Modelling the Impact of News on Volatility: A study on BSE Bankex Market Returns

Dr.Vandana Dangi, *Assistant Professor, Government College for Women, Rohtak*
vandanashoora@yahoo.com, vandanashoora@gmail.com

Abstract

The prediction of impact of news on volatility is vital for investors to measure the risk exposure in their investment. The present treatise is an attempt to construct an empirical model to study the impact of news on volatility in Indian banking sector indices of BSE Bankex. The daily banking sector indices for the period of January 2004 to December 2013 are taken from the online database maintained by the Bombay Stock Exchange. The data was initially studied for stationarity with the help of Augmented Dickey–Fuller test and further tested for autoregressive conditional heteroskedasticity with the help of Engle's ARCH test (i.e. Lagrange multiplier test) and Breush-Godfrey-Pagan test. These tests confirmed the stationarity and presence of ARCH effect in the BSE Bankex return series. The Nelson's EGARCH model was employed to study the impact of news on volatility in BSE Bankex return series. The test results indicate that the volatility in banking sector indices is highly persistent. The conditional variance of the BSE Bankex return series also reacts differently to a given positive shock than to a negative shock. The news impact curve indicates higher uncertainty following negative news as compared to positive news.

Keywords: Asymmetries, Autoregressive conditional heteroskedasticity, News impact curve and Stationarity.

Introduction

There is significant improvement in the performance of Indian banking sector especially in terms of transparency and efficiency due to recently introduced banking reforms. The enactment of the Securitization Act, change in the basis of income recognition and initiatives to improving recoveries spurted the treasury income of Indian banks. The outstanding track record of Indian banking sector is reflected in its market valuation. The prediction of volatility is one of the crucial aspects in investment decision making process. Investors need to study the risk-return relationship from different perspectives. News affects stock markets and it becomes vital for investors to analyse the relationship between the news and the market. The accurate modelling to study the impact of news is a necessity to study this relationship.

Review of Literature

The introduction of ARCH models by Engle and their generalization by Bollerslev had literally refined the approach to predict the volatility. They modelled the conditional volatility to capture the stylized characteristics of financial data. Crouhy Michel and Rockinger Michael (1997) applied AT-GARCH (1,1) model to study the volatility clustering. They further captured residual structure by extending AT-GARCH (1,1) to a hysteresis model (HGARCH) for structured memory effects. They found that bad news was discounted very speedily in volatility. However, good news had a very small impact on the volatility. Connolly, Robert A and Stivers, Christopher Todd (2005) studied volatility clustering in the daily stock returns at index and firm level from 1985 to 2000. They noticed decline in the relation between a day's index return shocks to its next period's volatility when important macroeconomic news was released. They finally concluded that volatility clustering was strong when there were disperse beliefs about the market's information signal. Hourvouliades.L.Nikolaos (2007) examined the existence and nature of volatility clustering in the Athens FTSE20 index futures contract to unearth the characteristics of clustering in derivatives market. He applied GARCH model and exponential smoothing model to compare forecasting power on volatility. He found volatility clustering in the time series of the Greek futures market with negative shocks being more persistent as compared to positive shocks.

Ramlall Indranarain (2010) studied the impact of the credit crunch on the volatility clustering and leverage effects in major international stock markets. He studied the impact with GARCH (1,1), GJR and news impact curves techniques. He noticed leverage effects in the post crisis period only in case of emerging markets such as JSE and SSEC. He concluded that the credit crunch accentuated the level of volatility clustering and also increased leverage effects in major international stock markets. Xue Yi and Gencay Ramazan (2012) studied multiple trading frequencies using Bayesian information updates in an incomplete market and introduced a market microstructure model to generate volatility clustering with hyperbolically decaying autocorrelations. They concluded that signal extraction induced by multiple trading frequencies can increase the persistence of the volatility. They found that the volatility of the underlying returns series varies greatly with the number of traders in the market.

Lin, Pin-te and Fuerst, Franz (2013) applied a Lagrange multiplier test for the autoregressive conditional heteroskedasticity effects and an exponential generalized autoregressive conditional heteroskedasticity-in-mean model to assess the similarity financial characteristics of regional house prices and stock indices in Canada. They found that volatility clustering, positive risk-return relationships and leverage effects exist in the majority of provincial housing markets of Canada. Researchers have given lot of attention to the volatility dynamics and impact of news in the developed and emerging financial markets. But there is lack of exploration on the impact of news on the sectorial indices of banking in India. The present treatise is an attempt to fill this gap by estimating the impact of news on volatility in Indian banking sector indices of BSE Bankex.

Objective of the study

The present treatise attempts to study the impact of news on volatility in the market returns of BSE Bankex.

Research Methodology

Database

The daily stock price data for the period of January 2004 to December 2013 on BSE Bankex has been taken from the online database maintained by the Bombay Stock Exchange. BSE Bankex indices track the performance of banking sector stocks listed on the Bombay Stock Exchange Ltd. The stocks of UTI Bank Ltd, Kotak Mahindra Bank, UCO Bank, Indian Overseas Bank, Jammu & Kashmir Bank, Vijaya Bank, Allahabad Bank Ltd, Centurion Bank Ltd, Indusind Bank Ltd, Karnataka Bank Limited, Federal Bank Ltd, Yes Bank Ltd and IDBI Bank Ltd are included in the present indices. One peculiar point to note here is that these stocks actually represent ninety percent of the total market capitalization of all banking sector stocks.

Econometric Methodology

The present treatise uses the log difference of closing prices of two successive periods in order to calculate the rate of return as the volatility in BSE Bankex indices has been estimated on returns. The following formula is applied to estimate the return series:

$$R_t = (InP_t - InP_{t-1}) * 100 \qquad (1)$$

Stationarity

The data was initially studied for stationarity with the help of Augmented Dickey–Fuller test. It examines whether a time series variable is non-stationary using an autoregressive model. It tests the existence of a unit root as the null hypothesis. The testing procedure for the ADF test consists of estimating the following regression:

$$\Delta y_t = \propto + \beta t + \gamma y_{t-1} + \delta_1 \Delta y_{t-1} + \cdots + \delta_{p-1} \Delta y_{t-p+1} + \varepsilon_t \qquad (2)$$

If the test statistic is less than the critical value, then the null hypothesis is rejected implying no unit root is present.

Autoregressive Conditional Heteroskedasticity Effect

The data is further tested for autoregressive conditional heteroskedasticity with the help of Engle's ARCH test (i.e. Lagrange multiplier test) and Breush-Godfrey-Pagan test. The ordinary least square equation may mislead in case of time varying variance. The residuals from the ordinary least square regression equation are tested for Autoregressive Conditional Heteroskedasticity effect. **Engle's ARCH test** is a Lagrange multiplier test to assess the significance of ARCH effects. The null hypothesis is:

$$\alpha_0 = \alpha_1 = \cdots = \alpha_m = 0 \quad (3)$$

The alternative hypothesis is:

$$e_t^2 = \alpha_0 + \alpha_1 e_{t-1}^2 + \cdots + \alpha_m e_{t-m}^2 + u_t \quad (4)$$

Where u_t is a white noise error process.

Breush-Godfrey-Pagan test is based on the Lagrange multiplier test principle that is used to test heteroskedasticity in the regression model. It examines whether the estimated variance of the residuals are dependent on the independent variable by regressing the squared residuals on the independent variables:

$$\hat{u}^2 = \Upsilon_0 + \Upsilon_1 x + \upsilon \quad (5)$$

Model Specification

Linear models cannot explain leptokurtosis, volatility clustering and leverage effect in the financial data. The Generalised Autoregressive Conditional heteroskedasticity (GARCH) type process very well characterised the dependence (Brooks 1996). But, the GARCH model cannot account for the leverage effects because it does not allow for direct feedback between the conditional mean and conditional variance. It enforces a systematic response to positive and negative shocks. It is the Nelson's (1991) Exponential Generalised Autoregressive Conditional heteroskedasticity (EGARCH) model that allows asymmetries. The artificial imposing of non-negativity constraints for the model parameters is not needed in this model. The

$$In\,({h^2}_t) = \alpha_0 + \Upsilon\,(e_{t-1}/h_{t-1}) + \lambda\,[(|e_{t-1}|/h_{t-1}) - (2/\pi)^{0.5}] + \beta In\,({h^2}_{t-1}) \quad (6)$$

Properties of BSE Bankex Market Returns

Daily closing prices have been taken for BSE Bankex and converted to daily returns. The basic statistics of BSE Bankex returns is portrayed in the Exhibit 1. The average statistics of BSE Bankex returns is positive implying the fact that BSE Bankex indices have increased over the period. The returns are negatively skewed. The value of kurtosis statistics is more than three that clearly indicates the leptokurtic nature of data. BSE Bankex returns series have a heavier tail than the standard normal distribution. Jarque-Bera test confirms the non-normality of return series.The return series of BSE Bankex is tested for stationarity by applying Augmented Dickey–Fuller test. The results of Augmented Dickey–Fuller test in Exhibit 2 indicate that the return series is stationary. The null hypothesis for the presence of unit root in BSE Bankex return series is rejected as the probability value is 0. Exhibit 3 portrays the daily returns and squared daily returns on BSE Bankex indices. There are distinct periods of high volatility and relative calm that indicates volatility clustering in the BSE Bankex indices.

Box-Jenkins methodology is applied to detect whether BSE Bankex return series follow a pure AR process or pure MA process or ARMA process. The results shown in Exhibit 4 and Exhibit 5 specify ARMA (1, 1) structure of the mean equation for BSE Bankex return series. The pictorial representation of return series indicates the clustering but Engle's ARCH test and Breush-Godfrey-Pagan test are applied to test the persistence and predictability of volatility in the Indian banking sector. The residuals are tested for ARCH-LM and the results of the same are displayed in exhibit 6 and 7. Engle's ARCH test confirms the presence of conditional heteroskedasticity in the return series of BSE Bankex as the probability value is zero. The results of Breush-Godfrey-Pagan test confirm that the estimated variance of the residuals is dependent on the independent variable as the probability value is more than 0.05.

Estimation of Market Volatility in terms of Asymmetrical Response to News

EGARCH model is estimated on the BSE Bankex return series in order to test the significance of the asymmetric effects i.e. the differential effect of good or bad news. Exhibit 8 portrays the results of EGARCH model estimation. The value of EGARCH parameter is close to one that indicates the persistence in the volatility shocks. The leverage effect term i.e C(5)*RESID(-1)/@SQRT(GARCH(-1)) in model is -0.060145 i.e. a negative value. This value is significantly different from zero that proves that news impact is assymetric during the sample period. The log likelihood in EGARCH model estimation for the BSE Bankex return series is higher than the estimates of GARCH(1,1) model. The Akaike info criterion and Schwarz criterion are lower in EGARCH model estimation as compared to GARCH(1,1) model. (The results of GARCH (1,1) is not given in the manuscript, but can be provided on the request of readers).

News Impact Curve

The news impact curve plots the volatility as σ^2 against the impact (i.e. $z=\varepsilon/\sigma$) where

$$\log \sigma_t^2 = \omega + \beta \log \sigma_{t-1}^2 + \alpha|Z_{t-1}| + \Upsilon Z_{t-1} \quad (7)$$

Firstly, last period's volatility is fixed. Secondly, one period impact is estimated. This one period impact is conditional on the last period's volatility. Thirdly, conditional variance series is generated and it is named as SIG2. Fourthly, z series is generated as a equispaced period between -10 and +10. Finally, news impact curve was estimated by highlighting the z series and SIG2 series from EGARCH model fitted to the BSE Bankex return series. Exhibit 9 plot the news impact curve for the BSE Bankex reurn series. The news impact curve drawn from EGARCH model which is fitted to the BSE Bankex return series clearly inidcates the asymmetrical leverage effect in the series. The conditional variance shows larger reaction to past negative news as compared to the positive news of the equal size.

Discussion

Black (1976), Christie (1982), and Crouhy Michel and Rockinger Michael (1997) have found the negative relation between returns and volatility. Further, Crouhy, Connolly, Robert A. and Stivers, Christopher Todd (2005), Hourvouliades, L.Nikolaos (2007), RamlallIndranarain (2010) and Lin, Pin-te and Fuerst, Franz (2013) statistically confirmed the impact of the news on the market. The plain GARCH model do not allow for asymmetries. It is the reason why EGARCH model was employed to study the impact of news on volatility in BSE Bankex return series. BSE Bankex return is the dependent variable in the present treatise and the time period includes the daily observations beginning with 1/02/2004 and ending with 12/31/2013 (2482 business days). The present study confirms to the results of earlier studies in terms of the basic nature of financial data of banking sector indices. The data is leptokurtic and skewed in nature. The present study also confirms that news effect market.

Conclusion

EGARCH model proposed by Nelson is employed to determine the asymmetries in the volatility. The results confirmed that there is high persistent volatility in the BSE Bankex return series. It was further found that the conditional variance of the BSE Bankex return series reacts differently to negative and positive shock of equal magnitude. The news impact curve clearly indicates that an unanticipated decrease in BSE Bankex return series leads to more uncertainty as compared to an unanticipated increase of equal size. The BSE Bankex market returns tend to be less volatile in response to good news and more vulnerable in response to the bad news.

References

1. Black, F., "Studies of stock price volatility changes", Proceedings of the 1976 Meetings of the American Statistical Association, *Business and Economical Statistical Section*, pp. 177-181.

2. Bollerslrv,T.,(1986) "Genaralised autoregressive conditional heteroskedasticity", *Journal of Econometrics*, Volume 31, pp. 307-327.

3. Christie, A. A., (1982), "The stochastic behaviour of common stock variances – value, everage and interest rate effects", *Journal of Financial Economics*, Volume 10, pp. 407-432.

4. CrouhyMichelandRockingerMichael, (1997), "Volatility Clustering, Asymmetry and Hysteresis in Stock Returns: International Evidence", *Financial Engineering and the Japanese Markets,* Volume 4, Issue 1, pp. 1-3.

5. Engle, R.F., (1982), "Autoregressive conditional heteroskedasticity with estimates of the variance of U.K. inflation", *Econometrica*, Volume 50, pp. 987-1008.

6. HourvouliadesL.Nikolaos,, (2007) "Volatility Clustering in the Greek Futures Market: Curse or Blessing?", *International Journal of Finance and Economics*, Volume 11, pp 41 – 52.

7. Jacobsen, Ben and Dannenburg, Dennis, (2003), "Volatility Clustering in Monthly Stock Returns", *Journal of Empirical Finance*, Volume 10, Number 4, pp. 10-20.

8. Joshi, Prashant Mahesh and Pandya, Kiran, (October 2012), "Volatility in Stock Markets of India and Canada", *TheIUP Journal of Applied Economics*, Volume 9, Number 4, pp. 72-79.

9. Lin, Pin-te and Fuerst, Franz, (2013), "Volatility Clustering, Risk-Return Relationship andAsymmetric Adjustment in Canadian Housing Markets", Retrieved from http://dx.doi.org/10.2139/ssrn.2197098 on 15-10-13.

10. Nelson, Daniel B., (March 1991), "Conditional Heteroskedasticity in Asset Returns: A New Approach",*Econometrica*, Vol. 59, No. 2, pp. 347-370.

11. RamlallIndranarain, (2010) "Has the US Subprime Crisis Accentuated Volatility Clustering and Leverage Effects in Major International Stock Markets?",*International Research Journal of Finance and Economics*, Issue 39, pp. 157-169.

12. Xue Yi and GencayRamazan, (2012), "Trading Frequency and Volatility Clustering", *Journal of Banking &Finance,*Volume36, Issue 3, pp. 760-773.

Exhibit 1: Basic statistics of BSE Bankex returns

Descriptive Statistics	BSE Bankex
Mean	0.060937
Median	0.111960
Maximum	17.54832
Minimum	-14.48036
Std. Dev.	2.130526
Skewness	-0.060399
Kurtosis	8.459875
Jarque-Bera	3083.141
Probability	0.000000
Observations	2481

Exhibit 2: Results of augmented Dickey–Fuller test on transformed series

Null Hypothesis	t-Statistic	Prob.*
BANKEX Returns has a unit root	-43.43202	0.0000

Exhibit 3: Plot of daily returns and squared daily returns

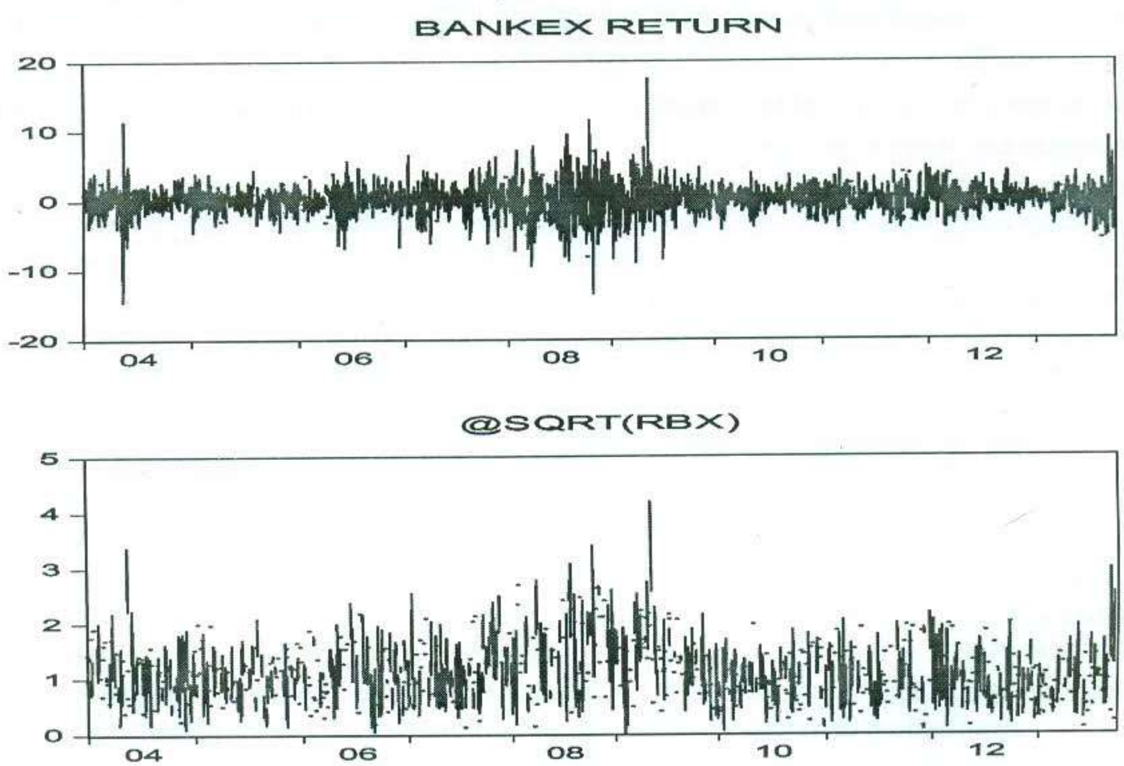

Exhibit 4: Results of ACF, PACF and Q statistics

Lags	AC	PAC	Q-stat	Prob.
1	0.136	0.136	45.674	0.000
2	-0.030	-0.050	47.976	0.000
3	-0.008	0.003	48.136	0.000
4	-0.026	-0.028	49.876	0.000
5	-0.055	-0.049	57.484	0.000
6	-0.063	-0.051	67.278	0.000
7	0.000	0.012	67.278	0.000
8	0.039	0.032	71.003	0.000
9	0.032	0.020	73.487	0.000
10	0.029	0.020	75.570	0.000
11	0.019	0.010	76.491	0.000
12	-0.008	-0.011	76.636	0.000
13	-0.008	0.000	76.803	0.000
14	0.032	0.041	79.402	0.000
15	0.009	0.004	79.593	0.000

Exhibit 5: Correlogram of return series of BSE Bankex

<table>
<tr><th></th><th colspan="2">Bankex</th></tr>
<tr><th>Lags</th><th>AC</th><th>PAC</th></tr>
<tr><td>1</td><td>|* |</td><td>|* |</td></tr>
<tr><td>2</td><td>| |</td><td>| |</td></tr>
<tr><td>3</td><td>| |</td><td>| |</td></tr>
<tr><td>4</td><td>| |</td><td>| |</td></tr>
<tr><td>5</td><td>| |</td><td>| |</td></tr>
<tr><td>6</td><td>| |</td><td>| |</td></tr>
<tr><td>7</td><td>| |</td><td>| |</td></tr>
<tr><td>8</td><td>| |</td><td>| |</td></tr>
<tr><td>9</td><td>| |</td><td>| |</td></tr>
<tr><td>10</td><td>| |</td><td>| |</td></tr>
<tr><td>11</td><td>| |</td><td>| |</td></tr>
<tr><td>12</td><td>| |</td><td>| |</td></tr>
<tr><td>13</td><td>| |</td><td>| |</td></tr>
<tr><td>14</td><td>| |</td><td>| |</td></tr>
<tr><td>15</td><td>| |</td><td>| |</td></tr>
</table>

Exhibit 6: Results of Engle's ARCH test

F-statistic	150.4625	Prob. F(1,2477)	0.0000
Obs*R-squared	141.9607	Prob. Chi-Square(1)	0.0000

Exhibit 7: Results of Breusch-Godfrey Serial Correlation LM Test

F-statistic	0.070244	Prob. F(2,2475)	0.9322
Obs*R-squared	0.140746	Prob. Chi-Squ	0.9320

Exhibit 8: EGARCH model estimation

Dependent Variable: RBANKEX
Method: ML - ARCH (Marquardt) - Normal distribution
Sample (adjusted): 1/02/2004 12/31/2013
Included observations: 2481 after adjustments
Convergence achieved after 19 iterations
Presample variance: backcast (parameter = 0.7)
LOG(GARCH) = C(3) + C(4)*ABS(RESID(-1)/@SQRT(GARCH(1)))+ C(5)*RESID(-1)/@SQRT(GARCH(-1)) + C(6)*LOG(GARCH(-1))

Variable	Coefficient	Std. Error	z-Statistic	Prob.
GARCH	-0.013114	0.014396	-0.910961	0.3623
C	0.121362	0.051524	2.355427	0.0185
	Variance Equation			
C(3)	-0.112557	0.010553	-10.66602	0.0000
C(4)	0.183060	0.014969	12.22951	0.0000
C(5)	-0.060145	0.007430	-8.094957	0.0000
C(6)	0.977692	0.003450	283.4018	0.0000

R-squared	-0.001144	Mean dependent var	0.060937
Adjusted R-squared	-0.001548	S.D. dependent var	2.130526
S.E. of regression	2.132174	Akaike info criterion	254.072
Sum squared resid	11269.95	Schwarz criterion	4.086320
Log likelihood	-5045.631	Hannan-Quinn criter.	4.077363
Durbin-Watson stat	1.731983		

Exhibit 9: News Impact Curve from EGARCH Estimations