crisis: Impact On The Indian Stock Markets

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ABSTRACT

Global Financial Crisis is one of the worst crisis that the economies met during 2008. During the crisis period there was a severe contagion in the banking sector of the United States later which spread to other economies. During the evolution of the crisis, the developing nations like Indian stock market was also affected to an extent. In this paper the existence of contagion in the BSE Sensex Index and Nifty 50 of India considering Dow Jones Industrial Average Index of the United States as independent variable for the period of 5 years before and 10 years after the collapse of the Lehman Brothers Holdings Inc. was studied. GARCH(1,1) model was used to analyse the presence of contagion in the Indian Stock Market.

Key Words: Contagion, Financial Crisis, Nifty 50, S&P BSE Sensex, Stock Market.

Introduction

A financial fear arose among the international investors during the Global Financial Crisis. As a result many investors withdraw their funds invested in financial instruments to prevent them from further losses. This led to a severe contagion in the financial markets of the economy. There was a drop in the prevalence of liquidity in the financial markets. As a result there was a crunch in the world wide economic activity.

During the period of Global Financial Crisis the developing nations were also affected to a certain extent (Gopinath et al., 2019). The transmission of shock was due to integration of financial markets, economic links, etc. and the degree of transmission depends on the economic policy, financial structure, trade links, capital flows, etc. Developing nations like India was also affected during the Global Financial Crisis and it was able to recover from the bad effects of the crisis within a short span.

In the year 1992, National Stock Exchange was incorporated and in April 1993 it was recognized as stock exchange by SEBI. Nifty 50 is the benchmark index of the National Stock Exchange and it is the weighted average index of 50 companies listed in the National Stock Exchange. It is owned and managed by NSE Indices Limited.

Bombay Stock Exchange is the oldest stock exchange in Asia was established in the year 1875. BSE Sensex is the major index of Bombay Stock Exchange. It is the free float market weighted stock market index (Pavithran et al., 2018).

In this paper the existence of contagion in the Indian markets is analysed using the GARCH(1,1) model based on the US markets for the pre crisis period of 5 years and a post crisis I period of 5 years and post crisis II period of 5 years.

Review of Literature

The research paper titled, “**Impact of Global Financial Crisis on Stock Market Volatility: Evidence from India**” by Sakthivelet al. (2014) has used GRJ GARCH model to analyse the impact of the volatility of the Global financial crisis on the Indian stock markets of National Stock exchange and Bombay Stock Exchange for the period 1st March 2005 to 30th December 2012. The results suggest that there is volatility has increased after the crisis period

The Article titled “**Volatility in Asian Stock Markets and Global Financial Crisis**” by Monica Singhania and Jugal Ancharia(2013) has studied the volatility of the Asian Markets of India, China, Hong Kong and Japan during the period of Sub prime crisis and the Eurozone crisis. The EGARCH model has been used to capture the volatility. The daily returns of the indices of Nifty, Shanghai Composite Index, Hang Seng and Nikkei 225 for the period 2005 to 2011 has been analysed. The results suggest that at the time of sub prime crisis there is impact of volatility on India, China and Japan and there is no signs of impact of volatility on Hong Kong. At the time of European debt crisis there is negative impact of volatility on India and China and there is no impact of volatility on Japan and Hong Kong.

Melissa Mun and Robert Brooks(2011) in their article titled “**The Role of News and Volatility in Stock Market Correlations During the Global Financial Crisis**” has studied the correlation between the stock markets to analyse role of volatility. The analysis has been done on the daily basis returns of the MSCI index of the countries of 17 countries - China, India, Australia, United States, United Kingdom, Argentina, Hungary, Czech Republic, South Korea, Malaysia, Mexico, Poland, Russia, Chile, Brazil, South Africa and Turkey for the period 27th February 2007 to 26th February 2010 to analyse the impact of the announcement of fifteen news. APARCH model has been used to analyse the impact of the volatility. The study concludes that the volatility in the market is the major cause for the change in the correlation during the various phases of the Global Financial Crisis.

The article titled “**The Global Financial Crisis: Causes and Consequences**” by Warwick J. McKibbin and Andrew Stoekel(2010) has analysed the global sub prime crisis as the onset of the shock of the busting of housing bubble, A high rise in the equity risk premium and reappraisal of risk by household and identified the shock using G-cubed model. The analysis has been done on six sectors namely Energy, Agriculture, mining, manufacturing durables, manufacturing non durables and services for 15 countries namely United States, Japan, Euro Area, Canada, United Kingdom, Rest of OECD, China, India, Other Asia, Latin America, Germany, Australia, Other LDC, East Europe and Former Soviet Union and Opec countries. The result suggest that there was competition among the government and the private sectors for the scarcity of fund. There was a increase in the interest rates and decrease in investment and the decrease in the export was not able to get back to normal for several years.

Jose Antonio Ocampo(2009) in his paper titled “**Latin America and the Global Financial Crisis**” has analysed the boom and growth of the Global Financial Crisis on Latin America and the channel of transmission of crisis which include remittances, trade shock, financial shock. The results suggest that Latin America has been hit hard during the Global Financial Crisis.

Rajni Mala and Mahendra Reddy(2007) in the article titled “**Measuring Stock Market Volatility in an Emerging Economy**” has used ARCH and GARCH models to identify the existence of volatility on Fiji's stock market. The study has been conducted for the period 2001 to 2005 and sixteen firms were analysed and the results suggest that seven firms are volatile.

Statement of the Problem

Due to the arise of shock in the financial markets, the investors will shift to other markets where there is no shock or contagion to protect themselves from future losses. As a result of shock the market is highly volatile. Volatility is the major factor considered by the investors. As volatility and risk are directly correlated the investors has to make an analysis on impact of contagion on financial markets during the period of crisis

Need of the study

The impact of the sub prime crisis was very worse. The financial disturbances affects the financial markets in the economy to a greater extent. Many researchers has used many techniques to identify the contagion arose because of the Global Financial crisis to make efficient financial investment decision.

Objectives of the Study

The following are the objectives of the study

1. To test the normality on the stock returns of the United States and India during the pre and post period of the Global Financial Crisis.
2. To test the stationarity on the stock returns of the United States and India during the pre and post period of the Global Financial Crisis.
3. To test the existence of contagion on the stock returns of India before and after the Global Financial Crisis.

Hypothesis of the Study

The study tests the following hypothesis.

1. NH1: There is no normality on the stock returns of the United States and India during the pre and post period of the Global Financial Crisis.
2. NH2: There is no stationarity on the stock returns of the United States and India during the pre and post period of the Global Financial Crisis.
3. NH3: There is no existence of contagion on the stock returns of India before and after the Global Financial Crisis.

Selection of Sample

S&P BSE SENSEX of Bombay Stock Exchange and Nifty 50 of National Stock Exchange are selected as the independent variable and the Dow Jones Industrial Average of United States is considered as dependent variable.

Table 1 List of the Developed Asian Countries and the Indices of the Stock Exchange Used in the Study

S.No	Name of the Country	Name of the Stock Exchange	Name of the Index
1	India	Bombay Stock Exchange	S&P BSE Sensex
		National Stock Exchange	Nifty 50
2	United States	New York Stock Exchange	Dow Jones Industrial Average

Collection of the Data

The study was based on the secondary data. The daily closing prices of the indices of the stock markets of India are collected from www.bseindia.com and www.nseindia.com and the Dow Jones Industrial Average is collected from Bloomberg database.

Period of the Study

The impact of contagion before and after the bankruptcy of the Lehman Brothers Holdings Inc. on Indian stock markets is studied in this paper. The study has used the daily returns of BSE SENSEX and Nifty 50 indices of the Bombay Stock Exchange and National Stock Exchange for the period 15th September 2003 to 16th September 2018. The period of the study is divided as follows

Table – 2 The List of the Details of the Periods covered in the study

Particulars	Period
Entire Sample Period	15 th September 2003 to 15 th September 2018
Before the Crisis	15 th September 2003 to 14 th September 2008
After the Crisis Period I	16 th September 2008 to 15 th September 2013
After the Crisis Period II	16 th September 2013 to 15 th September 2018

Tools Used for Analysis

1. Descriptive Statistics
2. Augmented Dickey Fuller Test (ADF)
3. GARCH(1,1)

Limitations of the Study

The study suffers from the following limitations.

1. The study is limited to the influence of the collapse of the Lehman Brothers Holdings Inc.
2. The study is limited to Indian markets.
3. The study is limited to a period of 15 years.

Data Analysis and Interpretation

Table-3 Results of Descriptive Statistics of Daily Returns of the Indices of India and the United States due to the Collapse of the Lehman Brothers Holdings Inc during the period 15th September 2003 to 15th September 2018

Period	Indices	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Probability	Observations
Before Crisis	S&P BSE Sensex	0.0011	0.0018	0.0825	-0.1114	0.0163	-0.4255	7.0256	885.9708	0	1256
	Nifty 50	0.0010	0.0018	0.0830	-0.1224	0.0168	-0.5858	7.7816	1268.3750	0	1256
	Dow Jones Industrial Average	0.0002	0.0004	0.0355	-0.0329	0.0083	-0.1619	4.8120	177.7351	0	1259
After	S&P BSE	0.00	0.000	0.1734	-0.1096	0.016	0.7683	16.5872	9660.35	0	1240

Crisis Period I	Sensex	04	6			4			40		
	Nifty 50	0.0004	0.0005	0.1774	-0.1220	0.0163	0.6992	18.1565	11969.9500	0	1240
	Dow Jones Industrial Average	0.0003	0.0005	0.1108	-0.0787	0.0144	0.2083	12.5627	4802.3340	0	1258
After Crisis Period II	S&P BSE Sensex	0.0006	0.0006	0.0343	-0.0594	0.0083	-0.3442	5.9775	480.9900	0	1236
	Nifty 50	0.0006	0.0006	0.0366	-0.0591	0.0085	-0.3277	5.8788	448.9290	0	1236
	Dow Jones Industrial Average	0.0005	0.0006	0.0395	-0.0460	0.0078	-0.5166	6.5232	707.7176	0	1260

Source : Data has been collected from www.bseindia.com and www.nseindia.com and Bloomberg database and computed using e-views

Table 3 discloses the results of the Descriptive Statistics of Daily Returns of the Indices of India and the United States due to the Collapse of the Lehman Brothers Holdings Inc during the period 15th September 2003 to 15th September 2018. During the pre crisis period S&P BSE Sensex has recorded a mean of 0.0011, standard deviation of 0.0163, Nifty 50 has recorded a mean of 0.0010 and standard deviation of 0.0168 and Dow Jones Industrial average has recorded a mean of 0.0002 and standard deviation of 0.0083. The skewness value is negative and the kurtosis value is greater than 3 which shows that the returns are leptokurtic. During after the crisis period I S&P BSE Sensex has recorded a mean of 0.0004 and standard deviation of 0.0164, Nifty 50 has recorded a mean of 0.0004 and standard deviation of 0.0163 and Dow Jones Industrial average has recorded a mean of 0.0003 and a standard deviation of 0.0144. The skewness value is positive and the kurtosis value is greater than 3 which shows that the returns are leptokurtic. During After the crisis period II S&P BSE Sensex has recorded a mean of 0.0006 and standard deviation of 0.0083, Nifty 50 has recorded a mean of 0.0006 and standard deviation of 0.0085 and Dow Jones Industrial average has recorded a mean of 0.0005 and a standard deviation of 0.0078. The skewness value is negative and the kurtosis value is greater than 3 which shows that the returns are leptokurtic. The value of Jarque Berastatistics is greater than 5 and the probability value is less than 0.05. Therefore the null hypothesis of “**There is no normality on the stock returns of the United States and India during the pre and post period of the Global Financial Crisis**” is accepted.

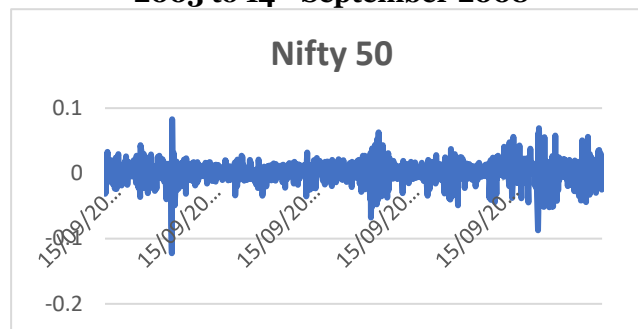
Table-4 Results of Augmented Dickey-Fuller test of Daily Returns of the Indices of India and the United States due to the Collapse of the Lehman Brothers Holdings Inc during the period 15th September 2003 to 15th September 2018

Period	Indices	ADF Value	1% level	5% level	10% level	Prob.
Before Crisis	S&P BSE Sensex	-33.6884	-3.4353	-2.8636	-2.5679	0
	Nifty 50	-33.7172	-3.4353	-2.8636	-2.5679	0
	Dow Jones Industrial Average	-38.8245	-3.4353	-2.8636	-2.5679	0
After Crisis Period I	S&P BSE Sensex	-32.4218	-3.4354	-2.8637	-2.5680	0
	Nifty 50	-32.7684	-3.4354	-2.8637	-2.5680	0
	Dow Jones Industrial Average	-32.7684	-3.4354	-2.8637	-2.5680	0
After Crisis Period II	S&P BSE Sensex	-32.1592	-3.4354	-2.8637	-2.5680	0
	Nifty 50	-32.1426	-3.4354	-2.8637	-2.5680	0
	Dow Jones Industrial Average	-36.5036	-3.4353	-2.8636	-2.5679	0

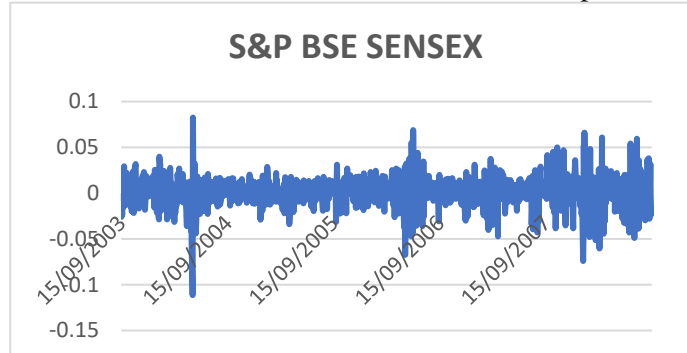
Source : Data has been collected from www.bseindia.com and www.nseindia.com and Bloomberg database and computed using e-views

The results of **Table-4** discloses that the ADF value is less than the test critical values and the accompanying probability value is less than 0.05. So the null hypothesis of “**There is no stationarity on the stock returns of the United States and India during the pre and post period of the Global Financial Crisis**” is rejected.

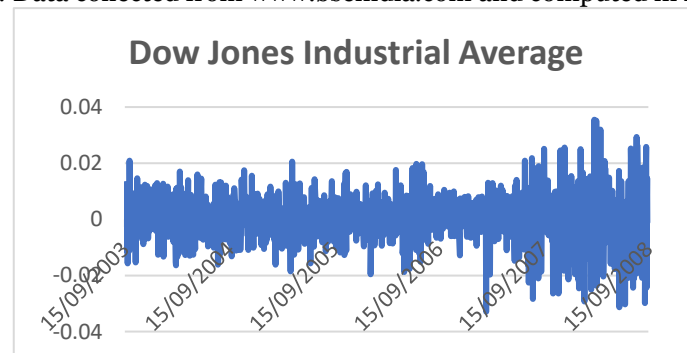
Chart – 1 The Line Chart of the Daily Returns of the Indices of India and the United States before the Collapse of the Lehman Brothers Holdings Inc during the period 15th September 2003 to 14th September 2008



Source: Data collected from www.nseindia.com and computed in MS Excel



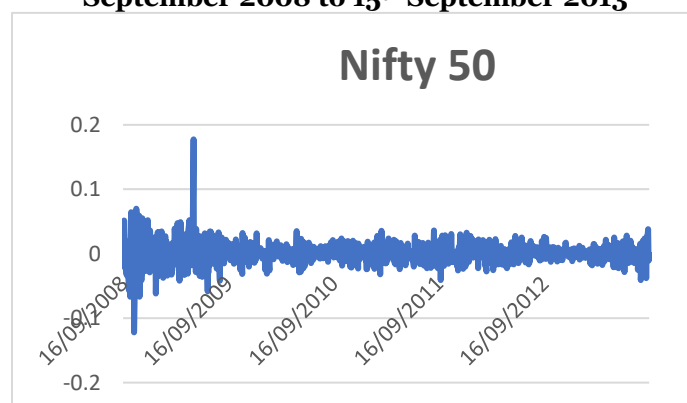
Source: Data collected from www.bseindia.com and computed in MS Excel



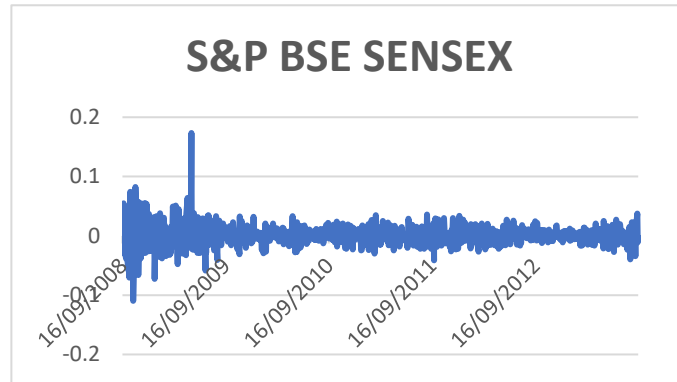
Source: Data collected from Bloomberg database and computed in MS Excel

The above **Chart-1** discloses the Daily Returns of the Indices of India and the United States before the Collapse of the Lehman Brothers Holdings Inc during the period 15th September 2003 to 14th September 2008. This shows the existence of time trend in the return series. It exhibits the features of time varying variance and clustering. **As it shows heteroscedasticity and clustering, GARCH model can be used.**

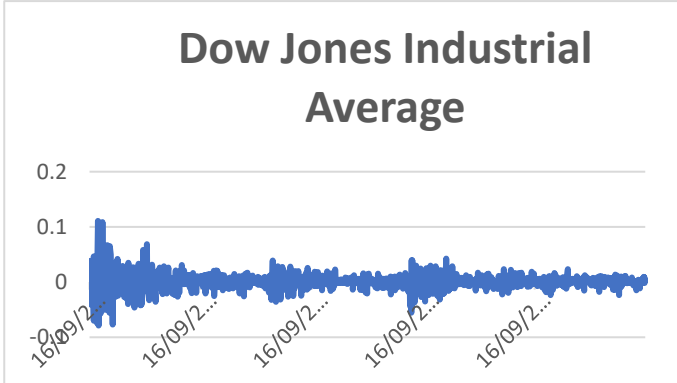
Chart – 2 The Line Chart of the Daily Returns of the Indices of India and the United States after the Collapse of the Lehman Brothers Holdings Inc during the period from 16th September 2008 to 15th September 2013



Source: Data collected from www.nseindia.com and computed in MS Excel



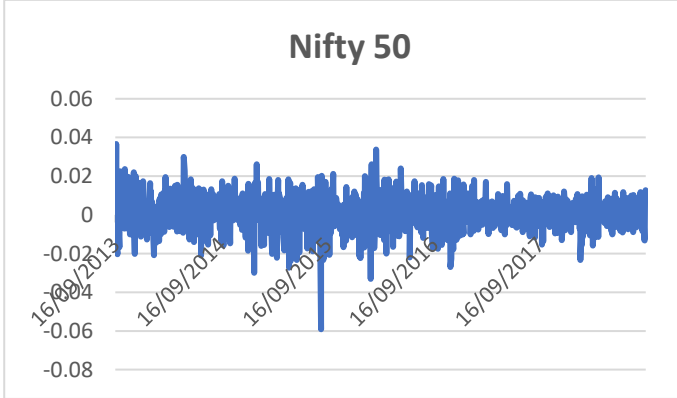
Source: Data collected from www.bseindia.com and computed in MS Excel



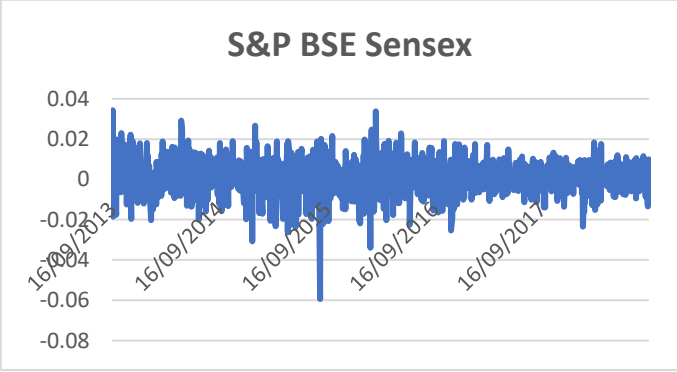
Source: Data collected from Bloomberg database and computed in MS Excel

The above **Chart-2** discloses the Daily Returns of the Indices of India and the United States after the Collapse of the Lehman Brothers Holdings Inc during the period from 16th September 2008 to 15th September 2013. This shows the existence of time trend in the return series. It exhibits the features of time varying variance and clustering. **As it shows heteroscedasticity and clustering, GARCH model can be used.**

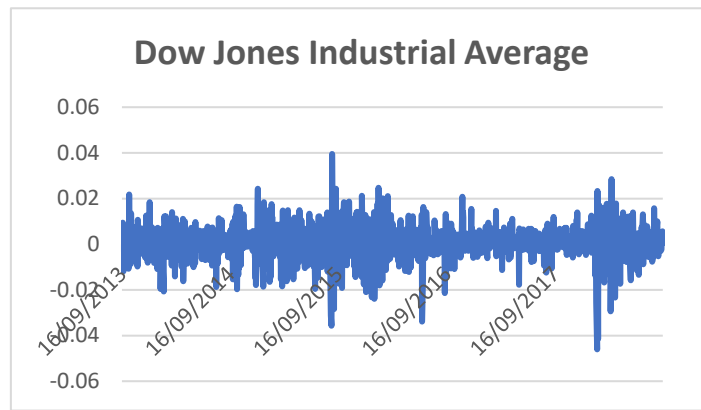
Chart – 3 The Line Chart of the Daily Returns of the Indices of India and the United States after the Collapse of the Lehman Brothers Holdings Inc during the period from 16th September 2013 to 15th September 2018



Source: Data collected from www.nseindia.com and computed in MS Excel



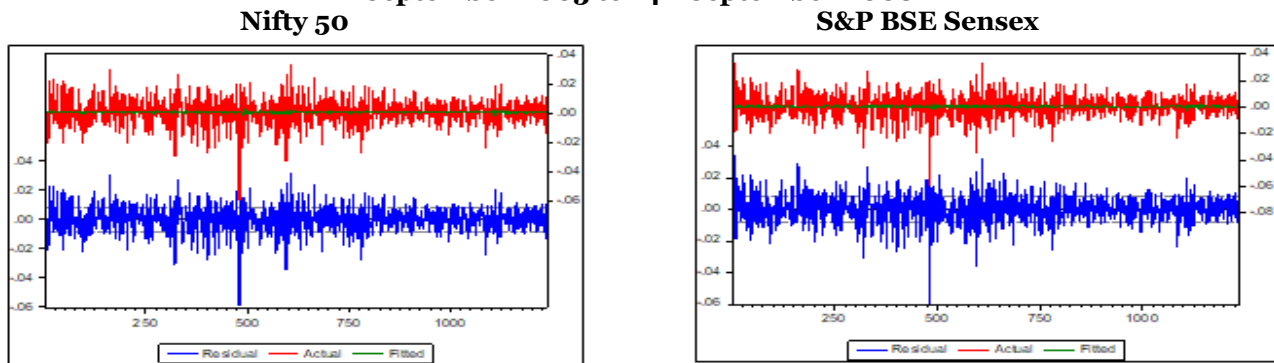
Source: Data collected from www.bseindia.com and computed in MS Excel



Source: Data collected from Bloomberg database and computed in MS Excel

The above **Chart-3** discloses the Daily Returns of the Indices of India and the United States after the Collapse of the Lehman Brothers Holdings Inc during the period from 16th September 2013 to 15th September 2018. This shows the existence of time trend in the return series. It exhibits the features of time varying variance and clustering. **As it shows heteroscedasticity and clustering, GARCH model can be used.**

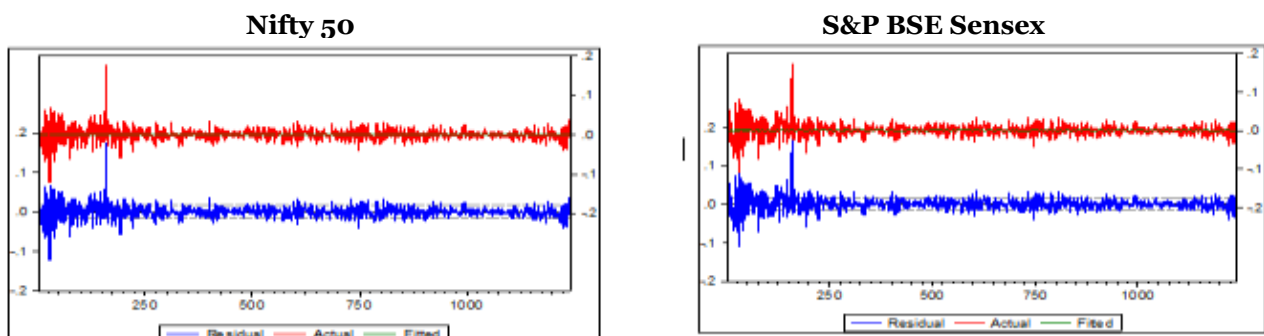
Chart-4 The Line Chart of the Residuals of the Daily return of the Indices of India and the United States before the Collapse of the Lehman Brothers Holdings Inc during the period 15th September 2003 to 14th September 2008



Source : Data has been collected from www.bseindia.com and www.nseindia.com and Bloomberg database and computed using e-views

In the Chart-4 the Residuals of the Daily return of the Indices of India and the United States before the Collapse of the Lehman Brothers Holdings Inc during the period 15th September 2003 to 14th September 2008 with S&P BSE Sensex and Nifty 50 as dependent variable and Dow Jones Industrial Average Index as independent variable. The chart shows the prolonged period of low volatility and high volatility. The period of low volatility are followed by periods of low volatility and the periods of high volatility are followed by periods of high volatility. This suggest that residual or error term is conditionally heteroscedastic and ARCH and GARCH terms can be used.

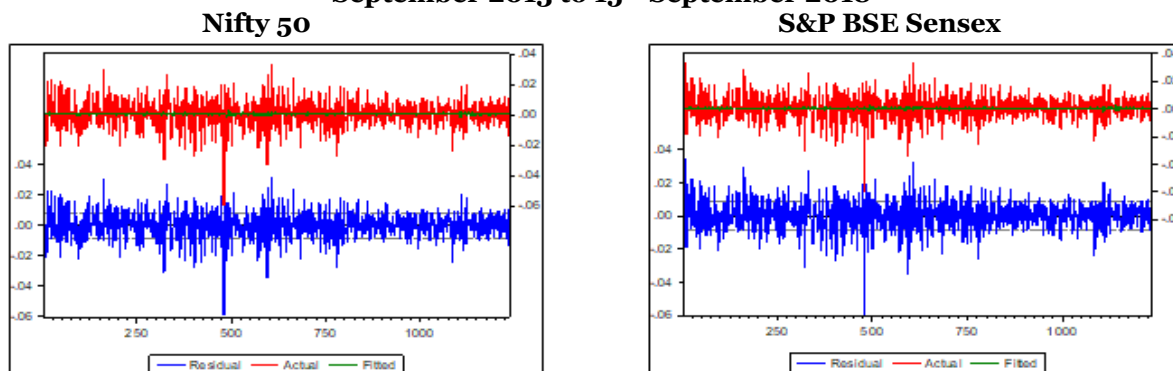
Chart-5 The Line Chart of the Residuals of the Daily return of the Indices of India and the United States after the Collapse of the Lehman Brothers Holdings Inc during the period 16th September 2008 to 15th September 2013



Source : Data has been collected from www.bseindia.com and www.nseindia.com and Bloomberg database and computed using e-views

Chart-5 shows the Residuals of the Daily return of the Indices of India and the United States after the Collapse of the Lehman Brothers Holdings Inc during the period 16th September 2008 to 15th September 2013 with S&P BSE Sensex and Nifty 50 as dependent variable and Dow Jones Industrial Average Index as independent variable. The chart shows the prolonged period of low volatility and high volatility. The period of low volatility are followed by periods of low volatility and the periods of high volatility are followed by periods of high volatility. This suggest that residual or error term is conditionally heteroscedastic and ARCH and GARCH terms can be used.

Chart-6 The Line Chart of the Residuals of the Daily returns of the Indices of India and the United States after the Collapse of the Lehman Brothers Holdings Inc during the period 16th September 2013 to 15th September 2018



Source : Data has been collected from www.bseindia.com and www.nseindia.com and Bloomberg database and computed using e-views

Chart-6 depicts the results of the Residuals of the Daily returns of the Indices of India and the United States after the Collapse of the Lehman Brothers Holdings Inc during the period 16th September 2013 to 15th September 2018 with S&P BSE Sensex and Nifty 50 as dependent variable and Dow Jones Industrial Average Index as independent variable. The chart shows the prolonged period of low volatility and high volatility. The period of low volatility are followed by periods of low volatility and the periods of high volatility are followed by periods of high volatility. This suggest that residual or error term is conditionally heteroscedastic and ARCH and GARCH terms can be used.

Table – 5 Results of Autocorrelation and Partial Auto Correlation of the Daily returns of the Indices of India and the United States before the Collapse of the Lehman Brothers Holdings Inc during the period 15th September 2003 to 14th September 2008

Lags	Nifty 50				S&P BSE Sensex			
	AC	PAC	Q-Stat	Prob*	AC	PAC	Q-Stat	Prob*
1	0.021	0.021	0.5794	0.447	0.01	0.01	0.1285	0.72
2	-0.009	-0.009	0.6789	0.712	-0.01	-0.01	0.257	0.879
3	0.046	0.046	3.2983	0.348	0.051	0.051	3.5162	0.319
4	0.049	0.047	6.3234	0.176	0.053	0.052	7.0664	0.132
5	-0.013	-0.014	6.532	0.258	-0.009	-0.009	7.1711	0.208
6	-0.028	-0.028	7.5036	0.277	-0.019	-0.021	7.6332	0.266
7	-0.034	-0.038	8.9725	0.255	-0.039	-0.045	9.5963	0.213
8	-0.03	-0.031	10.149	0.255	-0.035	-0.037	11.147	0.193
9	-0.019	-0.015	10.605	0.304	0.001	0.004	11.148	0.266
10	0.025	0.031	11.407	0.327	0.029	0.035	12.19	0.273
11	-0.046	-0.042	14.142	0.225	-0.057	-0.05	16.315	0.13
12	-0.038	-0.034	16.007	0.191	-0.024	-0.02	17.023	0.149
13	0.082	0.08	24.612	0.026	0.064	0.059	22.273	0.051
14	0.014	0.008	24.862	0.036	0.015	0.013	22.544	0.068
15	0	0.006	24.862	0.052	-0.005	0.001	22.579	0.094
16	0.002	-0.003	24.869	0.072	0.01	0.005	22.697	0.122
17	-0.022	-0.034	25.478	0.085	-0.017	-0.025	23.048	0.148
18	-0.008	-0.011	25.568	0.11	-0.013	-0.016	23.254	0.181

19	0.036	0.038	27.266	0.099	0.035	0.032	24.819	0.167
20	-0.006	-0.003	27.308	0.127	-0.003	0.001	24.833	0.208
21	-0.007	0.004	27.364	0.159	-0.006	0.007	24.872	0.253
22	0.03	0.031	28.494	0.16	0.03	0.028	26.016	0.251
23	0.068	0.056	34.463	0.059	0.071	0.062	32.476	0.091
24	0	0.003	34.463	0.077	0.001	0.004	32.477	0.116
25	-0.032	-0.028	35.771	0.075	-0.028	-0.028	33.503	0.119
26	-0.027	-0.041	36.72	0.079	-0.024	-0.036	34.215	0.13
27	0.005	0	36.748	0.1	0.007	0.002	34.283	0.158
28	-0.056	-0.054	40.792	0.056	-0.057	-0.055	38.483	0.09
29	-0.011	-0.003	40.952	0.07	-0.021	-0.015	39.072	0.1
30	0.026	0.042	41.796	0.075	0.043	0.059	41.411	0.08
31	0.003	0.014	41.81	0.093	0.012	0.024	41.584	0.097
32	-0.024	-0.027	42.55	0.101	-0.018	-0.018	41.982	0.111
33	0.006	0	42.591	0.122	-0.012	-0.021	42.167	0.132
34	0.012	0.009	42.788	0.143	0.016	0.013	42.502	0.15
35	-0.011	-0.015	42.945	0.167	-0.013	-0.019	42.706	0.174
36	-0.034	-0.044	44.426	0.158	-0.035	-0.045	44.278	0.162

Source : Data has been collected from www.bseindia.com and www.nseindia.com and Bloomberg database and computed using e-views

Table-5 shows Autocorrelation and Partial Auto Correlation of the Daily returns of the Indices of India and the United States before the Collapse of the Lehman Brothers Holdings Inc during the period 15th September 2003 to 14th September 2008. The probability value is greater than 0.05 and so there is no existence of serial correlation in the residuals during the study period.

Table – 6 Results of Autocorrelation and Partial Auto Correlation of the Daily returns of the Indices of India and the United States after the Collapse of the Lehman Brothers Holdings Inc during the period 16th September 2008 to 15th September 2013

Lags	Nifty 50				S&P BSE Sensex			
	AC	PAC	Q-Stat	Prob*	AC	PAC	Q-Stat	Prob*
1	-0.034	-0.034	1.4342	0.231	-0.035	-0.035	1.4993	0.221
2	-0.024	-0.025	2.1323	0.344	-0.026	-0.028	2.3683	0.306
3	-0.005	-0.006	2.161	0.54	-0.004	-0.006	2.3849	0.496
4	0.018	0.017	2.5739	0.631	0.027	0.026	3.313	0.507
5	-0.012	-0.011	2.7394	0.74	-0.021	-0.019	3.8442	0.572
6	0.01	0.01	2.8537	0.827	0.018	0.018	4.2418	0.644
7	0.008	0.008	2.9314	0.891	0.008	0.009	4.3293	0.741
8	-0.008	-0.008	3.0138	0.933	-0.005	-0.005	4.3654	0.823
9	-0.01	-0.01	3.1485	0.958	-0.01	-0.008	4.4816	0.877
10	0.038	0.037	4.9806	0.892	0.054	0.052	8.1875	0.611
11	-0.006	-0.004	5.0272	0.93	-0.006	-0.002	8.2275	0.693
12	0.002	0.004	5.0342	0.957	0.005	0.007	8.2534	0.765
13	-0.013	-0.013	5.2597	0.969	-0.02	-0.019	8.75	0.792
14	-0.007	-0.009	5.3133	0.981	-0.006	-0.01	8.7932	0.844
15	0	0.001	5.3135	0.989	-0.005	-0.004	8.8272	0.886
16	-0.003	-0.005	5.3269	0.994	0.004	0.001	8.8437	0.92
17	-0.02	-0.021	5.8479	0.994	-0.018	-0.017	9.2319	0.933
18	-0.003	-0.004	5.8599	0.997	0.002	0.001	9.2394	0.954
19	-0.019	-0.019	6.3014	0.997	-0.016	-0.015	9.5439	0.963
20	0.008	0.006	6.386	0.998	0.003	-0.001	9.556	0.976

21	0.007	0.007	6.4467	0.999	0.01	0.011	9.6861	0.983
22	-0.004	-0.004	6.4667	0.999	-0.009	-0.01	9.7908	0.988
23	-0.023	-0.022	7.1641	0.999	-0.033	-0.03	11.164	0.981
24	0.002	0.001	7.1696	1	-0.001	-0.003	11.166	0.988
25	-0.029	-0.03	8.2099	0.999	-0.035	-0.037	12.754	0.979
26	0.021	0.019	8.7469	0.999	0.011	0.008	12.896	0.985
27	-0.024	-0.023	9.4831	0.999	-0.029	-0.028	13.93	0.982
28	-0.004	-0.006	9.5065	1	-0.002	-0.005	13.933	0.988
29	0.017	0.019	9.868	1	0.016	0.019	14.257	0.99
30	-0.033	-0.035	11.238	0.999	-0.032	-0.034	15.582	0.986
31	0.008	0.007	11.323	1	0	0	15.582	0.99
32	-0.006	-0.008	11.373	1	-0.001	-0.003	15.583	0.993
33	-0.006	-0.007	11.425	1	-0.008	-0.007	15.674	0.995
34	0.031	0.032	12.666	1	0.027	0.029	16.611	0.995
35	0.044	0.047	15.113	0.999	0.047	0.052	19.491	0.984
36	-0.009	-0.007	15.207	0.999	-0.004	-0.002	19.517	0.989

Source : Data has been collected from www.bseindia.com and www.nseindia.com and Bloomberg database and computed using e-views

Table-6 shows Autocorrelation and Partial Auto Correlation of the Daily returns of the Indices of India and the United States after the Collapse of the Lehman Brothers Holdings Inc during the period 16th September 2008 to 15th September 2013. The probability value is greater than 0.05 and so there is no existence of serial correlation in the residuals during the study period.

Table – 7 Results of Autocorrelation and Partial Auto Correlation of the Daily returns of the Indices of India and the United States after the Collapse of the Lehman Brothers Holdings Inc during the period 16th September 2013 to 15th September 2018

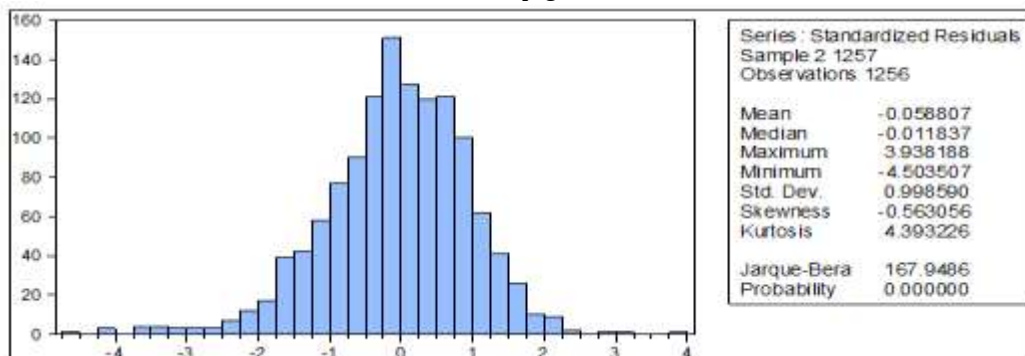
Lags	Nifty 50				S&P BSE Sensex			
	AC	PAC	Q-Stat	Prob*	AC	PAC	Q-Stat	Prob*
1	-0.014	-0.014	0.2267	0.634	-0.01	-0.01	0.1276	0.721
2	0.039	0.038	2.0748	0.354	0.031	0.031	1.2951	0.523
3	-0.003	-0.002	2.0896	0.554	0.002	0.002	1.298	0.73
4	-0.016	-0.017	2.395	0.664	-0.016	-0.017	1.6304	0.803
5	-0.016	-0.016	2.7082	0.745	-0.017	-0.017	1.977	0.852
6	0.046	0.047	5.2958	0.506	0.042	0.043	4.1687	0.654
7	-0.012	-0.01	5.4846	0.601	-0.013	-0.011	4.379	0.735
8	-0.01	-0.014	5.608	0.691	-0.013	-0.016	4.5738	0.802
9	0.018	0.018	6.0028	0.74	0.022	0.022	5.1678	0.819
10	-0.005	-0.002	6.0312	0.813	-0.001	0.002	5.1687	0.88
11	-0.016	-0.017	6.3701	0.848	-0.01	-0.01	5.2901	0.916
12	-0.024	-0.027	7.0888	0.852	-0.026	-0.029	6.1258	0.91
13	0.013	0.015	7.308	0.886	0.02	0.022	6.6379	0.92
14	0.014	0.018	7.5584	0.911	0.024	0.028	7.3611	0.92
15	-0.015	-0.018	7.826	0.931	-0.009	-0.012	7.4522	0.944
16	-0.01	-0.013	7.9548	0.95	-0.004	-0.007	7.4749	0.963
17	-0.019	-0.016	8.3909	0.957	-0.019	-0.017	7.9373	0.968
18	-0.007	-0.004	8.458	0.971	-0.006	-0.002	7.9784	0.979
19	0.003	0.002	8.4712	0.981	-0.002	-0.003	7.983	0.987
20	0.059	0.057	12.804	0.886	0.064	0.062	13.064	0.875
21	-0.005	-0.002	12.837	0.914	-0.001	0.003	13.065	0.906
22	-0.018	-0.024	13.266	0.925	-0.025	-0.03	13.829	0.907

23	-0.005	-0.005	13.298	0.945	-0.004	-0.006	13.853	0.931
24	-0.015	-0.01	13.57	0.956	-0.008	-0.004	13.934	0.948
25	-0.005	-0.003	13.606	0.968	-0.006	-0.002	13.973	0.962
26	-0.003	-0.008	13.619	0.978	-0.008	-0.013	14.05	0.972
27	0.048	0.048	16.501	0.943	0.049	0.049	17.134	0.928
28	-0.015	-0.012	16.788	0.953	-0.012	-0.008	17.32	0.942
29	0.005	-0.003	16.814	0.965	-0.003	-0.011	17.33	0.957
30	-0.018	-0.016	17.244	0.97	-0.015	-0.015	17.621	0.964
31	-0.014	-0.01	17.5	0.975	-0.01	-0.005	17.758	0.973
32	-0.008	-0.004	17.581	0.982	-0.007	-0.001	17.827	0.98
33	0.014	0.007	17.825	0.986	0.005	-0.003	17.856	0.985
34	-0.019	-0.02	18.284	0.987	-0.017	-0.021	18.241	0.988
35	-0.031	-0.031	19.521	0.984	-0.031	-0.029	19.498	0.984
36	-0.008	-0.008	19.605	0.988	-0.02	-0.019	19.989	0.986

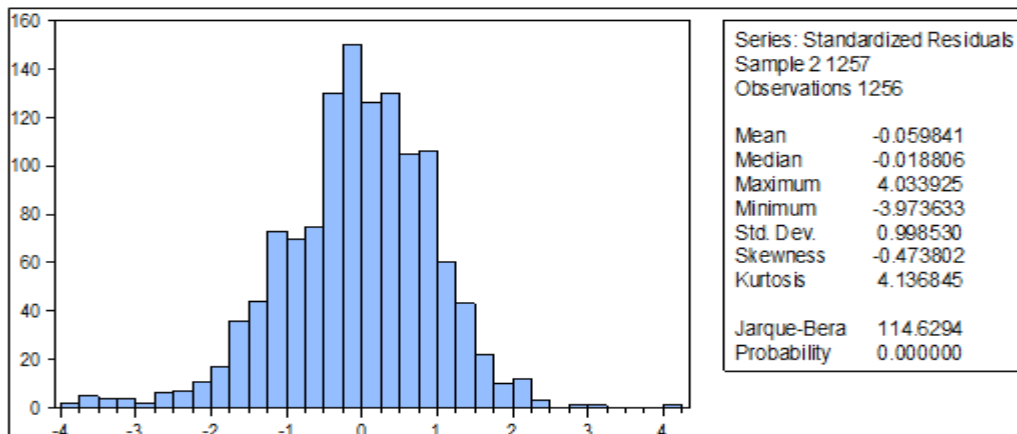
Source : Data has been collected from www.bseindia.com and www.nseindia.com and Bloomberg database and computed using e-views

Table-7 shows Autocorrelation and Partial Auto Correlation of the Daily returns of the Indices of India and the United States after the Collapse of the Lehman Brothers Holdings Inc during the period 16th September 2013 to 15th September 2018. The probability value is greater than 0.05 and so there is no existence of serial correlation in the residuals during the study period.

Figure-1 Results of the Standardised Residuals of the Daily returns of the Indices of India and the United States before the Collapse of the Lehman Brothers Holdings Inc during the period 15th September 2003 to 14th September 2008 Nifty 50



S&P BSE Sensex

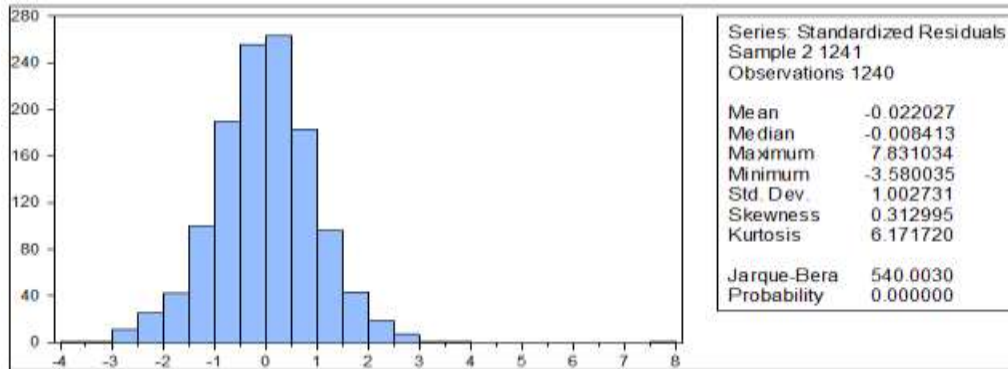


Source : Data has been collected from www.bseindia.com and www.nseindia.com and Bloomberg database and computed using e-views

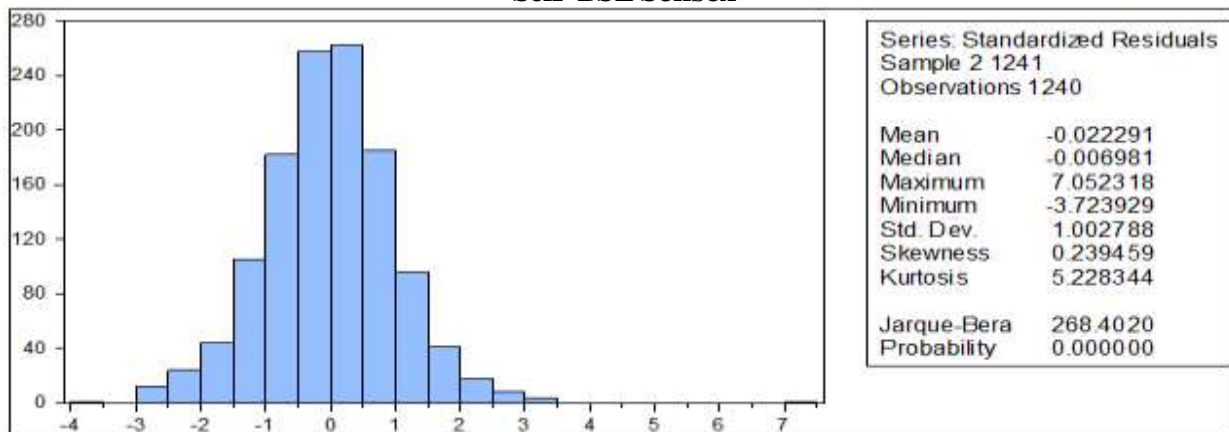
The above **Figure-1** shows the results of the Standardised Residuals of the Daily returns of the Indices of India and the United States before the Collapse of the Lehman Brothers Holdings Inc during the period 15th

September 2003 to 14th September 2008. The Jarque-Bera probability value is 0 which shows that there is no normality on the residuals.

Figure-2 Results of the Standardised Residuals of the Daily returns of the Indices of India and the United States after the Collapse of the Lehman Brothers Holdings Inc during the period 16th September 2008 to 15th September 2013
Nifty 50



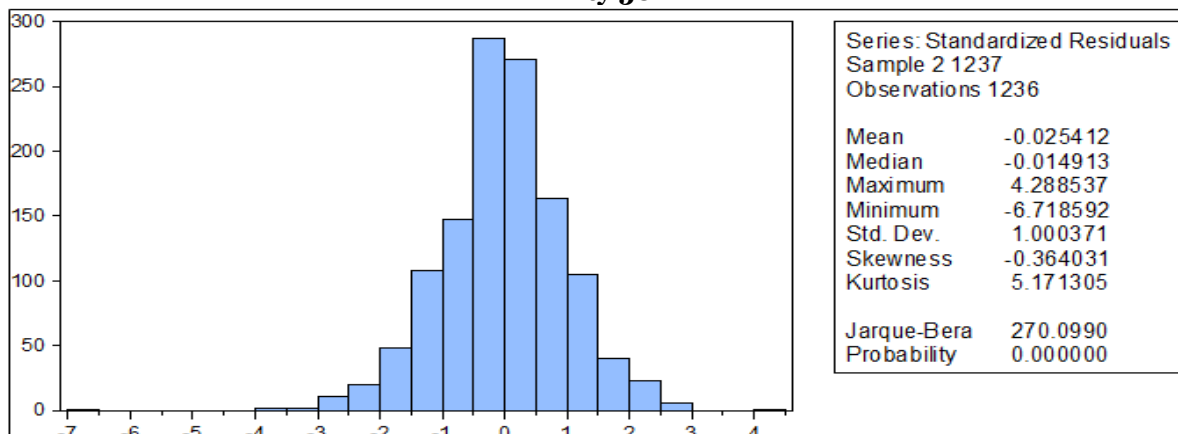
S&P BSE Sensex

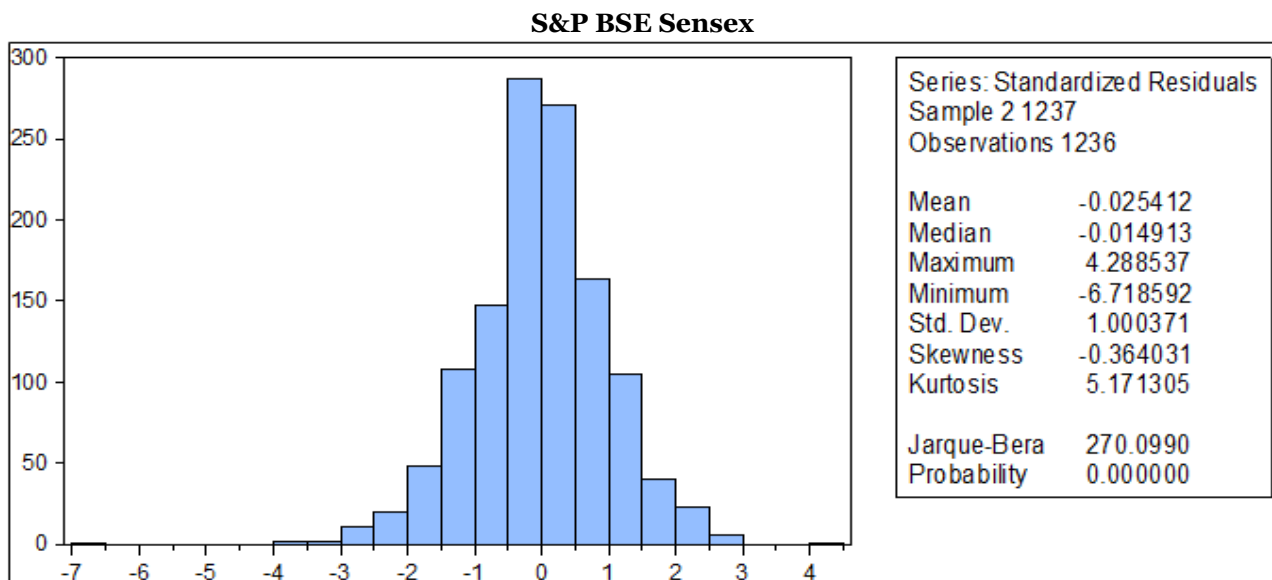


Source : Data has been collected from www.bseindia.com and www.nseindia.com and Bloomberg database and computed using e-views

The above **Figure-2** shows the results of the Standardised Residuals of the Daily returns of the Indices of India and the United States after the Collapse of the Lehman Brothers Holdings Inc during the period 16th September 2008 to 15th September 2013. The Jarque-Bera probability value is 0 which shows that there is no normality on the residuals.

Figure-3 Results of the Standardised Residuals of the Daily returns of the Indices of India and the United States after the Collapse of the Lehman Brothers Holdings Inc during the period 16th September 2013 to 15th September 2018
Nifty 50





Source : Data has been collected from www.bseindia.com and www.nseindia.com and Bloomberg database and computed using e-views

The above **Figure-3** shows the results of the Standardised Residuals of the Daily returns of the Indices of India and the United States after the Collapse of the Lehman Brothers Holdings Inc during the period 16th September 2008 to 15th September 2013. The Jarque-Bera probability value is 0 which shows that there is no normality on the residuals.

Table-8 Results of ARCH LM test of the Daily Returns of the Indices of India and the United States due to the Collapse of the Lehman Brothers Holdings Inc during the period 15th September 2003 to 15th September 2018

Period	Indices	Particulars			
Before Crisis	Nifty 50	Heteroskedasticity Test: ARCH			
		F-statistic	0.5770	Prob. F(1,1253)	0.4476
		Obs R-squared	0.5777	Prob. Chi-Square	0.4472
	S&P BSE Sensex	Heteroskedasticity Test: ARCH			
		F-statistic	0.1279	Prob. F(1,1253)	0.7207
		Obs R-squared	0.1281	Prob. Chi-Square	0.7204
After Crisis Period I	Nifty 50	Heteroskedasticity Test: ARCH			
		F-statistic	1.4294	Prob. F(1,1237)	0.2321
		Obs R-squared	1.4301	Prob. Chi-Square	0.2318
	S&P BSE Sensex	Heteroskedasticity Test: ARCH			
		F-statistic	1.4944	Prob. F(1,1237)	0.2218
		ObsR-squared	1.4951	Prob. Chi-Square	0.2214
After Crisis Period II	Nifty 50	Heteroskedasticity Test: ARCH			
		F-statistic	0.2258	Prob. F(1,1233)	0.6348
		ObsR-squared	0.2261	Prob. Chi-Square	0.6344
	S&P BSE Sensex	Heteroskedasticity Test: ARCH			
		F-statistic	0.1270	Prob. F(1,1233)	0.7216
		ObsR-squared	0.1272	Prob. Chi-Square	0.7214

Source : Data has been collected from www.bseindia.com and www.nseindia.com and Bloomberg database and computed using e-views

The results of **Table-8** discloses the ARCH LM test of the Daily Returns of the Indices of India and the United States due to the Collapse of the Lehman Brothers Holdings Inc during the period 15th September 2003 to 15th September 2018. The p value is more than 0.05 which shows there is no ARCH effect.

Table-9 Results of GARCH(1,1) Model of the Daily Returns of the Indices of India and the United States due to the Collapse of the Lehman Brothers Holdings Inc during the period 15th September 2003 to 15th September 2018

Period	Indices	ARCH (α)	Prob. Value of α	GARCH (β)	Prob. Value of β	(α) + (β)
Before Crisis	Nifty 50	0.1751	0	0.7901	0	0.9652
	S&P BSE Sensex	0.1644	0	0.8010	0	0.9654
After Crisis Period I	Nifty 50	0.0724	0	0.9255	0	0.9979
	S&P BSE Sensex	0.0684	0	0.9275	0	0.9959
After Crisis Period II	Nifty 50	0.0432	0	0.9400	0	0.9831
	S&P BSE Sensex	0.0362	0	0.9514	0	0.9876

Source : Data has been collected from www.bseindia.com and www.nseindia.com and Bloomberg database and computed using e-views

Table-9 shows the results of the GARCH(1,1) Model of the Daily Returns of the Indices of India and the United States due to the Collapse of the Lehman Brothers Holdings Inc during the period 15th September 2003 to 15th September 2018. The sum of the ARCH and GARCH parameters are very close to 1. This shows the existence of high volatility. Under this distribution the probability of ARCH parameter denoted as α and GARCH parameter denoted as β is 0. Which shows that the ARCH and GARCH parameters are significant. Therefore the null hypothesis of “**There is no existence of contagion on the stock returns of India before and after the Global Financial Crisis**” is rejected.

Findings of the Study

The following are the findings of the study

- During the pre crisis period S&P BSE Sensex has recorded a average of 0.0011, standard deviation of 0.0163, Nifty 50 has recorded a mean of 0.0010 and standard deviation of 0.0168 and Dow Jones Industrial average has recorded a mean of 0.0002 and standard deviation of 0.0083.
- During after the crisis period I S&P BSE Sensex has recorded a mean of 0.0004 and standard deviation of 0.0164, Nifty 50 has recorded a mean of 0.0004 and standard deviation of 0.0163 and Dow Jones Industrial average has recorded a mean of 0.0003 and a standard deviation of 0.0144.
- During After the crisis period II S&P BSE Sensex has recorded a mean of 0.0006 and standard deviation of 0.0083, Nifty 50 has recorded a mean of 0.0006 and standard deviation of 0.0085 and Dow Jones Industrial average has recorded a mean of 0.0005 and a standard deviation of 0.0078.
- There is no normality on the stock returns of the United States and India during the pre and post crisis period of Global Financial Crisis.
- There is stationarity on the stock returns of the United States and India during the pre and post crisis period of Global Financial Crisis.
- The daily returns of S&P BSE Sensex, Nifty 50 and Dow Jones Industrial Average Indices shows the existence of heteroscedasticity and clustering of data before and after the collapse of the Lehman Brothers Holdings Inc.
- There is existence of contagion on the stock returns of India before and after the Global Financial Crisis

Suggestions

- The mean of the daily return of the indices is high during before the collapse of the Lehman Brothers Holdings Inc. So investors can trade during this period for higher return.
- During after the collapse of the Lehman Brothers Holdings Inc period I the mean returns are very low. So the long term investors can invest in this period as there is increase in the mean returns during the after the collapse of the Lehman Brothers Holdings Inc period II.
- As the volatility is very less during before the collapse of the Lehman Brothers Holdings Inc this period is good for investors.
- As volatility is a signal of risk it is high during after the collapse of the Lehman Brothers Holdings Inc as the investors has to make careful investment measures before investing.

Conclusion

In this paper the impact of the before and after the Collapse of the Lehman Brothers Holdings Inc. is studied using GARCH (1,1) model. During the crisis period there is financial turmoil in the global financial markets

and the investors, Foreign Direct Investors, Foreign Institutional Investors, Policy Makers and the Business Companies and other stake holders of the share market has to make effective measure to prevent them from losses. In this paper the results suggests that there is downward trend immediately after the collapse of the Lehman Brothers Holdings Inc. but the stock Market is moving in the upward direction slowly during the After the Collapse of the Lehman Brothers Holdings Inc period II.

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