Causality Relationship between Trading Volume and Stock Return: Evidence from Nepalese Stock Market

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Abstract : *This paper aims to empirically examine the causal relation between trading volume and stock returns for Nepalese Stock Market using Garner causality procedure, using monthly data for the period of July 2007 to February 2015. The study analyzed for the investigation of the Granger causality between trading volume and stock price using monthly data sets to ascertain if the causality runs from volume to stock price or from stock price to volume or in both directions. This study detected unidirectional causality from stock returns to trading volume that is indicative of noise trading model of return volume interaction in this market.*

Key Words: Trading volume, Stock returns, Granger causality test, Nepalese stock market

I. INTRODUCTION

Return and volume are two important elements of every transaction and these elements are jointly determined by the same market dynamics and may contain valuable information about securities. Therefore, it is generally believed that these two variables should have very close and straightforward relationship. 'Volume analysis' is an important tool in the archery of technical analysts. It tries to forecast future price move on the basis of past volume. Two famous stock market adages say: "It takes volume to make prices move", and "Volume is heavy in bull market and light in bear market". These adages imply two different kinds of causalities between these two variables. However, conceptual and empirical findings on the relationship between these two variables are not so straightforward. Causality is a kind of statistical feedback concept which is widely used in the building of forecasting models. Causality tests can provide useful information on whether knowledge of past stock returns improves short run forecasts of current and

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future trading volume. There are several evidence for the presence of a causal relation between stock returns and trading volume in the literatures. First, Epps (1975) gave evidence based on the asymmetric reaction of two groups of investors-bulls and bears-to the positive information and negative information. Secondly, Clark (1973) developed mixture of distribution model and provided evidence that the speed of information flow is a latent common factor which influence stock returns and trading volume simultaneously. Third evidence is the sequential arrival of information model of Copeland (1976) which indicated a positive relationship between price changes and trading volume.

The objective of this study is to empirically examine the causal relation between volume and share price for Nepalese Stock Market using Garnger causality procedure. The study investigate the Granger causality between stock returns and trading volumes to ascertain if the causality runs from volume to stock returns or from stock returns to volume or in both directions. The study uses monthly time series data sets. The rest of the paper is organized as follows: the next section discusses the conceptual relationship between volume and price and presents a brief survey of empirical research on this issue. The third section highlights the methodology of the present study. This is followed by discussions on the results of the study in the fourth section. Section 5 concludes the paper.

II. REVIEW OF LITERATURE

Granger (1969) developed a methodology to examine whether changes in one series cause changes in another. If the current value of Y can be predicted by using the past values of X and considering other relevant information including the past values of Y, it may be concluded that X causes Y. To determine the presence of and the direction of a causal relation between return and volume, the Granger causality method has been chosen. Granger causality method was utilized by several researchers to investigate the causal relation between share price and trading volume. Some examples of such studies are as follows. Most of studies found bidirectional causality between trading volume and stock returns volatility. Some of the studies found unidirectional causality from volume to volatility and some from volatility to volume.

In nutshell, on the basis of above-mentioned studies it can be stated that the significant efforts have been made at the international level to evaluate stock return and trading volume, whereas in Nepal, the causal relationship between stock price index and market capitalizations with macro economic variables has been investigated by G.C. and Neupane (2006) using the time series data for the year 1988 to 2005. The study found the empirical evidence that the direction of causality from real GDP to stock price index but no reverse causation from stock price index to real GDP. The study also concluded bidirectional causality between market capitalizations. The causal relationship between stock returns and trading volume has not been investigated in Nepalese stock market. Therefore, the current study is an attempt to fill this gap and sheds light on the informational efficiency of Nepalese stock market. This paper examines the causal

Author	Assets	Period	Causality
Jain & Joh (1988)	S&P 500 stock index	1/1979-12/1983	unidirectional; Returns → Volume
Hiemstra & Jones (1994)	DIJA index	1915-1940;1941-1990	Bidirectional; Returns → Volume
Gwilym, McMillan and Speight (1999)	LIFFE future contract	1/1995-6/1995	Bidirectional; Returns → Volume
Chen, Firth and Rui (2001)	Nine developed national Market	1973-2000	unidirectional; Returns → Volume
Ciner (2002)	Tokyo Commodity Exchange	1/1992-9/2000	Bidirectional; Returns → Volume
Luu and Martens (2003)	S&P 500 Index	1/1990-6/1999	INTRA: Bidirectional; Returns → Volume SQUARED RETURNS: unidirectional; Returns → Volume
Sarwar (2003)	Currency options on the British Pound	1-1993-10/1995	Bidirectional; Returns → Volume
Darrat, Rahman and Zhong (2003)	DJIA Stocks	4/1998-6/1998	Bidirectional; Returns → Volume
Chen (2007)	Live cattle, pork bellies, German mark and Swiss franc futures	1/1995-12/1995	Bidirectional; Returns → Volume
Hatrick et al. (2011)	HSBC stock	01/2009-05/2009	Bidirectional; Returns → Volume
Hussain (2011)	DAX 30 Index	5/2004-9/2005	unidirectional; Volume → Returns but do NOT investigate returns Volume
Attari, Rafiq and Awan (2012)	Karachi Stock Exchange	2000-2012	Bidirectional; Return → Volume
Darwish (2012)	Palestine Stock Exchange	10/2000-8/2010	Bidirectional; Return → Volume
Halova (2012)	NYMEX (oil and gas futures)	1/8/2008-24/9/2010	Absolute return: Bidirectional; returns → Volume Conditional variance: unidirectional; Returns → Volume
Abdullahi, Kouhy and Muhammad (2014)	West Texas Intermediates and Brent crude oil futures	1/2008-5/2011	Neither trading volume nor returns have the power to predict the other
Samman and Al-Jafari (2015)	Muscat securities market	1/2009-12/2013	unidirectional; Volume → Return

relationship between stock returns and trading volume context in Nepalese stock market and contributes to the literature in several respects. It deploys the Granger causality test to investigate information flow between the variables instead of ARIMA. Moreover, the time period considered in the study helps to evaluate the impact of new regime changes in political situation of Nepal. Thus, the study will enhance the understanding of market asymmetry, market efficiency and information processing in Nepalese stock market.

III. DATA AND METHODOLOGY

This section describes the following aspects of research methodology to test the relationship between stock returns and trading volume in Nepalese stock market: (i)

nature and sources of data, (ii) selection of enterprises, (iii) the variables, (iv) methods of analysis, and (v) the limitations of the study.

Nature and Sources of Data

The relationship between trading volume and stock returns are examined by using secondary sources of trading volume and return data series. Most of the data related to stock returns and trading volume were collected from annual report and official reports of Security Exchange Board of Nepal (SEBON), official website of Nepalese Stock Exchange (NEPSE). The data set used in this study comprises monthly closing prices and trading volume in NEPSE. The study period covers the time period of eight years, ranging from July 2007 to February 2015 and thereby making 92 months. The monthly data set are collected from http://www.nepalstock.com/ which is available from July 2007 onward. Both series, (monthly trading volume and monthly closing prices) are expressed in the local currency. The monthly stock returns are computed using monthly closing prices.

Selection of enterprises

The study consists of all listed companies of Nepalese stock market at index level. The study also considers sector wise data of Nepalese stock market.

Variables specification

The study mainly considers monthly volume series and return series to examine the relationship between trading volume and stock returns.

Trading volume: The total number of shares traded were used to measure of trading volume for study of aggregate trading activities e.g., Epps and Epps, (1976), Gallant, Rossi, and Tauchen, (1992), Hiemstra and Jones (1994) and Ying (1966). Other studies used the total number of shares traded divided by the total number of shares outstanding as a measure of trading volume, e.g., Campbell, Grossman, Wang (1993), and LeBaron (1992). Individual share volume was often used in the analysis of price/volume and volatility/volume relations, e.g., Andersen (1996), Epps and Epps (1976), and Lamoureux and Lastrapes (1990, 1994). Alternatively, even the total number of trades was used by Conrad, Hameed, and Niden, (1994). James and Edmister, (1983) used the number of trading days per year as measures of trading activity.

The NEPSE provides three measures of trading volume: 1) the volume traded (the sum of the number of share traded during the period); 2) the number of trades (the sum of trade during the period); 3) the total value traded expressed in NPR (the sum of the price of share traded times the number of share traded). This study uses the total value traded of the shares as the measure of trading volume because it takes into account of the relative market value of shares while other measures mentioned above do not. The level volume series is non-stationary, thus the study use first order log difference volume series. The volume series at the time t noted as $D\,(LOG\,(V_t))$ is expressed as:

D(LOG (V_t)) = First order log differences ($Volume_t$)

Where $Volume_t$ is the NPR value of the shares traded at time t, and D (.) is the first order difference operator.

Stock returns: The study considered monthly price index change as stock returns. A monthly price index change is calculated using the natural log of the ratio of a stock's price index (P) from the current month (t) to the previous month (t-1) as:

$$R_t = \text{monthly stock returns} = Ln \left(\frac{P_t}{P_t} \right)$$

Where, P_t represents the closing price index for the period t; t is the time in months. P_{t-1} is the closing price index for the period of t-1; Ln (.) is the natural logarithm operator. All returns are expressed in local currencies and are not adjusted for dividends.

Methods of analysis

As stated earlier, the objective of the paper is to determine existence of and the direction of causality between returns and volume on the NEPSE as per the conventions of the Granger Causality methodology(Granger, 1969). To measure causality between the stock returns and trading volume, the Granger Causality Model is used. This test is used to determine whether or not return is the cause of trading volume, vice versa, or neither. The Granger Causality test provides four possible outcomes to a regression of stock returns and trading volume: No causality, stock returns causes trading volume only, trading volume causes stock returns only, and bi-directional causality. The Granger Causality Test estimates the results of two regressions:

$$R_t = \mu_R + \sum_{t=1}^{\rho} \alpha_j . R_{t-1} + \sum_{t=1}^{\rho} \beta_j . V_{t-1} + \varepsilon_t \quad .... \quad (1)$$

$$V_t = \mu_V + \sum_{t=1}^{\rho} \alpha_j . V_{t-1} + \sum_{t=1}^{\rho} \beta_j . R_{t-1} + \varepsilon_t \quad .... \quad (2)$$

Where, R_t = monthly stock returns of NEPSE index.

V_t = monthly trading volume of NEPSE.

Equation (1) regresses the dependent variable, R_t, to how it related to lagged variables of R_t and V_t . Equation (2) is similar to Equation (1), it regresses to lagged variables of R_t and V_t . Both equations assume that the disturbance terms, ε_t, are uncorrelated. The null hypothesis for equation (1) and (2) state no evidence of causation from R_t to V_t respectively.

Unit root Test

Unit root test has a crucial importance in the time series analysis as the choice of the techniques and procedures for further analysis and modeling of series depends on their order of integration. Without taking into account the presence of unit root in

the variables, the analysis may produce spurious results. For this purpose, the study uses the well-known Dickey-Fuller or the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1981) and Phillips- Perron (PP) unit roots are employed. Two variants of this model are estimated: (i) including only a constant term (α) as the deterministic regressor and (ii) including both constant (α) and time trend (t) terms as deterministic regressors. ADF unit root test is sensitive towards the lag length included in the regression equation. So, the lag lengths have been chosen based on Akaike Information Criterion (AIC). The respective models estimated took the following form:

$$\Delta y_t = \alpha_0 + \gamma y_{t-1} + \sum_{i=1}^{\rho} \beta_i \Delta y_{t-i} + \varepsilon_t \dots\dots\dots\dots (3)$$

$$\Delta y_t = \alpha_0 + \gamma y_{t-1} + \alpha_1 t + \sum_{i=1}^{\rho} \beta_i \Delta y_{t-i} + \varepsilon_t \dots\dots (4)$$

Where, y is the stock returns or trading volume.

Johansen's Co-integration Test

After confirming the non-stationary of time series in their levels, the next step is the investigation of presence of co-integration between trading volume and stock returns. For this purpose, the study employed Johansen's multivariate maximum likelihood method using this co-integrated process to test those variables have existed long-run equilibrium relationship (Johansen 1988). Co-integration test is to identify existence of any co-integrating relationship between trading volume and stock returns in Nepalese stock market.

Johansen's approach has used π to distinguish the number of co-integrated vector. It could use two likelihood ratio tests to process co-integration.

a. Likelihood ratio or Trace Test:

H_0: Rank (π) < r (at most r integrated vector)

H_1: Rank (π)> r (at least r+1 integrated vector)

$$\lambda_{trace} = -T \sum_{i=r+1}^{n} \ln (1 - \lambda_i) \dots\dots\dots (5)$$

T is sample size, λ_i is estimate of characteristic root. If test rejects H_0 that means variables exist at least r+1 (i.e. long-term co-integrated relationship).

b. Maximum Eigenvalue Test:

The maximum eigenvalue of statistic (λ_{max}) tests the null hypothesis of co-integrating vectors against the alternative of r+1 co-integrating vectors.

H_0 : Rank (π) r (at most r integrated vector)

H_1 : Rank (π)> r (at least r+1 integrated vector)

$$\lambda_{max}(r, r + 1) = -T(1 - \lambda_{r+1}) \dots\dots\dots (6)$$

If test accept H_0 that means variables have r co-integrated vector.

Limitations of the study

There are a large number of non-listed companies contributing to the dynamics of Nepalese economy; these are not included in the study due to data problems. The study used monthly data ranging from July 2007 to February 2015 comprising 92 months period. Perhaps a longer period of data could have yielded a more refined result. The results relating to causal relationship between stock returns and trading volume in this study based on Granger causality test using available monthly stock returns and trading volume data series.

IV. ESTIMATION AND RESULTS

The purpose of this section is to provide the empirical results of Granger causality between stock returns and trading volume in Nepalese stock market. The analysis consist of: (i) descriptive statistics of variables, (ii) Unit root test, (iii) Johansen's co-integration test and (iv) Results of Granger causality between stock returns and trading volume.

Descriptive statistics

The study started investigation with same basic descriptive statistics of time series of stock returns and trading volume from monthly data of NEPSE index for the period of 2007.07 to 2015.02. It would provide insight to the average size and deviation from mean value of the variable. The descriptive statistics for the variables are shown in annex 1. The analysis shows that the mean value of monthly stock returns over the period is -0.0039 with standard deviation of 0.3313.The maximum and minimum returns observed are 1.3438 and –1.4224 respectively. Applying Jarque-Bera test for normality, the test statistics clearly rejects the hypothesis, which implies that pattern of monthly trading volume and monthly stock stock returns series does not conform to normal distribution, which is the precondition for any market to be efficient in the weak form (Fama (1965), Stevenson and Bear (1970), Reddy (1997), Kamath (2008) and Mahajan and Singh (2008). Further, skewness and excess kurtosis preserve the evidence of the nature of departure from normality because the skewness and kurtosis value of stock returns are -0.3949 and 13.8980 respectively. The skewness coefficient in excess of unity is generally taken to be fairly extreme. Kurtosis generally either much higher or lower indicates extreme leptokurtic or extreme platykurtic (Parkinson, 1980). Thus, monthly stock returns and trading volume series are not normally distributed.

Similarly, the descriptive statistics of sector wise data set shows that the highest mean value of return series is 2.316% with standard deviation of 7.723% was found in hotel sector among the sectors. The highest mean value of trading volume is NPR 1654.896 with standard deviation of 3069.45 in commercial bank sector. The monthly stock returns and trading volume series are not normally distributed in all sectors except return series of commercial bank and other sector. It implies that pattern of almost all variables does not conform to normal distribution.

Unit Root Test

The time series variables - stock returns and trading volume - should be stationary for the analysis of time series statistics. The unit root test helps to test whether the times series variables are stationary or not.

The unit root test results are shown in annex 2. The statistics are inferior to the McKinnon critical value at 10% level. This indicates that the null hypothesis of unit root is rejected for the stock returns and volume variable have unit root in level form and no unit root in log differenced trading volume series in ADF test.

The PP test also rejected the null hypothesis of unit root for stock return and log differenced trading volume variable as of ADF test. Philips-Perron test have shown that volume variable have unit root in level forms and no unit root in the first difference. Hence, the study comes to conclusion that trading volume times series variable of the study should be changed with first order difference to get these variables are stationary. Having determined the non-stationary of time series in their levels, and they are also of some order of integration I(1), co-integration test has been applied to ascertain whether trading volume and stock returns are co-integrated or not. The similar result for sector wise data of stock returns and log differenced trading volume.

Johansen's Co-integration Test

Johansen's co-integration is an econometric property of time series variables. If two or more series are themselves non stationary, but a linear combination of time is stationary, then the series are said to be co-integrated. A vector of time series variable is co-integrated if each element of order one, I (1), but there exists a nonzero vector (called co-integrating vector) such that is integrated of order zero, I (0). Economic theory often suggests that certain subset of variable should be linked by a long-run equilibrium relationship. The Johansen's co-integration tests statistics are shown in annex 3. The result of the Johansen's co-integration tests shows that the null hypothesis of no co-integration between trading volume and stock returns is rejected since both Trace and Max-Eigen statistics are larger than the critical values at 1 percent significance level. In other words, for co-integrating regression, trading volume = f (stock returns), one can reject the null hypothesis r = 0 against the alternative hypothesis r = 1 since both Trace and Max-Eigen statistics are larger than the critical values at 1 percent significance level but cannot reject the null r1 against the alternative r = 2 since both Trace and Max-Eigen statistics are less than the critical values even at 1 percent level. The fact that the presence of co-integration between trading volume and stock returns suggest (i) that there is a long-run equilibrium relationship between the two time series, and (ii) the existence of causality in at least one direction.

Granger casualty test

The procedure used in this study for testing statistical causality relationship between stock returns and trading volume is the 'Granger-causality' test, developed by

C.W.J. Granger in 1969. The aim of this test is to determine the predictive content of one variable beyond that inherent in the explanatory variable itself. The Granger causality test requires the variables in the test to be stationary. According to the Granger representation theorem, if two variables say, X_t and Y_t are co integrated and each is individually I(1), that is, integrated of order 1, then either X_t must Granger-cause Y_t or Y_t must Granger-cause X_t.

The results of Granger causality tests between trading volume, stock returns and between trading volume and return volatility are shown in annex 4. The analyses indicate that the null hypothesis that stock returns do not Granger cause volume could not be rejected for market data series from 2007.07 to 2015.02. The F-statistic test shows the test is significant at 10% level. Therefore, there is a unidirectional Granger causality running from stock returns to trading volume but not vice versa. This means that volume does not contain predictive power for the stock returns and directional change in stock returns. The results of the Granger causality test in the sector wise firms also shows similar findings. The commercial bank sector shows two-way Granger causality between stock returns and trading volume. Finance company shows one way Granger causality from trading volume to stock returns. Manufacturing and processing sector shows one way Granger causality from stock returns to trading volume. Remaining sectors could not reject the null hypothesis.

V. SUMMARY AND IMPLICATIONS

The study has examined the granger causality relationship between trading volume and stock returns for Nepalese stock market. In particular, the study used ADF and PP unit root tests to determine the time series properties of both trading volume and stock returns. For causality test, the study applied the Granger causality test models.

The results from the various unit root tests indicate that stock returns are level stationary but trading volume are not level stationary. The study use log difference trading volume for further analysis. The result from the standard Granger causality test provided a unidirectional Granger causality running from stock returns to trading volume but not vice versa. This study detected unidirectional causality from stock returns to trading volume as found by Heimstra and Jones(1994) in Dow Jones stock returns and New York stock exchange, Ciner (2002) in Tokyo commodity futures market and Mahajan and Singh (2009) in Indian stock market and Meshkin, Gargaz and Abbasi (2014) in Tehran stock exchange that is indicative of noise trading model of return-volume interaction in this market. The results presented in this study helps to increase our understanding regarding the relationship between trading volume and stock returns, particularly for the NEPSE. These findings also help to explain the behaviour of returns and a better understanding of market movement. It also indicated that any study of trading volume and returns is necessarily relating to information flow and possibly to identify a better proxy for information flow. From investment perspective, the relationship between stock returns and trading volume is of great importance to individuals who invest and trace

a perspective as trading volume reflects information about market expectations and its relationship with price, having important implications on trading, speculation, forecasting and finally on hedging activities.

These results are useful for regulators, market participants, and the efficiency of the share market sector. The results are useful for regulators when they consider such measures as limits on price movements and positions. For market participants, the results are useful since they imply that volume can be used to predict prices, lending support to technical analysis. Finally, the results imply market inefficiency that may be due to the fact that traders may condition their prices on previous volumes.

The findings have a number of important implications for future research in this area. First, the results contribute to the empirical literature on Nepalese stock market by highlighting detectable Granger linear causalities. In addition, the findings of significant unidirectional Granger causality from trading volume to stock returns illustrate the importance of these predictor variables in the forecasting of stock prices.

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ANNEX 1   Descriptive statistic of variables

The data for this table are collected and compiled from the listed at Nepal Stock Exchange Limited for the period 2064.01 to 2071.11(July 2007 to February 2015) with 92 months .The table contained monthly stock returns and trading volume at index level. The monthly trading volume is calculated by multiplying number of shares traded times closing share price. The monthly trading volume has been used for volume (V_t). The monthly stock returns are calculated by natural log of current closing stock index divided by lagged closing stock index, i.e. monthly stock returns $(R_t) = LN\left(\frac{P_t}{P_{t-1}}\right)$. In the table, N represents number of observations and mean, median, maximum and minimum for average, maximum and minimum returns respectively for the period. SD stands for standard deviation of the returns. SK is a measure of skewness and KURT represents kurtosis. The Jarque-Bera (JB) test of normality is the test of the joint hypothesis that SK and KURT are 0 and 3, respectively. In that case, the value of the JB statistic is expected to be zero. JB is defined as JB=$n\left[\frac{S^2}{6} + \frac{(K-3)^2}{24}\right]$ any p-value less than 0.05 indicate that the distribution is not normal.

Panel I

Var	Mean	Med	Max	Min	SD	SK	KURT	JB Stat.	Prob	N
R_t	0.0039	0.0171	1.3438	-1.4224	0.3313	-0.3949	13.8980	457.661	(0.000)	92
V_t	2407.46	1511.62	15211.61	386.11	2602.151	2.4131	9.7233	262.565	(0.000)	92

Panel II

Sector	Var	Mean	Med	Max	Min	SD	SK	KURT	JB Stat	Prob	N
CB	R_t	0.084	0.421	30.323	-21.555	10.259	0.273	3.428	1.842	(0.398)	92
	V_t	1654.896	929.805	21887.150	117.550	3069.450	5.093	31.319	3471.892	(0.000)	
DB	R_t	0.468	-0.912	50.553	-40.705	12.406	0.764	7.780	96.535	(0.000)	92
	V_t	347.152	130.005	5753.390	33.350	788.790	5.476	34.882	4356.290	(0.000)	
FIN	R_t	0.150	-1.198	39.745	-26.007	8.091	1.287	9.611	192.908	(0.000)	92
	V_t	147.701	87.260	1161.160	15.160	183.065	3.253	16.408	851.413	(0.000)	
HP	R_t	1.054	-0.584	35.338	-42.027	11.295	-0.116	5.157	18.051	(0.000)	92
	V_t	299.544	127.855	4749.640	14.470	602.499	5.149	35.161	4371.439	(0.000)	
HTL	R_t	2.316	0.504	39.832	-13.684	7.723	2.685	13.269	503.619	(0.000)	90
	V_t	46.005	3.560	756.320	0.010	120.231	4.116	21.514	1539.592	(0.000)	
INS	R_t	2.096	0.676	53.937	-16.777	9.330	2.257	12.362	414.088	(0.000)	92
	V_t	323.507	32.280	5575.400	2.750	833.549	4.579	26.173	2380.032	(0.000)	
MFG	R_t	1.694	0.657	42.775	-33.860	8.487	0.882	14.717	491.425	(0.000)	84
	V_t	105.644	3.800	5232.100	0.010	585.293	8.194	71.824	17518.680	(0.000)	
OTR	R_t	-0.023	0.222	20.658	-15.268	6.763	0.271	3.484	1.736	(0.420)	79
	V_t	42.549	25.320	304.840	3.640	56.798	3.258	14.112	546.138	(0.000)	
TRD	R_t	0.264	0.000	43.977	-16.369	7.142	2.648	18.815	961.945	(0.000)	83
	V_t	2.317	1.590	11.660	0.010	2.323	1.392	5.018	40.897	(0.000)	

Annex 2 Summary result of Unit root test

This table reports the results of the ADF test and PP test for unit roots. The lag length (p) is chosen based on AIC. The empirical model; $\Delta Y_t = \mu + \delta Y_{t-1} + \sum_{j-1}^{m} \alpha_j \Delta Y_{t-i} + \gamma t + \varepsilon_t$ where ΔY is the first difference of the time series variable and i is the lag order of the autoregressive process. A constant μ and the coefficient on a time trend γ are also incorporated in the model to account for the different possibilities of the unit root process. If $\mu = 0$ and $\gamma = 0$, it corresponds to a random walk model and if only $\gamma = 0$, it equals to modeling a random walk with drift.

Panel I

Variables	ADF Unit Root Test			PP Unit Root Test		
	None	Constant	con.& trend	None	Constant	con.& trend
R_t	-15.241	-15.159	-15.133	-15.577	-15.492	-16.111
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
V_t	-1.739	-2.580	-3.179	-1.493	-2.288	-2.956
	(0.078)	(0.101)	(0.095)	(0.126)	(0.178)	(0.150)
D(log V_t))	-12.277	-12.223	-12.187	-14.215	-14.402	-15.014
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Panel II

Sector	Variables	ADF Unit Root Test			PP Unit Root Test		
		None	Constant	con.& trend	None	Constant	con.& trend
CB	R_t	-9.613	-9.560	-9.731	-9.612	-9.560	-9.731
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	(V_t)	2.876	2.418	2.939	-4.390	-5.094	-5.749
		(0.999)	(1.000)	(1.000)	(0.000)	(0.000)	(0.000)
	D (log (V_t))	-9.401	-9.373	-8.625	-12.692	-12.633	-13.374
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
DB	R_t	-8.493	-8.456	-6.405	-8.489	-8.453	-8.462
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	(V_t)	1.254	1.830	2.369	-3.958	-4.455	-4.937
		(0.946)	(1.000)	(1.000)	(0.000)	(0.001)	(0.001)
	D(log(V_t))	-9.512	-9.496	-9.581	-11.143	-12.156	-19.137
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
FIN	R_t	-4.212	-4.189	-5.864	-6.732	-6.691	-6.684
		(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
	(V_t)	0.014	-0.848	-0.517	-3.100	-4.463	-4.442
		(0.685)	(0.800)	(0.981)	(0.002)	(0.001)	(0.003)
	D(log (V_t))	-9.371	-9.322	-9.285	-13.443	-13.361	-13.483
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Sector	Variables	ADF Unit Root Test			PP Unit Root Test		
		None	Constant	con.& trend	None	Constant	con.& trend
HP	R_t	-10.547 (0.000)	-10.540 (0.000)	-10.732 (0.000)	-10.553 (0.000)	-10.548 (0.000)	-10.806 (0.000)
	(V_t)	1.151 (0.935)	0.572 (0.988)	-0.897 (0.951)	-5.900 (0.000)	-6.945 (0.000)	-7.993 (0.000)
	$D(\log(V_t))$	-8.591 (0.000)	-8.549 (0.000)	-8.504 (0.000)	-28.330 (0.000)	-27.710 (0.000)	-37.056 (0.000)
HTL	R_t	-7.593 (0.000)	-8.074 (0.000)	-8.194 (0.000)	-7.754 (0.000)	-8.102 (0.000)	-8.183 (0.000)
	(V_t)	2.106 (0.991)	0.614 (0.989)	-0.422 (0.985)	-4.059 (0.000)	-4.419 (0.001)	-5.030 (0.000)
	$D(\log(V_t))$	-14.634 (0.000)	-14.564 (0.000)	-14.497 (0.000)	-18.465 (0.000)	-18.586 (0.000)	-20.007 (0.000)
INS	R_t	-2.641 (0.009)	-7.952 (0.000)	-8.485 (0.000)	-7.915 (0.000)	-8.010 (0.000)	-8.476 (0.000)
	(V_t)	4.036 (1.000)	3.284 (1.000)	1.894 (1.000)	-4.002 (0.000)	-4.404 (0.001)	-5.374 (0.000)
	$D(\log(V_t))$	-9.566 (0.000)	-9.605 (0.000)	-9.590 (0.000)	-15.312 (0.000)	-17.728 (0.000)	-25.188 (0.000)
MFG	R_t	-8.229 (0.000)	-8.919 (0.000)	-8.945 (0.000)	-10.228 (0.000)	-14.953 (0.000)	-24.447 (0.000)
	(V_t)	-8.679 (0.000)	-8.907 (0.000)	-9.165 (0.000)	-8.679 (0.000)	-8.907 (0.000)	-9.165 (0.000)
	$D(\log(V_t))$	-9.863 (0.000)	-9.829 (0.000)	-9.751 (0.000)	-37.535 (0.000)	-47.008 (0.000)	-48.715 (0.000)
OTR	R_t	-10.674 (0.000)	-10.618 (0.000)	-11.009 (0.000)	-10.425 (0.000)	-10.376 (0.000)	-10.779 (0.000)
	(V_t)	-0.149 (0.629)	-1.154 (0.690)	-6.957 (0.000)	-5.362 (0.000)	-6.786 (0.000)	-8.611 (0.000)
	$D(\log(V_t))$	-8.194 (0.000)	-8.152 (0.000)	-8.175 (0.000)	-18.853 (0.000)	-18.494 (0.000)	-19.880 (0.000)
TRD	R_t	-9.164 (0.000)	-9.116 (0.000)	-9.132 (0.000)	-9.266 (0.000)	-9.239 (0.000)	-9.388 (0.000)
	(V_t)	-2.078 (0.037)	-5.697 (0.000)	-5.965 (0.000)	-3.386 (0.001)	-5.663 (0.000)	-5.948 (0.000)
	$D(\log$	-9.965 (0.000)	-9.902 (0.000)	-9.834 (0.000)	-32.099 (0.000)	-34.628 (0.000)	-35.204 (0.000)

Annex 3 Summary result of Johansen's Co-integration test

This table reports the results of the Johansen's Co-integration test. There are two statistics to process co-integration. (A).Trace test; the empirical model for trace test is   where, T is sample size, is estimate of characteristic root. If test rejects that means variables exist at least r+1 long term co-integrated relationship. and (b). Maximum eigenvalue test; The empirical model for maximum eigenvalue test is . The Johansen's co-integration test statistic of the sample firms for the period of 2064.4 to 2071.11(July 2007 to February 2015). P-values are in the parentheses

Panel I

Eigenvalue	Trace value	H0	H1	Max-Eigen statistic	H0	H1
0.3992	80.4560*	r=0	r≥1	44.8336*	r=0	r=1
0.3329	35.6264*	r≤1	r≥2	35.6264*	r≤1	r=2

*Note: * indicates significance at less than 1% level. Trace test and Max-Eigen test indicate 1 co-integrating equation(s) at 1% level.*

Panel II

Sector	Eigen value	Trace value	H0	H1	Max-Eigen	H0	H1	Eqn.#
CB	0.562	94.98	r=0	r≥1	72.647	r=0	r=1	2
	0.224	22.33	r≤1	r≥2	22.333	r≤1	r=2	
DB	0.442	79.92	r=0	r≥1	51.409	r=0	r=1	2
	0.277	28.51	r≤1	r≥2	28.513	r≤1	r=2	
FIN	0.443	68.39	r=0	r≥1	51.533	r=0	r=1	2
	0.174	16.85	r≤1	r≥2	16.852	r≤1	r=2	
HP	0.485	80.49	r=0	r≥1	58.356	r=0	r=1	2
	0.222	22.14	r≤1	r≥2	22.139	r≤1	r=2	
HTL	0.344	53.43	r=0	r≥1	36.321	r=0	r=1	2
	0.18	17.1	r≤1	r≥2	17.104	r≤1	r=2	
INS	0.461	69.83	r=0	r≥1	54.332	r=0	r=1	2
	0.161	15.5	r≤1	r≥2	15.496	r≤1	r=2	
MFG	0.466	94.33	r=0	r≥1	50.129	r=0	r=1	2
	0.424	44.2	r≤1	r≥2	44.2	r≤1	r=2	
OTR	0.524	74.51	r=0	r≥1	55.622	r=0	r=1	2
	0.223	18.89	r≤1	r≥2	18.892	r≤1	r=2	
TRD	0.488	82.43	r=0	r≥1	52.811	r=0	r=1	2
	0.313	29.62	r≤1	r≥2	29.616	r≤1	r=2	

Annex 4 Summary Statistics of Granger-causality test
The variable volume (V_t) is the log difference of trading volume in month t, Stock returns, R_p is the monthly stock returns. F-statistics of the Granger-causality test are shown for the period of 2064.4 to 2071.11(July 2007 to February 2015) P-values are in the parentheses

Panel I

Null Hypothesis	F-Statistic	(P-Value)
V_t does not Granger Cause R_t	1.0151	(0.4148)
R_t does not Granger Cause V_t	2.22631*	(0.0602)

Note: *** 1% or less, ** up to 5%, * up to 10% level significant.

Panel II

Sector	Null Hypothesis	F Statistic	P Value
CB	V_t does not Granger Cause R_t	4.350**	(0.016)
	R_t does not Granger Cause V_t	2.658*	(0.076)
DB	V_t does not Granger Cause RET	0.185	(0.831)
	R_t does not Granger Cause V_t	0.082	(0.921)
FIN	V_t does not Granger Cause R_t	2.814*	(0.066)
	R_t does not Granger Cause V_t	0.256	(0.775)
HP	V_t does not Granger Cause R_t	1.848	(0.164)
	R_t does not Granger Cause V_t	1.809	(0.170)
HTL	V_t does not Granger Cause R_t	0.367	(0.694)
	V_t does not Granger Cause V_t	0.275	(0.760)
INS	V_t does not Granger Cause R_t	1.328	(0.270)
	R_t does not Granger Cause V_t	0.088	(0.916)
MFG	V_t does not Granger Cause R_t	0.759	(0.472)
	R_t does not Granger Cause V_t	3.412**	(0.038)
OTR	V_t does not Granger Cause R_t	0.874	(0.422)
	R_t does not Granger Cause V_t	0.893	(0.414)
TRD	V_t does not Granger Cause Vt	2.235	(0.114)
	R_t does not Granger Cause V_t	0.054	(0.947)