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LEVERAGE EFFECT AND CAPITAL MARKET VOLATILITY – EVIDENCE FROM INDIAN EQUITY MARKET

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Abstract: Efficient market theory states that the market responds to the negative and positive shocks symmetrically. In reality, the market exhibit asymmetric response to the negative shocks over the positive shocks, this is called information asymmetry. The concept of leverage effects states that market is highly volatile during the arrival of negative shocks than the positive shocks. The standard GARCH model failed to capture leverage effect into its variance equation. This has been done by incorporating longer memory process into the variance equation of the EGARCH and TGARCH models. The paper focused on identifying the leverage effect in Indian stock market by studying the volatility of selected indices for a period of 6 years. The results accept the presence of information asymmetry and the models were failed in some extent to identify the presence of a strong leverage effect.

Key words: Leverage effect, Information Asymmetry, GARCH Model, EGARCH MODEL, TGARCH MODEL

1. INTRODUCTION

Efficient market theory states that the market processes the negative and positive shocks symmetrically, meaning that the information will contain in the prices quickly and there will not be any chance of making superior return from the fundamental difference. In reality, the efficiency of the market is in question and we cannot expect every investors in the market behave unanimously. This assimilated response is called information asymmetry. The leverage effect states that the market exhibits a differential response to the negative shocks over the positive shocks.

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India is an emerging market economy with the high potential for development. The structural reforms done by the Government boost the Foreign Investments in all spheres of economic activity including the capital market by the way of FII's. This makes the market more volatile and vulnerable. Volatility is the measure of tranquillity or the fluctuation in stocks performance (Engle 1982) by exhibiting dispersion in the stocks returns than the direction (Hady, 2014). Differential response of the market to the positive and negative shocks can be understood by checking the asymmetry in processing the information. Auto Regressive Conditional Heteroskedasticity (ARCH) models were used for identifying volatility of the market. This has been done by the studies of Engle, in 1982; by incorporating the variance of past innovation as a function of the present innovation. Later, the GARCH model was introduced by extending the variance of the past return along with the ARCH model (Bollerslev,1986). The scholars like Robins (1987), Nelson (1991), Poon & Granger (1992), Engle, Lilien (2003), further improvised the standard GARCH model.

Exponential GARCH model (Nelson,1991) was developed to tackle the impact of negative shocks over the positive shocks. This model uses log returns to absorb the Leverage effect in the performance of the stock returns. In 1993 the studies by Engle & Ng found that the bad shock makes high volatility than the good shocks. Threshold GARCH model was developed by the Zakoian (1994) by including the standard deviation of the past variance as in contrast to the conditional variance used in the basic GARCH model. Glosten, Jagannathan & Runkle (1993), applied the TGARCH model for checking the information asymmetry and they found that the bad shock shakes the market than the positive one.

Large number of studies was conducted on the volatility of Indian stock markets by using ARCH family models. It show the EGARCH and TGARCH models were fit the market to identify the information asymmetry.

National Stock Exchange (NSE) and Bombay Stock exchanges (BSE) are the major stock exchanges in India. BSE is the world's 10th largest stock exchange having higher market capitalization than the NSE. Hence the study focused on the sectoral indices of BSE for measuring the leverage effect. The S&P BSE BANKEX, S&P BSE OIL & GAS, S&P BSE India Infrastructure Index, S&P BSECONSUMER DURABLE, S&P BSE Healthcare were used for a period of six years for measuring the leverage effect on the market volatility.

The present study follows EGARCH and TARCH models using E-views in conformity with the existing literatures. The study has been done by the daily data of five sectoral indices for a period of six years from Jan 2012 to

July 2018. This period witnessed the tranquil performance of the stock market due to the various socio economic reasons such as change of central Govt and the policies priorities, Demonetization of higher denomination currency, and implementation of new indirect tax etc., In general, we want to check whether the returns were affected by the good and bad news on the Indian industries by using EGARCH and TARCH model.

2. OBJECTIVES OF THE STUDY

The study confine to the five sectoral indices of BSE for a period of six years from 02 January 2012 to 2018. All these sectors contribute to a major share in the GDP of the country. The very purpose of this study is to understand the existence of leverage effect in processing the information in Indian market by studying the sectoral indices.

3. DATA AND THE METHODOLOGY

Study uses daily closing data of the S&P BSE sectoral indices of banking, oil and gas, infrastructure, consumer durables and the health care sectors, spanning over a period of 6 years. The returns of the indices r_t is calculated by applying the following formula,

$$r_t = \frac{VI_t - VI_{t-1}}{VI_{t-1}} = \frac{VI_t}{VI_{t-1}} - 1 \tag{1}$$

$$\ln(r_t) = \ln\left(VI_t / VI_{t-1} \right) = \ln VI_t - \ln VI_{t-1} \tag{2}$$

VI_t Stands for the Value of index for the t^{th} period and VI_{t-1} stands for the value of index for $t\text{-}1^{th}$ period. In equation (2) the log return of the indices were applied by natural logarithm.

The following section explains the specification of GARCH model, EGARH and TGARH models under the condition of normal Gaussian error distribution.

GARCH MODEL: The basic form of GARCH model applied here is the GARCH (1,1) model, with one ARCH term (past innovation) and the one garch term (past conditional variance). The model has two parts, such as mean equation and the variance equation.

Mean equation: The daily Index returns obtained from the equation (1) were applied for running the uni-variate regression model

$$r_t = \alpha_0 + \varepsilon \tag{3}$$

Where, r_t is the return of index; α_0 is the constant term and ε is the error term. In equation (3), the index return is the linear function of constant and the error term.

Variance equation: Variance equation of GARCH Model explains the variance of the returns depends on the variance of the previous return and the error term.

$$\sigma_{r_t}^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 \quad (4)$$

α_0 is the constant term; α_1 is the coefficient of the ARCH term, β_1 is the coefficient of the past returns (ie, GARCH term) and $\sigma_{r_{t-1}}^2$ is the variance of the past index return.

The mean equation of the GARCH (1,1) model is regressed and the residual obtained was applied in the variance equation.

ARCH(1) model- this model regress the conditional variance with the previous error term innovation. Variance equation of this model is given by

$$\sigma_{r_t}^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 \quad (5)$$

ARCH Test: the residual obtained from model (3) were plotted to check the presence of volatility clustering. It is a necessary condition for testing ARCH effect (presence of autocorrelation of the time series). If there is ARCH effect, it justifies testing the EGARCH model and TGARCH model.

Exponential GARCH Model

This model extended variance equation of the basic GARCH model by incorporating the long memory process for information asymmetry.

$$\log(\sigma_{r_t}^2) = \omega + \alpha\left[\frac{\varepsilon_{t-1}}{\sqrt{\sigma_{r_{t-1}}^2}}\right] + \beta\log(\sigma^2{}_{r_{t-1}}) + \gamma\frac{\varepsilon_{t-1}}{\sqrt{\sigma^2{}_{r_{t-1}}}} \quad (5)$$

ω is the constant term; $\sigma_{r_{t-1}}^2$ is the variance of the past index return and

$\left[\frac{\varepsilon_{t-1}}{\sqrt{\sigma_{r_{t-1}}^2}}\right]$ EGARCH term

TGARCH or GJR Model: This model is developed for capturing the information asymmetry. It is a simple extension of basic GARCH (1,1) model by adding the Threshold term $\varepsilon_{t-1}^2 d_{t-1}$ in to the variance equation.

$$\sigma_{r_t}^2 = \alpha_0 + \alpha\varepsilon_{t-1}^2 + \gamma\varepsilon_{t-1}^2 d_{t-1} + \beta\sigma^2_{r_{t-1}} \quad (5)$$

After running this models the residual were diagnosed and included in the result session.

4. RESULTS AND DISCUSSIONS

The descriptive statistics of the sample returns were shown in the table 5.1.

Table 4.1
Showing Descriptive Statistics of the sample returns

	RET_BANKEX	*RET_CON_DURA*	*RET_HLTH*	*RET_INFR*	*RET_OIL*
Mean	0.000630	0.001019	0.000397	0.000257	0.000367
Maximum	0.049156	0.085951	0.048376	0.038921	0.048177
Minimum	-0.069885	-0.072283	-0.067546	-0.086650	-0.092041
Std. Dev.	0.011777	0.012799	0.011147	0.011514	0.011798
Observations	1033	1033	1033	1033	1033

Source: Calculation by author using Eviews

From the table above, the mean return of the Bankex is .063%, the consumer durable index is 8.5951%, the health care index is 4.8376%, the infra index is 3.8921% and the mean of the oil and gas index is 4.8177%. Sample statistics is corresponds to the 1033 observation for a period of 6 years.

SKEWNESS AND KURTOSIS TEST

Table 4.2
Showing Normality test of the sample returns

	RET_BANKEX	*RET_CON_DURA*	*RET_HLTH*	*RET_INFR*	*RET_OIL*
Skewness	-0.109010	0.250143	-0.514081	-0.780554	-0.600411
Kurtosis	5.117259	7.084823	5.725408	6.924108	7.067129

Source: Calculation by author using Eviews

Skewness is used to measure the normality of the data. If the value closes to zero, it means that there is symmetry in left and right half of the standard normal curve. The values of the bankex and consumer durable indices are in the range of (-0.5, 0.5) which shows an approximate symmetry in the distribution. The other indices are moderately skewed

Kurtosis measure the peak of the normal curve and the standard should be 3. All the indices have a higher value of kurtosis hence it is leptokurtic distribution, meaning that the indices have a heavier tail than the normal.

Residual plots: The stationarity of the data is a necessary condition for applying the ARCH family models. Residuals of the basic regression model (3) are plotted to test the presence of autocorrelation by checking the ARCH effect.

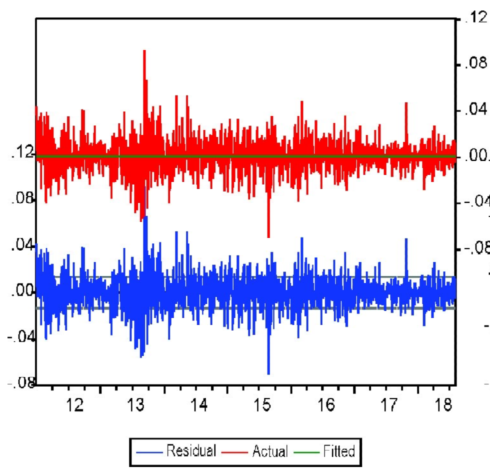

Figure 1a: Residual of Bankex Index

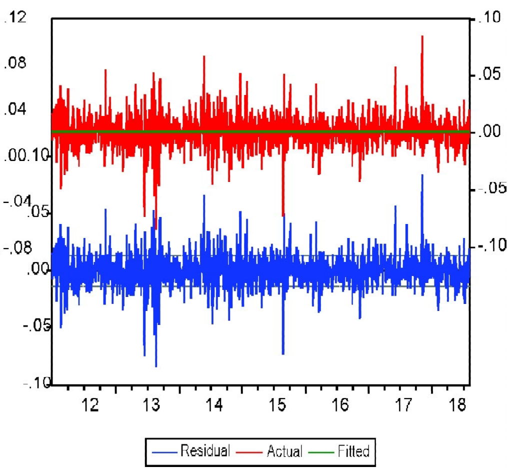

Figure 1b: Residuals of Consumer Durable Index

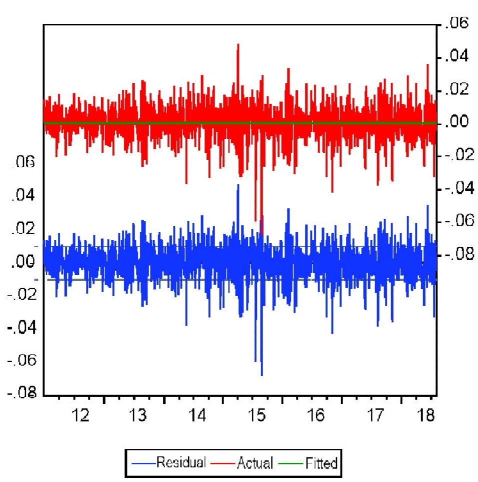

Figure 1c: Residual of health care index

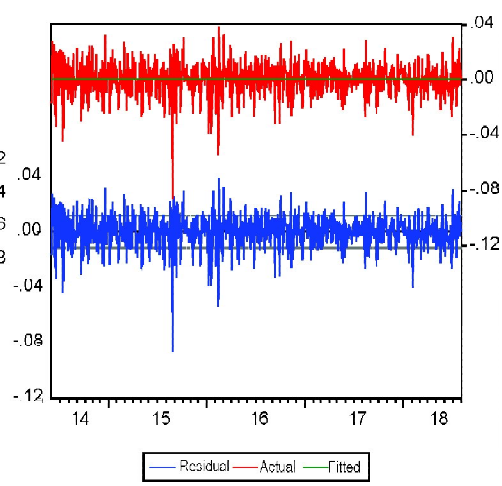

Figure 1d: Residual of Infra Index

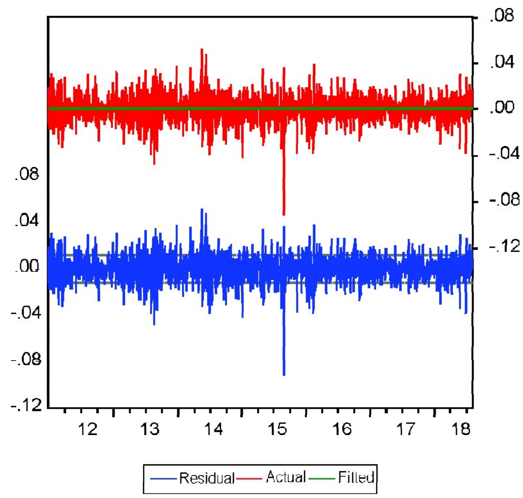

Figure 1e: Residual of oil & gas index

Figures 1a to 1f shows the results of the residual diagnostics of the basic regression model (3). All the six figures (1.a to 1.f) exhibit the existence of a strong volatility clusteringin the market (Stationarity). It justifies us, to test the presence autocorrelation using the ARCH tests (ie., Heteroskedasticity test)

ARCH tests: Following are hypothesis of the ARCH tests,

H0: There is no arch effect

H1: There is arch effect

The results of ARCH tests are given under,

Table 4.3
Showing the Heteroskedasticity test

Heteroskedasticity Test: ARCH					
	Bankex	*Cons. Durable*	*Health Care*	*Infra Index*	*Oil&Gas*
P value corresponding to the ARCH term	0.0000	0.0000	0.0000	0.0000	0.0000
Z statistic	7.59351	6.92081	6.43863	4.23289	5.36599

Source: E-views calculation

From the table above, the P value corresponding to the ARCH term is significant in all the cases, that is, Probability value is less than 0.05(5%). This will lead to the rejection of Null hypothesis and the Alternative hypothesis get accepted, i.e, there is ARCH effect. The existence of ARCH effect is an essential condition for running ARCH family Models.

In order to identify the presence of leverage effect i.e. the differential response of the market towards the negative shocks over the positive shocks. Exponential GARCH (EGARCH) and Threshold GARCH (TGARCH) models were applied under the Normal Gaussian error distribution.

EGARCH model: As suggested by literature, Exponential GARCH model were applied to test the presence of leverage effect. In doing so, the model incorporates the EGARCH term in to the normal GARCH model. Coefficient of this term makes the sense in understanding the presence of leverage effect.

H0: there is symmetry processing the information

H1: there exists information asymmetry

The results of the EGRACH model is as under,

Table 4.4
Showing the P value corresponding to the Coefficient of EGRACH term

Test: EGARCH					
	Bankex	*Cons. Durable*	*Health Care*	*Infra Index*	*Oil&Gas*
P value	0.0000	0.0000	0.0000	0.0000	0.0000
Coefficient of EGARCH term ie. , $\left[\frac{\varepsilon_{t-1}}{\sqrt{\sigma^2_{Ir_{t-1}}}}\right]$	0.99253	0.913444	0.97075	0.93045	0.93735

Source: authors calculation using E-views

In all the cases, the coefficients of the EGARCH terms are positive and the corresponding p-values are significant ($P < .05$). This will leads to the acceptance of the alternative hypothesis that there exists information asymmetry. But the model failed to explain the impact of information assimilation due to negative shocks as the coefficients of all the indices were positive.

TGARCH model: This model is applied for testing the information assimilation in the Market.

H0: there is symmetry processing the information

H1: there exists information asymmetry

The results of the model were as under.

Table 4.5
Showing the P value corresponding to the Coefficient of TGRACH term

Test: TGARCH Model					
	Bankex	*Cons. Durable*	*Health Care*	*Infra Index*	*Oil&Gas*
P value	0.0000	0.0026	0.0851**	0.0000	0.0000
Coefficient of TGARCH term i.e. $\varepsilon^2_{t-1}\, d_{t-1}$,	0.04783	0.04982	0.01847	0.12405	0.05744

Source: authors calculation using E-views

From the test statics, coefficients of TGARCH terms are positive and the P values are significant in all the cases except in the Health Care Index. The model accepts the presence of information asymmetry except in the Health Care Index but failed to explain the leverage effect.

5. CONCLUSION

The aim of the study is to understand, whether the market incorporates the positive and negative shocks symmetrically or asymmetrically. The TGARCH and EGARCH models were applied; all the indices were accepting the presence of asymmetry except the result of Health Care index. The major concern of this study is to understand the presence of leverage effect i.e. over reaction of market towards the negative shocks than positive shocks. From the results, nothing is explained regarding the impact of negative shocks over the positive shocks.

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