Comparing the Volatility of Returns in Indian and Chinese Information Technology Sector

Parul Tyagi*

Abstract

The growth in Indian and Chinese economies has been attributed to major reforms in the modus operandi of the capital market of the two economies. The stock market performance of the two leading economies of Asia has been a topic of discussion globally; especially after 2008. In the present research, the researcher has compared the performance and stock market volatility of Indian and Chinese I.T. Indices Returns during 2004 to 2017 i.e. thirteen years. Information Technology sector forms one of the major industries of any economy and contributes to the GDP of that economy as well. Present study uses advance econometric tools like ADF test to study stationarity, statistical tools to compare performance and Garch (1,1) model to study the volatility pattern of the I.T. sector indices of the two economies. The results were calculated on E-Views 8 software.

Keywords: Information Technology, ADF Test, Stationarity, Volatility, Garch (1, 1), E-Views 8.

Introduction

The two major fastest growing Asian economies i.e. India and China are becoming the area of interest among researchers. Few questions, which arise in this context are related to performance of these economies over time, movements in their stock indices and the volatility spill over mechanism of their stock indices including the sectoral diversification. Analysing the volatility of stocks, sectors and index as a whole has been one of the popular area of research. With global diversification of equity investment and emergence of global mind set in investing fuelled by removal of restrictions on capital account, it is obviously both of academic and corporate interest to conduct such study. India and China has witnessed a remarkable growth rate since 1980 coupled with poverty reduction. One third of the world population is covered by both of these economies. In the past many significant developments took place. One among them is emergence of China and India as major economic forces in an international economy. The growth in these economies has been attributed to major reforms in the modus operandi of the capital market of the two economies. The reforms in the capital markets brought about in 1980's and 1990's in the two economies have revolutionized the performance of their capital markets. The stock market performance of the two leading economies of Asia has been a topic of discussion globally, especially after 2008. The researcher finds that lot of studies had been conducted focusing on the overall performance and volatility in stock returns in these economies but no separate studies have been conducted targeting the sectoral index performances of these economies. In the present research, the researcher has compared the performance and stock market volatility of Indian and Chinese Information Technology Index Returns. Information Technology forms one of the major industries of any economy and contributes to the GDP of that economy as well. India accounts for 67% of US$ 124-130 billion market thus becoming world's largest source destination for IT sector. The industry is divided into engineering services, IT services, hardware, software products and business process management (BPM). This sector is expected to grow at 11% per annum and thus will triple its revenue by FY 2025. The internet economy of India is expected to reach 10

Dr. Parul Tyagi* Assistant Professor, Jaipuria School of Business, Indirapuram, Ghaziabad

trillion by 2018 according to BCG (Boston Consulting Group) report. Public cloud services revenue has reached US$ 838 million in 2015, growing by 33 per cent year-on-year. The industry has also increased the demand for computer science engineering in education sector. The Industry amounts to 12.3 per cent of the global market due to massive exports. These exports includes 56.12 percent from IT services thus forming 56.12 per cent of total IT exports (including hardware) from India. The Business Process Management (BPM) segment covers 23.46 percent of total IT exports during FY15.

The size of China's IT industry is $493 billion, which is much more in comparison to India. It is mainly involved in developing and publishing software and related services in China. The outsourcing market of China's IT Industry is expected to reach $60 billion by 2015, in which 60% exports belongs to Japan. Over the last few years I.T. sector has witnessed a massive growth in China. China is even planning to make this sector as a part of its seven strategic industries which will help the economy to flourish growth through innovation and creativity. The largest internet users (500 million) from the world come from China. Thus China's IT market is the fourth largest in the world. China is second largest software-outsourcing destination in the world next to India. Although the hardware markets of China earns only small margins. In 2015, revenue from IT sector reached total of $124.5 billion, up 7.5% from 2014.The research investigates the comparison of volatility and stock market performance of India and China IT Index from April 2004 to March 2017 using advance econometric tools. One of the major reason that these kind of study were not there is due to lack of availability of sectoral returns data of Chinese Stock Markets. In this study, Chinese IT Index for thirteen years on daily basis using Weighted Average Market Capitalization Method has been developed by the researcher.

Literature Review

Starting with the pioneering work of Mandelbrot (1963) and Fama (1965), various features of stock returns have been extensively documented in the literature, which is important in modeling stock market volatility. It has been found that stock market volatility is time varying and it also exhibits positive serial correlation *(volatility clustering).* This implies that changes in volatility are non-random. Moreover, the volatility of returns can be characterized as a long-memory process as it tends to persist (Bollerslev, Chou and Kroner, 1992).

Schwert (1989) agreed with this argument. Fama (1965) also found the similar evidence. Baillie and Bollerslev (1991) observed that the volatility is predictable in the sense that it is typically higher at the beginning and at the close of trading period.

Chan, Karceski & Lakonishok (1998) in their research paper concluded that "the macroeconomic factors do a poor job in explaining return covariation. In terms of understanding the return covariation across stocks, widely used factors such as industrial production growth and unanticipated inflation do not seem to be more useful than a randomly generated series of numbers."

Akgiray (1989) found that GARCH (1, 1) had better explanatory power to predict future volatility in US stock market. Poshakwale and Murinde (2001) modeled volatility in stock markets of Hungary and Poland using daily indices. They found that GARCH (1, 1) accounted for nonlinearity and volatility clustering.

Poon and Granger (2003) provided comprehensive review on volatility forecasting. They examined the methodologies and empirical findings of 93 research papers and provided synaptic view of the volatility literature on forecasting. They found that ARCH and GARCH classes of time series models are very useful in measuring and forecasting volatility.

Li et al.(2005) examined the relationship between expected stock return and volatility based on parametric EGARCH- M model. They found a positive but insignificant relationship between stock return and volatility.

Mishra (2010) in his work on the dynamics of stock market return volatility of India and Japan used TGARCH-M model. His findings revealed that these markets are impacted asymmetrically by bad news and good news. The return volatility persists in both countries.

Joshi (2010) investigated *the stock market volatility in the emerging stock markets of India and China* using daily closing price from 1st January, 2005 to 12th May, 2009. The results detect the presence of non-linearity through BDSL test; while, conditional Heteroscedasticity is identified through ARCH-LM test. The findings reveal that the GARCH (1, 1) model successfully captures nonlinearity and volatility clustering. The analysis suggests that the persistence of volatility in Chinese stock market is more than Indian stock market.

Guo & Savickas (2003) found that the high stock market returns are the results of combination of idiosyncratic stock market volatility as well as aggregate stock market volatility. Their research found positive relationship between risk and return of equity markets but this relationship was found negative in case of future returns of equity markets and idiosyncratic stock volatility. This idiosyncratic volatility was examined as a macro variable which helped in forecasting future share prices.

Engle & Ng (1993) examined the relationship of market news and stock market volatility. They evaluated the impact of any market information on stock prices and how this curve tends to slope? They compared various parametric and non-parametric models ARCH models and applied them on daily share price data of Japanese stock market. Non Diagnostic tests were performed showing that there is asymmetry in the news and stock market data. They found that this type of asymmetry in the data is being successfully captured through the models of Runkle, Jagannathan and Glosten(1989) also known as GJR model.

Maheshchandra (2014) studied that there exists long term volatility in the stock markets of India and China. The daily time series data of the stock exchanges BSE (Bombay Stock Exchange) and SSE (Shanghai Stock Exchange) were collected for a period of five years. To provide the evidence for the same FIGARCH models were used which proved out well fitted in the research and thus, provided a strong evidence for the existence of FIGARCH. However the property of long term volatility mechanism for found stronger in BSE as compared to SSE.

Thenmozhi and Chandra (2013) studied about the VIX (Indian Volatility Index) and how the risk management mechanism takes place in it. They found a negative relationship between NIFTY index and Indian VIX. They found that VIX captures market changes or ups and downs (Volatility) better than the traditional methods of capturing volatility like ARCH/GARCH models. They concluded that an investor can take the benefits of high positive returns by investing in Large Cap Portfolios and Mid Cap Portfolios when the VIX showing higher returns.

Mobarak (2005) studied how the growth & development & democracy of an economy are related to volatility of stock prices. Volatility and average growth were taken as 'two equation system'. Through this the author found that volatility decreases at high level of democracy & diversification in country especially in Muslim countries and at high volatility economic growth reduces. Author tried to identify an alternative link between development and democracy in a country through studying volatility in equity markets.

Raju and Ghosh (2004) have made comparison of stock market volatility in Indian market with several countries at international level, which the authors finds important to be studied as it decides the pricing of securities. They have taken both the mature economies like UK and US as well as emerging economies of Asia like India and China. The mature economies exhibited high volatility returns but the emerging economies exhibited lower as well as negative returns. Along with this Indian equity markets exhibit less skewness and kurtosis and are moving faster towards information technology.

Birău and Trivedi (2013) showed how volatility of capital markets is studied widely in the field of finance especially during the period of economic crises in these markets. These economies are a source of attraction for investors as well as possess higher growth prospects. They have done a deep inspection in these economies by using GARCH models and studying co-integration in the markets as a result of diversification of portfolio and becoming financially globalized.

Research Methodology

Objectives of Study:

i. To compare the Performance of Indian and Chinese IT Stock Indices during April 2004 to March 2017.

ii. To compare the Volatility of Indian and Chinese IT Stock Indices during April 2004 to March 2017.

Hypothesis:

i. Ho1: There is no significant difference in the performance of IT index of Indian and Chinese stock market during April 2004 to March 2017.

ii. Ho2: There is no significant difference in the volatility of IT index of Indian and Chinese stock market during April 2004 to March 2017.

Period of Study

The data was collected on daily basis using the index values of India and China for the time period of 13 years i.e. from April 2004 to March 2017. The data includes 2894 observations from Indian stock Indices and 2989 from Chinese stock indices depending upon their trading days during the period of study. The period has been chosen to capture the volatility effects in stock markets of IT Sector of the two economies accurately.

Data Collection:

Table 1: Source of Data Collection for China

Parameters	Internet Source
Nifty IT	Yahoo Finance
Net Income	www.morningstar.com
Earnings Per Share	www.morningstar.com
Share Price	http://in.finance.yahoo.com, www.google.com/finance
List of companies	http://www.infoseekchina.com

To create the Chinese IT Index, Weighted average methodology has been used to create the daily index values for thirteen years. List of top market players of this sector has been prepared including 25 companies. Then their daily M-Cap was calculated by using the formula (Share price* No. of outstanding Shares). While, assuming that outstanding shares remain constant for one year. These outstanding shares were calculated by using the formula (***Net Income / Earning per Share***). Once the daily M-Cap of companies for ten years was obtained, weighted average method was applied to calculate the daily index value. Initially daily returns of Stock Indices were calculated using the equation:

$$R_i = ((R_t - R_{t-1})/R_t)*100$$

Where R_i = Return for the day t

R_t = Closing value of the Index on the trading day t

R_{t-1}= Closing value of the Index on trading day t-1 i.e. immediately preceding the day t.

Then afterwards, In order to check the stationarity in the returns data series, Augmented Dickey Fuller (ADF) unit root test is being applied and the results were obtained through E-Views 8 software.

The first objective of measuring the performance was duly accomplished by using certain statistical tools like Mean, Median, Standard Deviation, Coefficient of Variation, Skewness, Kurtosis as well as the probability to check the significance of these statistical parameters of performance of stock price index. The output window has been obtained through E-Views 2008.

For the second objective, In order to compute and analyze the volatility of Indian and Chinese IT Index, Generalized Autoregressive Heteroscedastic, GARCH (1, 1) model is being used.

GARCH (1, 1) has two parts:

i. Mean Equation

ii. Variance Equation

The mean equation is as follows:

$$rt = c1 + c2(rt - 1) + e \ldots. \quad \text{(eq1)}$$

Here the variables are (Return of Index on day t)

$rt - 1$ Return of Index on day t-1)

rt is the dependent variable and $rt - 1$ is the independent variable

$c1$ is constant

$c2$is coefficient

e is the residual

Returns are calculated taking the daily data of thirteen years starting from 1st April, 2004 to 31st March, 2017.

The objective behind developing the Model is to check whether the return on day ***t*** is affected by return on day ***t-1*** i.e. measuring volatility.

Above regression equation or model (eq1) is being run on E-Views 8 using least square method.

Residual derived from mean equation (1) is used in making variance equation (2).

$$GARCH = C3 + C4 * RESID(-1)^2 + C5 * GARCH(-1)$$ (eq 2)

Here *GARCH* = Variance of the residual (error term) derived from eq (1). It is also known as current day's variance or volatility of index.

C 3 is the constant

RESID $(-1)^2$ is previous day's squared residual derived from eq (1). It is also known as previous day's index information about volatility. It is the ARCH term.

GARCH (–1)is the previous day's residual variance. It is called the GARCH term.

*C*4&*C*5 are coefficients of ARCH & GARCH terms respectively.

Above GARCH (1, 1) variance equation or model (eq2) is being run on E-Views 8 using normal distribution.

Data Analysis and Interpretation

Comparing the Performance of Indian and Chinese IT Index

The performance of Indian and Chinese I.T. markets have been measured with the help of descriptive statistics applied on thirteen years daily returns i.e. from (1st April, 2004 to 31st March, 2017) of Indian and Chinese I.T. Index as shown in following table:

Table 2: Performance Statistics of Indian and Chinese I.T. Indices

Basic Statistics	India	China
Mean	0.044357	0.135
Median	0.076188	0.056108
Maximum	12.60016	72.67681
Minimum	-90.5416	-18.6006
Std. Dev.	2.573426	2.415782
Coefficient of Variation	5801.623	1789.468
Skewness	-17.4597	10.41743
Kurtosis	618.364	319.7323
Jarque-Bera	39477137	10868780
Probability	0	0
Sum	110.6276	349.5145
Sum Sq. Dev.	16509.94	15103.58
Observations	2494	2589

Note: Calculations were done on E-VIEWS 8; Values are significant at 1% level.

Both the Indices showed positive mean returns during the study period but Chinese I.T. Index showed highest mean return of (0.135) as compared to Indian I.T. Index (0.044357). Indian I.T. Index showed maximum return of 12.60016 units as compared to Chinese I.T. index depicting a maximum return of 72.67681 units, which is much higher than Indian I.T. Index.

The variation in terms of mean returns was measured through standard deviation, which was a little more in Indian I.T. Index (2.573426) as compared to Chinese I.T. Index (2.415782). This depicts that the stock returns vary a little more in case of Indian I.T. Index i.e. the index is more volatile.

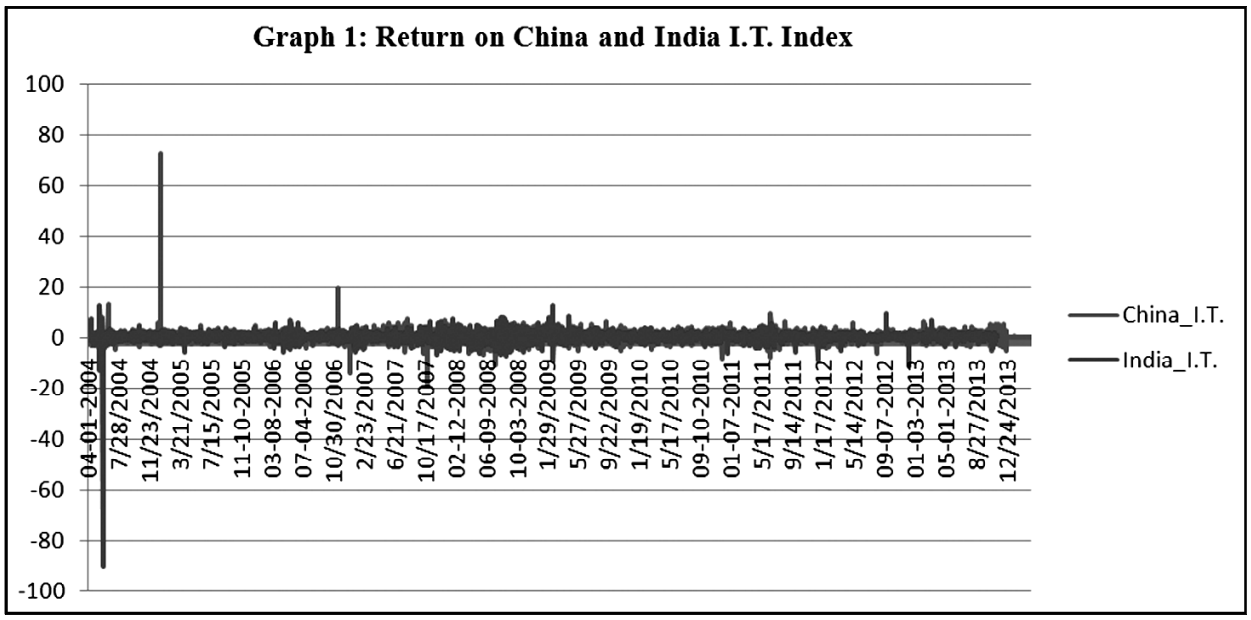
CV was found maximum in Indian I.T. Index (5801.623) percent as compared to Chinese I.T. Index showing (1789.468) percent. Thus, it can be interpreted that Indian I.T. markets are more risky than Chinese I.T. markets.

The skewness in both the Indiceswas different from zero; thus, showing that the return distribution series of both the Indices is not symmetric.

The value of kurtosis was greater than three in both the indices thus indicating that the return series of both the indices when diagrammatically shown will have heavier tails and both the series are leptokurtic in nature.

The computed values of JB (Jarque-Bera) statistics are significant at one percent level, thus null hypothesis is rejected i.e. there is no normality found in Indian and Chinese I.T. index return series.

The above interpretations can also be seen in the following graph:



Source: Author's own creation

The graph shows rough co-movement between Indian and Chinese I.T. Index. Although it is clear evidence from the graph that performance of Chinese I.T. Index is better as compared to Indian I.T. index. Hence from the investor's point of view, investing in Chinese I.T. markets will be much profitable and less risky as compared to investing in Indian I.T. markets. The results also reject the null hypothesis as the corresponding p-values are less than one percent significance level, showing that there is significant difference between the performance of Indian and Chinese I.T. Indices.

Comparing the volatility in Indian and Chinese I.T. Indices

Null Hypothesis: Indian and Chinese I.T. Index has a unit root

Table 3: Results of Unit Root Test

ADFTest	India	China
T-stat Value	-50.18540	-50.16489
Critical Values of ADF		
Significance Level	**India**	**China**
1%	-3.432779	-3.432779
5%	-2.862499	-2.862499
10%	-2.567326	-2.567326

Source: Author's own creation, *Note:* Values are significant at 1% level

Since the t-stat values are greater than all the critical values; hence, the null hypothesis is rejected i.e. Indian and Chinese I.T. Index do not have a unit root and thus, the data series is stationary.

Now the next step in the study was to model the volatility of Indian and Chinese I.T. index. For this purpose GARCH (1, 1) model was being applied to the data series of returns of Indian and Chinese I.T. index.

The regression equation or model (eq1) was being run on E-Views 8 using least square method. The output window showed the following table:

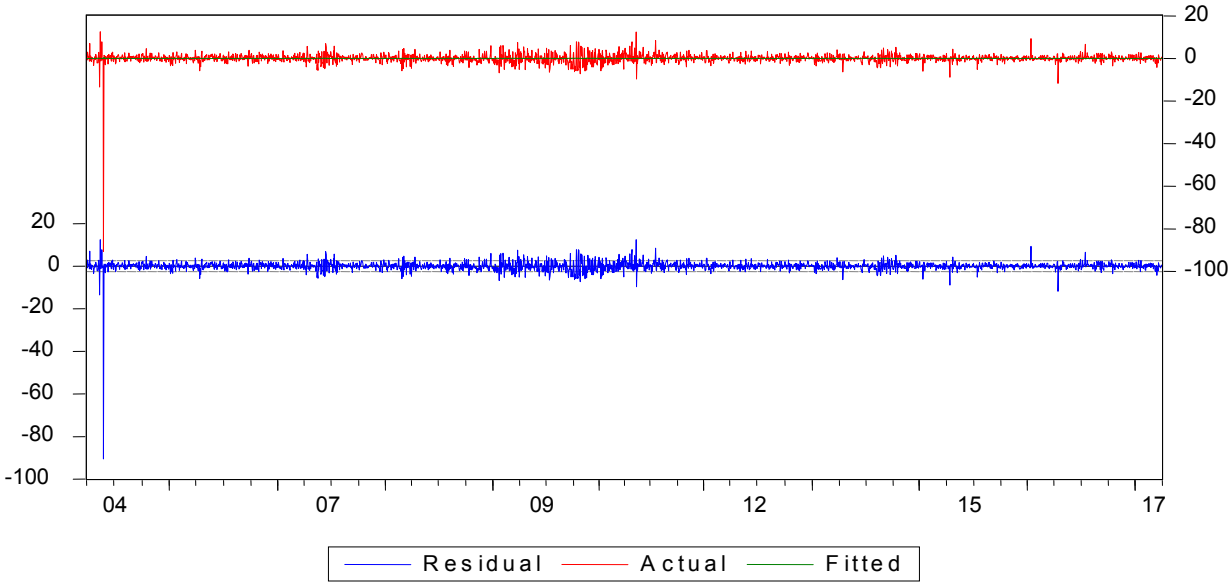
Table 4: Estimates of Mean Equation in Indian and Chinese I.T. Index

Index Descriptive Statistics	India		China	
	c	rt-1	c	rt-1
Coefficient	0.044598	-0.005475	0.133161	0.013620
t-value	0.865192	-0.273326	2.800047	0.692834
p-value	0.3870	0.7846	0.0051	0.4885
standard error	0.051547	0.020032	0.047557	0.019659

Source: Author's own creation

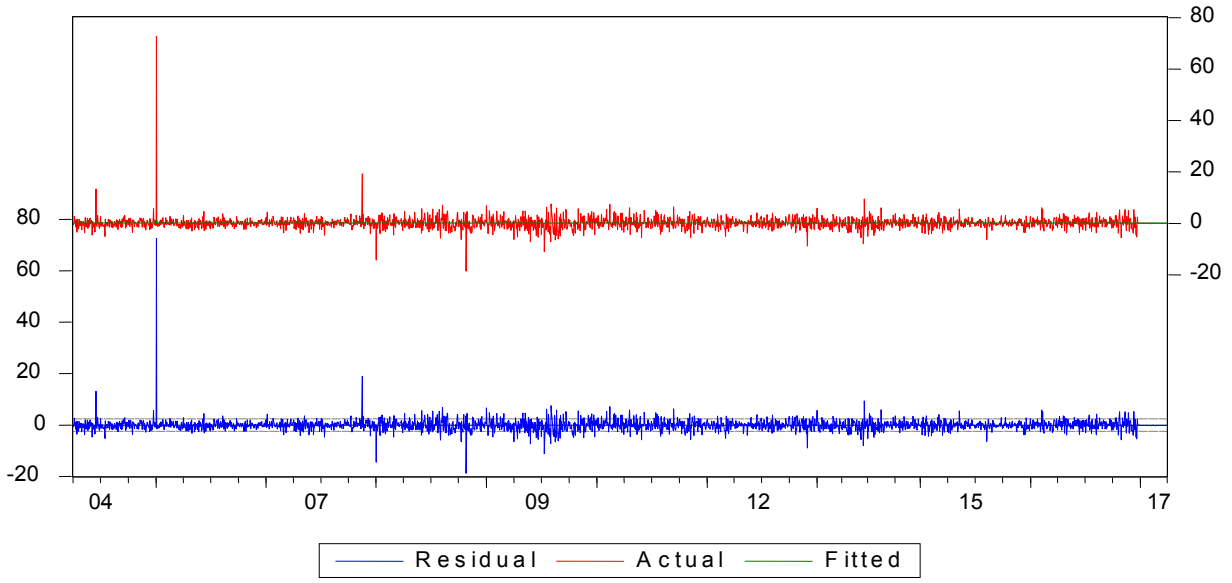
Residuals can be plotted on the graph with the help of the above outputs obtained.

Graph 2: Residual Distribution Graph of Indian I.T. Index



Source: Author's own creation

Graph 3: Residual Distribution Graph of Chinese I.T. Index



Source: Author's own creation

During 1st April, 2004 to 31st March, 2017 the residuals are fluctuating in Indian and Chinese I.T. index. From the above graphs it can be seen that in Indian ITindex, during April 2004 to mid of 2007 the fluctuation is small for a long time period of over three years. That means small fluctuation is creating another small fluctuation for a long time, which derives that small volatility is causing another small volatility for a long time. Again from mid of 2007 till mid of 2009 the volatility is peak in Indian IT index covering almost about two years. So, high volatility is creating another high volatility for a long period. In other words periods of low volatility are followed by periods of low volatility and periods of high volatility are followed

by periods of high volatility. This suggests that residual or error term is conditionally heteroscedastic and it can be represented by ARCH & GARCH model.

But, in case of Chinese I.T. index the returns appears to be fluctuating during the entire period of thirteen years. That is the volatility exists in the index but there is no pattern is no prolonged period of similar volatility i.e. high or low can be seen in an index. Thus it appears that the returns are not heteroscedastic in nature.

Residual derived from mean equation (1) is used in making variance equation (2).

GARCH (1, 1) variance equation or model (eq2) is being run on E-Views 8 using normal distribution. The output window showed the following table:

Null Hypothesis

H_O: ARCH term is not significant to explain the GARCH term.

Table 5: Estimates of Variance Equation in Indian and Chinese I.T. Index

Index Description		India	China
C	*Coefficient*	0.097348	3.774345
	Standard Error	0.007015	6.251969
	Z-stat	13.87634	0.603705
	P-stat	0.0000	0.5460
ARCH $[RESID(-1)^2]$	*Coefficient*	0.214940	-0.001710
	Standard Error	0.013516	0.003215
	Z-stat	15.90246	-0.531960
	P-stat	0.0000	0.5948
GARCH [GARCH(-1)]	*Coefficient*	0.816058	0.600786
	Standard Error	0.008855	0.661925
	Z-stat	92.15734	0.907635
	P-stat	0.0000	0.3641

Source: Author's own creation

The (coefficient of ARCH +coefficient of GARCH) in both the indices are non-zero and very close to but smaller than unity, therefore it can be interpreted that the model is valid that is mean returns on index will revert back to their previous values slowly. These ARCH and GARCH term represents the impact of recent and historical news/information respectively. The corresponding p-values of both ARCH and GARCH term are significant at 1% level in Indian I.T. index. Hence null hypothesis is rejected i.e. the ARCH term is significant to explain the volatility of GARCH term. Thus, it can be concluded that returns in Indian I.T. index are conditionally heteroscedastic. But the coefficient of GARCH term is significantly higher in Indian I.T. index thus explaining that the index returns are more affected by historical news. In Chinese I.T. Index the coefficient of ARCH term came out to be negative as well as statistically insignificant. Hence, the null hypothesis is accepted i.e. ARCH term is not significant to explain the GARCH term i.e. current day's volatility is not affected by previous days volatility i.e. the returns are not conditionally heteroscedastic. The negative ARCH term shows negative shock (a bad news). This shows the possibility of asymmetries in volatility i.e. the index returns are not heteroscedastic spread. The GARCH term also came out to be statistically insignificant. Hence, it can be interpreted that GARCH(1,1) model does not fit in Chinese I.T. index; since, the index returns have very poor volatility as well as asymmetries in volatility can be seen.

Conclusions and Recommendations

For those investors, whose investment portfolio includes Indian/Chinese I.T. Index stocks the results of present study indicates following recommendations: both the indices are yielding positive returns but Chinese I.T index has given higher returns during the period 2004-2017 as compared to Chinese I.T. index. Also, the investment was less risky. So, it was a green signal for investors of Chinese I.T stocks. But since Stock markets are unpredictable an investor should take decisions accordingly. The probable reason is that over the last few years China's I.T. sector has witnessed a massive growth. China is even planning to make this sector as a part of its seven strategic industries, which will help an economy to flourish growth through innovation and creativity. The largest internet users (500 million) from the world come from China. Thus, China's IT market is the fourth largest in the world. China is second largest software-outsourcing destination in the world next to India. Although the hardware markets of China earn only small margins. In 2015, revenue from IT sector reached total of $124.5 billion, up 7.5% from 2014.On the other hand; Indian I.T. stocks were not able to achieve high returns probably due to few political and economic scams and scandals in the country. The examples are

2G spectrum scam (2010), The Satyam Computer's Scam (2009), Speak Asia scam (2011), few Ponzi schemes, which collected thousands of crores of rupees from investors through online survey. But particularly if we look into Indian I.T. Stock market, a pattern has been seen that the small and mid-cap companies (First source Solutions, Persistent System, Larsen and Turbo Ltd, Sonata Software, Mindtree Ltd.), have always stolen the attraction of investors as compared to large cap companies. Thus "Separating Men from the Boys" in the market. As far as volatility in the indices is concerned, Indian I.T. markets are more volatile as compared to Chinese I.T. markets. In Indian market, an investor should plan investment accordingly by taking rational decision. Those who have invested in Indian/Chinese I.T. stocks should hold their investment for a long time. They may curb the volatility by ignoring short term volatility and thinking about future long term returns say for a period and 20-30 years.

References

- Akgiray, V. (1989).Conditional Heteroscedasticity in Time series of Stock Returns: Evidence and Forcasts. *The Journal of Business*, 62, 55-80.
- Andersen, T. G., Bollerslev, T., & Diebold, F. X. (2007). Roughing It up: Including Jump Components in the Measurement, Modeling, and Forecasting of Return Volatility. *The Review of Economics and Statistics*, 89(4), 701-720.
- Birău, R., & Trivedi, J. (2013). Modeling Return Volatility of Bric Emerging Stock Markets Using Garch Family Models. *Indian Journal of Applied Research,* 3(11), 119-121.
- Bollerslev, T., Ray, Y. C., & Kroner, K. F. (1992). ARCH modeling in Finance. *Journal of Econometrics*, 52, 5-59.
- Chan, L.K.C., J. Karceski& J. Lakonishok (1998). The Risk and Return from Factors, *Journal of Financial and Quantitative Analysis*, 33, 159 – 188.
- Engle, R. F., & NG, V. K. (1993). Measuring and Testing the Impact of News on Volatility. *The Journal of Finance*, 48(5), 1749-1778.
- Guo, H., & Savickas, R. (2003). Idiosyncratic Volatility, Stock Market Volatility, and Expected Stock Returns . *Federal Reserve Bank of St. Louis, Working Paper* 2003-028B.
- Joshi, P. (2010). Modeling Volatility in Emerging Stock markets of India and China. *Journal of Quantitative Economics*, 8(1).
- Lei, G. & Kling, G. (2005). Calendar Effects in Chinese Stock Markets. *Annals of Economics and Finance*, 6(1), 75-88.
- Maheshchandra, J. P. (2014). Long Memory Volatility of Stock Markets of India and Chin. *International Journal of Science and Research*, 3(7), 1198-1200.
- Mishra, A., Mishra, V., & Smyth, R. (2014). The Random-Walk Hypothesis on the Indian Stock Market. *Discussion Paper* 07/14, 1-28.
- Mobarak, A. M. (2005). Democracy, Volatility, and Economic Development. *The Review of Economics and Statistics*, 87(2), 348-361.
- Raju, M. T., & Ghosh, A. (2004). Stock Market Volatility – *An International Comparison. Securities and Exchange Board of India.*
- Schwert, W.G. (Dec 1989). Why does stock market volatility change over time? *The Journal of Finance*, 44(5).
- Thenmozhi, M., & Chandra, A. (2013). India Volatility Index (India VIX) and Risk Management in the Indian Stock Market. *National Stock Exchange of India*, 1-50.