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Causality and Volatility in the Firm Level Stock Returns and Volume in India: Evidence from National Stock Exchange

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Abstract

The present study has undertaken a comprehensive investigation of co-movement in stock returns and volume change using daily National Stock Exchange data for twenty-one listed firms from 1996 to 2005. It is observed that the direction of causality between stock returns and volume change vary over different periods and across firms. Generally there are causal relationships between volume and price over the full period. Once we take the three sub periods the relationship starts to weaken over the sub periods for most of the stocks. The study further indicates that most of the companies do not show long-term spillover effect on volatility as evident generally in short run. However, some major players in Indian stock market show evidence of long-term spillover volatility effect. The study indicates towards the presence of inefficiencies on the National Stock Exchange, which weakens in the later sub-period.

I. Introduction

STOCK PRICES ALONE are generally insufficient to assist investors for predicting the future prices. If price and quantity are the fundamental building blocks of any theory of market interactions, the importance of trading volume in modeling asset markets is clear (Lo and Wang, 2000). According to Karpoff (1986) there are various reasons why a better understanding of trading volume in the stock market is necessary. It adds insight to the structure of financial markets regarding information flow in the marketplace, the extent that prices reflect public information as well as the market size. Further, volume data are

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regularly reported in the financial media along with price data, yet it is not clear what is the information reflected by volume data. The effects of the institutional and regulatory design of the market - spot and futures - on trading volume are also not well understood. Griffin, Sultz and Nardari, (2005) identified the main reasons for trading as information asymmetries, differences of opinion, taxes and portfolio rebalancing needs.

Investors in the stock markets frequently revise their expected prices of stocks depending on the flow of information. Possible disagreement to informational events can also lead to increased trading. Trading volumes can increase even if investors interpret the information identically but they have divergent prior expectations. Blume et al. (1994) suggest that if stock markets are efficient in the sense that the current price impounds all information then examining the volume and price data is clearly pointless. But if the process through which prices adjust to information is not immediate, then market statistics may impound information that is not yet incorporated into the current market price. In particular, volume may be informative about the process of stock returns and more may be learned about volatility by studying prices in conjunction with volume, instead of prices alone. The objective of the present paper is to understand the role of trading volume and its relationship with stock price. We have examined the volume and price co-movement of twenty-one listed firms (See Appendix) using daily National Stock Exchange (NSE) data from 1996 to 2005.

The remainder of this paper is organized as follows: Section II discusses volume-price relationships. Section III provides review of empirical studies. Section IV deals with data and hypotheses. Section V explains the methodology used in the paper. Section VI presents empirical results. Finally concluding remarks are given in Section VII.

II. Volume-Price Relationship

Several studies have analyzed the relationship of trading volume to price changes. Ying (1966) shows that increases (decreases) in daily trading volume on the New York Stock Exchange (NYSE) tend to be followed by a rise (fall) in the price of the S & P 500 composite index. Bull markets are known to see increasing volume a conclusion reinforced by Epps (1975), Copeland (1976), Tauchen and Pitts (1983), Smirlock and Starks (1985), Karpoff (1986) and Harris (1986, 1987). They suggest that volume, after all investors receive the information, is positively related to the magnitude of the price change.

It has also been argued that current trading volume dictate the intensity of future return autocorrelations and volatility. Harris and Raviv (1993) and Shalen (1993) show that large trading volume tends to announce large subsequent absolute price changes, implying high volatility. Campbell, Grossman and Wang (1993) and Wang (1991) correlate volume with other variables but suggest that investors never learn or use volume in any decision making process. In contrast Blume et al. (1994) demonstrate why volume and the absolute value of price changes are positively correlated. According

to them traders use the specific volume statistic in updating their beliefs. Although all traders will learn the asset's value and prices will thus converge to the full information or strong form efficient price, volume does not converge to zero. In fact, volume has a limit distribution that is non-degenerate, demonstrating that markets do not shut down as beliefs converge.

Lo and Wang (2000) focus on the cross-section variation in volume of individual stocks. The emphasis is on why trading activity vary from stock to stock. According to them trading motives, depend primarily on changes in portfolio holdings due to changes in return distributions or preferences. There are other factors that motivate individual and institutional investors to adjust their portfolios, for example asymmetric information, idiosyncratic risk, transactions costs, taxes and other market imperfections. They attempt to model the motive for trade as a function of preferences, endowments and economic conditions to obtain likely explanations for the dynamic properties of volume and returns. Gervis, Kaniel and Mingelgrain, (2001) suggest that a high volume-return premium seems to exist in stock prices. This is due to shocks in trader interest in a particular stock, that is the stock's visibility. According to them individual stocks whose trading activity is unusually large (small) over periods of a day or a week, as measured by trading volume during those periods, tend to experience large (small) returns over the subsequent month.

Some broad generalizations can be drawn from the above studies. Market participants, individual or institutional, are heterogeneous in their personal valuation of an asset. Stock price differentials indicate different expectations or different life cycle generated liquidity desires across different group of investors. Investment behaviour is not assumed to be random, investors willingness to hold positions in the stock is a function of their expectations or liquidity desires. Investor perception on prices is revised during and between trading periods, the revision which appears to be a stochastic process. Unusually high volume can result from heterogeneous group of investor reactions to the flow of information. It does not necessarily reflect disagreement among investors; it may also reflect consensus among investors with diverse prior opinions or expectations.

III. Literature Review

Ying (1966) used volume data of the NYSE and S&P 500 index returns from January 1957 to December 1962. The trading volume was normalized by the number of shares outstanding and returns were adjusted to reflect quarterly dividends. The results show that a large volume is usually accompanied by an increase in returns while a small volume is usually accompanied by a fall in price. Copeland (1976) derives a model in which information arrives sequentially to investors. He shows that after all the investors receive the information, volume is positively related to the magnitude of the price change.

Morse (1980) determined that periods of abnormally large volume usually had positive autocorrelation of returns. He took daily price and volume data

from 1973 to 1976 for 50 stocks in the US stock market and concluded that for the given dataset, there was likely to be a serial correlation of returns. This, he suggested was due to the existence of asymmetrical information in the market. Tauchen and Pitts (1983) show a positive association between price variability (ΔP^2) and the trading volume. They predict that the variance of the price change decreases with more traders. The reason for this is that the market price change during a single market clearing is the average of the changes in the trader's reservation prices. More terms in the average tend to wash out the effects of inter trader differences.

Gallant (1992) investigates price and volume co-movement using daily NYSE data from 1928 to 1987. Non-parametric method was used throughout to avoid bias due to specification error. Examining the contemporaneous price-volume relationship generally large price movements was associated with unusually high volume, leading to increases in both the mean and variability of the volume. Both functions were fairly symmetric, indicating that market declines have the same effect on subsequent volume as market increases. Lagged volume impact on current price changes and volatility indicate that abnormally high and low volumes are associated with slightly increased future price volatility.

Campbel, Grossmanond and Way, (1993) claim that price changes due to high volume tend to be reversed over time. A value weighted index of stocks traded on NYSE and ASE during July 1962 - December 1974 and January 1975 until September 1987 along with 32 large capitalized stocks were analysed. The hypothesis is based on the idea that non-informational investors sometimes have a need to sell off assets for external reasons unrelated to the valuation of their holding. At times mutual funds may need to liquidate assets to satisfy redemptions. Any change in the components of an index would require portfolio rebalancing by an index fund. Individual investors may have personal reasons to sell assets such as buying a house, a car or funding their children education.

Hiemstra and Jones (1994) using weekly market returns during January 1993 to June 2003 find evidence of returns Granger causing volume on the NYSE. Bernardo and Judd (1996) show that, just like past returns help traders update their beliefs about expected returns, trading volumes enables them to update their beliefs about the risk of these returns. Lo and Wang (2000) focus is on cross sectional variation in volume among stocks listed on the NYSE and AMEX during July 1962 to December 1996. They indicate that volume is not nearly so variable as returns relative to their means. According to Gervis, Kaniel and Mingelgrin (2001) a high volume return premium exists in stock prices as holders of a particular stock will on the average tend to be the most optimistic about its future price. This is specially true if taking short positions in the stock is not possible due to institutional constraints on short selling. Also the high volume returns premium does not depend on how trading volume is measured: share volume, dollar volume, detrended volume and firm specific volume all yield the same results. Studies have also found

asymmetries in the return-volume relation. Chordia and Subrahmanyam (2001) find that daily market dollar volume is not significantly related to the previous week's positive market return but volume is more positively related to the previous week's negative market return. At the individual level Chordia and Subrahmanyam, (2004) find that turnover increases for past positive stock returns but also increases for negative returns. However, the increase in turnover for positive returns is much larger than the increase for negative returns.

Griffin, Sultz and Nardari (2005) investigates the dynamic relation between market wide trading activity and returns in 46 markets. The study was conducted between January 1993 through June 2003 with daily and weekly market returns and total traded value denominated in local currency. Many stock markets exhibit a strong positive relation between turnover and past returns. The relation between returns and turnover is more statistically and economically significant in countries with restrictions on short sales and where the allocative efficiency of the stock market is weaker. According to them uninformed investors trade more following positive returns because they infer news from such returns and are more drawn to participate in the markets as a result of such returns. Past returns are likely to be more informative in markets that are less informationally efficient. The trading of individual investors is generally perceived as more likely to be influenced by behavioural biases like overconfidence and the disposition effect than the trading of institutional investors. The return-turnover relation is much stronger in developing countries whereas for OECD countries in most cases it is weak.

Pant (2002) investigates whether any causality exists using both linear and nonlinear causality tests between Nifty returns and volume. The period of study is from January 1996 to August 2002 with three sub periods. Linear tests show bi-directional causality during the period when rolling settlement was either not introduced or introduced in a limited manner. The causality in either direction is not observed for the period when rolling settlement is introduced. However, non-linear Ganger causality is absent in either direction for all the time periods, suggesting that non-linear effect are not significant in NSE and linear effects could be sufficient for predicting causality.

Tambi (2005) analyses return volume relationship for the period April 2000 to March 2005 for NSE. Granger test shows a bi-directional causality between return and trading volume. Further the lead lag relationship confirms that trading activity is more for positive change in prices then for negative changes and there is more strong causal evidence from volume to return.

IV. Data and Hypotheses

4.1 *Data*

The present paper undertakes an econometric analysis of price volume relationship of twenty-one companies listed on the NSE. These companies

have a major presence on the NSE in terms of weightage in the stock indices, trading volumes and market capitalization. The stock prices of the companies have been normalized for bonus, rights issue and stock splits but have not been adjusted for dividend payouts. The information on volume and prices has been collected from nseindia.com.

A number of measures of volume have been proposed and studied (for an excellent survey see Lo and Wang, 2000). They begin with an explanation of notational conventions on volume - not a trivial task given the variety of volume measures used in the existing literature, for example, shares traded, dollars traded, number of transactions etc. They argue that turnover - shares traded, divided by shares outstanding - is a natural measure of trading activity when viewed in the context of standard portfolio theory. Blume, Easley and Hara (1994) say that volume is typically defined as the number of shares of the risky asset that are traded. Since every trade involves a buyer and a seller, volume could be calculated by simply adding up all buy orders or all sell orders. An equivalent approach in Walrasian equilibrium is to sum the absolute value of traders' demands and divide by two.

According to Chawla (2003) the quantities and monetary values of transactions are both termed alternatively and inter-changeably as 'volume' or 'turnover' or by twin terms like 'volume of turnover' and 'turnover of transaction'. Also brokers' turnover is the aggregate of purchases and sales made by them. It is twice the market turnover that is equal to aggregate purchases = aggregate sales in the market during a given period of time. Gervais, Kaniel and Mingelgrin (2001) say that results do not depend on how trading volume is measured: share volume, dollar volume, detrended volume and firm specific volume. The rupee volume has been taken as the variable for the present study. This variable is usually termed as turnover on the stock exchange (the total money value of securities traded, as calculated by multiplying price by the number of securities traded) be they NYSE or NSE as well as business channels and the media. Thus the concept of turnover used by Lo and Wang (2000) and generally perceived by investors seems to differ. From the investors perspective turnover is usually the surrogate for volume and it was deemed fit to use it for the study.

The time period of the present study is from 1996 to 2005. The period has been further subdivided into three sub periods: 1996 - 1999, 2000 - 2002 and 2003 - 2005. The periods taken reflect some of the NSE milestones after its incorporation in 1992 with the equity market segment going live in November 1995. The S&P CNX Nifty was launched in April 1996 and the National Securities Depository limited was set up in November 1996, which also saw the commencement of trading and settlement in dematerialized form. The year 2000 saw the commencement of internet trading as well as derivatives trading in Index futures. The Compulsory Rolling Settlement as per the directive of SEBI was introduced in December 2001 on a T+5 basis. The T+3 basis of settlement started in April 2002 and subsequently

the T+2 basis of settlement was introduced from April 2003 (for details see nseindia.com).

The raw data consists of the daily closing value of the twenty-one listed firms and their daily volume of shares traded on the NSE. Many empirical studies of volume use some form of detrending to induce stationarity. This usually involves either taking first differences or estimating the trend and subtracting it from the raw data. The daily closing price series P_t, is differenced in the logs to create the price change series or returns(R) calculated as ($\log P_t - \log P_{t-1}$). Similarly volume change (T) has been taken as ($\log V_t - \log V_{t-1}$).

Because of the limitations of existing theory, the empirical work is not organized around the specification and testing of a particular model or class of models. Instead the empirical effort is mainly data based.

4.2 *Hypotheses*

Hypothesis H0: *R does not Granger cause T*
Hypothesis H1: *T does not Granger cause R*
Hypothesis H2: *R volatility does not influence T volatility*
Hypothesis H3: *T volatility does not influence R volatility*

4.3 *Methodology*

For any time series analysis, all data series must be stationary. In the presence of nonstationary variables, there might be what Granger and Newbold (1974) call a spurious regression. We carry out unit root test which shows whether a variable or a series is stationary or not. In the present series, the stationarity condition has been tested using Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) tests (Dickey and Fuller, 1979, 1981; Gujarati, 2003; Phillips and Perron, 1988).

It may be observed that the test for causality between two stochastic variables may be framed in different ways. They are regression approach, examining the cross-correlations between two stationary series, and looking at cross-spectra between the two series. In this paper, we use the procedure of causality detection between the Stock Returns and Stock Volumes using regression approach as developed by Granger (1969, 1988).

V. Granger Causality Test

The dynamic linkage is examined using the concept of Granger's (1969, 1988) causality test. Formally, a time series x_t Granger-causes another time series y_t if series can be predicted with better accuracy by using past values of rather than by not doing so, other information being identical. In other words, variable fails to Granger-cause y_t if

$$Pr(y_{t+m} | \Omega_t) = Pr(y_{t+m} | \Psi_t) \quad (1)$$

where, $Pr(y_{t+m} | \Omega_t)$ denotes conditional probability of y_t, Ω_t is the set of all information available at time t, and $Pr(y_{t+m} | \Omega_t)$ denotes conditional

probability of y_t obtained by excluding all information on x_t from y_t this set of information is depicted as Ψ_t.

To test causal relations between stationary series x_t and y_t can be based on the following equations:

$$x_t = \alpha_0 + \sum_{j=1}^{k} \gamma_j x_{t-j} + \sum_{j=1}^{k} \beta_j y_{t-j} + u_{xt} \quad (2)$$

$$y_t = \alpha_0 + \sum_{j=1}^{k} \gamma_j x_{t-j} + \sum_{j=1}^{k} \beta_j y_{t-j} + u_{yt} \quad (3)$$

where, k is a suitably chosen positive integer, γ_j and β_j, j = 0,1, ..., k are parameters and α's are constants; and u_t's are disturbance terms with zero means and finite variances. The null hypothesis that y_t does not Granger-cause x_t is not accepted if the β_j's, j>0 in equation 2 are jointly significantly different from zero using a standard joint test (e.g., an F test). Similarly, x_t Granger-causes y_t if the γ_j's, j>0 coefficients in equation 3 are jointly different from zero.

In order to test the spillover effect of volatility of one series to another series, we apply Granger Causality test on the standard deviations derived from 50 working days intervals of stock returns and stock volumes as

$$\sigma_{x_t} = \delta_0 + \sum_{j=1}^{k} \lambda_j \sigma_{x_{t-j}} + \sum_{j=1}^{k} \eta_j \sigma_{y_{t-j}} + \varepsilon_{xt} \quad (4)$$

$$\sigma_{y_t} = \delta_0 + \sum_{j=1}^{k} \lambda_j \sigma_{x_{t-j}} + \sum_{j=1}^{k} \eta_j \sigma_{y_{t-j}} + \varepsilon_{xt} \quad (5)$$

λ_j and η_j, j = 0,1, ...,k are parameters and δ's are constants; and ε's are disturbance terms with zero means and finite variances. The null hypothesis that does not Granger-cause σ_{x_t} is not accepted if the η_j's, j>0 in equation 4 and the null hypothesis that σ_{x_t} does not Granger-cause σ_{y_t} is not accepted if the λ_j's, j>0 in equation 5 are jointly significantly different from zero using a standard joint test (e.g., an F test).

VI. Empirical Results

The mean and standard deviation of returns and volume change are calculated to do the preliminary investigation. The results are presented in Table I and II. It is found that average returns are positive in 20 out of 21 firms during 1996-2005. During the same period, mean value of volume change is positive for all the firms. However, the mean returns in sub-periods vary across firms. The mean returns in 7, 14 and 3 out of 21 firms are negative during 1996-99, 2000-2002 and 2003-2005 respectively. The mean of volume change in 2, 10 and 2 out of 21 firms are negative during 1996-99, 2000-2002

Table I
Descriptive Statistics(Returns)

	Mean				Std. Div			
	1996-2005	1996-99	2000-02	2003-05	1996-2005	1996-99	2000-02	2003-05
RACC	6.45E-05	-0.00013	-0.00065	0.001399	0.030968	0.034097	0.031596	0.022306
RBAJAJ	0.000385	-0.00037	0.000461	0.00158	0.022557	0.023633	0.023536	0.018273
RBHEL	0.00096	0.000935	-0.00029	0.002949	0.030974	0.031577	0.032962	0.026363
RGLAXO	0.00063	0.00137	-0.00127	0.001842	0.023591	0.025755	0.023821	0.017738
RGRASIM	0.000393	-0.00028	-0.00044	0.00282	0.027892	0.029135	0.029606	0.021884
RHDFC	0.00077	0.002328	-0.00189	0.001489	0.073449	0.078382	0.08786	0.022232
RHDFCB	0.001273	0.001669	0.00032	0.001756	0.026351	0.02922	0.024543	0.022544
RHERO	0.001456	0.003064	-0.00075	0.001641	0.034324	0.035778	0.037709	0.024673
RHLL	0.000375	0.001244	-0.00032	-0.00046	0.021034	0.018777	0.024504	0.019364
RINDH	-4.49E-05	-0.00062	-0.00074	0.002045	0.02245	0.022806	0.023076	0.020596
RINFOS	0.00227	0.006514	-0.00159	-0.00025	0.060702	0.076864	0.045368	0.040689
RITC	0.000728	0.000963	-9.30E-05	0.001333	0.025447	0.027943	0.026499	0.017202
ROBC	0.000779	-0.0002	5.39E-06	0.0037	0.028605	0.028657	0.01938	0.038099
RONGC	0.000707	0.0002	0.000649	0.00164	0.028243	0.029806	0.028239	0.02475
RRANB	0.000899	0.001744	-0.00069	0.001418	0.030171	0.033437	0.032643	0.016157
RREL	0.000722	0.00082	0.000226	0.001113	0.026241	0.029179	0.025672	0.020113
RSAIL	0.000377	-0.00086	-0.00034	0.003592	0.041288	0.044575	0.036058	0.041205
RSAT	0.001933	0.005378	-0.00195	0.000728	0.046453	0.044901	0.056554	0.029276
RSBIN	0.000513	0.000123	0.000198	0.00158	0.026059	0.028185	0.024678	0.023399
RTISCO	0.000292	-0.00034	-7.92E-06	0.001843	0.029739	0.029435	0.028212	0.032331
RWIPRO	0.001845	0.006115	-0.00164	-0.00133	0.063322	0.069356	0.041351	0.076143

Table II
Descriptive Statistics(Volume)

	Mean				Std. Div			
	1996-2005	1996-99	2000-02	2003-05	1996-2005	1996-99	2000-02	2003-05
TACC	0.001223	0.002042	-0.00265	0.005848	0.608038	0.649139	0.597802	0.529777
TBAJAJ	0.002154	0.003388	0.000384	0.001724	0.747899	0.715097	0.842073	0.660901
TBHEL	0.001399	0.001846	-0.00191	0.004906	0.85765	1.092462	0.629788	0.582531
TGLAXO	0.003016	0.004215	-0.002	0.004601	0.736443	0.801922	0.674034	0.682892
TGRASIM	0.002554	0.003719	0.000242	0.00356	0.845932	0.987644	0.741785	0.668643
THDFC	0.002137	0.003101	0.000618	0.008457	0.931299	1.009461	0.92109	0.770635
THDFCB	0.002042	0.003471	0.002137	0.006401	0.751175	0.717966	0.803333	0.728976
THERO	0.004553	0.007676	0.004223	0.004684	0.869827	0.987649	0.852513	0.604089
THLL	0.002691	0.004428	0.000436	0.003644	0.666314	0.73891	0.630674	0.560422
TINDH	0.002104	0.001357	-0.00093	0.005478	0.962341	1.163634	0.798271	0.716735
TINFOS	0.003953	0.008683	0.000258	-0.00263	0.694956	0.846446	0.605588	0.442448
TITC	0.001929	0.003257	-0.00193	0.003839	0.604914	0.569427	0.658485	0.590253
TOBC	0.002998	0.001846	-0.00097	0.00685	0.691468	0.723672	0.694927	0.61593
TONGC	0.003781	0.002908	0.005017	0.003656	0.806546	0.877178	0.842464	0.576813
TRANB	0.002309	0.005749	-0.00222	0.002062	0.788804	0.950143	0.655292	0.598266
TREL	0.000684	0.000105	2.43E-05	0.002488	0.529763	0.506746	0.601742	0.457469
TSAIL	0.003937	0.003734	-0.00093	0.008219	0.838817	1.030009	0.743328	0.467738
TSAT	0.004419	0.010823	0.001313	-0.00072	0.689505	0.862802	0.576309	0.397611
TSBIN	0.000503	-0.00216	-0.00023	0.003393	0.549584	0.50405	0.657254	0.447712
TTISCO	0.001254	-0.00077	0.000891	0.0033	0.534537	0.530732	0.609214	0.403925
TWIPRO	0.00507	0.011046	-0.00079	0.004176	0.794583	1.064973	0.479244	0.486786

and 2003-2005 respectively. At the same time it is pertinent to highlight that the performance of the firms are not uniform over the sub-periods. Still, the mean value of returns and volume change broadly indicates that the firms

are under performing during 2000-2002 while in recent years the performance has improved. Further, Table I and II reveals that the standard deviation of returns and volume change are declining in recent years. There has been a decline in the standard deviation over the time period for the firms except ITC. It is also observed that the standard deviation of volume change is higher than that for returns for all the firms during the different sub-periods.

Table III
Granger Causality between Volume Change to Firm Level Returns

Null : Hypothesis	1996-2005 F-Statistic	1996-1999 F-Statistic	2000-2002 F-Statistic	2003-2005 F-Statistic
TBAJAJ → RBAJAJ	1.15745	0.96351	0.39112	2.44031*
	(4)	(4)	(2)	(2)
RBAJAJ → TBAJAJ	2.91670*	2.39211	4.47068*	2.51498*
	(4)	(4)	(2)	(2)
TBHEL → RBHEL	0.71086	1.33610	0.40907	0.91973
	(2)	(4)	(2)	(2)
RBHEL → TBHEL	5.21197*	3.23493	2.42399	0.49138
	(2)	(4)	(2)	(2)
TGRASIM → RGRASIM	0.32440	0.31794	1.14573	1.37151
	(2)	(2)	(6)	(2)
RGRASIM → TGRASIM	4.47266*	5.03185*	1.07829	2.80469*
	(2)	(2)	(6)	(2)
TRANB → RRANB	0.58642	0.60753	0.33259	0.52765
	(4)	(4)	(2)	(2)
RRANB → TRANB	2.54732*	1.54519	2.64742*	0.90328
	(4)	(4)	(2)	(2)
TSAT → RSAT	0.24702	0.73026	0.48368	1.66227
	(2)	(6)	(4)	(2)
RSAT → TSAT	3.66084*	3.03466*	5.47209*	3.17953
	(2)	(6)	(4)	(2)
TSBIN → RSBIN	1.38625	3.31241*	0.95093	2.87774*
	(2)	(2)	(2)	(2)
RSBIN → TSBIN	11.3915*	1.65322	8.99349*	2.01263
	(2)	(2)	(2)	(2)

Note : * significant at 1 percent

To examine the causal relationships, Granger causality test has been carried out between volume change and firm level equity returns for the complete period of 1996 to 2005 as well as the three sub periods. For Bajaj Auto, BHEL, Grasim, ITC, Ranbaxy, Satyam and State Bank of India (SBI), it is returns, which influences volume over the full period (Table III). Glaxo, HDFC Bank, OBC, ONGC, Reliance, Sail and Tisco reveal bi-directional causal relationship over the full period. The bi-directional relationship exists for these firms in only the first two sub periods (Table IV). In the Hero Honda and Hindustan Lever, volume influences the equity returns over the full period. This relationship exists for Hero Honda in the first sub period and for Hindustan Lever in the first two sub-periods (Table V). HDFC, Infosys and Wipro do not show any relationship for the full period as well as

the three sub periods. Indian Hotel, ACC and ITC do not show any relationship for the full period, though they exhibit relationship in a sub period (Table VI).

Table IV
Granger Causality between Volume change to Firm Level Returns

Null : Hypothesis	1996-2005 F-Statistic	1996-1999 F-Statistic	2000-2002 F-Statistic	2003-2005 F-Statistic
TGLAXO → RGLAXO	4.40011* (2)	3.81486* (2)	0.93192 (2)	1.25257 (2)
RGLAXO → TGLAXO	5.94245* (2)	3.07330 (2)	3.91982* (2)	3.86614* (2)
THDFCB → RHDFCB	2.74112* (2)	9.92477* (2)	0.15522 (2)	1.01314 (2)
RHDFCB → THDFCB	6.66596* (2)	7.72567* (2)	0.98300 (2)	0.25457 (2)
TOBC → ROBC	5.46114* (2)	10.4639* (2)	2.56370* (6)	1.0034 (2)
ROBC → TOBC	9.22858* (2)	4.95178* (2)	3.92261* (6)	1.79172 (2)
TONGC → RONGC	5.55034* (2)	5.21107* (2)	3.02709* (2)	1.21346 (2)
RONGC → TONGC	16.7503* (2)	9.54677* (2)	6.29533* (2)	1.48187 (2)
TREL → RREL	2.75221* (2)	5.49107* (2)	0.27415 (4)	0.25792 (2)
RREL → TREL	6.09343* (2)	5.48063* (2)	2.59477* (4)	1.42037 (2)
TSAIL → RSAIL	4.45775* (2)	2.03444* (4)	3.98610*(2) (2)	0.74953 (2)
RSAIL → TSAIL	26.1217* (2)	7.36961* (4)	17.1786* (2)	7.84497 (2)
TTISCO → RTISCO	3.38489* (2)	1.83846 (4)	2.02249 (6)	1.48451 (2)
RTISCO → TTISCO	4.90323* (2)	6.64204* (4)	1.54473 (6)	0.41172 (2)

Note : * significant at 1 percent

Table V
Granger Causality between Volume change to Firm Level Returns

Null Hypothesis:	1996-2005 F-Statistic	1996-1999 F-Statistic	2000-2002 F-Statistic	2003-2005 F-Statistic
THERO → RHERO	2.84393* (2)	2.85657* (2)	1.00247 (2)	1.62206 (2)
RHERO → THERO	2.26501 (2)	0.33663 (2)	0.88067 (2)	7.8102* (2)
THLL → RHLL	11.3203* (2)	10.9907* (2)	3.87227* (2)	1.38815 (2)
RHLL → THLL	1.08373 (2)	0.95126 (2)	0.57828 (2)	0.2276 (2)

Note : * significant at 1 percent

Table VI
Granger Causality between Volume change to Firm Level Returns

Null Hypothesis:	1996-2005 F-Statistic	1996-1999 F-Statistic	2000-2002 F-Statistic	2003-2005 F-Statistic
THDFC → RHDFC	0.56047	0.48296	1.11537	0.56192
	(2)	(4)	(4)	(2)
RHDFC → THDFC.	0.23659	1.08772	0.36847	1.35971
	(2)	(4)	(4)	(2)
TINFOS → RINFOS	1.21085	1.84187	1.08124	0.95546
	(2)	(4)	(6)	(2)
RINFOS → TINFOS	0.03936	0.57251	2.26364	1.58667
	(2)	(4)	(6)	(2)
TWIPRO → RWIPRO	0.62548	0.23852	0.19472	0.62534
	(6)	(4)	(2)	(2)
RWIPRO → TWIPRO	1.02211	1.34758	0.22278	0.81374
	(6)	(4)	(2)	(2)
TINDH → RINDH	0.17785	0.75745	0.17662	2.07992
	(4)	(6)	(2)	(2)
RINDH → TINDH	2.47225	1.96564	4.06855*	0.34772
	(4)	(6)	(2)	(2)
TACC → RACC	1.05054	0.33209	1.40213	4.15253*
	(4)	(6)	(2)	(2)
RACC → TACC	5.59444*	3.09016*	6.11340*	0.28444
	(4)	(6)	(2)	(2)
TITC → RITC	1.58380	2.60643*	0.08051	0.47013
	(6)	(2)	(2)	(2)
RITC → TITC	2.02077	0.21948	3.72130*	0.22753
	(6)	(2)	(2)	(2)

Note : * significant at 1 percent

To examine the cross over volatility between variance of stock returns and volume, the granger causality test is applied. First the variance for stock returns and volume were estimated for each 50 working days. Then granger causality was applied on 50 days variances of the two variables price and volume. There seems to be no long-term persistence in volatility in 14 companies out of 21 companies (Table VII). In 4 major companies, there is evidence of long-term persistence flow of volatility from volume volatility to returns volatility. These are GLAXO, INFOSYS, ITC and SATYAM. Out of these four, two are the major software companies while ITC is a large FMCG company. All the three have large FIIs holding and weightage in the Nifty (Table VIII). Further, it is observed in three companies there is a long-term persistence flow of volatility from returns volatility to volume volatility. These companies are HDFC Bank, OBC and Hero Honda. Two of them belong to the banking sector (Table IX).

Table VII
Causality Test between Variance of Stock Returns And Volumes (No Causality)

VARIABLE	F-STATISTICS
ACCT → ACC	0.0507
ACC → ACCT	1.5217

BAJAJT	→	BAJAJ	0.1995
BAJAJ	→	BAJAJT	1.0949
BHELT	→	BHEL	0.7333
BHEL	→	BHELT	1.6761
GRASIMT	→	GRASIM	0.5051
GRASIM	→	GRASIMT	0.1908
HDFCT	→	HDFC	0.8617
HDFC	→	HDFCT	0.0461
HLLT	→	HLL	1.1342
HLL	→	HLLT	1.2829
INDHT	→	INDH	0.4472
INDH	→	INDHT	0.4764
ONGCT	→	ONGC	0.7852
ONGC	→	ONGCT	1.1627
RANBT	→	RANB	1.9083
RANB	→	RANBT	1.4986
RELT	→	REL	2.2362
REL	→	RELT	0.7428
SAILT	→	SAIL	0.4117
SAIL	→	SAILT	0.6303
SBINT	→	SBIN	0.5053
SBIN	→	SBINT	0.4635
TISCOT	→	TISCO	0.6721
TISCO	→	TISCOT	1.6062
WIPROT	→	WIPRO	0.7645
WIPRO	→	WIPROT	1.0546

Table VIII
Causality Test between Variance of Stock Returns and Volumes (Unidirectional)

VARIABLE			F-STATISTICS
GLAXOT	→	GLAXO	2.4600** (2)
GLAXO	→	GLAXOT	1.1210 (2)
INFOST	→	INFOS	2.4166** (2)
INFOS	→	INFOST	0.1344 (2)
ITCT	→	ITC	3.7739* (2)
ITC	→	ITCT	0.9190 (2)
SATT	→	SAT	11.1960* (2)
SAT	→	SATT	0.3836 (2)

Note : * significant at 1 percent
** significant at 5 percent

Table IX
Causality Test between Variance of Stock Returns and Volumes (Unidirectional)

VARIABLE			F-STATISTICS
HDFCBT	→	HDFCB	0.3400 (2)
HDFCB	→	HDFCBT	3.2956* (2)
OBCT	→	OBC	1.1073 (2)
OBC	→	OBCT	3.1546* (2)
HEROT	→	HERO	0.5287 (2)
HERO	→	HEROT	13.8914* (2)

Note : * significant at 1 percent

The above analysis, indicate that most of the companies do not show long term spillover effect on volatility as evident generally in short run. However, some major players in Indian stock market show evidence of long-term spillover volatility effect. Generally there are causal relationships between volume and price over the full period. Once we take the three sub periods the causal relationship starts to weaken over the sub periods for most of the stocks. For the last sub period 2003-2005, except ACC there are no stocks where volume influences returns. Also there are firms like Bajaj Auto, BHEL, Grasim, Ranbaxy, Satyam, SBI, Glaxo, HDFC Bank, OBC, ONGC, Reliance, SAIL and Tisco where returns are influencing volume over the total period but the number of firms decreases in the last sub period.

VII. Concluding Remarks

The information regarding price and quantity are the fundamental building blocks of any theory of market interactions, the importance of trading volume in modeling asset markets is clear. Stock prices and trading volume are important in the prediction of the future prices. Investors in the stock markets frequently revise their expected prices of stocks depending on the flow of information. Possible disagreement to informational events can also lead to increased trading. Trading volumes can increase even if investors interpret the information identically but they have divergent prior expectations. The present study have examined the volume and price co-movement of twenty one listed firms using daily National Stock Exchange (NSE) data from 1996 to 2005.

From the analysis, there is no explicit direction of causality. Direction of causality between stock returns and volume change vary over different periods and across firms. Generally there are causal relationships between volume and price over the full period and these relationships weaken over the sub periods for most of the stocks. The analysis further indicates that

most of the companies do not show long-term spillover effect on volatility as evident generally in short run. However, some major players in Indian stock market show evidence of long-term spillover volatility effect.

The study indicates towards the presence of inefficiencies in Indian equity markets. The information regarding trading volume and returns may be used to predict the future prices. However, indications are that the changes in the regulation and functioning of Indian equity markets for the period under study are in positive direction and inefficiencies seem to weaken in the later sub period.

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Appendix I
List of Firms

Abbreviation	Name of Firm	Sector
ACC	Associated Cement Company	Cement
BAJAJ	Bajaj Auto	Automobile
BHEL	Bharat Heavy Electricals Ltd.	Engineering
GLAXO	GLAXO	Pharmaceutical
GRASIM	Grasim	Diversified
HDFC	Housing Development Finance Corp.	Finance
HDFCB	HDFC Bank	Banking
HERO	Hero Honda	Automobile
HLL	Hindustan Lever	FMCG
INDH	Indian Hotels	Hotels
INFOS	Infosys	Software
ITC	Indian Tobacco Company	Tobacco / Diversified
OBC	Oriental Bank of Commerce	Banking
ONGC	Oil and Natural Gas Commission	Petroleum
RANB	Ranbaxy	Pharmaceutical
REL	Reliance Industry	Petroleum
SAIL	Steel Authority of India Ltd.	Steel
SAT	Satyam Computers	Software
SBIN	State Bank of India	Banking
TISCO	Tata Steel	Steel
WIPRO	Wipro	Software

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