Asian Economic and Financial Review
ISSN(e): 2222-6737/ISSN(p): 2305-2147
URL: www.aessweb.com

DO TRADING VOLUME AND BID-ASK SPREAD CONTAIN INFORMATION TO PREDICT STOCK RETURNS? INTRADAY EVIDENCE FROM INDIA

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ABSTRACT

Relying on the mixture of distribution hypothesis (MDH) and the sequential information arrival hypothesis (SIAH), this paper empirically examines the relationship between stock returns, trading volume and bid-ask spread for 50 Indian stocks using high frequency 5-minute data set for the period July 2, 2012 to December 31, 2012. This is the first study in India using bid-ask spread as yet another measure of information flow variable along with trading volume. Our empirical findings provide evidence of a positive contemporaneous relationship between absolute returns and trading volume as well as between absolute returns and bid-ask spread. The Granger causality test results show that the information content of trading volume and bid-ask spread are useful for predicting stock returns in Indian stock market. Overall results seem to indicate that information arrival to investors tends to follow a sequential rather than simultaneous process as suggested by SIAH. In summary, both trading volume and bid-ask spread serve as a good measure of information variable in India.

Keywords: Stock returns, Trading volume, Bid-ask spread, Market microstructure, MDH, SIAH.
JEL Classification: G12, G14.

Received: 12 October 2015/ **Revised:** 23 December 2015/ **Accepted:** 14 January 2016/ **Published:** 26 February 2016

Contribution/ Originality

This is the first study in India using bid-ask spread as yet another measure of information flow variable along with trading volume to investigate the relationship with stock returns.

1. INTRODUCTION

New information causes investors to adapt their expectations and this is the main source of price changes. A major issue concerns measurement of the information flow in the market. In this connection, market microstructure research has been focusing on the price-volume relationship since this empirical relation helps in understanding the competing theories of dissemination of information flow in the market. Many studies focused on to determine the true relationship between stock price changes and trading volume, both at a theoretical and at an empirical level. The majority opinion is that there exists a positive contemporaneous relationship between trading volume and absolute price changes in financial markets. On the theoretical level, the existence of such a positive relationship explained mainly by two theories; the Mixture of Distribution Hypothesis (MDH) and the Sequential Information Arrival

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DOI: 10.18488/journal.aefr/2016.6.3/102.3.135.150
ISSN(e): 2222-6737/ISSN(p): 2305-2147

Hypothesis (SIAH). Clark (1973) was the first to introduce MDH, and then it was extended by others such as, Epps and Epps (1976); Tauchen and Pitts (1983) and Harris (1986). They argue that absolute price changes and trading volume should be positively correlated because they jointly depend on a common underlying variable, which is the flow of new information in the market. This means that both stock price changes and trading volume simultaneously respond to the arrival of new information and they are contemporaneously correlated. In MDH, equilibrium price is immediately established and new information is received simultaneously by all the traders. The implication is that with simultaneous information arrival there is no information in the past volume that can be used in forecasting future absolute price changes that are not already contained in the past absolute price changes. Therefore, MDH supports only positive contemporaneous relationship but not the causal relationship between trading volume and absolute price changes.

On the other hand, the sequential information arrival hypothesis proposed by Copeland (1976) and discussed further in Jennings *et al.* (1981) suggests that the new information is disseminated sequentially rather than simultaneously to all the traders. This sequential dissemination of information initiates transactions at different price levels during the day, the number of which increases with the rate of information flow to the market. Consequently, both transaction volume and absolute price change increases as the rate of information flow into the market increases which implies the existence of a positive contemporaneous relationship between trading volume and absolute price changes. Smirlock and Starks (1988) have further extended the hypothesis that as the information comes sequentially rather than simultaneously to all the traders, past values of trading volume may have the ability to predict current absolute price changes or vice versa, which means that a causal relationship may exist between absolute price changes and trading volume. The researchers in this area have examined the volume-return relationship in a variety of contexts by employing a range of analytical methods. A good number of extensive and empirical studies are there that support the positive contemporaneous relationship between returns/ absolute returns and trading volume including Jain and Joh (1988) in US, Brailsford (1994) in Australia, Saatcioglu and Starks (1998) in Latin America, Ciner (2002) in US, McMillan and Speight (2002) in UK, Lee and Rui (2002) in US, UK and Japan, Fan *et al.* (2003) in China, Ciner (2003) in US and France, Chen *et al.* (2004) in China, Kamath and Wang (2006) in Asia, Medeiros and Doornik (2006) in Brazil, Kamath (2007) in Turkey, Khan and Rizwan (2008) in Pakistan, Deo *et al.* (2008) in Asia, Kamath (2008) in Chile, Thammasiri and Pattarathammas (2010) in Thiland, Mehrabanpoor *et al.* (2011) in Iran, Darwish (2012) in Palestine, Chuang *et al.* (2012) in Asia, Ansary and Atuea (2012) in Egypt, Attari *et al.* (2013) in Pakistan, AI-Jafari and TIiti (2013) in Jordan and He and Xie (2014) in China.

In the recent studies, the focus has moved to causal (dynamic) relationship between price changes and trading volume. That means that the recent studies have started to examine the causal relation by asking questions such as, “does trading volume help forecast stock returns” or “do investors trade more when stock prices go up?” The studies of Saatcioglu and Starks (1998) in Latin America, Ciner (2002) in Japan, Ciner (2003) in US and France, Pisedtasalasai and Gunasekarage (2005) in Singapore, Leon (2007) in West Africa, Medeiros and Doornik (2006) in Brazil, Ansary and Atuea (2012) in Egypt, He and Xie (2014) in China are some of those recent studies. Moreover, most of these studies assume that volume is a proxy for information arrival to the market. It is found that the information content of volume and sequential processing of information may lead to dynamic relationship between returns and trading volume.

Research on market microstructure also focused in explaining and exploring bid-ask spread and its relationship with price changes and volatility. Rahman *et al.* (2002) documented that intraday variations of bid-ask spread and intraday return volatility are expected to be positively correlated because an information arrival is supposed to stimulate an increase in volatility which in turn widens the bid-ask spread. In line with microstructure theory, a group of researchers like Wei (1991); Bollerslev and Melvin (1994); Galati (2001); McGroarty *et al.* (2009) and Gtifa and Liouane (2013) in foreign exchange markets, Ding and Chong (1997); Wang and Yau (2000); Frank and Garcia

(2011); Wang *et al.* (2014) in futures market and Rahman *et al.* (2002) and Hussain (2011) in equity markets find positive relationship between return volatility and spread. In addition, Rahman *et al.* (2002) and Hussain (2011) also reported lagged relationship in between them.

Several studies have been made, both empirically and theoretically, on the phenomenon of stock return and volume relationship. Even though the majority of those findings have confirmed the existence of positive contemporaneous relationship between trading volume and stock returns, the study of different stock markets has given mixed results about the causal relationship. Similarly in the context of India, there are a few studies that have focused on return-volume relationship. These includes: Tambi (2005); Deo *et al.* (2008); Mahajan and Singh (2009); Kumar and Singh (2009) and Tripathy (2011). Except Tripathy (2011) all these studies find positive contemporaneous relationship between returns/absolute returns and trading volume. However the causal relationship is still not clearly established. Deo *et al.* (2008) and Mahajan and Singh (2009) find strong evidence of return causing volume, Tambi (2005) find volume causing return, whereas, Tripathy (2011) find no causal linkages between returns and trading volume. Kumar and Singh (2009) find returns cause volume and that the volume also causes returns albeit to a lesser extent. Interestingly enough, none of the studies have focused on intraday relationship. Similarly, return-spread relationship is also not explored widely and in Indian context no study is done so far. Hence, there is a room left for further study. Therefore, in the present study, we made an attempt to empirically investigate the intraday contemporaneous as well as the causal relationship between stock returns, trading volume and bid-ask spread for 50 stocks of S&P CNX NIFTY index to bridge this research gap.

The paper organized as follows: Section 2 describes the data. In Section 3 we present the methodology of the study. Section 4 provides the empirical evidence. Finally, concluding remarks are made in Section 5.

2. DATA

Our primary data set consists of transaction price, trading volume, and the close bid and ask quote for each 5-minute intervals from 2 July 2012 to 31 December 2012 for all the stocks of S&P CNX Nifty index between trading timing 09:15 am to 15:30 pm IST. S&P CNX Nifty index is a well diversified 50 stock index accounting for 25 sectors of the Indian economy. Table 1 provides the list of companies and their industry type. All the data are obtained electronically from Bloomberg terminal. Stock returns, trading volume and bid-ask spread are relevant for this study. The percentage return of the stock is defined as $R_t = \log(P_t/P_{t-1}) * 100$, where R_t is the logarithmic percentage return at time t and P_t represents current 5 minutes interval trading price and P_{t-1} is the trading price for immediately preceding five minutes interval.

$$|R_t| = \text{Absolute value of stock return}$$

Following Wei (1991); Abhyankar *et al.* (1997) and Hussain (2011) the 5-minute proportional bid-ask spreads are calculated as $S = Ask - Bid/[(Ask + Bid)/2]$.

Next, the trading volume is the total number of shares traded at each five minute interval. Following Tian and Guo (2007) and AI-Jafari and TIiti (2013) the study uses logarithmic value of volume instead of raw volume to improve the normality properties of the series.

3. METHODOLOGY

3.1. Unit Root Test

To avoid spurious relation in time series model, the study adopts a test for a unit root to ensure that each variable is stationary. The unit root test is carried out by using Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) Test.

3.2. Contemporaneous Relationship

The contemporaneous relationships between trading volume and absolute returns and between bid-ask spread and absolute returns have been investigated using the following OLS equations respectively.

$$|R_t| = \alpha_1 + \beta_1 V_t + u_t \quad (1)$$

$$|R_t| = \alpha_2 + \beta_2 S_t + u_t \quad (2)$$

Where, R_t, V_t and S_t are stock returns, trading volume and bid-ask spread respectively at time t. The estimated parameter β_1 in equation (1) measures the contemporaneous relationship between absolute returns and trading volume. A statistically significant and positive value of β_1 would indicate a positive contemporaneous relationship between absolute returns and trading volume. Similarly, β_2 in equation (2) measures the contemporaneous relationship between absolute returns and bid-ask spread.

3.3. Causal Relationship

Our study covers not only the contemporaneous but also the causal relationship. Based on sequential information arrival hypothesis we test whether the information content of trading volume and bid-ask spread are useful for predicting stock returns. The pair wise causality between stock returns and trading volume has been checked by Granger causality test by the following unrestricted equations:

$$R_t = c_1 + \sum_{i=1}^{p} \alpha_i R_{t-i} + \sum_{j=1}^{p} \beta_j V_{t-j} + u_{1t} \quad (3)$$

$$V_t = c_2 + \sum_{i=1}^{p} \lambda_i R_{t-i} + \sum_{j=1}^{p} \delta_j V_{t-j} + u_{2t} \quad (4)$$

Where, R_t and V_t are stock returns and trading volume respectively. c_1 and c_2 are intercepts and $\alpha_i, \beta_j, \lambda_i$ and δ_j are parameters. If some of β_j values are statistically not zero, then volume is said to Granger cause returns. Similarly, if some of λ_i values are statistically not zero, stock returns is said to be Granger cause volume. If both β_j and λ_i are statistically significant then a feedback relationship is said to be existing. The optimum lag length is selected based on Schwarz Information Criterion (SC). Similarly, the causality between stock returns and bid-ask spread is checked by using the Granger causality test.

4. EMPIRICAL FINDINGS

4.1. Unit Root Test

The ADF and PP test statistics are reported in Table 2, 3 and 4 respectively for stock returns, trading volume and bid-ask spread. The results show that the null hypothesis that stock returns, trading volume and bid-ask spread are non-stationary (i.e. has a unit root) is rejected at 1% of level for all the series. This confirms that all the series are stationary for every one of the stocks and are therefore, suitable for further statistical analysis.

4.2. Cross-Correlation Analysis

As a first step to investigate the relationship between absolute stock returns, trading volume and bid-ask spread, we calculate the cross-correlation coefficients for all the stocks. The cross correlation coefficients are reported in Table 5. A positive correlation is found between absolute returns and trading volume, and absolute returns and lagged trading volume for all the stocks. Similarly, a positive correlation is also found between absolute returns and spread, and absolute returns and lagged spread for all the stocks except COAL, LT, TPWR and TTMT. The lagged relation gave an indication for causal relationship.

4.3. Contemporaneous Relationship between Returns and Volume

The results of the OLS regression using equation (1) to explain the contemporaneous relationship between absolute returns and volume are reported in Table 6. The parameter β_1, which measures the contemporaneous relationship is statistically significant and positive for all the 50 stocks, suggesting a positive contemporaneous relationship between absolute returns and volume.

Finally, the regression results also show that contemporaneous volume explains a relatively small portion of stock returns as evidenced by low R-square values. This weak positive contemporaneous relationship between trading volume and absolute stock returns indicate that, the Indian market is informationally inefficient. The information flow in market may well be disseminated sequentially instead of instantaneously as required in MDH.

4.4. Contemporaneous Relationship between Returns and Spread

The results of the OLS regression using equation (2) to explain the contemporaneous relationship between absolute returns and spread are reported in Table 7. The parameter β_2 is statistically significant and positive for all the stocks except COAL, HNDL, LT, TPWR, and TTMT, suggesting a positive contemporaneous relationship between absolute returns and spread. Likewise volume, in majority of the cases the spread also explains relatively a very small portion of stock returns and gives an indication of sequential information flow in the market.

4.5. Causal Relationship between Returns and Volume

The Granger causality test results between stock returns and trading volume are presented in Table 8. Causality test are highly sensitive to the lag order. The lag lengths for the causality test are determined on the basis of Schwartz information criterion (SC) and the selected lag period for each stock are reported in the same table.

The null hypothesis that lagged volume does not granger cause returns is rejected in the case of 44 stocks out of total 50 except BHARATI, COAL, HMCL, HUVR, KMB and NTPC. Similarly, the null hypothesis that past returns does not granger cause volume is rejected only for 22 stocks. Among these 22 stocks the study found a feedback relationship in 19 stocks. Only in case of BHARATI, HMCL and NTPC, no causality was traced in either direction.

The findings of bidirectional causality in some cases can be explained theoretically: volume, which implies information, leads to price changes, and large positive price changes that implies higher capital gain, encourage transactions by traders leading to increase in volume.

The Granger causality result shows that volume cause returns and that the returns also cause volume albeit to a lesser extent. This finding implies that in the presence of current and past returns, trading volume adds some significant predictive power for future returns. It is found that the information content of volume and sequential processing of information may lead to dynamic relationship between returns and trading volume.

4.6. Causal Relationship between Returns and Spread

The Granger causality test results between stock returns and spread are reported in Table 9. The test result shows that the null hypothesis that lagged spread does not granger cause return is rejected in case of 40 stocks out of 50. Similarly, the null hypothesis that lagged return does not granger cause spread is rejected only in case of 11 stocks. For ACEM, CAIR, DRRD, INFO and UTCEM, no causality was traced in either direction. The Granger causality test result shows a strong evidence of spread causing return rather than return causing spread. This clearly indicates that in the presence of current and past returns, spread adds some significant predictive power for future returns. In general, information flows from spread to return rather than return to spread.

5. SUMMARY AND CONCLUSION

This study investigated the contemporaneous and causal relationship between stock returns, trading volume and bid-ask spread using 5-minutes interval high frequency data from 50 stocks of S&P CNX NIFTY index over the period of 2 July 2012 to 31 December 2012.

The present study provides evidence of a positive contemporaneous relationship between absolute returns and trading volume for all the stocks in the sample, suggesting that increasing trading volume is associated with higher price changes and vice versa. The present study also provides evidence of a positive contemporaneous relationship between absolute returns and bid-ask spread for majority of the cases in the sample, suggesting that widening spread is associated with higher price changes and vice versa. However, in both cases the explanatory power of this contemporaneous relationship is weak. This indicates that, the Indian market is informationally inefficient and the information flow in market may well be disseminated sequentially instead of instantaneously as required in MDH. Our study not only focused on the contemporaneous relationship but also investigated the causal relationships. We investigated the information content of volume and spread for future returns by means of Granger causality test and found for majority of the cases, volume and spread caused returns. The overall findings suggest that information arrival follows a sequential rather than a simultaneous process which contradicts the mixture of distributions hypothesis (MDH) and supports the sequential information arrival hypothesis (SIAH). The past information of trading volume and bid-ask spread are useful to improve the prediction of future returns. The study suggests that regulators and market participants can use past information for monitoring the stock price movement in the market. This study could help the marginal and uninformed traders who cannot afford the cost of information acquisition; they can keep a close eye on the movements of both volume and spread for their investment decisions. Especially, this study may help the intraday investors for making their trading strategy.

Funding: This study received no specific financial support.
Competing Interests: The authors declare that they have no competing interests.
Contributors/Acknowledgement: All authors contributed equally to the conception and design of the study.

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Table-1. List of Constituents of S&P CNX NIFTY Index

Sl.No.	Company code	Company name	Industry
1	ACC	ACC Ltd.	Cement
2	ACEM	Ambuja Cements Ltd.	Cement
3	APNT	Asian Paints Ltd.	Chemicals
4	AXSB	Axis Bank Ltd.	Banks
5	BHARATI	Bharti Airtel Ltd.	Telecommunication services
6	BHEL	Bharat Heavy Electricals Ltd.	Electrical equipment
7	BJAUT	Bajaj Auto Ltd.	Automobile
8	BOB	Bank of Baroda Ltd.	Banks
9	BPCL	Bharat Petroleum Corporation Ltd.	Oil and Gas
10	CAIR	Carirn India Ltd.	Oil and Gas
11	CIPLA	Cipla Ltd.	Pharmaceuticals
12	COAL	Coal India Ltd.	Metals and Mining
13	DLFU	DLF Ltd.	Real Estate
14	DRRD	Dr. Reddy's Laboratories Ltd.	Pharmaceuticals
15	GAIL	GAIL (India) Ltd.	Energy, Petrochemicals
16	GRASIM	Grasim Industries Ltd.	Building materials
17	HCLT	HCL Technologies Ltd.	IT service; IT consulting
18	HDFC	Housing Development Finance Corporation Ltd.	Financial services
19	HDFCB	HDFC Bank Ltd.	Banks
20	HMCL	Hero Moto Corp Ltd.	Automobile
21	HNDL	Hindalco Industries Ltd.	Metals
22	HUVR	Hindustan Unilever Ltd.	Consumer goods
23	ICICIBC	ICICI Bank Ltd.	Banks
24	IDFC	IDFC Ltd.	Financial services
25	INFO	Infosys Ltd.	IT services, IT consulting
26	ITC	ITC Ltd.	FMCG
27	JPA	Jaiprakash Associates Ltd.	Infrastructure
28	JSP	Jindal Steel & Power Ltd.	Steel, Energy
29	KMB	Kotak Mahindra Bank Ltd.	Banks
30	LPC	Lupin Ltd.	Pharmaceuticals
31	LT	Larsen & Toubro Ltd.	Engineering and construction
32	MM	Mahindra & Mahindra Ltd.	Automotive
33	MSIL	Maruti Suzuki India Ltd.	Automotive
34	NTPC	NTPC Limited	Electric utility
35	ONGC	Oil & Natural Gas Corporation Ltd.	Oil and Gas
36	PNB	Punjab National Bank	Banks
37	PWGR	PowerGrid Corporation of India Ltd.	Electric utility
38	RBXY	Ranbaxy Laboratories Ltd.	Pharmaceuticals
39	RELI	Reliance Infrastructure Ltd	Energy
40	RIL	Reliance Industries Ltd.	Multi-industry
41	SBIN	State Bank of India Ltd.	Banks
42	SESA	Sesa Sterlite Limited	Mining
43	SIEM	Siemens Ltd.	Multi-industry
44	SUNP	Sun Pharmaceutical Industries Ltd.	Pharmaceuticals
45	TATA	Tata Steel Ltd.	Steel
46	TCS	Tata Consultancy Services Ltd.	IT services, IT consulting
47	TPWR	Tata Power Co. Ltd.	Electric utility
48	TTMT	Tata Motors Ltd.	Automotive
49	UTCEM	UltraTech Cement Ltd.	Cement
50	WPRO	Wipro Ltd.	IT services, IT consulting

Source: National Stock Exchange of India (NSE)

Table-2. Unit Root Test for Stock Returns

	Intercept		Intercept with Trend	
Stock	**ADF**	**PP**	**ADF**	**PP**
ITC	-34.45*	-83.11*	-34.48*	-82.98*
JPA	-34.68*	-84.47*	-34.79*	-84.11*
JSP	-32.25*	-83.89*	-32.40*	-83.29*
KMB	-37.24*	-67.51*	-37.35*	-67.32*
LPC	-35.21*	-76.89*	-35.21*	-76.88*
LT	-34.36*	-92.32*	-34.36*	-92.31*
MM	-32.50*	-86.04*	-32.60*	-85.64*
MSIL	-34.09*	-89.97*	-34.09*	-89.96*
NTPC	-34.36*	-86.85*	-34.48*	-86.44*
ONGC	-33.01*	-90.81*	-33.36*	-89.39*
PNB	-36.34*	-65.68*	-36.36*	-65.56*
PWGR	-32.07*	-83.66*	-32.18*	-83.22*
RBXY	-36.05*	-90.23*	-36.05*	-90.22*
RELI	-32.95*	-90.52*	-32.95*	-90.51*
RIL	-33.93*	-80.90*	-34.03*	-80.51*
SBIN	-35.01*	-66.91*	-35.03*	-66.88*
SESA	-36.06*	-69.44*	-36.13*	-69.29*
SIEM	-33.50*	-90.60*	-33.75*	-89.56*
SUNP	-33.31*	-89.34*	-33.39*	-89.04*
TATA	-34.81*	-82.40*	-34.82*	-82.36*
TCS	-36.01*	-90.64*	-36.02*	-90.62*
TPWR	-36.61*	-51.01*	-36.61*	-51.01*
TTMT	-37.30*	-86.17*	-37.31*	-86.15*
UTCEM	-36.10*	-91.18*	-36.14*	-91.01*
WPRO	-35.76*	-91.86*	-35.78*	-91.79*

Note: *Significant at 1% level

Table-3. Unit Root Test for Trading Volume

	Intercept		Intercept with Trend	
Stock	**ADF**	**PP**	**ADF**	**PP**
ACC	-20.05*	-65.84*	-20.16*	-65.58*
ACEM	-18.59*	-66.17*	-18.64*	-66.21*
APNT	-20.08*	-68.73*	-20.25*	-68.46*
AXSB	-20.51*	-56.95*	-20.92*	-56.82*
BHARATI	-18.37*	-60.69*	-18.37*	-60.69*
BHEL	-17.60*	-51.81*	-17.60*	-51.82*
BJAUT	-19.31*	-73.14*	-19.72*	-73.39*
BOB	-19.00*	-64.17*	-19.13*	-64.27*
BPCL	-20.44*	-68.48*	-20.61*	-68.45*
CAIR	-18.28*	-51.50*	-18.28*	-51.49*
CIPLA	-18.50*	-64.87*	-18.60*	-64.97*
COAL	-18.97*	-66.11*	-18.97*	-66.11*
DLFU	-20.79*	-62.41*	-21.16*	-62.27*
DRRD	-19.44*	-69.81*	-19.45*	-69.81*
GAIL	-21.22*	-68.53*	-21.23*	-68.51*
GRASIM	-22.47*	-81.19*	-22.47*	-81.19*
HCLT	-18.37*	-67.32*	-18.37*	-67.32*
HDFC	-18.79*	-56.32*	-18.87*	-56.37*
HDFCB	-21.82*	-58.12*	-21.83*	-58.11*
HMCL	-20.42*	-59.06*	-20.47*	-58.90*
HNDL	-20.18*	-54.71*	-20.20*	-54.71*
HUVR	-18.84*	-60.72*	-18.87*	-60.72*
ICICIBC	-20.28*	-57.39*	-21.10*	-56.96*
IDFC	-20.80*	-63.31*	-20.90*	-63.05*
INFO	-18.39*	-51.60*	-18.39*	-51.60*
ITC	-18.75*	-53.48*	-18.79*	-53.48*

JPA	-21.54*	-59.63*	-21.72*	-59.34*
JSP	-18.58*	-55.19*	-18.61*	-55.22*
KMB	-30.78*	-112.68*	-31.79*	-107.70*
LPC	-18.26*	-74.51*	-18.32*	-74.57*
LT	-22.17*	-56.81*	-22.32*	-56.53*
MM	-18.61*	-58.26*	-18.67*	-58.29*
MSIL	-17.82*	-61.35*	-18.36*	-62.08*
NTPC	-19.74*	-71.78*	-19.90*	-71.75*
ONGC	-19.98*	-58.84*	-20.03*	-58.84*
PNB	-18.53*	-55.22*	-18.53*	-55.22*
PWGR	-20.12*	-66.81*	-20.20*	-66.82*
RBXY	-20.51*	-59.67*	-20.66*	-59.71*
RELI	-24.15*	-57.50*	-24.43*	-57.01*
RIL	-20.23*	-50.63*	-20.23*	-50.63*
SBIN	-22.96*	-57.20*	-23.29*	-56.65*
SESA	-20.25*	-56.91*	-20.92*	-56.43*
SIEM	-20.98*	-74.90*	-20.99*	-74.89*
SUNP	-20.14*	-64.92*	-20.14*	-64.91*
TATA	-21.59*	-51.98*	-21.64*	-51.94*
TCS	-17.75*	-49.84*	-17.88*	-50.02*
TPWR	-17.84*	-58.12*	-17.87*	-58.12*
TTMT	-20.20*	-51.40*	-20.23*	-51.40*
UTCEM	-19.81*	-74.65*	-21.05*	-74.10*
WPRO	-19.18*	-66.96*	-19.26*	-66.92*

Note: *Significant at 1% level

Table-4. Unit Root Test for Bid-Ask Spread

	Intercept		Intercept with Trend	
Stock	**ADF**	**PP**	**ADF**	**PP**
ACC	-31.75*	-109.50*	-31.81*	-109.25*
ACEM	-33.12*	-107.95*	-33.32*	-106.76*
APNT	-30.42*	-110.67*	-30.65*	-109.74*
AXSB	-42.40*	-95.65*	-42.40*	-95.65*
BHARATI	-40.36*	-95.70*	-40.35*	-95.70*
BHEL	-35.85*	-100.08*	-35.87*	-100.01*
BJAUT	-31.51*	-112.69*	-31.57*	-112.44*
BOB	-32.87*	-109.82*	-32.87*	-109.81*
BPCL	-32.00*	-112.37*	-32.00*	-112.35*
CAIR	-33.51*	-102.08*	-33.66*	-101.23*
CIPLA	-42.06*	-94.03*	-42.12*	-94.06*
COAL	-35.58*	-101.85*	-35.69*	-101.47*
DLFU	-37.98*	-100.24*	-38.54*	-98.45*
DRRD	-35.09*	-106.00*	-35.09*	-105.99*
GAIL	-33.32*	-102.73*	-33.39*	-102.44*
GRASIM	-38.83*	-95.71*	-38.84*	-95.57*
HCLT	-40.45*	-95.42*	-40.45*	-95.41*
HDFC	-41.25*	-95.13*	-41.25*	-95.13*
HDFCB	-33.08*	-102.52*	-33.09*	-102.19*
HMCL	-36.56*	-103.04*	-36.59*	-102.94*
HNDL	-37.88*	-97.78*	-37.87*	-97.77*
HUVR	-36.04*	-103.56*	-36.17*	-103.10*
ICICIBC	-34.60*	-102.57*	-34.73*	-102.09*
IDFC	-36.14*	-104.53*	-38.08*	-97.22*
INFO	-33.54*	-103.24*	-33.55*	-103.18*
ITC	-35.02*	-100.87*	-35.50*	-98.75*
JPA	-33.02*	-127.71*	-37.69*	-106.73*
JSP	-35.63*	-103.95*	-35.80*	-103.08*
KMB	-20.65*	-71.01*	-21.21*	-70.53*
LPC	-30.51*	-115.38*	-30.55*	-115.19*
LT	-41.45*	-95.04*	-41.51*	-95.09*
MM	-32.80*	-110.84*	-32.93*	-110.22*
MSIL	-32.27*	-108.76*	-32.31*	-108.63*
NTPC	-36.09*	-101.49*	-36.20*	-100.81*

ONGC	-33.71*	-99.98*	-33.90*	-98.99*
PNB	-35.96*	-101.45*	-36.02*	-100.95*
PWGR	-35.90*	-97.90*	-36.21*	-96.65*
RBXY	-32.40*	-112.16*	-32.49*	-111.37*
RELI	-42.39*	-95.42*	-42.40*	-95.42*
RIL	-36.03*	-102.71*	-36.53*	-100.52*
SBIN	-42.48*	-95.79*	-42.48*	-95.79*
SESA	-42.54*	-95.72*	-42.66*	-95.79*
SIEM	-30.00*	-111.83*	-30.20*	-110.56*
SUNP	-32.77*	-110.12*	-32.82*	-109.88*
TATA	-39.22*	-94.69*	-39.32*	-94.47*
TCS	-35.03*	-102.65*	-35.04*	-102.59*
TPWR	-41.20*	-94.50*	-41.27*	-94.49*
TTMT	-43.06*	-95.64*	-43.07*	-95.65*
UTCEM	-27.21*	-115.49*	-27.57*	-114.27*
WPRO	-30.55*	-113.04*	-30.61*	-112.80*

Note: *Significant at 1% level

Table-5. Cross Correlation Coefficients

Stock	Return↔Volume	Return↔Spread	Return↔Lag Volume	Return↔Lag Spread
ACC	0.343	0.130	0.221	0.117
ACEM	0.321	0.112	0.206	0.114
APNT	0.365	0.123	0.243	0.099
AXSB	0.279	0.539	0.169	0.544
BHARATI	0.316	0.373	0.207	0.390
BHEL	0.435	0.044	0.259	0.097
BJAUT	0.323	0.113	0.216	0.160
BOB	0.340	0.087	0.234	0.112
BPCL	0.320	0.158	0.198	0.126
CAIR	0.331	0.098	0.222	0.117
CIPLA	0.243	0.515	0.174	0.561
COAL	0.322	-0.022	0.226	-0.004
DLFU	0.460	0.020	0.211	0.091
DRRD	0.273	0.129	0.201	0.107
GAIL	0.303	0.154	0.195	0.173
GRASIM	0.240	0.496	0.161	0.480
HCLT	0.237	0.490	0.166	0.497
HDFC	0.360	0.129	0.254	0.107
HDFCB	0.281	0.121	0.215	0.172
HMCL	0.365	0.060	0.246	0.166
HNDL	0.392	0.010	0.218	0.051
HUVR	0.261	0.443	0.189	0.453
ICICIBC	0.346	0.040	0.212	0.091
IDFC	0.360	0.071	0.178	0.115
INFO	0.324	0.064	0.224	0.071
ITC	0.354	0.078	0.248	0.115
JPA	0.430	0.040	0.189	0.064
JSP	0.428	0.093	0.274	0.116
KMB	0.262	0.117	0.164	0.129
LPC	0.331	0.094	0.217	0.110
LT	0.383	-0.212	0.213	-0.170
MM	0.315	0.115	0.215	0.148
MSIL	0.351	0.071	0.235	0.132
NTPC	0.289	0.171	0.208	0.114
ONGC	0.324	0.110	0.222	0.121
PNB	0.386	0.033	0.248	0.085
PWGR	0.282	0.127	0.196	0.128
RBXY	0.436	0.027	0.251	0.078
RELI	0.451	0.058	0.206	0.072
RIL	0.372	0.048	0.243	0.106
SBIN	0.281	0.595	0.144	0.593

SESA	0.250	0.591	0.135	0.589
SIEM	0.295	0.167	0.196	0.149
SUNP	0.308	0.111	0.207	0.141
TATA	0.423	0.062	0.239	0.118
TCS	0.356	0.163	0.259	0.188
TPWR	0.325	-0.238	0.229	-0.214
TTMT	0.380	-0.377	0.221	-0.351
UTCEM	0.240	0.187	0.167	0.152
WPRO	0.322	0.110	0.240	0.138

Source: Raw data from Bloomberg Terminal and correlation coeficients calculated by the Authors.

Table-6. Contemporaneous Relationship between Returns and Volume

$\lvert R_t \rvert = \alpha_1 + \beta_1 V_t + u_t$					
Stock	**α_1**	**t-statistics**	**β_1**	**t-statistics**	**R-squared**
ACC	-0.098	-23.6	0.043*	34.9	0.118
ACEM	-0.141	-23.7	0.045*	32.5	0.103
APNT	-0.062	-22.1	0.039*	37.5	0.133
AXSB	-0.292	-23.2	0.081*	27.8	0.078
BHARATI	-0.257	-26.0	0.067*	31.9	0.100
BHEL	-0.304	-38.6	0.080*	46.3	0.190
BJAUT	-0.113	-23.3	0.045*	32.7	0.104
BOB	-0.149	-25.1	0.055*	34.6	0.115
BPCL	-0.127	-22.8	0.046*	32.3	0.102
CAIR	-0.172	-27.3	0.048*	33.6	0.110
CIPLA	-0.163	-18.6	0.051*	24.0	0.059
COAL	-0.128	-24.3	0.041*	32.5	0.104
DLFU	0.068	83.6	0.076*	9.7	0.010
DRRD	-0.065	-16.5	0.031*	27.2	0.075
GAIL	-0.117	-21.5	0.043*	30.5	0.092
GRASIM	-0.039	-11.1	0.031*	23.7	0.058
HCLT	-0.142	-17.6	0.048*	23.4	0.056
HDFC	-0.192	-30.5	0.052*	36.9	0.129
HDFCB	-0.103	-20.4	0.032*	28.1	0.079
HMCL	-0.129	-27.7	0.050*	37.5	0.133
HNDL	-0.304	-33.6	0.077*	40.7	0.153
HUVR	-0.191	-21.3	0.054*	25.9	0.068
ICICIBC	-0.251	-29.4	0.067*	35.3	0.119
IDFC	-0.303	-30.2	0.078*	36.9	0.129
INFO	-0.205	-27.3	0.062*	32.8	0.105
ITC	-0.167	-29.1	0.044*	36.3	0.126
JPA	-0.536	-39.7	0.118*	45.6	0.185
JSP	-0.284	-36.0	0.083*	45.4	0.183
KMB	-0.070	-15.0	0.033*	26.0	0.069
LPC	-0.123	-24.0	0.045*	33.6	0.110
LT	-0.246	-32.9	0.072*	39.7	0.147
MM	-0.137	-23.6	0.046*	31.7	0.099
MSIL	-0.182	-28.3	0.060*	35.9	0.123
NTPC	-0.092	-19.7	0.031*	28.9	0.083
ONGC	-0.163	-25.5	0.047*	32.8	0.105
PNB	-0.166	-29.6	0.060*	40.1	0.149
PWGR	-0.099	-19.6	0.032*	28.1	0.079
RBXY	-0.166	-35.2	0.057*	46.4	0.190
RELI	-0.342	-40.0	0.097*	48.4	0.204
RIL	-0.198	-31.4	0.054*	38.3	0.138
SBIN	-0.353	-24.3	0.093*	28.0	0.079
SESA	-0.314	-20.3	0.090*	24.7	0.063
SIEM	-0.045	-14.1	0.030*	29.6	0.087
SUNP	-0.118	-22.4	0.042*	30.9	0.095
TATA	-0.321	-38.2	0.082*	44.7	0.179
TCS	-0.158	-28.6	0.050*	36.5	0.127
TPWR	-0.200	-25.5	0.059*	32.9	0.106
TTMT	-0.473	-34.6	0.108*	39.3	0.144
UTCEM	-0.032	-10.0	0.026*	23.6	0.057
WPRO	-0.148	-24.8	0.048*	32.6	0.104

Note: *Significant at 1% level

Table-7. Contemporaneous Relationship between Returns and Spread

$\lvert R_t \rvert = \alpha_2 + \beta_2 S_t + u_t$					
Stock	**α_2**	**t-statistics**	**β_2**	**t-statistics**	**R-squared**
ACC	0.037	41.9	20.7*	12.6	0.017
ACEM	0.041	35.7	21.1*	10.8	0.013
APNT	0.033	36.4	17.0*	11.8	0.015
AXSB	0.047	50.1	44.2*	61.3	0.291
BHARATI	0.039	39.6	56.5*	38.5	0.139
BHEL	0.054	36.9	15.6*	4.3	0.002
BJAUT	0.037	42.3	21.4*	10.9	0.013
BOB	0.047	41.2	17.8*	8.4	0.008
BPCL	0.037	32.7	26.9*	15.3	0.025
CAIR	0.032	31.3	26.4*	9.4	0.010
CIPLA	0.027	29.0	50.1*	57.5	0.265
COAL	0.044	53.1	-3.8**	-2.1	0.0004
DLFU	0.066	38.9	8.0***	1.9	0.0004
DRRD	0.036	52.3	14.5*	12.4	0.017
GAIL	0.035	32.5	25.8*	15.0	0.024
GRASIM	0.022	29.7	31.3*	54.7	0.247
HCLT	0.030	34.9	44.4*	53.8	0.240
HDFC	0.037	60.9	12.1*	12.5	0.017
HDFCB	0.032	47.0	23.9*	11.7	0.015
HMCL	0.041	51.5	8.8*	5.8	0.004
HNDL	0.061	31.7	3.1	0.9	0.0001
HUVR	0.013	13.9	108.5*	47.3	0.196
ICICIBC	0.046	45.5	16.4*	3.8	0.002
IDFC	0.055	30.6	24.9*	6.8	0.005
INFO	0.036	33.9	20.8*	6.1	0.004
ITC	0.035	37.7	21.2*	7.5	0.006
JPA	0.069	24.5	15.3*	3.8	0.002
JSP	0.061	38.8	30.5*	8.9	0.009
KMB	0.041	41.9	18.2*	11.3	0.014
LPC	0.041	41.7	18.0*	9.1	0.009
LT	0.056	80.2	-32.4*	-20.7	0.045
MM	0.039	45.9	25.9*	11.1	0.013
MSIL	0.041	35.4	19.7*	6.8	0.005
NTPC	0.027	25.7	29.6*	16.6	0.029
ONGC	0.037	36.3	24.1*	10.6	0.012
PNB	0.054	45.1	7.3*	3.1	0.001
PWGR	0.028	21.9	24.8*	12.3	0.016
RBXY	0.049	46.8	5.6*	2.6	0.001
RELI	0.068	76.5	6.3*	5.5	0.003
RIL	0.041	51.5	13.3*	4.6	0.002
SBIN	0.042	43.6	57.9*	70.8	0.354
SESA	0.035	26.7	60.0*	70.2	0.350
SIEM	0.033	30.2	22.2*	16.2	0.028
SUNP	0.036	38.0	21.3*	10.6	0.012
TATA	0.048	42.2	23.2*	6.0	0.004
TCS	0.034	43.1	39.8*	15.8	0.027
TPWR	0.076	67.2	-28.3*	-23.4	0.057
TTMT	0.075	76.3	-42.0*	-38.9	0.142
UTCEM	0.029	29.9	23.5*	18.2	0.035
WPRO	0.036	32.8	25.9*	10.6	0.012

Note: *Significant at 1% level, **Significant at 5% level and ***Significant at 10% level

Table-8. Granger Causality Test between Returns and Volume

Stock	Volume does not Granger cause Return			Return does not Granger cause Volume			Lag Length
	F-Stat	Prob.	Null Hypothesis	F-Stat	Prob.	Null Hypothesis	
ACC	2.1***	0.06	Rejected	1.9***	0.09	Rejected	5
ACEM	5.2*	0.00	Rejected	4.6*	0.00	Rejected	4
APNT	2.6**	0.02	Rejected	2.3**	0.04	Rejected	5
AXSB	4.4*	0.00	Rejected	0.9	0.46	Not Rejected	4
BHARATI	1.4	0.22	Not Rejected	1.3	0.26	Not Rejected	6
BHEL	2.9**	0.03	Rejected	0.5	0.75	Not Rejected	4
BJAUT	3.4*	0.01	Rejected	2.2***	0.07	Rejected	4
BOB	4.6*	0.00	Rejected	3.3*	0.01	Rejected	4
BPCL	3.2*	0.01	Rejected	1.9***	0.10	Rejected	4
CAIR	5.9*	0.00	Rejected	1.8	0.13	Not Rejected	4
CIPLA	10.5*	0.00	Rejected	5.7**	0.02	Rejected	4
COAL	0.9	0.46	Not Rejected	1.9***	0.10	Rejected	5
DLFU	3*	0.01	Rejected	1	0.43	Not Rejected	5
DRRD	2.4**	0.05	Rejected	2***	0.09	Rejected	4
GAIL	4.5*	0.00	Rejected	0.8	0.55	Not Rejected	4
GRASIM	6.3*	0.00	Rejected	1.9***	0.08	Rejected	5
HCLT	5.9*	0.00	Rejected	1.5	0.17	Not Rejected	6
HDFC	3.2**	0.02	Rejected	2.2***	0.09	Rejected	3
HDFCB	2.6**	0.05	Rejected	4.4*	0.00	Rejected	3
HMCL	0.1	0.99	Not Rejected	1.1	0.35	Not Rejected	4
HNDL	5.6*	0.00	Rejected	0.5	0.68	Not Rejected	3
HUVR	0.5	0.76	Not Rejected	5.1*	0.00	Rejected	5
ICICIBC	6.8*	0.00	Rejected	0.4	0.84	Not Rejected	5
IDFC	2.9*	0.01	Rejected	3.1*	0.01	Rejected	5
INFO	2**	0.09	Rejected	0.4	0.80	Not Rejected	4
ITC	3.5*	0.01	Rejected	1	0.41	Not Rejected	4
JPA	3.3*	0.01	Rejected	1.4	0.23	Not Rejected	5
JSP	2.9*	0.01	Rejected	2.9*	0.01	Rejected	5
KMB	1.1	0.35	Not Rejected	2.9**	0.02	Rejected	4
LPC	3.1*	0.01	Rejected	0.4	0.88	Not Rejected	5
LT	8.8*	0.00	Rejected	2.1***	0.10	Rejected	3
MM	14.2*	0.00	Rejected	0.9	0.48	Not Rejected	4
MSIL	2.4**	0.03	Rejected	3.8*	0.00	Rejected	5
NTPC	1.5	0.18	Not Rejected	0.6	0.72	Not Rejected	5
ONGC	2.3**	0.05	Rejected	1.6	0.16	Not Rejected	4
PNB	3**	0.02	Rejected	1.9***	0.10	Rejected	4
PWGR	1.9***	0.10	Rejected	0.8	0.50	Not Rejected	4
RBXY	3.4*	0.01	Rejected	0.4	0.84	Not Rejected	4
RELI	3.8*	0.01	Rejected	0.5	0.67	Not Rejected	3
RIL	2.1***	0.08	Rejected	0.6	0.64	Not Rejected	4
SBIN	2.5**	0.03	Rejected	0.8	0.53	Not Rejected	5
SESA	7.8*	0.00	Rejected	0.8	0.54	Not Rejected	4
SIEM	2.7**	0.03	Rejected	2.6**	0.03	Rejected	4
SUNP	5.1*	0.00	Rejected	1.6	0.18	Not Rejected	4
TATA	7.1*	0.00	Rejected	0.4	0.73	Not Rejected	3
TCS	3.9*	0.00	Rejected	1	0.40	Not Rejected	4
TPWR	4.7*	0.00	Rejected	1	0.43	Not Rejected	5
TTMT	10.2*	0.00	Rejected	1.4	0.24	Not Rejected	4
UTCEM	2.2***	0.06	Rejected	2.3**	0.04	Rejected	5
WPRO	1.8***	0.10	Rejected	3.1*	0.01	Rejected	5

Note: *Significant at 1% level, **Significant at 5% level and ***Significant at 10% level

Table-9. Granger Causality Test between Returns and Spread

Stock	Spread does not Granger cause Return			Return does not Granger cause Spread			Lag Length
	F-Stat	Prob.	Null Hypothesis	F-Stat	Prob.	Null Hypothesis	
ACC	2.8**	0.02	Rejected	0.5	0.81	Not Rejected	5
ACEM	0.6	0.73	Not Rejected	1.0	0.41	Not Rejected	5
APNT	6.8*	0.00	Rejected	1.6	0.18	Not Rejected	4
AXSB	2065*	0.00	Rejected	0.2	0.64	Not Rejected	1
BHARATI	836.6*	0.00	Rejected	1.3	0.25	Not Rejected	1
BHEL	10.3*	0.00	Rejected	3.1**	0.02	Rejected	3
BJAUT	3.4*	0.01	Rejected	0.8	0.50	Not Rejected	4
BOB	2***	0.06	Rejected	1.6	0.15	Not Rejected	6
BPCL	0.5	0.76	Not Rejected	3.1*	0.01	Rejected	5
CAIR	0.7	0.61	Not Rejected	1.0	0.39	Not Rejected	4
CIPLA	2356*	0.00	Rejected	1.9	0.17	Not Rejected	1
COAL	31.9*	0.00	Rejected	1.7	0.18	Not Rejected	2
DLFU	17*	0.00	Rejected	0	0.97	Not Rejected	1
DRRD	1.7	0.16	Not Rejected	0.7	0.54	Not Rejected	3
GAIL	5.8*	0.00	Rejected	1.3	0.27	Not Rejected	3
GRASIM	624.5*	0.00	Rejected	0.6	0.53	Not Rejected	2
HCLT	715.1*	0.00	Rejected	0.2	0.80	Not Rejected	2
HDFC	13.4*	0.00	Rejected	69.9*	0.00	Rejected	7
HDFCB	0.5	0.71	Not Rejected	2.3***	0.08	Rejected	3
HMCL	9.5*	0.00	Rejected	1.4	0.24	Not Rejected	3
HNDL	6.3*	0.01	Rejected	0	0.95	Not Rejected	1
HUVR	263.1*	0.00	Rejected	4.9*	0.00	Rejected	3
ICICIBC	2.8**	0.04	Rejected	1.8	0.15	Not Rejected	3
IDFC	12.7*	0.00	Rejected	0.7	0.52	Not Rejected	2
INFO	1.4	0.22	Not Rejected	0.1	0.98	Not Rejected	5
ITC	5.8*	0.00	Rejected	0.3	0.73	Not Rejected	2
JPA	1.3	0.22	Not Rejected	5.6*	0.00	Rejected	8
JSP	31.2*	0.00	Rejected	2.3	0.13	Not Rejected	1
KMB	2***	0.08	Rejected	3.3*	0.01	Rejected	5
LPC	1.9***	0.08	Rejected	1.1	0.33	Not Rejected	6
LT	190.4*	0.00	Rejected	2.3	0.13	Not Rejected	1
MM	6.3*	0.00	Rejected	1.2	0.31	Not Rejected	4
MSIL	8.4*	0.00	Rejected	1.4	0.21	Not Rejected	5
NTPC	4.2*	0.01	Rejected	2.1	0.12	Not Rejected	2
ONGC	2.6**	0.05	Rejected	1.8	0.15	Not Rejected	3
PNB	1.3	0.28	Not Rejected	3.9**	0.02	Rejected	2
PWGR	4.1*	0.01	Rejected	1.3	0.27	Not Rejected	3
RBXY	3.9*	0.00	Rejected	1.4	0.21	Not Rejected	5
RELI	7.4*	0.00	Rejected	0.9	0.46	Not Rejected	4
RIL	4*	0.01	Rejected	0.2	0.89	Not Rejected	3
SBIN	2589.5*	0.00	Rejected	0.0	0.96	Not Rejected	1
SESA	2421.8*	0.00	Rejected	0.1	0.77	Not Rejected	1
SIEM	3.2*	0.00	Rejected	1.8***	0.09	Rejected	6
SUNP	2***	0.07	Rejected	1.4	0.23	Not Rejected	5
TATA	27.9*	0.00	Rejected	2	0.15	Not Rejected	1
TCS	31.2*	0.00	Rejected	2.7**	0.04	Rejected	3
TPWR	324.1*	0.00	Rejected	1.6	0.20	Not Rejected	1
TTMT	860*	0.00	Rejected	1.3	0.26	Not Rejected	1
UTCEM	1.5	0.18	Not Rejected	1.0	0.41	Not Rejected	7
WPRO	1.1	0.37	Not Rejected	1.9***	0.09	Rejected	5

Note: *Significant at 1% level, **Significant at 5% level and ***Significant at 10% level