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Stock Market Volatility, Firm Size and Returns: A Study of Automobile Sector of National Stock Exchange in India

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Abstract:
The paper examines the relationship between stock market volatility and returns, volatility clustering, leverage effect and the persistence of volatility for the automobile sector of National Stock Exchange (NSE) in Indian for the financial year 2005-06 to 2013-14. The study further investigates the impact of firm size and volatility on returns. The GARCH-M model is used to examine the volatility clustering and persistence of volatility and the relationship between returns and volatility. The EGARCH model is used to capture the asymmetric effect. A panel regression model is estimated to shows the relationship among firm size, volatility and returns. The study reveals that the volatility in all the automobile firms exhibits the characteristics like volatility clustering, asymmetry effect and persistence of volatility in their daily returns. The study also finds the existence of leverage effect in AL, EL, MS and CNX Auto indicating that the negative shocks or bad news have more impact on volatility than that of positive shocks or good news. The relationship between returns and volatility is statistically significant for EL, HMT, HNM, M&M, MS, SI and TM. The study also finds significant small size firm effect on returns

Keywords: *Stock returns, Volatility clustering, Leverage Effect, Firm Size, GARCH-M and EGARCH model.*
JEL Classification: G10, G11, G12, G20

1. Introduction

Economic growth is essential for improving the quality of life. Standard classical and neo-classical theories emphasize the role of investment in enhancing economic growth. Monetary and financial sectors play a key role in mobilizing resources. Financial stability is crucial for promoting investment. In a situation of financial stability, financial institutions and markets are able to efficiently mobilize savings, provide liquidity and allocate investment. The growing role of the financial sector in the efficient allocation of resources at appropriate prices could significantly enhance the efficiency with which our economy functions. If financial markets work well, they will direct resources to their most productive uses. Risks will be more accurately priced and will be borne by those who have appetite for absorbing risks. Real economic activity with higher investments, in both quantity as well as quality, would result in growth with macroeconomic stability and fewer financial uncertainties. A stable financial system facilitates efficient transmission of monetary policy initiatives.

Financial sector reforms constitute the core of the New Economic Policy initiated in India in early 1990s.Because of this, Indian stock market has witnessed metamorphic changes and transition from a dull to an emerging stock market in international arena. Improved market surveillance, trading mechanism and introduction of new financial instruments have made it a center of attraction for the international investors. Entry of Foreign Institutional Investors (FIIs) and at the domestic level spectacular growth of the corporate sector and mutual fund industry have further added to the depth and width of the Indian stock market. Introduction of screen based trading depository system; derivative instruments, rolling settlements etc. have changed the very complexion of the stock market. The market has witnessed substantial increase in the number of listed companies, greater reliance on market for resource mobilization, remarkable increase in number of brokers and investors are some of the developments that have taken place in Indian stock markets. In such an emerging market, investment analysts, institutional investors, fund managers and other market players continuously search for investment strategies that can outperform the market

2. Review of Literature

There are many literatures on stock market volatility and return. Some literatures are reviewed as follows:

Gahan et al. (2012) examine the volatility pattern of BSE Sensex and NSE Nifty during the pre and post derivative period. They estimate volatility by recognizing the stylist features of volatility like persistence, asymmetry etc. for both pre and post derivative period. They use daily closing index levels of BSE Sensex and NSE Nifty over a period of 1992-2012 and 1995-2012 respectively. They find that volatility is lower in the post derivative period as compared to the pre derivative period. They also find that recent news has more impact on volatility in the post derivative period in comparison to the pre derivative period. They further find that introduction of derivatives has increased the asymmetric effect on volatility.

Nicholas et al (2011) examine the relationship between stock returns and volatility for the three largest stock markets in Europe. They find that volatility changes for majority of the stocks rapidly during the crisis period with changes being persistent. They also find that before the crisis more investors are rewarded for market wide risk and during the crisis less stocks exhibit a positive relationship between stock returns and volatility. Finally, they find that most stocks don't exhibit positive and statistically significant leverage effects.

Tripathy et al. (2009) investigate the relationship between leverage effect and daily stock returns, volume and volatility in the BSE Sensex index in India during the period January 2005 to June 2009. They find that there exist substantial ARCH effects in the residuals and the volatility shocks are quite persistent in the market. They also find that both the recent news and the old news have an impact on the volatility of the stock. They find the evidence of leverage and asymmetric effect on stock market. They find that bad news generates more impact on change in trading volumes and volatility of the market. They also observed that asymmetric GARCH models provide a better fit than the symmetric GARCH model suggesting that systematic variations in trading volume are assumed to be caused only by the arrival of new information.

Sarkar and Banerjee (2006)measure the volatility in the daily return at five-minute intervals of the Indian National Stock Exchange from June 1, 2000 through January 30, 2004. They find that the Indian stock market experiences volatility clustering and hence GARCH model predict the market volatility better than simple volatility models like historical average, moving average etc. They also observe that the asymmetric GARCH models provide better fit than the symmetric GARCH model, confirming the presence of leverage effect. Finally, the study reveals that the change in volume of trade in the market directly affects the volatility of asset returns. Further, the presence of FII in the Indian stock market does not appear to increase the overall market volatility.

Balaban and Bayar (2005) examine relationship between stock market returns and their forecast volatility derived from the daily observations of stock market indices of 14 countries covering the period December 1987 to December 1997 are used. Both weekly and monthly returns and their volatility are investigated. Expected volatility is derived from the ARCH (p), GARCH (1, 1), GJR-GARCH (1, 1) and EGARCH (1, 1) forecast models. Expected volatility is found to have a significant negative or positive effect on country returns in a few cases. Unexpected volatility has a negative effect on weekly stock returns in six to seven countries and on monthly returns in nine to eleven countries depending on the volatility-forecasting model.

Chang-Jin Kim et al. (2004) investigate whether evidence for a positive relationship between stock market volatility and the equity premium is more decisive when the volatility feedback effects of large and persistent changes in market volatility are taken into account for the period from January 1926 to December 2000. They derive and estimate a formal model of volatility feedback under the assumption of Markov-switching market volatility. They find that a negative and significant volatility feedback effect, supporting a positive relationship between stock market volatility and the equity premium.

Samanta (2003) examines the roles of stock market on excess return and volatility in predicting future output growth of Indian economy for the period April 1993 to December 2002. He finds that past values pointing to the presence of significant volatility-feedback effects in the stock market. The volatility is also quite strongly related to excess return in recent years. However, roles of stock market return and volatility in predicting future output growth are not clear. Thus, there is a need to undertake further in-depth research for understanding the relationship between stock market return / volatility and future output growth in the context of Indian economy.

Song et al. (1998) examine the relationship between returns and volatility of the Shanghai and Shenzhen Stock Exchanges in China over a period from May 1992 to February 1996. They use GARCH models to analyses the relationship between returns and volatility. They find that there is a positive relationship between returns and volatility. Volatility transmission between the two markets (the volatility spill-over effect) is also found to exist. The results of one month ahead ex ante forecasts show that the conditional variances of the returns of the two stock markets exhibit a similar pattern.

French et al (1987) examine the relationship between stock returns and stock market volatility. They use daily values of the Standard and Poor's (S&P) composite portfolio for the period from January 1928 through December 1984. They use auto regressive integrated moving average (ARIMA), auto regressive conditional heteroscadasticity (ARCH) and generalized auto regressive conditional heteroscadasticity (GARCH) model. They find that the expected market risk premium is positively related to the predictable volatility of stock returns. They also find that unexpected stock market returns are negatively related to the unexpected change in the volatility of stock returns.

3. Objectives

The study is based on the following objectives.

- To examine the nature of volatility of the Automobile sector firms of NSE India.
- To examine whether the asymmetric effect or leverage effect exist in the Automobile sector firms of NSE India.

- To examine the relationship between returns and volatility of the Automobile sector firms of NSE India.
- To examine the impact of firm size and volatility on returns of Automobile sector firms.

4. Data Source and Methodology

4.1. Data Source

The study is based on the closing index value of the CNX Auto and 12 automobile firms which are enlisted in automobile sector of National Stock Exchange in India. The selected automobile companies are Ashok Leyland (AL), Escorts Ltd (EL), Hero Motors (HM), Hindustan Motors(HNM), Hindustan Machine Tools (HMT), Mahindra & Mahindra(M&M), Maharashtra scooters ltd (MSL), Maruti Suzuki India (MSI), SML Isuzu Ltd (SIL), Tata Motors (TM), TVS Motors Company (TVS) and V.S.T. Tiller Tractors (VST). The period of the study is from April 1, 2005 to April 1, 2014. The data is collected from the NSE website, www.nseindia.com.

4.2. Methodology

The stock return is calculated using the following formula

$$r_t = ln\left(\frac{c_t}{c_{t-1}}\right)$$

$$r_t = [\ln(c_t) - \ln(c_{t-1})] \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where; r_t= stock market return
c_t= closing price at time period t
c_{t-1}= closing price at time period t-1.
ln = natural logarithm

The data is first tested for normality by using JB (Jarque-Bera) test and to test unit root, Augmented Dickey Fuller and Phillips Perron tests are used.

To examine the nature of volatility and the relationship between returns and volatility GARCH-M (Generalized Auto Regressive Conditional Heteroscadasticity) model is used. Engle (1982) introduced the ARCH model in his study "Autoregressive Conditional Heteroscedasticity with estimates of the Variance of United Kingdom Inflation" as the first formal model, which seemed to capture the phenomena of changing variance in time series data. Bollerslev (1986) extends Engle's (1982) ARCH process by allowing the conditional variance to follow an ARMA process. This model is known as a generalized ARCH model, or GARCH model. Engle, Lilien and Robins (1987) extend the basic ARCH framework to allow the mean of a sequence to depend on its own conditional variance. This class of model, called the ARCH in mean (ARCH –M) model, is particularly suited to the study of asset markets. The basic insight is that risk-averse agents will require compensation for holding a risky asset. The GARCH –M model form as follows:

$$r_t = \omega + \theta h_t + \sum_{i=1}^{p} \emptyset_i \, r_{t-i} + \varepsilon_t + \sum_{i=1}^{q} \delta_i \, \varepsilon_{t-i} \ldots\ldots\ldots (2)$$

Where r_t is the daily returns on equity and r_{t-i} represents lag returns and h_t represents conditional variance which are considered as regressors and ε_t represent random shocks.

The conditional variance equation is formed as:

$$\varepsilon_t = v_t\sqrt{h_t} v_t \sim iid(0,1)$$

$$h_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i \, \varepsilon_{t-i}^2 + \sum_{j=1}^{q} \beta_j \, h_{t-i} \text{GARCH (p, q)} \ldots . (3)$$

Where, $\alpha_0 > 0, \alpha_i \geq 0, \beta_j \geq 0$ and$\alpha_i + \beta_j < 1$.

A significant ARCH coefficient (α_1) indicates that there is significant impact of previous period shocks on current period volatility. The ARCH coefficient (α_i) is also treated as recent "news" component which explains that recent news has a significant impact on price changes which implies the impact of yesterday's news on today's volatility.

The GARCH coefficient (β_i) measures the impact of last period variance on current period volatility. A significant GARCH coefficient (β_i) indicates the presence of volatility clustering. A positive β_i indicates that positive stock price changes are associated with further positive changes and vice versa. A relatively higher values of $\beta_1$implies a larger memory for shocks. The GARCH coefficient (β_1) also treated as old "news" component, which implies that the news, which is old by more than one day, plays a significant role in volatility. The sum of the ARCH and GARCH coefficients i.e. (α_i+ β_i) indicates the extent to which a volatility shock is persistent over time. A persistent volatility shock raises the asset price volatility.A positive θ indicates that the return is positively related to volatility process. In other words, higher value of θ represents greater the impact of conditional variance on returns.

To examine the leverage effect EGARCH (Exponential Generalized Auto Regressive Conditional Heteroscedasticity) model can be used. Though ARCH and GARCH models respond to good and bad news or positive and negative shocks and quite useful in forecasting and measuring volatility but these models are unable to capture the "leverage effect" or asymmetric information. The rational and underlying logic of asymmetric or "leverage effect is that the distribution of stock return is highly asymmetric. An interesting future of asset prices is that "bad news" (negative shocks) seems to have a more pronounced effect on volatility than that of "good news" (positive shocks) of the same magnitude, that is, bad news is followed by larger increase in price volatility than good news of the same magnitude. It is known that the magnitude of the response of asset prices to shocks depends on whether the shock is negative or positive. To demonstrate this point Engle and Ng (1990) mapped the relationship between the conditional variance of asset returns to exogenous shocks, which resulted in what they termed a news impact curve. Nelson (1991) proposed an exponential GARCH model or EGARCH model that is the earliest extension of the GARCH model that incorporates asymmetric effects in returns from speculative prices based on a logarithmic expression of the conditional variability of variable under analysis. The conditional variance equation in the EGARCH (1, 1) model is

$$\ln(h_t) = \alpha_0 + \alpha_1 \frac{|\varepsilon_{t-1}|}{\sqrt{h_{t-1}}} + \lambda_1 \left(\frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}}\right) + \beta_1 \ln(h_{t-1})$$

Where, h_t is an asymmetric function of past $\mathcal{E}_t$ and α_0, α_1 λ_1 and $\beta_1$re constant parameters.

Note that the left hand side is the log of the conditional variance. This implies that the leverage effect is exponential, rather than quadratic and that forecasts of the conditional variance are guaranteed to be nonnegative. In this model specification,β_1 is the GARCH term that measures the impact of last period's forecast variance. A positive β_1 indicates volatility clustering implying that positive stock price changes are associated with further positive changes and vice versa. If $\frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}}$ is positive the effect of the shock on the log of the conditional variance is $(\alpha_1+\lambda_1)$. If $\frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}}$ is negative, the effect of the shock on the log of conditional variance is $(-\alpha_1+\lambda_1)$. λ_1 measures the leverage or asymmetric effect. λ_1 is expected to be negative implying that bad news has a bigger impact on volatility than that of good news of the same magnitude.

To examine the relationship between firm size, volatility and returns the study here employs the following panel regression model

$$r_{it} = \alpha_1 + \theta_1 D_1 + \theta_2 D_2 + \beta_1 h_{it} + \delta_1 P_1 + \delta_2 P_2 + \varepsilon_{it}$$

Where

i stands for i th cross sectional unit, i = 1, 2, ..., N

t stands for t th time periodt = 1, 2, ..., T

D_1 = 1 for small size firm or 0 otherwise

D_2 = 1 for medium size firm or 0 otherwise

D_3= 1 for large size firm or 0 otherwise

P_1 = $h_t$for small size firms or 0 otherwise

P_2 = $h_t$for medium size firms or 0 otherwise

P_3 = $h_t$for large size firms or 0 otherwise

Since D_1, D_2& D_3 are intercept dummies and P_1, P_2& P_3 are slope dummies

5. Result and Discussion

Return Series	Mean	Std. Dev.	Maximum	Minimum	Skewness	Kurtosis	J.B.-Statistic	P-Value
Ashok Leyland (AL)	0.00002	0.031	0.15	-0.69	-4.83	112.2	1122145	0
Escorts Ltd (EL)	0.00016	0.035	0.18	-0.23	0.05	6.17	940	0
Hero Motors (HM)	0.00029	0.017	0.07	-0.08	-0.12	4.73	84	0
Hindustan Motors (HNM)	-0.00117	0.031	0.18	-0.08	1.65	10.36	2105	0
Hindustan machine tools (HMT)	-0.00012	0.037	**0.27**	-0.2	1.18	8.82	3681	0
Mahindra & Mahindra (M&M)	0.0003	0.032	0.21	-0.69	-8.19	179.79	2943598	0
Maharashtra Scooters Limited(MSL)	0.00041	0.03	0.18	-0.22	0.04	10.06	4596	0
Maruti Suzuki India(MSI)	0.00067	0.023	0.12	-0.13	-0.06	5.68	671	0
SML Isuzu Limited (SIL)	**-0.00026**	0.024	0.18	-0.1	0.93	8.29	1040	0
Tata Motors Ltd (TM)	-0.00009	**0.055**	0.16	**-1.66**	-21.56	649.99	22353939	0
TVS Motor Company (TVS)	0.00014	0.035	0.25	-0.66	-2.71	64.35	354243	0
V.S.T Tillers Tractors (VST)	**0.00092**	0.019	0.12	-0.07	1.05	8.58	1030	0
CNX_AUTO	0.00074	**0.015**	0.140046	-0.10315	-0.13923	8.54191	2875.05	0

Table 1: Descriptive Statistics of Automobile Sector:
Source: Computed on the basis of secondary data collected from www.nseindia.com, 2014

The descriptive statistics of daily returns of selected Automobile companies and Automobile sector index are reported in Table 1. From Table 1, it is observed that the daily mean return of V.S.T. Tiller Tractors is relatively higher than that of other Automobile firms. The daily mean return of CNX Auto, i. e. Auto sector index is 0.00073 (0.073%). The mean returns of all other selected companies are lower than the CNX Auto except V.S.T. Tiller Tractors. The lowest even negative mean return is shown in SML Isuzu limited. However, AL, EL, HM, M&M, MSL, MSI and TVS shows positive returns whereas HNM, HMT, SML and TM shows negative mean returns. In the Automobile sectors (within selected companies) the return is fluctuated between 0.27 to -1.66. The highest standard deviation or volatility is shown in Tata Motors whereas the lowest is shown in Hero Motors. Here, it is observed that the highest mean return is associated with the lower risk while the lowest mean return is associated with the higher risk, which is controversial to the Capital Asset Pricing Model (CAPM). The volatility of sectoral index return is lower than that of all other companies. From this, it can be said that the investor can invest in those companies which provides good returns with lower risk. The EL, HM, HMT, MS, SML and VST are positively skewed whereas the AL, HM, M&M, MSI, TM, TVS and CNX Auto are negatively skewed. A positively skewed return series indicates that it has higher possibility to generate positive returns while negatively skewed implies higher probability to generate negative returns. The kurtosis of all the return series are greater than three (excess kurtosis) thus, they are leptokurtic, i. e. the frequency distribution assigns a higher probability to return around zero as well as very high positive and negative returns. From Table 1, it is also observed that the J. B. Statistic for all the return series are highly significant even at less than one percent level which indicates that the return series are not normally distributed implying the presence of heteroscedasticity. Hence GARCH model is suitable for testing the hypothesis.

Return Series	**Augmented Dickey Fuller Test**		**Phillips Perron Test**	
	Statistic	Prob.*	Statistic	Prob.*
Ashok Leyland	-19.42	0.00	-26.21	0.00
Escort Ltd	-32.15	0.00	-38.07	0.00
Hero Motors	-14.31	0.00	-6.79	0.00
Hindustan Machine Tools	-19.75	0.00	-29.81	0.00
Hindustan Motors	-10.59	0.00	-35.34	0.00
Mahindra & Mahindra	-24.41	0.00	-78.58	0.00
Maharashtra Scooters ltd	-19.8	0.00	-67.47	0.00
Maruti Suzuki India	-21.47	0.00	-40.31	0.00
SML Isuzu Limited	-10.5	0.00	-32.79	0.00
Tata Motors Ltd	-16.72	0.00	-45.03	0.00
TVS Motor Company	-30.48	0.00	-330.61	0.00
V.S.T Tillers Tractors	-8.26	0.00	-13.62	0.00
CNX_AUTO	-33.17	0.00	-38.93	0.00
Test critical values:				
1% level		5% level		10% level
-3.43308		-2.86263		-2.5674

Table 2: Unit Root Test: Automobile Sector
Source: Estimated based on secondary data collected from www.nseindia.com, 2014

For thetime series analysis, the first important task is to check whether the data series of the concerned variables are stationary or not. To check whether the data series are stationary or not the study here employs the unit root test. For the test of unit root the present study applies the Augmented Dickey Fuller Test and Phillips Perron Test. These tests are used to measure the stationarity of the time series data which in turn tells whether regression can be done on the data or not. From Table 2, it is observed that the Augmented Dickey-Fuller test statistic and Phillips-Perron test statistic for all the return series of Automobile sector is greater than the critical values even at less than one percent level of significance. Both ADF and PP test statistic confirms that there is no unit root. Therefore, the null hypothesis that the return series has unit root is rejected for all the return series and thus data for all return series are found to be stationary.

Return Series	**F- Statistic**	**P Value**	**Observed R^2**	**P Value**
Ashok Leyland	91.05	0.00	87.56	0.00
Escort Ltd	171.92	0.00	159.79	0.00
HM	25.97	0.00	25.05	0.00
Hindustan Machine Tools	142.29	0.00	133.90	0.00
Hindustan Motors	35.49	0.00	34.01	0.00
Mahindra & Mahindra	26.40	0.00	26.12	0.00
Maharashtra Scooters ltd	89.06	0.00	85.68	0.00
Maruti Suzuki India	19.87	0.00	19.71	0.00
SML Isuzu Limited	8.13	0.00	8.07	0.00
Tata Motors Ltd	12.34	0.00	12.24	0.00
TVS Motor Company	206.64	0.00	189.32	0.00
V.S.T Tillers Tractors	13.85	0.00	13.62	0.00
CNX_AUTO	52.53	0.00	51.37	0.00

Table 3: ARCH-LM Test: Automobile Sector
Source: Estimated based on secondary data collected from www.nseindia.com, 2014

Before apply any ARCH or GARCH model it is important to check whether there is ARCH effect or not. To check ARCH effect, the study here employs the ARCH LM test of Engle (1982). The ARCH LM test regress the squared residual of the mean model (ε_t^2) on lagged squared residual (ε_{t-1}^2) and a constant. The ARCH LM test provides two statistics, that is, F-statistic value and Observed R square value. From Table 3, it is observed that the F-statistic and the observed R square value is greater than their critical values for all the return series of Automobile sector, as indicating by their corresponding P-value which is less than one percent level. Therefore, the null hypothesis that is no ARCH effect is rejected for all the return series indicating that there is ARCH effect for all the return series of Automobile sector. Thus, it is confirmed that the study can apply ARCH or GARCH model.

5.1. Result of GARCH-M Models

The most popular member of the ARCH class of model, i.e. GARCH-M (p, q) model is used to model volatility of Automobile sector return series. The Maximum Likelihood Estimation technique is used for the estimation of GARCH-M model. When using this technique, the model selection is based on AIC and SIC. The model with lower value of AIC and SIC fits the data best.For model estimation the study here uses Eviews-6 software.

In the estimation of GARCH type models, we start with a general specification of the mean equation (1) and the variance equation (2).

$$r_t = \omega + \theta h_t + \sum_{i=1}^{p} \phi_i \, r_{t-i} + \varepsilon_t + \sum_{i=1}^{q} \delta_i \, \varepsilon_{t-i} \dots\dots\dots (1)$$

$$h_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i \, \varepsilon_{t-i}^2 + \sum_{j=1}^{q} \beta_j \, h_{t-i} \dots . (2)$$

For time series analysis, it is desirable to have stationary series. Stationarity of the variance can be found by summation of ARCH and GARCH coefficient, i.e. $\alpha_i + \beta_j$ and the value of summation should be less than one (Bollerslave, 1987). As far the stationarity of the variance process is concerned, it is observed that the summation of α_1 and β_1 for all return series are less than one and hence the stationary condition is satisfied for all the return series of Automobile sectors. However, the sum is rather close to one which indicates a long persistence of shock on volatility (Akigray1989) (Magnus & Fosu, 2006).

The ARCH coefficient (α_i) measures the impact of previous period's squared residuals on current period volatility. A significant ARCH coefficient (α_i) indicates that there is significant impact of previous period's shocks (ε^2_{t-i})on current period volatility (h_t). The ARCH coefficient is also treated as 'recent news' component which explains that recent news has significant impact on volatility. That is previous day's stock return information about today's volatility. From Table 4, it is observed that for all the return series of Automobile sector the ARCH coefficient is statistically significant at less than one percent level of significance which indicates that previous period shocks influence the current period volatility. Some companies return series such as AL, EL, HMT, MS, TM, TVS, VST and CNX Auto fit the GARCH-M (2, 1) or GARCH-M (2, 2) model. For these return series the second period lag shocks (ε^2_{t-2}) has some impact on current period volatility as the ARCH coefficient (α_2) is also statistically significant.

Result of GARCH-M Model for Automobile Sector														Diagnostic Test			
Return Series	θ	**ω**	ϕ_1	ϕ_2	ϕ_3	δ_1	δ_2	α_0	α_1	α_2	β_1	β_2	$\alpha_i+\beta_i$	Adj R	Log like	F-statistic	AIC
AL	-1.93	0.00003	1.40	-0.96		-1.21	0.41	0.00000	0.05	1.49	-0.57		0.98	0.85	11946	1288	-10.66
	0.41	0.05290	0.00	0.00		0.00	0.00	0.00350	0.00	0.00	0.00					0.00	
EL	0.00	0.00225	-0.38			0.60		0.00000	0.20	-0.09	0.86		0.97	0.55	10337	17	-9.22
	0.09	0.07240	0.00			0.00		0.00060	0.00	0.03	0.00					0.00	
HM	0.29	0.00030	1.48	-0.98		-0.93	-0.06	0.00000	0.04		0.95		0.98	0.97	4405	2691	-13.34
	0.60	0.00000	0.00	0.00		0.00	0.10	0.13510	0.02		0.00					0.00	
HMT	-21.15	-0.00074	0.86			-0.49		0.00000	0.19	-0.17	1.44	-0.47	.99	0.20	9063	61	-8.08
	0.01	0.00780	0.00			0.00		0.11750	0.00	0.00	0.00	0.00				0.00	
HNM	-19.80	-0.00130	0.04	-0.96		0.49	0.77	0.00000	0.21		0.51		0.72	0.74	3812	239	-9.81
	0.04	0.00000	0.00	0.00		0.00	0.00	0.00210	0.01		0.00					0.00	
M&M	47.90	0.00009	2.03	-1.47	0.38	-1.58	0.63	0.00000	0.15		0.82		0.97	0.39	11288	141	-10.08
	0.00	0.02410	0.00	0.00	0.00	0.00	0.00	0.00000	0.00		0.00					0.00	
MS	14.92	0.00026	0.24	0.43		-0.72		0.00000	0.37	-0.30	1.29	-0.38	0.99	0.19	9708	54	-8.78
	0.01	0.00000	0.01	0.00		0.00		0.13560	0.00	0.00	0.00	0.00				0.00	
MSI	5.04	0.00066	1.18	-0.52		-0.85		0.00000	0.09		0.88		0.96	0.28	12042	110	-10.75
	0.82	0.00000	0.00	0.00		0.00		0.00030	0.00		0.00					0.00	
SI	-23.99	0.00044	-0.58			0.38		0.00000	0.26		0.56		0.82	0.55	3290	6	-8.28
	0.07	0.03910	0.00			0.00		0.00150	0.00		0.00					0.00	
TM	32.04	-0.00041	1.11	-0.66		-0.73		0.00000	0.31	-0.30	1.22	-0.25	0.99	0.46	6320	110	-9.90
	0.00	0.00000	0.00	0.00		0.00		0.01280	0.00	0.00	0.00	0.07				0.00	
TVS	3.44	0.00013	-1.59	-0.93		0.34		0.00000	0.38	-0.38	1.37	-0.39	.99	0.91	14224	2386	-12.70
	0.11	0.00000	0.00	0.00		0.00		0.01300	0.00	0.00	0.00	0.00				0.00	
VST	27.07	0.00077	1.39	-0.99		-1.38	0.84	0.00000	0.25	-0.24	0.98		0.99	0.46	6320	110	-9.90
	0.47	0.00000	0.00	0.00		0.00	0.00	0.48420	0.01	0.01	0.00					0.00	
INDEX	9.55	0.00076	0.66	-0.31		-0.50		0.00000	0.08		0.90		0.98	0.09	10822	29	-9.66
	0.54	0.00000	0.00	0.00		0.00		0.00030	0.00		0.00					0.00	

Table 4: Result of GARCH-M Model for Automobile Sector

Source: Estimated based on secondary data collected from www.nseindia.com, 2014

The GARCH coefficient (β_1) measures the impact of last period variance (h_{t-1}) on current period volatility (h_t). A significant GARCH coefficient (β_1) indicates the presence of volatility clustering, i.e. is a positive β_1 implies that a positive stock price changes are associated with further positive changes and vice versa. The GARCH coefficient (β_1) is also treated as 'old or historical news' component which implies that the news that is old by more than one day plays a significant role on volatility. From Table 4, it is observed that the GARCH coefficient β_1 andβ_2 are statistically significant indicating that h_{t-1} and h_{t-2} has influenced the current period volatility (h_t). A relatively large value of GARCG coefficient indicates that shocks to conditional variance take a long time to die out. However, low value of ARCH coefficient suggests that market surprises induce relatively small revision in future volatility. A large sum of these coefficients implies that a large positive and negative return will lead future forecasts of the variance to be high for a particular period. So investor can take advantage for the same and by analyzing recent and historical news can forecast the future market movement and can take their investment strategies accordingly.

In the GARCH-M model in the mean equation the most important variable is h_t i.e. conditional variance. Here the coefficient of h_t i.e. θ is the risk parameter. A significant positive θ indicates that there is positive relationship between predicted return and volatility. If volatility increases, then expected return will also increase and vice versa. From Table 4, it is observed that θ is statistically significant for the return series of EL, HMT, HNM, M&M, MS, SI and TM. But the coefficient θ is positive only for EL, M&M, MS and TM while it is negative for HMT, HNM, and SI. For the rest of the companies such as HM, MSI, TVS, VST and CNX Auto the coefficient θ is statistically insignificant. From this, it can be said that when volatility rises expected return is also rises for EL, M&M, MS, and TM companies. On the other hand, when volatility rises, predicted return falls for HMT, HNM, and SI. The result of Automobile sector is partially inconsistent with the theory of asset pricing. In the mean equation, the autoregressive (AR) and moving average (MA) coefficients are statistically significant for all companies of Automobile sector which indicates that one, two, or three period lag return and one or two period lag residual has some impact on current period return.

A high value of R^2 depicts a very high degree of explained variation. Apart from this AIC and SIC is used in the study indicating lower for the regression which is quite reasonable and fit for our models. A high value of F-statistic states that the statistical models that are used are fit and appropriate.

ARCH LM TEST					**Standardized Residuals**		**Square Standardized Residual**	
Return Series	F-Statistics	P-Value	Obs. R^2	P-Value	Q-Stat (36)	Prob	Q-Stat (36)	Prob
AL	0.25	0.62	0.25	0.62	7227.70	0.00	1.42	1.00
EL	0.42	0.52	0.42	0.52	32.65	0.53	31.20	0.61
HM	0.12	0.73	0.12	0.73	32.83	0.43	17.93	0.98
HMT	0.00	0.98	0.00	0.98	213.36	0.00	30.89	0.62
HNM	0.01	0.92	0.01	0.92	32.50	0.21	13.09	0.99
MM	0.01	0.92	0.01	0.92	35.57	0.30	0.36	1.00
MS	0.41	0.52	0.41	0.52	34.68	0.39	37.93	0.26
MSI	0.84	0.36	0.84	0.36	22.25	0.92	20.57	0.96
SI	0.25	0.62	0.25	0.62	118.63	0.00	13.84	1.00
TM	0.00	0.99	0.00	0.99	18.07	0.98	0.08	1.00
TVS	10.86	0.00	10.82	0.00	31.01	0.44	23.63	0.89
VST	0.30	0.59	0.30	0.58	32.83	0.43	24.70	0.82
INDEX	0.47	0.49	0.47	0.49	39.96	0.16	14.95	1.00

Table 5: ARCH LM Test:
Source: Estimated based on secondary data collected from www.nseindia.com, 2014

To check the adequacy of the mean models the Ljung-Box Q statistics of standardized residual is used and that of square standardized residual is used to check for the adequacy of variance models. The diagnostic test for model adequacy as shown in Table 5 suggests that the Ljung Box Q statistic of standardized residuals is insignificant for all the return series of Automobile sector except AL, HMT and SI indicating that the estimated mean models of each company fits the data well except AL, HMT and SI. For these three companies, different models are used but still there remains serial correlation. Finally, we have selected those mean models for these companies which have lowered AIC and SIC. However, the Ljung-Box Q statistic of square standardized residual is highly insignificant for all the return series of Automobile sector indicating that the estimated variance models fits the data very well. That is the GARCH-M models are suitable for the return series of Automobile sector.

To check whether the estimated models capture the ARCH effect or there remains further ARCH effect, the study here employs the ARCH-LM test. From Table 5, it is observed that the ARCH- LM test statistic i.e. observed R^2 for all the return series of Automobile sector is less than their critical values imply that the null hypothesis of no ARCH effect is accepted. This implies that there is no further ARCH effect. That means the estimated models are appropriate.

5.2. Result of EGARCH Models

Though ARCH and GARCH models are responds to good and bad news and quite useful in forecasting and modeling volatility but these models have not capture leverage effect and information asymmetry. The rational and underlying logic of asymmetric or leverage effect is that the distribution of stock returns is highly asymmetric. Bad news (negative shocks) is followed by larger increase in price volatility than that of good news (positive shocks). Because when stock prices fall the value of the associated company's equity declines. As a result, the debt equity ratio of the company rises, thereby signaling that the company has become riskier. Increased risk is considered an indicator of higher volatility (Black 1976). So it is important to use EGARCH model to test asymmetric shocks to volatility.

$$\ln(h_t) = \alpha_0 + \alpha_1 \frac{|\varepsilon_{t-1}|}{\sqrt{h_{t-1}}} + \lambda_1 \left(\frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}}\right) + \beta_1 \ln(h_{t-1}) \quad (3)$$

Table 6 presents the result of EGARCH model for the return series of Automobile sector. The EGARCH model takes the leverage effect into account. From Table 6, it is observed that the asymmetric term (λ_1) is negative and statistically significant for AL, EL, MS and CNX Auto companies indicating that the volatility is high when there is bad news or negative shocks in the market than that of good news or positive shocks for these companies (Nelson, 1991) (Jinho, Chang Jin and Nelson, 2007) (Song et al, 2013). But the asymmetric term (λ_1) is positive and statistically significant for HM, HNM, TM and VST companies indicating that the volatility is high when there is good news or positive shocks in the market than that of bad news or negative shocks for these companies (Triphaty, 2010). However, the asymmetric term (λ_1) is statistically insignificant for HMT, M&M, MSI, IS and TVS companies indicating that these companies have not significant asymmetric or leverage effect (Bekaert and Wu, 2000). In the variance equation, the ARCH and GARCH coefficients are statistically significant for all the return series of Automobile sector implying that a greater shock on volatility (Bollerslave 1986).

							Diagnostic Test					
Return Series	α_0	α_1	α_2	λ_1	β_1	β_2	Adj. R^2	Log like	F-statistic	AIC	SIC	Obs.R^2
AL	-0.627	-0.36	0.62	-0.09	0.97		0.46	10736	240	-9	-9	0.74
	0.000	0.00	0.00	0.00	0.00				0			0.38
EL	-0.690	0.34		-0.11	-0.02	0.96	0.05	10333	17	-9	-9	0.00
	0.000	0.00		0.03	0.33	0.00			0			0.95
HM	-0.530	0.23		0.09	0.98		0.77	3755	324	-13	-13	0.38
	0.000	0.00		0.04	0.00				0			0.53
HMT	-0.142	0.46	-0.40	-0.01	1.53	-0.54	0.19	9059	59	-8	-8	1.13
	0.064	0.00	0.00	0.36	0.00	0.00			0			0.28
HNM	-1.038	0.17		0.06	1.45	-0.52	0.26	3327	35	-11	-11	0.83
	0.001	0.01		0.07	0.00	0.01			0			0.36
M&M	-0.717	0.19		-0.03	0.95		0.32	11279	135	-10	-10	0.00
	0.000	0.00		0.16	0.00				0			0.93
MS	-1.746	0.52		-0.07	0.88		0.20	9706	71	-8	-8	0.00
	0.000	0.00		0.02	0.00				0			0.98
MSI	-0.462	0.26	-0.10	-0.01	0.97		0.28	12044	98	-10	-10	0.18
	0.002	0.00	0.07	0.71	0.00				0			0.66
SI	-3.167	0.45		0.01	0.74		0.01	3273	3	-8	-8	0.41
	0.005	0.00		0.82	0.00				0			0.52
TM	-0.742	0.16		0.04	0.95		0.46	6318	134	-9	-9	1.38
	0.003	0.00		0.26	0.00				0			0.99
TVS	-3.443	0.52		0.00	0.80		0.91	14226	2982	-12	-12	2.64
	0.000	0.00		0.98	0.00				0			0.10
VST	-7.165	0.40		0.15	0.48		0.84	3637	461	-10	-10	0.09
	0.000	0.00		0.05	0.00				0			0.75
CNX	-0.361	0.16		-0.07	0.97		0.02	6406	5	-9	-9	0.16
Auto	0.000	0.01		0.00	0.00				0			0.68

Table 6: The Result of E-GARCH Model of Automobile Sector

Source: Estimated based on secondary data collected from www.nseindia.com, 2014

Table 6 presents the result of EGARCH model for the return series of Automobile sector. The EGARCH model takes the leverage effect into account. From Table 6, it is observed that the asymmetric term (λ_1)is negative and statistically significant for AL, EL, MS and CNX Auto companies indicating that the volatility is high when there is bad news or negative shocks in the market than that of good news or positive shocks for these companies (Nelson, 1991) (Jinho, Chang Jin and Nelson, 2007) (Song et al, 2013). Butthe asymmetric term (λ_1) is positive and statistically significant for HM, HNM, TM and VST companies indicating that the volatility is

high when there is good news or positive shocks in the market than that of bad news or negative shocks for these companies (Triphaty, 2010). However, the asymmetric term (λ_1) is statistically insignificant for HMT, M&M, MSI, IS and TVS companies indicating that these companies have not significant asymmetric or leverage effect (Bekaert and Wu, 2000). In the variance equation, the ARCH and GARCH coefficients are statistically significant for all the return series of Automobile sector implying that a greater shock on volatility (Bollerslave 1986).

To check whether the estimated models capture the ARCH effect or there remains further ARCH effect, the study here employs the ARCH-LM test. From Table 6, it is observed that the ARCH- LM test statistic i.e. observed $R^2$for all the return series of Automobile sector is less than their critical values imply that the null hypothesis of no ARCH effect is accepted. This implies that there is no further ARCH effect. That means the selected models are appropriate.

The study here investigates the relationship between return and firm size. Firm size is classified into three categories, viz; small size firm, medium size firm and large size firm based on a composite index constructed by using market capitalization, net sales and profit after tax. The study here tries to find out which firm size provides higher return. The study here also examines the effect of change in volatility on return for each category of firm size. That means if the small size firms' volatility changes then what will be the change in return of small size firm.

To examine the relationship between return and firm size the study here employs panel regression. Before estimating panel regression, it is necessary to check which estimation technique (Pooled OLS, Fixed Effect or Random Effect model) is suitable for the panel data. For this we use Hausman tests and it is find that Random Effect Model is suitable.

Random-Effects GLS Regression				
Group variable: PI		Number of observation=17650		
		Number of groups=11		
R-Square:	Within = 0.0108	Observation per group: min =661		
	Between= 0.1361	Average =1604.5		
	Overall = 0.0139	Maximum = 2241		
Corr. (u_i, X)= 0 (assumed)		Wald $chi^2(5)$=194.23		
Dependent Variable = Return		Prob. > chi^2=0.0000		
Coefficients	Value of Coefficients	Std. Error	t-statistic	P-Value
β_1	0.00049	0.000324	1.53	0.127
θ_1	-0.00047	0.000278	-1.7	0.090
θ_2	-0.00011	0.000298	-0.38	0.707
δ_1	-0.08133	0.024438	-3.33	0.001
δ_2	-0.00287	0.00037	-7.76	0.000
α_1	0.000313	0.000195	1.6	0.100
Sigma u		0.000379		
Sigma e		0.003322		
Rho		0.012869		

Table 7: Result of Automobile Sector (REM):
Source: Estimated based on secondary data collected from www.nseindia.com, 2014

From Table 7, it is observed that the intercept term (α_1) which captures the structural factors for large size firms is significant at ten per cent level of significant and that implies there would be a positive return (0.031percent) from investment in large size firms without any risk though the magnitude is very small in this case. The intercept differential term (θ_1) of small size firm as compared to large size firm is negative and statistically significant at less than 10 per cent level of significance. This indicates that the intercept differential impact of small size firm as compared to large size firm on return decreases by 0.047 per cent in case of automobile sector. The return decreases by 0.016 per cent in case of small size firm. However, the effect of medium size firm (θ_2) on return is not statistically significant.

There is no statistically significant effect of change in volatility of small size firms on return for automobile sector. The estimated coefficient (β_1) is positive but statistically insignificant. The slope differential effect of medium size firm as compared to small size firm (δ_1) is negative and statistically significant at one per cent level of significance. This indicates that if volatility increases by one per cent for medium size firms then return may decreases by approximately 8 per cent compare to small size firms. The slope differential effect of large size firms compares to small size firms (δ_2) is also negative and statistically significant at one per cent level of significance. For large size firm, one per cent increase in volatility may result 0.2 per cent decrease in return of large size firms compare to small size firms. But the slope differential effect of large size firms is relatively lower than that of medium size firms.

6. Conclusions

From the above analysis it can be conclude that the volatility in all the automobile firms exhibits the characteristics like volatility clustering, asymmetry effect and persistence of volatility in their daily returns. The study also finds the existence of leverage effect in AL, EL, MS and CNX Auto indicating that the negative shocks or bad news have more impact on volatility than that of positive shocks or good news. The relationship between returns and volatility is statistically significant forEL, HMT, HNM, M&M, MS, SI and TM. The study also finds significant small size firm effect on returns.

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