Significance of Open Interest-Based and Trading Volume-Based Predictors—An Empirical Study of the Option Market in India

Swagata Sen
Professor, Department of Commerce
University of Calcutta
e-mail : swagata_sen_in@rediffmail.com

Avijit Sikdar
Assistant Professor, Department of Commerce
Kidderpore College, Kolkata
e-mail : sikdar.avijit@yahoo.com

Abstract : The information content of the option market for predicting the future price index in the underlying cash market in India has been examined in this paper by applying the method of open interest and trading volume-based predictors. Daily data for both price as well as non-price variables for the study period of July 2014 to December 2014 have been employed to explore the above relationship. In the study, open interest-based predictors are found to be significant in predicting the future underlying cash market. But as far as volume-based indicators are concerned, it shows some mixed evidence. Both the indicators are statistically significant at any conventional level of significance when all of them are taken together. However, volume-based predictors turned out statistically insignificant when it estimates alone with the current cash index, the future price of the Index in cash market. Based on the value of Adjusted R Squared and F-Statistics in the study period we can conclude that informational role in the Indian Derivative market has played an important role in predicting future price of underlying cash market.

Key-words : Open interest based predictor, trading volume based predictor, underlying assets.

1. Introduction

Derivative securities are considered as additional means for informed traders to trade on their information and for others to discover that information. Derivatives may not only lead the underlying assets in imparting information, they may also provide information that simply cannot be inferred from the markets in underlying assets. This paper examines the role of non price variables of options market like open interest and trading volume in conveying information about the future movement of the underlying asset. This study shows that the activity in the equity options market seems to contain information about future stock price that can be exploited for trading purposes. Financial economists have long been interested in the process of price formation when informed traders, uninformed liquidity (or noise) traders and market makers interact in the asset market. Derivative instruments, like option contracts, enhance informational efficiency of the underlying's market. An option is a contract between two parties giving the taker (buyer) the right, but not the obligation, to buy or sell an underlying asset at a predetermined price on or before the predetermined date. It is one of the important derivative instrument traded in derivative exchanges all over the world. It is well known that trading in options may be more attractive than trading in underlying assets in spot (cash) market

due to economic incentives provided by reducing transaction cost, capital requirements and trading restrictions, commonly seen in the equity market. The attractiveness in the equity market can be proved by the increasing trend in the total traded value in the option market over a period of time in a fast moving developing country like India. Option can be used for both hedging as well as speculation. It is well documented in the research that not only the option prices, but also the non-price variables, such as open interest, trading volume, etc., form the option market can affect the stock prices in the underlying equity market.

2. Objective of the Study

The study investigates the impact of non-price variables viz. open interest and trading volume of index option from the option market in predicting the price index; viz. Nifty index in the underlying cash market in India. By applying the method of open interest and volume-based predictors for both call and put options, this study empirically investigates the hypothesis (stated below) that the above non-price variables in the option market cannot be used to predict the future price index in the underlying cash market. This study is based on daily data for both price as well as non price variables over the sub period June 2014 to December 2014. It reveals that the open interest based predictors are significant in predicting the underlying spot price index in the sub period.

H_0 : Non-price variables in the option market cannot be used to predict the future price index in the underlying cash market.

H_1 : Non-price variables in the option market can be used to predict the future price index in the underlying cash market.

3. Review of Literature

A considerable amount of literature deals with the interrelationship between the derivative markets, viz., options market, and underlying cash market. Different issues addressed in those studies include (1) the effect of option listing on the volatility, bid-ask spread and liquidity of underlying cash market; (2) the options expiration effect on the prices of underlying cash market at maturity; (3) the lead-lag relationship among the price as well as non-price variables from both options market; (4) the role of the option market in discovering the price in underlying cash market etc. A brief review of some of the past literature, relevant to this study, is presented below.

Many of the previous research studies have tried to examine the options listing effect on the volatility, liquidity etc., of the underlying cash market all over the world, document the option expiration effect on the prices of the underlying cash market at the time of maturity, and report the lead-lag relationship among the price as well as non price variables from both options and underlying cash market. Since the main aim of the study is to examine whether the open interest and trading volume from the option market are significant in explaining the future movement of prices in the underlying cash market, it could not be explained by the previous studies discussed here– which cover all the aspects of the interrelationship between the options and cash market.

Bhuyan, Rafiqul and Chaudhury (2001) examined the role of option market's open interest to capture information about the future movement of underlying stock and show that the trading

strategies based on this predictor yields better results as compared to the buy-and-hold and passive covered call strategies. Further, Bhuyan and Yan (2002) developed several price predictors from the open interests and trading volumes of individual stocks from the option market and concluded that these factors exhibit significant explanatory and predictive power for the future stock prices. The encouraging results provided by this study are one of the driving forces for the present initiative.

There is a general agreement with the basic premise drawn by Bhuyan and others (2001), and Bhuyan and Yan (2002) that as against the total volume considered by one of the previous studies, net open interest of call options and put options together should provide a better indication of the future stock price movement. Srivastava (2003) examined the informational role of stock option market in India using this approach. However, it was conducted for a small period, i.e., four months. The present study is among one of the earlier attempts to document the impact of non-price variables of stock option market on the underlying stocks in the Indian context with a longer sample period.

Through this study, the authors seek to provide a valuable input to the uninformed investors using, which they can discover, the price of underlying asset in a more efficient as well as effective manner. The results are encouraging and provide a basis for further examination of different variables in option market and their interrelationships with the underlying stock price.

4. Data and Methodology

The National Stock Exchange (NSE) India has commenced trading in S&P CNX Nifty Index Options from June 4, 2001. This study covers the study period July 2014 to December 2014. Daily data relating to price as well as non-price variables such as spot price index in the underlying cash market, and open interest, trading volume, different strike price, etc. in the option market, have been collected for the sub periods. There are three types of options contracts available in the Indian market—which gets matured in one month, two months and three months. Since the option price on the nearest contract is characterized by high level of activity, all the data for both price and non price variables of index option on the first nearest contract, i.e., on the next month contract, are taken into account. Further, all the data on the expiration day have been excluded from the study in order to avoid possible bias expected to occurr due to expiration effect. All the relevant data have been collected from NSE website and all the calculations have been made using MS-Excel and SPSS (version 16.0).

Methodology

The interrelationship between the open interest and trading volume in the option market and the prices in the underlying cash market can be measured by various techniques. But the present study, is based on a simple methodology used by Bhuyan, Rafiqul and Chaudhury (2001), Bhuyan and Yan (2002) and Srivastava (2003) for investigating the significance of the net open interest and trading volume in the Index option market. The term and notations applied in the methodology are same as used in the above studies.

Let 'T' be the time of maturity of a set of call and put option. The current price of the cash index is assumed to be I_t; while, X_i^C and X_j^P are assumed to be the set of strike prices for call

and put options, where i = 1,2,.....k; j = 1,2,.....,m. Let O_{it}^{c} and O_{jt}^{p} be the net open interest at the current time 't' for call and put option with the strike price X_i^c and X_j^p respectively. Similarly, V_i^c and V_j^p are assumed to be the trading volume for a call and put option at time t with strike price X_i^c and respectively.

Now the two predictors open interest-based predictor and volume-based predictors that are proposed to be used in predicting the price of underlying cash index, can be defined by using the above variables.

The call option Open interest-based predictor (COP) can be defined as:

$$O_t^c = \Sigma_{i=k}^{k} W_{it}^c X_i^c$$

In the above equation, O_t^c represents the call option open interest-based predictor at a time t; while k denotes number of different types of call options showing some non zero open interest. W_{it}^c is the weight of call options with strike price of X_i^c.

The put option Open interest-based predictor (POP) can be defined as:

$$O_t^p = \Sigma_{i=k}^{k} W_{it}^p X_i^p$$

In the above equation, O_t^p represents the put option open interest-based predictor at a time t; while k denotes number of different types of put options showing some non zero open interest. W_{it}^p is the weight of put options with strike price of X_i^p.

The call option Volume-based predictor (VOP) can be defined as:

$$V_t^c = \Sigma_{i=k}^{k} q_{it}^c X_i^c$$

In the above equation, V_t^c represents the call option value-based predictor at a time t; while k denotes number of different types of call options showing some non zero open interest. q_{it}^c is the weight of call options with strike price of X_i^c.

The put option Volume-based predictor (VOP) can be defined as:

$$V_t^p = \Sigma_{i=k}^{k} q_{it}^p X_i^p$$

In the above equation, V_t^p represents the put option value-based predictor at a time t; while k denotes number of different types of put options showing some non zero open interest. q_{it}^p is the weight of put options with strike price of X_i^p.

Based on the open interest and volume-based predictors for call and put options, it is easy to find out the relative significance of each of these predictors by using multiple regression model such that:

$$LnIT = \alpha_0 + \alpha_1 ln(T-t) + \alpha_2 lnI_t + \alpha_3 lnO_t^c + \alpha_4 lnO_t^p + \alpha_5 lnV_t^c + \alpha_6 lnV_t^p + \varepsilon_t$$

Where I_T and I_t are the stock price at the date of maturity and at the current date respectively. (T–t) represents the actual time to maturity; O_t^C and O_t^P are the open interest-based predictors; while V_t^C and V_t^P are the volume-based predictors. ε_t denotes error term assumed to be white noise such that $\varepsilon \sim N(0, \sigma^2)$ and Cov $(\varepsilon_t, \varepsilon_{t-1}) = 0$. The natural logarithms of the entire variables are used to account for the heteroskedasticity, i.e. unequal variance among the variables. It is to be noted that, since the variable (T-t) is unable to improve the overall explanatory power (as shown by adjusted R^2) hence, it is removed from the above equation. Now the revised equation is

$$LnIT = \alpha_0 + \alpha_1 lnI_t + \alpha_2 lnO_t^C + \alpha_3 lnO_t^P + \alpha_4 lnV_t^C + \alpha_5 lnV_t^P + \varepsilon_t \text{....(Eq. 1)}$$

In order to find out the relative significance of open interest-based predictors and volume-based predictors separately in the matter of price fixation in the underlying cash market, the following regression equations have been estimated excluding one set of parameter (either open interest or trading volume):

$$LnIT = \alpha_0 + \alpha_1 lnI_t + \alpha_2 lnO_t^C + \alpha_3 lnO_t^P + \varepsilon_t \text{....(Eq. 2)}$$

$$LnIT = \alpha_0 + \alpha_1 lnI_t + \alpha_2 lnV_t^C + \alpha_3 lnV_t^P + \varepsilon_t \text{....(Eq. 3)}$$

All the above regression equations have been solved for the study period July 2014 to December 2014. To remove the influence of expiration of option contracts at the date of maturity, all the equations have been estimated by excluding the date of expiration of the contract in one case and by excluding the previous five days up to the expiration in the other.

5. Results

The hypothesis that the non price variables viz., open interest and trading volume in the option market, do not have the significant explanatory power in predicting the future price of the underlying cash index is tested through the multiple regression equations (eq 1 to 3). Though the price index at the time of maturity and at the current date can be directly observable, but the value of other independent variables have been calculated as in the same way as mentioned in the 'data and methodology' section.

The meaning of notations used in regression equation in the following table are as follows.

LnI_T	Natural log of closing index at maturity
LCI($\ln I_t$)	Natural log of current index
LOIBPCO ($\ln O_t^C$)	Natural log of open interest-based predictor based on call option
LVBPCO ($\ln V_t^C$)	Natural log of value-based predictor based on call option
LOIBPPO ($\ln O_t^P$)	Natural log of open interest-based predictor based on put option
LVBPPO (lnV_t^P)	Natural log of value-based predictor based on call option

Table 1 : Regression Result for the Study Period

Panel A : Excluding only the expiration date				
Variable	Coefficient	S.E	t-Statistics	Prob.
Intercept	-3.216	0.731	-4.397	0.000
LCI (lnI_t)	0.427	0.195	2.183	0.031
LOIBPCO ($ln O_t^c$)	1.244	0.194	6.409	**0.000**
LVBPCO (lnV_t^c)	0.025	0.123	0.203	0.839
LOIBPPO ($ln O_t^p$)	0.298	0.216	1.379	0.171
LVBPPO (lnV_t^p)	-0.636	0.17	-3.738	**0.000**
Adjusted R square = 0.823; F = 103.39				
Panel B: Excluding last five days up to the expiration date				
Variable	Coefficient	S.E	t-Statistics	Prob.
Intercept	-4.051	0.959	-4.223	0.000
LCI (lnI_t)	0.494	0.221	2.241	0.028
LOIBPCO ($ln O_t^c$)	1.558	0.287	5.42	**0.000**
LVBPCO (lnV_t^c)	-0.083	0.171	-0.487	0.628
LOIBPPO ($ln O_t^p$)	-0.003	0.334	-0.01	0.992
LVBPPO (lnV_t^p)	-0.515	0.241	-2.133	**0.036**
Adjusted R square = 0.803 ; F = 71.32				

The findings have been broadly categorised into two parts. The first category includes all the results derived from regression equation 1 where both open interest-based predictors and volume-based predictors for both call option and put option are taken into consideration to observe their relative significance in predicting the future price index in the underlying cash market. The results are reported in table 1. While the second category is derived from equation 2 and equation 3 where both the predictors for call and put options are considered separately (through different equations) and are reported in table 2 and table 3.

The results in all the tables (1 to 3) are divided into 2 panels. Panel A in each table reports the results which are based on the data set where all the data only on the date of expiration of option contract are excluded. While the panel B reports the results based on the data set excluding all the data of previous five days up to the date of expiration of option contract.

Table 1 reports the results based on regression equation 1 where both open interest-based predictors and volume-based predictors for both call option and put option are taken into

consideration to observe their relative significance in predicting the future price index in the underlying cash market during the study period July to December 2014 i.e. just after the end of coalition government UPA 2 in India. The table shows that there is not much difference in the result reported in Panel A and Panel B. Both panels reveal that open interest-based predictors based on call option and volume-based predictors based on put option are found to be significant in explaining future movement of the underlying price movement at conventional 1% or 5% level of significance. It is noted that result of open interest-based predictors during the study period found significant positive coefficient and negative coefficient with volume based put option predictors. It indicates that the investors expecting the price of underlying cash index to increase and they prefer to buy the call option at higher strike price and prefer to sell put option. In other words, the relationship among the open interest-based predictor and future price is positive for call option and negative among the value-based predictors and future price in case of put option.

From the table 2 it can be observed that there is not much difference in the results if an open interest-based indicator is considered separately in estimating the equation 2. This table confirms that open interest-based predictor during the study period of Panel A and Panel B shows significant explanatory power in predicting the future price index in the underlying cash market. From table 3 it can be observed that there is much difference in the results if value-based indicators are considered in predicting the future price of underlying cash market. These indicators fail to explain statistically the future price index at conventional level 1% and 5% level of significance.

Table-2 : Regression Result for Open Interest-based Predictor during the Study Period

Panel A : Excluding only the expiration date				
Variable	Coefficient	S.E	t-Statistics	Prob.
Intercept	-3.747	0.966	-3.250	0.002
LCI (lnl_t)	0.121	0.12	0.008	0.994
LOIBPCO ($ln O_t^c$)	1.72	0.256	6.435	**0.000**
LOIBPPO ($ln O_t^p$)	-0.425	0.245	-0.237	0.813
Adjusted R squared = 0.802; F = 149.44				
Panel B : Excluding last five days up to the expiration date				
Variable	Coefficient	S.E	t-Statistics	Prob.
Intercept	-3.747	0.966	-3.877	0.000
LCI (lnl_t)	0.121	0.12	1.002	0.319
LOIBPCO ($ln O_t^c$)	1.72	0.256	6.714	**0.000**
LOIBPPO ($ln O_t^p$)	-0.425	0.245	-1.733	0.087
Adjusted R squared = 0.795; F = 112.1				

Table 3 : Regression Result for Volume-based Predictor during the Study Period

Panel A : Excluding only the expiration date				
Variable	Coefficient	S.E	t-Statistics	Prob.
Intercept	3.252	0.528	6.159	0.000
LCI (lnI_t)	0.002	0.294	0.005	0.996
LVBPCO (lnV_t^C)	0.333	0.184	1.814	0.072
LVBPPO (lnV_t^P)	0.304	0.208	1.461	0.147
Adjusted R squared = 0.58; F = 52.57				
Panel B : Excluding last five days up to the expiration date				
Variable	Coefficient	S.E	t-Statistics	Prob.
Intercept	3.894	0.624	6.24	0.000
LCI (lnI_t)	-0.047	0.325	-0.143	0.887
LVBPCO (lnV_t^C)	0.226	0.243	0.929	0.356
LVBPPO (lnV_t^P)	0.388	0.24	1.621	0.109
Adjusted R squared = 0.803; F = 71.32				

However, there is a little change (except table 3) in the value of adjusted R square while going from Panel A to Panel B (table 1 and 2) and there is a significant decrease in their F-value in all cases (except table 3) while going from Panel A to Panel B (table 1 and 2), which confirms that the overall explanatory power of non-price variable in option market is influenced by not only the date of expiration but also the previous five days up to the date off expiration.

6. Conclusion

By applying daily data on both price and non-price variables from equity and option markets, an effort has been made to examine the significance of open interest and trading volume from the index option market in explaining the future price movements in the underlying cash market in India. This study documents significant results in explaining the price movement when all the variables i.e. price variable and non-price variable in the recent time in the option market of India but when volume-based indicators are considered alone they fail to capture the future price movement of cash market index. However we can conclude that the informational role of the option market non-price variable in predicting the future price index played an important role in Indian capital market.

References

Bhuyan, Rafiqul and Chaudhury, Mo. (2001). "Trading on the Information Content of Open Interest: Evidence from the US Equity Options Market", *Working Paper*, McGill.

Bhuyan, R. and Yan, Y. (2002). "Informational role of Open Interests and Volumes: Evidence from option markets", Paper presented at Twelfth Annual Asia Pacific Futures Research Symposium, December.

Kumar, R., Sarin, A. and Shastri, K. (1988). "The impact of option trading of the market quality of underlying security: An Empirical Analysis", *Journal of Finance*, 53, pp. 717-732.

Mukherjee, K.N. and Misra, R.K. (2007). "Information Role of Non-Price Variables: An Empirical Study of the Indian Option Market", *The ICFAI Journal of Applied Finance*, 13 (2).

Srivastava, S. (2003). "Information content of trading volume and Open Interest–An empirical Study of Stock Option market in India", *Journal of Finance*, 45, pp. 191-220.

URL

www.nscindia.com

Annexure

Steps to be followed while calculating the open interest-based and volume-based predictors for both call and put option

Step 1 : Extract the data for the nearest month contract and also nonzero open interest.

Step 2 : Remove all the data other than current data, date of maturity, strike price and open interest.

Step 3 : Calculate the weights proposed to be used for different strike price. This step follows two sub steps.

(i) Calculate the sum of nonzero open interest for different strike prices in a given trading day which is denoted by $\sum_{i=1}^{k} O_{it}^{c}$ or $\sum_{j=1}^{k} O_{it}^{P}$, i and j refers to the set of strike prices for call option and put option respectively; and t is the current time.

(ii) Divide the open interest for different strike price by that sum for all the days, such that $W_{it}^{c} = O_{it}^{c} / \sum_{i=1}^{k} O_{it}^{c}$ or $W_{jt}^{P} = O_{jt}^{P} / \sum_{i=1}^{k} O_{jt}^{P}$.

Step 4 : Multiply each strike price with their corresponding weights calculated as per the above steps.

Step 5 : Sum up the resultant strike prices for a given day as given in step 4 to get a single strike price in a single day. The final figure is termed as open interest (Call or Put)-based predictors.

The volume-based predictors are also calculated in the same way.