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GLOBAL FINANCIAL CRISIS AND CONTAGION IN DEVELOPED ASIAN MARKETS

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Abstract

During the Global Financial Crisis in the year 2008, the shock from the US economy has spread to many economies. The transmission of shock from one economy to other economy is defined as contagion effect. At the time of Global Financial Crisis, the contagion occurred at international level. The prevalence of Contagion effect of the Global Financial Crisis during the post period of the bankruptcy of Lehman Brothers Holdings Inc. on the developed markets - Hong Kong, Japan and Singapore are analyzed in this paper. GARCH (1,1) model is used in the study to analyse the contagion effect on the daily basis returns of the stock indices of the sample countries for the period of 10 years at the post period of the collapse of the Lehman Brothers Holding Inc.

Key Words: Financial Crisis, Developed Markets, Contagion, Volatility

Introduction

The financial system was threatened globally during the Global Financial Crisis. There was a downturn in the United States housing market which was considered as the initial stage of the Global Financial Crisis. This lead to the evolution of economic boom all over the world. The impact of the Global Financial Crisis was very severe that there were loss of job, bankruptcy faced by banks, etc. There was recession in the economy. The recession emerging from the United States multiplies its negative impact on the financial markets of the developed nations. The economic growth of the nation depends on the performance of the financial markets to a greater extent (Gopinath et al., 2019). When there is shock in the financial market, the development of the nation is affected to a greater extent because of the change in the investment behavior of the investors.

The transmission of shocks across countries is considered as contagion. The transmission of shocks takes place because of the financial links, macro economy links and political links (Pavithran et al.,2018). The financial links states the links between the financial market system, the macro economy link deals with the links due to fundamental factors like foreign direct investments, international trade, etc. Political links deals with the links in the political system of the countries.

In this paper the existence of contagion effect on the developed markets of Asia - Hong Kong, Japan and Singapore during the post period of the collapse of Lehman Brothers Holdings Inc. for the period of ten years is studied.

Review of Literature

The study entitled **"Financial Contagion in the Subprime Crisis Context: A Copula Approach"** by Zorgati Imen et al. (2018) has studied the financial contagion that arose due to sub prime crisis in the markets of American countries of Brazil, Argentina, Mexico, Canada, USA and Asian countries of Japan, Hong Kong, India, Australia, Indonesia, Malaysia, Korea, China and Singapore. The study period is from January 1, 2003 to December 30, 2011 using the model copula approach. The wavelet technique is implemented to identify the origin of the crisis and July 17, 2007 is considered as the beginning of the crisis. The results suggest that all the Stock markets of America are exposed to contagion effect and the Asian markets of India, Australia, Indonesia, Malaysia, China and Singapore are prone to contagion. The American markets were facing contagion to a greater extent than Asian markets.

Alex Cukierman(2018) in his paper titled "**A Retrospective on the Subprime Crisis and its Aftermath Ten Years after Lehman's Collapse**" has reviewed the relationship between the policy making, financial system and the economy of the US before, during and after the sub prime crisis. The author has studied the critical and the moderate phases of the crisis. The paper suggests that due to the increase in the bailout uncertainity and the aversion of this uncertaining, the collapse of the Lehman Brothers Holdings Inc. created a open financial panic.

The article titled, "**The Financial Crisis of 2008 and the Developing Countries**" by Wim Naude(2009) has discussed about the financial crisis that broke in the year 2008 in the United States and some Western economies and its impact on the developed nations. This paper suggest that there is a need for constituting a short term crisis management for the developed markets for the development of the financial economy in the country. The crisis has depicted the importance of the credit and the risk management companies for the economic development and the effective functioning of the monetary sector. The domestic financial management and the international financial structure forming are very essential for the financial development in developed nations. The results suggests that there are certain countries that are high affected and certain countries are less affected.

Stephany Griffith Jones and Jose Antonio Ocampo (2009) in their article titled "**The financial Crisis and its Impact on Developing Countries**" has identified the mechanism of spread of the financial crisis from the developed nations to the developing nations. They have provided a national, global and regional level policy recommendations. The results suggest that a fair number of countries were able to protect themselves from and overcome the crisis in the short run and few countries were in need of additional policy implication for the development.

The article titled "**Global Financial Crisis and Emerging Stock Market Contagion: A Volatility Impulse Response Function Approach**" by Xiaoye Jin and Ximeng An(2016) has studied the spread of the Contagion Effect between the BRIC's and the United States during the

Sub prime crisis. The BEKK Model and the Volatility Response Impulse Function has been applied to identify the Contagion effect for the study period of 2nd July 1997 to 31st December 2013 using the data Morgan Stanley Capital Index for the United States and the BRIC nations. The results suggest that the United States and the BRIC nations are interrelated by volatilities. There were increased evidences of contagion during the crisis period. This shows that the financial crisis have stronger impact on the volatility on the stock markets.

The research paper titled "**Asymetric Contagion Effect from the US Stock Market Around the Subprime Crisis Between 2007 and 2010**" by Yu Sheng Kao et al. (2019) has tested the existence of contagion effect on 23 markets which include seven markets of Asia, twelve major markets of Europe and four major markets of America during the sub prime crisis period from 1st September 2005 to 31st March 2010. The method of Enders and Siklos asymmetric co-integration framework, Momentum threshold Autoregressive and Logistic SmoothTransition Co-integration model has been used in the study. The findings of the study proves that there is contagion effect during the sub prime crisis period on all the sample markets except China. There was a interdependence effect between China and US during the Sub prime Crisis period.

RESEARCH METHODOLOGY

Statement of the Problem, Need of the Study, Objectives, Hypothesis, Selection of Sample, Collection of Data, Period of the Study, Tools used for Analysis and Limitations of the Study are discussed in Research Methodology Section.

Statement of the Problem

Volatility which denotes fluctuations in the market is considered as the important factor of the measure of the risk. There are various reason for the existence of volatility in the markets. The changes in the market may be due to domestic reasons or international reasons. When a shock occurs in the economy it spreads to other economies and there is transmission of contagion from one market to other markets. When the stock price fall there is change in the behavior of the investors and the investors of the other country may also withdraw their fund to prevent them from future losses. There will be vast fluctuations in the market. As a result in order to prevent losses the investor has to take careful measures to protect them from losses.

Need of the study

Many researchers have conducted study on contagion effect on various crisis adopting different methods. The behavior of the fimancial market during the period of the crisis is very unfortunate. The contagion that arise during the crisis time affects the economy to a greater extent. As the financial market are linked the disturbances in one market spreads to the other market domestically and internationally. Volatility is not constant. They change as per the trading activity and the investor behavior in the market. During the crisis time the volatility may be high and this

may causes panic among the investors. In this study the existence of contagion in the developed markets after the collapse of the Lehman Brothers Holdings Inc is studied.

Objectives of the Study

The following are the objectives of the study

1. To test the normality on the daily stock returns of the United States and developed nations of Asia after the collapse of the Lehman Brothers Holdings Inc.
2. To test the stationarity on the daily stock returns of the United States and developed nations of Asia after the collapse of the Lehman Brothers Holdings Inc.
3. To test the existence of contagion on the stock returns of the developed nations of Asia after the collapse of the Lehman Brothers Holdings Inc.

Hypothesis of the Study

The study tests the following hypothesis.

1. NH1: There is no normality on the daily stock returns of the United States and developed nations of Asia after the collapse of the Lehman Brothers Holdings Inc.
2. NH2: There is no stationarity on the daily stock returns of the United States and developed nations of Asia after the collapse of the Lehman Brothers Holdings Inc.
3. NH3: There is no existence of contagion on the stock returns of the developed nations of Asia after the collapse of the Lehman Brothers Holdings Inc.

Selection of Sample

In this study the sample of three developed Asian nations listed under MSCI ACWI and Frontier market index are considered to analyse the existense of the contagion effect after the collapse of the Lehman Brother Holdings Inc.

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	Hong Kong	The Stock Exchange of Hong Kong	Hang Seng Composite Index
2	Japan	Japan Exchange Group Tokyo Stock Exchange	TOPIX
3	Singapore	Singapore Exchange	Straits Time Index
4	United States	New York Stock Exchange	Dow Jones Industrial Average

Collection of the Data

Secondary data has been used in the study. The closing prices of the daily indices of the stock markets of the selected developed Asian countries were collected from Bloomberg database.

Period of the Study

The present study has been conducted to analyse the impact of contagion after the bankruptcy of the Lehman Brothers Holdings Inc. on the developed nations of Asia. The study has used the daily basis stock returns of indices of the stock markets of the developed Asian nations and the US from 16th September 2008 to 14th September 2018 in order to evaluate the after effect of the bankruptcy of the Lehman Brothers Holdings Inc.

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 impact of the bankruptcy of the Lehman Brothers Holdings Inc on the developed Asian markets
2. The study has used secondary data collected from the Bloomberg database.
3. The study period is limited to 10 years.

Data Analysis and Interpretation

Table-2

Results of Descriptive Statistics of Daily Returns of the Indices of the United States and the Developed Asian Countries after the Collapse of the Lehman Brothers Holdings Inc. for the Period of 16th September 2008 to 14th September 2018

Particulars	Hong Kong	Japan	Singapore	United States
Mean	0.0001	0.0002	0.0001	0.0003
Median	0.0005	0.0006	0.0002	0.0006
Maximum	0.1181	0.1286	0.0753	0.1051
Minimum	-0.1220	-0.1001	-0.0870	-0.0820
Std. Dev.	0.0148	0.0144	0.0106	0.0116
Skewness	-0.0442	-0.4015	-0.1543	-0.1292
Kurtosis	12.0864	11.7372	11.9212	15.0707
Jarque-Bera	8490.947	7865.171	8330.176	15293.44
Probability	0	0	0	0
bservations	2468	2452	2509	2518

Source: Data has been collected from Bloomberg database and computed using E-views.

Table 2 shows the Results of Descriptive Statistics of Daily Returns of the Indices of the United States and the Developed Asian Countries after the Collapse of the Lehman Brothers Holdings Inc. for the Period of 16th September 2008 to 14th September 2018. The highest mean of 0.0003 has been recorded for United States and the lowest mean of 0.0001 has been recorded for

Hong Kong and Singapore. The highest maximum return has been recorded at 0.1286 for Japan and the lowest maximum return of 0.0753 has been recorded for Singapore. The standard deviation which is the measure of risk is highest for Hong Kong recorded at 0.0148 and the lowest is recorded at 0.0106 for Singapore. The negative skewness value is recorded for all the countries and the Kurtosis value is greater than 3 which states that the distribution is leptokurtic for all the countries. The Jarque Bera probability value is less than 0.05. Therefore the null hypothesis of **"There is no normality on the daily stock returns of the United States and developed nations of Asia after the collapse of the Lehman Brothers Holdings Inc."** is accepted.

Table-3

Results of Augmented Dickey Fuller Test of Daily Returns of the Indices of the Hong Kong after the Collapse of the Lehman Brothers Holdings Inc. for the Period of 16th September 2008 to 14th September 2018

Particulars		**t-Statistic**	**Prob.**
Augmented Dickey-Fuller test statistic		-48.1729	0.0001
Test critical values	1% level	-3.43281	
	5% level	-2.86251	
	10% level	-2.56733	

Source: Data has been collected from Bloomberg database and computed using E-views.

The results of **Table-3** discloses the Augmented Dickey Fuller Test of the Daily Returns of the Indices Hong Kong after the Collapse of the Lehman Brothers Holdings Inc. for the Period of 16th September 2008 to 14th September 2018. The ADF value is less than the test critical values and the accompanying probability value is less than 0.05. The returns are stationary at trend and intercept. So the null hypothesis of **"There is no stationarity on the stock returns of Hong Kong after the collapse of the Lehman Brothers Holdings Inc."** is rejected.

Table-4

Results of Augmented Dickey Fuller Test of Daily Returns of the Indices of Japan after the Collapse of the Lehman Brothers Holdings Inc. for the Period of 16th September 2008 to 14th September 2018

Particulars		**t-Statistic**	**Prob.**
Augmented Dickey-Fuller test statistic		-49.9576	0.0001
Test critical values:	1% level	-3.43282	
	5% level	-2.86252	
	10% level	-2.56734	

Source: Data has been collected from Bloomberg database and computed using E-views.

Table-4 shows the results of the Augmented Dickey Fuller Test of the Daily Returns of the Indices of Japan after the Collapse of the Lehman Brothers Holdings Inc. for the Period of 16th September 2008 to 14th September 2018. The ADF value is less than the test critical values and

the accompanying probability value is less than 0.05. The returns are stationary at trend and intercept. So the null hypothesis of **"There is no stationarity on the stock returns of Japan after the collapse of the Lehman Brothers Holdings Inc."** is rejected.

Table-5

Results of Augmented Dickey Fuller Test of Daily Returns of the Indices of Singapore after the Collapse of the Lehman Brothers Holdings Inc. for the Period of 16th September 2008 to 14th September 2018

Particulars		**t-Statistic**	**Prob.**
Augmented Dickey-Fuller test statistic		-48.2754	0.0001
Test critical values:	1% level	-3.43276	
	5% level	-2.86249	
	10% level	-2.56732	

Source: Data has been collected from Bloomberg database and computed using E-views.

Table-5 shows the results of the Augmented Dickey Fuller Test of the Daily Returns of the Indices of Singapore after the Collapse of the Lehman Brothers Holdings Inc. for the Period of 16th September 2008 to 14th September 2018. The ADF value is less than the test critical values and the accompanying probability value is less than 0.05. The returns are stationary at trend and intercept. So the null hypothesis of **"There is no stationarity on the stock returns of Singapore after the collapse of the Lehman Brothers Holdings Inc."** is rejected.

Table-6

Results of Augmented Dickey Fuller Test of Daily Returns of the Indices of United States after the Collapse of the Lehman Brothers Holdings Inc. for the Period of 16th September 2008 to 14th September 2018

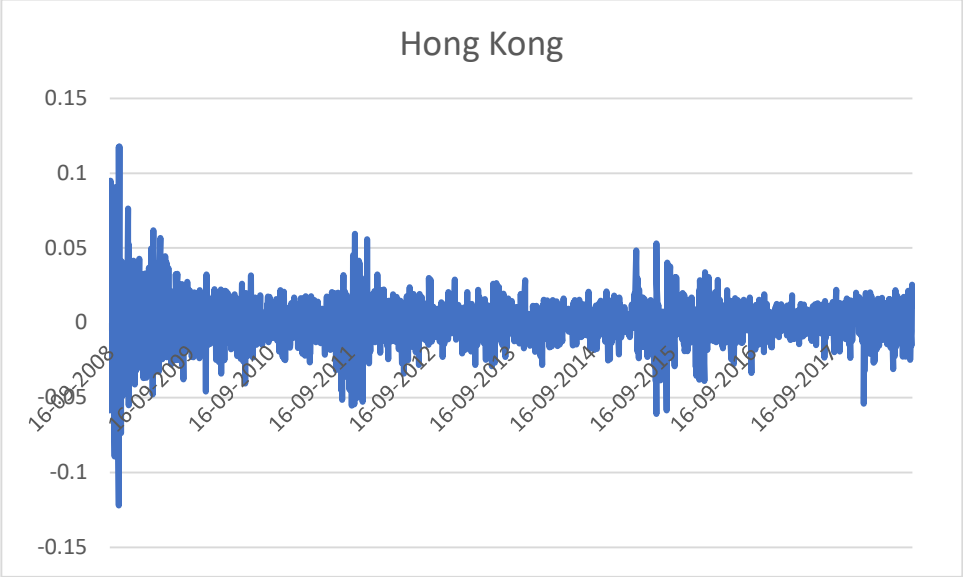
Particulars		**t-Statistic**	**Prob.**
Augmented Dickey-Fuller test statistic		-24.3570	0.0000
Test critical values:	1% level	-3.4328	
	5% level	-2.8625	
	10% level	-2.5673	

Source: Data has been collected from Bloomberg database and computed using E-views.

Table-6 shows the results of the Augmented Dickey Fuller Test of the Daily Returns of the Indices of United States after the Collapse of the Lehman Brothers Holdings Inc. for the Period of 16th September 2008 to 14th September 2018. The ADF value is less than the test critical values and the accompanying probability value is less than 0.05. The returns are stationary at trend and intercept. So the null hypothesis of **"There is no stationarity on the stock returns of United States after the collapse of the Lehman Brothers Holdings Inc."** is rejected.

Chart – 1

The Line Chart of the Daily Returns of the Indices of Hong Kong after the Collapse of the Lehman Brothers Holdings Inc. for the Period of 16th September 2008 to 14th September 2018

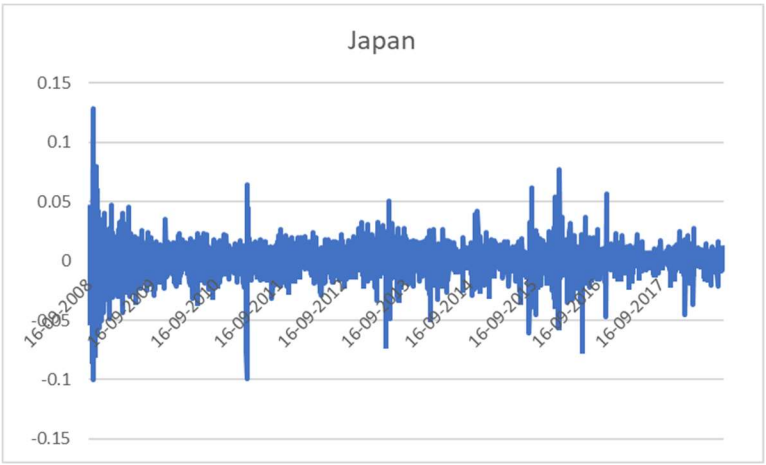


Source: Data has been collected from Bloomberg database and computed using E-views.

The above **Chart-1** discloses the Daily Returns of the Indices of Hong Kong after the Collapse of the Lehman Brothers Holdings Inc. for the Period of 16th September 2008 to 14th September 2018. This shows the presence 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 Japan after the Collapse of the Lehman Brothers Holdings Inc. for the Period of 16th September 2008 to 14th September 2018

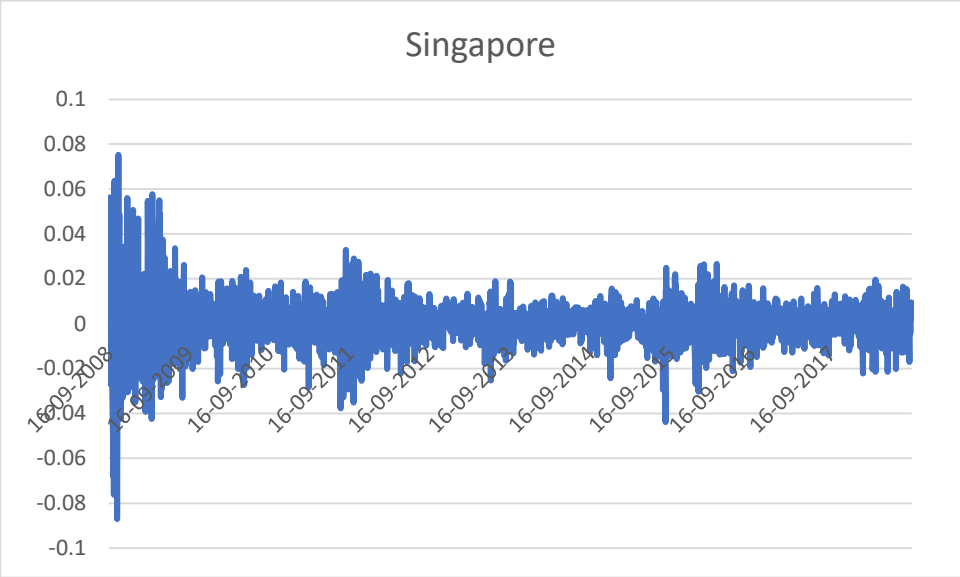


Source: Data has been collected from Bloomberg database and computed using E-views.

The above **Chart-2** discloses the Daily Returns of the Indices of Japan after the Collapse of the Lehman Brothers Holdings Inc. for the Period of 16th September 2008 to 14th September 2018. The return series shows the existence of time trend. 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 Singapore after the Collapse of the Lehman Brothers Holdings Inc. for the Period of 16th September 2008 to 14th September 2018

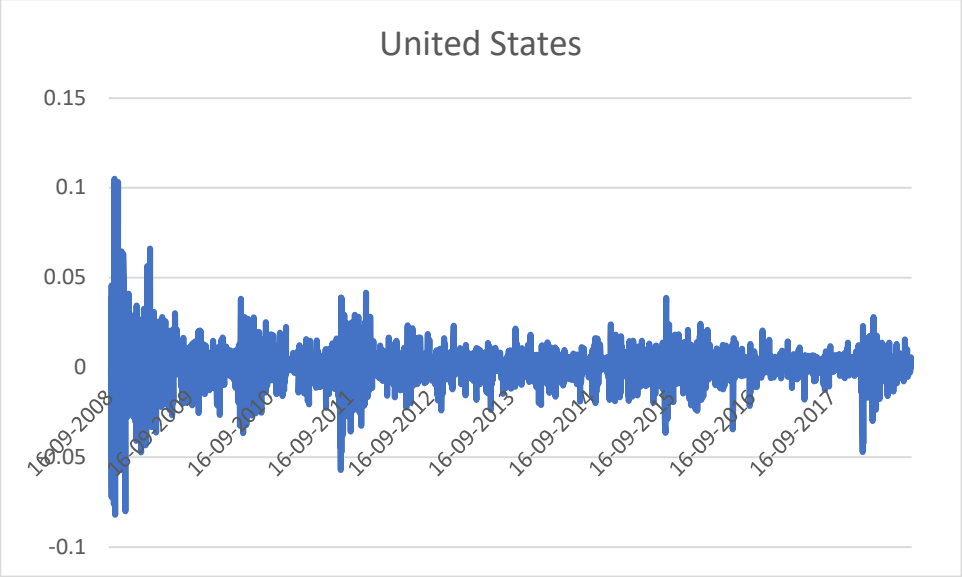


Source: Data has been collected from Bloomberg database and computed using E-views.

The **Chart-3** discloses the Daily Returns of the Indices of Singapore after the Collapse of the Lehman Brothers Holdings Inc. for the Period of 16th September 2008 to 14th September 2018. The return series shows the existence of time trend. This shows the feature of time varying variance and clustering. **As it shows heteroscedasticity and clustering, GARCH model can be used.**

Chart – 4

The Line Chart of the Daily Returns of the Indices of United States after the Collapse of the Lehman Brothers Holdings Inc. for the Period of 16th September 2008 to 14th September 2018



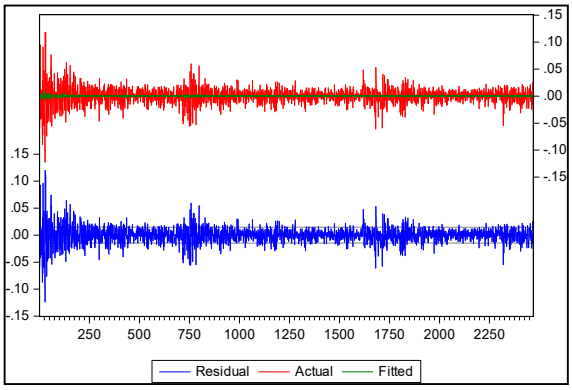
Source: Data has been collected from Bloomberg database and computed using E-views.

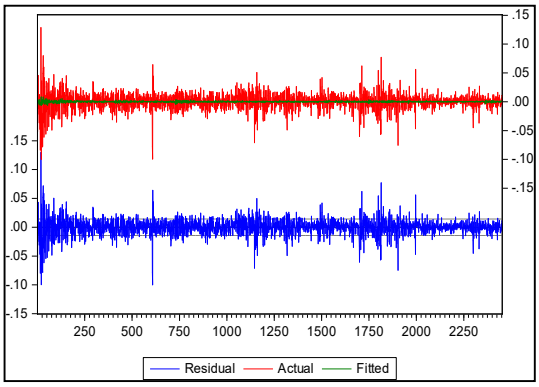
The **Chart-4** discloses the Daily Returns of the Indices of United States after the Collapse of the Lehman Brothers Holdings Inc. for the Period of 16th September 2008 to 14th September 2018. The return series shows the existence of time trend. This shows the feature of time varying variance and clustering. **As it shows heteroscedasticity and clustering, GARCH model can be used.**

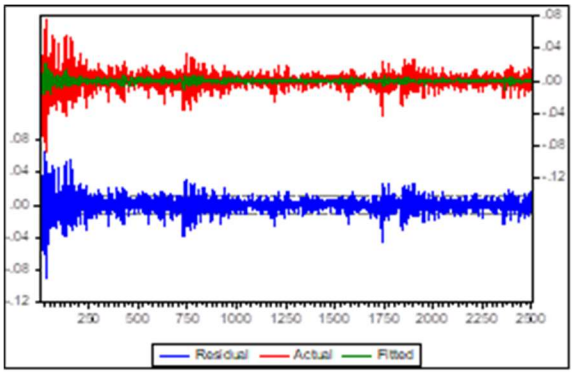
Chart-5

The Line Chart of the Residuals for the Daily Returns of the Indices of the United States and the developed Asian nations after the Collapse of the Lehman Brothers Holdings Inc. for the Period of 16th September 2008 to 14th September 2018

Hong Kong **Japan**







Source: Data has been collected from Bloomberg database and computed using E-views.

In the Chart-5 the residuals are shown for the Daily Returns of the Indices of the United States and the developed Asian nations after the Collapse of the Lehman Brothers Holdings Inc. for the Period of 16th September 2008 to 14th September 2018. 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 - 6

Results of Autocorrelation and Partial Auto Correlation of the Daily Returns of the Indices of the United States and Hong Kong after the Collapse of the Lehman Brothers Holdings Inc. for the Period of 16th September 2008 to 14th September 2018

Lags	AC	PAC	Q-Stat	Prob
1	-0.022	-0.022	1.1622	0.281
2	0.016	0.015	1.7565	0.416
3	0.052	0.053	8.4802	0.037
4	0.015	0.017	9.0226	0.061
5	0.017	0.016	9.7336	0.083
6	0.002	-0.001	9.7423	0.136
7	-0.017	-0.019	10.423	0.166
8	-0.016	-0.019	11.096	0.196
9	0.011	0.01	11.38	0.251
10	0.006	0.009	11.483	0.321
11	-0.009	-0.007	11.684	0.388
12	-0.012	-0.013	12.066	0.44
13	0.005	0.004	12.126	0.517
14	-0.01	-0.009	12.368	0.577
15	-0.015	-0.015	12.917	0.609
16	-0.017	-0.017	13.597	0.629
17	-0.012	-0.011	13.961	0.67
18	-0.003	-0.001	13.983	0.73

19	-0.017	-0.015	14.664	0.744
20	0.009	0.01	14.845	0.785
21	-0.008	-0.006	15.006	0.823
22	-0.035	-0.035	18.136	0.698
23	-0.011	-0.014	18.433	0.734
24	0.008	0.009	18.584	0.774
25	0.017	0.022	19.306	0.782
26	-0.017	-0.014	20.013	0.791
27	-0.028	-0.029	21.921	0.741
28	-0.029	-0.032	24.072	0.678
29	-0.017	-0.019	24.813	0.688
30	0	0.001	24.813	0.734
31	0.026	0.031	26.492	0.697
32	-0.001	0.006	26.496	0.741
33	0.024	0.024	27.988	0.715
34	0.039	0.035	31.891	0.571
35	-0.011	-0.013	32.188	0.605
36	0.029	0.022	34.251	0.552

Source: Data has been collected from Bloomberg database and computed using E-views.

Table-6 shows the Autocorrelation and Partial Auto Correlation of the Daily Returns of the Indices of the United States and Hong Kong after the Collapse of the Lehman Brothers Holdings Inc. for the Period of 16th September 2008 to 14th September 2018. The probability value is greater than 0.05 and therefore There is no existence of serial correlation during the study period is accepted.

Table - 7

Results of Autocorrelation and Partial Auto Correlation of the Daily Returns of the Indices of the United States and Japan after the Collapse of the Lehman Brothers Holdings Inc. for the Period of 16th September 2008 to 14th September 2018

Lags	AC	PAC	Q-Stat	Prob
1	0.137	0.137	46.328	0
2	0.15	0.134	101.69	0
3	0.149	0.117	156.42	0
4	0.064	0.015	166.55	0
5	0.118	0.079	200.95	0
6	0.1	0.057	225.6	0
7	0.103	0.059	251.8	0
8	0.105	0.051	278.98	0
9	0.139	0.09	326.51	0
10	0.071	0.006	339.06	0

11	0.105	0.046	366.15	0
12	0.168	0.113	436	0
13	0.065	-0.003	446.57	0
14	0.064	-0.014	456.73	0
15	0.139	0.082	504.21	0
16	0.049	-0.011	510.23	0
17	0.059	-0.013	518.92	0
18	0.056	-0.009	526.56	0
19	0.053	0.01	533.48	0
20	0.062	0.003	543.11	0
21	0.073	0.018	556.33	0
22	0.032	-0.017	558.79	0
23	0.044	-0.007	563.64	0
24	0.059	0.003	572.35	0
25	0.037	0.009	575.77	0
26	0.053	0.013	582.86	0
27	0.082	0.034	599.58	0
28	0.03	-0.009	601.77	0
29	0.041	0.004	605.94	0
30	0.041	0	610.18	0
31	0.067	0.045	621.47	0
32	0.048	0.006	627.18	0
33	0.093	0.057	648.48	0
34	0.028	-0.016	650.5	0
35	0.069	0.031	662.31	0
36	0.056	0.004	670.08	0

Source: Data has been collected from Bloomberg database and computed using E-views.

Table-7 shows the Autocorrelation and Partial Auto Correlation of the Daily Returns of the Indices of the United States and Japan after the Collapse of the Lehman Brothers Holdings Inc. for the Period of 16th September 2008 to 14th September 2018. The probability value is less than 0.05 and therefore There is existence of serial correlation during the study period is accepted.

Table - 8

Results of Autocorrelation and Partial Auto Correlation of the Daily Returns of the Indices of the United States and Singapore after the Collapse of the Lehman Brothers Holdings Inc. for the Period of 16th September 2008 to 14th September 2018

Lags	AC	PAC	Q-Stat	Prob
1	0.023	0.023	1.3709	0.242
2	-0.011	-0.012	1.6992	0.428
3	0.04	0.041	5.7156	0.126

4	0.006	0.004	5.7939	0.215
5	-0.021	-0.02	6.8918	0.229
6	-0.009	-0.009	7.0897	0.313
7	-0.044	-0.044	11.95	0.102
8	0.056	0.059	19.71	0.011
9	0.028	0.025	21.637	0.01
10	0.027	0.03	23.437	0.009
11	-0.007	-0.012	23.555	0.015
12	-0.018	-0.022	24.372	0.018
13	-0.016	-0.017	25.038	0.023
14	0.002	0.003	25.045	0.034
15	0.025	0.034	26.649	0.032
16	-0.019	-0.02	27.605	0.035
17	0.009	0.009	27.791	0.047
18	-0.013	-0.023	28.238	0.059
19	0.018	0.018	29.084	0.065
20	0.005	0.005	29.147	0.085
21	0.001	0.007	29.152	0.11
22	-0.017	-0.015	29.924	0.12
23	0.02	0.015	30.951	0.124
24	-0.017	-0.018	31.72	0.134
25	-0.015	-0.016	32.282	0.15
26	0.008	0.013	32.462	0.178
27	-0.017	-0.018	33.201	0.191
28	-0.031	-0.028	35.614	0.153
29	-0.009	-0.013	35.809	0.179
30	0.006	0.009	35.903	0.211
31	-0.017	-0.017	36.635	0.224
32	0.002	0.005	36.648	0.262
33	-0.016	-0.016	37.336	0.277
34	0.009	0.007	37.555	0.31
35	-0.017	-0.018	38.283	0.323
36	-0.004	0	38.315	0.365

Source: Data has been collected from Bloomberg database and computed using E-views.

Table-8 shows the Autocorrelation and Partial Auto Correlation of the Daily Returns of the Indices of the United States and Singapore after the Collapse of the Lehman Brothers Holdings Inc. for the Period of 16th September 2008 to 14th September 2018. The probability value is greater than 0.05 and therefore There is no existence of serial correlation during the study period is accepted.

Table-9

Results of ARCH LM test of the Daily Returns of the Indices of the United States and and the developed Asian Countries after the Collapse of the Lehman Brothers Holdings Inc. for the Period of 16th September 2008 to 14th September 2018

Heteroskedasticity Test: ARCH(HONG KONG)			
F-statistic	1.1600	Prob. F	0.2816
Obs*R-squared	1.1603	Prob. Chi-Square(1)	0.2814
Heteroskedasticity Test: ARCH (JAPAN)			
F-statistic	47.2178	Prob. F(1,2449)	0
Obs*R-squared	46.3624	Prob. Chi-Square(1)	0
Heteroskedasticity Test: ARCH (SINGAPORE)			
F-statistic	1.36854	Prob. F(1,2506)	0.2422
Obs*R-squared	1.368884	Prob. Chi-Square(1)	0.242

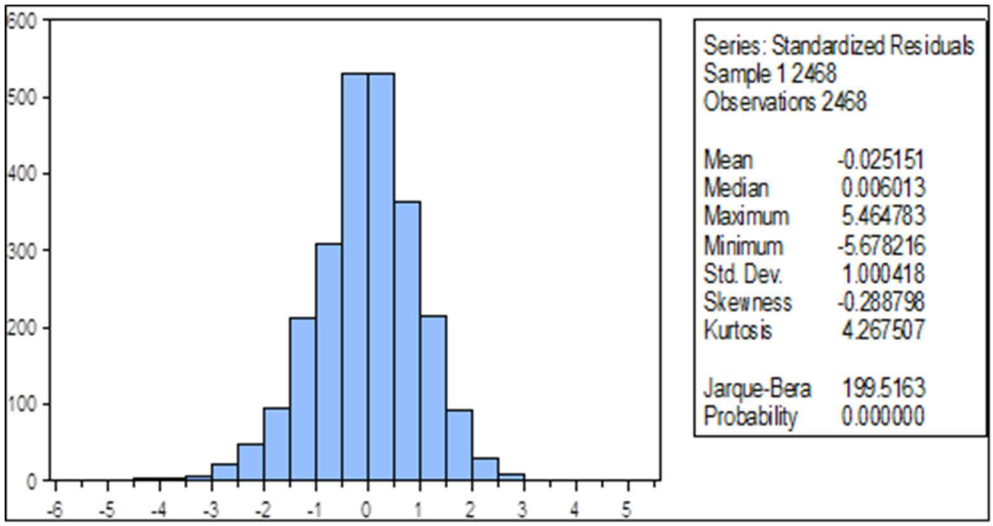
Source: Data has been collected from Bloomberg database and computed using E-views

The results of **Table-9** discloses the ARCH LM test of the Daily Returns of the Indices of the United States and the developed Asian Countries after the Collapse of the Lehman Brothers Holdings Inc. for the Period of 16th September 2008 to 14th September 2018. The p value is more than 0.05 for Hong Kong and Singapore which shows no existence of ARCH effect. The P value is less than 0.05 for Japan which show there is ARCH effect.

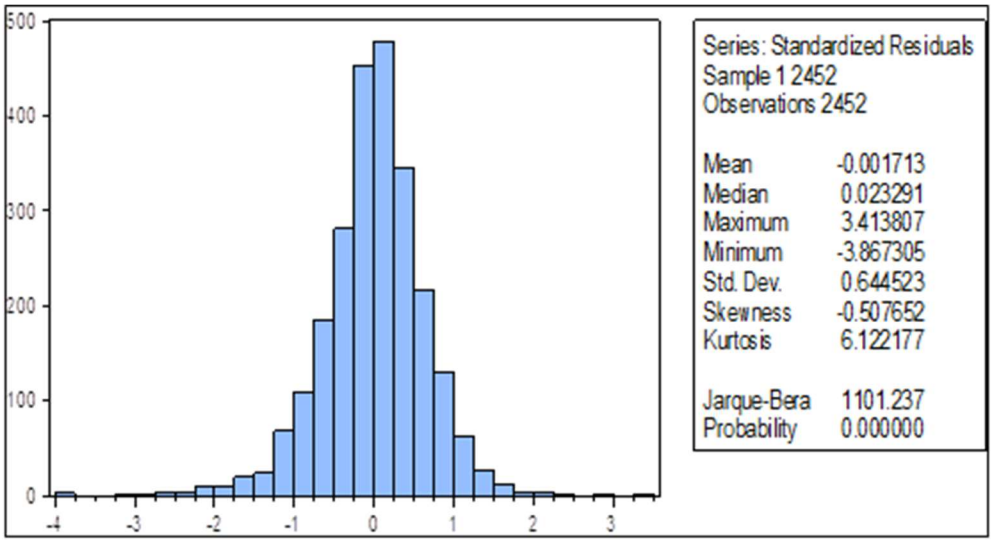
Figure-1

Results of the Standardised Residuals of the Daily Returns of the Indices of the United States and the developed Asian Countries after the Collapse of the Lehman Brothers Holdings Inc. for the Period of 16th September 2008 to 14th September 2018

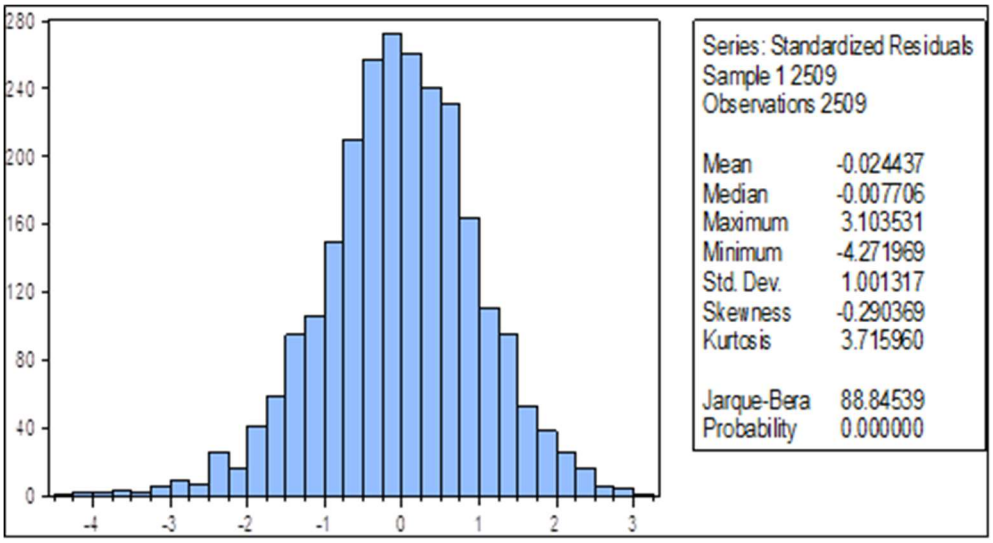
Hong Kong



Japan



Singapore



Source: Data has been collected from Bloomberg database and computed using E-views

The above **Figure-1** shows the result of the standardised residuals of the Daily Returns of the Indices of the United States **and the developed Asian Countries after the Collapse of the Lehman Brothers Holdings Inc. for the Period of 16th September 2008 to 14th September 2018.** The Jarque-Bera probability value is 0 which shows that there is no normality. Therefore **There is no existence of normality on the residuals**.

Table-10

Results of GARCH(1,1) Model of the Daily Returns of the Indices of the United States and Hong Kong after the Collapse of the Lehman Brothers Holdings Inc. for the Period of 16th September 2008 to 14th September 2018

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.0000	0.0000	5.4297	0.0000
ARCH(α)	0.0623	0.0071	8.8119	0.0000
GARCH(β)	0.9220	0.0081	113.5986	0.0000
α+β	0.9843			

Source: Data has been collected from Bloomberg database and computed using E-views

Table-10 shows the results of the GARCH(1,1) Model of the Daily Returns of the Indices of the United States and Hong Kong after the Collapse of the Lehman Brothers Holdings Inc. for the Period of 16th September 2008 to 14th September 2018. The sum of the parameters α and β are very close to 1. This shows the existence of high volatility. Under this distribution the probability of ARCH parameter is denoted as α and GARCH parameter is denoted as β is 0 which is less than 0.05. This 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 Hong Kong after the collapse of the Lehman Brothers Holdings Inc."** is rejected.

Table-11

Results of GARCH(1,1) Model of the Daily Returns of the Indices of the United States and Japan after the Collapse of the Lehman Brothers Holdings Inc. for the Period of 16th September 2008 to 14th September 2018

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.0001	0.0000	3.8105	0.0001
ARCH(α)	0.1500	0.0345	4.3519	0.0000
GARCH(β)	0.6000	0.0962	6.2380	0.0000
α+β	0.7500			

Source: Data has been collected from Bloomberg database and computed using E-views

Table-11 shows the results of the GARCH(1,1) Model of the Daily Returns of the Indices of the United States and Japan after the Collapse of the Lehman Brothers Holdings Inc. for the Period of 16th September 2008 to 14th September 2018. The sum of the parameters α and β are close to 1 to a lesser extent. This shows the existence of moderate volatility. The probability value of ARCH and GARCH are less than 0.05. This 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 Japan after the collapse of the Lehman Brothers Holdings Inc."** is rejected.

Table-12

Results of GARCH(1,1) Model of the Daily Returns of the Indices of the United States and Singapore after the Collapse of the Lehman Brothers Holdings Inc. for the Period of 16th September 2008 to 14th September 2018

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.0000	0.0000	3.9131	0.0001
ARCH(α)	0.0719	0.0076	9.4367	0.0000
GARCH(β)	0.9175	0.0085	108.1013	0.0000
α+β	0.9894			

Source: Data has been collected from Bloomberg database and computed using E-views

Table-12 shows the results of the GARCH(1,1) Model of the Daily Returns of the Indices of the United States and Singapore after the Collapse of the Lehman Brothers Holdings Inc. for the Period of 16th September 2008 to 14th September 2018. The sum of the parameters α and β are very close to 1 at 0.9894. This shows the existence of high volatility. The probability value of ARCH and GARCH are less than 0.05. This 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 Singapore after the collapse of the Lehman Brothers Holdings Inc."** is rejected.

Findings of the Study

The following are the findings of the study

- The highest mean of 0.0003 has been recorded for United States and the lowest mean of 0.0001 has been recorded for Hong Kong and Singapore.
- The highest maximum return has been recorded at 0.1286 for Japan and the lowest maximum return of 0.0753 has been recorded for Singapore.
- The standard deviation which is the measure of risk is highest for Hong Kong recorded at 0.0148 and the lowest is recorded at 0.0106 for Singapore.
- The negative skewness value is recorded for all the sample countries selected for the study.
- The Kurtosis value is greater than 3 for all the sample countries which states that the distribution is leptokurtic for all the countries.
- There is no normality on the stock returns of the United States and developed nations of Asia after the collapse of the Lehman Brothers Holdings Inc.
- There is stationarity on the daily return on the indices of the United States and the selected developed Asian countries at intercept and trend.
- There is high volatility on the daily returns of the indices of Hong Kong and Singapore after the collapse of the Lehman Brothers Holdings Inc.
- There is moderate volatility on the daily returns of the indices of Japan after the collapse of the Lehman Brothers Holdings Inc.

Suggestions

- The investors has to be careful in investing in Hong Kong as the mean returns are low and the standard deviation is high.
- Singapore market is suitable for the investors who are interested in moderate returns as the mean return is low and the standard deviation is also low.

- As there is existence of moderate volatility on the returns of the indices of the Japan, the investors can invest to overcome the risk involved.

Conclusion

The spread of contagion is the major problem that investors face globally during the crisis period. The investors has to undergo careful investment decision before investing in the financial market when there is a shock. In this paper analysis has been done on the developed markets of Asia – Hong Kong, Japan and Singapore during the period of Sub prime crisis after the collapse of the Lehman Brothers Holdings Inc and the results states that when compared to the three markets Hong Kong market can be preferred by the long term investors and the moderate risk is involved in the markets of Singapore.

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