INTRAWEEK AND INTRADAY RETURN PATTERNS OF INDIAN STOCK MARKET

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ABSTARCT

Intraweek and Intraday return patterns of Indian stock market are explored using five-minute interval return data under following sub-objectives: a) Intraweek variation of returns b) Intraday variation of returns and c) Intraday variation of returns across the week. Results depict presence of Day of the week effect. However, this Day of the week anomaly disappeared on Nifty, ICICI Bank, Axis Bank Ltd., DLF, Bharat Heavy Electricals Ltd. and Sesa Goa Ltd. after the introduction of pre-opening session. Intraday variation of returns reveals U-shaped pattern and reverse J shape or L-shape pattern in Indian stock market. Intraday variation of returns across the week reveal prominent Monday morning returns in many companies across the three periods.

Key Words: Day of the week effect, Intraweek patterns, Intraday patterns, Seasonality.

INTRODUCTION

The literature provide an evidence that expected returns are not constant, but contains a time-varying element that is predicted by past returns, prior observed variables, and calendar rotating points. These effects are also termed as 'seasonal effects', where the behavior of return series is dependent on the calendar/time. Substantial evidence has been accumulated on asset price behavior, including stock returns, commodity prices and exchange rates using daily, weekly or monthly data. There is less number of evidence supporting studies by using tick by tick data (high frequency data), especially in Indian markets.

To accommodate the Intraday pattern in returns, time-of-day or trading session dummy for each return observation is required (Andersen et. al, 2000).Various empirical work on Intraday seasonality have been done on bid-ask spreads, trading volume, stock returns and volatility for spot, derivative, currency and other markets. Majority of studies documents the U-shaped pattern over the trading day (Foster and Viswanathan, 1993; McInish and Wood, 1992; Wood, McInish and Ord, 1985; Harris, 1986; Jain and Joh, 1988; Abhyankar et al. 1997; Bildik, 2001; Lee, Fok and Liu, 2001; Ke, Mei-chu, et al., 2004; Alabed and Al-khouri, 2008). Strong evidence of intraday patterns, i.e. more intensive trading at the beginning and the end of the trading day combined with higher price volatility is observed from existing literature. (Admati and Pfleiderer, 1988).

Intraday pattern or behavior in financial markets has attracted much of the research attention. Exploration of the cause of such behavior has a critical role in the microstructure theory. To analyze this Intraday anomalous behavior, understanding the cause of this behavior is utmost important. Admati and Pfleiderer (1988) beautifully categorized various traders in the market, which include, informed traders, discretionary liquidity traders, non-discretionary liquidity traders and uninformed traders (noise traders). There are basic two motives of trades happening in the financial market, one is information and another is liquidity. Based on these two motives, above said traders are categorized. Informed traders are those traders that trade on the basis of the private information, which is solely available to them. Liquidity traders look for the large trades for their

liquidity needs. There are two types of liquidity traders- discretionary and nondiscretionary liquidity traders. Non- discretionary liquidity traders trade a particular number of stocks in particular time. If their liquidity needs are not met completely, then discretionary liquidity traders, strategically trade within 24 hours or end of the day, so that their liquidity needs are met. These volume and price variability at a particular time is due to the interacting strategic decisions of discretionary liquidity traders, which will prefer to trade when the market is trading bulky. Discretionary liquidity traders more likely to choose limit orders than market orders. Till the time, limit order discretionary traders have an informational disadvantage comparison to informed traders, the adverse collection of stocks is likely to be more severe around the market open and close, due to concerted informed trading around these periods. However, uniformed traders (noise traders) trade on basis of already reflected information in stock prices. This further draws the attention of informed traders to take more advantage from their private information when trade is done by noise traders.

This study discusses the Intraweek and Intraday seasonality patterns in returns of Indian stock market using high frequency data. These returns patterns are explored under three sub-objectives that include a) Intra-week variation of returns b) Intraday variation of returns and c) Intraday variation of returns across the week.

REVEIW OF LITERATURE

Empirical evidence for the Intraweek patterns

The empirical literature demonstrates two types of Intraweek Patterns: 1) Day of Week effect and 2) Weekend effect. (Lakonishok and Levi , 1982; Rogalski et al. , 1984; Jaffe & Westerfield, 1985a; Jaffe & Westerfield, 1985b; Liano & Gup, 1989; Kling and Goa, 2005; Savva et al., 2006; Baker et al., 2008; Onyuma, 2009 etc.). Day-of-the-Week effect is defined as trading pattern that differs across the different trading days of the week. However, Weekend effect refers to the propensity of shares to exhibit comparatively higher returns on Fridays in contrast to those on Mondays.

Existing literature represents *Weekend effect* where the trading returns are negative on Monday and positive on Friday (Cross, 1973; French, 1980; Lakonishok and Levi 1982; Rogalski 1984; Jaffey and Wasterfield 1985 a, b; Defusco et al., 1993; Ranjan and Padhye, 2000; Kling and Goa, 2005). These studies have recognized that there is negative correlation between Monday and Friday. The reason behind such correlation is might be due to the sufficient time for traders to analyze the expected behavior of the market on Weekends (Saturday and Sunday), which entails that there might be majority of net buyers on Friday, then there might be majority of net sellers on Monday, so as to book their profits.

Another major explanation of Weekend effect is due to information dissemination asymmetry throughout the week. Publicly available information assimilates in the market during the trading days; however, private information reaches insiders throughout the week (including weekends). Therefore, traders with private information (Informed traders) obtain maximum benefit on Mondays, which is the initial trading day of the week. After that, variance turns down through the week and become at the lowest level on Friday, as the rising public information throughout the week prevent the gain through advantage of private information (Foster and Viswanathan 1990, 1993). Informed traders trade on Monday based on quality information accumulated on weekends. Whereas, uninformed discretionary traders do not prefer to trade on Monday, they wait till Tuesday, so as prices become more informative (Boynton et al. 2009).

Human have a tendency to proclaim good news rapidly and to postpone bad news. Mostly bad news is announced in non-trading period (usually weekend) and market absorbs the shock over the Weekend (Jacobs and Levy, 1988). This influence the bulk of the investors pessimistically, which in turn grounds the fact of highest selling activity on the following Monday (Bildik 2001).

Weekend effect creates ripple effect from one country to another. This occurs due to the "time zone hypothesis", which was observed by Jaffe and Wasterfield (1985a). The time zone hypothesis states that the time difference in different nations might influence the each other's price behavior in their financial market. In their scholastic study, Japan and Australia are ahead of western countries (basically US) by 12 to 16 hours. Therefore, negative Monday effect in the US corresponded to *Tuesday effect* in Japan and Australia, in contrast to the Monday effect.

Various empirical studies support the *Wednesday effect*, which includes Liano & Gup, 1989; Poshakwale, 1996; Kiymaz, 2001; Baker et al., 2008; Tachiwou, 2010; McGowan & Ibrihim, 2011; Thushara & Perera, 2014. The literature demonstrates that behavioral aspect of Indian investors leads to the *Wednesday effect*, which depicts that Indians have positive attitude towards making any trade on Wednesday most of the times (Ranjan and Padhye 2000; Amanulla and Thiripalraju 2001; Gupta and Aggarwal 2004)

Thursday Effect was evident in many studies such as Liano & Gup, 1989; Kiymaz & Berument, 2003; Dicle & Hassan, 2007; Baker et al., 2008, Chen & Zhang, 2008; Marrett & Worthington, 2009; Rahman, 2009; Tachiwou, 2010; Qiang et. al, 2013; Thushara & Perera, 2014. Reason for this elevated trading activity is due to several macroeconomic news releases taking place on Thursday and Friday (Kiymaz and Berument, 2003). Another possible reason for Thursday effect is due to the expiration of derivatives contract on last working Thursday. Highest trading volume is evident on contract expiration day (Thursday). (Debasish & Puri, 2010).

There are a number of studies which are existing to support the *Friday effect.*(Cross, 1973; French, 1980; Gibbons & Hess, 1981; Lakonishok and Levi, 1982; Rogalski et al., 1984; Liano & Gup, 1989; Ranjan and Padhye, 2000; Berument & Kiymaz, 2001; Kiymaz & Berument, 2003; Dicle & Hassan, 2007; Baker et al., 2008; Chia et al., 2008; Marrett & Worthington, 2009; Onyuma, 2009; Tachiwou, 2010; McGowan & Ibrihim, 2011; Thushara & Perera, 2014; Bampinas et al. 2015).

Many studies have tried to explore the Day of week effect in early 1980's and 1990's. Interesting findings of all such studies revealed the absence of day of week effect in recent years. (Kamath & Chusanachoti, 2002; Kohers et al, 2004; Kenourgios et al, 2005). In contrary, Yamori & Kurihara (2004) found evident day-of-the-week effect existed for only some currencies in 1980's, however, significant in every currency in 1990.

Intraweek pattern reveals the behavior of stock prices across the trading week. However, for effective decision-making (related to trading, investments or portfolio optimization) revealing the intraday patterns is a need of the hour. With advent of electronic technology, high-frequency data is available in all financial markets. Present literature also deals in examining the various scholastic studies that explored the intraday patterns using the high frequency data.

Empirical evidence for the Intraday patterns

The literature demonstrates intensive trading at the opening and the end of the trading day combined with higher price volatility. (Smirlock and Starks, 1986; Baillie & Bollerslev, 1991; Ho & Cheung, 1991; Cornett et al., 1995; Ahn and Cheung, 1999; Docking et al., 1999; Hong & Wang, 2000; Andersen et al., 2000; Bildik, 2001; Ederington and Lee, 2001; Tang and Lui, 2002; Niarchos & Alexakis, 2003; Goh and Kok, 2006; Kalev & Pham, 2009; Haniff & Pok, 2010; Han et al., 2016). Abhyankar et. al (1997) tried to explore Intraday effects in bid ask spread, trading volume and volatility. Various irregularities in London stock exchange were reported. Trading volume was higher at market open and close, but intraday bid ask spread was constant throughout the trading day. Similarly, Alabed and Al-Khouri (2008) tried to explore intraday liquidity dynamics of Amman Stock Exchange (ASE) and observed highest activity levels at market open and close, whereas it was least active between 11.20 am and 11.35 am. In contrast, Ederington and Lee (2001) explored the intraday volatility

in interest rate and foreign-exchange markets observed volatility was slightly higher in mid-morning than at the open or close.

The significant open jump effect is very much prominent in the literature. Harris (1986) found significant first 45 minutes of a trading session of all days of the week except Monday. Similarly, Camino (1996) found positive returns in the first hour of the trading session in all trading days except Monday and Wednesday. Likewise, Cankaya et al. (2012) explored similar significant opening session on Istanbul Stock Exchange (ISE) which is due to considerable short-selling activity at the beginning of the day. However, Chelley-Steeley and Park (2011) examined that there were immediate significant patterns at market opening for few minutes, which further decline rapidly thereafter and becomes flat for many hours during the day. Significant patterns at immediate opening is explained due to lack of continuity of trading session between consecutive trading days leads to an accumulation of private information, which cause volatility at market opening and further, decline of volatility in the next to the early part of the trading session. During the non-trading periods, informed trader's gather private information, which incorporated into share prices in immediate opening of trading period and uncertainty steadily resolved as trading progresses (Admati and Pfleiderer, 1988). Various researchers has also observed significant trading activity at closing session (Smirlock and Starks, 1986; Baillie & Bollerslev, 1991; Cornett et al., 1995; Ahn and Cheung, 1999; Docking et al., 1999; Hong & Wang, 2000; Goh & Kok, 2004; Kalev & Pham, 2009; Han et al., 2016).

Wide-ranging studies documented most prominent pattern observed is a U-shaped pattern (which indicate significant volatility and returns at the market open and close). Wood, Mc Inish & Ord (1985) and Mc Inish & Wood (1992) observed that trading activity was elevated at the open and it turn down to a low point at midday and then increase at the close. Similarly, Abhyankar et al. (1997) has observed the U shaped pattern for the heavily traded stocks. Likewise, Bildik (2001) has explored intraday seasonalities in Turkish stock markets is that the return, volume and volatility of the stock prices and bid-ask spreads all follow a U-shaped or more precisely a W-shaped pattern over the trading day at the Istanbul Stock Exchange.

However, Lee, Fok and Liu (2001) has demonstrated that trading volume exhibits a J-shaped pattern on the Taiwan Stock Exchange. The study revealed J-shaped Intraday pattern for real orders and reverse J-shaped pattern of waiting orders. Further, Hmaied et. al (2006) has observed reverse J shaped pattern (which are lowest on the market open and widen significantly towards the close) for Intraday spreads. Similarly, Mcinish, and Wood (1992) has provided evidence for intraday time-weighted bid-ask spreads of NYSE stocks follow a crude reverse J-shaped pattern. However, Bildik (2001) has documented a L-shape pattern over the two sessions of trading for all days of the week on the Turkish stock market.

DATABASE AND RESEARCH METHODOLOGY

The sample used for the study include Nifty 50 and top 10 frequently traded stocks for the period 1st January 2009-31st March 2011 using 5-minute interval data for prices. Out of top 50 frequently traded stocks only top 10 frequently traded stocks are selected based on following filters:

1) Stocks whose prices are not adjusted due to any corporate action such as, Issue of bonus shares, Stock Splits, Merger or Acquisition during the sample period are excluded.

2) Then top 10 stocks, which have highest turnover (trading volume multiplied by share price) are selected.

During the period of our study, the stock market in India has seen two major significant structural changes in stock trading which are as follows:

1. Advancement of trading hours (market opening changed from 9:55am to 9:00am) on 1 January 2010

2. Pre-opening session (pre-auction period) launched on 18 October 2010.

Based on these major structural changes complete data period was divided into 3 parts

Period 1: 1st January 2009-31st December 2009

Period 2: 1st January 2010-17th October 2010

Period 3: 18th October 2010-31st March 2011

Database as a CD ROM for capital market high frequency data for the Capital Market segment purchased from Dotex International Limited. This database is managed in two steps using software Visual Fox Pro to extract into desired intervals in two steps:

1) Company Based Management: Data set includes complete transaction book for each trading date separately. In this step, the complete database, which is a complete transaction book was arranged company wise using Microsoft visual fox pro. Results output contains tick by tick information for each company separately.

2) Time Based Management: The second step of database management is time based management, in which proper interpolation rule is used to extract data at fixed intervals. Using nearest value and trading volume adjusted weighted average prices, desired companies or indices were extracted at required fixed intervals (5-minute interval).

Transformed series of 5- minute interval return data is taken as a logarithmic transformation of the price series. The returns are calculated as the difference of the logarithmic prices i.e

$Rp = Log (P_t - P_{t-1})$

Where Rp= Returns, Pt= Price at interval t and $Pt-_1$ =Price at interval t-1

Statistical tests are applied in two steps; the first step includes preliminary analysis, which forms the basis for every time series statistical analysis. It includes the summary statistics using Mean, Standard Deviation, Skewness and Kurtosis. Unit Root test or Augmented Dickey Fuller (ADF) test is used to check stationarity of the series. ARMA model is used to recognize auto-correlations the return series. The second step is applying the main time series statistics tools based on research hypothesis.

PRELIMINARY ANALYSIS

Table 1: Augmented Dickey fuller test for return series

	1st January 2009-31st December 2009	1st January 2010-17th October 2010	18th October 2010-31st March 2011
Nifty	-126.0697*	-125.9588*	-96.28364*
I C I C I Bank Ltd.	-133.0759*	-133.9139*	-93.88809*
State Bank Of India	-134.8637*	-133.5734*	-101.8897*
Infosys Ltd.	-141.662*	-94.77399*	-94.81085*
H D F C Bank Ltd.	-136.7357*	-97.02641*	-96.72336*

Axis Bank Ltd.	-139.7727*	-142.4274*	-92.98996*
D L F Ltd.	-135.4036*	-130.894*	-93.02633*
Bharat Heavy Electricals Ltd.	-134.4812*	-139.2791*	-95.79307*
Hindalco Industries Ltd.	-136.6923*	-138.6035*	-94.80577*
N T P C Ltd.	-102.6888*	-99.89903*	-97.9824*
Sesa Goa Ltd.	-143.366*	-132.4362*	-94.24607*

* 1% significance level

a) Unit Root Test

Foremost condition for any time series analysis is that the series must be stationary. Augmented Dickey-Fuller test is used to check stationarity of the series. The null hypothesis for testing stationarity is that the series has a unit root (series is non-stationary), against the alternative that series is stationary. From table 1, Augmented Dickey-Fuller test for return series depicts that all the return series are stationary at 1% significance level.

b) Descriptive Statistics

Descriptive statistics include analysis of mean, maximum values, minimum values, standard deviation, skewness and kurtosis. Further, normality has been checked by applying the Jarque bera test. Skewness and kurtosis helps to understand the characteristics of a distribution. From table 2, 3 and 4, it is observed that Mean returns are positive in Nifty and all companies in Period 1. In Period 2, Mean returns are positive for Nifty and companies, but negative returns for NTPC Ltd. and Sesa Goa Ltd. However, in period 3, negative returns are observed in Nifty and all companies. Low standard deviation of 5-minute interval returns for sample under study depicts the mean reverting behavior of high frequency data. The coefficient of the Jarque-bera is significant at 1 percent for Nifty and all companies in three periods. It documents that the trading returns are asymmetric and do not have the normal distribution. Leptokurtic distribution (kurtosis>3) of all the trading returns is evident.

One of the major assumptions of any econometric model is that time series should be free from auto-correlations**.** Problem of auto-correlation is removed by using ARMA (Auto-regressive Moving Average Model). Return's residual from ARMA model is taken for further analysis of Intraweek and Intraday return patterns. An ARMA model is a special type of regression model in which the dependent variable is stationarized and the independent variables are all lags of the dependent variable and lags of the errors.

Table 2: Descriptive statistics for period 1st January 2009-31st December 2009 (Period 1)

	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	P-value of Jarque-Bera
Nifty	3.43E-05	5.89E-05	0.11089	-0.03012	0.002322	6.783139	335.6882	75795022	0.000*
I C I C I Bank Ltd.	4.07E-05	3.33E-05	0.16806	-0.0692	0.004723	2.479522	122.7614	9824291	0.000*
State Bank Of India	3.27E-05	0.000	0.09115	-0.03609	0.003577	2.380227	66.91133	2799652	0.000*
Infosys Ltd.	5.18E-05	2.50E-05	0.04901	-0.04637	0.003012	0.0206	42.25659	1052109	0.000*
H D F C Bank Ltd.	3.28E-05	0.000	0.07495	-0.05699	0.003481	1.154628	53.30064	1732477	0.000*
Axis Bank Ltd.	4.03E-05	0.000	0.13293	-0.10944	0.004569	1.300141	99.78504	6410326	0.000*
D L F Ltd.	1.57E-05	0.000	0.17941	-0.1654	0.006161	0.411079	120.0274	9365278	0.000*
Bharat Heavy Electricals Ltd.	3.43E-05	0.000	0.0957	-0.03356	0.003234	2.226727	69.92403	3076146	0.000*
Hindalco Industries Ltd.	6.84E-05	0.000	0.07658	-0.08657	0.004833	-0.12941	29.81664	491812.5	0.000*
N T P C Ltd.	1.64E-05	0.000	0.16415	-0.06321	0.003137	8.017291	482.7048	1.58E+08	0.000*
Sesa Goa Ltd.	9.48E-05	0.000	0.16000	-0.11855	0.005426	1.099536	103.9483	6949431	0.000*

* 1% significance level

Table 3: Descriptive statistics for period 1st January 2010-17th October 2010(Period 2)

	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	P-value of Jarque-Bera
Nifty	9.77E-06	5.84E-06	0.01175	-0.01751	0.001082	-0.69118	36.10491	712456.2	0.000*
I C I C I Bank Ltd.	1.56E-05	-1.08E-05	0.03257	-0.034	0.002126	-0.34396	36.47846	730654.3	0.000*
State Bank Of India	2.13E-05	-7.10E-06	0.02627	-0.0456	0.001722	-0.26168	58.577	2012663	0.000*
Infosys Ltd.	1.07E-05	0.000	0.03549	-0.0297	0.001725	0.263927	56.83744	1888776	0.000*
H D F C Bank Ltd.	2.17E-05	0.000	0.03454	-0.03512	0.001784	-0.25482	42.42539	1012900	0.000*
Axis Bank Ltd.	2.63E-05	0.000	0.03868	-0.03132	0.002172	0.410178	37.83964	791280	0.000*
D L F Ltd.	2.26E-06	-3.23E-05	0.03143	-0.03882	0.002528	-0.06218	22.00318	235355.6	0.000*
Bharat Heavy Electricals Ltd.	2.27E-06	0.000	0.02225	-0.02028	0.00163	0.207371	21.56959	224826	0.000*
Hindalco Industries Ltd.	1.75E-05	0.000	0.05848	-0.05769	0.002844	-0.06669	57.05449	1904230	0.000*
N T P C Ltd.	-9.76E-06	0.000	0.02481	-0.02274	0.001596	-0.43096	35.36726	683239.7	0.000*
Sesa Goa Ltd.	-5.64E-06	-3.09E-05	0.02590	-0.05886	0.002793	-0.99289	35.77561	702616.7	0.000*

* 1% significance level

Table 4: Descriptive statistics for period 18th October 2010-31st March 2011(Period 3)

	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	P-value of Jarque-Bera
Nifty	-5.57E-06	1.90E-05	0.01390	-0.02103	0.00141	-0.32273	20.1968	103046.6	0.000*
I C I C I Bank Ltd.	-7.86E-07	0.000	0.02413	-0.03062	0.00251	0.121985	16.20857	62167.54	0.000*
State Bank Of India	-1.62E-05	-6.88E-06	0.04024	-0.04204	0.00224	-0.82987	52.9939	875959	0.000*
Infosys Ltd.	6.26E-06	0.000	0.02282	-0.03182	0.00176	-1.27713	38.32065	446711.2	0.000*
H D F C Bank Ltd.	-5.49E-07	4.67E-06	0.01518	-0.02578	0.00210	-0.3955	12.33624	31275.58	0.000*
Axis Bank Ltd.	-6.02E-06	-8.06E-06	0.02290	-0.02397	0.00243	0.024135	12.42489	31642.27	0.000*
D L F Ltd.	-3.73E-05	-2.71E-05	0.02180	-0.0331	0.00291	-0.36293	14.40844	46549.1	0.000*
Bharat Heavy Electricals Ltd.	-2.37E-05	0.000	0.01650	-0.03203	0.00190	-0.60522	21.22814	118877.5	0.000*
Hindalco Industries Ltd.	-2.11E-06	0.000	0.04096	-0.0329	0.00288	-0.10208	20.6578	111079.8	0.000*
N T P C Ltd.	-6.70E-06	0.000	0.01926	-0.01568	0.00176	0.201118	13.6081	26452.47	0.000*
Sesa Goa Ltd.	-2.91E-05	0.000	0.0210	-0.02521	0.00268	-0.21432	14.57414	47783.38	0.000*

* 1% significance level

Table 5: Average (ARMA) terms in return series

	1st January 2009-31st December 2009		1st January 2010-17th October 2010		18th October 2010-31st March 2011	
	AR terms	MA terms	AR terms	MA terms	AR terms	MA terms
Nifty	AR(1) 0.016046 (0.039)**		AR(2) AR(4) -0.0177 0.024704 (0.0271)** (0.0021)*		AR(1) -0.04694 (0.000)*	
I C I C I Bank Ltd.	AR(1) -0.03794 (0.000)*			MA(1) -0.07005 (0.000)*	AR(2) 0.563832 (0.002)*	MA(2) -0.54272 (0.003)*
State Bank Of India		MA(1) -0.05217 (0.000)*		MA(1) -0.06661 (0.000)*		MA(1) -0.10123 (0.000)*
Infosys Ltd.		MA(1) -0.10332 (0.000)*	AR(1) 0.4345 (0.000)*	MA(1) -0.5046 (0.000)*	AR(1) -0.02355 (0.029)**	
H D F C Bank Ltd.	AR(1) -0.06513 (0.000)*		AR(1) 0.11875 (0.027)**	MA(1) -0.2605 (0.000)*	AR(1) AR(2) 0.422996 0.052032 (0.043)** (0.000)*	MA(1) -0.46811 (0.025)**
Axis Bank Ltd.		MA(1) -0.0851 (0.000)*		MA(1) -0.12759 (0.000)*	AR(2) AR(3) 0.0297 0.0197 (0.006)* (0.068)***	
D L F Ltd.		MA(1) MA(2) -0.056 -0.01605 (0.000)* (0.040)**		MA(1) -0.04469 (0.000)*	AR(17) -0.02247 (0.038)**	
Bharat Heavy Electricals Ltd.	AR(1) 0.334 (0.009)*	MA(1) -0.383 (0.002)*		MA(1) -0.1097 (0.000)*		MA(1) -0.0348 (0.001)*
Hindalco Industries Ltd.		MA(1) -0.0603 (0.001)*		MA(1) -0.1005 (0.000)*	AR(1) -0.0241 (0.025)**	
N T P C Ltd.		MA(1) -0.1775 (0.000)*		MA(1) -0.2036 (0.000)*		MA(1) -0.0557 (0.000)*
Sesa Goa Ltd.		MA(1) -0.1124 (0.000)*		MA(1) -0.0578 (0.000)*	AR(1) -0.8218 (0.000)*	MA(1) 0.8014 (0.000)*

* 1% significance level ** 5% significance level *** 10% significance level

Visualization of Table 5 reveals significant AR and MA terms for Nifty and all companies at various lags and all AR and MA terms are significant at 1% or 5% significance level. Another fundamental assumption for the modeled error terms is that they should be unrelated, normally distributed and their variances do not differ with the effects being modeled. If error terms, do not have constant variance, they are said to be heteroscedastic. Heteroscedasticity: ARCH Test statistics for returns residuals is used to check the conditional heteroscedasticity in table 6. This test reveals significant ARCH effects through heteroscedasticity test at 1 % significance level. Based on this test, model under study is better fit for GARCH model.

Table 6: Heteroskedasticity Test: ARCH test

	1st January 2009-31st December 2009		1st January 2010-17th October 2010		18th October 2010-31st March 2011	
	F-statistics	p-value	F-statistics	p-value	F-statistics	p-value
Nifty	46.65296	0.000*	100.7077	0.000*	48.47189	0.000*
I C I C I Bank Ltd.	62.00874	0.000*	727.4613	0.000*	58.13098	0.000*
State Bank Of India	1833.424	0.000*	374.0223	0.000*	764.8163	0.000*
Infosys Ltd.	1511.131	0.000*	815.8887	0.000*	387.002	0.000*
H D F C Bank Ltd.	1635.375	0.000*	2555.182	0.000*	62.5085	0.000*
Axis Bank Ltd.	3347.442	0.000*	1299.572	0.000*	195.6403	0.000*
D L F Ltd.	167.9396	0.000*	462.859	0.000*	110.1322	0.000*
Bharat Heavy Electricals Ltd.	642.7608	0.000*	1089.268	0.000*	91.41244	0.000*
Hindalco Industries Ltd.	1099.581	0.000*	2138.143	0.000*	61.07063	0.000*
N T P C Ltd.	46.42308	0.000*	1342.532	0.000*	128.5512	0.000*
Sesa Goa Ltd.	1320.322	0.000*	176.5055	0.000*	220.033	0.000*

* 1% significance level

INTRAWEEK RETURN PATTERN

a) To test variation in returns across trading days of the week

Efficient Market Hypothesis (EMH) assumes that at any time, stock prices fully reveal all available information which entail that the price movements do not follow any pattern. (Fama 1991; Malkiel 2003). According to EMH and trading time hypothesis, trading returns for all trading days should not be significantly different from each other (Draper and Paudyal 2002). To test this hypothesis, following econometric model has been used under study:

$$Rt = \beta_1 D_{monday} + \beta_2 D_{tuesday} + \beta_3 D_{wednesday} + \beta_4 D_{thursday} + \beta_5 D_{friday} + €$$

Rt= Return's residual from ARMA model
D_{monday},= dummy variable for Monday (1=if weekday is Monday, otherwise 0),
$D_{tuesday}$ =dummy variable for Tuesday (1=if weekday is Tuesday, otherwise 0),
$D_{wednesday}$= dummy variable for Wednesday (1=if weekday is Wednesday, otherwise 0),
$D_{thursday}$= dummy variable for Thursday (1=if weekday is Thursday, otherwise 0),
D_{friday} = dummy variable for Friday (1=if weekday is Friday, otherwise 0),
€= error term

Variance equation

$\sigma_t^2 = ώ + ώ_1 u_{t-1}^2 + \delta \sigma^2_{t-1}$

Above model includes dummy in mean equation of GARCH(1,1). Conditional variance equation of GARCH(1,1) is dependent upon its information about volatility during the previous period ($ώ_1 u_{t-1}^2$) and the incorporated variance for the previous period (σ^2_{t-1}). The GARCH model is used to capture the financial market volatility that appears in clusters and persist over the time.

Table 7: Day of the week effect in returns using Intraday data for the period 1st January 2009 - 31st December 2009

Return Equation						Variance Equation		
	Monday	Tuesday	Wednesday	Thursday	Friday	C	ARCH	GARCH
Nifty	-1.64E-05	1.04E-05	2.96E-05	2.18E-05	6.81E-05	2.00E-07	0.20	0.79
p-value	0.487	0.694	0.200	0.344	0.009*	0.000*	0.000*	0.000*
I C I C I Bank Ltd.	0.00014	1.77E-05	2.28E-05	2.25E-05	-0.000203	3.60E-07	0.13	0.86
p-value	0.005*	0.756	0.648	0.684	0.000*	0.000*	0.000*	0.000*
State Bank Of India	-3.83E-05	4.00E-05	-3.58E-05	3.71E-05	3.55E-05	2.01E-06	0.37	0.54
p-value	0.299	0.316	0.203	0.253	0.341	0.000*	0.000*	0.000*
Infosys Ltd.	3.33E-05	7.32E-06	-3.16E-05	-1.76E-05	9.65E-05	9.00E-07	0.35	0.64
p-value	0.2069	0.7916	0.1918	0.5891	0.000*	0.000*	0.000*	0.000*
H D F C Bank Ltd.	4.32E-05	9.57E-05	2.82E-05	2.61E-05	-6.66E-05	2.69E-06	0.48	0.41
p-value	0.073***	0.0001*	0.2374	0.4578	0.004*	0.000*	0.000*	0.000*
Axis Bank Ltd.	-9.35E-05	6.13E-05	4.67E-05	-4.32E-05	0.000185	7.06E-07	0.19	0.80
p-value	0.052***	0.127	0.413	0.395	0.000*	0.000*	0.000*	0.000*
D L F Ltd.	-1.47E-05	7.91E-06	8.15E-05	1.26E-05	0.000134	1.20E-06	0.16	0.82
p-value	0.861	0.925	0.136	0.809	0.009*	0.000*	0.000*	0.000*
Bharat Heavy Electricals Ltd.	4.14E-05	6.90E-05	5.62E-05	3.17E-05	5.17E-05	5.66E-07	0.22	0.77
p-value	0.3412	0.0611***	0.1483	0.4025	0.1554	0.000*	0.000*	0.000*
Hindalco Industries Ltd.	-5.94E-05	5.58E-05	0.000116	-6.31E-06	9.30E-05	3.15E-06	0.31	0.60
p-value	0.3085	0.3413	0.0532	0.9206	0.002*	0.000*	0.000*	0.000*
N T P C Ltd.	4.60E-05	7.09E-05	4.66E-05	5.22E-05	0.000258	1.06E-06	0.59	0.40
p-value	0.088***	0.005*	0.058***	0.016**	0.000*	0.000*	0.000*	0.000*
Sesa Goa Ltd.	0.000147	8.19E-05	0.000172	0.000311	0.000198	7.87E-06	0.72	0.27
p-value	0.000*	0.093***	0.001*	0.000*	0.000*	0.000*	0.000*	0.000*

* 1% significance level ** 5% significance level *** 10% significance level

Source: Author's calculations.

Table 8: Day of the week effect in returns using Intraday data for the period 1st January 2010 - 17th October 2010

	Return Equation					Variance Equation		
	Monday	Tuesday	Wednesday	Thursday	Friday	C	ARCH	GARCH
Nifty	2.95E-05	-9.84E-06	1.88E-05	2.48E-06	2.28E-05	7.52E-08	0.25	0.73
p value	0.020*	0.432	0.170	0.849	0.057***	0.000*	0.000*	0.000*
I C I C I Bank Ltd.	9.83E-05	-1.45E-05	2.19E-05	-2.74E-05	2.81E-05	8.68E-07	0.25	0.59
p value	0.000*	0.561	0.427	0.165	0.206	0.000*	0.000*	0.000*
State Bank Of India	4.12E-06	-3.46E-05	6.26E-06	-1.55E-05	0.000128	4.33E-07	0.29	0.61
p value	0.834	0.136	0.794	0.403	0.000*	0.000*	0.000*	0.000*
Infosys Ltd.	-9.97E-06	-1.15E-06	1.59E-05	4.43E-06	-3.47E-05	3.11E-07	0.44	0.57
p value	0.406	0.908	0.301	0.606	0.006*	0.000*	0.000*	0.000*
H D F C Bank Ltd.	1.44E-05	5.85E-05	3.57E-05	-2.34E-05	-2.32E-05	6.57E-07	0.41	0.46
p value	0.494	0.000*	0.023*	0.055***	0.239	0.000*	0.000*	0.000*
Axis Bank Ltd.	7.08E-05	-8.00E-05	-3.98E-05	4.68E-05	0.000145	6.09E-07	0.27	0.64
p value	0.014**	0.001*	0.114	0.083***	0.000*	0.000*	0.000*	0.000*
D L F Ltd.	1.11E-05	-5.88E-06	4.29E-05	3.84E-06	8.55E-06	1.11E-06	0.17	0.66
p value	0.7818	0.880	0.2347	0.8737	0.7746	0.000*	0.000*	0.000*
Bharat Heavy Electricals Ltd.	1.44E-05	-3.10E-06	1.15E-05	-9.16E-06	-2.85E-06	5.18E-07	0.26	0.56
p value	0.4425	0.887	0.549	0.5982	0.8764	0.000*	0.000*	0.000*
Hindalco Industries Ltd.	7.73E-05	-7.61E-05	6.47E-05	-2.53E-05	2.54E-05	1.56E-06	0.24	0.60
p value	0.042**	0.026**	0.000*	0.533	0.412	0.000*	0.000*	0.000*
N T P C Ltd.	3.08E-05	-1.59E-05	-5.67E-07	3.09E-05	7.64E-05	4.11E-07	0.50	0.47
p value	0.020**	0.084***	0.972	0.004*	0.000*	0.000*	0.000*	0.000*
Sesa Goa Ltd.	3.84E-05	-4.27E-05	6.82E-05	-9.75E-05	-5.68E-05	9.28E-07	0.23	0.69
p value	0.3186	0.2209	0.061***	0.001*	0.073***	0.000*	0.000*	0.000*

* 1% significance level ** 5% significance level *** 10% significance level

Source: Author's calculations.

Table 9: Day of the week effect in returns using Intraday data for the period 18th October 2010-31st March 2011

	Return Equation					Variance Equation		
	Monday	Tuesday	Wednesday	Thursday	Friday	C	ARCH	GARCH
Nifty	2.10E-05	1.44E-05	8.30E-06	-1.29E-06	-2.76E-05	1.28E-07	0.15	0.80

p-value	0.222	0.547	0.797	0.960	0.283	0.000*	0.000*	0.000*
I C I C I Bank Ltd.	-3.01E-05	-6.74E-05	7.28E-05	-5.45E-05	1.41E-06	6.03E-07	0.19	0.74
p-value	0.4745	0.1114	0.1676	0.2729	0.9786	0.000*	0.000*	0.000*
State Bank Of India	0.000135	-1.46E-05	-9.20E-06	-4.71E-05	-7.26E-05	3.87E-07	0.15	0.79
p-value	0.000*	0.732	0.775	0.252	0.079***	0.000*	0.000*	0.000*
Infosys Ltd.	0.000103	-1.86E-06	5.67E-05	3.96E-05	-1.90E-05	6.99E-07	0.22	0.59
p-value	0.001*	0.9601	0.0332**	0.2348	0.6013	0.000*	0.000*	0.000*
H D F C Bank Ltd.	5.72E-05	1.86E-05	-1.83E-05	7.52E-05	-3.78E-05	3.96E-07	0.17	0.75
p-value	0.116	0.6127	0.6885	0.0324*	0.3774	0.000*	0.000*	0.000*
Axis Bank Ltd.	2.51E-05	-6.47E-06	1.15E-06	-2.62E-06	-5.29E-05	5.08E-07	0.19	0.73
p-value	0.541	0.884	0.982	0.954	0.279	0.000*	0.000*	0.000*
D L F Ltd.	1.62E-05	1.63E-05	-9.19E-06	-3.54E-05	-0.00017	8.60E-07	0.12	0.78
p-value	0.7712	0.7946	0.8871	0.5597	0.0059*	0.000*	0.000*	0.000*
Bharat Heavy Electricals Ltd.	5.11E-06	9.75E-06	-4.01E-05	4.65E-05	-2.36E-05	5.28E-07	0.27	0.63
p-value	0.8582	0.7821	0.3022	0.1419	0.4681	0.000*	0.000*	0.000*
Hindalco Industries Ltd.	6.71E-05	-1.67E-05	2.18E-05	-2.30E-06	-0.0002	6.58E-07	0.18	0.76
p-value	0.218	0.663	0.697	0.969	0.001*	0.000*	0.000*	0.000*
N T P C Ltd.	3.57E-05	5.31E-05	-1.99E-05	-3.60E-06	7.28E-06	3.60E-07	0.18	0.71
p-value	0.216	0.063***	0.613	0.912	0.840	0.000*	0.000*	0.000*
Sesa Goa Ltd.	-2.27E-05	2.23E-05	-6.74E-05	1.33E-06	-4.41E-05	1.10E-06	0.17	0.69
p-value	0.651	0.642	0.242	0.982	0.446	0.000*	0.000*	0.000*

* 1% significance level ** 5% significance level *** 10% significance level

Source: Author's calculations.

Visual inspection of table 7, 8 and 9 reveals that *Monday and Friday effect* pre-dominated by most companies separately as well as collectively. Literature demonstrate *Week-End effect* which says that that the trading returns are negative on Monday and positive on Friday. (Gibbons and Hess 1981; Lakonishok and Levi 1982; Rogalski 1984; Draper and Paudyal 2002; Savva et al. 2006; Chia,et al. 2007). However, reversal of Weekend effect is observed in this study, where, aggregate returns of Monday are observed positive and aggregate returns of Friday is observed negative in some companies. This reversal of Weekend effect is a corroborative outcome of various scholastic studies of Brooks and Persand (2001), Hansen and Lunde (2005) Lucey and Pardo (2005).

Wednesday effect pre-dominate for few companies such as NTPC Ltd., Sesa Goa Ltd. in Period 1, HDFC Bank, Hindalco Industries, Sesa Goa Ltd. in Period 2 and Infosys in Period 3. The possible explanation for positive Wednesday trading returns may be due to the positive attitude of the Indian investors to make their transactions on Wednesday (Ranjan and Padhye 2000; Gupta and Aggarwal 2004)

One interesting finding is observed that *no evident Day of week anomaly* appeared for Nifty, ICICI Bank, Axis Bank Ltd., DLF, Bharat Heavy Electricals Ltd. and Sesa Goa Ltd. after the introduction of pre-opening session. Pre-opening session has been introduced in the market to control excess volatility at market opening, though, it has shown significant change in trading returns across weekdays. During this period, stock returns tend to efficient for Nifty and few companies across the trading days.

INTRADAY RETURN PATTREN

b)To examine patterns of return during the trading sessions.

According to Efficient Market Hypothesis, trading returns during a trading session should not be significantly different from each other (Niarchos & Alexakis (2003). Hence, stock returns should be independent of time and is represented as

$$Rt = \beta_6 D_{morning} + \beta_7 D_{duringtheday} + \beta_8 D_{afternoon} + €$$

Rt= Return's residual from ARMA model
$D_{morning}$ = Dummy for morning session (Market open till 11:30 am) is taken 1, otherwise 0
$D_{duringtheday}$ = Dummy for during the day (11:35 am till 1:55pm) is taken 1, otherwise 0
$D_{afternoon}$ =Dummy for afternoon session (2:00pm till 3:30pm) is taken 1, otherwise 0.
€= error term

Variance equation

$\sigma_t^2 = ώ + ώ_1 u_{t-1}^2 + \delta \sigma^2_{t-1}$

Above model includes dummy in mean equation of GARCH(1,1). Conditional variance equation of GARCH(1,1) is dependent upon its information about volatility during the previous period ($ώ_1 u_{t-1}^2$) and the incorporated variance for the previous period (σ^2_{t-1}). The GARCH model is used to capture the financial market volatility that appears in clusters and persist over the time.

Table 10: Trading session dummy in return equation of GARCH (1,1) for the period 1st January 2009 - 31st December 2009

Return Equation				Variance Equation		
	Morning Session	During the Day	Afternoon Session	C	ARCH	GARCH
Nifty	6.90E-05	1.07E-05	-3.11E-05	1.97E-07	0.20	0.79
p-value	0.000*	0.610	0.059***	0.000*	0.000*	0.000*
I C I C I Bank Ltd.	0.000145	-2.55E-05	-4.47E-04	3.37E-07	0.14	0.85
p-value	0.004*	0.603	0.000*	0.000*	0.000*	0.000*
State Bank Of India	0.000121	-3.13E-06	-0.000133	2.00E-06	0.37	0.54
p-value	0.000*	0.932	0.000*	0.000*	0.000*	0.000*
Infosys Ltd.	3.10E-05	5.05E-05	-0.000227	9.00E-07	0.34	0.64
p-value	0.135	0.081***	0.000*	0.000*	0.000*	0.000*
H D F C Bank Ltd.	-2.56E-05	2.82E-05	9.39E-05	2.70E-06	0.48	0.41
p-value	0.165	0.357	0.000*	0.000*	0.000*	0.000*
Axis Bank Ltd.	0.000138	-4.60E-05	0.000134	7.03E-07	0.19	0.80
p-value	0.002*	0.302	0.000*	0.000*	0.000*	0.000*
D L F Ltd.	0.000205	-4.08E-05	-0.000197	1.26E-06	0.15	0.82
p-value	0.000*	0.529	0.000*	0.000*	0.000*	0.000*
Bharat Heavy Electricals Ltd.	9.80E-05	-4.73E-06	0.000192	5.59E-07	0.21	0.77
p-value	0.004*	0.876	0.000*	0.000*	0.000*	0.000*
Hindalco Industries Ltd.	0.000177	1.39E-05	-0.000106	3.12E-06	0.31	0.60
p-value	0.000*	0.776	0.000*	0.000*	0.000*	0.000*
N T P C Ltd.	0.000101	3.20E-06	0.000376	9.55E-07	0.56	0.41
p-value	0.000*	0.883	0.000*	0.000*	0.000*	0.000*
Sesa Goa Ltd.	0.000114	-7.81E-05	0.000944	7.87E-06	0.72	0.27
p-value	0.013**	0.124	0.000*	0.000*	0.000*	0.000*

* 1% significance level ** 5% significance level *** 10% significance level

Source: Author's calculations.

Table 11: Trading session dummy in return equation of GARCH (1,1) for the period 1st January 2010 - 17th October 2010

Return equation				Variance equation		
	Morning Session	During the Day	Afternoon Session	C	ARCH	GARCH
Nifty	1.41E-05	6.62E-06	3.61E-05	7.51E-08	0.24	0.73
p-value	0.148	0.574	0.000*	0.000*	0.000*	0.000*
I C I C I Bank Ltd.	-1.24E-05	3.04E-05	0.000109	8.45E-07	0.25	0.60
p-value	0.558	0.195	0.000*	0.000*	0.000*	0.000*
State Bank Of India	-2.13E-05	-1.01E-05	0.000177	4.14E-07	0.29	0.62
p-value	0.207	0.536	0.000*	0.000*	0.000*	0.000*
Infosys Ltd.	-3.55E-05	1.68E-05	1.00E-05	3.11E-07	0.45	0.57
p-value	0.002*	0.2835	0.0718***	0.000*	0.000*	0.000*
H D F C Bank Ltd.	-2.13E-05	2.20E-05	6.78E-05	6.70E-07	0.41	0.45
p-value	0.149	0.247	0.000*	0.000*	0.000*	0.000*
Axis Bank Ltd.	8.90E-06	1.56E-05	0.000138	6.04E-07	0.27	0.64
p-value	0.667	0.502	0.000*	0.000*	0.000*	0.000*
D L F Ltd.	1.14E-05	-1.20E-05	8.50E-05	1.07E-06	0.17	0.67
p-value	0.6593	0.6961	0.0001*	0.000*	0.000*	0.000*
Bharat Heavy Electricals Ltd.	2.14E-06	-1.79E-05	7.05E-05	5.14E-07	0.26	0.56
p-value	0.884	0.342	0.002*	0.000*	0.000*	0.000*
Hindalco Industries Ltd.	1.14E-06	1.38E-05	5.81E-05	1.61E-06	0.24	0.59
p-value	0.967	0.706	0.000*	0.000*	0.000*	0.000*
N T P C Ltd.	1.97E-05	1.55E-06	0.000113	4.05E-07	0.52	0.46
p-value	0.062***	0.906	0.000*	0.000*	0.000*	0.000*
Sesa Goa Ltd.	3.08E-05	-7.55E-05	6.77E-05	9.24E-07	0.23	0.69
p-value	0.256	0.009*	0.001*	0.000*	0.000*	0.000*

* 1% significance level ** 5% significance level *** 10% significance level **Source:** Author's calculations.

Table 12: Trading session dummy in return equation of GARCH (1,1) for the period 18th October 2010-31st March 2011

Return equation				Variance equation		
Period 3	Morning Session	During the Day	Afternoon Session	C	ARCH	GARCH
Nifty	4.97E-05	-3.86E-06	-0.000191	1.12E-07	0.16	0.80
p-value	0.020*	0.863	0.000*	0.000*	0.000*	0.000*
I C I C I Bank Ltd.	6.22E-06	1.09E-05	-9.63E-05	6.03E-07	0.20	0.73
p-value	0.871	0.788	0.011**	0.000*	0.000*	0.000*
State Bank Of India	4.25E-05	-4.00E-05	9.80E-05	3.86E-07	0.15	0.79
p-value	0.153	0.260	0.000*	0.000*	0.000*	0.000*
Infosys Ltd.	2.93E-05	2.00E-05	0.000145	6.95E-07	0.23	0.59
p-value	0.242	0.543	0.000*	0.000*	0.000*	0.000*
H D F C Bank Ltd.	4.67E-05	2.60E-05	-7.71E-05	3.93E-07	0.17	0.75
p-value	0.1331	0.4007	0.0062*	0.000*	0.000*	0.000*
Axis Bank Ltd.	3.78E-05	-1.86E-05	-6.62E-05	5.05E-07	0.19	0.73
p-value	0.293	0.618	0.041**	0.000*	0.000*	0.000*
D L F Ltd.	4.93E-05	-8.36E-05	-5.70E-05	8.64E-07	0.12	0.77
p-value	0.272	0.091***	0.2036	0.000*	0.000*	0.000*
Bharat Heavy Electricals Ltd.	3.35E-05	5.38E-07	-7.63E-05	5.25E-07	0.27	0.63
p-value	0.1996	0.985	0.0327**	0.000*	0.000*	0.000*
Hindalco Industries Ltd.	1.16E-05	-9.95E-06	-0.000175	6.39E-07	0.18	0.76
p-value	0.787	0.823	0.000*	0.000*	0.000*	0.000*
N T P C Ltd.	4.93E-05	-1.16E-05	1.75E-05	3.61E-07	0.18	0.71
p-value	0.0538***	0.6327	0.4954	0.000*	0.000*	0.000*
Sesa Goa Ltd.	-4.31E-05	-1.03E-05	-2.20E-08	1.10E-06	0.17	0.69
p-value	0.253	0.832	1.000	0.000*	0.000*	0.000*

* 1% significance level ** 5% significance level *** 10% significance level

Source: Author's calculations.

Table 10, 11, 12 reveals the intraday pattern during the trading session in three sub periods. Significant trading returns in morning and evening session are observed in Period 1. It is interesting to note that in this period Intraday stock returns form a U-shape pattern (as morning and afternoon session is evident). There are wide-ranging studies which have also acknowledged similar pattern of return, volatility trading volume and bid ask spread at the market open and close. (Al Suhaibani and Kryzanowski, 2000; Wood, Mc Inish & Ord; 1985) Reasons for such patterns are explained by Wood, Mc Inish & Ord (1985) and Mc Inish & Wood (1992), which is due to trading activity is elevated at the open; it turns down to a low point at midday and then increase at the close.

On the other hand, only afternoon session is evident in Period 2 and Period 3. During this period, market tends to follow reverse J shape or L-shape patterns (evidence of significant returns in afternoon session). A similar pattern has been observed by Bildik, 2001; Lee, Fok and Liu, 2001; Brooks et al. ,2003; Hmaied et. al, 2006 in various financial asset variables. Cushing and Madhavan (2000) observed that the closing trading period has a disproportionate fraction of a stock's daily return. He observed 18% of the variation in daily returns is explained by the return in the last 5 min of trading. Further, Chan (2005) justified the reason for end of day effect is due to the significant increase of trade at the ask price over the last one minute of trading time.

c) To study the pattern of returns during the trading session across a week.

From above analysis, it is observed a significant day of the week effect and time of the day effect in Indian Stock Market. These results show aggregated results for the weekdays and trading session separately. Return pattern for trading session across the trading days is discussed in this sub-section. For this purpose, interactive dummies for trading session as on different trading days of the week is used. Following is the econometric model used with interactive dummies:

$$Rt = \Sigma\beta_m D_{Weekday} * D_{Morning} + \Sigma\beta_n D_{Weekday} * D_{DuringtheDay} + \Sigma\beta_o D_{Weekday} * D_{Afternoon} + €$$

Rt= Return Residual's from ARMA Model

$\sum D_{Weekday} * D_{Morning}$= Sum of each Weekday dummy multiplied by Morning session dummy.

$\sum D_{Weekday} * D_{DuringtheDay}$= Sum of each Weekday dummy multiplied by During the Day session dummy.

$\Sigma D_{Weekday} * D_{Afternoon}$= Sum of each Weekday dummy multiplied by Afternoon session dummy.

€= error term

Variance equation

$\sigma_t^2 = ώ + ώ_1 u_{t-1}^2 + \delta \sigma^2_{t-1}$

Above model includes dummy in mean equation of GARCH(1,1). Conditional variance equation of GARCH(1,1) is dependent upon its information about volatility during the previous period ($ώ_1 u_{t-1}^2$) and the incorporated variance for the previous period (σ^2_{t-1}). The GARCH model is used to capture the financial market volatility that appears in clusters and persist over the time.

Table 13: Interactive time and weekday dummy in return equation of GARCH(1,1) for the period 1st January 2009 - 31st December 2009

	Return Equation														Variance Equation		
	Monday Morning	Tuesday Morning	Wednesday Morning	Thursday Morning	Friday Morning	Monday During the Day	Tuesday During the Day	Wednesday During the Day	Thursday During the Day	Friday During the Day	Monday Afternoon	Tuesday Afternoon	Wednesday Afternoon	Thursday Afternoon	Friday Afternoon	C	ARCH	GARC
Nifty	-6.87E-05	5.32E-05	0.000192	3.02E-05	0.000139	4.01E-06	3.07E-05	3.78E-05	5.83E-06	-3.41E-05	4.57E-05	-0.00012	-0.00037	5.63E-05	0.000357	1.97E-07	0.20	
p-value	0.094***	0.263	0.001*	0.428	0.010**	0.937	0.507	0.418	0.891	0.431	0.259	0.005**	0.000*	0.179	0.000*	0.000*	0.000*	0.0
I C I C I Bank Ltd.	0.000156	0.00014	6.01E-05	3.80E-05	0.000213	2.61E-07	-1.57E-05	9.24E-05	9.04E-06	-3.18E-05	0.000551	-0.00017	-0.0004	0.000147	0.004873	5.55E-07	0.25	
p-value	0.310	0.188	0.555	0.703	0.064***	0.998	0.858	0.296	0.913	0.697	0.000*	0.013**	0.000*	0.025**	0.000*	0.000*	0.000*	0.0
State Bank Of India	3.62E-05	0.000229	8.87E-05	-6.88E-06	0.000283	-4.22E-05	-1.55E-05	3.93E-06	3.07E-05	4.21E-06	-0.00017	-0.00013	-0.00033	0.000119	-0.00018	2.02E-06	0.38	
p-value	0.539	0.000*	0.229	0.926	0.000*	0.609	0.854	0.962	0.708	0.959	0.005*	0.046**	0.000*	0.004*	0.000*	0.000*	0.000*	0.0
Infosys Ltd.	9.67E-05	8.80E-07	-4.72E-05	-0.00015	0.000248	5.12E-05	4.98E-05	0.00012	2.55E-05	1.59E-05	-0.00017	-0.00017	-0.00109	7.58E-05	-0.00011	7.93E-07	0.39	
p-value	0.111	0.989	0.364	0.014**	0.000*	0.462	0.408	0.039**	0.671	0.797	0.000*	0.000*	0.000*	0.116	0.001*	0.000*	0.000*	0.0
H D F C Bank Ltd.	0.000216	-2.46E-05	-0.000181	-8.19E-05	-4.22E-05	-1.72E-05	-2.53E-05	7.58E-05	6.98E-05	2.40E-05	-2.87E-05	0.001078	0.000273	4.59E-05	-0.00061	2.50E-06	0.56	
p-value	0.000*	0.725	0.000*	0.274	0.458	0.794	0.632	0.258	0.256	0.739	0.440	0.000*	0.000*	0.329	0.000*	0.000*	0.000*	0.0
Axis Bank Ltd.	0.000248	7.44E-05	0.000138	-1.65E-05	0.000287	-0.000176	-5.80E-05	-8.95E-06	4.85E-06	-3.80E-05	-0.00053	0.00052	7.65E-05	-0.00029	-0.00218	7.06E-07	0.19	
p-value	0.056	0.419	0.165	0.863	0.008*	0.035	0.522	0.928	0.958	0.672	0.000*	0.000*	0.385	0.000*	0.000*	0.000*	0.000*	0.0
D L F Ltd.	0.000204	0.000128	0.000304	8.03E-05	0.000108	-9.40E-05	6.92E-06	8.19E-05	-9.95E-05	-7.54E-05	-0.00039	-0.0006	-0.00088	0.000421	0.004274	9.41E-07	0.17	
p-value	0.207	0.313	0.031**	0.447	0.272	0.446	0.955	0.463	0.390	0.491	0.001*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.0
Bharat Heavy Electricals Ltd.	0.000148	-1.71E-05	0.000115	4.41E-05	0.000101	-4.36E-05	5.42E-05	3.56E-05	-3.63E-05	-5.62E-05	8.19E-05	0.000166	1.45E-05	0.000785	0.001335	4.94E-07	0.22	
p-value	0.106	0.802	0.118	0.554	0.192	0.485	0.391	0.557	0.518	0.298	0.335	0.028**	0.848	0.000*	0.000*	0.000*	0.000*	0.0
Hindalco Industries Ltd.	7.44E-05	1.82E-05	0.000313	8.62E-05	0.000367	-9.74E-05	0.000101	6.04E-05	2.61E-05	-3.22E-05	-0.00015	-1.23E-05	6.06E-07	-0.00026	-3.44E-05	3.10E-06	0.31	
p-value	0.481	0.863	0.003*	0.451	0.000*	0.376	0.349	0.571	0.812	0.771	0.094***	0.897	0.995	0.010**	0.344	0.000*	0.000*	0.0
N T P C Ltd.	5.33E-05	0.000141	8.73E-05	0.000131	3.37E-05	9.63E-06	2.49E-05	1.13E-05	2.75E-05	-5.24E-05	0.000158	-7.06E-05	6.13E-05	-0.0008	0.001726	3.55E-07	0.32	

p-value	0.473	0.003*	0.136	0.012**	0.395	0.844	0.570	0.782	0.510	0.281	0.000*	0.080***	0.074***	0.000*	0.000*	0.000*	0.000*	0.0
Sesa Goa Ltd.	0.000158	0.000115	0.000187	7.00E-05	9.14E-05	-9.30E-05	-0.00012	-1.65E-05	-5.27E-05	-9.77E-05	0.00163	0.000445	0.000353	0.002029	0.001758	3.80E-06	0.60	
p-value	0.116	0.275	0.072***	0.493	0.464	0.350	0.245	0.873	0.608	0.418	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.0

* 1% significance level ** 5% significance level *** 10% significance level , **Source:** Author's calculations.

Table 14: Interactive time and weekday dummy in return equation of GARCH(1,1) for the period 1st January 2010 - 17th October 2010

	Returns equation															Variance equation		
	Monday Morning	Tuesday Morning	Wednesday Morning	Thursday Morning	Friday Morning	Monday During the Day	Tuesday During the Day	Wednesday During the Day	Thursday During the Day	Friday During the Day	Monday Afternoon	Tuesday Afternoon	Wednesday Afternoon	Thursday Afternoon	Friday Afternoon	C	ARCH	GARC
Nifty	5.09E-05	-1.94E-05	4.77E-05	-1.28E-05	1.47E-05	1.87E-05	1.00E-05	-2.09E-05	1.41E-05	6.92E-06	1.19E-05	-9.79E-05	5.71E-05	2.67E-05	0.000247	7.26E-08	0.25	0.
p-value	0.008*	0.451	0.026**	0.575	0.545	0.473	0.685	0.430	0.586	0.799	0.603	0.000*	0.022**	0.186	0.000*	0.000*	0.000*	0.00
I C I C I Bank Ltd.	0.000105	-6.53E-05	-3.61E-05	-1.74E-05	-4.89E-05	5.24E-05	1.70E-05	1.57E-05	-5.86E-06	8.94E-05	0.000352	9.62E-05	0.000194	-0.00014	-0.00102	6.20E-07	0.28	0.
p-value	0.030**	0.110	0.428	0.723	0.375	0.350	0.768	0.767	0.915	0.010**	0.000*	0.001*	0.000*	0.000*	0.000*	0.000*	0.000*	0.00
State Bank Of India	3.37E-05	-9.99E-05	-1.29E-05	-2.07E-05	-2.01E-05	-2.09E-05	-2.07E-05	-1.68E-05	3.14E-05	-2.67E-05	-3.22E-06	8.60E-05	0.00012	-0.00013	0.00112	3.59E-07	0.30	0.
p-value	0.445	0.002*	0.722	0.552	0.594	0.404	0.628	0.664	0.459	0.435	0.929	0.007*	0.002*	0.000*	0.000*	0.000*	0.000*	0.00
Infosys Ltd.	5.82E-06	-7.84E-05	-2.11E-05	-2.90E-06	-7.60E-05	4.92E-05	1.26E-05	2.59E-06	1.51E-05	-1.84E-06	-0.00031	0.000132	0.000147	-2.35E-05	-1.13E-05	2.81E-07	0.47	0.
p-value	0.828	0.001*	0.404	0.917	0.001*	0.126	0.694	0.938	0.629	0.957	0.000*	0.000*	0.000*	0.007*	0.422	0.000*	0.000*	0.00
H D F C Bank Ltd.	-1.33E-05	-6.99E-05	-9.75E-06	-1.06E-06	-2.49E-06	1.98E-05	5.63E-05	-5.43E-07	3.40E-05	-1.05E-05	6.47E-05	0.000383	0.000278	-0.00031	-0.00013	6.23E-07	0.46	0.
p-value	0.673	0.045**	0.799	0.969	0.940	0.616	0.159	0.989	0.399	0.799	0.057***	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.00
Axis Bank Ltd.	8.01E-05	-8.55E-05	-7.46E-05	9.71E-05	3.91E-05	4.11E-05	4.68E-05	-4.97E-05	-4.86E-05	8.38E-05	0.000115	-0.00065	0.000109	0.000333	0.000782	5.26E-07	0.29	0.
p-value	0.097***	0.047**	0.131	0.024**	0.428	0.447	0.312	0.335	0.309	0.061***	0.011**	0.000*	0.001*	0.000*	0.000*	0.000*	0.000*	0.00
D L F Ltd.	-7.10E-06	4.27E-06	5.35E-05	3.48E-05	-4.20E-05	2.55E-05	1.24E-06	-0.00012	-2.25E-05	5.29E-05	1.70E-05	-4.46E-05	4.65E-04	-2.40E-05	5.45E-05	1.11E-06	0.18	0.
p-value	0.907	0.944	0.404	0.560	0.474	0.729	0.986	0.096***	0.693	0.469	0.827	0.550	0.000*	0.455	0.139	0.000*	0.000*	0.00
Bharat Heavy Electricals Ltd.	7.37E-05	-7.21E-06	2.13E-05	-3.56E-05	-4.35E-05	-4.17E-05	-1.64E-05	-4.14E-05	1.05E-05	5.14E-07	8.45E-05	5.23E-05	0.000162	-1.04E-05	7.23E-05	5.09E-07	0.26	0.
p-value	0.036**	0.825	0.552	0.304	0.162	0.297	0.717	0.354	0.803	0.989	0.082***	0.376	0.001*	0.830	0.119	0.000*	0.000*	0.00

Hindalco Industries Ltd.	2.05E-04	-0.000181	4.83E-05	-4.03E-05	-1.67E-05	-2.97E-05	1.18E-05	3.66E-05	2.72E-05	5.50E-06	3.18E-05	1.83E-04	8.46E-05	-2.59E-04	1.63E-03	9.94E-07	0.29	0.
p-value	0.000*	0.001*	0.354	0.565	0.787	0.651	0.867	0.604	0.689	0.941	0.616	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.00
N T P C Ltd.	3.03E-05	-2.71E-05	1.23E-05	2.53E-05	6.21E-05	1.35E-05	1.20E-05	-2.13E-05	2.10E-05	-7.91E-06	8.06E-05	-4.08E-05	2.53E-05	0.000187	0.000704	4.05E-07	0.42	0.
p-value	0.312	0.069***	0.610	0.392	0.019**	0.570	0.561	0.463	0.453	0.802	0.000*	0.000*	0.260	0.000*	0.000*	0.000*	0.000*	0.00
Sesa Goa Ltd.	6.62E-05	2.18E-06	0.000122	5.82E-07	-2.77E-05	-4.21E-06	-8.22E-05	-9.99E-05	-0.00013	-8.60E-05	0.000143	-4.89E-06	0.000348	-0.00137	0.000145	8.22E-07	0.25	0.
p-value	0.266	0.966	0.039**	0.993	0.699	0.955	0.255	0.149	0.000*	0.210	0.007**	0.923	0.000*	0.000*	0.000*	0.000*	0.000*	0.00

* 1% significance level ** 5% significance level *** 10% significance level, **Source:** Author's calculations.

Table 15: Interactive time and weekday dummy in return equation of GARCH(1,1) for the period 18th October 2010-31st March 2011

Return Equation															Variance equation		
Period 3	Monday Morning	Tuesday Morning	Wednesday Morning	Thursday Morning	Friday Morning	Monday During the Day	Tuesday During the Day	Wednesday During the Day	Thursday During the Day	Friday During the Day	Monday Afternoon	Tuesday Afternoon	Wednesday Afternoon	Thursday Afternoon	Friday Afternoon	C	ARCH	GARCH
Nifty	0.000177	2.40E-05	4.32E-05	6.03E-05	-6.49E-05	-5.09E-07	2.66E-05	1.54E-05	-5.03E-05	-2.24E-05	-0.00051	3.22E-06	-0.00015	0.000759	0.000205	7.77E-08	0.19	0.8
p-value	0.000*	0.639	0.388	0.162	0.222	0.991	0.569	0.738	0.226	0.613	0.000*	0.903	0.000*	0.000*	0.000*	0.000*	0.000*	0.000
I C I C I Bank Ltd.	0.000191	-0.000201	0.000119	-2.48E-05	-3.69E-05	-8.47E-05	5.04E-05	9.58E-05	-5.50E-05	5.13E-05	-1.65E-05	-4.82E-05	-0.00021	-0.0001	-0.000103	6.00E-07	0.20	0.7
p-value	0.031**	0.015**	0.175	0.766	0.695	0.337	0.550	0.302	0.535	0.605	0.853	0.505	0.022**	0.258	0.228	0.000*	0.000*	0.000
State Bank Of India	0.000187	-4.43E-05	-1.20E-05	7.09E-05	-1.34E-05	-2.20E-05	5.44E-06	-4.94E-05	-9.19E-05	-5.84E-05	0.001224	-1.34E-05	0.000373	-0.00012	-0.001094	2.76E-07	0.19	0.7
p-value	0.011**	0.604	0.802	0.303	0.877	0.771	0.937	0.454	0.201	0.457	0.000*	0.852	0.000*	0.044**	0.000*	0.000*	0.000	0.000
Infosys Ltd.	7.38E-05	2.74E-05	-7.63E-06	0.000108	-3.80E-05	4.24E-05	0.000105	2.26E-05	-3.11E-05	-7.77E-06	0.00137	-0.00022	0.000792	-0.00122	4.01E-05	6.95E-07	0.23	0.5
p-value	0.166	0.608	0.892	0.052	0.564	0.363	0.026**	0.670	0.411	0.873	0.000*	0.000*	0.000*	0.000*	0.326	0.000*	0.000*	0.000
H D F C Bank Ltd.	8.52E-05	1.80E-05	1.53E-05	0.000154	-6.93E-05	9.22E-05	1.07E-05	1.68E-05	3.23E-05	-3.69E-05	-0.00015	6.30E-05	-0.00019	-0.0001	3.74E-05	3.88E-07	0.17	0.7
p-value	0.177	0.810	0.838	0.027**	0.311	0.128	0.872	0.827	0.609	0.647	0.008*	0.241	0.018**	0.049**	0.630	0.000*	0.000*	0.000
Axis Bank Ltd.	0.000217	-4.08E-05	2.99E-05	0.000108	-0.000172	-1.90E-05	3.81E-05	1.91E-05	-0.00013	-9.32E-06	-0.00057	-4.86E-05	-9.88E-05	0.000164	6.33E-05	4.86E-07	0.20	0.7
p-value	0.009*	0.609	0.703	0.163	0.044**	0.805	0.628	0.836	0.085	0.918	0.000*	0.500	0.276	0.018**	0.430	0.000*	0.000*	0.000
D L F Ltd.	0.000174	1.23E-05	0.000123	9.09E-05	-0.000194	-0.000109	1.91E-05	-6.74E-05	-0.00017	-9.73E-05	8.85E-05	1.68E-05	-0.00015	7.89E-05	-0.000312	8.70E-07	0.12	0.7
p-value	0.0928***	0.9063	0.1792	0.3736	0.0702***	0.2944	0.8563	0.5919	0.1062	0.3963	0.3225	0.8868	0.2338	0.453	0.001*	0.000*	0.000*	0.000
Bharat Heavy Electricals Ltd.	0.00013	-6.37E-05	8.05E-06	0.000119	-1.61E-05	3.86E-05	4.13E-05	-4.97E-05	-2.75E-05	-1.06E-05	-0.00048	1.81E-05	-0.00015	0.000179	-6.94E-05	4.98E-07	0.27	0.6
p-value	0.0204**	0.3184	0.8968	0.0269**	0.7945	0.5979	0.5741	0.5049	0.690	0.8163	0.000*	0.8363	0.111	0.0294	0.305	0.000*	0.000*	0.000
Hindalco Industries Ltd.	0.000136	2.04E-05	0.000105	-4.59E-05	-0.000264	-8.10E-06	5.55E-05	-5.49E-06	-3.08E-05	-7.92E-05	0.000327	-0.00038	-4.43E-05	-0.00012	-0.000486	6.41E-07	0.19	0.7
p-value	0.100	0.834	0.289	0.658	0.015**	0.932	0.555	0.956	0.761	0.454	0.000*	0.000*	0.628	0.195	0.000*	0.000*	0.000*	0.000
N T P C	2.34E-05	0.000107	4.45E-05	5.26E-	1.64E-	9.44E-	-1.71E-05	-3.62E-05	-6.14E-05	-3.73E-	-0.00017	0.000149	-9.51E-	6.37E-	0.00018	3.61E-	0.18	0.7

Ltd.				05	05	05				05			05	05		07		
p-value	0.660	0.026**	0.499	0.365	0.810	0.021	0.753	0.571	0.248	0.555	0.000*	0.001**	0.198	0.257	0.000*	0.000*	0.000*	0.000
Sesa Goa Ltd.	1.78E-05	-6.80E-05	-4.00E-05	-6.69E-06	-0.000131	-1.10E-05	1.03E-05	-2.79E-06	-4.22E-06	-5.46E-05	-0.00016	0.000252	-0.00033	2.75E-05	0.000442	1.07E-06	0.17	0.6
p-value	0.807	0.388	0.681	0.945	0.149	0.914	0.924	0.981	0.968	0.616	0.062***	0.000*	0.000*	0.804	0.000*	0.000*	0.000*	0.000

* 1% significance level ** 5% significance level *** 10% significance level, **Source:** Author's calculations.

Visualization of Table 13, 14 and 15 reveals the return patterns for each trading day across a week. Morning and afternoon sessions are significant overall as compared to during the day session. However, afternoon session is more prominent throughout the week. Literature revealed reverse J shaped pattern, where trading returns are higher at close as compared to morning session. Hmaied et. al (2006) has observed similar reverse J shaped pattern for Intraday spreads.

Significant Monday morning returns are prominent in many companies across the three periods. Monday morning session being the first trading session of the week shows significant returns due to information released on weekends. Other days of the morning sessions are found significant in many cases due to information released overnight (Bildik, 2001). Similarly, Strawinski And Slepaczuk (2008) found that in The Warsaw Stock Exchange, there was the existence of a positive, persistent and significant open jump effect for all days except Wednesday and observe the end of session effect for Monday, Thursday and Friday.

CONCLUDING OBSERVATIONS

Intra-week and Intraday return patters is explored in three parts: a) Intra-week variation of returns b) Intraday variation of returns and c) Intraday variation of returns across the week. Intra-week variation of returns reveal *Monday and Friday effect* pre-dominated by most companies separately as well as collectively. Further reversal of Weekend effect is observed in this study, where, aggregate returns of Monday are observed positive and aggregate returns of Friday are negative in some companies. In addition, *Wednesday effect* pre-dominate for few companies such as NTPC Ltd., Sesa Goa Ltd. in Period 1, HDFC Bank, Hindalco Industries, Sesa Goa Ltd. in Period 2 and Infosys in Period 3. Another interesting finding is observed that *no evident Day of week anomaly* appeared on Nifty, ICICI Bank, Axis Bank Ltd., DLF, Bharat Heavy Electricals Ltd. and Sesa Goa after the introduction of pre-opening session. The pre-opening session was introduced in the market to control excess volatility at market opening, though, it has shown significant change in trading returns across weekdays.

Intraday variation of returns reveal significant trading returns in the morning and afternoon session (corroborating literature evidence for a U - shaped pattern) in Period 1. However, for Period 2 and 3, market tend to follow reverse J shape or L-shape patterns (evidence of significant returns in afternoon session). Intraday variation of returns across the week reveal prominent Monday morning returns in many companies across the three periods. Monday morning session being the first trading session of the week shows significant returns due to information announced and private information gathered by informed traders on weekends. Hence, this study provides an evidential support to the role of Informed traders on Monday morning as described by Admati and Pfleiderer in1988. (Kalev & Pham, 2009).

REFERENCES

1. Abhyankar, A., Ghosh, D., Levin, E., & Limmack, R. J. (1997). Bid-ask Spreads, Trading Volume and Volatility: Intra-day Evidence from the London Stock Exchange. *Journal of Business Finance & Accounting*, *24*(3), 343-362.
2. Admati, A. R., & Pfleiderer, P. (1988). A theory of intraday patterns: Volume and price variability. *Review of Financial studies*, *1*(1), 3-40.
3. Agrawal, A., & Tandon, K. (1994). Anomalies or illusions? Evidence from stock markets in eighteen countries. *Journal of international Money and Finance*, *13*(1), 83-106.
4. Ahn, H. J., & Cheung, Y. L. (1999). The intraday patterns of the spread and depth in a market without market makers: The Stock Exchange of Hong Kong. *Pacific-Basin Finance Journal*, *7*(5), 539-556.
5. Alabed, M. F., & Al-Khouri, R. (2008). The pattern of intraday liquidity in emerging markets: The case of the Amman Stock Exchange. *Journal of Derivatives & Hedge Funds*, *14*(3), 265-284.

6. Al-Suhaibani, M., & Kryzanowski, L. (2000). An exploratory analysis of the order book, and order flow and execution on the Saudi stock market. *Journal of Banking & Finance*, *24*(8), 1323-1357.
7. Amanulla, S., & Thiripalraju, M. (2001). Week-end effect: New evidence from the Indian stock market. *Vikalpa*, *26*(2), 33-50.
8. Andersen, T. G., Bollerslev, T., & Cai, J. (2000). Intraday and interday volatility in the Japanese stock market. *Journal of International Financial Markets, Institutions and Money*, *10*(2), 107-130.
9. Baillie, R. T., & Bollerslev, T. (1991). Intra-day and inter-market volatility in foreign exchange rates. *The Review of Economic Studies*, *58*(3), 565-585.
10. Baker, H. K., Rahman, A., & Saadi, S. (2008). The day-of-the-week effect and conditional volatility: Sensitivity of error distributional assumptions.*Review of Financial Economics*, *17*(4), 280-295.
11. Bampinas, G., Fountas, S., & Panagiotidis, T. (2015). The day-of-the-week effect is weak: Evidence from the European real estate sector. *Journal of Economics and Finance*, 1-19.
12. Bildik, R. (2001). Intra-day seasonalities on stock returns: evidence from the Turkish Stock Market. *Emerging Markets Review*, *2*(4), 387-417.
13. Boynton, W., Oppenheimer, H. R., & Reid, S. F. (2009). Japanese day-of-the-week return patterns: New results. *Global Finance Journal*, *20*(1), 1-12.
14. Brooks, C., & Persand, G. (2001). Seasonality in Southeast Asian stock markets: some new evidence on day-of-the-week effects. *Applied Economics Letters*, *8*(3), 155-158.
15. Brooks, C., Hinich, M., & Patterson, D. (2003). Intra-day patterns in the returns, bid-ask spreads, and trading volume of stocks traded on the New York stock exchange. ICMA Centre Discussion Papers in Finance icma-dp2003-14, Henley Business School. *Reading University*.
16. Chan, Y. C. (2005). Price Movement Effects on the State of the Electronic Limit-Order Book. *Financial Review*, *40*(2), 195-221.
17. Chelley-Steeley, P., & Park, K. (2011). Intraday patterns in london listed exchange traded funds. *International review of financial analysis*, *20*(5), 244-251.
18. Chen, X. B., & Zhang, Z. C. (2008). The Day-of-the-Week Effect on Stock Return and Volatility in China: Empirical Evidence from Modified GARCH Model [J]. *Chinese Journal of Management Science*, *4*, 007.
19. Chia, R. C. J., Liew, V. K. S., Wafa, S., & Wafa, S. A. (2006). Calendar anomalies in the Malaysian stock market. *MPRA Paper No*, *516*.
20. Cornett, M. M., Schwarz, T. V., & Szakmary, A. C. (1995). Seasonalities and intraday return patterns in the foreign currency futures market. *Journal of Banking & Finance*, *19*(5), 843-869.
21. Cross, F. (1973). The behavior of stock prices on Fridays and Mondays.*Financial analysts journal*, *29*(6), 67-69.
22. Cushing, D., & Madhavan, A. (2000). Stock returns and trading at the close.*Journal of Financial Markets*, *3*(1), 45-67.
23. Debasish, S. S., & Puri, T. N. (2010). An Empirical Study On Expiration Day Effects In Stock Index Futures In Indian Stock Market. *International Journal of Finance*, *22*(3).
24. DeFusco, R. A., McCabe, G. M., & Yook, K. C. (1993). Day of the week effects: A test of the information timing hypothesis. *Journal of Business Finance & Accounting*, *20*(6), 835-842.
25. Dicle, M. F., & Hassan, M. K. (2007). Day of the week effect in Istanbul stock exchange. *Scientific Journal of Administrative Development*, *5*.
26. Docking, D. S., Kawaller, I. G., & Koch, P. D. (1999). Mid-day volatility spikes in US futures markets. *Journal of Futures Markets*, *19*(2), 195-216.
27. Draper, P. and Paudyal, K. (2002). Explaining Monday Returns. *The Journal of Financial Research*, 25(4), 507-520.
28. Ederington, L. H., & Lee, J. H. (1993). How markets process information: News releases and volatility. *The Journal of Finance*, *48*(4), 1161-1191.

29. Foster, F. D., & Viswanathan, S. (1993). Variations in trading volume, return volatility, and trading costs; Evidence on recent price formation models. *The Journal of Finance*, *48*(1), 187-211.
30. French, K. R. (1980). Stock returns and the weekend effect. *Journal of financial economics*, *8*(1), 55-69.
31. Gibbons, M. and Hess, P. (1981). Day of the Week Effects and Asset Returns. *Journal of Business*, 54(4), 579-596.
32. Goh, K. L., & Kok, K. L. (2004). Time-of-the-day effect in the Malaysian stock market. *Labuan Bulletin of International Business and Finance*, *2*(1), 31-49.
33. Goh, K. L., & Kok, K. L. (2006). Beating the random walk: Intraday seasonality and volatility in a developing stock market. *International Journal of Business and Economics*, *5*(1), 41.
34. Gupta, M., & Aggarwal, N. (2004). Day of the week effect: Empirical evidence from indian stock market. *Paradigm*, *8*(2), 9-13.
35. Han, J., Ryu, D., Ryu, D., & Webb, R. I. (2016). The price impact of futures trades and their intraday seasonality. *Emerging Markets Review*.
36. Haniff, M. N., & Pok, W. C. (2010). Intraday volatility and periodicity in the Malaysian stock returns. *Research in International Business and Finance*,*24*(3), 329-343.
37. Hansen, P. R., & Lunde, A. (2005). A realized variance for the whole day based on intermittent high-frequency data. *Journal of Financial Econometrics*, *3*(4), 525-554.
38. Harris, L. (1986). A transaction data study of weekly and intradaily patterns in stock returns. *Journal of financial economics*, *16*(1), 99-117.
39. Hmaied, D. M., Grar, A., & Sioud, O. B. (2006). Dynamics of market liquidity of Tunisian stocks: An analysis of market resiliency. *Electronic Markets*,*16*(2), 140-153.
40. Ho, Y. K., & Cheung, Y. L. (1991). Behaviour of intra-daily stock return on an Asian emerging market-Hong Kong 1. *Applied Economics*, *23*(5), 957-966.
41. Hong, H., & Wang, J. (2000). Trading and returns under periodic market closures. *The Journal of Finance*, *55*(1), 297-354.
42. Jacobs, B. I., & Levy, K. N. (1988). Calendar anomalies: Abnormal returns at calendar turning points. *Financial Analysts Journal*, *44*(6), 28-39.
43. Jaffe, J., & Westerfield, R. (1985a). The Week-End Effect in Common Stock Returns: The International Evidence. *The journal of finance*, *40*(2), 433-454.
44. Jaffe, J., & Westerfield, R. (1985b). Patterns in Japanese common stock returns: Day of the week and turn of the year effects. *Journal of financial and quantitative analysis*, *20*(02), 261-272.
45. Jain, P. C., & Joh, G. H. (1988). The dependence between hourly prices and trading volume. *Journal of Financial and Quantitative Analysis*, *23*(03), 269-283.
46. Kalev, P. S., & Pham, L. T. (2009). Intraweek and intraday trade patterns and dynamics. *Pacific-Basin Finance Journal*, *17*(5), 547-564.
47. Kamath, R., & Chusanachoti, J. (2002). An investigation of the day-of-the-week effect in Korea: has the anomalous effect vanished in the 1990s.*International Journal of Business*, *7*(1), 47-62.
48. Ke, M. C., Jiang, C. H., & Huang, Y. S. (2004). The impact of tick size on intraday stock price behavior: evidence from the Taiwan Stock Exchange.*Pacific-Basin Finance Journal*, *12*(1), 19-39.
49. Kenourgios, D., Samitas, A., & Papathanasiou, S. (2005, July). The day of the week effect patterns on stock market return and volatility: Evidence for the Athens Stock Exchange. In *Proceedings of the 2nd Applied Financial Economics (AFE) International Conference on "Financial Economics", Samos island, Greece*.
50. Kiymaz, H. (2001). The effects of stock market rumors on stock prices: evidence from an emerging market. *Journal of Multinational Financial Management*, *11*(1), 105-115.
51. Kiymaz, H., & Berument, H. (2003). The day of the week effect on stock market volatility and volume: International evidence. *Review of Financial Economics*, *12*(4), 363-380.

52. Kling, G., & Gao, L. (2005). Calendar effects in Chinese stock market.*Annals of Economics and Finance*, *6*(1), 75-88.
53. Kohers, G., Kohers, N., Pandey, V., & Kohers, T. (2004). The disappearing day-of-the-week effect in the world's largest equity markets. *Applied Economics Letters*, *11*(3), 167-171.
54. Lakonishok, J., & Levi, M. (1982). Weekend effects on stock returns: a note.*The Journal of Finance*, *37*(3), 883-889.
55. Lee, Y. T., Fok, R. C., & Liu, Y. J. (2001). Explaining intraday pattern of trading volume from the order flow data. *Journal of Business Finance & Accounting*, *28*(1-2), 199-230.
56. Liano, K., & Gup, B. E. (1989). The day-of-the-week effect in stock returns over business cycles. *Financial Analysts Journal*, *45*(4), 74-77.
57. Lucey, B. M., & Pardo, A. (2005). Why investors should not be cautious about the academic approach to testing for stock market anomalies. *Applied Financial Economics*, *15*(3), 165-171.
58. Marrett, G. E., & Worthington, A. C. (2009). The day-of-the-week effect in the Australian stock market: An empirical note on the market, industry and small cap effects. *International Journal of Business and Management*, *3*(1), 3.
59. McGowan Jr, C. B., & Ibrihim, I. (2011). An analysis of the day-of-the-week effect in the Russian stock market. *International Business & Economics Research Journal (IBER)*, *8*(9).
60. McInish, T. H., & Wood, R. A. (1992). An analysis of intraday patterns in bid/ask spreads for NYSE stocks. *the Journal of Finance*, *47*(2), 753-764.
61. Nath, G. C., & Dalvi, M. (2004). Day of the week effect and market efficiency-evidence from Indian equity market using high frequency data of national stock exchange. *Available at SSRN 1092765*.
62. Niarchos, N. A., & Alexakis, C. A. (2003). Intraday stock price patterns in the Greek stock exchange. *Applied Financial Economics*, *13*(1), 13-22.
63. Onyuma, S. O. (2009). Day-of-the-week and month-of-the-year effect on the Kenyan stock market returns. *Eastern Africa Social Science Research Review*, *25*(2), 53-74.
64. Qiang, F. U., Liang, Q., & Chen, Y. U. A. N. (2013). An Empirical Evidence on the Day-of-the-Week Effect of Exchange Rate Return and Volatility in China [J]. *Journal of Chongqing University (Social Science Edition)*, *1*, 012.
65. Rahman, M. L. (2009). Stock market anomaly: Day of the week effect in Dhaka stock exchange. *International Journal of Business and Management*,*4*(5), 193.
66. Ranjan, R., & Padhye, A. (2000). Market Anomalies in Emerging Markets: Revisiting the Calendar Effect in Stock Prices. *ICICI Research Centre. Org*, 1-19.
67. Rogalski, R. J. (1984). New findings regarding day-of-the-week returns over trading and non-trading periods: a note. *The Journal of Finance*, *39*(5), 1603-1614.
68. Savva, C. S., Osborn, D. R., & Gill, L. (2006). The day of the week effect in fifteen European Stock Markets. *University of Manchester*.
69. Smirlock, M., & Starks, L. (1986). Day-of-the-week and intraday effects in stock returns. *Journal of Financial Economics*, *17*(1), 197-210.
70. Strawiński, P., & Ślepaczuk, R. (2008). „Analysis of high frequency data on the Warsaw Stock Exchange in the context of efficient market hypothesis".*Journal of Applied Economic Sciences*, *3*(3), 306-319.
71. Tachiwou, A. M. (2010). Day-of-the-week-effects in West African regional stock market. *International Journal of Economics and Finance*, *2*(4), 167.
72. Thushara, S. C., & Perera, P. (2014). Day of the week effect of stock returns: Empirical evidence from Colombo stock exchange. *Kelaniya Journal of Management*, *1*(2).
73. Wood, R. A., McInish, T. H., & Ord, J. K. (1985). An investigation of transactions data for NYSE stocks. *The Journal of Finance*, *40*(3), 723-739.
74. Yamori, N., & Kurihara, Y. (2004). The day-of-the-week effect in foreign exchange markets: multi-currency evidence. *Research in International Business and Finance*, *18*(1), 51-57.