# IMPACT OF FOREIGN INSTITUTIONAL INVESTORS INVESTMENT ON INDIAN STOCK MARKET VOLATILITY: A STUDY OF BSE SENSEX

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**Abstract**

*The present paper focuses on measurement of stock market returns volatility in India and contribution of Foreign Institutional Investors (FIIs) investment to this stock market returns volatility. Both symmetric model GARCH (1,1) as well as asymmetric models E-GARCH (1,1) and TARCH (1,1) is applied using a set of high frequency daily data on Bombay Stock Exchange, Sensitive Index (BSE, Sensex) for a period from Jan., 3, 1999 to Dec., 30, 2013. Similarly daily data on gross purchases and gross sales by FIIs for the same period are considered. These models confirm the persistence of volatility and existence of leverage effect in Indian stock market. Study found that FIIs investment significantly contribute to stock return volatility in India and impact of gross purchases on stock return volatility is more significant than gross sales by FIIs. Study suggests that policies regarding FIIs investment in the Indian stock market should be tailored in such a way that they remain positively invested so as to get rid of frequent panic like situations in the market consequent to withdrawal of investment by FIIs.*

***Key Words: Volatility persistence, Leverage, Symmetric and Asymmetric GARCH model.***

## Introduction

The issue of stock market volatility has become increasingly important in recent times due to increasing links of national stock market with the world stock markets consequent to financial sector reforms. The two major capital market reforms of (i) entry of Foreign Institutional Investors (FIIs) in Indian stock market (ii) permission to Indian companies for raising capital from foreign stock exchanges by means of American Depository Receipts (ADRs) / Global Depository Receipts (GDRs). Further introduction of two-way fungibility in these instruments of ADRs / GDRs leads to reduction of the sovereignty of Indian stock market. As such, Indian stock market now, is not only sensitive to national events but also more sensitive to international events. Due to the speculative motive of FIIs investment, investment by FIIs is subject to frequent reversals. India is enjoying maximum blessings of FIIs, and attracting substantial amount of FIIs investment as compared to other emerging securities markets. Stock prices in India frequently deviate from fundamental values and these deviations are largely due to the presence of FIIs in Indian stock market.

Volatility is a measure of how far the current price of an asset deviates from its average past prices. Greater this deviation, greater is the volatility. Volatility is a standard measure of financial vulnerability of an economy. Thus, volatility is an unattractive feature that has adverse implications for decisions pertaining to investment in financial assets such as equity shares and other stock market instruments. The persistence of volatility makes the investors risk averse. Investors demand higher risk premium as a compensation for increased risk due to volatility. A higher risk premium implies higher cost of capital and thus lowers investment. The prevailing inefficiency in emerging securities markets including India further magnifies the problem of volatility. In this paper, an effort is made to predict stock return volatility and contribution of FIIs investment to that volatility using high frequency data (daily data).

## Review of Literature

In earlier studies, efforts have been made by many researchers to forecast volatility in the emerging stock markets and found that FIIs investment has a significant impact on volatility in the stock markets of emerging economies. Samal (1997), argued that the main emerging feature of India's equity market since 1991 is its gradual integration with global market and problem faced due to capital movement by foreign institutional investors. The FIIs are manipulating equity market and equity price movement is greatly influenced by them, thus leading to greater volatility.

Pal (1998), verified the hypothesis that the entry of foreign portfolio investment boosts a country's stock market and economy and found that the hypothesis does not seem to be working in India. The influx of FIIs failed to invigorate Indian stock market.

According to Kohli (2001), composition of flows makes a significant difference both in term of impact and smooth management. Portfolio flows, because of their short-term nature, can cause uneven expansion and contraction in domestic liquidity and thus have a greater impact upon stock market and expansion in money supply and domestic credit.

Roy (2001-a) found that liberalisation and growth of stock market has resulted in volatility in Indian stock market. Study concluded that emerging stock markets must work out a comprehensive and balanced plan to bring the adverse impact of FIIs investment to a tolerable limit.

Nilsson (2002) has concluded that stock market liberalisation can lead to excess volatility possibly because of noise trading for Nordic stock markets. He found the evidence of higher expected return, higher volatility and stronger links with international stock markets characteristic of the deregulated period in all Nordic stock markets.

Dornbusch and Park (1995) observed that financial market opening is likely to increase the volatility of asset prices.

From the literature surveyed, it is clear that issue of increase in stock returns volatility due to opening up of emerging stock market to FIIs has received considerable attention. However, very few studies focused on stock return volatility due to FIIs in Indian context.

There is a gap in existing literature on measurement of stock return volatility in India due to FIIs investment using high frequency data and sophisticated volatility measurement models. This paper is an attempt to fill this gap.

## Objectives of Study

Study is undertaken to analyze the following objectives:

1. To observe the stock returns volatility applying both symmetric and asymmetric models without any exogenous variable / s.
2. To examine the contribution of Foreign Institutional Investors investment to stock return volatility considering:
   (a) The differential impact of gross purchases and gross sales by FIIs and

   (b) The combined impact of investment by FIIs in the form of gross turnover by FIIs.

## Data Base & Methodology

BSE sensex is the selected index to estimate the returns on stocks. Daily data on BSE sensex is used for a period from Jan., 3, 1999 to Dec., 30, 2013. Similarly daily data on gross purchases and gross sales by FIIs for the same period are considered. The days on which there is no trading by FIIs are excluded while taking the data on sensex.

Following, Raju and Ghosh (2004), BSE sensex data is converted into sensex based return series by applying following formula:

$$BSER_t = \log I_t - \log I_{t-1} \quad (1)$$

Where;

$BSER_t$ = Return on BSE sensex on t day

$\log I_t$= Logarithmic of closing value of BSE sensex on t day

$\log I_{t-1}$= Logarithmic of closing value of BSE sensex on t-1 day

The data on BSE sensex is taken from website of Bombay Stock Exchange and data on FIIs gross purchase and gross sales is taken from the website of securities and exchange Board of India (SEBI). Since daily data on FIIs is available only from Jan 1999 onwards, accordingly study is undertaken for the period from Jan 1999 to Dec 2013.

Each of the four series i.e., daily returns on BSE sensex, gross purchase by FIIs, gross sales by FIIs and gross turnover by FIIs are checked for stationarity by applying unit root test. For this the following types of Augmented Dickey Fuller

( ADF ) regression has been applied:

$$\Delta Y_t = \alpha_1 Y_{t-1} + \sum_{m=1}^{n} \beta_m \Delta Y_{t-m} + \mu_t \qquad (2)$$

$$\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \sum_{m=1}^{n} \beta_m \Delta Y_{t-m} + \mu_t \qquad (3)$$

Where, $\mu_t$ is white noise. The additional lagged terms have been included to ensure that errors are uncorrelated. If the calculated ADF statistics are higher than their critical values from Fuller's table, then the series are non-stationary or not integrated of order zero. Hence, unit root exists. Alternatively, if the calculated ADF statistics are less than their critical values from Fuller's table, then the series are stationary or integrated of order zero. Hence, unit root does not exist. Having checked the variables for stationarity, we proceed further to state the models to measure volatility. Both symmetric as well as asymmetric Generalised Autoregressive Conditional Heteroskedasticity (GARCH) type models are applied. The symmetric GARCH model focuses on the time varying variance of the conditional distributions of returns. These models capture the existence of volatility clustering or volatility persistence (symmetric model) and leverage effect (asymmetric models) which went unrecognized in traditional volatility models such as the historical average, which assumed market volatility as constant.

## GARCH (1, 1) Model

GARCH is a symmetric model and it captures the effect of volatility clustering or persistence of volatility shocks in stock market returns (Bollerslev, 1986).The two distinct specifications for GARCH (1, 1) model are: one for conditional mean specification and another for conditional variance.

These specifications are expressed as follow:

$$Y_t = c + e_t \qquad (4)$$

$$\sigma_t^2 = \alpha_0 + \alpha_1 e^2_{t-1} + \beta \sigma^2_{t-1} \qquad (5)$$

Equation (4) is the mean specification equation where **C** is constant and $e_t$ is error term.

On the other hand, equation (5) represents the conditional variance specification and is a function of following three terms:

(a) The mean, $\alpha_0$

(b) News[1] about volatility from the previous period which is measured as the mean lag of the squared residual from the mean equation: $e^2_{t-1}$ and is called the ARCH term.

(c) Last period's forecast variance i.e., $\sigma^2_{t-1}$ which is called the GARCH term.

## Exponential GARCH (E- GARCH)

Stock return volatility is also estimated using asymmetric GARCH (E- GARCH) model. News about volatility can be good or bad having different effects on stock indices returns. Asymmetric GARCH models account for this differential impact of news on stock market returns. This model captures the leverage effect existing in most of emerging market stock return series (Nelson, 1991). Stock market returns in India are non-normal. Asymmetric E- GARCH model that allows for non-normality of stock return series is therefore considered appropriate to estimate volatility. Thus, this model captures both leverage and volatility clustering effects. Under E – GARCH model two distinct specifications for mean and variance are as follow:

$$Y_t = c + e_t \quad (6)$$

$$\log(\sigma_t^2)=\alpha_0+ \alpha_1\log (\sigma^2_{t-1})+ \gamma\ |e_{t-1}/ \sigma_{t-1}| + \beta e_{t-1}/\sigma_{t-1} \quad (7)$$

The equation (6) is mean equation specification and equation (7) variance equation specification. In this model $\alpha_1$ is GARCH term, which measures the impact of last period's forecast variance. A positive and significant $\alpha_1$ indicates that volatility clustering is associated with further positive changes and vice-a-versa. $\gamma$ is the ARCH term, which measures the effect of news about volatility from the previous period on current period volatility.

$\beta$ measures leverage effect. $\beta$ is expected to be negative implying that bad news has a bigger impact on volatility than good news of the same magnitude.

## The TARCH Model

Threshold ARCH (TARCH) model is another variant of asymmetric E- GARCH model for capturing leverage effect. Under TARCH model specification of variance differs from E – GARCH and is specified as follow:

$$\sigma_t^2 = \alpha_0 + \alpha_1 e^2_{t-1} + \gamma\, e^2_{t-1} d_{t-1} + \beta\, \sigma^2_{t-1} \quad (8)$$

In this model, good news ($e_t>0$) and bad news ($e_t < 0$) have different effects on the conditional variance. Good news has an impact to the tune of $\alpha_1$ while bad news has an impact to the tune of ($\alpha_1+ \gamma$). If $\gamma> 0$ then, leverage effect exists i.e., bad news increases volatility. Hence, news impact is asymmetric.

All the three models i.e., GARCH (1,1), E-GARCH (1,1) and TARCH (1,1) are firstly applied without any exogenous variable, taking daily returns on sensex as dependent variable. Secondly, the mean and variance equations under each model are extended to include gross purchases, gross sales by FIIs as two exogenous variables. Thirdly, the mean and variance equations under each model are extended to include gross turnover by FIIs as one single exogenous variable.

## Results of Analysis and Discussion

## Summary Statistics

Summary statistics for Daily returns on sensex (BSER), Gross Purchases, Gross Sales and gross turnover by FIIs are presented in table1.

Table 1: Summary Statistics of Daily BSER, GP, GS and GT

| Variable | Skewness | Kurtosis | J-B Statistic | (P-Value) |
|---|---|---|---|---|
| **BSER** | **-0.33** | **7.46** | **1690.53*** | **0.0000** |
| **GP** | **2.04** | **8.10** | **3548.07*** | **0.0000** |
| **GS** | **2.39** | **10.23** | **6227.65*** | **0.0000** |
| **GT** | **2.04** | **7.64** | **3171.76*** | **0.0000** |

(*) denotes significant at 1% level of significance.

It is clear from the table that daily returns on sensex (BSER) indicate negative skewness and excess kurtosis implying leptokurtic distribution of returns. Gross Purchases, Gross Sales and Gross turnover by FIIs indicate positive skewness and excess kurtosis implying leptokurtic distribution of the series. Jarque-Bera (J-B) test statistic is also significant for all the series. Hence, all the four series i.e., Daily returns on sensex (BSER), Gross Purchases (GP), Gross Sales (GS) and Gross Turnover (GT) by FIIs are non-normal.

The results of the standard Augmented Dickey Fuller unit root test, applied for determining the order of integration for the variables i.e., Daily returns on sensex (BSER), Gross Purchases, Gross Sales and gross turnover by FIIs are presented in table 2.

**Table 2: Results for the Augmented Dickey-Fuller Unit Root Test**

| Variables | ADF value (Actual) | ADF value (Critical) | P-value |
|---|---|---|---|
| BSER | -41.51* | -2.86 | 0.0000 |
| GP | -3.97* | -2.86 | 0.0016 |
| GS | -3.25* | -2.86 | 0.0175 |
| GT | -3.23* | -2.86 | 0.0184 |

Note : - (*) denotes statistically significant at 5% level of significance.

It is clear from the table that calculated or actual ADF statistics are less than critical values of ADF from Fuller's table and these are significant at 5% level of significance. Hence, the variables are of zero-mean stationarity and are integrated of order zero.

## Volatility clustering in Stock Return Series

The parameter estimates of GARCH models are presented in table 3. The sizes of ARCH and GARCH parameters determine the short-run dynamic of the resulting volatility time series. Large GARCH Coefficient normally indicates the persistence of volatility and large ARCH coefficient implies that volatility is less persistent and more 'Spiky'. Table shows that the sum of ARCH and GARCH parameters for Symmetric GARCH (1, 1) model in all cases i.e.

**Table 3: Parameter Estimates of GARCH Model**

| Model | Coefficient | Value of coefficient | Z-Value | P-Value | AIC | SC |
|---|---|---|---|---|---|---|
| GARCH (1,1) | Intercept ARCH | 2.20E-06 | 6.72* | 0.0000 | -7.35 | -7.34 |
| | GARCH | 0.158 | 11.32* | 0.0000 | | |
| | | 0.799 | 51.43* | 0.0000 | | |
| GARCH (1,1) with GP&GS | Intercept ARCH | 2.90E-06 | 6.42* | 0.0000 | -7.35 | -7.32 |
| | GARCH | 0.149 | 10.48* | 0.0000 | | |
| | GP | 0.796 | 46.96* | 0.0000 | | |
| | GS | -2.57E-09 | -3.04* | 0.0023 | | |
| | | 2.51E-09 | 2.56* | 0.0103 | | |
| GARCH (1,1) with GT | Intercept | 2.74E-06 | 6.24* | 0.0000 | -7.35 | -7.33 |
| | ARCH | 0.163 | 11.21* | 0.0000 | | |
| | GARCH | 0.789 | 46.81* | 0.0000 | | |
| | GT | -2.12E-10 | -1.98** | 0.0481 | | |

(*) denotes significant at 1% level of significance.

(**) denotes significant at 5% level of significance.

(i) without any exogenous variables, (ii) taking gross purchases and gross sales by FIIs as exogenous variables and (iii) taking gross trade of FIIs as exogenous variable are very close to one. In addition, size of GARCH Coefficients is large in comparison to ARCH coefficients. This clearly implies that volatility shocks are quite persistent in Indian stock market returns. Thus, it confirms the volatility clustering effect in Indian stock market returns.

**Table 4: Parameter Estimates of E- GARCH Model**

| Model | Coefficient | Value of coefficient | Z-Value | P-Value | AIC | SC |
|---|---|---|---|---|---|---|
| E-GARCH (1,1) | Intercept | -0.944 | -9.47* | 0.0000 | -7.37 | -7.35 |
| | ARCH | 0.270 | 103.38* | 0.0000 | | |
| | GARCH | 0.928 | -10.35* | 0.0000 | | |
| | Leverage | -0.127 | | 0.0000 | | |
| E-GARCH (1,1) with GP&GS | Intercept ARCH | -1.057 | -9.09* | 0.0000 | -7.37 | -7.34 |
| | GARCH | 0.272 | 10.74* | 0.0000 | | |
| | Leverage | 0.916 | 83.57* | 0.0000 | | |
| | GP | -0.124 | -8.93* | 0.0000 | | |
| | GS | -8.55E-05 | -2.34** | 0.0193 | | |
| | | 7.75E-05 | 2.02** | 0.0435 | | |
| E-GARCH (1,1) with GT | Intercept | -0.998 | -9.24* | 0.0000 | -7.37 | -7.34 |
| | ARCH | 0.277 | 11.75* | 0.0000 | | |
| | GARCH | 0.922 | 92.37* | 0.0000 | | |
| | Leverage | -0.131 | -9.85* | 0.0000 | | |
| | GT | -7.68E-06 | -1.82*** | 0.0684 | | |

(*) denotes significant at 1% level of significance.

(**) denotes significant at 5% level of significance.

(***) denotes significant at 10% level of significance.

## Leverage Effect in Indian Stock Return Series

Leverage effect (Volatility asymmetry) implies that the amplitude of relative price fluctuations of stock indices tends to increase when its price drops. Thus, Leverage effect is a negative volatility-return relationship whereby a large price drops of the market as a whole, trigger a significant increase in trading activity. Since volatility in emerging stock markets like India is generally not symmetric

and symmetric GARCH model is not capable of capturing leverage effect present in asymmetric stock return series of such emerging markets. In order to capture the presence of leverage effect in Indian stock return series, which is indicated by negatively skewed stock return series (table1), we have also applied asymmetric GARCH models. It is clear from the table 4 that the value of leverage coefficient is negative and significant in asymmetric E-GARCH model in each of the three cases i.e., (i) without any exogenous variables, (ii) taking gross purchases and gross sales by FIIs as exogenous variables and (iii) taking gross trade of FIIs as exogenous variable. Thus, it confirms the leverage effect in Indian stock return series. Also, Akaike Information Criterion (AIC) and Schwartz Criterion (SC) values are minimum for the E-GARCH model when compared with other versions of GARCH models (GARCH and TARCH) in all the cases i.e., (i) without any exogenous variable, (ii) gross purchases and gross sales by FIIs as exogenous variables and (iii) gross turnover by FIIs as an exogenous variable. Hence, asymmetric E-GARCH model predicts the volatility best.

**Table 5: Parameter Estimates of TARCH Model**

| Model | Coefficient | Value of coefficient | Z-Value | P-Value | AIC | SC |
|---|---|---|---|---|---|---|
| T-ARCH (1,1) | Intercept | 3.06E-05 | 33.66* | 0.0000 | -7.25 | -7.24 |
| | ARCH | 0.180 | 5.89* | 0.0000 | | |
| | TARCH | 0.354 | 5.89* | 0.0000 | | |
| TARCH (1,1) | Intercept | 3.34E-05 | 29.13* | 0.0000 | -7.26 | 7.24 |
| with GP&GS | ARCH | 0.184 | 5.88* | 0.0000 | | |
| | TARCH | 0.343 | 5.56* | 0.0000 | | |
| | GP | -7.32E-09 | -6.43* | 0.0000 | | |
| | GS | 3.08E-09 | 2.05* | 0.0000 | | |
| TARCH (1,1) | Intercept | 3.36E-05 | 29.30* | 0.0000 | -7.26 | -7.24 |
| with GT | ARCH | 0.185 | 6.30* | 0.0000 | | |
| | TARCH | 0.351 | 5.81* | 0.0000 | | |
| | GT | -2.65E-09 | -4.99* | 0.0000 | | |

(*) denotes significant at 1% level of significance.

TARCH is another variant of asymmetric GARCH models. The parameter estimates of TARCH model are presented in table 5.It is clear from the table that TARCH coefficients are greater than zero and significant in all the three cases i.e., (i) without any exogenous variables, (ii) taking gross purchases and gross sales by FIIs as exogenous variables and (iii) taking gross trade of FIIs as exogenous variable. Thus, it supports the existence of leverage effect in stock market returns based on sensex data. It further highlights that the news impact is asymmetric in Indian stock market returns.

## Contributions of Gross purchases, Gross sales and Gross Turnover by FIIs to stock return volatility

The results of symmetric as well as asymmetric GARCH models presented in tables 3,4 and 5 respectively indicate that the coefficients of both gross purchases by FIIs and gross sales by FIIs are significant in all the three models i.e., GARCH, TARCH and E-GARCH. Hence, both gross purchases and gross sales by FIIs significantly contribute to stock return volatility. The coefficient of gross purchases is more significant implying that a greater volatility in gross purchases by FIIs could have greater implications for the volatility of stock return indices during that particular period than volatility in gross sales by FIIs. When gross turnover by FIIs is taken as exogenous variable instead of gross purchases and gross sales by FIIs, the results again indicate that FIIs contribute significantly to stock return volatility, as coefficient of gross turnover is also significant in each model. Normality and autocorrelation tests for all versions of GARCH model are based on squared standardized residuals and results are reported in table 6. The Jarque-Bera (J-B) test statistics for each model indicate that squared standardized residuals are not normally distributed. Similarly, Q-statistic for each model is insignificant. Thus, squared standardized residuals are uncorrelated.

**Table 6 : Normality and Autocorrelation tests for Models**

| Model | Jarque-Bera (J-B) | P-value | Q-Statistic | P-value |
|---|---|---|---|---|
| GARCH (1,1) | 756.75 | 0.0000 | 0.39 | 0.53 |
| E-GARCH (1,1) | 507.64 | 0.0000 | 0.19 | 0.91 |
| TARCH (1,1) | 826.39 | 0.0000 | 0.50 | 0.48 |
| GARCH (1,1) With GP & GS | 694.45 | 0.0000 | 0.29 | 0.59 |
| E-GARCH (1,1) With GP & GS | 475.61 | 0.0000 | 0.02 | 0.88 |
| TARCH (1,1) With GP & GS | 756.61 | 0.0000 | 0.65 | 0.42 |
| GARCH (1,1) With GT | 694.45 | 0.0000 | 0.29 | 0.59 |
| E-GARCH (1,1) With GT | 475.61 | 0.0000 | 0.02 | 0.88 |
| TARCH (1,1) With GT | 756.61 | 0.0000 | 0.65 | 0.42 |

Note; Q stands for Ljung-Box Q-statistic

All the versions of GARCH model are based on only first-order autoregressive variance and squared error terms. The correctness for this variance equation specification has been verified by means of checking for correlogram of squared standardized residuals. It was found that all the Q-statistics are insignificant. Hence, there is no remaining ARCH in variance equation and specification of the variance equations is correct in all the cases considered under study.

## Conclusion

Daily returns on sensex (BSER) indicate negative skewness and excess kurtosis implying leptokurtic distribution of returns. Gross Purchases, Gross Sales and Gross Turnover by FIIs indicate positive skew ness and excess kurtosis implying leptokurtic distribution of the series. Jarque-Bera (J-B) test statistic is also significant for all the series. Hence, all the four series i.e., Daily returns on sensex (BSER), Gross Purchases (GP), Gross Sales (GS) and Gross Turnover (GT) by FIIs are non-normal. All these variables are of zero-mean stationarity and are integrated of order zero.

There is evidence that volatility shocks are quite persistent in Indian stock market since the sum of ARCH and GARCH coefficients is close to one in symmetric GARCH (1,1) models. Also, GARCH coefficients are greater than ARCH coefficients for each model further confirming persistence of volatility in Indian stock market returns. Study found the existence of leverage effect in Indian stock market returns as indicated by negative and significant coefficients of leverage in E-GARCH models and significantly positive (greater than zero) coefficients of TARCH under TARCH models. Thus, the amplitude of relative price fluctuations of stock indices tends to increase when its price drops. The coefficients of both gross purchases and gross sales by FIIs are significant in all the three models. Hence, both gross purchases and gross sales by FIIs significantly contribute to stock return volatility in India. Moreover, the coefficient of gross purchases is more significant implying that a greater volatility in gross purchases by FIIs could have greater implications for the volatility of stock return indices during that particular period than volatility in gross sales by FIIs.

Some policy implications concerning investment by FIIs emerge from the present study. Policies regarding FIIs investment in the Indian stock market should be tailored in such a way that FIIs remain positively invested in Indian stock market so that there is always a positive net investment and there are steady inflows (gross purchases) by FIIs. Otherwise, there will be frequent instances of panic like situations in Indian stock market created by net sales of FIIs.

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