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Volatility Patterns in Indian Stock Market before and After Introduction of Securities Lending and Borrowing Scheme

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Abstract

The securities lending and borrowing scheme was introduced in India on 21st April 2008. This paper tries to evaluate whether the scheme have impact on Indian stock market. The volatility of the NSE CNX NIFTY is measured before and after the introduction of the scheme using ARCH (1) model. If the scheme had attracted more participants then more borrowing and lending might have taken place which might have increased volatility. Our results revealed that the volatility has not increased but instead decreased. Hence, the scheme might not have got active participation and the reasons for that are discussed. Alternatives such as selling futures instead of borrowing, the costs associated with the scheme, the difficulty in retailer participations and all seem to be the flaws. SEBI has made many changes in the scheme after introduction, like changing the tenure and allowing pre-closure of the contract etc. But, unless the problems related to cost and stock available for trading are solved, other changes cannot attract people towards this scheme.

Keywords: Securities, NSE, NIFTY, ARCH model, SEBI, Stock market

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1. Introduction

Volatility is a measure for variation of price of a financial instrument over time. It is a tool to measure the market risk of an instrument. It may be stocks or derivatives or even a portfolio of assets. Stock return volatility is the volatility of a stock over time and is derived from time series of past market prices. But, if volatility is measured for derivative instruments whose prices are implied upon the prices of the underlying assets it is said to be implied volatility. It is derived from the market price of a market traded derivative. There are different types of volatility such as the actual historical volatility, actual future volatility, historical implied volatility, current implied volatility and future implied volatility. All these slightly differ relating to the time period and the instrument which is measured. Traditionally volatility is measured using a constant one period variance. A new class of stochastic process called autoregressive conditional heteroskedasticity (ARCH) was introduced by Robert. F. Engle in 1982 after which many extensions of that model were developed. A natural generalization of the ARCH (Autoregressive Conditional Heteroskedastic) process is proposed by Bollerslev in 1986. Engle himself along with Ng (1993) published the paper "Measuring and Testing the Impact of News on Volatility", in which he defines the news impact curve. Braun, Nelson, & Sunier (1995) investigated the conditional covariance of stock returns using bivariate exponential ARCH (EGARCH) models. Glosten, Ravi jagannathan, & Runkle (1993) published the paper On the Relation between the Expected Value and the Volatility of the Nominal Excess Return on Stocks. "Threshold heteroskedastic models" by Zakoian (1994) is the paper wherein TARCH model was specified. Sentana(1995) published the Quadratic ARCH Models.

But in India only after 1990's researches have started to head towards this area. Chaudhury (1991) measured the seasonality in share returns which seems to be the preliminary evidence on day of the week effect. Roy and Karmakar (1995) focused on the measurement of average level of volatility as a sample standard deviation and examines whether volatility has increased in the early 1990's. Kaur (2004) studied whether the day of the week effect, calendar month effect and spillover from U.S effect are

present in SENSEX an NIFTY or not using GARCH, EGARCH and TARCH models. Singh, Kumar & Pandey (2008) studied the price and volatility spillovers across North American, European and Asian stock markets. Goudarzi and Ramanarayanan (2010) estimated the Indian stock market volatility.

Securities lending and borrowing scheme:

Securities lending and borrowing scheme was introduced in India in April 21, 2008 wherein the traders can borrow security from another trader through an online order matching platform. Say if a trader had done a short selling, obviously he will not have any stocks in his hands. In such case if he wishes to borrow securities from another trader he can borrow for a period ranging from 1 month to 12 months and the securities traded in futures and options segment are eligible for trading under this scheme. The settlement date is the first Thursday of every month and each leg of settlement date is assigned a specified number. The lender can place a request of early recall of the securities lent and also the borrower can make early payment. The National Securities Clearing Corporation Limited (NSCCL) provides an online automated order matching platform through which the participant can borrow, lend, recall and repay.

There were no conclusive researches evaluating the securities lending and borrowing scheme. Some researches evaluating the lending systems in India are there. Basu and Srivastava (2005) reviewed level of financial access to India's rural poor. Shah and Thomas in 2001 evaluated the policy issues in Indian securities market. Banerjee and Duflo (2008) in their working paper tested the credit constraints in Indian firms using the direct lending programs. Verma (2002) has examined the reforms in Indian financial sector that have happened over a decade.

This paper empirically investigates the ARCH effect in SENSEX before and after introduction of the securities lending and borrowing scheme. The ARCH model to measure the volatility before and after the scheme is computed. As the scheme is based upon lending and borrowing securities in need, if it is effectively utilized by the borrowers, then it might have caused the trading to increase and the volatility in the market should also be increased.

Hence, the effectiveness of the scheme is checked by measuring the volatility through ARCH model.

2. Research Methodology:

The period of study spans from 2003 to 2013 which is further split into two sections before and after the introduction of the scheme. The scheme was first introduced in April 21, 2008. Hence 1 month before and 1 month after the scheme was left out as there will not be much impact during that period. 5 years before that 1 month before the scheme and 5 years after the 1 month after the scheme were taken for study. The two splitted periods are from 1st Mar 2003 to 29th Feb 2008 and from 1st June 2008 to 31st May 2013.

The sample

NSE CNX NIFTY index closing prices are taken for calculation purposes. Although BSE is the oldest stock exchange, NSE is the exchange with higher turnover. Hence, we have taken NSE CNX NIFTY.

Database

The data have been taken from National Stock Exchange of India website www.nseindia.com.

Statistical tools

Descriptive statistics and Jarque-Bera test for normality have been computed.

Econometric methodology

The closing prices of the NSE CNX NIFTY are taken and are tested for stationarity using Augmented Dickey Fuller test. As the variables are not stationary, they are differenced and are tested again after first differencing. These variables are stationary. Then the regression equation of CNX NIFTY and C is run and is tested for ARCH effect. As the ARCH effect was prevalent, ARCH modelling is done. Then the goodness of the model is evaluated using the diagnostic tests such as Corelogram squared residual test, ARCH LM test and Jarque-Bera test of normality. All these

procedures were done for both the splitted years and the volatility before and after the introduction of the scheme are checked.

Model specification

Any time series data that we take for evaluation purpose need to be stationary in order to avoid spurious relationships. If a time series data is stationary it means that the variances and co-variances are constant and does not depend on the period. All the three models of Augmented Dickey Fuller test such as intercept and no trend, intercept and trend and no intercept and no trend are taken as models.

$$\Delta y_t = \alpha + \gamma y_{t-1} + v_t$$

The test is conducted by estimating the regression and implementing a t-test for the following hypothesis:

$$H_0: \gamma = 0$$

$$H_1: \gamma < 0$$

The default lag length given by Eviews has been selected. The t-test values in the result are compared with ADF critical values. If the Augmented Dickey Fuller test statistic is greater than the critical value then the null hypothesis cannot be rejected and it should be accepted. Thus the stationarity is measured. Then we estimated the ARCH effect through ARCH-LM test. We run the regression equation of intercept alone without explanatory variables. Thus, our regression equation will be

$$y = \beta + e_t$$

To test for ARCH effect, we can use the Lagrange Multiplier (LM) test. To conduct this test we first estimate the mean equation, store the least square residuals from the mean equation and run the auxiliary regression of regressing ${e^2}_t$ one${e^2}_{t-1}$.

$${e^2}_t = \gamma_0 + \gamma_1 {e^2}_{t-1} + v_t$$

Where v_t is the random error of the auxiliary relationship. The null and alternative hypotheses to the test are:

$$H_0 : \gamma_1 = 0$$

$$H_1 : \gamma_1 \neq 0$$

If there are no ARCH effects, then $\gamma_1 = 0$ and if there are ARCH effects, then $\gamma_1 \neq 0$. The significance of the f-statistics and t-statistics also prove the ARCH effect. If there is ARCH effect then we can run the ARCH model.

$$y_t = \varphi + e_t \quad \text{.....1}$$

$$e_t | I_{t-1} \sim N(0, h_t) \quad \text{.....2}$$

$$h_t = \alpha_0 + \alpha_1 e^2{}_{t-1}, \qquad \alpha_0 > 0, \alpha_1 < 1 \quad \text{.....3}$$

These are the autoregressive conditional heteroskedastic (ARCH) equations. The second equation says that the error term is normal where I_{t-1} represents the information available at time t-1with mean 0 and time varying variance h_t. The third equation models h_t as a function of constant term and the lagged error squared $e^2{}_{t-1}$. The name—ARCH—conveys the fact that we are working with time-varying variances (heteroskedasticity) that depend on (are conditional on) lagged effects (autocorrelation). This is an ARCH (1) model. Since the time varying variance h_t is a function of a constant term and an error term lagged once, the co-efficient α_0 and α_1 have to be positive to ensure a positive variance. The co-efficient α_1 must be less than one or h_t will continue to increase over time. The ARCH model has become very important econometric model because it is able to capture stylized facts of real-world volatility. This is useful for situations when it is important to understand risk, as measured by the volatility of the variable.

Diagnostic tests

To check whether the ARCH model which we used to compute is a good fit model or not, we used some diagnostic tests. The residuals after ARCH are tested for serial correlation, normality and ARCH effect using Corelogram Q statistics, Jarque-Bera statistics and ARCH LM test respectively.

ARCH model for NIFTY

Unit root test

Hypothesis	Test statistic		MacKinnon critical values at 5% level of confidence
	NIFTY before SLB	Nifty after SLB	
Intercept alone	-16.93226	-16.27220	-2.8643
Trend and intercept	-16.93859	-16.26921	-3.4158
None	-16.75983	-16.26544	-1.9396

The first differenced series of NIFTY before and after the scheme in all the possible options with intercept alone, with trend and intercept and without trend and intercept are all stationary. Hence we can proceed with further testing and modeling.

Descriptive statistics after first differencing.

Statistic	NIFTY before SLB	NIFTY after SLB
Mean	3.307903	1.004311
Standard deviation	53.68925	70.48275
Skewness	-0.672924	0.466859
Kurtosis	16.39222	9.374223
Jarque-bera statistics	9503.499 (p=0.00)	2146.027 (p=0.00)

The descriptive statistics on NIFTY before and after the Securities Lending and Borrowing scheme indicates that the before-SLB series is skewed towards left meaning that most values are concentrated on the right of the mean and the after-SLB series skewed towards right meaning that most values are concentrated on left of the mean. And both the series are leptokurtic with heavy tails and sharp peak which means there is higher probability for extreme values. The Jarque-Bera test for normality indicates that the null hypothesis of normality is rejected. All these prove that both the series are skewed and leptokurtic and are not normal which is usually the case for financial time series.

Does Volatility Increases after the Introduction of the Scheme?

Coefficients of ARCH model

Coefficient	**ARCH in NIFTY before SLB**	**ARCH in NIFTY after SLB**
ARCH LM test	186.0729 (p=0.00) (lag=1)	11.62354 (p=0.020382) (lag=5)
α_0	1258.395 (p=0.0000)	4241.865 (p=0.0000)
α_1	0.695201 (p=0.0000)	0.163587 (p=0.0000)
ARCH LM in residual	0.153538 (p=0.695177)	0.350693 (p=0.553721)
Jarque-bera statistic	1644.552 (p=0.0000)	4416.455 (p=0.0000)

The ARCH LM test after the regression in both the cases proves that there is ARCH effect. Hence we do the ARCH modeling with dependent variable and constant and the volatility is measured. Both the coefficients α_0 and α_1 are positive which ensure a positive variance. The co-efficient α_1 is less than one which proves that h_t will continue to increase over time and all the conditions of ARCH model are satisfied. But as expected volatility have not increased after the introduction of the scheme. Instead volatility has decreased. Volatility in NIFTY before the introduction of the scheme was 69.52% where as volatility after the introduction of the scheme was 16.35%. This proves that the scheme is not successful. The ARCH test after modeling the two series was conducted and it revealed the fact that there was no ARCH effect left over in the model. Corelogram test reveals that there is no serial correlation among residuals and the Jarque-Bera test indicates that the series is not normal.

3. Conclusion

The ARCH test indicates that the volatility decreased after the introduction of the scheme and henceforth we can say that the scheme is not successful. The reasons behind this may be that the scheme has met with little response from the traders. The Securities Lending and Borrowing scheme is limited to futures and options stock only. Already there is proven way of hedging against short

selling that the traders are practicing. By selling futures short selling can be hedged. Then the costs associated with the scheme are too high. The borrowers need to pay the amount for borrowing and also the margins such as mark-to-market margin, Value-At-Risk margin, and an Extreme Loss Margin. And last the retails participation in this scheme seems to be difficult. While there is no such restriction like that the brokers are not integrating this in their trading terminals. SEBI has done many changes in the scheme after introduction like changing the tenure and allowing pre-closure of the contract. Unless the problems related to cost and stock available for trading are solved, other changes cannot attract people towards this scheme.

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