Day of the Week Effect in Returns and Volatility of Nifty 50: An Evidence using High Frequency Data

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Abstract

Return and volatility patterns of stock market are of huge concerns for academicians, investors, traders and market regulators. Availability of high frequency data has made a paradigm shift to re-test these patterns. Therefore, this study has tried to explore Day of the week effect in return and volatility using the five-minute interval of Nifty 50 for the period before and after introduction of pre-opening session. Results depicts that Monday and Friday returns are significant for period before the introduction of pre-opening session. However, no day of the week effect is evident for period after the introduction of pre-opening session. Additionally, volatility significantly differ across the trading days except on Monday (before the introduction of pre-opening session) and Friday (after the introduction of pre-opening session). Highest volatility is observed on Thursday in both the sub-periods. However, lowest volatility is observed on Tuesday for the period before the introduction of pre-opening session and Wednesday for the period after the introduction of pre-opening session.

Keywords: Day of the week effect, High-frequency data, Pre-opening session, Return, Volatility.

Introduction

Day-of-the-Week effect is defined as a trading pattern that differ across the trading days of the week. According to Efficient Market Hypothesis (EMH), returns, volume or volatility are same for all trading days of the week which indicates that the expected return on a security is same for all days of the week. However, there are large number of studies rejecting this EMH and provide the evidences for presence of Day-of-the-Week effect. (Poshakwale,1996; Ranjan and Padhye, 2000; Al-Loughani, & Chappell, 2001; Bhattacharya et al., 2003; Kenourgios et al., 2005; Rahman, 2009; Muhammad & Rahman, 2010).

All the above studies mentioned have observed significant trading pattern across the trading days. Developing and testing the trading strategies based on the trading behaviour of the market on different trading days may help in decision making related to short-term trading, investments and portfolio optimization. Based on day of the week trading patterns, Mangala and Mittal (2005) had suggested that shares must be purchased on Friday and sold on Wednesday, due to superior trading return probable on Wednesday.

But the prior research related to Day-of-the-Week effect have made use of daily data. However, difficulty linked with the daily data is that it is an average of last 30 minutes trade. Therefore, daily data is not suitable to reveal the dynamics of entire trading session. But, emergence of high speed electronic technology these days have made the high frequency data available. Therefore, present study has tried to explore day of the week effect anomaly using high frequency data.

Literature Review

There is huge amount of literature evidence for Day-of-the-Week effect not only in domestic markets as well as in International markets. Research is not only restricted to stock market, but also in bond, derivatives and commodities markets. However, there are some studies which highlight that Day-of-the-Week effect is more prominent in the securities market, because institutional investors participate a greater role (Sias and Starks 1995).

Existing literature provides an evidence for significant returns, volume or volatility on different trading days. Monday was evident in Lakonishok and Levi 1982; Rogalski 1984; Defusco et al., 1993; Ranjan and Padhye, 2000; Kling and Goa, 2005 studies. This is due to the traders with private information (informed traders) obtain maximum benefit on Mondays, which is the initial trading day of the week (Foster and Viswanathan 1990, 1993).

Tuesday is also apparent in various empirical studies such as Aggarwal & Rivoli (1989); Goswami and Anshuman (2000); Amanulla and Thiripalraju (2001), Nath and Dalvi (2004), Boynton et al. (2006) etc. Various empirical studies support the Wednesday effect, which includes Poshakwale, 1996; Kiymaz, 2001; Berument et al., 2007; Baker et al., 2008; Chen & Zhang, 2008; Tachiwou, 2010; McGowan & Ibrihim, 2011; Aziz & Ansari, 2015. The literature demonstrates that behavioural aspect of Indian investors, which lead to Wednesday effect. Indians have positive attitude towards making any trade on Wednesday most of the times, hence, significant patterns are observed on Wednesday (Ranjan and Padhye 2000; Amanulla and Thiripalraju 2001; Gupta and Aggarwal 2004).

Thursday is evident in many studies such as Liano & Gup, 1989; Kiymaz & Berument, 2003; Bhattacharya et al., 2003; Berument et al., 2007; Dicle & Hassan, 2007; Baker et al., 2008, Chen & Zhang, 2008; Marrett & Worthington, 2009; Rahman, 2009; Tachiwou, 2010; Qiang & Chen, 2013; Thushara & Perera, 2014. Reason behind this evidence have been justified via major macro-economic releases on Thursday (Kiymaz and Berument, 2003). Another possible cause for Thursday effect is due to the expiration of derivatives contract on Thursday. Highest trading volume is evident on contract expiration day (Thursday). (Debasish & Puri, 2010).

There are a number of studies which support the existence of Friday effect (Rogalski et al., 1984; Berument & Kiymaz, 2001; Demirer & Karan, 2002; Baker et al., 2008; Onyuma, 2009; Tachiwou, 2010; McGowan & Ibrihim, 2011; Rodriguez, 2012; Thushara & Perera, 2014; Bampinas et al. 2015). Literature demonstrate the Friday effect due to huge buying activities by insider traders. Hence, this Friday effect causes the "Weekend effect" , due to consequent selling activity to succeeding Monday.

All these previous studies have mostly used the low frequency (mostly daily) data. A few studies have used the high frequency data for exploring the day of the week effect, which include Tang and Lui (2002) for Hong Kong Stock and Futures Market; Nath & Dalvi (2004) for Indian Stock Market Kalev & Pham (2009) for Australian Stock Market etc. The present study has also tried to contribute to Indian high frequency literature by exploring day of week effect in returns and volatility using 5-minute interval return for the Nifty 50.

Database And Methodology

Five minute interval data for Nifty 50 returns for the period 1st January 2010-31st March 2011 is used. Pre-opening session launched on 18th October 2011. Therefore, total data period was bifurcated into 2 parts

- Sub-period I: 1st January 2010-17th October 2010 (Before the launch of pre-opening session)
- Sub-period II: 18th October 2010-31st March 2011 (After the launch of pre-opening session)

Database for high frequency data for the Capital Market segment has been purchased from Dotex International Limited, a subsidiary of National Stock Exchange. Visual Fox Pro is used to manage the data base. Nifty 50 price data has been extracted at 5-minute interval. The 5-minute interval returns are calculated as the difference of the logarithmic prices i.e

$$Rp = Ln (Pt - Pt-1)$$

Where Rp denote return, Pt denote price at interval t and Pt-1 denote price at interval t-1.

Summary statistics and various statistical tests are used for the analysis. Descriptive statistics, Augmented Dickey Fuller (ADF), ARMA (Auto-regressive Moving Average) model is used in preliminary examination. Further, Day of the week effect in returns and volatility is explored using GARCH (1,1) (Generalized Auto-regressive Conditional Heteroskedasticity) by incorporating weekday dummy variables.

Analysis And Interpretation

Preliminary Analysis

Descriptive statistics for entire sample are computed to

study the distribution pattern. From table 1, it is observed that mean returns for Nifty is positive in sub-period I and negative in sub-period II. Nifty returns series have low standard deviation in both the sub-periods, which depicts that returns have the mean reverting behaviour.

The coefficient of the Jarque-bera is significant at 1 percent both the sub-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 in both sub-periods is evident.

Augmented Dickey-Fuller test statistic is employed to test the stationarity of the return series. It is also called as unit root test. From table 1, it is clearly evident that nifty returns are stationary at the 1% level of significance.

Auto-correlations are confirmed using ARMA model. Table 1 reveals significant AR and MA for both the sub-periods. AR(2) and AR(4) is significant for the sub-period I. AR(1) is significant for the sub-period II.

Table 1: Preliminary analysis statistics

	Nifty (Sub-period I)		Nifty (Sub-period II)
Mean	9.77E-06		-5.57E-06
Median	5.84E-06		1.90E-05
Std. Dev.	0.001082		0.00141
Skewness	-0.69118		-0.32273
Kurtosis	36.10491		20.1968
Jarque-Bera	712456.2*		103046.6*
Augmented Dickey -Fuller test statistic	-126.026*		-96.32451*
Auto-regressive Moving Average (ARMA) terms	AR(2) -0.0177 (0.0271)**	AR(4) 0.0247 (0.0021)*	AR(1) -0.04694 (0.000)*

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

Day of the week effect in returns

Efficient Market Hypothesis (EMH) states that trading returns for all trading days must not be significantly dissimilar from each other (Draper and Paudyal 2002). Following econometric model has been used to test this hypothesis:

$Rt = \beta 1\ Dmonday + \beta 2\ Dtuesday + \beta 3\ Dwednesday + \beta 4 D\ thursday + \beta 5 D\ friday + €$

Where, Rt represents return's residual from ARMA model,

Dmonday represent dummy variable for Monday (1=if weekday is Monday, otherwise 0), Dtuesday represent dummy variable for Tuesday (1=if weekday is Tuesday, otherwise 0), Dwednesday represent dummy variable for Wednesday (1=if weekday is Wednesday, otherwise 0), Dthursday represent dummy variable for Thursday (1=if weekday is Thursday, otherwise 0), Dfriday represent dummy variable for Friday (1=if weekday is Friday, otherwise 0) and € is error term. Intraday returns variances are dependent of time, therefore, above model is adjusted to take into account these Autoregressive Conditional Heteroscedasticity (ARCH) effects. There GARCH(1,1) is employed for the above model

Table 2: Day of week effect in Mean equation of GARCH (1,1)

	Nifty (Sub-period I)	Nifty (Sub-period II)
Monday	2.95E-05 (0.020)*	2.10E-05 (0.222)
Tuesday	-9.84E-06 (0.432)	1.44E-05 (0.547)
Wednesday	1.88E-05 (0.170)	8.30E-06 (0.797)
Thursday	2.48E-06 (0.849)	-1.29E-06 (0.960)
Friday	2.28E-05 (0.057)***	-2.76E-05 (0.283)
C	7.52E-08 (0.000)*	1.28E-07 (0.000)*
ARCH	0.25 (0.000)*	0.15 (0.000)*
GARCH	0.73 (0.000)*	0.80 (0.000)*

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

From table 2, it is observed that Monday and Friday returns are significant for sub-period I. However, for sub-period II, above said hypothesis is found to be true i.e. nifty returns for all trading days is not be significantly different from each other.

Day of the week effect in volatility

According to EMH, volatility for all trading days should not be significantly different from each other (Kiymaz and Berument, 2003). To test this hypothesis, following econometric model is used.

Mean Equation: $R_t = c + u_t$

Where, Rt= Return's residual from ARMA model

Variance Equation:

$\sigma_t^2 = \alpha_n + \alpha_1 u_{t-1}^2 + \beta \sigma_{t-1}^2 + \alpha_2 D_{monday} + \alpha_3 D_{tuesday} + \alpha_4 D_{wednesday} + \alpha_5 D_{friday} + €$

This is GARCH 1 ( )model ,which deals in two equation : Mean Equation , which is included the residuals from ARMA model and Variance Equation .Where ,σ ²t denotes conditional variance , α n isconstant of variance equation , (q u²t ₁)represents lag of the squared residual from the mean equation , (βσ t ₁²) represents forecasted variance the model during the previous period , Dmonday denotes dummy variable for Monday (=if weekday is Monday , otherwise 0) Dtuesday denotes dummy variable for Tuesday (=if weekday is Tuesday , otherwise 0), Dwednesday denotes dummy variable for Wednesday (=if weekday is Wednesday , otherwise 0) Dfriday denotes dummy variable for Friday (=if weekday is Friday , otherwise 0)and is error term

Table 3: Day of week effect in Variance equation of GARCH (1,1)

	Nifty (Sub-period I)	Nifty (Sub-period II)
Constant	6.60E-08^ (0.000)*	1.62E-07^ (0.000)*
ARCH (1)	0.25 (0.000)*	0.14 (0.000)*
GARCH (1)	0.73 (0.000)*	0.80 (0.000)*
Monday	-3.08E-09 (0.390)	-1.84E-08 (0.000)*
Tuesday	1.53E-08" (0.000)*	-3.47E-08 (0.000)*
Wednesday	2.76E-08 (0.000)*	-9.27E-08" (0.000)*
Friday	2.75E-08 (0.000)*	-3.39E-09 (0.677)

* 1% significance level ** 5% significance level Source: Author's calculations.
Constant= representing dummy for Thursday. ^Highest significant volatility "Lowest significant volatility.

From table 3, it is observed that volatility significantly differ across the trading days except on Monday (for sub-period I) and Friday (for sub-period II). Highest volatility is observed on Thursday in both the sub-periods. Kiymaz and Berument (2003) has given a very justified reason for the high volatility on Thursday and Friday, due to several macroeconomic news releases taking place on Thursday and Friday. Another possible explanation of highest volatility on Thursday is due to expiration of derivatives contract on the last Thursday of the month. Debasish & Puri (2010) observed a significant increase in trading volume on expiration day. Hence, higher trading volume leads to higher volatility for the day.

However, lowest volatility is observed on Tuesday for sub-period I and Wednesday for sub-period II. Lowest volatility on Tuesday is also observed by Bayar & Kan (2012). The low volatility on Wednesday is explained by Kiymaz and Berument (2003), is due to the "middle of the week". They explained that investors enfold information sets on the days before Wednesday and forecast for the subsequent next two days.

Conclusion

Patterns in returns and volatility might facilitate investors to take advantage of relatively regular shifts in the market by designing trading strategies which accounts for such predictable patterns (Kiymaz and Berument 2003). This study have tried to explore such pattern in return and volatility using the five-minute interval. It is observed that Monday and Friday returns are significant for period before the introduction of pre-opening session. However, for period after the introduction of pre-opening session, no day of the week effect is evident.

Additionally, Volatility significantly differ across the trading days except on Monday (before the introduction of pre-opening session) and Friday (after the introduction of

pre-opening session). Highest volatility is observed on Thursday in both the sub-periods. However, lowest volatility is observed on Tuesday for the period before the introduction of pre-opening session and Wednesday for the period after the introduction of pre-opening session.

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