

Investigating the Causal Relationship among Returns of NIFTY50 stocks in Nine industries Using High-frequency Data

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Abstract— This study investigates the presence of Granger causal relationship between stock returns among different companies in the same industry using five-minute wise data (converted from tick - tick data). The study includes Nifty50 stocks traded in the NSE, for the duration of July 2014 to June 2015. Pair wise Granger causality model is used to check for causality relationship of stock returns between companies in the same industry. From the results, it can be seen that there are twenty instances where the companies exhibited bidirectional causal relationship and thirty-five instances where the companies exhibited unidirectional causal relationship and hundred and nine instances where there are no causal relationships among companies. The results suggest that efficient market hypothesis (EMH) does not hold good for those fifty-five instances for the duration of the study.

Keywords— Granger Causality test, Nifty50, Pairwise Model, Causal Relationship, 5 Minute Wise Data

I. INTRODUCTION

Reference [1] suggested that the change in stock prices are subjective to new information available to the market and thus riskless profits are not possible as the market is efficient. The Efficient Market Hypothesis (EMH) suggests that there is no possibility of predicting the future prices by analyzing the past data or publicly available new information or through a combination of public and private data. Fama also splits the efficiency into three forms such as weak form (where current stock prices depend on historical data), semi-strong form (where current stock prices depend on the information that is publicly available) and strong form (where current stock price depends on both the company's insider information and information that is publicly available).

Academic literature has shown inconsistency with EMH and has created doubts about the unpredictability of future prices. Reference [2] suggests two arguments towards predicting future stock price or stock returns in the market. One, exploiting inefficiencies in the operation of capital markets such as trading costs, human errors in processing the available information etc. and two, predictability is the result of the

capital market being efficient. The paper found evidence for semi-strong form of predictability and lesser convincing evidence for weak form of predictability.

The purpose of this paper is to study the causal relationship in stock returns among companies in the same industry using Granger causality test. We use Pairwise Granger causality test to check for the existence of causal relationship among companies. Lot of research has already been done on the predictability of stock returns, but the differentiating factor is the use of five-minute wise closing price data of Nifty50 companies for the duration of July 2014 to June 2015. The purpose of this study is to determine whether a causal relationship exists in stock return among the companies in the same industry and where the efficient market hypothesis holds good in these cases or not.

II. LITERATURE REVIEW

Reference [3] examined the resilience of efficient market hypothesis by studying the relationship between stock price and the volume traded. Granger causality test was used as a means to study the relationship between the stock price and volume traded data. The results showed that out of 21 cases, 17 cases showed a lead-lag relationship between the volume traded and the stock price suggesting that having knowledge of historical volume traded data improves the forecasting of future stock price data rather than forecasting using only historical stock price data.

Reference [4] explores the existence of relationship between NSE Futures and spot index in terms of returns and volatility using 5-min closing price data for a period from 1st March, 2007 to 31st January 2008. The results show that weak form of market efficiency does not hold good and hence both the futures and spot price moves in an equilibrium path in the long run. The granger causality results show that there is a unidirectional causal relationship with the futures prices causing the spot prices.

Reference [5] used Granger causality test to studied the predictability of returns in the US stock market using closing stock prices from 1954 to 1992 for a period of 39 Years. The results showed that the predictability of stock returns changes as time and trend changes with change in volatility of stock returns.

Reference [6] analyzes the relationship between daily stock returns and the volume trade for a period of 12 years from 1998 to 2009. The results show the evidence that there exists a unidirectional causal relationship from daily stock return to volume traded.

Reference [7] analyzes the relationship between stock index returns and percentage volume trade for a period of 5 years with a total of 1266 observations daily. The results suggest that volume traded has a significant nonlinear correlation with stock price, whereas the stock price has a linear correlation with volume trade.

Reference [8] analyzed the lead-lag relationship in stock returns by using 16 sets of portfolios on the basis of size and turnover (as a measure of volume traded). It explains that particular low volume portfolios are slower to adjust to new information available in the market. The results clearly show that the return of high volume traded portfolios lead the return of low volume traded portfolios due to the differential speeds in adjusting to available information thus creating a cross-autocorrelation pattern in stock returns.

Reference [9] analyzed the correlation between volume traded, stock returns and volatility of stock indices by using daily price index and volume traded data of 9 of the largest stock exchanges in the world over a period of 27 years (1973-2000). The results from granger causality test shows that in some countries the volume traded granger causes the stock returns indicating the predictability of stock returns from historical data and also in some cases the stock returns granger causes the volume traded.

Reference [10] analyzed the existence of causal relationship in the Stock return time series data. It explains the existence of causal relationship between the cause and effect. It showed a completely new approach to determining the strength of the causal relationships using temporal logic framework. It showed existence of causal relationship through the analysis of the results,” when price of A went up the price of B went down” and also that “when the price of A went up the price of B went up as well”, with A being the cause and B being the effect. This shows that stock prices or returns can be predicted.

Reference [11] explains the difficulties in determining the causal relationship due to existence of nonsynchronous trading effects in the data obtained from the US, the European and the Asian Stock markets including FTSE100, DAX30, HIS and Nikkei225. There are two kinds of nonsynchronous trading - a) inconsistent number of observations b) difference in time zones of different markets. There is significant difference in results when there is presence of nonsynchronicity and in the presence of synchronicity.

Reference [12] evaluated the movement of Indian stock market in correlation with 13 other markets from May 2006 to August 2010 for a duration of 4 years. Using granger causality test, it is

checked whether daily index returns can be predicted using daily stock return data. The test results showed that other market including USA, Hong Kong etc., can be used to predict returns of Indian Stock market.

Reference [13] studied the occurrence of granger causal relationship between stock price and volume traded among Nifty50 companies for a time period between July 2014 to June 2015 using minute wise data. Granger causality test was used to find out the relationship between price and volume and the results showed that 29 companies out of 50 showed a lead-lag relationship stretching the limits of efficient market hypothesis.

III. RESEARCH METHODOLOGY

Second by Second (Tick – Tick) closing price data of companies that are list in the NSE was collected for the duration from July 2014 to June 2015 (One year). Due to the enormous size of the data, big data tools like Spark was used to compress the tick-tick data into minute wise data and the average closing price at that minute was taken. SPSS was used to extract the data of Nifty50 companies and MS-Excel was used to convert the minute wise data into five-minute wise data.

The following regression model is used to analyze the causal relationship between the Stock Returns of Different companies in the same industry. Five-minute wise closing price data of NIFTY50 stocks are used to calculate returns.

$$\text{Return} = \ln\left(\frac{\text{Price during time } (t)}{\text{Price during time } (t-1)}\right)$$

EViews software is used to run the Granger Causality Tests. Initially, the stock return data are checked for stationarity using Augmented Dickey-Fuller (ADF) Unit root test. If the data is found to be not stationary, then the first or second differences are taken to make the series data stationary. If the data is found to be stationary, then the optimal lag for the series data is estimated using VAR. Then the stationary data is tested using pairwise granger causality test to check whether one series data can be used to cause another series data (i.e. does one company’s return’s series data causes another companies return’s series data).

Generalized model for pairwise granger causality test between two companies A and B

$$A_t = \alpha_0 + \alpha_1 B_{t-1} + \dots + \alpha_n B_{t-n} + \beta_1 A_{t-1} + \dots + \beta_n A_{t-n} + \epsilon_t$$

$$B_t = \gamma_0 + \gamma_1 A_{t-1} + \dots + \gamma_n A_{t-n} + \sigma_1 B_{t-1} + \dots + \sigma_n B_{t-n} + \mu_t$$

Variable Description:

$\alpha, \beta, \gamma, \sigma$ = Pairwise granger causality model coefficients

ϵ_t, μ_t = the residual term for each time series.

n = Lag

Hypothesis:

Generalized hypothesis for pairwise granger causality test to study the causal relationship between two companies A and B are as follows:

H01a: A's returns does not granger cause B's returns

H11a: A's returns does granger cause B's returns

H01b: B's returns does not granger cause A's returns

H11b: B's returns does granger cause A's returns

IV. RESULTS

Initially, the Nifty 50 companies were split into different groups based on the industry which they belonged to. The different industry groups are automobile, cement & construction, consumer goods, energy, financial services, industrial manufacturing, IT, media & entertainment, metals, pharma, services and telecom. Since industrial manufacturing, media & entertainment and services industries had only one company granger causality test could not be performed for those industries. Unit root test is performed to check for stationarity of the data and the results show that the data is stationary and we proceed to Granger causality test. Results of Granger causality test for each industry are shown separately. All granger causality results represent null hypothesis and if the p-value of a particular hypothesis is less than 0.05 then the null is rejected.

A. Automobile Industry

Table 1 shows the results of granger causality test for the automobile industry. The results show that there is one bidirectional causal relationship (i.e., both the companies cause each other) and five unidirectional causal relationships (i.e. one company causes the other but the reverse is not possible) and five instances where there are no causal relationships among the companies of the automobile industry.

Table 1 Granger causality test results for Automobile Industry

Pairwise Granger Causality Tests			
Date: 02/09/17 Time: 15:52			
Sample: 7/01/2014 09:15 6/30/2015 15:40			
Lags: 5			
Null Hypothesis:	Obs.	F-Statistic	Prob.
HEROMOTOCO does not Granger Cause BAJAJ_AUTO	18398	15.2662	5.E-15
BAJAJ_AUTO does not Granger Cause HEROMOTOCO		4.39285	0.0005
M_M does not Granger Cause BAJAJ_AUTO	18398	5.91057	2.E-05
BAJAJ_AUTO does not Granger Cause M_M		2.10704	0.0615
TATAMOTORS does not Granger Cause BAJAJ_AUTO	18398	3.72808	0.0022
BAJAJ_AUTO does not Granger Cause TATAMOTORS		1.35768	0.2369
M_M does not Granger Cause HEROMOTOCO	18398	4.70681	0.0003
HEROMOTOCO does not Granger Cause M_M		1.06119	0.3797
TATAMOTORS does not Granger Cause HEROMOTOCO	18398	3.11446	0.0082
HEROMOTOCO does not Granger Cause TATAMOTORS		0.87905	0.4940
TATAMOTORS does not Granger Cause M_M	18398	4.75121	0.0002
M_M does not Granger Cause TATAMOTORS		0.21534	0.9561

B. Cement and Construction Industry

Table 2 shows the results of granger causality test for the cement and construction industry. The results show that there

are four bidirectional causal relationships (i.e., both the companies cause each other) and two unidirectional causal relationships (i.e. one company causes the other but the reverse is not possible) and two instances where there are no causal relationships among the companies of the cement and construction industry.

Table 2 Granger causality test results for Cement and Construction Industry

Pairwise Granger Causality Tests			
Date: 02/09/17 Time: 15:14			
Sample: 7/01/2014 09:15 6/30/2015 15:40			
Lags: 2			
Null Hypothesis:	Obs.	F-Statistic	Prob.
AMBUJACEM does not Granger Cause ACC	18401	69.9684	5.E-31
ACC does not Granger Cause AMBUJACEM		67.6083	6.E-30
ULTRACEMCO does not Granger Cause ACC	18401	123.419	6.E-54
ACC does not Granger Cause ULTRACEMCO		46.5138	7.E-21
LT does not Granger Cause ACC	18401	29.0076	3.E-13
ACC does not Granger Cause LT		0.34199	0.7104
ULTRACEMCO does not Granger Cause AMBUJACEM	18401	82.5360	2.E-36
AMBUJACEM does not Granger Cause ULTRACEMCO		34.9408	7.E-16
LT does not Granger Cause AMBUJACEM	18401	10.5278	3.E-05
AMBUJACEM does not Granger Cause LT		0.97696	0.3765
LT does not Granger Cause ULTRACEMCO	18401	13.0638	2.E-06
ULTRACEMCO does not Granger Cause LT		4.10206	0.0166

C. Consumer Goods

Table 3 shows the results of granger causality test for the consumer goods industry. The results show that there is one bidirectional causal relationship (i.e., both the companies cause each other) and one unidirectional causal relationships (i.e. one company causes the other but the reverse is not possible) and three instances where there are no causal relationships among the companies of the consumer goods industry.

Table 3 Granger causality test results for Consumer Goods Industry

Pairwise Granger Causality Tests			
Date: 02/09/17 Time: 15:16			
Sample: 7/01/2014 09:15 6/30/2015 15:40			
Lags: 2			
Null Hypothesis:	Obs.	F-Statistic	Prob.
HINDUNILVR does not Granger Cause ASIANPAINT	18397	6.07459	0.0023
ASIANPAINT does not Granger Cause HINDUNILVR		1.26832	0.2813
ITC does not Granger Cause ASIANPAINT	18397	1.41896	0.2420
ASIANPAINT does not Granger Cause ITC		2.36805	0.0937
ITC does not Granger Cause HINDUNILVR	18401	5.80174	0.0030
HINDUNILVR does not Granger Cause ITC		8.52798	0.0002

D. Energy Industry

Table 4 shows the results of granger causality test for the energy industry. The results show that there are two bidirectional causal relationships (i.e., both the companies cause each other) and seven unidirectional causal relationships (i.e. one company causes the other but the reverse is not possible) and thirty-one instances where there are no causal relationships among the companies of the energy industry.

Table 4 Granger causality test results for Energy Industry

Pairwise Granger Causality Tests
Date: 02/09/17 Time: 15:19
Sample: 7/01/2014 09:15 6/30/2015 15:40
Lags: 17

Null Hypothesis:	Obs	F-Statistic	Prob.
GAIL does not Granger Cause BPCL BPCL does not Granger Cause GAIL	18386	1.00909 1.97556	0.4440 0.0095
NTPC does not Granger Cause BPCL BPCL does not Granger Cause NTPC	18386	0.81992 0.80022	0.6714 0.6949
ONGC does not Granger Cause BPCL BPCL does not Granger Cause ONGC	18386	1.08272 1.14984	0.3638 0.2982
POWERGRID does not Granger Cause BPCL BPCL does not Granger Cause POWERGRID	18386	1.70777 1.37889	0.0343 0.1356
RELIANCE does not Granger Cause BPCL BPCL does not Granger Cause RELIANCE	18386	0.59142 1.27047	0.9013 0.2008
TATAPOWER does not Granger Cause BPCL BPCL does not Granger Cause TATAPOWER	18386	1.46689 1.01965	0.0963 0.4320
NTPC does not Granger Cause GAIL GAIL does not Granger Cause NTPC	18386	0.76367 1.05563	0.7373 0.3924
ONGC does not Granger Cause GAIL GAIL does not Granger Cause ONGC	18386	1.96390 0.80426	0.0101 0.6901
POWERGRID does not Granger Cause GAIL GAIL does not Granger Cause POWERGRID	18386	1.25566 1.29289	0.2113 0.1857
RELIANCE does not Granger Cause GAIL GAIL does not Granger Cause RELIANCE	18386	0.36448 0.75469	0.9918 0.7475
TATAPOWER does not Granger Cause GAIL GAIL does not Granger Cause TATAPOWER	18386	0.66329 1.50160	0.8418 0.0837
ONGC does not Granger Cause NTPC NTPC does not Granger Cause ONGC	18386	1.28854 1.23097	0.1886 0.2298
POWERGRID does not Granger Cause NTPC NTPC does not Granger Cause POWERGRID	18386	0.73075 0.57162	0.7738 0.9150
RELIANCE does not Granger Cause NTPC NTPC does not Granger Cause RELIANCE	18386	1.59710 1.21844	0.0560 0.2395
TATAPOWER does not Granger Cause NTPC NTPC does not Granger Cause TATAPOWER	18386	1.55652 0.75835	0.0666 0.7433
POWERGRID does not Granger Cause ONGC ONGC does not Granger Cause POWERGRID	18386	1.33775 1.75059	0.1580 0.0282
RELIANCE does not Granger Cause ONGC ONGC does not Granger Cause RELIANCE	18386	1.63236 2.10426	0.0481 0.0049
TATAPOWER does not Granger Cause ONGC ONGC does not Granger Cause TATAPOWER	18386	1.05377 2.43039	0.3944 0.0008
RELIANCE does not Granger Cause POWERGRID POWERGRID does not Granger Cause RELIANCE	18386	1.49321 1.76505	0.0866 0.0264
TATAPOWER does not Granger Cause POWERGRID POWERGRID does not Granger Cause TATAPOWER	18386	2.46069 2.54846	0.0007 0.0004
TATAPOWER does not Granger Cause RELIANCE RELIANCE does not Granger Cause TATAPOWER	18386	0.90837 2.20745	0.5637 0.0029

E. Financial Sector

Table 5 shows the results of granger causality test for the financial sector. The results show that there are five bidirectional causal relationships (i.e., both the companies cause each other) and thirteen unidirectional causal relationships (i.e. one company causes the other but the reverse is not possible) and forty-nine instances where there are no causal relationships among the companies of the financial sector.

Table 5 Granger causality test results for the Financial Sector

Pairwise Granger Causality Tests
Date: 02/09/17 Time: 15:20
Sample: 7/01/2014 09:15 6/30/2015 15:40
Lags: 11

Null Hypothesis:	Obs	F-Statistic	Prob.
BANKBARODA does not Granger Cause PNB PNB does not Granger Cause BANKBARODA	18392	0.14627 0.07654	0.9995 1.0000
HDFC does not Granger Cause PNB PNB does not Granger Cause HDFC	18392	2.62717 3.56524	0.0024 5.E-05
HDFCBANK does not Granger Cause PNB PNB does not Granger Cause HDFCBANK	18392	0.24048 1.15720	0.9946 0.3115
ICICIBANK does not Granger Cause PNB PNB does not Granger Cause ICICIBANK	18392	0.08753 0.06285	1.0000 1.0000
INDUSINDBK does not Granger Cause PNB PNB does not Granger Cause INDUSINDBK	18392	1.41743 0.74902	0.1571 0.6917
KOTAKBANK does not Granger Cause PNB PNB does not Granger Cause KOTAKBANK	18392	0.41514 0.87446	0.9503 0.5650
SBIN does not Granger Cause PNB PNB does not Granger Cause SBIN	18392	0.03851 0.04112	1.0000 1.0000
YESBANK does not Granger Cause PNB PNB does not Granger Cause YESBANK	18392	0.38655 1.02443	0.9619 0.4211
HDFC does not Granger Cause BANKBARODA BANKBARODA does not Granger Cause HDFC	18392	1.10082 1.00141	0.3556 0.4420
HDFCBANK does not Granger Cause BANKBARODA BANKBARODA does not Granger Cause HDFCBANK	18392	0.98585 0.45832	0.4564 0.9291
ICICIBANK does not Granger Cause BANKBARODA BANKBARODA does not Granger Cause ICICIBANK	18392	0.12542 0.04369	0.9997 1.0000
INDUSINDBK does not Granger Cause BANKBARODA BANKBARODA does not Granger Cause INDUSINDBK	18392	2.09379 0.52453	0.0175 0.8882
KOTAKBANK does not Granger Cause BANKBARODA BANKBARODA does not Granger Cause KOTAKBANK	18392	0.32893 0.62724	0.9798 0.8071
SBIN does not Granger Cause BANKBARODA BANKBARODA does not Granger Cause SBIN	18392	84.1023 0.04485	2E-186 1.0000
YESBANK does not Granger Cause BANKBARODA BANKBARODA does not Granger Cause YESBANK	18392	0.48711 3.32355	0.9126 0.0001
HDFCBANK does not Granger Cause HDFC HDFC does not Granger Cause HDFCBANK	18392	7.18689 3.49297	2.E-12 7.E-05
ICICIBANK does not Granger Cause HDFC HDFC does not Granger Cause ICICIBANK	18392	1.71596 1.46154	0.0635 0.1384
INDUSINDBK does not Granger Cause HDFC HDFC does not Granger Cause INDUSINDBK	18392	1.97917 0.76783	0.0263 0.6729
KOTAKBANK does not Granger Cause HDFC HDFC does not Granger Cause KOTAKBANK	18392	2.38986 1.34432	0.0059 0.1925
SBIN does not Granger Cause HDFC HDFC does not Granger Cause SBIN	18392	0.83207 1.17884	0.6078 0.2956
YESBANK does not Granger Cause HDFC HDFC does not Granger Cause YESBANK	18392	3.22911 2.19500	0.0002 0.0122
ICICIBANK does not Granger Cause HDFCBANK HDFCBANK does not Granger Cause ICICIBANK	18392	1.63207 0.38611	0.0828 0.9621
INDUSINDBK does not Granger Cause HDFCBANK HDFCBANK does not Granger Cause INDUSINDBK	18392	3.58162 1.90426	5.E-05 0.0340
INDUSINDBK does not Granger Cause ICICIBANK ICICIBANK does not Granger Cause INDUSINDBK	18392	0.10175 1.85782	0.9999 0.0398
KOTAKBANK does not Granger Cause ICICIBANK ICICIBANK does not Granger Cause KOTAKBANK	18392	0.96505 2.05883	0.4761 0.0199
SBIN does not Granger Cause ICICIBANK ICICIBANK does not Granger Cause SBIN	18392	0.00632 0.05194	1.0000 1.0000

YESBANK does not Granger Cause ICICIBANK ICICIBANK does not Granger Cause YESBANK	18392	0.37967 2.44988	0.9645 0.0047
KOTAKBANK does not Granger Cause INDUSINDBK INDUSINDBK does not Granger Cause KOTAKBANK	18392	2.11537 0.86125	0.0162 0.5783
SBIN does not Granger Cause INDUSINDBK INDUSINDBK does not Granger Cause SBIN	18392	0.41019 0.67127	0.9525 0.7672
YESBANK does not Granger Cause INDUSINDBK INDUSINDBK does not Granger Cause YESBANK	18392	9.15531 2.68881	1.E-16 0.0019
SBIN does not Granger Cause KOTAKBANK KOTAKBANK does not Granger Cause SBIN	18392	1.94878 1.72114	0.0292 0.0624
YESBANK does not Granger Cause KOTAKBANK KOTAKBANK does not Granger Cause YESBANK	18392	2.11000 1.29102	0.0166 0.2222
YESBANK does not Granger Cause SBIN SBIN does not Granger Cause YESBANK	18392	1.58549 0.42606	0.0956 0.9454

F. Metals Industry

Table 6 shows the results of granger causality test for the Metals industry. The results show that there are two bidirectional causal relationships (i.e., both the companies cause each other) and one unidirectional causal relationship (i.e. one company causes the other but the reverse is not possible) and one instance where there are no causal relationships among the companies of the metals industry.

Table 6 Granger causality test results for the Metals Industry

Pairwise Granger Causality Tests			
Date: 02/09/17 Time: 15:23			
Sample: 7/01/2014 09:15 6/30/2015 15:40			
Lags: 2			
Null Hypothesis:	Obs.	F-Statistic	Prob.
HINDALCO does not Granger Cause COALINDIA COALINDIA does not Granger Cause HINDALCO	18401	4.90166 3.32958	0.0074 0.0358
TATASTEEL does not Granger Cause COALINDIA COALINDIA does not Granger Cause TATASTEEL	18401	4.24588 1.51382	0.0143 0.2201
TATASTEEL does not Granger Cause HINDALCO HINDALCO does not Granger Cause TATASTEEL	18401	26.8832 16.5878	2.E-12 6.E-08

G. Telecom Industry

Table 7 shows the results of the granger causality test for Telecom industry. From the results, it can be seen that both IDEA and BHARTIARTL have a two-way causality (i.e., both the companies cause each other) relationship between them.

Table 7 Granger causality test results for Telecom Industry

Pairwise Granger Causality Tests			
Date: 02/09/17 Time: 15:26			
Sample: 7/01/2014 09:15 6/30/2015 15:40			
Lags: 6			
Null Hypothesis:	Obs.	F-Statistic	Prob.
IDEA does not Granger Cause BHARTIARTL BHARTIARTL does not Granger Cause IDEA	18397	4.67179 3.93243	9.E-05 0.0006

H. IT Industry

Table 8 shows the results of granger causality test for the IT industry. The results show that there is one bidirectional causal relationship (i.e., both the companies cause each other) and three unidirectional causal relationships (i.e. one company causes the other but the reverse is not possible) and fifteen

instances where there are no causal relationships among the companies of the IT industry.

Table 8 Granger causality test results for the IT Industry

Pairwise Granger Causality Tests			
Date: 02/09/17 Time: 15:22			
Sample: 7/01/2014 09:15 6/30/2015 15:40			
Lags: 2			
Null Hypothesis:	Obs.	F-Statistic	Prob.
INFY does not Granger Cause HCLTECH HCLTECH does not Granger Cause INFY	18401	0.03190 0.63741	0.9686 0.5287
TCS does not Granger Cause HCLTECH HCLTECH does not Granger Cause TCS	18401	4.29070 1.33915	0.0137 0.2621
TECHM does not Granger Cause HCLTECH HCLTECH does not Granger Cause TECHM	18401	8.67351 0.16360	0.0002 0.8491
WIPRO does not Granger Cause HCLTECH HCLTECH does not Granger Cause WIPRO	18401	0.04320 2.24441	0.9577 0.1060
TCS does not Granger Cause INFY INFY does not Granger Cause TCS	18401	2.07308 0.93399	0.1258 0.3930
TECHM does not Granger Cause INFY INFY does not Granger Cause TECHM	18401	0.36506 0.00462	0.6942 0.9954
WIPRO does not Granger Cause INFY INFY does not Granger Cause WIPRO	18401	0.40497 0.73989	0.6670 0.4772
TECHM does not Granger Cause TCS TCS does not Granger Cause TECHM	18401	5.17115 0.76697	0.0057 0.4644
WIPRO does not Granger Cause TCS TCS does not Granger Cause WIPRO	18401	7.54420 37.1345	0.0005 8.E-17
WIPRO does not Granger Cause TECHM TECHM does not Granger Cause WIPRO	18401	1.83631 0.17725	0.1594 0.8376

I. Pharma Industry

Table 9 shows the results of granger causality test for the pharma industry. The results show that there are three bidirectional causal relationships (i.e., both the companies cause each other) and three unidirectional causal relationships (i.e. one company causes the other but the reverse is not possible) and three instances where there are no causal relationships among the companies of the pharma industry.

Table 9 Granger causality test results for the Pharma Industry

Pairwise Granger Causality Tests			
Date: 02/09/17 Time: 15:25			
Sample: 7/01/2014 09:15 6/30/2015 15:40			
Lags: 1			
Null Hypothesis:	Obs.	F-Statistic	Prob.
DRREDDY does not Granger Cause CIPLA CIPLA does not Granger Cause DRREDDY	18402	16.0343 13.3141	6.E-05 0.0003
LUPIN does not Granger Cause CIPLA CIPLA does not Granger Cause LUPIN	18402	13.5703 31.5500	0.0002 2.E-08
SUNPHARMA does not Granger Cause CIPLA CIPLA does not Granger Cause SUNPHARMA	18402	48.7667 0.39242	3.E-12 0.5310
LUPIN does not Granger Cause DRREDDY DRREDDY does not Granger Cause LUPIN	18402	20.2878 44.7888	7.E-06 2.E-11
SUNPHARMA does not Granger Cause DRREDDY DRREDDY does not Granger Cause SUNPHARMA	18402	75.1076 0.05871	5.E-18 0.8086
SUNPHARMA does not Granger Cause LUPIN LUPIN does not Granger Cause SUNPHARMA	18402	30.2099 2.86762	4.E-08 0.0904

V. CONCLUSION

In existing literature, adequate research on the existence of causal relationship between the stock returns of companies within the same industry and predictability of stock returns has not been done. This study also uses high frequency data to examine the existence of causal relationship between companies during the period from July 2014 to June 2015. The results from the granger causality test suggests that efficient market hypothesis does not hold good in fifty-five instances where the companies exhibit bidirectional causal relationship in twenty instances and exhibit unidirectional causal relationship in thirty-five instances whereas the efficient market hypothesis holds good for hundred and nine instances where the companies show no causal relationship between them. The results also suggest that there is a lead-lag relationship in stock returns of different companies in the same industry and hence there is possibility for predicting future stock returns using lead indicators for the stock.

LIMITATIONS

The scope of this study is limited to only Nifty50 companies. Further research can include more companies from both NSE and BSE. Duration of the study is limited to one year time period from July 2014 to June 2015, which can be extended to a longer period so as to test the limits of efficient market hypothesis even further.

REFERENCES

- [1] Fama, E. F. (1970). Efficient capital markets: A review of theory and empirical work. *The journal of Finance*, 25(2), 383-417.
- [2] Ferson, W. E. (2007). Stock Price Predictability. *Dictionary of Economics*,.
- [3] Singh, D., & Balasubramanian, P. (2000). Price-Volume Relationship: Some Evidence from the Indian Stock Market. *Vision*, 4(1), 17-28.
- [4] Pati, P. C., & Rajib, P. (2011). Intraday return dynamics and volatility spillovers between NSE S&P CNX Nifty stock index and stock index futures. *Applied Economics Letters*, 18(6), 567-574.
- [5] Pesaran, M. H., & Timmermann, A. (1995). Predictability of stock returns: Robustness and economic significance. *The Journal of Finance*, 50(4), 1201-1228.
- [6] SRIKANTH, P. (2012). The Stock Price -- Volume Relationship -- Evidence from the Indian Stock Market. *Finance India*, 26(4), 1261-1273.
- [7] Rashid, A. (2007). Stock prices and trading volume: An assessment for linear and nonlinear Granger causality. *Journal Of Asian Economics*, 18(4), 595-612.
- [8] Chordia, T., & Swaminathan, B. (2000). Trading volume and cross-autocorrelations in stock returns. *The Journal of Finance*, 55(2), 913-935.
- [9] Chen, G. M., Firth, M., & Rui, O. M. (2001). The dynamic relation between stock returns, trading volume, and volatility. *Financial Review*, 36(3), 153-174.
- [10] Kleinberg, S., Kolm, P. N., & Mishra, B. (2010). Investigating causal relationships in stock returns with temporal logic based methods. arXiv preprint arXiv:1006.1791.
- [11] Baumöhl, E., & VÝrost, T. (2010). Stock market integration: Granger causality testing with respect to nonsynchronous trading effects. *Finance a Uver*, 60(5), 414.
- [12] Meric, G., Pati, N., & Meric, I. (2011). Co-movements of the Indian stock market with other stock markets: Implications for portfolio diversification. *Indian Journal of Finance*, 5(10), 13-20.
- [13] Abinaya, P., Kumar, V. S., Balasubramanian, P., & Menon, V. K. (2016, September). Measuring stock price and trading volume causality among Nifty50 stocks: The Toda Yamamoto method. In *Advances in Computing, Communications and Informatics (ICACCI)*, 2016 International Conference on (pp. 1886-1890). IEEE.