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The Empirical Investigation of Relationship between Stock Volatility and Trading Volume in India

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Abstract: *The objective of the study is to measure the relationship between trading volume and returns; and change in trading volume and returns of stocks in India. ADF Unit Root Test, PP Unit Root Test and GARCH Model have been applied on the data to determine the relationship between aforesaid variables. For this purpose, weekly data of National Stock Exchange Nifty has been collected and analyzed from time period January 2002 to March 2014. The results indicate a significant positive relationship between trading volume and returns. The study also found positive relationship between change in trading volume and returns. The study is having great importance to making policy regarding investment as trading volume reflects information about market expectations, and relationship between volume and price can have important implications for trading, speculation and hedging activities.*
Keywords: *ARCH, ADF, GARCH, Trading Volume*

I. INTRODUCTION

The empirical studies show that trading volume and stock returns are interrelated. Risk or volatility can be the result of company related factors like potential growth with expected limits, projected expectation about return, competition from inside and outside of the country, changes which are taking place in the management and changes in the financing patterns. This is unsystematic risk which can be eliminated. But, other type of risk is said to be as systematic risk or market risk which is affected by factors such as market sentiments, fiscal budget, agricultural production and foreign exchange reserves through which stock prices is pushed up and down within different times. Volatility adversely effects the functioning of the financial system and hence economic performance. Higher returns encourage the investors to invest and increase the capital inflow in the companies whereas in volatile environments the returns are not certain and hard to predict effecting investment eventually. Risk is the major factor that determines the return. The previous studies suggest that where there is high risk, there will be higher return. The analysis of the current study revolves around the volume and price, which is also known as volume-return relationship. The objective of present study is to measure the relationship between trading volume and returns in the stock market of India. Most of the research in order to measure this relationship has been undergone at the international level but very few study has been conducted in local market i.e. India.

II. REVIEW OF LITERATURE

Muradoglu et al. (1999) examined how determinants of volatility and stock returns change with financial crisis in an emerging market such as that of Pakistan. Authors have found that during a financial crisis in an emerging market, risk-return relationship and the factors that determine this relationship change. **Floros and Vougas (2007)** studied the relationship between trading volume and returns in Greek Stock Index Futures Market and found significant positive contemporaneous relationship between the two in FTSE/ASE-20. **Pathirawasam (2008)** conducted a study using stock volume and returns from Colombo Stock Exchange and found that stock returns are positively related to changes in volume, but negatively to past trading volume. Author attributed this negative cause to misspecification and illiquidity issues. **Tripathy(2011)** investigated the dynamic causal relationship between stock return and trading volume of Indian stock Market and found bi-directional causality between the two. Also, the results of Johansen's co integration test depicted long-run relationship between volume and returns. **Rehman et al. (2012)** revealed a strong positive relation between returns and trading volume. In the case of emerging markets and economy, numerous studies are found which had discussed this return-volume relationship and how volatility can be understood in this context.

III. RESEARCH METHODOLOGY

The sample of data used in this current study comprises weekly stock price index and trading volume of the NSE Nifty. The daily data is converted into weekly basis by taking the average of the whole week stock

price index and trading volume. The weekly data is used because of the thin trading, small market size and to avoid the day of the week effect. The realization period has covered from January 2002 to March 2014 and has been collected from CMIE and business recorder database. The weekly rate of return (Rt) was calculated as: Rt= (Pt/Pt−1) from the values of the closing index. The changes in trading value (ΔVt) were calculated as: $ChangeinVt$ = (Vt / Vt−1). The study examines whether rising price leads to higher volume or vice versa. For this purpose, regression equation was tested: Rt=∝1+ $\beta 1Rt$−1+ $b1Vt$+∈t1. Then another equation that was tested: Rt=∝2+ $\beta 2Rt$−1+ $b2\Delta Vt$+∈t2
WhereRt stands for return, Vt is trading volume and ΔVt is the change in trading volume at time t.Rt−1is included in the equations to account for serial correlation in returns series.

ARCH (q) Model: The data used is time series and is prone to high and low volatility periods. So the value of the disturbance term can be greater in certain periods as compared to others. The assumption of homoskedasticity is limiting in such cases and to model the behavior of conditional variance, ARCH model is used. The conditional variance is denoted by: $\sigma t2$=var ($etet$−1et−2..,.) =[(et−Eet 2)et−1et−2….]

GARCH (p, q) Model: Generalized Autoregressive Conditional Hetroskedasticity (GARCH) model was used to investigate about the relationship between trading volume and returns. GARCH includes the lagged conditional variance terms as autoregressive terms, one of the drawbacks of ARCH model. The GARCH (p, q) model (where p is the order of the GARCH terms and q is the order of the ARCH terms () is given by
$\sigma t2$ = ∝0 + ∝1∈t−12 + … + ∝q∈t−q2 + $\beta 1\sigma t$−12 + … + $\beta p\sigma t$−p2 = ∝0 + ∝iqi=1∈t−i2 + βipi=1σt−i.

IV. ANALYSIS

The descriptive statistics has been used to analyze the high returns and riskiness through mean and Standard deviation respectively.

Table 1: Descriptive Statistics of Return, Volume and Change in Volume

Description	Rt	Vt	ΔVt
Min	-0.165686	11.92310	-4.135521
Max	0.104371	23.20434	8.348180
Mean	0.002445	21.35112	0.001316
Standard Deviation	0.030867	1.157538	0.38012
Skewness	-1.056189	-2.690541	4.154921
Kurtosis	7.128724	24.18088	63.50867
Jarque-Bera	571.9372 0.000000	12056.82 0.000000	102061.5 0.000000

The results of Table 1 show that the NSE Nifty index has only positive returns. The riskiness has been determined through standard deviation, which shows that the NSE Nifty is less risky. The results of skewness of returns show that the data series exhibit asymmetric and redundant kurtosis. The trading volume shows positives skewness and an indication of GARCH effects. The JB-stats show that the all series have highly significant results at 1% level and the acceptance of hypothesis that the series are not normally distributed.

Table 2: ADF Unit Root Test and PP Unit Root Test Statistic

Variable	ADF Unit Root Test		PP Unit Root Test	
	No Trend	K	**No Trend**	**T**
Rt	-16.891*	0	-16.874*	1
Vt	-3.872*	1	-5.516*	10
ΔVt	-35.801*	0	-37.128*	11

*Denotes Mackinnon critical Values for rejection of null hypothesis of a unit root and significance at the 1% level.

Table 2 represent the results which indicates that the time series data at level I(0)is stationary at 1% level of significance at different lags. The deterministic trend means that the time series is now completely predictable and not variable. So, all the times series of the variables are stationary, this implies that all the shocks that would be temporary and their effects would be eliminated over time as the series regress to their long term variance.

Table 3: GARCH Model

Regression Eq.: $Rt=\propto 1+\beta 1Rt-1+b1Vt+\in t1$				
Convergence achieved after 16 iterations				
Variable	**Coefficient**	**Std. Error**	**Z-Statistic**	**Prob.**
C	-0.061820	0.004521	-13.71764	0.0000
Rt-1	0.203471	0.026230	7.149841	0.0000
Vt	0.003145	0.000234	13.53422	0.0000
Variance Equation				
C	0.000102	2.31E-04	5.316134	0.0000
ARCH(1)	0.254123	0.050178	5.789021	0.0000
GARCH(1)	0.655761	0.034787	13.67341	0.0000

Table 4: GARCH Model

Regression Eq.: $Rt=\propto 2+\beta 2Rt-1+b2\Delta Vt+\in t2$				
Convergence achieved after 52 iterations				
Variable	**Coefficient**	**Std. Error**	**Z-Statistic**	**Prob.**
C	0.002768	0.001005	2.768810	0.0000
Rt-1	0.352345	0.035045	8.510987	0.0000
ΔVt	0.016956	0.001634	10.23650	0.0000
Variance Equation				
C	0.000134	2.09E-04	7.048091	0.0000
ARCH(1)	0.454771	0.033179	11.13467	0.0000
GARCH(1)	0.469134	0.041890	12.21678	0.0000

In **Table 3** and **Table 4**, the coefficients of both the squared of residual (ARCH (1)) and of the conditional variance (GARCH (1)) are highly statistically significant at 1%, level. In the variance equation, the intercept coefficient is very small (but significant) and similarly the coefficient of the ARCH (1) is equal to 0.2 and 0.4 respectively. It has been expected, that in a typical GARCH model for financial data the coefficient of GARCH is statistically significant, as shown in Table 3 and Table 4, which depicts that the shocks to the conditional variance are consistent and that major changes in the conditional variance are followed by other great changes and small changes are followed by other minor changes. The coefficient of GARCH in the conditional variance equation of volume is greater than the change volume. This indicates that a minor market shock leads to relatively large changes in future volatility.

Table 5: Granger Causality Results

Regression Eq.: $Rt=\propto 1+\beta 1Rt-1+b1Vt+\in t1$			
Null Hypothesis	**Observation**	**F-Statistic**	**Prob.****
V does not Granger Cause R	640	5.34870	0.01250
R does not Granger Cause V	640	8.12568	0.00078
Regression Eq.: $Rt=\propto 2+\beta 2Rt-1+b2\Delta Vt+\in t2$			
Null Hypothesis	**Observation**	**F-statistics**	**Prob.****
ΔVt does not Granger Cause R	640	1.45340	0.23416
R does not Granger Cause ΔVt	640	0.17118	0.80451

The test results show that there is bidirectional causality between volume and return, i.e. the volume had two way effects on the return of India. But there is no causal relationship between change in volume and return.

V. CONCLUSION

This paper empirically examines the dynamic relationship between stock returns and volume in the context of Indian Stock market. It has found a significant positive relationship between returns and volume which indicates that rising market goes with rising volume and vice versa. It is also found that information content of volume affects future stock return. It has also been the existence of bi-directional granger causality between volume and return i.e. the volume had two way effects on the return of India. But there is no causal relationship between change in volume and return. The explanation of this finding with regard to literature is that volume which is affected by market information leads to price changes. The higher capital gains which depict positive price changes lead to increase in volume and encouraging buying or long transactions of traders. These results suggest that regulators like speculators and hedgers can use past information of stock price and trading volume to foresee future trends in stock price and use it for sale and purchase decisions.

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