The Effects of Option Expiration on NSE volume and prices

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*Acknowledgements

We would like to thank Dr. Gangadhar Dharba for his helpful comments and for making available NSE intra-day data.

November, 2003

Introduction

In the last decade the financial markets have been characterized by the development of derivative securities such as options, swaps and futures. The positive effects of these new securities are due to new risk sharing opportunities and more complete financial markets. On the negative side derivative securities, whose payoffs are a function of some other assets prices, also offer new opportunities of price manipulation.

This paper studies the effects of the expiration day of stock options on the trading of the underlying shares. A trader with a sufficiently large position in an option or a future might be tempted to manipulate the underlying spot price, by buying or selling before the expiration. The loss in the spot market is covered by the gain in the options or futures market if the option or future is settled with cash.

Sources of Expiration-Day Effects

Expiration-day price effects may arise from a combination of factors including the existence of arbitrage opportunities, the cash settlement feature of options, the stock market procedures for accommodating the unwinding of arbitrage positions in the stocks, and attempts to purposely manipulate prices. This section discusses these possibilities.

Cash Settlement

Arbitrage positions are frequently unwound at the expiration of the options contract. If a stock option expires at the close, the option self-liquidates through cash settlement at the closing price level. The stock position, on the other hand, must be liquidated through trades in the marketplace. An arbitrageur who is long the underlying stocks and short the option contract must sell the underlying stocks at their closing prices. If many arbitrageurs liquidate positions at the same time and in the same direction, price effects are possible.

Stock Market Procedures

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 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 stock options contracts that settle at the close, arbitrage positions must be unwound at closing prices. In the US, arbitrageurs place market on-close (MOC) orders, indicating their desire to trade at the closing price, whatever it may be. If large MOC orders are received late in the day and investors to take the other side are difficult to locate, price effects are possible. Modifications in trading mechanisms such as requiring early placement of MOC orders can reduce the risk of unexpected imbalances at the close.

Manipulation

Expiration-day stock price effects may also arise from attempts to manipulate stock prices. Such attempts may occur directly in the way an arbitrage position is unwound or indirectly through arbitrage unwinding that benefit other positions. An arbitrageur might engage in indirect manipulation, not to benefit the arbitrage account but to benefit another account. Suppose, for example, a broker is instructed to buy stocks for one account while, at the same time, is unwinding a long-stock/short-options arbitrage position for another account. By selling the stocks forcefully at the strike price, the broker may lower stock prices for the benefit of the buyer. No harm is done to the options arbitrage account because the loss due to the decline in stock prices is offset by gain on the long options position. A broker confident that prices can be forced lower can also benefit by selling options or stocks prior to the expected price decline. The manipulation effort will fail and the effect on stock prices will be limited, however, if other knowledgeable investors are standing ready to buy at bargain prices and thereby keep prices from falling.

We could follow any of the following method to show the expiration day effect:

Abnormal Trading Volume

Method1:

$Trading\ volume = \sum(i=1, i=no.\ of\ trades)\ price\ per\ share_i * no.\ of\ shares_i$

Abnormal trading volume is measured by the ratio of the dollar trading volume in the last half-hour of trading in that stock on expiration day to total dollar trading volume in that stock on that day.

Normal trading volume is defined as relative trading volume at the close on the days exactly one week prior to the expiration day.

Method2:

Compare average volume, average transaction size, average no. of transactions for exp day, exp day +1, to 2 control days say exp day -7 and exp day -6.

Abnormal price movements

Method1:

Calculate the variance of the five-minute return in individual stocks on expiration days in comparison to non-expiration days. Five-minute returns are calculated on the basis of the last transaction price in each five-minute interval.

Method 2:

Abnormal return for stock i on date t is:

ARi,t = Ri,t – E(Ri,t)

Expected value of last half an hour or whole exp day return is found by using data for say last thirty days.

Individual stock reversal

Method1:

Stock *i*'s return *before* the close, *Rb,i*, is defined as the return over the last thirty minutes of the day, that is,

$Rb,i = (Pclose,i - Pclose\text{–}30,i)/Pclose\text{–}30,i$

where *Pclose*–30,*i* is stock *i*'s price thirty minutes before the market close on expiration day, and *Pclose,i* is stock *i*'s price at the close. Stock *i*'s return *after* the close, *Ra,i*, is defined as the return from the close until the following morning's open, that is,

$Ra,i = (Popen,i - Pclose,i)/Pclose,i$

where *Popen,i* is stock *i*'s price at the open on the following morning. Based on these two stock returns, an *individual stock reversal* is defined as:

$REVi = Ra,I$ if $Rb,i < 0$

$-Ra,I$ if $Rb,i >= 0$

The stock reversal *REVi* is positive when the sign of the stock return after expiration is the opposite of the sign of the return before expiration, and the stock reversal is negative when stock price movement after expiration continues in the same direction as before.

A normal stock reversal is defined as the stock reversal observed on the days exactly one week prior to the expiration day. To measure the abnormal stock reversal, we test for a meaningful difference between the average reversal on expiration days and the average reversal on non-expiration days for the same set of stocks. Average stock reversal is computed as:

$REVavg = (1/n) \sum (i=1, i=n) REVi$.

Method 2:

Same as Method 1 except that instead of just taking opening price on exp +1 day take price at end of 1st half an hour of trading on exp +1 day

We have used method 1 for normal trading volume and method 2 for Abnormal price movement. We want to pursue this study further with the other methods also.

Data Collection

Data collection activity starts from deciding the stocks which we need to test to show the effects of option expiration day. To show the effect of expiration day on stock trading, we chose to start our analysis from the stocks which are heavily traded and which have large open interest on expiration day. We chose Reliance, Satyam, Infosys and Telco for our analysis.

For comparison, we collected trading data on these stocks for EXP-7, EXP-1, EXP and EXP+1 days from June 2000 to August 2002 (EXP stands for Option Expiration day). Exp -7 serves as a normal representative day for testing any unusual trading activity (as used by Ferris, Chance and Wolfe). Since Exp-7 also falls on a Thursday, it avoids day of the week effect. We assumed that average trading would be equal to trading on EXP-7 and trading on EXP-1 and EXP days would show the effect of expiration day on trading. EXP+1 day trading volume would be used to show if there was some price or volume reversal after expiration day.

We used tick by tick transaction data from NSE as our base data. We extracted time of transaction, price and volume for these four scripts for the above mentioned days from June 2000 to August 2002 and used these files for further data analysis.

Average Volume results

To understand the effects of expiration day on trading volumes, we observe the trading volume data for selected stocks from June 2000 to August 2002. To compare the trading volumes on expiration day to normal days, we have taken the data for these stocks for EXP-7, EXP-1, EXP and EXP+1 days from June 2000 to September 2003 (EXP stands for Option Expiration day).

The data clearly shows that on average, the trading volumes on the expiration day are higher than the volumes on other days. This phenomenon is observed for all the selected stocks and for all expiration dates. This effect can be explained by the reason that market operators have to square off their positions on the expiration day. Thus, they have to buy the stocks and deliver increasing the volumes in the process.

Stock pinning:

On days when equity options expire (typically the last Thursday of a given month), many stocks seem to close near a multiple of strike interval (which is different for different stocks). A possible reason for this phenomenon is that a few market participants have large short gamma positions. For example, they may have sold a large number of straddles (combinations of puts and calls at the same strike). These traders' delta hedging activities cause the stock price to move towards the strike. For example, consider a trader who is short straddles at struck at Rs. 100. As the stock moves from 102 to 101, the trader is inclined to sell more stock, thus pushing the stock price even lower. If the stock continues to drop and reaches 99, the trader will be inclined to purchase shares, driving the stock price up.

In our case, we have defined two degrees of pinning for a given stock:

A. stock closes within 1/5th of the strike interval from a strike.

B. stock closes within 1/10th of the strike interval from a strike.

For instance in case of HDFC, second case corr. to a stock price closing within +/- 3 from the strike price (since the strike interval is 30). If a stock price was to evolve randomly and prices were continuous, then the stock would be expected to close within 30 strike 6/30 of the time. If we assume that the change in a given stock were never smaller than 0.25, and that the initial stock price were an integer multiple of 0.25, then the stock would trade of 25/120 = 20.833% of the time within 3 of a strike price. As can be seen in the results summary, HDFC closed within 3 of a strike price only 18.52% of the time, evidence against stock pinning for this particular equity.

Testing for Statistical Significance

We compared the differences of means of volume data for the four companies – Satyam, Infosys, Telco and Reliance. The means of volumes on days Exp (t-1), Exp (t+1) and Exp(t-7) were compared with the mean on expiration day. This comparison was drawn for daily as well as last half hour volumes for both dollar volume and simple volume data. However in all cases there wasn't any statistically significant difference between means as the t-values show. We also did a study on mean returns for the above dates for above companies and found no statistically significant difference was prevalent between them. The data used for the above analysis was from 2001-2002.

However when we used 2002-2003 data we found that Satyam volumes on Exp day had a significant difference in mean volumes compared to Exp(t-1) and Exp(t+1). But no such difference was found with mean volume of an average day on Exp(t-7). Again its returns also failed to show any significant difference. Reliance data however didn't show up such differences in means.

Conclusion

Overall we tested for abnormal trading volume, abnormal price movement, individual stock reversal and stock pinning on expiration days. Even though on average, trading volume did

turned out to be more on expiration day as compared to the control day used: Exp -7 as well as Exp -1 and Exp +1 day but the difference was not statistically significant. Stock pinning behavior on expiration days also was not suggested by the data for the five stocks considered: Satyam, Telco, Reliance, HDFC and Infosys. We believe that the present study has been comprehensive in covering all the major areas in the research related to the expiration day's effects in the options market and testing them on NSE data. Financial options trading in India is a new phenomenon (started in 2000), and also the past two years have not been very good for the economy. Now that the economy is picking up and more and more big players are entering the market, there is a possibility of presence of expiration day effect in newer data. Infact, for Satyam volume traded on expiration days did turned out to be statistically different from volume traded on the control day when tested using 2002-03 data. Therefore, our future research would aim at using this data and increasing the scope of our analysis.