

# Expiration Day Impact on the Indian Spot Market Volatility

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## Abstract

This paper examines the impact of expiration of derivatives on the spot market volatility. The study uses daily data of National Stock Exchange of India from June 12, 2000 to December 31, 2015. It is noticed that in Indian stock exchanges, the expiration effect is not restricted to expiration days; it impacts the entire expiration week. To examine this attribute, the expiration day and the expiration weeks are taken into consideration to find out the volatility in the underlying spot market. The results of the GARCH, TGARCH, EGARCH indicate that for the entire period undertaken for study, the derivatives expiration days/weeks are considerable factors in enhancing the

volatility of the spot market. It is observed that the expiration day impact is primarily owing to increased volumes in near-month contracts and following the cash based settlement system. The observations may be applied by the investors to strategize their investments in the derivatives and the spot market respectively and also by the policy makers to consider upon a more appropriate settlement system.

**Key Words:** *Expiration Day Effects, Volatility, GARCH (1,1), TGARCH, EGARCH*

**JEL classification:** G12, G14.

## 1. Introduction

Spot market volatility dynamics is recognized to be influenced by the expiration day effect on the expiration of derivative contracts. It is identified to be triggered by trading strategies of arbitrageurs and speculators, and is documented by the settlement procedure followed in a specific market. Increased volatility reduces the effectiveness of a hedge made by arbitrageurs as they unwind their position in proportion to the volume traded during the relevant period, which cannot be estimated specifically in advance. If numerous arbitrageurs liquidate around the same time and in the similar direction, price effects are probable. A further potential explanation for expiration day price effects is the conscious attempts to manipulate prices wherein a speculator with a naked position in an expiring contract might have a considerable financial interest in the contract's settlement price and thereby willing to place small cash market trades at non-equilibrium prices to influence the index in a constructive direction. It is observed that around and during expiration days during the settlement of derivative contracts, there is a significant increase in volume and volatility across the exchanges.

This paper examines the expiration effects on the market index as opposed to prices of individual stocks thereby extenuating problems that may occur due to information that affects prices of individual stocks considerably more than a broader market index. The market indices are likely to be affected less by liquidity effects than the prices of individual stocks. Furthermore, the turnover in the index derivatives markets is significantly greater than that in the market for derivatives products related with individual stocks. Hence, expiration day effects are likely to be much more prominent for market indices than for individual stocks. In this study, the GARCH model and the asymmetric GARCH model like TGARCH and EGARCH are applied to capture the expiration day/week effects.

The present study examines the expiration day effects and the expiration week effects on the spot market volatility during the post-derivatives period taking into account the longest time period of study in the Indian context.

## 2. REVIEW OF LITERATURE

Empirical literature relating to the impact of expiration day of financial derivatives i.e. both futures and options, on the stock market, has received enormous attention of the regulators and has consequently generated interest on such effects within the research community. This facet is broadly segregated into two components i.e. the studies undertaken in the international arena and in India, which are enumerated below:

The consequence of derivative expirations on the spot market has been studied in the past. The series of studies done by Stoll and Whaley (1986, 1987, and 1991) inspected expiration-day effects of U.S. index derivatives. Prior to June 1987, all US stock index futures and options were cash-settled at closing index levels. Stoll and Whaley (1986, 1987) investigated the impact of expiration-day for this period and established abnormally high index stock trading volume and small stock price movements in the last hour of trading on quarterly expiration days when all index derivative contracts expired simultaneously. On non-quarterly expirations, fewer index contracts expired and, consequently, trading volumes were not as high and price effects were smaller.

Edwards (1988) investigated the volatility of the S&P 500 index and the Value Line Composite Index (VLCI) indices previous to and after the introduction of the corresponding futures using daily data from the period 1973-1987. However, it was concluded that there is no extended impact of index futures trading on spot market volatility. It was instituted that a higher short-term volatility of the spot market exists,

predominantly on the expiration days of index futures contracts.

Herbst and Maberly (1990) investigated whether the change of the expiration settlement procedures for the S&P 500 in June 1987 lowered the spot expiration volatility. They found the change in triple witching hour volatility and expected price reversal, in two different studies respectively, before and after the new settlement procedure. The outcome of their study was consistent with the observations of Stoll and Whaley (1991). They identified that the volatility on the expiration days has been significantly reduced, but the volatility has been shifted within a day together with a significant increase in the first hour volatility.

Hancock (1991) applied minute-by-minute S&P 500 index values for the period from April 30, 1987 to July 24, 1989 to investigate the triple witching hour effect. He established that there was no expiration-day effect in the underlying spot market. He further designated that the remarkable increase or decrease in the underlying spot market volatility around the triple witching hour in the US may be ascribed to investors' reaction to new information, especially vital economic news which is generally disclosed on Fridays, that is, the identical day as the expiration of the futures contracts.

Pope and Yadav (1992), Schlag (1996) Karolyi (1996) observed a strong influence of the expiration day effects. Karolyi (1996) studied anomalous price and volume effects for Japanese stocks during the period May 1988 through November 1991. He recognized abnormally large trading volume during expiration and small but economically insignificant price effect reversals of 0.20%.

Stoll and Whaley (1997) established identical inferences for the SFE's (Sydney Futures Exchange) AOI futures and options. He observed that the volume

in the last half-hour of trading was 30.81% of the total daily volume on expiration days as evaluated with 21.07% during non-expiration days. They observed considerable volume effects on account of expiration days and did not observe any significant price effect on expiration days.

Bollen and Whaley (1999) investigated the price and volume changes during expirations of the Hong Kong Futures Exchange's Hang Seng Index (HSI) derivative contracts and observed no confirmation of augmented stock market volatility. They also established that volatility increased during expiration week but was not significantly dissimilar from non-expiration week.

Corredor, Lechon and Santamaria (2001) studied the effect of expiration of the IBEX-35 Index derivatives and the first four stock options traded in the Spanish Equity Derivatives Exchange on the return, conditional volatility and trading volume of the underlying assets. The period of study was from January 1992 to December 1995. On applying the GARCH (1, 1) model they found that there was a downward pressure on prices, a decline in the volatility level in the week prior to the expiration date and a noteworthy rise in the trading volume during the expiration date.

Kan (2001) observed the stock market of Hong Kong for the period March 1989 to December 1992. He did not find any impact of expiration day effect, neither on the whole expiration day nor instantaneously prior to the close. Kan recommended that the disparity in market microstructure between North America and Hong Kong could clarify the inconsistency in the outcomes. The variation in the market microstructure comprised of dissimilar expiration days, the distinction in the calculation of the settlement price, the variation in the trading mechanism of the underlying spot markets, the differentiation in short selling restrictions and the lack of program trading in Hong Kong. Kan recommended that distinct macroeconomic factors

may be the factors for the dissimilar consequences.

Chow, Yung and Zhang (2003) analyzed the evidence of the expiration of Hang Sang Index (HSI) derivatives on the underlying spot market in Hong Kong. They used the Comparison Period Approach, from 1990 to 1999 and confirmed that expiration days in Hong Kong may be associated with some return volatility on the underlying stock market and a negative price effect. They observed that there was no abnormal trading volume on the expiration day or price reversal after expiration. Hence, the survival of expiration day effects was not recognized in the Hong Kong exchange.

Hagelin, Niclas & Alkeback, Per (2004) analyzed the index futures and options expiration day effects on the Swedish market and confirmed that the trading volumes on the spot market are considerably increased on expiration days as compared to other days. The study found no evidence of price distortions.

Lien and Yang (2005) examined the expiration day effect of the stock options traded in Australian Stock Exchange (ASX) on volatility, return and the price changes of individual stocks from 1993 to 1997 and inferred that the switch of a futures contract from cash settlement to physical delivery promoted the expiration effect on volatility and return, and had a leveraged impact on the temporary price changes on expiration days.

Fung, Joseph K.W. and Yung, Haynes (2007) did not observe any significant price compression patterns or price reversal. However, they observed order imbalance pattern on some expiration days. The outcomes showed no relationship between order imbalance pattern and the next-day return. They observed no price reversal pattern on the following day.

There are studies related to the impact of the expiration day effect on the Indian stock market which are enumerated below:

Thenmozhi and Thomas (2004) had undertaken a study period from June 2000 to August 2003 to study the expiration effects and applied the GARCH (1,1) model. They concluded that expiration day effect is irrelevant in explaining the spot market volatility; however, in the sub-period of their study which included the trading of all the derivative products, they inferred that expiration day is a vital factor in explaining the spot market volatility. They observed an increase in the volatility on expiration days and expiration weeks.

Vipul (2005) used 14 equity shares to examine the impact of expiration day in the Indian stock market. The stocks were chosen in a manner that simulated a series of different liquidities for the associated derivative products. The volatility, price and volume of the underlying shares in the spot segment were examined by using the Wilcoxon matched-pairs signed-rank test. He concluded that prices in the spot market were slightly low a day before the expiration on the derivative contracts and strengthened considerably the day after the expiration. He inferred that several shares do not result in price reversals and the trading volumes are higher on expiration days rather than on non-expiration days.

Singh and Bhatia (2006) confirmed that there was absence of any unfavourable effect of expiration day on the spot market volatility. Their analyses demonstrated a significant, however small, decrease in volatility on expiration days.

Bhaumik and Bose (2007) applied the daily data of Nifty from June 2000 to September 2006 for their study and applied the AR-GARCH model. They concluded that the trading volumes were notably high

on expiration day and during the expiration week. They observed a considerable expiration day impact on daily returns of the market index and also on the volatility of these returns.

Mukherjee and Mishra (2007) investigated on the option expiration day effect and observed that the option expiration effect did not happen exactly on the expiration date. They observed that the impact began from the previous five days till the date of expiration.

Jindal and Bodla (2007) found the existence of an abnormally high volume and volatility on expiration day, confirming that manipulating and arbitrage activities took place in the market and that positions are unwound at the time of expiration. They observed that the unwinding of arbitrage positions did not cause any major price deformation at expiration, since there is no momentous change in the return on stocks during the expiration day.

Maniar, Bhatt and Maniar (2009) studied the expiration hour effect of futures and options markets on the cash market. They applied the daily and high frequency data on S&P CNX Nifty Index. They observed that although there is no downward or upward pressure on index returns, the volatility was considerably influenced by the contracts expirations. However, no such effect was observed in the daily data.

Bodla and Jindal (2008), Debasish (2010), Tripathy (2010) have found significant volume effects on account of expiration days.

It is found that various researchers have observed unusual action in the underlying markets on the expiration of the derivatives contract. The researchers also claim that the alterations in the volatility on expiration day may be owing to issues such as some economic news revealed on the same day of the expiration of the derivatives contract.

This study examines the dynamics of expiration day/week effect in the Indian context. The study is unique as it takes into account the longest period for studying this aspect and used the econometric technique - both the symmetric GARCH model and the asymmetric GARCH model - namely TGARCH and EGARCH.

### 3. METHODOLOGY

This study evaluates the expiration days/weeks effects during the period from June 12, 2000 to December 31, 2015. The data used in this study has been taken from the National Stock Exchange website and includes daily observations for the closing price of S&P CNX Nifty. It is observed that in the Indian stock market, the expiration effect is not restricted to expiration days; it is noticed in the entire expiration week. To investigate this feature, the expiration weeks are also taken into account to find out the volatility in the underlying spot market. Expiration day and expiration week effects are wholly associated with the post derivatives trading. For evaluating the structure of volatility, 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:

$$R_{nifty,t} = \beta_0 + \beta_1 R_{niftyjunior,t} + \beta_2 R_{SP500,t-1} + \sum_{j=3}^6 \beta_j DAY_j + \varepsilon_t, \quad \varepsilon_t | \Phi_{t-1} \sim N(0, h_t) \quad (1)$$

where  $R_{nifty,t}$  is the daily change in natural log prices for S&P CNX Nifty Index.

$R_{niftyjunior,t}$  is the daily changes in natural log prices for CNX Nifty Junior Index.

$R_{SP500, t-1}$  is the daily changes in natural log prices for lagged S&P 500 Index.  $DAY_j$  are day-of-week dummy variables for Tuesday to Friday. A significant  $\beta_0, \beta_3, \beta_4, \beta_5, \beta_6$  demonstrates that Nifty returns display Monday effect, Tuesday effect, Wednesday effect, Thursday effect and Friday effect respectively. As the proxy variables eliminates the market wide influences, world market influences and day-of-the-week effect, the error term captures the impact of factors specific to the market on which the futures contract is written and the variance of  $\varepsilon_t$  offers a measure of volatility precisely to the introduction of derivatives.

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 h_{t-1} + \alpha_3 D_{ED} \quad (2)$$

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 h_{t-1} + \alpha_3 D_{EW} \quad (3)$$

where  $h_t$  is the conditional volatility.

$\alpha_0, \alpha_1, \alpha_2$  are parameters to be estimated,  $\alpha_0 > 0, \alpha_1 \geq 0, \alpha_2 \geq 0$ .

The stationary condition for GARCH (1,1) is  $\alpha_1 + \alpha_2 < 1$ . If this stipulation is satisfied, it confirms that the conditional variance is finite. The parameters  $\alpha_1$  and  $\alpha_2$  establishes the short run dynamics of the resulting volatility of the time series. Outsized GARCH lag coefficient  $\alpha_2$  signifies that shocks to conditional variance take a long time to fade out, so volatility is 'incessant'. Large GARCH error coefficient  $\alpha_1$  shows that volatility responds strongly to market movements, so if  $\alpha_1$  is comparatively high and  $\alpha_2$  is reasonably low, then volatility tends to be further spiky.

$D_{ED}$  is a dummy variable. It has the value of one on expiration days of derivatives contracts and 0 for other days. Likewise,  $D_{EW}$  is a dummy variable having the value of one on all the days in an expiration week of derivatives contracts and 0 for other days.

A positive value for  $\alpha_3$  suggests an increase in volatility

and a negative value entails decline in volatility. If the coefficient of the dummy is statistically significant, then there is an expiration day effect and the expiration week effect on the spot market volatility.

GARCH models display some confines in capturing the stylized characteristics of the data like volatility clustering, leverage effect and heavy tails. The most noteworthy characteristic is the leverage effect which results as predictable volatility increases significantly due to unexpected drop in price due to bad news than unexpected increase in price due to good news of matching scale. A fall in price accentuates financial leverage, which makes the stock riskier and enhances its volatility. Researchers treat leverage effect identical to asymmetric volatility. The asymmetric effect is captured using three models, namely, EGARCH model and TGARCH model.

## 4. Results

The expiration day effect on volatility is discussed first, followed by the evidence on volatility and expiration week effect.

### 4.1 Expiration Day Effect on Spot Market Volatility

The results of the impact of Nifty index derivatives expiration days on the volatility of the spot market is reported in Exhibit 1. It is evident that for the entire period undertaken for study, the expiration days is a significant factor in explaining the volatility of the spot market. A significant positive  $\alpha_3$  implies that there is an increase in the volatility on expiration days. Hence, the null hypothesis that Nifty index derivatives expiration days do not affect spot market volatility is rejected.

**Exhibit 1: Estimates of GARCH (1,1) Model ,TGARCH (1,1), EGARCH(1,1) Amplified with Expiration Day Effects**

Parameters		Entire - Period (June 2000- December 2015)
		Estimates
$\beta_0$	Intercept	0.000135
$\beta_1$	Nifty Junior Return	0.752863**
$\beta_2$	Lagged S&P 500	0.118545**
$\beta_3$	Tuesday Dummy	0.000291
$\beta_4$	Wednesday Dummy	-0.000468
$\beta_5$	Thursday Dummy	0.000589
$\beta_6$	Friday Dummy	0.000298
$\alpha_0$	ARCH0	1.24E-06
$\alpha_1$	ARCH1	0.058894**
$\alpha_2$	GARCH(1,1)	0.709128**
	TGARCH (1,1)	0.082712**
	EGARCH (1,1)	0.041821**
$\alpha_3$	Expiration Day Dummy	1.86E-05**
N		3967
Expiration Days		187
Adjusted R-squared		0.755826
Unconditional Variance		0.00002648
Persistence of Volatility		0.984892

Note: \*\* Significant at 5% level of significance

#### 4.2 Expiration Week Effect on Spot Market Volatility

The effect of Nifty index derivatives expiration weeks on the volatility of the spot market is illustrated in Exhibit 2. It is observed that expiration week effect for the entire period plays an insignificant role on the spot

market. A positive  $\alpha_3$  denotes that there is an increase in the volatility on expiration weeks. Thus, the null hypothesis that Nifty index derivatives expiration weeks do not affect spot market volatility is rejected.

**Exhibit 2: Estimates of GARCH (1,1) Model ,TGARCH(1,1), EGARCH (1,1) Amplified with Expiration Week Effects**

Parameters		Entire - Period (June 2000- December 2015)
		Estimates
$\beta_0$	Intercept	0.000158
$\beta_1$	Nifty Junior Return	0.768608**
$\beta_2$	Lagged S&P 500	0.124896**
$\beta_3$	Tuesday Dummy	0.000379
$\beta_4$	Wednesday Dummy	-0.000584
$\beta_5$	Thursday Dummy	0.000968
$\beta_6$	Friday Dummy	0.000236
$\alpha_0$	ARCH0	1.72E-06**
$\alpha_1$	ARCH1	0.066137**
$\alpha_2$	GARCH(1,1)	0.808712**
	TGARCH(1,1)	0.909871**
	EGARCH(1,1)	0.721824**
$\alpha_3$	Expiration Week Dummy	2.36E-06
N		3967
	Expiration Weeks	920
	Adjusted R-squared	0.782411
	Unconditional Variance	0.00005308
	Persistence of Volatility	0.975539

Note: \*\* Significant at 5% level of significance

## 5. Conclusion

The analysis of the post derivatives period confirms that the effect of both the expiration days and expiration weeks on the spot market volatility is very significant. Volatility on expiration and expiration days designates that investors are unsure and desire to roll over their position. It may be owing to manipulative activities. The temporary increase in volatility cannot destabilize the markets in the long run. It can be concluded that due to the introduction of futures and options of the near month, the spot market volatility has increased in the expiration days and expiration weeks. The manipulation by speculators may be the central basis behind high volatility during and subsequent to expiry of these contracts. The effect of expiry day volume on return and volatility shows that

affirmative and significant causality is running from volume to volatility and return which focuses on the fact that prices are speculative and the traders take large spot positions to cover their risk thereby accentuating the volatility during the expiration period.

It is concluded that volumes in near-month contracts should be regulated in order to avoid such an anomaly. The regulators must take essential actions to curb volatility whenever volumes rise to a level higher than normal level during expiration. One of the measures which may be taken is by familiarizing the far-month contracts and also by taking measures like implementing physical settlement rather than going for cash settlement.



The potential future work which may be undertaken in this domain is to examine the impact of the expiration day by using high frequency intra-day data to capture the information displayed in the opening trading

section and across the trading windows which will bring out explicitly the potential factors accountable for the market anomalies of the expiration day effects.

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