Expiration Effects of Stock Futures on the Price and Volume of Underlying Stocks: Evidence from India

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Abstract

The National Stock Exchange (NSE) of India was ranked the first in terms of trading of individual stock futures in the year 2007. The financial derivatives like stock futures have always been accused of causing instability in the spot market. This paper investigates the effects of individual stock futures expiration on the underlying stock market in the NSE. Using daily data of forty two sample stocks of high market capitalization, this study has found positive abnormal return and also abnormal volume on days prior to the expiration day..

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I. Introduction

Introduction of financial derivatives like stock futures is considered to be one of the most important financial innovations that have taken place in the sphere of financial market in the last few decades. The primary objective of such a structural change in the financial market is to contain the risk involved in the financial investment strategies. The National Stock Exchange (NSE) of India has introduced a variety of financial derivatives to keep pace with rest of the world in maintaining efficiency and quality of the financial market. The stock futures was introduced for trading in the NSE on November 9, 2001 on a limited number of common shares. However, over the course of time, the spectrum of stock futures traded in the NSE has widened and NSE was ranked the first in the world in the year 2007 in terms of trading activity in the stock futures market. As of now, 266 stocks are allowed to be traded in the futures segment of the NSE. However, the increased acceptance of stock futures as an effective investment instrument raises many questions regarding the possible impact of stock futures trading on markets for other securities, especially on the market for underlying stocks. Therefore, this paper attempts to investigate the effects of stock futures expiration on the price and volume of the underlying stocks.

The expiration day effect may be defined as the effect on securities prices and volume as traders adjust their positions shortly before expiration of options and futures contracts. The expiration day effect may arise from several sources (Stoll and Whaley, 1997). One is from the arbitrageurs who unwind arbitrage positions in the stock market due to the deviation of the futures price from

its fair value stipulated by the cost-of-carry relationship. If many arbitrageurs liquidate at the same time and in the same direction, price effects are possible. However, this strategy termed as cash-and-carry arbitrage make sense only when the cost involved is less than the arbitrage profit. The market price manipulation is another source of expiration day effect. The investors with positions in the futures market may have concerns with respect to the settlement price and will try to manipulate the underlying market price in a favorable direction.

The stock market procedure also leads to the expiration day effects. The severity of price effects on expiration day depends in part on the stock market procedures for accommodating order imbalances that may arise when arbitrage positions are unwound. If the underlying market for the index stocks is deep and if suppliers of liquidity are quick to respond to selling or buying pressure, the price effects of large arbitrage unwinding will be small. If unjustified price effects were known to occur, knowledgeable investors would stand ready to buy under priced stocks and sell overpriced stocks-actions that would normally limit price effects to fall within the bounds of transaction costs. If market mechanisms are not well designed to offset sudden imbalances, however, the price effects may be substantial. In the case of index futures contracts that settle at the close, arbitrage positions must be unwound at closing prices.

The rest of the paper is organized as follows. Section II presents a brief description of the stock futures market in the NSE. Section III the outlines relevant previous research related to the issue considered here. Data and methodology used are explained in section IV. The empirical results and conclusion of the study are given in sections V and VI respectively.

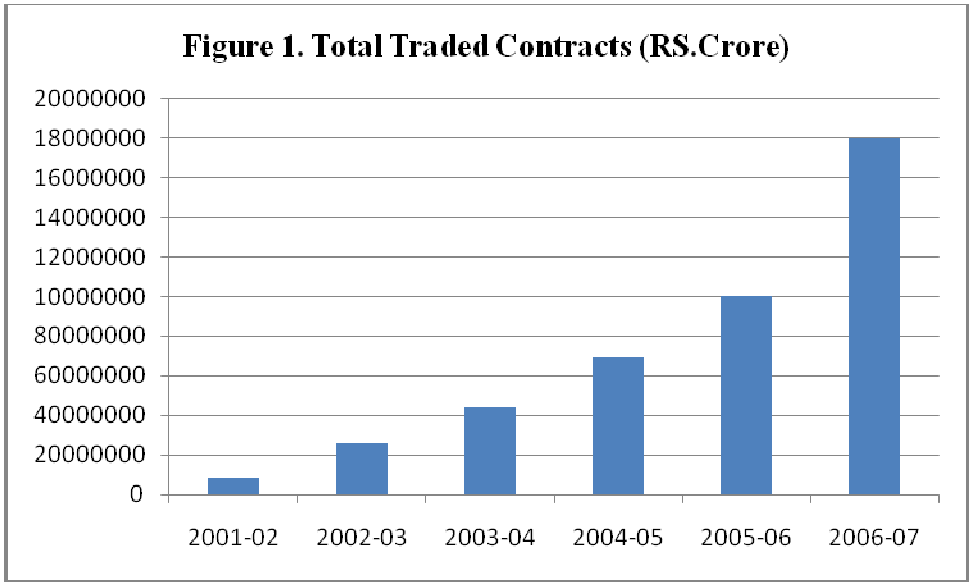
II. Stock Futures in the NSE

Stock-futures is an agreement between two parties to buy or sell a standardized contract based on an underlying equity for settlement or delivery at a pre-specified future date at a specified price. NSE defines the characteristics of the futures contract such as the underlying security, market lot, and the maturity date of the contract

Futures contracts have a maximum of 3-month trading cycle - the near month (one), the next month (two) and the far month (three). New contracts are introduced on the trading day following the expiry of the near month contracts. Futures contracts expire on the last Thursday of the expiry month. If the last Thursday is a trading holiday, the contracts expire on the previous trading day. The value of the futures contracts on individual securities may not be less than Rs. 2 lakhs at the time of introduction for the first time at any exchange. On the introduction day, the base price will be the theoretical futures price and on subsequent trading days, the base price will be equal to the daily settlement price of futures contracts.

The Futures and Options Trading System provides a fully automated trading environment for screen-based, floor-less trading on a nationwide basis and an online monitoring and surveillance mechanism. The system supports an order driven market and provides complete transparency of trading operations. National Securities Clearing Corporation Limited (NSCCL) is the clearing and settlement agency for all deals executed on the Derivatives (Futures & Options) segment. NSCCL acts as legal counter-party to all deals on NSE's F&O segment and guarantees settlement. A Clearing Member (CM) of NSCCL has the responsibility of clearing and settlement of all deals executed by Trading Members (TM) on NSE, who clear and settle such deals through them.

Stock futures market in the NSE has witnessed tremendous growth since its inception. Figure 1 shows the number of contracts traded in the stock future market over the years. As of now, stock futures trading accounts for more than 60% of the total trading activity in the derivative segment of the NSE.



III. Previous Studies

Most of the previous studies on expiration effects of derivatives upon the underlying stocks are related to the index derivatives or stock options. Regarding the price effect of option expiration, Klemkosky (1978), Officer and Trennepohl (1981), Bhattacharya (1987), Pope and Yadav (1992) found a negative effect of option expiration on the returns of the underlying security. Cinar and Vu (1987) in their study of six underlying stocks found significant positive return for one stock during the expiration week and significant negative return for another stock and

insignificant for all other four stocks. Day and Lewis (1988) and Chamberlain *et al* (1989) found significant differences in mean return at expiration of index futures and options in Canada and the US respectively.

Stoll and Whaley (1986, 1987, 1990, 1991), Feinstein and Goetzmann (1988), Herbst and Maberly (1990), Hancock (1993), and Chen and Williams (1994) in their studies on the expiration day effects of the US index derivatives, and Karolyi's (1996) investigation of the expiration day effect of Nikkei 225 futures contracts, noted that all index derivatives expiration have resulted in the abnormal trading in the underlying market and price effect is negligible. Schlag (1996) reported significant increase in trading volume for both index futures and options expirations in Germany. The expiration day effect of the Sydney Futures Exchange's All Ordianries Share Price Index (SPI) was examined by Stoll and Whaley (1997). The results of their study indicated that, while some expiration day volume effects were evident, there was no evidence of a systematic price effect. The absence of even small abnormal price effect is inconsistent with the evidence reported for the US and Japan, where small, economically insignificant price effects were observed

Some recent studies by Corredor *et al* (2001) on Spanish market and Kan (2001) on Hong Kong market found no expiration effect on the return process and trading activity of underlying stocks. The study of introduction and expiration day effects of warrants in Hong Kong by Chen and Wu (2001) documented positive and permanent price effect upon introduction of equity warrants. The expiration of warrants had resulted in a positive price effect and a negative price effect after expiration day for in-the-money equity warrants, and a negative price effect prior to expiration for out-of-money warrants. Chow *et al* (2003) found that both the price effect and volatility on the underlying stock market were negative, but no evidence of any abnormal trading volume on

the expiration day, or any price reversal after the expiration Hang Seng Index (HIS) derivatives. Vipul (2005) found significant increase in the trading volume in Indian Market.

Ni *et al* (2005) based on a study of the US market concluded that option expiration is associated with stock price clustering. Chung and Hseu (2008) examined the expiration day effects of the Taiwan futures Exchange Index (TX) and Singapore Morgan Stanly Capital International Taiwan stock index (MSCI-TW) on the Taiwan stock market using high-frequency data. Their evidence showed that there were no expiration day effects on the TX through out the whole study period; at the same time, significant expiration day effects were noted on the MSCI-TW futures.

Thus, it becomes clear from the above review that there is no unanimity on the expiration effect of derivatives. However, most of the studies have reported a price effect, either positive or negative, around the expiration days or weeks.

IV. Data and Methodology

IV.1 Data

This study is based on 42 sample stocks traded in the NSE which are selected based on the following criteria: (a) Stock should be of highest market capitalization. To fulfill this criterion, CNX-Nifty constituent stocks are considered, (b) Data should be available for the study period. Thus, out of 50 constituent stocks of CNX-Nifty, 42 stocks qualify both of these criteria. The list of sample stocks is given in appendix. These stocks represent diverse sectors of the economy. The data set consists of daily closing prices and daily trading volume. In order to calculate market return, daily closing values of CNX-Nifty are used. The data are collected from the

official website of NSE (www.nseindia.com). The date of expiration of futures contracts is identified from the data collected from the same website.

IV.2 Methodology

In order to examine the impact of stock futures expiration on the underlying market, an event study methodology is employed. The event of interest in this study is formally defined as the expiration of stock futures contracts. In this study, we have considered only the expiration of near-month contracts as the trading of both middle-month and far-month contracts are not as active as that of near-month contracts in the NSE. Since stock futures expiration takes place on the last Thursday of every month right from its inception, only a particular expiration day, i.e., last Thursday of December 2007, is considered in a random manner. An event window of 15 days, i.e., seven days each just before and after the day of event (denoted as t = 0) is considered. For the calculation of expected or normal return, an estimation window of 200 days prior to the event window is identified. When an estimation window of 200 days is identified, all weeks in which other expiring days falls is excluded so as to control for the effect of other expiration days on the estimated coefficients.

The actual return on each sample stock during both event window and estimation window is found as follows:

$$r_{i,t} = (p_{i,t} - p_{i,t-1})/p_{i,t-1} \quad \ldots (1)$$

Where

$r_{i,t}$ = Return on stock i in the period t

$p_{i,t}$ = Price of security i in the period t

$p_{i,t-1}$ = Price of security i in the period t-1

The actual market return on CNX-Nifty is found in the similar manner as follows:

$$r_{m,t} = (I_t - I_{t-1})/I_{t-1} \quad \ldots (2)$$

Where

$r_{m,t}$ = Market return in the period t

I_t = Index value in the period t

I_{t-1} = Index value in the period t-1

The following linear market model for stock *i* is estimated from the estimation window:

$$r_{i,t} = \alpha_i + \beta_i r_{m,t} + u_{i,t} \quad \ldots (3)$$

Where

$r_{i,t}$ = Return on stock i on day t

α_i = Intercept

β_i = Beta of the stock i

$r_{m,t}$ = Market return of CNX-Nifty on day t

$u_{i,t}$ = Residual error term which is assumed to satisfy the usual assumptions of linear regression model.

Then, the estimated coefficients of the market model, α_i and β_i, are used to find the expected return during the event window. The abnormal return (AR), if any, during the event window is defined as the difference between actual return and expected return which is given by:

$$AR_{i,t} = r_{i,t} - \hat{\alpha}_i - \hat{\beta}_i r_{m,t} \quad \ldots (4)$$

Next, the average abnormal return on day't' (AAR_t) for a portfolio of forty two stocks is calculated as shown below:

$$AAR_t = \frac{1}{N} \sum_{i=1}^{N} AR_{i,t} \quad \ldots (5)$$

where 'N' is the number of sample securities.

The t-statsic for the AAR_t is calculated cross-sectionally as given below:

$$t = \frac{AAR_t}{S_P} \quad \ldots (6)$$

where S_P is standard deviation of sample stocks. It is calculated as follows:

$$S_P = \sqrt{\frac{\sum_{i=1}^{N} S_i^2}{N}} \quad \ldots (7)$$

where $S_i = \sqrt{\frac{\sum_{t=1}^{k} (AR_{i,t} - \mu_i)^2}{k}}$,

t = 1,…k is the length of estimation window and μ_t is the mean abnormal return of stock i.

The cumulative abnormal return (CAR_k) over 'k' days during event window is calculated as:

$$CAR_k = \sum_{t=1}^{k} AAR_t \quad \ldots(8)$$

It is well documented in the literature that abnormal return would be associated with changes in the trading volume also. For example, Cambell *et al* (1993) concluded that the first-order daily return autocorrelation tends to decline with volume. Therefore, this study further examines whether the abnormal return resulted in connection with stock futures expiration is associated with any volume effect of underlying stocks. Following Michaely *et al* (1995) and Chen and Wu (2001), stock traded on each day expressed as a ratio of all stocks outstanding is taken as a proxy for the daily trading volume. Event analysis method is employed to study the volume effect of expiration of stock futures contracts. The same estimation and event windows used for the analysis of price effect are used here. Here also, trading volume of other expiration days which occurs during these 200 days of estimation window is being excluded so as to control for their effect on the normal volume. The average trading volume of a stock during the estimation window is termed as normal volume.

The daily volume of stock i on day t is calculated as follows:

$$V_{i,t} = \frac{\text{i th share traded at time t}}{\text{Total shares outstanding}} \quad \ldots (9)$$

where t represents the estimation period.

The normal mean volume over estimation period is calculated as:

$$\overline{V_i} = \frac{\sum_{t=1}^{N} V_{i,t}}{200}, \qquad N = 1, 2 \ldots 200 \quad \ldots(10)$$

The mean volume for a portfolio of N stocks is calculated as:

$$V_i = \frac{1}{N} \sum_{i=1}^{N} \frac{V_{i,t}}{\overline{V_i}} \quad \ldots(11)$$

where t represents the estimation window.

The abnormal volume (%) for day t and corresponding standard deviation are expressed as follows:

$$AV_t = V_t - 1 , \qquad t = -10, -9, \ldots..+10 \quad \ldots (12)$$

$$SD_t = \frac{1}{200} \sum_{t=1}^{N} (AV_t - \overline{AV})^2 \quad \ldots (13)$$

where N represents estimation window and;

$$\overline{AV} = \frac{1}{200} \sum_{t=1}^{N} AV_t \quad \ldots (14)$$

V. Empirical Analysis:

The empirical results of price effect of stock futures expiration on the underlying stocks is given in table 1. The average abnormal returns during the week before the expiration day are found to be statistically significant for six days. The interesting aspect of this result is that abnormal returns turn positive as the expiration day approaches. Even though the abnormal returns are negative and highly significant during the period -8 to -6, it appears to be positive during the period -4 to -1 (abnormal return on day -3 is not statistically significant). The mean abnormal

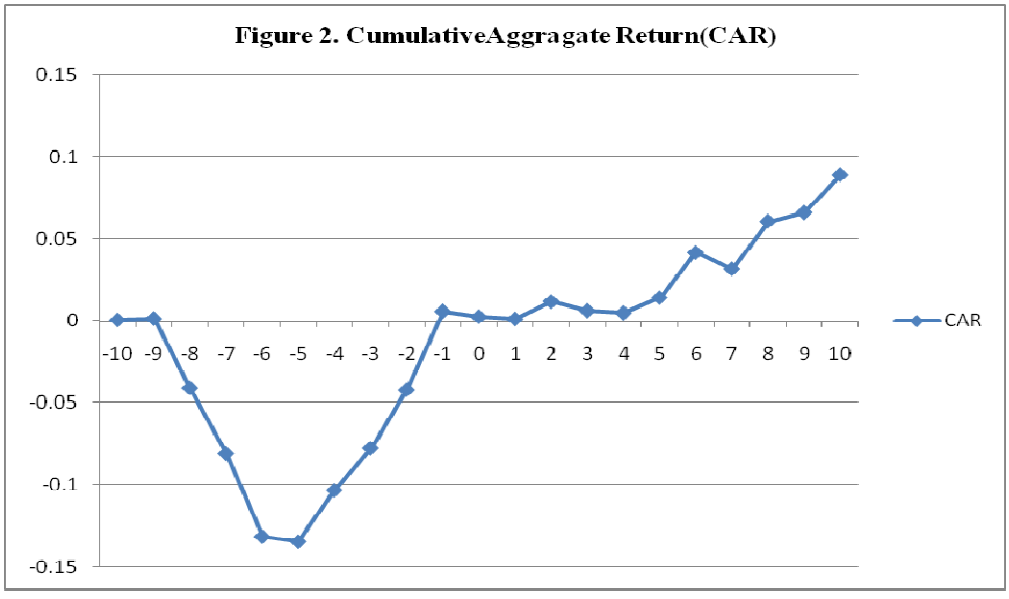
return on day -1 and -2 are 0.04 % and 0.03 % respectively. However, the results do not show any price distortions on the event day. This price effect of expiration can be due to the cash settlement mechanism of futures contracts which facilitate the unwinding of arbitrage positions causing price distortions and also position adjustments by the market makers. Thus, the results reject the null-hypothesis that futures expiration did not affect the price of underlying stocks. Moreover, the finding of positive abnormal return of economically significant size erodes the validity of informational efficiency of financial markets.

The plot of cumulative aggregate return (CAR) in figure 2 also corroborates the earlier finding. It is quite evident that cumulated returns have declined dramatically from day -9 to -5 and started to move upward from there onwards. The decline in return over the week leading to the expiration day can be, given the uncertainty in the market, due to unwinding of the already established positions in the spot market. Then the arbitrage opportunities available as the expiration approaches might have pressured the price up.

Table 1. Price Effect of Futures Expiration

Event Window	AAR	t-statistic	CAR
-10	0.000551076	0.027554	0.000551
-9	0.000860059	0.043003	0.001411
-8	-0.042299844	-2.1149**	-0.04089
-7	-0.040117117	-2.0058**	-0.08101
-6	-0.05055003	-2.527**	-0.13156
-5	-0.003117025	-0.15585	-0.13467
-4	0.031240691	1.56203*	-0.10343
-3	0.025757617	1.287881	-0.07767
-2	0.035618753	1.78093*	-0.04206
-1	0.047859099	2.39295**	0.005803
0	-0.003205812	-0.16029	0.002597
+1	-0.00145859	-0.07293	0.001139
+2	0.010564932	0.528247	0.011704
+3	-0.005532365	-0.27662	0.006171
+4	-0.001312098	-0.0656	0.004859
+5	0.009242057	0.462103	0.014101
+6	0.027631582	1.381579	0.041733
+7	-0.010091547	-0.50458	0.031641
+8	0.029151952	1.457598	0.060793
+9	0.005278156	0.263908	0.066072
+10	0.022992756	1.149638	0.089064

** Significance at the 1% level
* Significance at the 5% level.



The results of volume effect of stock futures expiration is given in table 2. The results show that there is a positive abnormal volume during some of the days leading to the expiration of futures contracts. The values of abnormal volume are found to be statistically significant on days -5, -2, -1, 0 and +2 at both 5 and 10 percent levels. Thus, the results are consistent with the finding of Chen and Wu (2001) for Hong Kong derivative equity warrents.

Table 2. Volume Effcts of Futures Expiration

Event Window	AV(%)	t-statistic
-10	0.528494	0.60821
-9	0.678471	0.780815
-8	0.327625	0.37704
-7	0.201833	0.23227
-6	0.263684	0.30345
-5	0.357442	4.113604**
-4	0.102327	1.177629
-3	-0.06606	-0.76023
-2	0.337908	3.888798**
-1	0.142412	1.638948*
0	0.047904	12.05977**
+1	0.103217	1.187865
+2	0.208988	2.405126**
+3	-0.05251	-0.60425
+4	0.623177	0.717181
+5	0.234623	0.10756
+6	0.443157	0.85525
+7	0.095998	0.11.462
+8	0.185174	0.13639
+9	0.9385	0.10800
+10	0.137006	0.13085
** Significance at the 1% level * Significance at the 5% level		

VI. Conclusion

This study empirically examined the effect of stock futures expiration on both price and volume of underlying stocks in the National Stock Exchange in India. It is shown that futures expiration has resulted in the positive price and volume effects during the days leading to the expiration date. This result is at variance with the findings of studies on US where negative price effect before the expiration day was found. The reported expiration day effects may be due to the unwinding of arbitrage positions in the spot market. While cash settlement feature of stock futures contracts allows futures positions to be self-closed, spot positions must be closed through trades in the spot market. The unwinding of arbitrage positions in an enormous scale in the same direction would stimulate price and volume effects. Further research with high frequenct data would throw more light on the expiration day effects of stock futures, as the electronic trading system in the NSE has imparted much dynamism to the system.

Appendix: List of Sample Stocks

S.No	Company Name	NSE Symbol
1	ABB Ltd.	ABB
2	Associated Cement Co. Ltd.	ACC
3	Ambuja Cements Ltd.	AMBUJACEM
4	Bharti Airtel Ltd.	BHARTIARTL
5	Bharat Heavy Electricals Ltd.	BHEL
6	Bharat Petroleum Corporation Ltd.	BPCL
7	Cipla Ltd.	CIPLA
8	Dr. Reddy's Laboratories Ltd.	DRREDDY
9	GAIL (India) Ltd	GAIL
10	Grasim Industries Ltd.	GRASIM
11	HCL Technologies Ltd.	HCLTECH
12	Housing Development Finance Corporation Ltd.	HDFC
13	HDFC Bank Ltd.	HDFCBANK
14	Hero Honda Motors Ltd.	HEROHONDA
15	ICICI Bank Ltd	ICICIBANK
16	Infosys Technologies Ltd.	INFOSYSTCH
17	ITC Ltd	ITC
18	Larsen & Toubro Ltd.	LT
19	Mahindra & Mahindra Ltd.	M&M
20	Maruti Suzuki India Ltd.	MARUTI
21	National Aluminium Co. Ltd.	NATIONALUM
22	NTPC Ltd.	NTPC
23	Oil & Natural Gas Corp. Ltd.	ONGC
24	Punjab National Bank	PNB
25	Ranbaxy Laboratories Ltd.	RANBAXY
26	Reliance Communications Ltd.	RCOM
27	Reliance Infrastructure Ltd.	RELINFRA
28	Reliance Industries Ltd.	RELIANCE
29	Reliance Petroleum Ltd.	RPL
30	Steel Authority of India Ltd	SAIL
31	Satyam Computer Services Ltd.	SATYAMCOMP
32	State Bank of India	SBIN
33	Siemens Ltd.	SIEMENS
34	Sterlite Industries (I) Ltd.	STER
35	Sun Pharmaceuticals India Ltd.	SUNPHARMA
36	Suzlon Energy Ltd.	SUZLON
37	Tata Motors Ltd.	TATAMOTORS
38	Tata Power Co. Ltd.	TATAPOWER
39	Tata Steel Ltd.	TATASTEEL
40	Tata Consultancy Services Ltd.	TCS
41	Unitech Ltd.	UNITECH
42	Wipro Ltd.	WIPRO

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