An Empirical Evaluation of Volatility and Causal Interlinkages of Mid-Cap Securities in Indian Stock Market

Padmashree V[1], K.B. Nalina[2]

[1]Research Scholar, JSS Research Foundation, University of Mysore, India

[2]Associate Professor, MBA Department, JSS Science and Technology University

Abstract: ***A market index is said to be healthy when it is successful in adjusting the movements and reflecting the dynamics of changes in the market. The market ability should be able to accept and get along with the information provided simultaneously. In this context the current research article intends to find whether Mid-cap securities of Indian stock market are enough strong to adjust with the new information arrived at the market, meanwhile how sensitive or volatile does it express during the activity? In intention of resolving these queries, selected indices from NSE - NIFTY Mid-cap 50, NIFTY Mid-cap 250 are considered as bench mark index the implied volatility of market is captured. The observation of frequency is purely based on the closing stock of these indices. Times series econometric tools, such as Granger Causality Test, VAR impulse response test, GARCH family model were applied for the studies and it was found that Mid-cap segments are not influenced by any broad market index and are more influenced by its own past prices. Further we could also find that there is bilateral causality between the implied volatility of the market and the Mid-cap indices.***

Keywords: Volatility, NIFTY FIFTY index, GARCH model, VAR impulse response test, Granger Causality Test, Mid-cap.

1. Introduction

The new information to which the investors respond rapidly in the market is created by the efficiency, i.e. the information's ability to function. Financial market has its complete stimulus on flow of information and money. Information in bourse is free of cost and in turn with the information flow, the determination of prices and interest rates takes place, in other words, the flow of information influences the demand for the stock and supply in bourse. Market structure is most frequently recognized as market cap, basically the current share price and total outstanding stocks provides the base for aggregate value of a company. On the basis of aggregate value of company an investor determines risk and returns of the share; in turn it also acts as an indication to investors to select the right investment option in market. Hence market capitalization is one of the significant features for an investor to identify the risk and return of the share in market. The derivation of market structure is obtained by multiplying company's current stock price (market price) with company's total number of outstanding shares.

Market Capitalization = Current Stock Price X Shares Outstanding

Market cap of company initially was classified into large-cap, mid-cap, and small-cap, later mega-cap, micro-cap and Nano-cap were also identified. As discussed above Market structure is broadly divided in to multiple structures according to the classes to which the outstanding shares and company bonds, its values in the market. Small cap falls under the broad classification of market capitalization that refers to the company's market capitalization that lies between $300 million and $2 billion classified under Market capital structure.

The companies considered under Small-cap are mostly newly developed and untested. This cap offers less options of product for the investors and does not propose a healthy financial reserve. It becomes very difficult for investors, researchers and academicians to gather information about Small-cap companies as they are newly started and have not gained familiarity in the market when compared to other caps. Though stock of small-cap tends to be volatile its ability of earning returns is comparatively high with considerable risk when related to large cap and companies that have been well established.

In India BSE with the intention of tracking the companies performance introduced comparatively smaller market capitalization, or, 'BSE Small-cap index'. The recent addition of these indices has considerably contributed to the growth of market. Apart from BSE, NSE also has introduced several small-cap indices. The research in volatility most of the time is limited to large-cap as the efficiency is higher when compared to Mid-cap and Small-cap. The empirical study on small-caps and its shock remain untouched and hence the current research intends to fill this gap. The aim of the current study is to identify the nature and characteristics of Small-cap segments, to analyze whether the Small-cap segments is under sensitivity, i.e., whether it is affected by the information which is provided in the market. In this context the study involves adopting the suitable statistical tools to reveal the unexplored conditions in Small-cap segments. The research further aims in examining whether there are macro market changes which influence on the impact Small-cap segments and its volatility. To achieve the above mentioned aims of the study the statistical tools have been tested on the data which were chosen from Nifty 50 Index, Nifty Small Cap 50 and Nifty Small Cap 250.

2. Literature Review

Stock market being the platform to invest, earn on investments and research, opens a huge lot of opportunity to the academicians for in-depth study. The volatility of market and its impact have been studied over decades. Its research in the late 1990s and early 2000s (such as Fleming, Ostdiek & Whaley, 1995; Whaley, 2000) recognized the argument that implied volatility contains all relevant information to explain the realized volatility. Moraux, Navatte and Villa (1999) during their study initiated to find a strong relation between future realized volatility in French market and volatility index (VX1). Later Poon and Granger (2003) had detected that implied volatility outperforms the other competing volatility forecasts (such as historical returns volatility, lagged realized volatility, and ARCH\GARCH conditional volatility). Yang and Liu's (2012) empirical evidences show that the volatility index (TVIX) is a strong indicator of Taiwanese stock market volatility, and TVIX outperforms the stock index returns volatility forecasts (e.g., historical and GARCH). Siriopoulos and Fassas (2012) concluded that Greek implied volatility index (GRIV) best explains the future realized volatility in Greek stock market beyond that impound in the historical volatility. Similarly, the Indian volatility index NVIX will be the most appropriate benchmark to study the impact of market volatility on Indian companies listed in NSE, India. Extant research (Glosten & Milgrom, 1985; Roll, 1984) shows that at least one source of volatility can be explained by the liquidity provision process. When the stock market infers the possibility of adverse selection, they adjust their trading ranges, which, in turn, increase the band of price oscillation, and hence generate volatility (Chakravarty, Gulen & Mayhew, 2004; Easley & O'Hara, 1992; Sandås, 2001). Hence, to investigate the outcome regarding our first hypothesis on individual Small-cap companies,

Objectives

- To capture and analyse the sensitivity of Mid-cap securities
- To understand the influence of volatility on Mid-cap securities
- To investigate the effect of macro market fluctuations on Mid-cap securities.

3. Research Design

In order to study the volatality of Mid-Cap shares in Indian Stock Market, the following variables are selected. Nifty 50 Index is chosen as the benchmark index for the sum total effect of Indian Stock Market (Hiremath, 2014), Nifty Mid-Cap 50 and Nifty Mid-Cap 250 are chosen representatives of the Mid-Cap segment, Nifty Volatility Index(VIX) is chosen as the proxy for the different perceptions and emotional decision making of the investors that causes the volatility of stock markets.

The Data Sets of daily closing prices of the selected Indices for a period of four years starting from 01-01-2014 to 31-12-2018 are taken for the study. As it is well-established practice,("John Y. Campbell, Andrew W. Lo, A. Craig MacKinlay, Andrew Y. Lo-The Econometrics of Financial Markets-Princeton University Press (1996)), these series are differnced for one previous period and the return series are generated which are used for various tests.

3.1 Statistical Tools Applied

To determine and examine the price behavior and volatility of Mid-cap shares the study approaches to apply the below mentioned time series econometric tests. The time series econometric tests are as follows:

a) Descriptive Tests
b) Unit Root Tests

i) Augmented Dickey-Fuller test (ADF Test)

Broadly speaking a data series is said to be stationary if its mean and variance are constant (non-changing) over time and the value of covariance between two time periods depends only on the distance or lag between the two time periods and not on the actual time at which the covariance is computed [Gujarati (2003)].

In order to test for the existence of unit roots, and to determine the degree of differencing necessary to induce stationarity, we have applied the *Augmented Dickey-Fuller test* (ADF Test). Given an observed time series $Y_1, Y_2, \ldots, Y_N$ Dickey and Fuller consider three differential-form autoregressive equations to detect the presence of a unit root:

$$(1)\ \Delta Y_t = \gamma Y_{t-1} + \sum_{j=1}^{p} \left(\delta_j \Delta Y_{t-j}\right) + e_t$$

$$(2)\ \Delta Y_t = \alpha + \gamma Y_{t-1} + \sum_{j=1}^{p} \left(\delta_j \Delta Y_{t-j}\right) + e_t$$

$$(3)\ \Delta Y_t = \alpha + \beta t + \gamma Y_{t-1} + \sum_{j=1}^{p} \left(\delta_j \Delta Y_{t-j}\right) + e_t$$

- t is the time index,
- α is an intercept constant called a drift,
- β is the coefficient on a time trend,
- γ (gamma) is the coefficient presenting process root, i.e. the focus of testing,
- p is the lag order of the first-differences autoregressive process,
- e_t is an independent identically distributed error/ residual term.

The difference between the three equations concerns the presence of the deterministic elements α (a drift term) and βt (a linear time trend). The focus of testing is whether the coefficient γ equals to zero, which means that the original $Y_1, Y_2, \ldots, Y_N$ process has a unit root; hence, the null hypothesis of $\gamma = 0$ or $\rho=1$ (random walk process) is tested against the alternative hypothesis $\gamma < 0$ which signifies the given series is stationary.

ii) The Phillips-Perron (PP) Test

Phillips and Perron (1988) propose an alternative (nonparametric) method of controlling serial correlation when testing for a unit root. The PP method estimates the non-augmented DF test equation and modifies the t -ratio of the α coefficient so that serial correlation does not affect the asymptotic distribution of the test statistic. The PP test is based on the statistic:

$$\tilde{t}_\alpha = t_\alpha\left(\frac{\gamma_0}{f_0}\right)^{1/2} - \frac{T(f_0-\gamma_0)(se(\hat{\alpha}))}{2f_0^{1/2}s}$$

where $\hat{\alpha}$ is the estimate, and t_α the t-ratio of α, $se(\hat{\alpha})$ is a coefficient standard error, and s is the standard error of the test regression. In addition, γ_0 is a consistent estimate of the error variance in (calculated as $(T-k)s^2/T$, where k is the number of regressors). The remaining term, f_0, is an estimator of the residual spectrum at frequency zero.

iii) Granger Causality Test

According to the concept of Granger's causality test (1969, 1988), a time series X_t Granger-causes another time series Yt if series Yt can be predicted with better accuracy by using past values of X_t rather than by not doing so, other information is being identical. If it can be shown, usually through a series of F-tests and considering AIC on lagged values of X_t (and with lagged values of Y_t as well), that those X_t values provide statistically significant information about future values of Yt time series then X_t is said to Granger-cause Yt, i.e., X_t can be used to forecast Yt. The pre-condition for applying Granger Causality test is to ascertain the stationarity of the variables in the pair. Engle and Granger (1987) show that if two non-stationary variables are co-integrated, a vector auto-regression in the first differences is unspecified. If the variables are co-integrated, an error-correcting model (VECM) must be constructed. In the present case, the Granger causality test is applied at the first difference of the variables.

The second requirement for the Granger Causality test is to find out the appropriate lag length for each pair of variables. For this purpose, we used the programme specified lag order given by Eviews.

Since the time series of Nifty 50 and Nifty Mid-Cap 250 is non-stationary, they are converted into a stationary form or I(0) from the ADF test, and then Granger Causality test is performed as follows:

$$\Delta Ln\ NSCF_t = \sum_{i=1}^{n} \alpha \Delta\ LnNSCF_{t-1} + \sum_{j=1}^{n} \beta_j \Delta Ln\ NF_{t-j} + u_t \quad \text{.....................} (3.2.1)$$

$$\Delta Ln\ NF_t = \sum_{i=1}^{n} \lambda \Delta Ln\ NF_{t-j} + \sum_{i=1}^{n} \delta\ \Delta LnNSCF_{t-1} + \quad \text{.....}(3.2.2)$$

Where n is a suitably chosen positive integer; j = 0, 1… k are parameters and α β λ δ's are constant; and Ut's are disturbance terms with zero means and finite variances.

($\Delta Ln\ NF$ is the first difference at time t of NIFTY FIFTY and $\Delta Ln\ NSCF_t$ is the first difference of Nifty Mid-Cap 50 Index Series.)

iv) Test of Cointegration

Two variables are said to be Cointegrated when a linear combination of the two variables is stationary implying that there is a long-term relationship existing between them. Lack of Cointegration suggests that no such relationship exists.

The co-integration test represents the gesticulation of long-run equilibrium relationship between two variables say y_t and x_t. Let both be integrated at one, that is $y_t \sim I(1)$ and $x_t \sim I(1)$. Then y_t and x_t are said to be Cointegrated if there exists a β such that $y_t - \beta x_t$ is I (0). This is denoted by saying y_t and x_t are CI (1,1), that is y_t and x_t are Cointegrated. Different types of co-integration techniques are available for the time series analysis. These tests include the Engle and Granger test (1987), Stock and Watson procedure (1988) and Johansen's method (1988).

The most popular system method is the Johansen (or Johansen and Juselius, JJ) method, based on canonical correlations (Johansen 1988; Johansen and Juselius 1990), that provides two likelihood ratio (LR) tests. The first, trace test, tests the null hypothesis that there are at most r ($0 \leq r \leq n$) Cointegrating vectors, or equivalently, n–r unit roots. The second, maximum eigenvalue test, tests the null hypothesis that there are r Cointegrating vectors against the alternative of r+1 Cointegrating Vectors. Johansen and Juselius recommend the second test as better. Reimers (1992) argues through a Monte Carlo study of the Johansen LR test that the test statistic is corrected for the number of estimated parameters to obtain satisfactory size properties in small samples. The correction is by replacing T by T–np in the test statistic, where T is the number of observations, n is the number of variables and p is the lag length of the VAR (Pillai-2001).

v) VAR Model

The vector autoregression (VAR) is commonly used for forecasting systems of interrelated time series and for analysing the dynamic impact of random disturbances on the system of variables. The reduced form VAR approach sidesteps the need for structural modelling by treating every endogenous variable in the system as a function of *p*-lagged values of all of the endogenous variables in the system (Serpinis et al., 2017;[1]).

A stationary, K-dimensional, VAR (*p*) process as can be expressed as

$Y_t = A_1 Y_{t-1} + \ldots\ldots\ldots\ldots\ldots A_p Y_{t-p} + Cx_t + E_t$

where,

Y_t is a (k x1) vector of endogenous variables
X_t is a (d x 1) vector of exogenous variables
A_1 and A_p are k x k matrices to be estimated
C_t is a k x k matrix of exogenous variables to be estimated
E_t is the white noise error term of the VAR
By applying the least square estimation we get
$B = ((ZZ^{1)-1} Z^* I_k\ )\ y.$

vi) GARCH Modelling

In order to analyze the transmission of volatility and volatility spillover effects between the Nifty 50 and Mid-Cap Shares in Indian Stock Markets, Generalized Autoregressive Conditionally Heteroscedastic model (GARCH), Generalized Autoregressive Conditionally Heteroscedastic model with external regressors, Garch-in-Mean, and GJR-GARCH models are taken into consideration. GARCH models allow the conditional variance to be dependent on previous lags apart from the

Paper ID: SR20527130622 DOI: 10.21275/SR20527130622

past innovation. Through GARCH model, it is possible to interpret the current fitted variance as a weighted function of long-term average value information about volatility during the previous period as well as the fitted variance from the model during the previous period.

The first step in GARCH modeling is to fit a mean equation. This is done by fitting AR or MA models and the residuals are checked for autocorrelation and ARCH effect.

The following AR model was used to fit an ARIMA model (Narwal et al., 2016):

Mean Equation

AR model: $\mathbf{Y_t = \alpha + \beta Y_{t-p} + \varepsilon_t}$, $\varepsilon_t \sim N(0,\sigma_t^2)$ and.......(6) p=1,2,3......n

MA model: $\mathbf{Y_t = \alpha_t - \upsilon_t - \theta_{at-1}}$ ....(7)

The next step was to fit a variance equation by taking the residuals from the fitted ARIMA model. For this purpose the model used was

Variance Equation

$$\sigma^2_t = \alpha_0 + \beta\, \varepsilon^2_{t-1} + \alpha_1\, \sigma^2_{t-1} \quad ....(8)$$

where $\alpha_0 > 0$, $\beta_1 \geq 0$, $\alpha_1 \geq 0$. In the above equation, σ_t is the conditional variance of exchange rates, which is a function of mean α_0. News about volatility from the previous period is measured as the lag of the squared residuals from the mean equation (ε_{t-1}^2), last period's forecast variance (σ^2_{t-1})

GARCH REGRESSOR Equation

$$\sigma_t = \omega_0 + \beta\, \varepsilon^2_{t-1} + \alpha_1 h_{t-1} + \omega_{(\text{square resid LVIX})} \quad ....(9)$$

In the GARCH REGRESSOR Equation, we used the squared residual of VIX (ω) instead of residual on their level, which is used as a proxy for the shock of VIX on Mid-cap markets.

4) Presentation and Discussion of Results

a) Descriptive Statistics.

In order to analyze the data characteristics and understand its nature, descriptive statistical tools were adopted and the data series were subjected to the following test

Table 1: Descriptive Statistical Test results of the series

	RNMCTF	RNMCF	RNF
Mean	2.280917	1.068726	3.702029
Median	9.325000	6.335000	5.925000
Maximum	182.9100	131.9400	237.8500
Minimum	-410.1400	-339.9200	-490.9500
Std. Dev.	57.11925	46.95796	73.04950
Skewness	-1.179512	-1.205985	-0.520819
Kurtosis	7.437495	7.523684	5.326326
Jarque-Bera	1296.493	1349.108	333.5024
Probability	0.000000	0.000000	0.000000
Observations	1232	1232	1232

From the above approach of data subjected to the Descriptive Test it is found that the NIFTYFIFTY series express the highest average returns of 3.70, whereas Nifty Mid-Cap 250 and Nifty Mid-Cap50 returns are 2.28 and 1.068 respectively. This shows that the returns from Mid-cap shares are normal.

Even though NIFTYFIFTY has high returns, the series express high standard deviation meanwhile in turn to this the variations and volatility are equal in large-cap market. When the variations and volatility is high the investment will be equally risky. The Nifty Mid-Cap 50 records the minimum volatility and all the series exhibit a negatively skewed distribution with Nifty Mid- Cap50 being the highest with (-1.2) followed by Nifty Mid- Cap250 (-1.17) and lastly Nifty50 (-0.5), which is an indication of fat tails or extreme outliers and a sign of more negative returns. This phenomenon suggests that the Indian Stock Markets witnessed high swing during these four years that are under the study. It is evident that all the series have extreme excess returns and the returns are not uniform at Mid-cap securities of Indian Stock Markets.

The Jarque-Bera Test Statistic of Normality of Distribution is clearly reporting that all the series are non-normally distributed.

b) Unit Root Test Results

Table 2: Unit Root Test Results of the chosen variables

Index Series	ADF Test				Phillips-Perron Test			
	At Levels		At First Diff		At Levels		At First Diff	
	Ʈ-Value	*P-Value*	*Ʈ-Value*	*P-Value*	*Ʈ-Value*	*P-Value*	*Ʈ-Value*	*P-Value*
Nifty Mid-Cap 50	-2.17	0.216	-29.86	0.00	-2.09	0.2486	-29.60	0.00
Nifty Mid-Cap 250	-2.06	0.2574	-28.96	0.00	-2.00	0.2847	-28.75	0.00
Nifty Fifty	-1.28	0.6371	-32.55	0.00	-1.30	0.6299	-32.47	0.00

a) *The ADF Tau critical values are -3.435445, -2.863678,, -2.567958 for 1% ,5% ,10% level of significance respectively followed by MacKinnon(1996) one sided p-values*

b) *The Philips-Perron Test critical values are -3.435445, -2.863678, -2.567958 for 1%, 5%,and 10% level of significance followed by MacKinnon(1996) one sided p-values*

From the above Table-02, the ADF Test statistic **Tau** (**Ʈ**) reports results for Nifty Mid- Cap 50, Nifty Mid- Cap 250, and Nifty Fifty as -2.17, -2.06 and -1.28 respectively and all the p-values are greater than 0.05% level of significance and accordingly the null hypothesis of the presence of unit root cannot be rejected. This result clearly says these variables are non-stationary at their levels.

Whereas the **Tau** (**Ʈ**) statistic report results for Nifty Mid-Cap 50, Nifty Mid- Cap 250, and Nifty Fifty statistic reports values of -29.86, -28.96 and -32.55 respectively. Here the all the p-values are lesser than 0.05% level of significance and substantially high and this says the variable is stationary when subjected to their first differences.

c) Granger Causality Test

Table 3: Results of Granger Causality Test on the variables

Null Hypothesis:	At 1 Lag		At 3rd Lag		At 5th Lag	
	F-Statistic	Prob.	F-Statistic	Prob.	F-Statistic	Prob.
RNMCF does not Granger Cause RNF	0.26513	0.6067	0.7103	0.5459	1.78536	0.1129
RNF does not Granger Cause RNMCF	1.98557	0.1591	0.9094	0.4358	1.09667	0.3604
RNMCTF does not Granger Cause RNF	0.33227	0.5644	0.99999	0.392	1.98019	0.0789
RNF does not Granger Cause RNMCTF	0.22633	0.6343	0.29412	0.8297	0.70796	0.6175
VIX does not Granger Cause RNF	1.47475	0.2248	0.81745	0.4842	0.55375	0.7355
RNF does not Granger Cause VIX	4.01653	0.0453	2.43498	0.0633	2.01446	0.074
RNMCTF does not Granger Cause RNMCF	0.59046	0.4424	0.82701	0.479	1.15571	0.329
RNSCF does not Granger Cause RNMCTF	0.27434	0.6005	0.70447	0.5494	1.06624	0.3774
VIX does not Granger Cause RNMCF	1.66553	0.1971	1.0714	0.3602	2.79439	0.0162
RNMCF does not Granger Cause VIX	6.30125	0.0122	3.12335	0.0251	2.71888	0.0188
VIX does not Granger Cause RNMCTF	1.67214	0.1962	1.40181	0.2407	2.62632	0.0227
RNMCTF does not Granger Cause VIX	8.42105	0.0038	4.03699	0.0072	3.07024	0.0093

i. *Nifty Mid- Cap 50, Nifty Mid- Cap 250 and Nifty 50 are termed as RNMCF, RNMCTF AND RNF respectively and Nifty Volatility Index as VIX.*
ii. *p-values reported are on 0.05% level of significance*

This test is basically utilised in the study to find whether one variable leads in of changes to other variables. Granger causality test for the series are run on the basis of three different variable lags i.e., 1st lag, 3rd lag, and 5th lag, in order to prove and investigate the causality as well as its effect on supplementary variables at different levels of time. On one end of the scale the study subjected to RNMCF & RNMCTF, their outcomes and more significance is given on their outputs. When RNF is concerned as a variable it is expressed as independent in nature and from the bangs of results it is very clear that RNMCF has no effects due to RNF. Hence the null of no causality cannot be rejected. Similarly, from the results of RNMCTF obtained the report evidently suggests that it has not been affected by RNF.

Therefore, the lags between these variables are highly independent and have not affected each other. When the study is subjected to VIX and NMCF and its outcomes it denotes that the null of no causality cannot be rejected as 1st lag and 3rd lag for F-statistic of 1.66 and 1.07 respectively are equivalent to the p-values of 0.19 and 0.36. But interestingly when the 3rd lag is considered with F-statistic of 2.71 with p-value 0.01 it leads to the null of no causality can be rejected. Hence bidirectional nature is expressed due to the causality inferred and clearly proves that NMCF and VIX run bilaterally.

d) <u>Test of cointegration Johansen and Juselius Test of Cointegration</u>

Table 4: Results of Johansen Test of Cointegration

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None	0.020950	43.19457	47.85613	0.1279
At most 1	0.007852	17.19504	29.79707	0.6256
At most 2	0.004790	7.514548	15.49471	0.5187
At most 3	0.001317	1.618681	3.841466	0.2033

i. Trace test indicates no Cointegration at the 0.05 level
ii. * denotes rejection of the hypothesis at the 0.05 level
iii. **MacKinnon-Haug-Michelis (1999) p-values

Trace Test

Table 5: Maximum Eigenvalue Test

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None	0.020950	25.99953	27.58434	0.0786
At most 1	0.007852	9.680491	21.13162	0.7740
At most 2	0.004790	5.895867	14.26460	0.6266
At most 3	0.001317	1.618681	3.841466	0.2033

i. Max-eigenvalue test indicates no Cointegration at the 0.05 level
ii. * denotes rejection of the hypothesis at the 0.05 level
iii. **MacKinnon-Haug-Michelis (1999) p-values

In order to investigate the relationship between the variables of non-stationary time series the cointegration technique is adopted in the study. If two or more series are themselves non-stationary, but a linear combination of them is stationary, then the series are said to be cointegrated. The variable above clearly reports about the complete absence of long-term relationship between the series and from both the tests i.e. Trace test and Maximum Eigenvalue test results in the table 4 and 5 proves the rejection of null of no cointegration. Hence from the above test it can be concluded that the variables has no long-term relationship and rejection of null of cointegration.

e) <u>VAR Impulse Response Test</u>

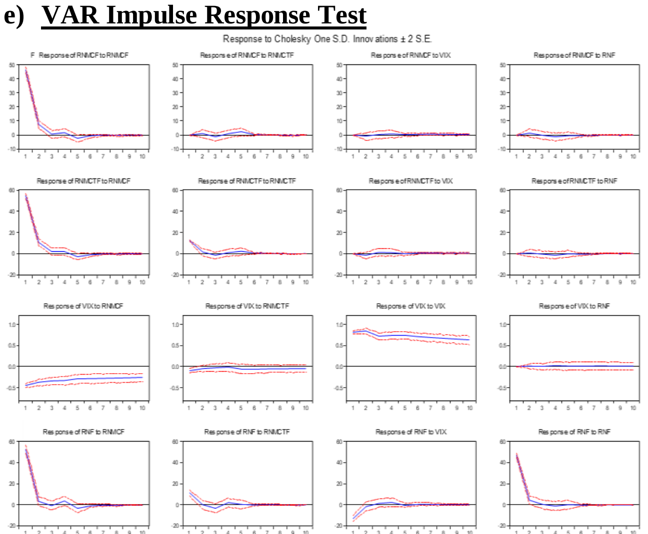

Figure 1: Result of VAR Impulse Response Test of the variables

International Journal of Science and Research (IJSR)
ISSN: 2319-7064
ResearchGate Impact Factor (2018): 0.28 | SJIF (2019): 7.583

VAR Model approach is utilized to detect the impulse response of the series. In this test the given series if affected, due to the shock and information adjusted in the market over a period of time are sensibly perceived and its effects are revealed. As a result, Residual test and Stability test are the two-test developed under stationary VAR model and the series immediately was induced for further test of impulse response to report the variables i.e. RNMCF and RMCTF are affected under shock.

But the result phenomenon stated that there was no effect by RNF, VIX and RMCTF rather it was observed there was a reaction during the preceding times. Hence it can be concluded that the variables are not affected by RNF and VIX.

f) GARCH (Generalised Autoregressive Conditional Hetroskedasticity) Results

Table 6(a): Results of GARCH MODELS of Variables

Series	GARCH(1,1)			GJR-GARCH		
	α_0	μ^2_{t-1}	σ^2_{t-j}	μ^2_{t-1}	σ^2_{t-j}	λ
RNMCF	179.5*	0.16*	0.76*	.002	.71*	0.25*
RNMCTF	225.4*	0.17*	0.76*	.000	0.69*	0.3*
RNF-RNMCF						
VIX-RNMCF						
RNF-RNMCTF						
VIX-RNMCTF						

Table 6(b)

Series	GARCH in M			GARCH with EXT	
	$\lambda\sigma^2_{t-1}$	μ^2_{t-1}	σ^2_{t-j}	σ^2_{t-j}	Ω
RNMCF	0.35*	0.19*	0.72*	0.69*	-0.3
RNMCTF	0.32*	0.20*	0.72*		
RNF-RNMCF				0.69	-0.3
VIX-RNMCF				.77	-3.86
RNF-RNMCTF				0.69	-5.29
VIX-RNMCTF				0.76	-4.43

The coefficients used in GARCH Models follow traditional notations and are defined as follows: α is the conditional intercept of the garch equation,, μ^2t-1 is the previous period variance, σ^2 t-j is the fitted conditional variance which is also called as the persistence coefficient, λ is the dummy coefficient for leverage impact of news and ω is the regressor coefficient.

i. ** represents that the coefficients are significant at 0.05* level of significance
ii. *Nifty Mid Cap 50, Nifty Mid Cap 250 and Nifty 50 are termed as RNMCF, RNMCTF AND RNF respectively and Nifty Volatility Index as VIX.*

GARCH Modelling

One of the main objectives of the current study is to determine the volatility and also the spillover effects caused among the variables NIFTY FIFTY and other variables in the Indian bourse. The series are subjected to the application of GARCH model. GARCH (1, 1), GJR-GARCH, GARCH-IN-MEAN, and GARCH with external regressors are the four main techniques of GARCH models variants approached.

(i) GARCH (1, 1)

Initially to determine the importance of volatility of previous intervals (**μ^2_{t-1}**) and persistence of coefficient (**σ^2_{t-i}**) in other words the past conditional variance, one of the GARCH family model namely GARCH (1, 1) has been utilized. However, the outcome of the study reports that volatility of previous intervals or past period volatility (**μ^2_{t-1}**) and persistence coefficient (**σ^2_{t-i}**) expresses the positive importance and the results noticeably states that when is (**μ^2_{t-1}**) 0.000 and (**σ^2_{t-i}**) is 0.76, it is marked that the past conditional variance/persistence coefficient (**σ^2_{t-i}**) has higher significance than past period volatility which mean when shocks are arrived at the market both the variable require equal amount of time to get along and admit hence express its long memory.

(ii) GJR-GARCH

In order to understand and reveal the effect of leverage regarding positive and negative information in the market GJR-GARCH has been applied. The variables were denoted as **λ**. in the table 06 and it reports that the variables RNMCF & RNMCTF indicated 0.25 and 0.3 which is significant and active. This indicates that the good news that appears in the market approves high positive reaction when compared to that with the bad news.

(iii) GARCH-IN-MEAN

The above technique is basically utilized to characterize the volatility and to investigate the risk dependency (because the return of the security is mostly depending on the volatility) and to know whether risk returns relationship is favorable among the variables in the market. Here risk premium or mean equation id denoted as **ω** coefficient. When variables were subjected to model the above-mentioned phenomenon, the results evidently showed that ~~it~~ there is a positive and high significance in statistics of the coefficient. Meanwhile, it clearly states that there is excess risk premium rewarded to the investors of Mid-cap market.

(iv) **GARCH regressor** models an econometrics approach developed to estimate the volatility and spillover effect among the variables. Finally, the model of the study reports that RNF and VIX do not impact or have effect on the variables of volatility, also RNMCF and RNMCTF series has no spillover effect.

4. Conclusion

The current research article is constructed with the intension of achieving the objectives as mentioned below.

Firstly, to capture and analyze the sensitivity of Mid-cap security. When series of data were subjected to Descriptive statistics in order to understand the nature and characteristics of the variables, with the verification of the results it was found that when NIFTY FIFTY was compared to rest of the considered index it marked the maximum average returns. These high returns have occurred due to an unexpected upswing in the alpha effect. It also substantiated that the returns were uneven at Mid-cap of Indian stock market by evidence of leptokurtic distribution.

Secondly, when the Variables were further subjected to the Unit root test- the presence of Unit root has been accepted since the variables are non-stationary are different levels and the p-value was relatively high which was evident from the results of ADF test and the p-value was relatively low when the Tau (Ţ) variables were stationary which is proved in the Phillips-Perron test.

Thirdly, Granger causality test was conducted to verify the presence of lead lag relationship among the variables and the influence of other variables. The test reports that the RNMCF is independent in nature and there is no effect caused by RNF to RNMCF but, RNMCF and VIX had a mutual response towards each other.

Fourthly, when the study approached the cointegration test and the subtest namely Johansen test of cointegration, Trace test and Maximum Eigen value test, the results concluded that the variables do not have long-term relationship and the rejection of null of cointegration are to be considered.

Further, with the evidence of VAR Impulse response test results it has been clear that the RNMCF and RNMTF have no impact on RNF and VIX.

Finally, when the variables were subjected to model the phenomenon, GARCH model was utilized to investigate the volatility effect and its influence on predicting the price of shares. The results revealed that the market required enormous amount of time to recover from the fluctuation created by the information appeared at the market. In addition to this the outcome of GJR GARCH model indicates that there is a positive and favorable response during the good news in the market when compared to the bad news appeared in the market. GARCH-IN-MEAN is approached to expose that risk return premium for investors and the results declared that there is high risk premium rewarded for the investors of Mid-cap market investors as there is the presence of positive ω coefficient.

Therefore, from the above techniques adopted and the results acquired, it can be concluded that RNF and VIX variables are said to be completely independent. The variables have no impact of volatility due to RNF and VIX and there is no spillover effect among the variables.

5. Future Scope

The research can be further continued for the prediction and volatility check in large-cap markets, the similar mechanism can be applied to analyse the inter-linkages between different indices and different forms of market. Thus the investigation contributes in identifying causal inter-linkages among variables predominant in the stock market.

References

[1] Christie-David, R. (2002). *Analysis of Financial Time Series. Journal of Financial Research* (Vol. 25). https://doi.org/10.1111/1475-6803.00029
[2] F., F. E., & R., F. K. (2012). The Cross-Section of Expected Stock Returns. *The Journal of Finance*, *47*(2), 427–465. https://doi.org/doi:10.1111/j.1540-6261.1992.tb04398.x
[3] Hiremath, G. S. (2014). *SPRINGER BRIEFS IN ECONOMICS Indian Stock Market An Empirical Analysis of Informational Efficiency*. Springer New Delhi. https://doi.org/10.1007/978-81-322-1590-5
[4] John Y. Campbell, Andrew W. Lo, A. Craig MacKinlay, Andrew Y. Lo-The Econometrics of Financial Markets-Princeton University Press (1996).pdf. (n.d.).
[5] Narwal, K. P., Sheera, V. P., & Mittal, R. (2016). IMPLIED VOLATILITY Vs. REALIZED VOLATILITY, *17*(2), 75–85.
[6] Sermpinis, G., Stasinakis, C., & Hassanniakalager, A. (2017). Reverse adaptive krill herd locally weighted support vector regression for forecasting and trading exchange traded funds. *European Journal of Operational Research*, *263*(2), 540–558. https://doi.org/10.1016/j.ejor.2017.06.019
[7] Cumby, R., Figlewski, S., & Hasbrouck, J. (1993). Forecasting volatility and correlations with EGARCH models. Journal of Derivatives, 1(2), 51–63.
[8] Bagchi, D. (2014). Application of the concept of dissonance to explain the phenomenon of return-volatility relationship. *IUP Journal of Applied Finance*, *20*(2), 5–17.
[9] Kumar, A. V., & Jaiswal, S. (2013). The information content of alternate implied volatility models: Case of Indian markets. *Journal of Emerging Market Finance*, *12*(3), 293–321.
[10] Mariana, M., & Semmler, W. (2002). Market share instability and stock price volatility during the industry life cycle: The US automobile industry. In *Economic evolution, learning and complexity* (pp. 97–126).
[11] Berlin and Heidelberg: Springer-Verlag. Marianne Sensier, M., & Van Dijk, D. (2004). Testing for volatility changes in U.S. macroeconomic time series. *The Review of Economics and Statistics*, *86*(3), 833–839.

Authors Profile

Padmashree V, Research Scholar, JSS Research Foundation, University of Mysore, MBA , BBM. Teaching Experience – 4 Years, Industry Experience – 6 Years. **Professional Experience:** Started career at IISc as Admin staff for 5 years and served as Lab Manager at Prof. Sathees C Raghavan's laboratory for one year. In 2016, began an academic career. Currently working at Jindal college for Women as Assistant Professor for Post- Graduation & Graduation Courses under the Department of Commerce and Management. **Research Interest:** Finance

Dr. K.B. Nalina, Associate Professor, MBA Department, JSS Science and Technology University, Ph.D, MBA , B.E. Teaching Experience – 8 Years. Industry Experience – 3Years. **Professional Experience:** Started career in ICICI Home Loans as Credit Processing Executive. Have worked in industries for 3 Years. In 2004, began an academic career and worked in two reputed institute before joining the present institution. In the present institution, working as Assistant Professor in the area of Finance and Quantitative Techniques. **Research Interest:** Finance