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Volatility in stock market: evidence from india

N. Shunmuga Rajan[a] and N. Rajasekar[b]

[a]*Research Scholar,Manonmaniam Sundaranar University,Tirunelveli,Tamilnadu,India.*
[b]*Professor &Head, Department of Business Administration, Thiagarajar College, Madurai,Tamilnadu,India.*

ABSTRACT: Volatility has been one of the most active and successful areas of research in time series econometrics and economic forecasting in recent decades. Volatility is a statistical measure of the dispersion of returns for a given security or market Index. The main objective of the study is to analyze the volatility of Indian stock market. We have taken five oil sector companies from BSE for this study. The sample companies are Bharath Petroleum, Hindustan Petroleum, Indian Oil, ONGC and Reliance Industries. The Study was conducted from January 2007 to December 2012 and we employed Descriptive Model and Unit Root Test and GARCH Model for making the research more effective and we found that there is high volatility during the study period.

Keywords: Stock Market, Volatility, GARCH Model, Unit Root Test.

INTRODUCTION

Volatility is a statistical measure of the dispersion of returns for a given security or market index. Volatility is generally measured either by using the standard deviation or variance between returns from that same security or market index. Commonly, the higher the volatility, the riskier is the security. In terms of options pricing, volatility is a variable in option-pricing formula showing the extent to which the return of the underlying asset will fluctuate between now and the options expiration. Volatility, expressed as a percentage coefficient within option-pricing formula, arises from daily trading activities. How volatility is measured will affect the value of the coefficient used.

Volatility is the variability of the asset price changes over a particular period of time and it is very hard to predict it correctly and consistently. In financial markets volatility presents a strange paradox to the market participants, academicians and policy makers – without volatility superior returns are cannot be earned, since a risk free security offers meager returns, on the other hand if it is _high' it will lead to losses for the market participants and represent costs to the overall economy. Therefore there is no gainsaying with the statement that volatility estimation is an essential part in most finance decisions be it asset allocation, derivative pricing or risk management.

Volatility is an important phenomenon in markets in general and security markets in particular. Modeling stock market volatility has been the subject of empirical and theoretical investigation by both academicians and practitioners. As a concept, volatility is simple and intuitive. It measures the variability or dispersion about a central tendency. In other words, it measures how for the current price of an asset deviates from its average past values. The study of volatility becomes more important due to the growing linkages of national markets in currency, commodity and stock with rest of the world markets and existence of common players have given volatility a new property- that of its speedy transmissibility across markets. To many among the general public, the term volatility is simply synonymous with risk: in their view high volatility is to be deplored, because it means that security values are not dependable and the capital markets are not functioning as well as they should.

IMPLIED VOLATILITY

An essential element determining the level of option prices, volatility is a measure of the rate and magnitude of the change of prices (up or down) of the underlying. The volatility of a stock, *a,* is a measure of our uncertainty about the returns provided by the stock.

The volatility of a stock price can be defined as the standard deviation of the return provided by the stock in one year when the return is expressed using continuous compounding. If volatility is high, the premium on the option will be relatively high, and vice versa. Once the measure of statistical volatility (SV) for any underlying has been obtained, we can plug the value into a standard options pricing model and calculate the fair market value of an option. A model's fair market value, however, is often out of line with the actual market value for that same option. This is known as option mispricing. What does this all mean? To answer this question, a closer look at the role IV plays in option pricing is warranted.

NATURE OF STOCK MARKET VOLATILITY IN EMERGING MARKETS

There are few studies which examined emerging equity market volatility. 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. In fully integrated markets volatility is strongly influenced by world factors whereas in segmented markets it is strongly influenced by local factors. More open economies had lower volatility and political risk to a large extent explained the cross sectional variation in volatility. Finally, they found

significant decline in volatility in emerging markets following capital market liberalization. Bekaert et al. (1998) argued that emerging markets returns are highly non- normally distributed and exhibit positive skewness in it.

REVIEW OF LITERATURE

The study conducted by **Sharpe** (1966). He conducted a performance evaluation of 34 Open-ended oil during the period 1954-63 by the measure so developed. He found the performance of 11 funds superior to that of Dow Jones Industrial Average (DJIA). His study concluded that out of 34 funds selected, 19 had outperformed the benchmark in terms of total risk.

Treynor and Mazuy (1966) found no statistical evidence that investment managers of the 57 funds had successfully out guessed the market. The results suggested that the returns for an investor in oil was completely depend on fluctuations in the general market.

It did suggest that improvement in the rate f return was due to the fund manager's ability to identify under priced securities of industries and companies and not because of their ability to outguess turns in the level of market as a whole. These findings were based on the methodology developed earlier for reviewing the performance of fund management.

A study on the performance of oil sector by **Jenson** developed a composite portfolio evaluation technique that considered returns adjusted for risk differences and used it for evaluating 115 open-ended oil sector during the period 1945-66. For the full period, Jenson examined returns net of expenses and gross of expenses. The analysis of net returns indicated that 39 funds (34%) had above average returns adjusted for risk, while 7666%) experienced abnormality poor return.

Carlson in his study on the aggregate performance of oil sector (1970), examined the overall performance of Mutual Funds for the period 1948-1967 with emphasis on analyzing the effect of market series used over different time periods. The analysis of performance relative to the market indicated that results are heavily dependent on the market series used, viz; S and P 500, NYSE composite or DJIA. The results indicated no relationship with size or expense ratio, although there was a relationship between performance and a measure of new cash into funds.

STATEMENT OF THE PROBLEM

Most of the stock market investors are not able to pick rights stocks at right time and they met with loss. Our project work is taken to give guidance to the investors on how to invest in stocks at right time.

OBJECTIVES OF THE STUDY

- To analyze the volatility behaviour of selected companies listed in BSE.
- To analyze the volatility using GARCH model.

SCOPE OF THE STUDY

- This study helps us to understand the Indian stock market and its significant growth and guiding the investors for their investment.
- This study helps to know the reasons for volatility in Stock Market.
- This study can also be used as a referral for other forth coming studies in the similar field.

SAMPLE DESIGN

- **Sampling Area:** Indian Stock Market.
- **Population:** The population of the study is taken from BSE India.
- **Sample Companies:** 5 Oil Sector Companies Selected from BSE.
- **Study Period:** The study is being taken from January 2007 to December 2012(Monthly Closing price).
- **Sampling Techniques:** The research has adopted the non-probability convenience sampling. A convenience sampling is one in, which the sample units are chosen primarily on the basis of the convenience to the investigator.

SAMPLE COMPANIES FOR THE STUDY

- Bharath Petroleum Corporation Limited
- Hindustan Petroleum Corporation Limited
- Indian Oil Corporation Limited
- Oil and Natural Gas corporation Limited
- Reliance Industries Limited

TOOLS USED FOR THE STUDY

- Descriptive Model
- Unit Root Test
- GARCH Model

Software Used

E.Views-7

- **DESCRIPTIVE MODEL**

Descriptive statistics are typically distinguished from inferential statistics. With descriptive statistics you are simply describing what is or what the data shows. With inferential statistics, you are trying to reach conclusions that extend beyond the immediate data alone. For instance, we use inferential statistics to try to infer from the sample data what the population might think.

❖ **UNIT ROOT TEST**

A linear stochastic process has a unit root if 1 is a root of the process's characteristic equation. Such a process is non-stationary. If the other roots of the characteristic equation lie inside the unit circle — that is, have a modulus (absolute value) less than one — then the first difference of the process will be stationary.

- AR(1) models
  - Model: $Y_t - \mu = \rho (Y_{t-1} - \mu) + e_t$
  - Y_t = observation at time t
  - e_t = error or "shock" at time t (assumed id normal)
  - μ = series mean (assumed constant over time)
  - ρ = Autoregressive coefficient

❖ **GARCH MODEL**

Generalized Auto Regressive Conditional Heteroskedasticity (GARCH) Process

An econometric term developed in 1982 by Robert F. Engle, an economist and 2003 winner of the Nobel Memorial Prize for Economics to describe an approach to estimate volatility in financial markets. There are several forms of GARCH modeling. The GARCH process is often preferred by financial modeling professionals because it provides a more real-world context than other forms when trying to predict the prices and rates of financial instruments.

DATA ANALYSIS AND INTERPRETATION

❖ **DESCRIPTIVE STATISTICS**

TABLE NO - 1 DESCRIPTIVE STATISTICS OF SELECTED INDEXES FROM 2007 TO 2012

Index	Mean	Median	Std.dev	Skewness	kurtosis
BPCL	0.048521	-0.070000	-2.612705	0.702160	6.609628
HPCL	-0.453544	-0.630000	2.686514	0.711123	6.355765
IOC	-0.453544	-0.630000	2.686514	0.711123	6.355765
ONGC	0.056543	0.000000	2.322051	0.185370	7.559834
RELIANCE	0.094768	0.050000	2.563964	0.299623	9.761782

Source: Compute from E Views Version 7

The table presents a summary of Descriptive Statistics for month ending returns of the oil Industries. The mean average returns were high for Reliance Industries compared to other companies. The mean average returns were low for HPC, IOC. The median average returns were high for Reliance Industries. The median average return was low for Bharath Petroleum. The skewness values are positive and kurtosis too.

❖ **UNIT ROOT TEST**

TABLE NO. 4.2 UNIT ROOT TEST FOR BHARATH PETROLEUM

		t-statistic	Prob*
Augmented Dickey-Fuller test statistic		- 38.26077	0.0000
Test critical values	1% level	- 3.434543	
	5% level	- 2.863279	
	10% level	- 2.567744	

Source: Compute from E Views Version 7

Table–4.2 reports the results of Augmented Dickey Fuller Test of Stationary of Bharath petroleum returns for the study period. It is to be noted that the Bharath petroleum are stationary in the level difference itself with the value of -38.26077 and with the probability value of 0.00000. The test statistic value was smaller than the Test Critical values were -3.434543, -2.863279 and -2.567744 at 1% level, 5% level and 10% level respectively. It is concluded that during the study period, the returns of Bharath petroleum were stationary in the level difference itself. Hence, the return values were considered to be stationary.

TABLE NO.4.3 UNIT ROOT TEST FOR HINDUSTAN PETROLEUM CORPORATION

		t-statistic	Prob*
Augmented Dickey-Fuller test statistic		-7.325169	0.0000
Test critical values	1% level	-3.434570	
	5% level	-2.863291	
	10% level	-2.567751	

Source: Compute from E Views Version 7

Table – 4.3 reports the results of Augmented Dickey Fuller Test of Stationary of Hindustan petroleum returns for the study period. It is to be noted that the Hindustan petroleum are stationary in the level difference itself with the value of -7.325169 and with the probability value of 0.00000. The test statistic value was smaller than the Test Critical values were -3.434570, -2.863291 and -

2.567751 at 1% level, 5% level and 10% level respectively. It is concluded that during the study period, the returns of Hindustan petroleum were stationary in the level difference itself. Hence, the return values were considered to be stationary.

TABLE NO.4.4 UNIT ROOT TEST FOR HINDUSTAN PETROLEUM CORPORATION

Augmented Dickey-Fuller test statistic		**t-statistic**	**Prob***
		-7.325169	0.0000
Test critical values	1% level	-3.434570	
	5% level	-2.863291	
	10% level	-2.567751	

Source: Compute from E Views Version 7

Table – 4.4 reports the results of Augmented Dickey Fuller Test of Stationary of Hindustan petroleum returns for the study period. It is to be noted that the Hindustan petroleum are stationary in the level difference itself with the value of -7.325169 and with the probability value of 0.00000. The test statistic value was smaller than the Test Critical values were -3.434570, -2.863291 and -2.567751 at 1% level, 5% level and 10% level respectively. It is concluded that during the study period, the returns of Hindustan petroleum were stationary in the level difference itself. Hence, the return values were considered to be stationary.

TABLE NO. 4.5 UNIT ROOT TEST FOR OIL AND NATURAL GAS CORPORATION LIMITED

Augmented Dickey-Fuller test statistic		- 37.00278	0.0000
Test critical values	1% level	- 3.434543	
	5% level	- 2.863279	
	10% level	- 2.567744	

Source: Compute from E Views Version 7

Table–4.5 reports the results of Augmented Dickey Fuller Test of Stationary of Oil And Natural Gas Corporation Limited returns for the study period. It is to be noted that the Oil And Natural Gas Corporation Limited are stationary in the level difference itself with the value of -37.00278 and with the probability value of 0.00000. The test statistic value was smaller than the Test Critical values were -3.434543, -2.863279 and -2.567744 at 1% level, 5% level and 10% level respectively. It is concluded that during the study period, the returns of Oil And Natural Gas Corporation Limited were stationary in the level difference itself. Hence, the return values were considered to be stationary.

TABLE NO.4.6 UNIT ROOT TEST FOR RELIANCE INDUSTRIES

Augmented Dickey-Fuller test statistic		**t-statistic**	**Prob***
		-35.84324	0.0000
Test critical values	1% level	-3.434543	
	5% level	-2.863279	
	10% level	-2.567744	

Source: Compute from E Views Version 7

Table–4.6 reports the results of Augmented Dickey Fuller Test of Stationary of Reliance Industries returns for the study period. It is to be noted that the Reliance Industries are stationary in the level difference itself with the value of -35.84324 and with the probability value of 0.00000. The test statistic value was smaller than the Test Critical values were -3.434543, -2.863279 and -2.567744 at 1% level, 5% level and 10% level respectively. It is concluded that during the study period, the returns of Reliance Industries were stationary in the level difference itself. Hence, the return values were considered to be stationary.

❖ **GARCH MODEL**

TABLE NO. 4.7 GARCH MODEL FOR BHARATH PETROLEUM

GARCH = C(1) + C(2)*RESID(-1)^2 + C(3)*GARCH(-1)

Variable	**Coefficient**	**Std. Error**	**z-Statistic**	**Prob.**
Variance Equation				
C	0.579671	NA	NA	NA
RESID(-1)^2	-0.012067	NA	NA	NA
GARCH(-1)	0.519575	NA	NA	NA

Source: Compute from E Views Version 7

The results of GARCH (1, 1) effect for Bharath petroleum returns are given in **Table-4.7**. According to the Table, the effect of mean equation co-efficient of Bharath petroleum was 0.579671. The Co-efficient of parameters Bharath petroleum _C‘ at 0.579671, Resid (-1) at -0.012067 and GARCH (-1) 0.519575. The sum of Resid (-1) + GARCH (-1) Bharath petroleum was close to one. This reveals the Bharath petroleum experienced the lower volatility. It‘s not at the very risky to the investors during the study period from 2006 to 2012.

TABLE NO.4.8 GARCH MODEL FOR HINDUSTAN PETROLEUM CORPORATION

GARCH = C(1) + C(2)*RESID(-1)^2 + C(3)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Variance Equation				
C	0.261509	0.052695	4.962700	0.0000
RESID(-1)^2	0.092654	0.013912	6.660110	0.0000
GARCH(-1)	0.874272	0.017940	48.73412	0.0000

Source: Compute from E Views Version 7

The results of GARCH (1, 1)effect for Hindustan petroleum returns are given in **Table-4.8**. According to the Table, the effect of mean equation co-efficient of Hindustan petroleum was 0.261509. The Co-efficient of parameters Hindustan petroleum _C' at 0.261509, Resid (-1) at 0.092654 and GARCH (-1) 0.874272. The sum of Resid (-1) + GARCH (-1) Hindustan petroleum was close to one. This reveals the Hindustan petroleum experienced the lower volatility. It's not at the very risky to the investors during the study period from 2006 to 2012.

TABLE NO. 4.9 GARCH MODEL FOR INDIAN OIL CORPORATION LIMITED

GARCH = C(1) + C(2)*RESID(-1)^2 + C(3)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Variance Equation				
C	0.004776	0.000348	13.73441	0.0000
RESID(-1)^2	0.194230	0.018241	10.64791	0.0000
GARCH(-1)	0.837521	0.012060	69.44739	0.0000

Source: Compute from E Views Version 7

The results of GARCH (1, 1) effect for Indian Oil Corporation Limited returns are given in **Table - 4.9**. According to the Table, the effect of mean equation co-efficient of Indian Oil Corporation Limited was 0.004776. The Co-efficient of parameters Indian Oil Corporation Limited _C' at 0.004776, Resid (-1) at 0.194230 and GARCH (-1) 0.837521. The sum of Resid (-1) + GARCH (-1) Indian Oil Corporation Limited was close to one. This reveals the Indian Oil Corporation Limited experienced the lower volatility. It's not at the very risky to the investors during the study period from 2006 to 2012.

TABLE NO. 4.10 GARCH MODEL FOR OIL AND NATURAL GAS CORPORATION LIMITED

GARCH = C(1) + C(2)*RESID(-1)^2 + C(3)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Variance Equation				
C	1.097199	NA	NA	NA
RESID(-1)^2	-0.012044	NA	NA	NA
GARCH(-1)	0.519606	NA	NA	NA

Source: Compute from E Views Version 7

The results of GARCH (1, 1) effect for Oil And Natural Gas Corporation Limited returns are given in **Table-4.10**. According to the Table, the effect of mean equation co-efficient of Oil And Natural Gas Corporation Limited was 1.097199. The Co-efficient of parameters Oil and Natural Gas Corporation Limited _C' at 1.097199, Resid (-1) at -0.012044 and GARCH (-1) 0.519606. The sum of Resid (-1) + GARCH (-1) Oil And Natural Gas Corporation Limited was close to one. This reveals the Oil And Natural Gas Corporation Limited experienced the lower volatility. It's not at the very risky to the investors during the study period from 2006 to 2012.

TABLE NO.4.11 GARCH MODEL FOR RELIANCE INDUSTRIES

GARCH = C(1) + C(2)*RESID(-1)^2 + C(3)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Variance Equation				
C	0.478221	NA	NA	NA
RESID(-1)^2	-0.012072	NA	NA	NA
GARCH(-1)	0.519567	NA	NA	NA

Source: Compute from E Views Version 7

The results of GARCH (1, 1) effect for Reliance Industries returns are given in **Table-4.11.** According to the Table, the effect of mean equation co-efficient of Oil And Reliance Industries was 0.478221. The Co-efficient of parameters Reliance Industries _C‘ at0.478221, Resid (-1) at -0.012072 and GARCH (-1) 0.519567. The sum of Resid (-1) + GARCH (-1) Reliance Industries was close to one. This reveals the Reliance Industries experienced the lower volatility. It‘s not at the very risky to the investors during the study period from 2006 to 2012.

FINDINGS

BHARATH PETROLEUM

- The result of Augmented Dickey Fuller Test is noted that the Bharath petroleum is stationary in the level difference itself with the value of -38.26077.
- The results of GARCH (1, 1) effect for Bharath petroleum The Co-efficient of parameters Bharath petroleum _C‘ at 0.579671, Resid (-1) at -0.012067 and GARCH (-1) 0.519575.

HINDUSTAN PETROLEUM

- The results of Augmented Dickey Fuller Test is noted that the Hindustan petroleum are stationary in the level difference itself with the value of -7.325169.
- The results of GARCH (1, 1) effect for Hindustan petroleum The Co-efficient of parameters Hindustan petroleum _C‘ at 0.261509, Resid (-1) at 0.092654 and GARCH (-1) 0.874272.

OIL AND NATURAL GAS CORPORATION LIMITED

- The result of Augmented Dickey Fuller Test is noted that the Oil And Natural Gas Corporation Limited are stationary in the level difference itself with the value of 37.00278.
- The results of GARCH (1, 1) effect for Oil And Natural Gas Corporation Limited the Co-efficient of parameters Oil And Natural Gas Corporation Limited _C‘ at 1.097199, Resid (-1) at -0.012044 and GARCH (-1) 0.519606.

RELIANCE INDUSTRIES

- The results of Augmented Dickey Fuller Test is noted that the Reliance Industries are stationary in the level difference itself with the value of -35.84324.
- The results of GARCH (1, 1) effect for Reliance Industries. The Co-efficient of parameters Reliance Industries _C‘ at0.478221, Resid (-1) at -0.012072 and GARCH (-1) 0.519567.

INDIAN OIL CORPORATION LIMITED

- The result of Augmented Dickey Fuller Test is noted that the Indian Oil Corporation Limited are stationary in the level difference itself with the value of -5.336787.
- The results of GARCH (1, 1) effect for Indian Oil Corporation Limited. The Co-efficient of parameters Indian Oil Corporation Limited _C‘ at 0.004776, Resid (-1) at 0.194230 and GARCH (-1) 0.837521.

CONCLUSION

One and half years ago, stock market (SENSEX) has crashed from 20,000 to 9000 because of economic crisis in US economy. It affected stock market throughout the world. So majority of the people started selling their shares to avoid the huge loss. It further reduced the SENSEX value and broke the past twenty year‘s record. Now the situation is slowly recovering with the help of steps taken by government of all countries. So this is chance for the investors to get more profit in the future by investing the money on the selected sectors.

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