PRICE-VOLUME DYNAMICS: INVESTIGATING THE INTERPLAY WITHIN NSE INDICES IN THE INDIAN STOCK MARKET

DR. SANJEET SHARMA
Assistant Professor, University College of Business Studies, Chaura Maidan, Himachal Pradesh University, Shimla, India
MEENAKSHI JASWAL
Research Scholar, Department of Commerce, Himachal Pradesh University, Shimla, India

ABSTRACT

The objective of the present study is to investigate the relationship between stock return and trading volume in Indian stock market. The present study covers the daily closing prices and volume data for a period of five years starting from 1st July, 2018 to 30th June, 2023 on three NSE sectoral indices- Nifty Realty, Nifty Auto and Nifty Financial Services. Augmented Dickey Fuller (ADF) test is used to check the stationarity of data. The study employed Vector Auto Regression model and Granger Causality test to examine the dynamic relation between stock returns and trading volume. The study showed that no clear causation can be established between the stock return and trading volume.
Keywords: *Augmented Dickey Fuller test, Granger Causality Test, Stock Return, Trading Volume, Vector Auto Regression model.*

INTRODUCTION

The Indian stock market, one of the most dynamic and significant financial markets in the world, plays a crucial role in driving economic growth and attracting domestic and international investments. Investors, analysts, and policymakers constantly seek to decipher the underlying patterns and factors that influence stock prices, aiming to optimize investment decisions and enhance market efficiency. Granger and Morgenstern (1963) marked the initial endeavour to establish a connection between price movements and trading volume in the stock market and the investigation was further extended by Godfrey, Granger and Morgenstern (1964). Both research studies reach the conclusion that price and volume show little to no significant relationship, and price changes appear to follow a random walk. In contrast, Crouch (1970), Clark (1973) and Westerfield (1973) employing daily and hourly price changes for market indices and individual stocks, discovered a positive correlation between trading volume and the magnitude of returns. Analysing the connection between volume and returns, Rogalski (1978) observed a positive simultaneous correlation using monthly stock and warrant data, while Epps (1975, 1977) confirmed this finding by utilizing transaction data. Karpoff (1987) seminal work proposed the importance for examining the relationship between price and volume in financial markets.

The relationship between stock return and volume has long been a subject of interest among researchers and market participants globally but no substantial evidence found on the relationship between stock price and volume. The rest of the paper is segregated as follows. The second section briefly consolidated the previous literature on the price-volume relationship. Section three shows the data and methodology used in the study. Section four discusses the analysis and interpretation. Last section concludes the paper.

REVIEW OF LITERATURE

Kumar, Singh and Pandey (2009) examined the relationship between price and trading volume for Indian stocks. It found a positive and asymmetric relationship between volume and price changes. The research also indicated a bi-directional relationship between volume and returns, although the dynamic relationship between returns and volume was found to be weak. The study's results regarding the Mixture of Distributions Hypothesis (MDH) were inconclusive. Tripathy (2011)focused on the Indian stock market and utilized various econometric models. It revealed a bi-directional causality between trading volume and stock return volatility, with trading volume playing an influential role. Johansen's co-integration analysis indicated a long-run equilibrium relationship between stock returns and trading volume. Chen (2012) investigated the relationship between stock returns and trading volume during different phases of the stock market. It found strong evidence of asymmetry in the correlation between stock returns and trading volume. The study showed that stock returns could predict trading volume in both bull and bear markets, but the reverse relationship was weaker. Assan and Thomas (2013) explored the influence of firm size on the relationship between stock returns and trading volume in the Indian stock market. It found that stock returns had a causal effect on trading volume, with a bidirectional causality for smaller firms. The impact of the subprime crisis on this relationship was also examined. Akpansung and Gidigbi (2015) looked at the relationship between trading volume and stock returns in the Nigerian Stock Exchange. It found that these variables move together but do not Granger-cause each other. The study highlighted the importance of managing interest and exchange rates for their influence on trading volume. Pathirawasam (2011) analysed the relationship between trading volume and stock returns at the Colombo Stock Exchange. It found a positive relationship between stock returns and contemporaneous trading volume but a negative relationship with past trading volume changes, potentially due to investor misspecification or illiquidity. Hsu, Wu, Wu and Chang (2016) proposed a new theory regarding the impact of trading information heterogeneity on the price-volume dynamics in the stock market. The findings supported the theory, showing that extreme trading volumes during stock price reversals or rebounds were influenced by the extent of information heterogeneity among traders. Abukari and Assogbavi (2019) explored the connection between stock prices and trading volume in South Africa. It confirmed contemporaneous and bi-directional causal relationships between stock returns and trading volume but found a strong negative asymmetric relationship. The research also suggested quasi-instantaneous information dissemination, indicating market efficiency in the Johannesburg Stock Exchange. Nyakurukwa (2021) scrutinized the dynamic relationship between trading volume and stock returns on the Johannesburg Stock Exchange. It found evidence of causality from returns to trading volume during stable periods, with diminishing causality during crisis and post-COVID periods. There was no evidence of causality from trading volume to stock returns. The highest impact occurred in the middle of the conditional distribution.

DATA AND METHODOLOGY

The study covers the sample period of five years starting from 1st July, 2018- 30th June, 2023 and the data set includes the daily closing index values and daily volumes of the three NSE Sectoral Indices (Nifty Auto Index, Nifty Financial Services Index and Nifty Realty Index) extracted from the website of yahoofinance.com. The three NSE Sectoral indices were randomly selected for the study. Stock return of indices is calculated as the ratio of today's closing price of the stock to yesterday's closing price of the same stock in view of measuring the performance of stocks. The positive value indicates the appreciation in price and alternatively, the negative value indicates the depreciation in price. The stock returns of the stock indices are calculated using logarithm return formula:

$$\text{Stock Return} = LN\left(\frac{\text{Today's Price}}{\text{Yesterday's Price}}\right)$$

Volume is defined as the total number of shares (or units of a security) that are traded on a trading day. It represents the total activity of buying and selling a particular stock or security during a specific time frame. A total of 1216 trading days are taken under the study.

Augmented Dickey Fuller (ADF) test is used to check the stationarity of data. The study employed Vector Auto Regression model and Granger Causality test to examine the dynamic relation between stock returns and trading volume.

UNIT ROOT TEST (AUGMENTED DICKEY FULLER TEST)

Ensuring the stationarity of the variables under investigation is crucial to avoid the presence of serial autocorrelation, which could potentially yield misleading statistical outcomes in the study. As emphasized by Granger and Newbold (1974), non-stationary variables may lead to spurious results, making it essential to have stationary data series for accurate analysis. By testing for stationarity, we can mitigate the risk of drawing unreliable conclusions and enhance the validity of the research findings.

CAUSALITY TEST (GRANGER CAUSALITY TEST AND VECTOR AUTO REGRESSION TEST)

In our analysis, we utilize both the Granger Causality test and VAR (Vector Auto regression) parameter estimates to gain insights into the dynamic relationship between volume and returns in the market. By employing these two approaches, we aim to comprehensively explore the causal links and the intricate interactions between the trading volume and stock returns.

DATA ANALYSIS AND INTERPRETATION

Table 1: Descriptive Statistics of Stock Return and Trading Volume for three NSE Sectoral Indices

NSE Sectoral Indices	Variables	Mean	Median	Max.	Min.	Standard Deviation	Skewness	Kurtosis	Jarque-Bera (P- value)
Nifty Auto Index	Stock Return	0.000280	0.000685	0.098997	-0.149055	0.016181	-0.535622	13.32863	5463.291 (0.000000)***
	Trading Volume	2154444	676150.0	6.01E+08	100.0000	25807773	20.59396	432.2945	9423505 (0.000000)***
Nifty Financial Services Index	Stock Return	0.000501	0.001111	0.089107	-0.173623	0.016179	-1.295058	18.84475	13060.08 (0.000000)***
	Trading Volume	2791005	977750.0	7.04E+08	100.0000	31440567	20.24624	414.0148	8642356 (0.000000)***
Nifty Realty Index	Stock Return	0.000544	0.001241	0.083025	-0.120523	0.019519	-0.508011	6.451299	655.8175 (0.000000)***
	Trading Volume	666803.5	184150.0	2.72E+08	100.0000	9617825	23.86615	609.8592	18774858 (0.000000)***

Source: www.yahoofinance.com

Table 1 provides the descriptive statistics for stock return and trading volume of the three NSE sectoral indices. The stock return values for Nifty auto, Nifty financial services, and Nifty realty are (0.000280), (0.000501), and (0.000544) respectively, with corresponding median values of (0.000685), (0.001111), and (0.001241). The skewness of 23.86615 and kurtosis of 609.8532 indicate substantial departure from a normal distribution, with the lowest skewness being (-0.508011) and the lowest kurtosis being 13.32863.The results of the Jarque-Bera test of normality for all three indices are statistically significant at the 1% level, leading to the rejection of the null hypothesis that the data series follows a normal distribution. The significance level is denoted by ***.These findings suggest that the data series for stock return and trading volume in the three NSE sectoral indices do not adhere to a normal distribution, which should be taken into consideration when interpreting the results of further analyses.

Table 2: Unit Root Test Results for three NSE Sectoral Indices

NSE Sectoral Indices	Variables	ADF Test statistic	Test Critical Values			Probability Value (P-value)
			1%	5%	10%	
Nifty Auto Index	Stock Return	-34.81149	-3.435519	-2.863710	-2.567976	0.0000
	Trading Volume	-5.717963	-3.435590	-2.863742	-2.567992	0.0000
Nifty Financial Services Index	Stock Return	-14.31885	-3.435541	-2.863720	-2.567981	0.0000
	Trading Volume	-6.018578	-3.435590	-2.863742	-2.567992	0.0000
Nifty Realty Index	Stock Return	-32.01982	-3.435519	-2.863710	-2.567976	0.0000
	Trading Volume	-5.470939	-3.435590	-2.863742	-2.567992	0.0000

Source: www.yahoofinance.com

Table 2 presents the findings of the unit root test. The results indicate that the ADF (Augmented Dickey-Fuller) statistic surpasses the critical values, leading to the rejection of the null hypothesis. This suggests that the data series of both stock return and trading volume exhibit stationarity. Moreover, the p-values (0.0000) obtained for stock return and trading volume across all three indices are statistically significant, providing robust evidence in favour of the stationarity of these data series.

Table 3: Pairwise Granger Causality Test

NSE Sectoral Indices	Null Hypothesis	Decision	F-statistic	Probability Value
Nifty Auto Index	Trading Volume does not Granger cause stock return	Accept	0.24551	0.7823
	Stock Return does not granger cause Trading volume	Accept	0.04616	0.9549
Nifty Financial Service Index	Trading Volume does not Granger cause stock return	Accept	0.37535	0.6871
	Stock Return does not granger cause Trading volume	Accept	0.00792	0.9921
Nifty Realty Index	Trading Volume does not Granger cause stock return	Accept	0.74331	0.4758
	Stock Return does not granger cause Trading volume	Accept	0.71288	0.4904

Source: www.yahoofinance.com

Table 3 displays the outcomes of the pairwise Granger causality test. The results indicate that all the associations between stock return and trading volume are statistically significant, supporting the acceptance of the null hypothesis. Consequently, there is no evidence to suggest causation from trading volume to stock return or vice-versa.

Table 4: VAR Estimation Results

	Nifty Auto Index			Nifty Financial Services Index			Nifty Realty Index	
	Stock Return	Trading Volume		Stock Return	Trading Volume		Stock Return	Trading Volume
Stock Return (-1)	-0.001915 [-0.06637]	15292928 [0.33105]	Stock Return (-1)	0.000784 [0.02739]	9619592 [0.17103]	Stock Return (-1)	0.083625 [2.91046]***	-806835.1 [-0.05642]
Stock Return (-2)	0.044635 [1.54800]	1091605 [0.02365]	Stock Return (-2)	-0.033254 [-1.16296]	3270951 [0.05820]	Stock Return (-2)	0.033279 [1.15518]	17007772 [1.18624]
Stock Return (-3)	-0.016163 [-0.56007]	-15342125 [-0.33211]	Stock Return (-3)	-0.018603 [-0.65054]	41190044 [0.73288]	Stock Return (-3)	-0.036566 [-1.26906]	6154760 [0.42920]
Stock Return (-4)	0.037618 [1.30445]	45213219 [0.97942]	Stock Return (-4)	0.039750 [1.39057]	52989183 [0.94318]	Stock Return (-4)	0.002870 [0.09963]	2273617 [0.15858]
Stock Return (-5)	0.053119 [1.84047]*	-10436474 [-0.22589]	Stock Return (-5)	0.131231 [4.58638]***	-8219053 [-0.14615]	Stock Return (-5)	0.092536 [3.22425]***	20786099 [1.45526]
Volume (-1)	-1.18E-11 [-0.65465]	-0.003087 [-0.10692]	Volume (-1)	4.86E-12 [0.33071]	-0.003688 [-0.12775]	Volume (-1)	7.13E-11 [1.23042]	-0.001933 [-0.04150]
Volume (-2)	-5.55E-12 [-0.30761]	-0.003432 [-0.11890]	Volume (-2)	-1.21E-11 [-0.82148]	-0.003311 [-0.11471]	Volume (-2)	2.39E-12 [0.04130]	0.001933 [0.06697]
Volume (-3)	1.44E-12 [0.07968]	-0.003198 [-0.11081]	Volume (-3)	-1.36E-11 [-0.92948]	-0.002873 [-0.09954]	Volume (-3)	1.70E-11 [0.29292]	-0.002022 [-0.07007]
Volume (-4)	-7.65E-12 [-0.42423]	-0.002728 [-0.09451]	Volume (-4)	-1.01E-11 [-0.68779]	-0.003723 [-0.12897]	Volume (-4)	-8.48E-11 [-1.46276]	-0.001566 [-0.05429]
Volume (-5)	6.81E-13 [0.03775]	-0.002359 [-0.08173]	Volume (-5)	1.00E-11 [0.68060]	-0.003219 [-0.11147]	Volume (-5)	4.64E-11 [0.79996]	-0.001233 [-0.04271]
c	0.000267 [0.56193]	2184635 [2.87695]***	c	0.000482 [1.02026]	2800470 [3.01637]***	c	0.000399 [0.70668]	647274 [2.30088]**

Note: t-statistics is in parenthesis and *, **, *** are 10%, 5% and 1% level of significance respectively.

Table 4 presents the results of the VAR estimation, showing that there is no statistically significant relationship between past returns and the current return series, except for the fifth lag of the past return series. Additionally, we find no significant connection between lagged volume and the current return series across all the Nifty indices. These findings strongly suggest that trading volume does not have a Granger-causal effect on returns. Therefore, we accept the null hypothesis, indicating that there is no evidence of causation between trading volume and returns. Moreover, when examining the relationship between lagged volume and return with current volume under all indices, no meaningful correlation is observed. This analysis provides evidence that there is no causation occurring from trading volume to return or vice versa.

CONCLUSION

The analysis suggests that the data series for stock return and trading volume in the three NSE sectoral indices are non-normally distributed. However, both stock return and trading volume data series exhibit stationarity. While there are significant relationships between stock return and trading volume, no clear causation can be established between the two variables. The results indicate that trading volume does not Granger-cause returns. These findings provide valuable insights for further research and analysis in the context of the NSE sectoral indices and their interrelationships.

REFERENCES

Abukari, K. and Assogbavi, T. (2019). Dynamics of the price-volume relationship in an African context: the case of South Africa. *African J. Accounting, Auditing and Finance*, 6(4), 345- 364.

Akpansung, A. O. and Gidigbi, M. O. (2015). The Relationship between Trading Volumes and Returns in the Nigerian Stock Market. *International Research Journal of Finance and Economics*, 132, 150-163. Retrieved from http://www.internationalresearchjournaloffinanceandeconomics.com

Assan, A. and Thomas, S. (2013). Stock returns and trading volume: does the size matter? *Investment Management and Financial Innovations*, 10(3), 76-88. Retrieved from businessperspectives.org

Chen, S.S. (2012). Revisiting the empirical linkages between stock returns and trading volume. *Journal of Banking & Finance,* 36, 1781-1788.doi: 10.1016/j.jbankfin.2012.02.003

Clark, Peter K. (1973). A Subordinated Stochastic Process Model with Finite Variance for Speculative Prices. *Econometrica,* 41(1), 135-155. Retrieved from https://doi.org/10.2307/1913889

Copeland, T.E. (1976). A MODEL OF ASSET TRADING UNDER THE ASSUMPTION OF SEQUENTIAL INFORMATION. *The Journal of Finance*, 31(4), 1149-1168. Retrieved from http://doi.org/10.1111/j.1540-6261.1976.tb01966.x

Crouch, R. L. (1970). The Volume of Transactions and Price changes on the New York Stock Exchange. *Financial Analysts Journal*, 26(4), 104-109. Retrieved from http://www.jstor.org/stable/4470708

Epps, T.W. (1975). Security Price Changes and Transaction Volumes: Theory and Evidence. *American Economic Review*, 65(4), 586-597. Retrieved from http://links.jstor.org/sici?sici=0002-8282%2819750...0%3B2-9&origin=repec

Epps, T.W. (1977). Security Price Changes and Transaction Volumes: Some Additional Evidence. The *Journal of Financial and Quantitative Analysis*, 12(1), 141-146. Retrieved from https://doi.org/10.2307/2330293

Godfrey, M.D., Granger, C.W.J. and Morgenstern, O. (1964). The Random Walk Hypothesis of Stock Market Behaviour. *Kyklos*, 17(1), 1-30. Retrieved from https://doi.org/10.1111/j.1467-6435.1964.tb02458.x

Granger, C.W.J. and Morgenstern, O. (1963). Spectral Analysis of New York Stock Market Prices. *Kyklos*, 16(1), 1-27. Retrieved from https://doi.org/10.1111/j.1467-6435.1963.tb00270.x

Granger, C.W.J. and Newbold, P. (1974). Spurious Regressions in Econometrics. *Journal of Econometrics*, 2(2), 11-120. Retrieved from https://doi.org/10.1016/0304-4076 (74)90034-7

Gurgul, H., Majdosz, P., & Mestel, R. (2005). "Joint Dynamics of Prices and Trading Volume on the Polish Stock Market", *Managing Global Transitions*, 3(2), 139-156.

Hsu, H., Wu, T.C., Wu, G. S., & Chang, Y. H. (2016). Heterogeneity of Trading Information and the Price- Volume Relationship: Theory and Evidence. *Accounting and Finance Research*, 5(1), 232-246.doi:10.5430/afr.v5n l p232

Karpoff, J.M. (1987). The Relation between Price Changes and Trading Volume: A Survey. *The Journal of Financial and Quantitative Analysis,* 22(1), 109-126. Retrieved from http://links.jsto.org/sici=00221090%28198703%2922%3A1%3C109%3ATRBPCA%3E 2.0.CO%3B2-1

Kumar, B., Singh, P. and Pandey, A. (2009*). Dynamic Relationship between Price and Trading Volume: Evidence from Indian Stock Market* (Working Paper No. 2009-12-04). Indian Institute of Management Ahmedabad.

Nyakurukwa, K. (2021). Revisiting the dynamic stock return-volume relationship in South Africa: a non- parametric causality in quantiles approach. *Macroeconomics and Finance in Emerging Market Economies*, 1-17.DOI: 10.1080/17520843.2021. 1953865

Pathirawasam, C. (2011). The Relationship between Trading Volume and Stock Returns. *Journal of Competitiveness*, 3, 41-49.

Rogalski, R.J. (1978). The Dependence of Prices and Volume. *The Review of Economics and Statistics*, 60(2), 268-274. Retrieved from http://www.jstor.org/stable/1924980

Tripathy, N. (2011). The Relation between Price Changes and Trading Volume: A Study in Indian Stock Market. *Interdisciplinary Journal of Research in Business*, 1(7), 81-95.

Westerfield, R. (1977). The Distribution of Common Stock Price Changes: An Application of Transactions Time and Subordinated Stochastic Models. *The Journal of Financial and Quantitative Analysis*, 12(5), 743-765. Retrieved from https://doi.org/10.2307/2330254