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Expiration and Week effect: Empirical Evidence from the Indian Derivative Market

* Naliniprava Tripathy

This study investigates the expiration day and week effects for nifty futures by using Kruskal-Wallis test for the period from November 2007 to November 2009. The study also analyzed the day of the week effect in Bearish phase and Bullish phase to see to what extent the day of the week effect is visible in these specific market phases. The study explains that the Day of the Week effect found to be absent in the Bearish phase but is seen in bullish phase. Further, the study found that the trading volume for the NIFTY future index increased as the expiration date move towards nearer. It also indicates that the trading volume on the expiration day is significantly different than the trading volume on other days. The study concludes that the day-of-the-week effect is not persistent in either the derivatives or the cash markets in India.

Key words: Stock market, Kruskal-Wallis test, expiration week, day-of-the-week, expiration day

JEL Classification: G1, G12, G 14

Field of Research: Finance, Stock Market, Emerging economics

1. Introduction

The impact of introduction of derivative products on the underlying stock market volatility received major attention all over the world. Stock index future contracts are the most successful financial innovation during 1980s.The main reason for the success of this instrument is that index futures provide a fast and inexpensive means of changing stock market risk exposures internationally. All stock index future contracts call for cash settlement on the expiration day.The day-of-the-week effect has been one of the widely studied market anomalies (see Pettengill, 2003 and Bildik, 2004 for survey), but researchers are still not unanimous about its exact source and implication. However, most of the published research work in the past has focused on developed market. Over the last two decades the emerging markets, with their liberalization policies have gained the significance both for researchers and investors world over (See for example, Bekaert *et al.* 2003, 2007; Bekaert and Harvey, 2003, Phylaktis and Ravazzolo, 2005) . Since, these markets have gone through many changes in their macro and micro structure; they provide us a good opportunity to understand the importance of market structure, practices and policies in price discovery process. Index derivatives are frequently accused of creating "undesirable" effects on the market for the underlying securities. One of these effects is the expiration day effect. Expiration day effects may arise from stock index arbitrageurs unwinding of arbitrage positions in the stock market. If many arbitrageurs liquidate at the same time and in the same direction, price effects are possible. Another possible explanation for expiration day price effects is deliberate attempts to manipulate prices. A speculator with a naked position in an expiring

Associate Professor (Finance), Indian Institute of Management Shillong, Mayurbhanj Complex, Nongthymmai, Shillong, Meghalaya PIN 793 014, INDIA, Phone: +91-364-2308037, Fax: +91-364-2230041,Email: nt@iimshillong.in, nalini_prava@yahoo.co.in

contract may have a significant financial interest in the contract's settlement price and may be willing to put through small cash market trades at non-equilibrium prices to manipulate the index in a favourable direction. Previous research on expiration-day effects on Index futures has generally found that spot trading volume is abnormally high at expiration and that the volatility increases as the expiration date comes nearer. Others studies have found no significant affect on volatility. Keeping in view, the present study raised three research questions .First this paper is expected to extend prior research and provides new insights about the implications the day of the week effect. However no research has been conducted in Indian so far that explicitly addresses the effect of changing expiration day effects of the index futures on their volatility on the intra-week behaviour of the stock returns. So secondly, we use Kruskal Wallis test to examine the expiration day effects of the index futures on their volatility. Thirdly, the study also analyzed the day of the week effect in Bearish phase and Bullish phase to see to what extent the day of the week effect is visible in these specific market phases. Therefore the findings of the present study are expected to add a fuller dimension to the literature in this area. The remaining of this paper is structured as follows: the next section presents a brief survey of the literature, in Section 3 describes the data and the methodology used and the results of the study are presented in Section 4 and finally Section 5 concludes the paper.

2. Literature Review

Several hypotheses have been extended to explain the day-of-the-week effect; the most prominent among them are the information release hypothesis, the information processing hypothesis and the settlement regime hypothesis (Keef and Roush, 2005). In US the negative Monday-effect has been found much larger than the positive Friday-effect and the settlement procedure is unable to explain it completely (Gibbons and Hess, 1981; Dyl and Martin, 1985). In some other markets, the day-of-the-week effect has been found to take place on the days other than the days which are expected to produce higher or lower returns on the basis of settlement system (Lakonishok and Levi, 1982; Jaffe and Westerfield, 1985, Choudhry, 2000).There is extensive empirical evidence on the expiration-day effects of US derivatives markets, where the *triple witching hour* has encouraged specific studies (Feinstein and Goetzmann 1988, Herbst and Maberly, 1990, Hancock, 1993). Empirical results generally report abnormally high trading volume and lower average returns on expiration days. However, the downward pressure on the underlying stock market does not tend to reverse at the next opening, suggesting that expiration should not be associated with this price pattern. Stoll and Whaley (1997) also found evidence of some increased volatility in individual stock returns in the Australian Stock Exchange. Chow et. al. (2003) provides evidence of abnormal volatility in the Hang Seng Index relative to one and five trading days before the expiration of their futures and options derivative contracts. However, other studies have found no significant effects on volatility. Finally, Corredor et al. (2001) provided empirical evidence suggesting that the expiration of the Ibex 35 index derivatives has no significant effect on the conditional variance of the Ibex 35 spot index. The day of the week effect in Indian market was examined by many researchers in the Indian context as well. Bhattacharya et al (2003) used GARCH framework by incorporating the lagged returns (BSE 100) as explanatory variables in the conditional mean. They have used reporting and non-reporting weeks to study the day of the week effect. Hagelin,

Niclas & Alkeback, Per,(2004) examines index futures and options expiration day effects on the Swedish market and indicate that trading volumes on the cash market are significantly higher on expiration days than on other days, no evidence suggesting that price distortions occurred is found. Arora, Varun and Das, Sromon (2007) investigates the existence of seasonality in India's stock market, primarily trying to detect the day of the week effect in the Stocks listed on the National Stock Exchange for the period from November 1994 to September 2007. The results confirm the existence of seasonality (in the form of Day of the Week Effect) stock returns in India for 66 Stocks spanning across various sectors. The results of the study imply that the stock market in India is inefficient, and hence, investors can time their share investments to improve returns and make abnormal profits. However the Day of the Week effect was found to be absent in the Bullish as well as the Bearish phase. Fung, Joseph K.W. and Yung , Haynes (2007) does not find significant price reversal and price compression patterns but order imbalance pattern is found on some expiration days. The results show no association between order imbalance pattern and the next-day return also No price reversal pattern can be found on the next day.

3. Data and Methodology

The required time series data have been collected from www.nse.com for a period of two years from November 2007 to November 2009.The two years which we have chosen consist of index futures having 25 different expiration dates. For convenience, we treat all those index futures differently. The expiration dates are 29-Nov-07, 27-Dec-07, 31-Jan-08, 28-Feb-08, 27-Mar-08, 24-Apr-08, 29-May-08, 26-Jun-08, 31-Jul-08, 28-Aug-08, 25-Sep-08, 29-Oct-08, 27-Nov-08, 25-Dec-08, 29-Jan-09, 26-Feb-09, 26-Mar-09, 30-Apr-09, 28-May-09, 25-Jun-09, 30-Jul-09, 27-Aug-09, 24-Sep-09, 29-Oct-09, and 26-Nov-09. Returns are proxied by the log difference change in the price index. The index return is calculated as the continuously-compounded return using the closing price:

$$R_t = \ln(\frac{P_t}{P_{t-1}}) * 100\%$$

Now, the study is divided into two parts. First is to determine the expiration day effects on the price volatility and volume for NIFTY Index futures. For determining the expiration day effect on volatility, we took the 30 day moving standard deviation of the returns multiplied by the square root of the no. of trading days which would be 252 in our case:

$$Volatility\ per\ annum = Volatility\ per\ trading\ day \times \sqrt{No.of\ trading\ days\ per\ annum}$$

Both t-test and F-test are applied on the data to find whether the trading volume, volatility and returns change significantly on the expiration day and expiration week effect on volatility of NIFTY futures index.

Further, for the expiration week effect on volatility of NIFTY futures index and trading volume of NIFTY futures index, the data is divided into two groups: the comparison

group (having all the returns except that of expiration week) and the expiration group (having the returns of the expiration week). The mean and standard deviation are calculated for both comparison and expiration groups. And then, two-sided t-test is applied to find out whether mean return at expiration and trading volume at expiration week is different than the mean return of the data comprising the comparison group. Also, F-test is applied to find out whether the volatility at expiration is same or different than the volatility during the comparison weeks.

For day of the week effect, we use the Kruskal Wallis test. The Kruskal-Wallis one way analysis of variance by ranks is a non-parametric method for testing equality of means across groups. It is similar to a one way analysis of variance with the data replaced by their ranks. The reason why we chose this test is that it is nonparametric in nature, and thus does not compel us to assume a normal population. For this purpose, our null hypothesis is that the mean returns across all the trading days are equal. If the Kruskal-Wallis statistic is less than the critical chi-square value, it implies that the null hypothesis should not be rejected, and that mean returns across the week-days are not significantly different from each other. The opposite reasoning holds when the K-W statistic is more than the critical value.

The formula for calculating the K-W statistic is:

$$K-W=\frac{12}{N(N+1)}\sum_{i=1}^{k}R_i^2-3(N+1)$$

Empirical Analysis

The trading volume for the NIFTY future index increased as the expiration date came nearer. It is maximum around 10-15 days prior to expiration and decreased as the expiration approached. This can be attributed to the fact that the strike price equals the spot price on the expiration date. As far as the price volatility is concerned, it is observed that for some index futures, the volatility increased as expiration date came nearer, for some it decreased and for some it had an irregular pattern. The above table-1 shows that the daily returns and volatility on the expiration day is not significantly different from the returns and volatilities on other days.

Table-1 Expiration Day Effect on Volatility
Daily returns and standard deviation for the NIFTY future index

Expiry Date	Statistics	Comparison Group	Expiration Group	t-test	Critical t-value (5%)	F-test
Common	Mean	-0.000729	0.00148			
	Standard Deviation	0.027887	0.01476	0.3788	1.96	0.2801

Table-2 Expiration Day Effect on Trading Volume
Daily adjusted trading volume for the NIFTY Future index

Expiry Date	Statistics	Comparison Group	Expiration Group	t-test	Critical t-value (5%)
Common	Mean	245533.47	485576		
	Standard Deviation	315497.57	114912	3.6433*	1.96

The table 2 output shows that the trading volume on the expiration day is significantly different than the trading volume on other days at 95% confidence level.

Table-3 Expiration Week Effect on Volatility & Trading Volume
Daily returns and standard deviation for the NIFTY future index

Expiry Date	Statistics	**Volatility**			**Trading Volume**		
		Comparison Group	Expiration Group	t-test	Comparison Group	Expiration Group	t-test
Common	Mean	-0.0009452	0.002901	7.51*	216957.7	566164	10.3*
	Standard Deviation	0.02814569	0.020306		306701.4	165922	

*Null hypothesis rejected at 5% significance level

It is evidence from table-3 that the weekly returns and volatilities of NIFTY futures during the expiration week are not significantly different from the returns and volatilities during other comparison weeks. It is also observed from the table 3 that the trading volume on expiration days and in expiration weeks is significantly larger than on comparison days and during comparison weeks. So it suggests that there are no price distortions on the expiration day or during the expiration week for the complete sample period. Also, when all the NIFTY futures indices are taken as one irrespective of their expiration dates, it is found that the trading volume during expiration week is found to be significantly different than that of other comparison weeks at 5% significance level. The significantly higher trading volumes on the expiration day and during the expiration week suggest that arbitrage activity took place and that positions are unwound before the actual expiration.

Table 4 Day of the week effect: NIFTY futures Kruskal Wallis Test

DAY	N	Mean Rank
Monday	13	31.92
Tuesday	13	40.38
Wednesday	12	28.17
Thursday	10	22.70
Friday	11	24.09
Total	59	

Test Statistics

Chi-square	8.160*
Df	4
Asymp.sig	0.086

The null hypothesis states that the mean rank of the returns in the given period is equal for all weekdays. The probability of the Kruskal Wallis is 0.086, which is less than or equal to the level of significance of 10%. We reject the null hypothesis that the mean rank of the returns in the given time horizon are different for one or more weekdays.

Table-5 Day of week Effect

Expiry Date	Chi- Square Value	Asymp. Sig.
29-Nov-07	7.091	0.131
27-Dec-07	2.117	0.714
31-Jan-08	5.043	0.283
28-Feb-08	2.178	0.703
27-Mar-08	2.846	0.584
24-Apr-08	1.312	0.859
29-May-08	2.161	0.706
26-Jun-08	2.258	0.668
31-Jul-08	7.795*	0.093
28-Aug-08	4.281	0.369
25-Sep-08	6.389	0.172
29-Oct-08	8.16*	0.086
27-Nov-08	4.445	0.349
25-Dec-08	2.121	0.714
29-Jan-09	2.618	0.624
26-Feb-09	0.453	0.978
26-Mar-09	1.681	0.794
30-Apr-09	7.562*	0.109
28-May-09	3.576	0.466
25-Jun-09	2.173	0.704
30-Jul-09	3.482	0.481
27-Aug-09	2.824	0.588
24-Sep-09	3.047	0.555
29-Oct-09	1.26	0.868
26-Nov-09	3.436	0.488

* Null hypothesis rejected at 10% significance level

K-W statistics gives us a basic idea of non- the existence of market anomalies in the Indian market. It is clearly visible from table 5 that day of the week effect is observed in only three out of twenty-five futures indices expiration dates. This indicates that day of the week effect is not present in almost all of the NIFTY futures indices. This could be attributed to the fact that the data we have taken is primarily of the bearish phase.However, one needs to discount these findings in light of the fact that the K-W test is after all a non-parametric test, and its results are not conclusive.

Table-6 Day of the week effect: 50 stocks constituting the NIFTY

Name of Stock	Bullish	Weekday Effect Observed for Bullish Market	Bearish	Weekday Effect Observed for Bearish Market
ABB Ltd.	35.994	Y	42.217	Y
ACC Ltd.	48.077	Y	5.822	N
Ambuja Cements Ltd.	3.984	N	11.322	Y
Axis Bank Ltd.	1.95	N	599.19	Y
Bharat Heavy Electricals Ltd.	43.76	Y	11.544	Y
Bharat Petroleum Corporation Ltd.	15.276	Y	9.69	Y
Bharti Airtel Ltd.	16.34	Y	6.392	N
Cairn India Ltd.	3.151	N	6.69	N
Cipla Ltd.	40.17	Y	1.352	N
DLF Ltd.	3.213	N	1.84	N
GAIL (India) Ltd.	35.374	Y	-189.327	N
Grasim Industries Ltd.	41.449	Y	2.752	N
HCL Technologies Ltd.	51.9	Y	2.998	N
HDFC Bank Ltd.	60.01	Y	1.424	N
Hero Honda Motors Ltd.	52.758	Y	3.925	N
Hindalco Industries Ltd.	4.34	N	3.222	N
Hindustan Unilever Ltd.	8.04	N	-59.7	N
Housing Development Finance Corporation Ltd.	45.397	Y	0.8679	N
I T C Ltd.	41.01	Y	1.688	N
ICICI Bank Ltd.	42.62	Y	1.171	N
Idea Cellular Ltd.	2.98	N	6.91	N
Infosys Technologies Ltd.	43.49	Y	4.32	N
Jindal Steel & Power Ltd.	33.4	Y	2.176	N
Larsen & Toubro Ltd.	-9.43	N	3.177	N
Mahindra & Mahindra Ltd.	41.95	Y	2.002	N
Maruti Suzuki India Ltd.	48.51	Y	1.698	N
NTPC Ltd.	30.004	Y	1.129	N
National Aluminium Co. Ltd.	38.59	Y	2.29	N
Oil & Natural Gas Corporation Ltd.	42.89	Y	1.482	N
Power Grid Corporation of India	3.551	N	1.636	N
Punjab National Bank	45.8	Y	-5.44	N
Ranbaxy Laboratories Ltd.	44.174	Y	4.977	N
Reliance Capital Ltd.	42.62	Y	2.8	N
Reliance Communications Ltd.	11.18	Y	2.04	N

Reliance Industries Ltd.	43.88	Y	2.66	N
Reliance Infrastructure Ltd.			1.334	N
Reliance Power Ltd.			1.504	N
Siemens Ltd.	39.45	Y	2.508	N
State Bank of India	42.3	Y	2.384	N
Steel Authority of India Ltd.	35.875	Y	1.535	N
Sterlite Industries (India) Ltd.	26.33	Y	2.695	N
Sun Pharmaceutical Industries	40.77	Y	2.021	N
Suzlon Energy Ltd.	20.736	Y	7.827	N
Tata Communications Ltd.			4.076	N
Tata Consultancy Services Ltd.	39.89	Y	4.79	N
Tata Motors Ltd.	49.88	Y	4.688	N
Tata Power Co. Ltd.	37.58	Y	3.814	N
Tata Steel Ltd.	13.64	Y	1.66	N
Unitech Ltd.	38.588	Y	1.03	N
Wipro Ltd.	50.83	Y	-8.5	N

It is observed from the table 6 that three stocks Tata Communications Ltd., Reliance Power Ltd. and Reliance Infrastructure Ltd. are listed at the beginning of the bearish phase, hence the k-values for the bullish phase are absent for these stocks. It is also evident that in the bullish phase (1st January 2005 to 18th January 2008), 38 stocks exhibit the weekday effect and 9 stocks don't exhibit the weekday effect. In the bearish phase (21st January 2008 to 6th August 2009), 5 stocks exhibit the weekday effect and 45 stocks don't exhibit the weekday effect.

4. Conclusion and limitation

This study examined potential expiration effects on the nifty index by comparing the trading volume and return process on expiration days and during expiration weeks with a set of comparison days and comparison weeks. On the basis of our analysis, it is found that the daily returns and volatility on the expiration day is not significantly different from the returns and volatilities on other days. But the trading volume on the expiration day is significantly different than the trading volume on other days at 95% confidence level. It is also observed from the expiration week effects on volatility and trading volume and found that the weekly returns and volatilities of NIFTY futures during the expiration week are not significantly different from the returns and volatilities during other comparison weeks. The results suggest that there are no price distortions on the expiration day or during the expiration week for the complete sample period. The study also found that day of the week effect is not present in almost all of the NIFTY futures indices. While looking for day of the week effect for the fifty stocks constituting the NIFTY, it is found that in the bullish phase thirty-eight stocks exhibit the weekday effect and nine stocks don't exhibit the weekday effect. In the bearish phase five stocks exhibit the weekday effect and forty stocks don't exhibit the weekday effect. One of the limitations of study is that we have used the K-W test which only gives us an indicative answer, and not a conclusive one. Secondly we have taken data for a period of two years. This period is mainly turmoil phase of

world financial market.So, the day of the week effect in case of derivatives and stocks have shown similar results because of the common time period chosen in the stock market. This can be attributed to the fact that all investors think in same way and are driven by the same instincts during these phases of the market.

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