Business Analyst, ISSN 0973 - 211X, 39(2), 119-135, ©SRCC

COMPARING THE VOLATILITY OF RETURNS IN INDIAN AND CHINESE PHARMACEUTICAL SECTOR

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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 Pharmaceutical Indices Returns during 2004 to 2017 i.e. thirteen years. Pharmaceutical 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 Pharmaceutical sector indices of the two economies. The results were calculated on E-Views 8 software.

Key words: Pharmaceutical, ADF Test, Stationarity, Volatility, Garch (1, 1), E-Views 8.

INTRODUCTION

"The love of economy is the root of all virtue": George Bernard Shaw

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 the performance of these economies over time, movements in their stock indices and the volatility spillover mechanism of their stock indices including the sectoral diversification. Analyzing the volatility of stocks, sectors and index as a whole has been one of the popular areas of research. With global diversification of equity investment and emergence of global mindset in investing fueled 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

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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 the 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 a 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 sectorial index performances of these economies. In the present research, the researcher has compared the performance and stock market volatility of Indian and Chinese Pharmaceutical Indices Returns. Pharmaceutical Sector forms one of the major industries of any economy and contributes to the GDP of that economy as well. Indian Pharmaceutical market is the third largest market in the world in terms of volume. The majority of revenue collected from the Pharma sector is sales of generic drugs constituting 70% revenue. The CAGR of Pharma market is 17.46 % in 2015 as compared to 6 billion in 2005. The cost of production is significantly lower in India as compared to US and European market which makes it more competitive. The country also enjoys major position in the global pharmaceutical market by providing 20 % of global generic medicines. The sector has received FDI of US$ 13.32 billion during 2000 to 2015. The Indian government has taken various initiatives to reduce cost of production in the Pharma sector and bring down healthcare expenses. While looking from China's point of view, the Pharmaceutical industry is one of the leading sectors of China. It includes Synthetic Chemicals, Apparatus and Instruments, Packing Materials, Prepared Chinese Medicines, Hygiene Materials, Medical Devices and Pharmaceutical Machinery. The Pharmaceutical market of China is currently second largest in the world (worth $ 105 billion). The overall pharmaceutical sales in 2015 had been $107.1 billion. The government is paying concern on the Parma sector by providing the RMB 1422.6 Billion expenditure in 2015. The generic drug sales in China had been RMB 614.8 Billion in 2015 which continue to dominate the market but the patented drugs also seeks significant growth in the sector (RMB 112.7 Billion).

The research investigates the comparison of volatility and stock market performance of

India and China Pharmaceutical 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 sectorial returns data of Chinese Stock Markets. Here the researcher has herself created the Chinese Pharmaceutical Indices for thirteen years on daily basis using Weighted Average Market Capitalization Method.

REVIEW OF LITERATURE

Volatility of stock returns in the developed countries has been studied extensively. After the seminal work of Engle (1982) on Autoregressive Conditional Heteroscedasticity (ARCH) model on UK inflation data and its Generalized form GARCH (Generalized ARCH) by Bollerslevet al. (1986), much of the empirical work used these models and their extensions to model characteristics of financial time series.

Initially SCHWERT (1989) analyzed the *relation of stock market volatility with real and nominal macroeconomic volatility, economic volatility, financial leverage and stock trading* activity using monthly data from 1857 to 1987. He noted the important fact mentioned by Officer (1973) is that the stock return variability was unusually high during the 1929-1939 Great Depression. While aggregate leverage is significantly correlated with volatility, it explains a relatively small part of the movements in stock volatility. The amplitude of the fluctuations in stock volatility is difficult to explain using simple models of stock valuations especially during the great Depression.

Time variation in market volatility can often be explained by macroeconomic and micro structural factors (Schwert, 1989a, and b). Volatility in national markets is determined by world factors and part determined by local market effects, assuming that the national markets are globally linked. It is also consistent that world factors could have an increased influence on volatility with increased market integration.

Bekaert and Harvey (1995) examined the emerging equity market characteristics in relation to developed markets. Emerging markets found to have four distinguishing features: average returns were higher, correlations with developed markets returns were low, returns were more predictable and volatility is higher. They argued that modeling volatility is difficult in emerging markets, especially in segmented markets. They finally found significant decline

in volatility in emerging markets following capital market liberalization.

Harvey (1995) found that serial correlation in emerging market returns are much higher than observed in developed markets. He argued that lack of diversification and trading depths in emerging markets are primarily responsible for such serial correlation pattern. Bekaertet al. (1998) argued that emerging markets returns are highly non-normally distributed and exhibit positive skewness in it.

Aggarwal et al. (1999) examined the events that caused large shifts in volatility in emerging markets. They found the dominance of local events in causing shifts in volatility. Volatility was high in emerging markets and shifts in volatility are related to important country specific political, social, and economic events. Mexican crisis, hyperinflation in Latin America, Marcos- Aquino conflict in Philippines and stock market scandal in India were some of the local events that caused significant shifts in volatility. Among global events, the October 1987 crash has caused significant volatility shifts during the study period 1985- 1995.

Aggarwal et al. examined whether global or local events are more important in causing major shifts in emerging markets' volatility by using iterated cumulative sums of squares (ICSS) algorithm to identify the points of shocks/sudden changes in the variance of returns in each market and how long the shift lasts. They then identify events around the time period when shifts in volatility occur. Most events tend to be local and include the Mexican peso crisis, periods of hyperinflation in Latin America, the Marcos-Aquino conflict in the Philippines, and the stock market scandal in India. The October 1987 crash is the only global event during the period 1985-1995 that caused a significant jump in the volatility of several emerging stock markets.

Hammoudeh and Li (2008) examined the sudden changes in volatility in emerging markets i.e. five Gulf area Arab stock markets. The study has identified large shifts in and found that most of the Gulf Arab stock markets were more sensitive to global events compared to local or regional events. This finding is in sharp contrast to the study of Aggarwal et al. (1999), which found dominance of local events in causing large shifts in volatility.

Prajapati*et al*. (2013) worked on 11 stock markets situated in different corners of the world. Their intension was to help investors to find those stock markets in which they can earn

profitable returns. Their study proposed the existence of day-of-the-week effect in all stock markets and hence those days which yield higher returns were profitable to invest for.

Mangala&Lohia (2013) successfully captured the equity performance of emerging markets taking Argentina, Brazil, China, India, Indonesia, Mexico, Malaysia, Russia and Taiwan. The performance was measured using basic statistics and testing the significance of stationarity in data through Augmented Dickey Fuller Test and Phillip Perron Test. Mexico showed the highest mean return followed by Brazil and Russia. However the variation was found highest in Argentina and lowest in Mexico. Trading in China, Malaysia and Taiwan was found riskier from investor's point of view.

RESEARCH METHODOLOGY

Objectives of Study:

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

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

Hypothesis:

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

ii. Ho2: There is no significant difference in the volatility of pharmaceutical 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 thirteen 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 the two economies accurately.

Data Collection:

Table 1: Source of Data Collection for China

Parameters	Internet Source
Nifty Pharma	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 Pharmaceutical 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.

Thereafter the first Objective was by initially calculating the daily returns in the index series 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 Pharmaceutical Index, Generalized Autoregressive Heteroscedastic, GARCH (1, 1) model is being used.

GARCH(1,1) has two parts:

i. 1) Mean Equation

ii. 2) Variance Equation

The mean equation is as follows:

$$rt = c1 + c2(rt - 1) + e \ldots \quad \ldots\ldots(1)$$

Here the variables are ***rt*** (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

***c*1** is constant

***c*2** is coefficient

e is the residual

Returns are calculated taking the daily data of 13 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).

$$GARCH = C3 + C4 * RESID(-1)^2 + C5 * GARCH(-1) \quad \text{.....(2)}$$

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.

C3 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.

C4 & C5 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 in Indian and Chinese Pharmaceutical Indices

The performance of Indian and Chinese Pharmaceutical 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 Pharma Index as shown in following table:

Table 2: Performance Statistics of Indian and Chinese Pharma Indices

Basic Statistics	India	China
Mean	0.067677	0.040889
Median	0.096243	0.045412
Maximum	11.80528	27.683
Minimum	-8.27137	-13.5928
Std. Dev.	1.258018	1.927131
Coefficient of Variation	1858.856	4713.079
Skewness	-0.33914	0.935119
Kurtosis	10.40141	25.26026
Jarque-Bera	5740.458	53831.45
Probability	0	0
Sum	168.787	105.8623
Sum Sq. Dev.	3945.448	9611.4
Observations	2494	2589

Source: Author's own Calculation

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 Indian Pharma Index showed highest mean return of (0.067677) as compared to Chinese Pharma Index (0.040889). Indian Pharma Index showed maximum return of 11.80528 units as compared to China Pharma index depicting a maximum return of 27.683 units which is contrastingly much higher than Indian Pharma Index.

The variation in terms of mean returns was measured through Standard Deviation which was less in Indian Pharma Index (1.258018) as compared to Chinese Pharma Index (1.927131). This depicts that the stock returns vary more in case of Chinese Pharma Index i.e. the index is more volatile.

CV was found maximum in Chinese Pharma Index (4713.079) percent as compared to Indian Pharma Index showing (1858.856) percent. Thus it can be interpreted that Chinese Pharma markets are more risky than Indian Pharma markets.

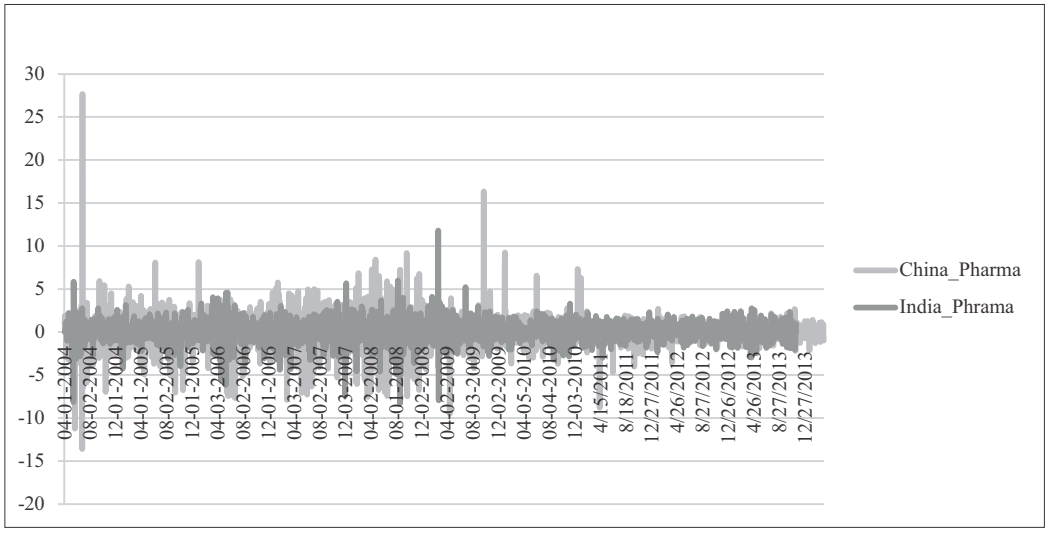
The skewness in both the Indices was found different from zero thus showing that the return distribution series of both the Indices is not Symmetric.

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 Pharma index return series.

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

Graph 1: Return on Indian and Chinese Pharmaceutical Index



The graph shows rough co-movement between Indian and Chinese Pharma Index. Although it is clear evidence from the graph too that performance of Indian Pharma Index is better as compared to Chinese Pharma index. Hence from the investor's point of view, investing in Indian Pharma markets will be much profitable and less risky too as compared to investing in Chinese Pharma markets. And as whole 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 Pharma Index.

Comparing the volatility in Indian and Chinese Pharmaceutical Indices

Null Hypothesis: Indian and Chinese Pharmaceutical Index have a unit root

Table 3: Results of Unit Root Test

ADFTest	India	China
T-stat Value	-47.05690	-51.69757
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 Calculation

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 Pharmaceutical 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 Pharmaceutical index. For this purpose GARCH (1, 1) model was being applied to the data series of returns of Indian and Chinese Pharmaceutical 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:

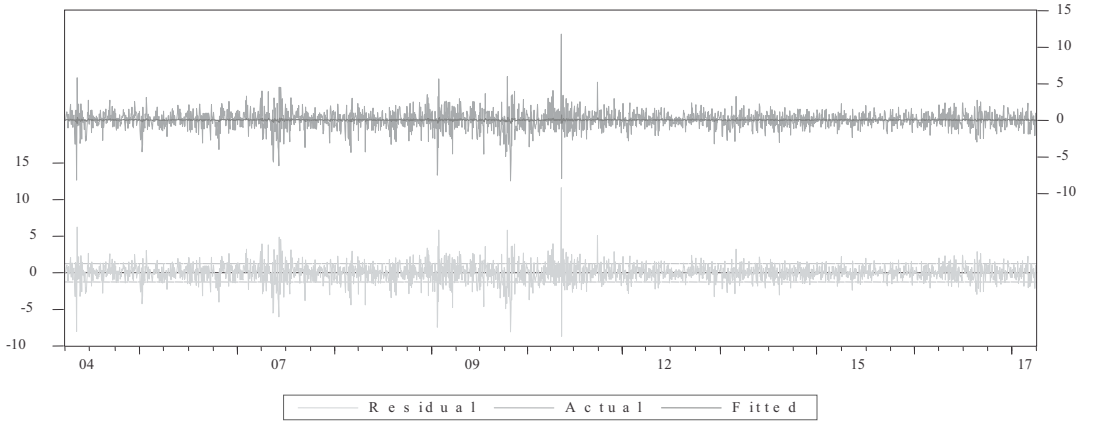
Table 4: Estimates of Mean Equation in Indian and Chinese Pharmaceutical Index

Index / Descriptive Statistics	India		China	
	c	rt-1	c	rt-1
Coefficient	0.063697	0.058795	0.041572	-0.016379
t-value	2.528832	2.940107	1.097299	-0.833202
p-value	0.0115	0.0033	0.2726	0.4048
standard error	0.025188	0.019997	0.037885	0.019658

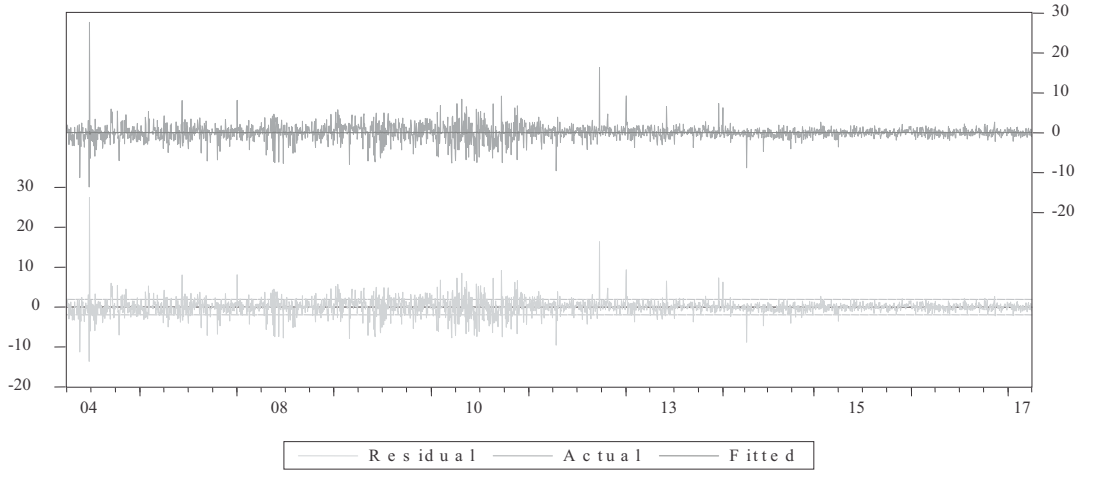
Source: Author's own Calculation

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

Graph 2: Residual Distribution Graph of Indian Pharmaceutical Index



Graph 3: Residual Distribution Graph of Chinese Pharmaceutical Index



During 1st April, 2004 to 31st March, 2017 the residuals are fluctuating in Indian and Chinese Pharmaceutical index. From the above two graphs it can be seen that in Indian Pharmaceutical index , during April 2004 to mid of 2006 the fluctuation is small for a long time period of over two years and in Chinese Pharmaceutical index the fluctuation is small during April, 2004 to mid of 2006 . 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 2006 till mid of 2009 the volatility is peak in Indian Pharmaceutical Index covering almost about three years and in Chinese Pharmaceutical index the volatility is peak during 2006 to mid of 2008 covering 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.

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_0: ARCH term is not significant to explain the GARCH term:

Table 5: Estimates of Variance Equation in Indian and Chinese Pharmaceutical Index

Description \ Index		India	China
C	*Coefficient*	0.065138	0.003381
	Standard Error	0.010542	0.001267
	Z-stat	6.179189	2.668142
	P-stat	0.0000	0.0076
ARCH [RESID(-1)^2]	*Coefficient*	0.125783	0.030206
	Standard Error	0.011538	0.001125
	Z-stat	10.90209	26.85508
	P-stat	0.0000	0.0000
GARCH [GARCH(-1)]	*Coefficient*	0.835881	0.970942
	Standard Error	0.014443	0.001158
	Z-stat	57.87523	838.6701
	P-stat	0.0000	0.0000

Source: Authors' Calculation

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 both Indian/Chinese Pharmaceutical 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 both Indian/Chinese Pharmaceutical index are conditionally heteroscedastic. But the coefficient of GARCH term is significantly higher in both the indices thus explaining that the index returns are more affected by historical news specifically more in case of Chinese

Pharmaceutical index. If it is being looked from the Volatility Comparison point of view, the table clearly shows that the volatility in Chinese Pharmaceutical Index returns is higher as compared to Indian Pharmaceutical Index.

CONCLUSIONS AND RECOMMENDATIONS

Investing in Indian Pharma markets will be much profitable and less risky too as compared to investing in Chinese Pharma markets. The probable reason is that Indian Pharmaceutical market is the third largest market in the world in terms of volume. The CAGR of Pharma market is 17.46 % in 2015 as compared to 6 billion in 2005. The cost of production is significantly lower in India as compared to US and European market which makes it more competitive. The sector has received FDI of US$ 13.32 billion during 2000 to 2015. The Indian government has taken various initiatives to reduce cost of production in the Pharma sector and bring down healthcare expenses. These things attract Investors. Especially the attraction is towards smaller companies like FDC Ltd. and Ipca Laboratories Ltd which are top gainers recently. Other blue chip companies like Apollo Hospitals Enterprice Ltd, Sanofi India Ltd, Fortis Healthcare Ltd have gained marginally.

However, the investor's should also consider the famous quote of Warren Buffett *"Be greedy when others are fearful and fearful when others are greedy"* before investing in these markets. Both Indian/Chinese Pharmaceutical index are conditionally heteroscedastic. But the coefficient of GARCH term is significantly higher in both the indices thus explaining that the index returns are more affected by historical news specifically more in case of Chinese Pharmaceutical index and making it more volatile as well."The higher level of volatility that comes with bear markets has a direct impact on portfolios. It also adds to the level of concern and worry on the part of investors as they watch the value of their portfolios move more violently and decrease in value. This causes irrational responses which can increase investors' losses. As an investor's portfolio of stocks declines, it will likely cause them to "rebalance" the weighting between stocks and bonds by buying more stocks as the price falls. Investors can use volatility to help them buy lower than they might have otherwise." From the Investors point of view as far as volatility in the indices is concerned, Chinese Pharma markets are more volatile as compared to Indian Pharma markets. Still for Investors knowledge the major players in Chinese Pharmaceutical sectorsare Harbin Pharma,Weigo Holding, North China Pharmaceutical Group, China National Pharmaceutical Group, Bayer

Healthcare China, Shanghai Pharmaceuticals, Kangmei Pharmaceuticals and so on. These companies have been included in the research as well. An investor should plan investment accordingly by taking rational decision. Those who have invested in Indian/Chinese Pharma 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.

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