CHAPTER-6
FINDINGS AND IMPLICATIONS OF THE STUDY

6.1 OVERVIEW
Volatility represents risk and is a matter of concern for anyone who is dealing with money or investing in the stock market or any other financial instruments. Hence, the issue of volatility has become increasingly significant in recent times for the financial practitioners, market participants, retail investors, regulators and researchers.

Although the issue of stock market volatility is of vital importance, yet limited efforts have been made in India to examine it empirically and adequately. A plethora of research has been done on this subject in developed markets such as USA, Australia, UK and other European markets, and some emerging markets of Southeast Asia and Latin America. However, only one or two studies have been done on the magnitude and pattern of volatility in the Indian stock market. The present study is an attempt to fill this gap and aims to empirically investigate stock market volatility in India.

6.2 OBJECTIVES OF THE STUDY
The objectives of the present study are as under:
1. To study the trends of volatility in Indian stock market.
2. To examine the factors which influence volatility of stock prices.
3. To study the relationship between volatility and stock price behaviour.
4. To analyze the positive and negative consequences of volatility.
5. To arrive at stock market volatility model.

6.3 EXTENT AND PATTERN OF VOLATILITY OF STOCK MARKET INDICES
The summary results of measurements done for the market indices viz. BSE Sensex and S&P CNX nifty, are as follow.

6.3.1 Yearly Volatility of Monthly Returns
6.3.1.1 It has been found that the market volatility was the highest during the year 2008 (in case of BSE 41.47% and in case of NSE 43.13%) followed by 2009 (in case of BSE 32.84% and in case of NSE 33.74%), 1997 (in case of BSE 28.10% and in case of NSE 27.51%), 2000 (in case of BSE 27.62% and in case of NSE 27.35%).
6.3.1.2 The year 2008 witnessed violent changes in stock price for the reasons such as (a) Investor disappointed because Reliance Power stock went below issue price on debut; (b)
Chinese government announced a $586-billion infrastructure and public welfare spending package on Sunday to support the economy; (c) The Bear Stearns crisis led to a sharp fall in the US market, and this was echoed across Asian markets.

6.3.1.3 The year 2009 also recorded higher volatility. The main reasons were (a) Chairman of Satyam Computer Services, Mr. B. Ramalinga Raju’s admittance to the company’s hugely inflated balance sheet; (b) Reports of US plan to help banks and financial institutions dispose of their toxic assets; (c) Stock market greeted the victory of the Congress-led alliances.

6.3.1.4 The main reasons of volatility in stock price occurred in 1997 were (a) Announcement by congress President withdrawing the party’s support to the ruling United Front Government. President asks PM to prove majority before April 7th; (b) Worldwide meltdown in stock markets.

6.3.1.5 The market volatility was also highest during year 2000. The main reasons were (a) Union Budget causes disappointment due to doubling of dividend tax, levy of progressive tax on export earning, failed to address macro-economic issues such as fiscal deficit, government spending and public sector disinvestment; (b) Reports of Income tax department issuing notices to FII who route investment through Mauritius.

6.3.1.6 For the period under study, the overall monthly volatility of Sensex was 7.35% and of Nifty was 7.40%. The corresponding annualized figures are 25.43% and 25.60% respectively. While the monthly volatility has been in the range of 4% to 12% for Sensex and 5% to 13% for Nifty. The annualized volatility has been in the range of 17% to 42% for Sensex and 16% to 44% for Nifty.

6.3.2 Yearly Volatility of Daily Returns

6.3.2.1 It has been found that the year 2008 (44.7% for BSE and 44.05% for NSE) recorded the highest volatility followed by 2009 (34.19% for BSE and 33.40% for NSE). The year-wise analysis showed that volatility was calmer during the period 1996 to 1999 but it rose in 2000 (33.20% for BSE and 31.65% for NSE). Again, it was calmer during the period 2001 to 2007, but it rose consecutively to a record level for the next two years, i.e., 2008 and 2009.

6.3.2.2 The overall daily volatility of both Sensex and Nifty was 1.64% each for the whole period under study. The corresponding annualized figures are 25.91% each. While the daily volatility has been in range of 1% to 3% for both Sensex and Nifty. The annualized volatility has been in range of 16% to 45% for both Sensex and Nifty.
6.3.3 Monthly Volatility of Daily Return

6.3.3.1 Volatility has varied across the months in a year and across the years, the year 2008 being the most volatile of all the years. Almost all the months in 2008 were found to be most volatile as compared to the corresponding months in other years.

6.3.3.2 Further the month of May (1.78%) has been observed as most volatile followed by March (1.74%) and April (1.71%) in the case of Sensex. This could have been for the reason that the Union budget, is usually presented at the fag end of February.

6.3.3.3 In the case of Nifty October (1.81%) has been the most volatile followed by May (1.77%) and April (1.74%). This could be probably due to the Diwali period.

6.3.4 Top 25 most volatile months

6.3.4.1 It has been found that October 2008 stands out as the most volatile month followed by May 2009 for the Sensex. For Nifty, the most volatile month was October 2008 followed by May 2004. Interestingly, top two volatile months in the case of Sensex and one such month in the case of Nifty belong to the period 2008 and 2009 when the volatility was at the extreme level.

6.3.4.2 Out of the 25 most volatile months of the period under study, 9 months belong to the year 2008 in the case of Sensex; while in the case of Nifty, 7 months pertain to the year 2008. It shows that the year 2008 is the most volatile year.

6.3.4.3 Overall, for Sensex and Nifty 15 of the most volatile months belong to the years 2008, 2009, 2000 and 1997, 2 months each belong to the years 1998 and 2006, and 1 month each to 1999, 2004 and 2007. However, in the case of Sensex, 3 of the most volatile months belong to the year 2001, while for Nifty 2 months belong to the year 2001 and 1 month belongs to year 1996.

6.3.5 Spike Volatility

6.3.5.1 Daily returns in excess of ±4.92% are considered as "spikes". For both the indices, the year 2008 (BSE 27 and NSE 25) tops the list with the highest number of spikes (negative or positive), followed by 2000 (BSE 10 and NSE 7). It can be said that the years with more frequent spikes had higher overall volatility also.

6.3.5.2 It has been found that for the Sensex, there were 70 days out of total 3965 trading days out of selected period under study on which daily return was outside the plus or minus 4.92% limit.

6.3.5.3 Similarly, for Nifty, there were 64 days out of 3992 trading days out of selected period under study on which the spikes occurred.
6.3.5.4 The largest one-day price change as well as positive change in both Sensex (+15.99%) and Nifty (+16.33%) occurred on 18 May, 2009 as stock market greeted the victory of the congress-led alliance. This was in direct contrast to what happened on May 17, 2004, after the general elections that brought the same Congress-led UPA to power.

6.3.5.5 The largest negative change in the value of Sensex (-11.8%) and Nifty (-13.05%) occurred on May 17, 2004. This was due to the unexpected defeat of the NDA government in the Parliamentary elections.

6.4 FACTORS AFFECTING STOCK MARKET VOLATILITY

6.4.1 Impact of FII on Stock Market

6.4.1.1 It has been found that ADF statistic is -4.408207 for FII. The ADF value for FII is lesser than critical values leading to inference of rejection of hypothesis with unit root at 1%, 5% and 10% level of significance. This proves that the time series data of net FII investments is stationary.

6.4.1.2 The results shows that ADF statistic is -4.588579 for volatility of BSE Sensex return and -5.136850 for volatility of NSE Nifty return. Both the ADF values for volatility of stock market return of BSE Sensex and NSE Nifty are lesser than critical values leading to inference of rejection of hypothesis with unit root at 1%, 5% and 10% level of significance. This proves that the time series data of stock market volatility in BSE Sensex and NSE Nifty is stationary.

6.4.1.3 Results from Granger Causality suggest independence between FII and stock market volatility i.e. BSE Sensex and NSE Nifty. It means there is no relationship between FII equity flows and volatility of stock market returns in India.

6.4.1.4 It has been observed that for the H$_i$ and H$_j$ hypothesis, the probability is 0.25180 and 0.60501 respectively, which is greater than critical value 0.05, hence, null hypothesis (H$_{oi}$ : Net FII investment does not Granger cause Volatility in the Stock Market (BSE), H$_{oj}$ : Stock Market Volatility (BSE) does not Granger cause Net FII investment) is accepted, i.e., it proves that foreign institutional investments do not cause stock market volatility (BSE Sensex) and volatility in BSE Sensex does not cause FII investment. Similarly results appear for H$_k$ and H$_l$ hypothesis thus, null hypothesis (H$_{ok}$ : Net FII investment does not Granger cause Volatility in the Stock Market(NSE), H$_{ol}$ : Stock Market Volatility(NSE) does not Granger cause Net FII investment) is accepted in these cases also.
6.4.1.5 Thus, it has been found that FII equity flows have neither increased nor dampened volatility of stock market returns in India. There could be several reasons for such insignificant relationship.
6.4.1.6 One of the reasons could be that FIIs are allowed to perform only delivery based trading and are not allowed to indulge in short selling. This considerably restricts trading activity.
6.4.1.7 Secondly, FIIs had to register with an Indian broker to carry out their transactions (Mazumdar, 2004). They were required to pay higher brokerage for trading as compared to domestic institutional investors. This made their transactions more expensive than those of domestic institutions.
6.4.1.8 Thirdly, FIIs have expert knowledge, and therefore, can accurately make predictions about emerging markets performance in advance, and hence, pro-active with regard to invest or withdraw decision (Dhillon and Kaur, 2007).
6.4.1.9 Despite the significant share that is allowed to foreign institutional investments in India, there is no evidence of any strong statistical relationship between FII equity flows and volatility of stock market returns in India.

**6.4.2 Impact of Union Budget on Stock Market**
6.4.2.1 It has been found that in most of the cases budget day returns (ignoring sign) are more than the returns during the previous 30, 15 and 3 trading days.
6.4.2.2 When the budget day returns (Z) compared with the long-term pre-budget return in the case of Sensex, it shows that budget day returns exceed in all years i.e. (19 out of 19 budgets), compared to medium-term (19 out of 19 budgets) and short-term (13 out of 19 budgets).
6.4.2.3 In case of Nifty it shows that budget day returns exceed (18 out of 19 budgets) when compared with the long-term pre-budget returns, when the budget day returns (Z) compared with the medium-term pre-budget return, it shows that budget day returns exceed (18 out of 19 budgets) and when the budget day returns (Z) compared with the short-term pre-budget returns, it shows that budget day returns exceed (14 out of 19 budgets).
6.4.2.4 It has been further statistically tested by Paired t test. The budgets are found to take the markets by surprise in all the cases. In all the tests, the actual values are found to exceed the table values leading to acceptance of alternative hypothesis.
6.4.2.5 In the second set of tests, it has been found that budget have maximum impact in the short-term period (alternative hypotheses have been accepted in all three cases). In medium-term, the alternative hypothesis have been accepted in two out of three cases and in long-term, no alternative hypothesis have been accepted. In total, the actual values exceed the tabular values in five cases (3+2+0) out of nine at the left tail.

6.4.2.6 It has been found that budgets, when taken together, have the maximum impact in the short term post-budget period, with some impact extending into the medium-term and no significant impact at all on long-term average returns.

6.4.2.7 F-test shows, in the case of Sensex barring the year 2002, in no other year the actual value exceeded the tabular value. However, in Nifty, there was no case where the actual value exceeded the tabular value. This signifies that volatility does not generally increase in post-budget situation as the time progresses.

6.4.2.8 When variance of returns in Sensex and Nifty during short-term, medium-term, and long-term post-budget periods with that of long-term pre-budget period. In the case of Sensex, maximum number of significant cases (in 9 out of 19 budgets) appeared during the long-term period as compared to medium-term (in 6 out of 19 budgets) and short-term (in 2 out of 19 budgets) periods. However, in the case of Nifty, maximum number of significant cases (in 10 out of 19 budgets) emerged during the long-term period as compared to medium-term (in 7 out of 19 budgets) and short-term (in 2 out of 19 budgets) periods. It indicates that the long-term period after the budget tends to be more volatile than the medium-term and short-term periods as compared to similar long-term period before the budget.

6.4.2.9 Budget day moves made since the year 1996, the steep cut was witnessed in the year 2009 when the Sensex and Nifty tumbled over 6%. Silence on major policy reforms, increase in MAT and soaring deficits were some of the irritants that led to the decline.

6.4.2.10 In 2000, once again, the Sensex tumbled over 5 per cent and Nifty over 4%. The budget caused disappointment among the investors as it did not live up to the `hype' created ahead of its announcement. The increase in the tax on dividend outgo for companies and subjecting export earnings to a 20 per cent tax per annum over the next five years were seen as unfavourable by the market and also, the Budget failed to address macro-economic issues such as fiscal deficit, Government spending and public sector disinvestment.
6.4.2.11 The stock markets fell by 3 per cent with a lukewarm budget in 2002. In 2007, the stock market crashed by 4 per cent. This was the biggest fall on a Budget day in the past few years. The fall was due to market unfriendly Union budget. It increased dividend distribution tax from 12.5 per cent to 15 per cent, followed by an increase in excise duty on cement prices, and an extension of minimum alternate tax (MAT) for the IT sector.

6.4.2.12 It has been found that there have been occasions when budget had helped the market to move up in jiffy. In 1997, 1999, 2001 and 2005, popular measures taken by the finance minister like relaxations in taxes helped the Sensex and Nifty to climb sharply.

6.4.3 Impact of Inflation on Stock Market

6.4.3.1 It has been found that ADF statistic is -4.956150 for Inflation. The ADF value is lesser than critical values leading to inference of rejection of hypothesis with unit root at 1%, 5% and 10% level of significance. This proves that the time series data of inflation is stationary.

6.4.3.2 The results show that ADF statistic is -4.588579 for volatility of BSE Sensex return and -5.136850 for volatility of NSE Nifty return. Both the ADF values for volatility of stock market return of BSE Sensex and NSE Nifty are lesser than critical values leading to inference of rejection of hypothesis with unit root at 1%, 5% and 10% level of significance. This proves that the time series data of stock market volatility in BSE Sensex and NSE Nifty is stationary.

6.4.3.3 Results from Granger Causality suggest independence between inflation and stock market volatility, i.e., BSE Sensex and NSE Nifty. It can be clearly observed that for the H_m and H_n hypothesis, the probability values are 0.91553 and 0.12785 respectively, which are greater than critical value 0.05, hence, null hypothesis (H_m: Inflation does not Granger cause Stock Market Volatility(BSE), H_n : Stock Market Volatility(BSE) does not Granger cause Inflation) is accepted. It proves that inflation does not cause stock market volatility (BSE Sensex) and volatility of BSE Sensex return do not cause Inflation. A similar position exists in the case of H_o and H_p hypotheses and hence, null hypothesis (H_o: Inflation does not Granger cause Stock Market Volatility (NSE), H_p : Stock Market Volatility(NSE) does not Granger cause Inflation) is accepted in these cases also.
6.4.3.4 It can be inferred that inflation neither increases nor dampens volatility of stock market returns in India. There could be several reasons for such insignificant relationship. However, it could be due to net inflows brought by the FIIs and the FDIs.

6.4.4 Impact of Interest rate on Stock Market

6.4.4.1 It has been found that in most of the cases, announcement of interest rate day returns (ignoring sign) are more than the returns during the previous 30, 15 and 3 trading days.

6.4.4.2 When the announcement of interest rate day returns (Z) compared with the long-term pre-announcement of interest rate return in the case of Sensex, it shows that announcement of interest rate day returns exceed in all years i.e. (15 out of 15) compared to medium-term (12 out of 15) and short-term (11 out of 15).

6.4.4.3 In case of Nifty it shows that when the announcement of interest rate day returns (Z) compared with the long-term pre-announcement of interest rate return, it shows that announcement of interest rate day returns exceed (14 out of 15) compared to medium-term (12 out of 15) and short-term (12 out of 15) that budget day returns exceed.

6.4.4.4 It has been further statistically tested by Paired t-test. The announcements of interest rate are found to take the markets by surprise in all cases. In all the tests, the actual values are found to exceed the table values leading to acceptance of alternative hypothesis.

6.4.4.5 In the second set of tests, which proves that announcement of interest rate has maximum impact in the short-term period (alternative hypotheses have been accepted in all the three cases). However, in medium-term and long-term periods, the alternative hypotheses have been accepted in one out of three cases. In total, the actual values exceed the tabular values in five cases (3+1+1) out of nine at the left tail. This proves that announcement of interest rate, when taken together, has maximum impact in the short-term post-announcement of interest rate period, with some impact extending into the medium-term and long-term average returns.

6.4.4.6 F-test shows, in case of Sensex and Nifty, except in two years, in no other year the actual value exceeds the tabular value. This signifies that volatility does not generally increase in post-announcement of interest rate situation as time period increases.

6.4.4.7 When the variance of returns in Sensex and Nifty during short-term, medium-term and long-term post-announcement of interest rate periods with that of long-term pre-announcement of interest rate period. In the case of both Sensex and Nifty, there
have been 9 out of 15 significant cases in the long-term period, whereas the medium-term and short-term periods are represented by 8 out of 15 and 4 out of 15 such cases respectively. It indicates that the long-term period and medium-term period after the announcement of interest rate tend to be more volatile than the short-term period when compared to similar long-term period before the announcement of interest rate.

6.4.5 Impact of Corporate Fundamentals on Stock Market

6.4.5.1 Analysis of HDFC Bank

The results of the test reveal that in both the cases, i.e., BSE and NSE the F-values are significant for being less than the significance level of 0.05. Hence, null hypothesis that there is no relationship between the market price and independent variables in the case of both BSE (H₀) and NSE (Hₒr) stands rejected. The computed values of Durbin-Watson statistics are 1.78 and 1.75 in the case of BSE and NSE respectively. Hence, no autocorrelation exists.

The value of R in both the cases is 0.985 which shows a stronger relationship. For regression equation, R² is 0.970 in both the cases, indicating that 97.0 per cent of the variation in market price is explained by the variations in Earning Price share and Price/Earning ratio.

In both the regression equations two of the predictors have positive b-values indicating positive relationships. Hence, in both the cases market price increases with an increase in Earning Per share as well as Price Earning Ratio.

**Coefficients of HDFC Bank (BSE Sensex)**

**Earning Per Share** (EPS) (b = 27.37): This value indicates that as EPS increases by Re.1, MP increases by Rs.27.37. This interpretation stands true only if the effect of P/E is held constant.

**Price/Earning Ratio** (P/E) (b =10.11): This value indicates that as P/E increases by Re.1, MP increases by Rs.10.11. This interpretation is true only if the effect of EPS is held constant.

**Coefficients of HDFC Bank (S&P CNX Nifty)**

**Earning Per Share** (EPS) (b = 27.35): This value indicates that as EPS increases by Re.1, MP increases by Rs.27.35. This interpretation stands true only if the effect of P/E is held constant.
**Price/Earning Ratio (P/E)** (b =10.09): This value indicates that as P/E increases by Re. 1, MP increase by Rs. 10.09. This interpretation is true only if the effect of EPS is held constant.

For both the models, the EPS and P/E are the significant predictors of market price as their values stand below the significance level of 0.05. The magnitude of t-statistics reflects that EPS has greater impact than P/E in both the cases.

**6.4.5.2 Analysis of State Bank of India**

The results of the test reveal that in both the cases, the F-values are significant for being less than the significance level of 0.05. Hence, null hypothesis that there is no relationship between the market price and independent variables in the case of both BSE (H₀) and NSE (H₀₀) stands rejected. The computed values of Durbin-Watson statistics are 1.77 and 1.19 in the case of BSE and NSE respectively. Hence, no autocorrelation exists.

The values of $\hat{R}^2$ are 0.983 (BSE) and 0.977 (NSE) which reflect a stronger relationship. For regression equation, $R^2$ values are 0.966 (BSE) and 0.954 (NSE) indicating that 96.6 per cent and 95.4 per cent respectively of the variation in market price is explained by the variations in Earning Per Share, Book Value, and Price/Earning Ratio.

In both the regression equations two of the predictors have positive b-values indicating positive relationships and one has a negative b-value showing a negative relationship. Hence, market price increases with an increase in Price Earning Ratio as well as Book value. However, a decrease in Earning Per Share causes an increase in market price.
Coefficients of State Bank of India (BSE Sensex)

**Earning Per Share** (EPS) \( (b = -2.21) \): This value indicates that as EPS decreases by Re. 1, MP increases by Rs. 2.21. This interpretation stands true only if the effects of BV and P/E are held constant.

**Book Value** (BV) \( (b = 1.64) \): This value indicates that as BV increases by Re. 1, MP increases by 1.64. This interpretation stands true only if the effects of EPS and P/E are held constant.

**Price/Earning Ratio** (P/E) \( (b = 36.53) \): This value indicates that as P/E increases by Rs. 1, MP increases by Rs. 36.53. This interpretation is true only if the effects of EPS and BV are held constant.

Coefficients of State Bank of India (S&P CNX Nifty)

**Earning Per Share** (EPS) \( (b = -10.60) \): This value indicates that as EPS decreases by Re. 1, MP increases by Rs. 10.60. This interpretation stands true only if the effects of BV and P/E are held constant.

**Book Value** (BV) \( (b = 1.84) \): This value indicates that as BV increases by Re. 1, MP increases by 1.84. This interpretation stands true only if the effects of EPS and P/E are held constant.

**Price/Earning Ratio** (P/E) \( (b = 97.49) \): This value indicates that as P/E increases by Rs. 1, MP increases by Rs. 97.49. This interpretation is true only if the effects of EPS and BV are held constant.

For both the models, the EPS, BV, and P/E are the significant predictors of market price as their values stand below the significance level of 0.05. The magnitude of t-statistics reflects that P/E has greater impact than BV and EPS in both the cases.

### 6.4.5.3 Analysis of Tata Motors

The results of the test reveal that in both the cases the F-values are significant for being less than the significance level of 0.05. Hence, null hypothesis that there is no relationship between the market price and independent variables in the case of both BSE \( (\text{H}_0) \) and NSE \( (\text{H}_0) \) stands rejected. The computed values of Durbin-Watson statistics are 1.57 and 1.92 in the case of BSE and NSE respectively. Hence, no autocorrelation exists.

The values of \( \hat{\sigma}^2 \) are 0.947 (BSE) and 0.982 (NSE) which prove a stronger relationship. For regression equation, \( R^2 \) values are 0.897 (BSE) and 0.964 (NSE),
indicating that 89.7 per cent and 96.4 per cent respectively of the variation in market price is explained by variations in Dividend Per Share, Book Value and Dividend Yield.

In both the regression equations two of the predictors have positive b-values indicating positive relationships and one has a negative b-value showing a negative relationship. Hence, with the increase in Dividend Per Share, market price increases as other variables like Book value and Dividend Yield remain constant. Similarly, with increase in Book Value and decrease in Dividend Yield individually (if other variables remain constant), market price increases. The b-values also explain what degree each predictor affects the outcome if the effects of all other predictors are held constant.

**Coefficients of Tata Motors (BSE Sensex)**

- **Dividend Per Share** (DPS) \( (b = 50.77) \): This value indicates that as DPS increases by Re. 1, MP increases by Rs. 50.77. This interpretation stands true only if the effects of BV and DY are held constant.
- **Book Value** (BV) \( (b=1.25) \): This value indicates that as BV increases by Re. 1, MP increases by Rs. 1.25. This interpretation stands true only if the effects of DPS and DY are held constant.
- **Dividend Yield** (DY) \( (b = -127.85) \): This value indicates that as DY increases by Re. 1, MP decreases by Rs. 127.85. This interpretation stands true only if the effects of DPS and BV are held constant.

**Coefficients of Tata Motors (S&P CNX Nifty)**

- **Dividend Per Share** (DPS) \( (b = 58.12) \): This value explains that as DPS increases by Re. 1, MP increases by Rs. 58.12. This interpretation stands true only if the effects of BV and DY are held constant.
- **Book Value** (BV) \( (b =0.97) \): This value depicts that as BV increases by Re. 1, MP increases by 97 paise only. This interpretation stands true only if the effects of DPS and DY are held constant.
- **Dividend Yield** (DY) \( (b = -145.46) \): This value reflects that as DY increases by Re. 1, MP decreases by Rs. 145.46. This interpretation stands true only if the effects of DPS and BV are held constant.

For both the models, the DPS, BV, and DY are the all significant predictors of market price as their values appear below 0.05. The magnitude of t-statistics reflects that DPS has deeper impact than DY and BV in both the cases.

**6.4.5.4 Analysis of Mahindra and Mahindra**
The results of the test describe that in both the cases, i.e., BSE and NSE the F-values are significant for being less than the significance level of 0.05. Hence, null hypothesis that there is no relationship between the market price and independent variables in the case of both BSE (H_{0q}) and NSE (H_{0r}) stands rejected. The computed values of Durbin-Watson test are 1.28 and 1.46 in the case of BSE and NSE respectively. Hence, no autocorrelation exists.

The values of $\hat{\sigma}R\hat{\sigma}$ are 0.991 (BSE) and 0.959 (NSE) which show a stronger relationship. For regression equation, $R^2$ values are 0.983(BSE) and 0.920 (NSE), indicating that 98.3 per cent and 92.0 per cent respectively of the variation in market price is explained by variations in Earning Price Share, Price/Earning Ratio and Dividend Yield.

In both the regression equations, three of the predictors have positive b-values indicating positive relationships. Hence, with the increase in Earning Per Share market price increases as other variables like Price Earning Ratio and Dividend Yield remain constant. Similarly, with increase in P/E and DY individually (if other variables remain constant), market price increases.

**Coefficients of Mahindra and Mahindra (BSE Sensex)**

**Earning Per Share (EPS) (b = 13.98):** This value reflects that as EPS increases by Re.1, MP increases by Rs 13.98. This interpretation stands true only if the effects of P/E and DY are held constant.

**Price/Earning Ratio (b = 28.02):** This value indicates that as P/E increases by Re. 1, MP increases by Rs. 28.02. This interpretation stands true only if the effects of EPS and DY are held constant.

**Dividend Yield (DY) (b = 3.94):** This value indicates that as DY increases by Re. 1, MP increases by Rs. 3.94. This interpretation stands true only if the effects of EPS and P/E are held constant.

**Coefficients of Mahindra and Mahindra (S&P CNX Nifty)**

**Earning Per Share (EPS) (b = 15.11):** This value explains that as EPS increases by Re.1, MP increases by Rs. 15.11. This interpretation stands true only if the effects of P/E and DY are held constant.
Price/Earning Ratio (b = 19.29): This value means that as P/E increases by Re. 1, MP increases by Rs. 19.29. This interpretation stands true only if the effects of EPS and DY are held constant.

Dividend Yield (DY) (b = 5.65): This value indicates that as DY increases by Re. 1, MP increases by Rs. 5.65. This interpretation stands true only if the effects of EPS and P/E are held constant.

For both the models, the EPS, P/E, and DY are the significant predictors of market price as their values appear less than the significance level of 0.05. The magnitude of t-statistics reflects that EPS has greater impact than P/E and DY in both the cases.

6.4.5.5 Analysis of Hero Motors

The results of the test reveal in both the cases the F-values are significant for being less than the significance level of 0.05. Hence, null hypothesis that there is no relationship between the market price and independent variables in the case of both BSE (H_{0b}) and NSE (H_{0r}) stands rejected. The computed values of Durbin-Watson test are 1.78 and 1.45 in the case of BSE and NSE respectively. Hence, no autocorrelation exists.

The values of \(\hat{\sigma}^2\) is 0.997(BSE) and 0.996(NSE) which prove a stronger relationship. For regression equation, \(R^2\) values are 0.994 (BSE) and 0.996 (NSE), indicating that 99.4 per cent and 99.6 per cent of the variation in market price is explained by variations in Earning Price Share, Price/Earning Ratio, Dividend Yield.

In both the regression equations, two of the predictors have positive b-values indicating positive relationships and one has a negative b-value showing a negative relationship. Hence, market price increases with an increase in Earning Per Share as well as Price Earning Ratio. However, a decrease in Dividend Yield causes an increase in market price.

Coefficients of Hero Motors (BSE Sensex)

Earning Per Share (EPS) (b = 17.24): This value indicates that as EPS increases by Re.1, MP increases by Rs. 17.24. This interpretation stands true only if the effects of P/E and DY are held constant.

Price/Earning Ratio (b = 25.76): This value indicates that as P/E increases by Re. 1, MP increases by Rs. 25.76. This interpretation comes true only if the effects of EPS and DY are held constant.
**Dividend Yield (DY)** (b = -18.15): This value explains that as DY increases by Re. 1, MP decreases by Rs. 18.15. This interpretation appears true only if the effects of EPS and P/E are held constant.

**Coefficients of Hero Motors (S&P CNX Nifty)**

**Earning Per Share (EPS)** (b = 17.78): This value denotes that as EPS increases by Re.1, MP increases by Rs 17.78. This interpretation comes true only if the effects of P/E and DY are held constant.

**Price/Earning Ratio** (b = 29.15): This value reflects that as P/E increases by Re. 1, MP increases by Rs. 29.15. This interpretation stands true only if the effects of EPS and DY are held constant.

**Dividend Yield (DY)** (b = -11.61): This value indicates that as DY increases by Re. 1, MP decreases by Rs. 11.61. This interpretation comes true only if the effects of EPS and P/E are held constant.

For both the model, the EPS, P/E, and DY are the significant predictors of market price as their values appear less than the significance level of 0.05. The magnitude of t-statistics reflects that EPS has greater impact than P/E and DY in both the cases.

The results of the test reveal that in all the selected companies (HDFC Bank, State Bank of India, Tata Motors, Mahindra and Mahindra, and Hero Motors) and in both the cases (i.e. BSE and NSE) the F-values are significant for being less than the significance level of 0.05. Hence, the null hypothesis that there is no relationship between the market price and independent variables in the case of both BSE (H₀) and NSE (H₀) stands rejected. The computed values of Durbin-Watson test in the case of all the selected companies are less than 2 which reflect that no autocorrelation exists.

The values of R and R² are greater than 0.90 in all companies under study as well as in BSE and NSE which establish a stronger relationship between Market Price and independent variables while R² indicates that 90.0 per cent of the variation in market price is explained by variations in independent variables respectively.

The regression analysis further provides that in all the companies under study as well as in BSE and NSE, the variables such as EPS, P/E, and DY have contributed most in determining share prices. It has also been found that EPS, and P/E are the most important determinants which have influenced the share price in banking sector, while in the automobile sector DY, P/E and EPS are the most significant variables.

**6.5 RELATIONSHIP OF VOLATILITY AND STOCK PRICE RETURNS**
It has been found that all the coefficients are significant. In the case of both BSE Sensex and NSE Nifty, ARCH and GARCH coefficients are positive and leverage term is negative, i.e. BSE Sensex (-0.077) and NSE Nifty (-0.083) and statistically different from zero indicating the existence of the leverage effect for the stock market returns during the period under study. Therefore return is negatively correlated with volatility. This implies that returns tend to be more volatile in response to bad news and less volatile in response to good news i.e. evidence of asymmetry in stock price behaviour.

The observations of the present study just document as evidence of the findings developed by Schwert (1989), French et al. (1987), Christie (1982) and Black (1976). They also found out that returns are negatively correlated with volatility. The main reason of negative correlation between stock and volatility is leverage effect, i.e., when stock price declines, the value of equity relative to corporate debt also reduces. Thus, it leads to increase the risk of holding stocks.

6.6 FORECASTING STOCK MARKET VOLATILITY USING GARCH MODEL

6.6.1 The time series graph of daily returns on Sensex and Nifty reveals that returns continuously fluctuated around the mean value that was close to zero. The return measures were both in positive and negative area. More fluctuations be tending to cluster together and were separated by periods of relative calm. This was in agreement with Fama's (1965) observation of "volatility clustering" (Volatility Clustering means that large changes in time series tend to be followed by large changes and small changes be followed by small changes.).

6.6.2 From the time series graph of the returns for both the markets, it is analyzed that high volatilities are followed by high volatilities and low volatilities are followed by low volatilities. That means time series have important time varying variances. Additionally, it is appropriate to put conditional variance into the function to clarify the impact of risk on the returns. Hence, GARCH model is the excellent tool for the study.

6.6.3 For Sensex and Nifty, the skewness statistic for daily returns is found to be different from zero indicating that the return distribution is not symmetric.

6.6.4 Furthermore, the relatively large excess kurtosis suggests that the underlying data is leptokurtic or heavily tailed and sharply peaked about the mean when compared with the normal distribution.
6.6.5 The Jarque-Bera statistic calculated to test the null hypothesis of normality rejects the normality assumption. The results confirm the well-known fact that daily stock returns are not normally distributed but are leptokurtic and skewed.

6.6.6 The calculated p-values of ADF for both markets (BSE Sensex and S&P CNX Nifty) were less than the significance level of 0.05 which leads to an inference that both the return series are stationary.

6.6.7 The values of $Q^2(1)$ test statistic reject the null hypothesis which confirmed the presence of first-order autocorrelation in the series. The existence of a leptokurtic distribution, presence of volatility clustering suggested an ARCH or GARCH process, which was confirmed by computing the value of Lagrange Multiplier (LM) which rejects the null hypothesis. To sum up, the analysis indicates that daily return series of the index are not normal and exhibits ARCH effect.

6.6.8. As for the stationarity of the variance process, it was observed that $\hat{U}_t + \hat{\delta}_t$ is 0.983 for Sensex (value of $\hat{U}_t$ is +0.120 and that of $\hat{\delta}_t$ is +0.863) and for S&P CNX Nifty it was observed that $\hat{U}_t + \hat{\delta}_t$ is 0.981 (value of $\hat{U}_t$ is +0.130 and that of $\hat{\delta}_t$ is +0.851). Hence, Stationarity condition ($\hat{U}_t + \hat{\delta}_t < 1$) is satisfied in both markets.

6.6.9 However, the sum was rather close to one which indicated a long persistence of shocks in volatility implies a long memory.

6.6.10 A large value of GARCH lag coefficients $\hat{\delta}_t$ (+0.863 for Sensex and +0.851 for Nifty) indicates that shocks to conditional variance take a long time to die out, so the volatility is persistent.

6.6.11 Low value of error coefficient $\hat{\delta}_t$ (i.e., +0.120 for Sensex and +0.130 for Nifty) suggests that market surprises induce relatively small revisions in future volatility.

6.6.12 The present study has attempted to devise a volatility forecast model for the BSE Sensex and S&P CNX Nifty, and concluded the GARCH(1,1) specification fits the Sensex return and Nifty return time series quite well.

6.6.13 The value of one-day-ahead volatility is .00008118 for Sensex and .00008663 for Nifty. Hence, one-day-ahead volatility can be forecast from constructed model.

**6.7 IMPLICATIONS OF THE FINDINGS OF THE STUDY**

6.7.1 Implications for Investors

The present study and its empirical findings would be useful to investors as it provides strong evidence of stock market volatility in India. Investors always aim at making more profitable and less risky investments. Therefore, it is of utmost importance
for them to study and analyze stock market volatility, among many other factors, before making investment decisions.

It has appeared from the period under study the month of May has been the most volatile followed by March and April in the case of Sensex. This could be probably due to the most significant economic activity in a year, viz. the presentation of Union budget, usually on the last day of February. There is a lot of speculation in the run-up to the Budget as to what is stored in it. After the presentation of the Budget, the market reacts sharply to the actual announcements made as a part of the budget. Therefore, an investor needs to be cautious while investing around the presentation of the Budget. It is a time when the risk taken may lead an investor to a great profit or a loss.

It has appeared from the period under study the month of October has been the most volatile followed by the months of April and May in case of Nifty. This could be probably due to the festive period of Diwali. Another reason that could be attributed to it is that companies declare their financial results in the first week of September. The investors’ decision to buy/sell a particular company’s scrip depends on the financial position registered by the companies. An investor should, therefore, consider investing around this period if he can bear the heightened risk.

The investor should also be aware of the fact that the Indian stock market has a very strong speculative element. Also, investing in the Indian stock market is riskier than investing in other developed and developing stock markets of the world. Therefore, the investors need to take cognizance of this fact before investing in the Indian stock market.

6.7.2 Implications for Policy-makers and Regulatory Agencies

There has been extensive research on stock market volatility in both the developed and some of the developing countries. However, not much work has been done on the Indian stock market from volatility perspective. It has been found to be quite useful in portfolio risk assessment, designing regulatory mechanisms for the market and introducing sophisticated financial products such as options and futures. The present study attempts to present a comprehensive analysis of the stock market volatility in India.

Volatility per se is not unnatural or unwanted. However, excessive volatility caused by irrational (speculative) behaviour of the traders and investors, trading mechanism imperfections and lack of information transparency is not desirable. If stock market volatility increases, it may have serious repercussions for investors and policy-
makers. Investors may equate higher volatility with greater risk and may alter their investment decisions due to increased volatility. Policy-makers may remain concerned that stock market volatility will spill over into the real economy and harm economic performance. Apart from it, they may feel that increased stock volatility threatens the viability of financial institutions and the smooth functioning of financial markets.

In the past, some episodes of excessive volatility were reported which led to boom and busts in the stock market causing heavy losses to millions of investors as well as the traders. The stock market in India has had its fair share of crises engendered by excessive speculation resulting in excessive volatility, for example the Pay Order Scam of 2001. On this occasion, market players had defaulted on their payment commitments plunging the markets into chaos. The widespread concern of the stock exchange management, brokers and investors alike focused upon the need of measuring and predicting stock market volatility so that an effective monitoring mechanism can be developed to avoid dangers associated with excessive volatility. In this way, the present study could be beneficial to policy-makers and stock exchange regulatory authorities in framing appropriate policy guidelines for the benefit of investors and smooth working of the stock market.

It is found that volatility has not increased due to the arrival of the FII investments. In fact, liberalizing foreign access to domestic capital markets can bring substantial benefits to developing countries. Liberalization enables countries to tap into large overseas pools of capital bringing in FII investment that increases price-earning ratios and the depth and liquidity of the domestic capital market. This in turn reduces the cost of capital for domestic firms. Moreover, foreign participation may have important spillover effects on emerging markets in the form of improved accounting and disclosure practices and human capital. The findings about the impact of FII investment on stock market volatility can be used for guiding FII investments in India.

Volatility is central to many investment decisions in new product areas; and it is the critical variable in option pricing. The cost of many sophisticated hedging strategies, such as portfolio insurance, also depends on the level of market volatility. The present study has attempted to devise a volatility forecast model for the BSE Sensex and S&P CNX Nifty, and concluded the GARCH(1,1) specification fits the Sensex return and
Nifty return time series quite well. Such constructs can be used while designing advanced financial products such as derivatives.

6.8 SCOPE FOR FURTHER RESEARCH

Although a sincere effort has been made to produce the present study as representative in the field of stock market volatility, yet it is limited in its scope to examine only the specific objectives. Some of the important issues that can be considered for further research are as under:

- The present study has restricted itself to the two major stock market indices. Now-a-days, numerous indices specifically designed to track a specific industry group or market capitalization category are maintained by research agencies and financial dailies. Further studies can be conducted involving other indices available.
- There are number of factors which result into either rise or fall of stock prices. However, the present study examines only a few factors having impact on stock market volatility. Future research can be directed towards investigating other factors that affect the stock market volatility.
- Volatility is said to be related to the frequency of trading and traded volume. With the online availability of high frequency trading data, research can be conducted in order to establish the relationship of volatility with the trading volume and the frequency of trades.
- Volatility could depend upon the trading mechanism prevalent in a specific market. There could be separate mechanisms for opening and closing trades thereby leading to different volatility patterns during the course of trading day. It might be interesting to investigate the effects of the mechanism used to curb excessive volatility, e.g., Circuit breakers and Circuit filters. A related area of research could be the effect of arbitrage opportunities across various stock markets in India.
- The present study analyses the influence of various company related fundamental factors on stock prices and it included only two sectors. Future research can be directed towards investigating the impact of fundamental factors on stock prices on other sector also.
• One of the most important areas of research concerning volatility is its impact on investors’ confidence in the capital market. Surveys or suitable proxies could be used for determining the level of investors’ confidence during high market volatility.

• Future research can be directed towards investigating the possible application of volatility forecasts to portfolio management and designing sophisticated trading instruments such as options and futures.

• There are number of other issues that would appear attractive for further research on modelling the stock market volatility. For example, as most of the studies have considered the volatility of returns on some aggregate stock market index, it would therefore be an interesting exercise to investigate the applicability of GARCH models to individual company share price data. Any significant findings about the variance of the share price for an individual company would have important implications for the valuation of options on that company’s share.
BIBLIOGRAPHY


Amadeo, Kimberly (2012), "What are Interest Rates and how do they work?" [http://useconomy.about.com/od/glossary/g/Interest_Rate.htm](http://useconomy.about.com/od/glossary/g/Interest_Rate.htm).


Carver, Robert; and Nash, Jane (2009), Doing Data Analysis with SPSS, Cengage Learning, Fourth Reprint.


Chandra, Prasanna (1981), Valuation of Equity Shares in India, Sultan Chand and Sons, New Delhi, pp. 1-78.


Chaudhuri, Tamal (2007), "Why does the Indian Stock Market Move the Way it does?" Portfolio Organizer, July, pp. 31-44.


Chowhan, Piyush; and Shukla, Vasant (2004), "Volatility in Indian Stock Market" ideas.repec.org/p/wpa/wuwipi/0004010.html.


