

Impact of Derivatives Expiration on Underlying Securities: Empirical Evidence from India

Priyanka Ostwal
Amity University
Noindia
Priyanka.ostwal@gmail.com

Abstract

Derivative products are perceived to have a discerning affect on the stock market in various ways ever since their inception in June 2000. Currently, derivative trading constitutes approximately 90% of the total turnover of the NSE (National Stock Exchange). Launching of derivatives and their expiration (last Thursday of every month) in the Indian stock market has been perceived to have direct ramifications on the return, volatility, efficiency and marketability of the stock market. This paper tries to analyze both empirically and objectively the expiration day effect of stock derivatives on underlying securities. Event study methodology and GARCH (1,1) model have been used to derive the results. Using daily data of 50 stocks constituting NIFTY Index, the study has found a perceptible positive relation between expiration day and return as well as the volatility of the stock market.

Keywords: Stock Futures, Event Study, Event Window, Estimation Window

JEL Classification Code: G32, G14

INTRODUCTION

There has been a major transformation and structural change from the past one decade in the Indian capital market as a result of ongoing financial sector reforms. The major objective behind these reforms was to bring the Indian capital market up to a certain international standard. Towards this end one of the major step taken in the secondary market is the introduction of derivative products in two major stock exchanges in India viz. National Stock Exchange (NSE) and Bombay Stock Exchange (BSE), with a view to provide tools for risk management to investors and to improve the informational efficiency of the cash market. The impact of introduction and expiration of derivatives on the stock market has been a matter of concern since the time of their inception. It is normally argued that the introduction and expiration of derivatives will affect the return, volatility, marketability and efficiency of the market. Derivative contract expires on the last Thursday of each month. A lot of studies have already been conducted to check whether the expiration day has any impact on the return and volatility of the market. Most of the researchers have concluded that the volatility of expiration day is significantly higher than that of the other days. In this study, we have also tried to examine empirically whether expiration of derivatives affects the returns and volatility of the stock market.

Literature Review

Literature that shows the impact of expiration day of derivatives (financial) on stock market to international market is as follows:

Chow Y.F., Yung H.M. and Zhang H¹ (2003) observed the impact of the expiration of HSI (Hang Seng Index) derivatives on the underlying cash market in Hong Kong for the period from 1990 to 1999. The study used an alternative setting for testing the expiration day and concluded that expiration days in Hong Kong might be associated with a negative price effect and some return volatility on the underlying stock market. But there was no evidence of the abnormal trading volume on the expiration day or price reversal after expiration. Hence, the existence of expiration-day effects could not be confirmed in the Hong Kong market.

Lien D and Yang L² (2005) compared the expiration-day impact of the stock options traded on Australian Stock Exchange on return, volatility, trading volume, and temporary price changes of individual stocks with settlement method of individual stock futures contracts. The period of study was from 1993 to 1997. The study concluded that the options expiration has significant impact on return and volatility of the underlying stocks in absence of individual stock futures. After introduction of a cash-settled stock future contract, the effect decrease notably. And then the switch of a futures contract from cash settlement to physical delivery promotes the expiration effects on return and volatility and boosts temporary price change on expiration days. Finally, the study concluded that options expiration has little effect on trading volume.

Chou HC, Chen NW, Chen HD³ (2006) examined the expiration effects of TAIEX index derivative on the underlying stock market between 1998 and 2002. The empirical findings showed no significant expiration day effect, but concluded that expiration effect has strengthened as more relative index derivatives are listed on the TAIEX. In general, the research concluded that the expiration effects in Taiwan are not as significant as those in U.S. market but are stronger than those in the Hong Kong market. The special settlement procedures adopted by the TAIEX may account for the difference.

Studies given below shows previous researches on expiration effect of derivatives on Indian Stock Market:

Vipul⁴ (2005) examined the future and option expiration effect on selected 14 stocks of Indian capital market. The study compared the price, volatility, and volume of the underlying shares in the cash market one day prior to expiration, on the day of expiration and one day after expiration with the corresponding values of these variables one week and two weeks prior to the expiration days by using the Wilcoxon matched-pairs signed-ranks test. It was found that prices in the cash market were depressed a day before the expiration on the derivative contracts, but got strengthened significantly the day after the expiration.

Jindal and Bodla⁵ (2007) analyzed the effect of expiration of stock derivatives on the volatility and marketability of Indian stock market as well as the underlying individual stocks. The results presented that the expiration days of financial derivative witnessed an abnormally high volume trading which was attributed to arbitrage

activities in the market. This clearly shows that expiration day results into high volatility in the stock market.

Bhaumik Sumon and Bose Suchismita⁶ (2007) analyzed the impact of expiration of derivative contracts on the underlying cash market, trading volume, and volatility of returns. The tool used for analysis was AR-GARCH. The study concluded that trading volume were significantly higher on expiration days and during the five days leading up to expiration days ("expiration weeks"), compared with non expiration days (weeks). The study also showed that expiration day has a significant effect on daily returns of market index and their volatility.

Wats Sangeeta⁷ (2010) examined the impact of expiration of spot market volatility using NSE Nifty as market proxy. The study indicated that due to the introduction of future and option, the spot market volatility has increased on the expiration days and expiration weeks. The study also concluded that expiration week effect on volatility of the spot market is more predominant than expiration day effect.

Research Methodology:

Expiration day effect of derivatives on the returns of the underlying stocks:

To analyze the expiration day effect on the returns of the underlying securities event study methodology has been adopted. The event in this case is defined as expiration of stock derivatives. For calculations purposes an event window of 21 days has been formed which includes the expiration day- 24th February, 2011 (chosen on a random basis), 10 days before the event day and 10 days after the event day. Besides event window an estimation window has also been formed, which includes 200 days prior to the event window was identified. Further to nullify the effect of other expiry days that falls in the estimation window, the weeks that contains the expiry day have been excluded. Sample stocks include the 50 stocks comprising S&P CNX NIFTY. Data for the share prices has been collected from the official website of National Stock Exchange (www.nseindia.com). For calculation purposes the following steps has been followed:

1. The actual returns for individual securities and S&P CNX NIFTY have been calculated for estimation window. The following formulas have been used for this purpose:

$$R_t = (P_t - P_{t-1}) / P_{t-1} \quad (i)$$

$$R_{nifty} = (I_t - I_{t-1}) / I_{t-1} \quad (ii)$$

Where R_t and R_{nifty} are the returns of individual security and S&P CNX NIFTY respectively. P_t and P_{t-1} is the price of individual security at time t and $t-1$ respectively. I_t and I_{t-1} is the value of S&P CNX NIFTY at time t and $t-1$ respectively.

2. Estimated return of event window has been calculated using the following regression model:

$$R_{i,t} = a_0 + \beta_1 R_{nifty,t} + \varepsilon_t \quad (iii)$$

Where $R_{i,t}$ stands for returns of security i at time t , $R_{nifty,t}$ is the return on S&P CNX NIFTY at time t and ε_t is the error term.

3. Abnormal return of event window has been calculated by using the below mentioned formula:

Abnormal Return = Actual Return of stock i at time t - Estimated Return of stock i at time t

4. Average abnormal return has been calculated using the following formula:

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

Where AAR_t stands for the Average Abnormal Return at time t , $AR_{i,t}$ is the Average Return of security i at time t and N is the number of sample securities.

5. And then t statistics has been used to derive the results. The formula used to calculate the t value is:

$$t = \frac{AAR_t}{S_p}$$

----- (v)

Where AAR_t is the Average Abnormal Return at time t and S_p is the standard deviation of stock i at time t for event window.

Expiration day effect of derivatives on the volatility of the underlying stocks:

This part of the study evaluates the expiration day effect on the volatility of the underlying securities during the period ranging from 2nd July, 2001 to 31st December, 2010 as the first derivatives in individual stocks were introduced on 2nd July, 2001 in the form of stock options. Stock option trading was allowed on 31 securities at the time of inception of derivatives trading. Out of these stocks, that created history by introducing derivatives for the first time in Indian capital market, 21 stocks meeting the criteria of continuous trading from 2nd July, 2001 to 31st December, 2010 has been selected for calculations purposes. The data has been collected from the official website of National Stock Exchange (www.nseindia.com) and includes daily observations for the closing prices of the underlying stocks.

Tool used: For analyzing the volatility structure, the GARCH class of models is used due to the time varying nature of volatility, which also provides an avenue for verifying the presence of endogenous drivers of volatility shifts. The mean equation is estimated as follows:

$$R_{i,t} = \alpha + \beta_1 R_{nifty,t} + \beta_2 LR_{i,t} + \varepsilon_t \quad (vi)$$

Where $R_{i,t}$ represents the return on security i at time t , $R_{nifty,t}$ represents the return on Nifty index at time t , $LR_{i,t}$ represents the lagged returns of security i at time t , is used as persistence effect of previous day return on today's return. α , β_1 , and β_2 are the coefficients whose significance is tested at 1 per cent. ε_t stands for the error term.

For analyzing the structure of volatility, the variance of return (square of error term) has been calculated with the help of mean return equation. The variance of the return series has further been analyzed using GARCH (1, 1) model that captures the time varying volatility. Further to capture the effect of expiration day a dummy for expiration has also been introduced. Thus variance equation becomes:

$$\sigma_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2 + \delta D_{\text{exp}} + V_t \quad (\text{vii})$$

Where, σ_t^2 is the conditional variance; ω is a constant term; α , β and δ are the parameters to be estimated; ε_{t-1}^2 (ARCH term) represents the news about volatility from the previous period, measured as the lag of the squared residual from the mean equation; σ_{t-1}^2 is the GARCH term representing last period's forecast variance. D_{exp} is the dummy for expiration day which assumes a value of 1 on expiration days and 0 on other days. V_t is the white noise error term.

Empirical Result:

This paper has tried to examine the expiration day effect of derivatives on return and volatility of the underlying securities. To test this t statistics and GARCH (1,1) model has been used.

Table 1 Analyzing the Expiration Day Effect of Derivatives on Returns of Underlying Stocks

Event window	AAR (%)	t- statistic	CAR ¹
-10	0.040	2.536**	0.040
-9	0.433	2.200**	0.472
-8	-0.004	-0.027	0.468
-7	-0.359	-1.896***	0.109
-6	0.254	1.509	0.363
-5	0.285	1.603	0.649
-4	-0.024	-0.203	0.625
-3	-0.090	-0.614	0.535
-2	-0.172	-1.167	0.364
-1	0.323	1.749***	0.687
0	-0.105	-0.581	0.582
1	-0.307	-1.840 ***	0.275
2	0.258	0.822	0.532
3	-0.280	-1.504	0.252
4	-0.055	-0.290	0.197
5	-0.016	-0.104	-0.016
6	-0.147	-0.951	-0.147
7	-0.103	-0.631	-0.069
8	-0.330	-2.057**	-0.399
9	-1.246	-3.125*	-1.645
10	0.623	2.546**	-1.022

¹ Cumulative Abnormal Return

* 1% level of significance

** 5% level of significance

*** 10% level of significance

Table 1 as given above analyzes the impact of expiration of derivatives on the returns of the underlying securities. The table shows that the t statistics has been tested for 1%, 5% and 10% levels

of significance. The AAR is significant on -10, -9, -7, -1, 8, 9, 10 days during the event window. An interesting aspect of this result is that the abnormal return turns positive a day before the expiration day and that there are no price distortions on the event day. The CAR is positive throughout the week before the expiration day. The decline in CAR 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 2 Analyzing the Expiration Day Effect of Stock Derivatives on the Volatility of the Underlying Securities:

	Variables	Constant	ARCH	GARCH	EXP Dummy
ACC	Coefficient	0.000	0.065	0.907	0.000
	p-Value	0.000	0.000	0.000	0.032
BAJAJ	Coefficient	0.000	0.172	0.830	0.000
	p-Value	0.000	0.000	0.000	0.959
BPCL	Coefficient	0.000	0.014	0.963	0.000
	p-Value	0.000	0.000	0.000	0.000
BHEL	Coefficient	0.000	0.260	0.370	0.001
	p-Value	0.000	0.000	0.000	0.000
CIPLA	Coefficient	0.000	0.000	0.806	-0.001
	p-Value	0.000	0.896	0.000	0.000
Dr. Reddy	Coefficient	0.001	-0.008	0.571	-0.001
	p-Value	0.000	0.000	0.000	0.000
GRASIM	Coefficient	0.000	0.162	0.752	0.000
	p-Value	0.000	0.000	0.000	0.262
GUJARAT AMBUJA	Coefficient	0.000	-0.001	0.970	-0.001
	p-Value	0.000	0.000	0.000	0.000
HUL	Coefficient	0.000	0.109	0.781	0.000
	p-Value	0.000	0.000	0.000	0.174
HPCL	Coefficient	0.000	0.096	0.871	0.000
	p-Value	0.000	0.000	0.000	0.000
HINDALCO	Coefficient	0.000	1.409	0.062	0.000
	p-Value	0.000	0.000	0.000	0.126
HDFC	Coefficient	0.000	0.155	0.711	0.000
	p-Value	0.000	0.000	0.000	0.722
ICICI	Coefficient	0.000	0.059	0.928	0.000
	p-Value	0.768	0.000	0.000	0.000
INFOSYS	Coefficient	0.001	0.185	-0.009	-0.001
	p-Value	0.000	0.000	0.550	0.000
ITC	Coefficient	0.000	-0.001	1.002	-0.001
	p-Value	0.000	0.000	0.000	0.000
MTNL	Coefficient	0.000	0.163	0.703	0.000
	p-Value	0.000	0.000	0.000	0.001
RANBAXY	Coefficient	0.000	1.119	-0.003	0.000
	p-Value	0.000	0.000	0.586	0.000
RIL	Coefficient	0.000	0.318	-0.003	0.001
	p-Value	0.000	0.000	0.734	0.000
SBI	Coefficient	0.000	0.066	0.891	0.000
	p-Value	0.000	0.000	0.000	0.000
TATA POWER	Coefficient	0.000	0.083	0.897	0.000
	p-Value	0.002	0.000	0.000	0.001
TATA STEEL	Coefficient	0.000	0.030	0.960	0.000
	p-Value	0.496	0.000	0.000	0.003

Table 1 indicates that out of 21 stocks under study, 15 stocks indicate that there is a significant impact of expiration of

derivatives on the volatility of the underlying securities. These stocks include BPCL, BHEL, CIPLA, Dr. REDDY, GUJARAT AMBUJA, HPCL, ICICI, INFOSYS, ITC, MTNL, RANBAXY, RIL, SBI, TATA POWER and TATA STEEL. Out of these 15 stocks, 10 stocks have reported an increased and rest of 5 stocks has reported a decreased in volatility of their returns on expiration day. Hence the hypothesis that the derivatives expiration does not affect the spot market volatility is rejected in case of 10 stocks. While analyzing the structure of volatility from statistics as per the table given above, it was found that past news as indicated by GARCH (1) as well as recent news indicated by ARCH (1) has a significant impact on the volatility. It means historical information also affect the market in a significant way.

Conclusion

The empirical study revealed the impact of expiration day on the return and volatility of underlying stocks. The study indicates a significant effect of expiration day on the returns of the underlying securities. 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. As a whole, it can be said that the returns and volatility in returns is higher on expiration days as compared to other days. The results obtained also signify that on expiration day, the arbitrageurs and speculators join the market to take advantage of price differentials and price discovery.

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