Final Revised Proposal 81

Informational Content Of Trading Volume And Open Interest – An Empirical Study Of Stock Option Market In India

Abstract

This study examines the role of certain non-price variables, namely open interest and trading volume, from the stock option market in determining the price of underlying shares in cash market. In order to examine the significance of these variables, I used the call and put option open interest and volume based predictors as given by Bhuyan and Yan (2002). The results show that these predictors have significant explanatory power with open interest being more significant as compared to trading volume. The study provides deterministic parameters that can be used by the uninformed investors to predict the price of underlying shares using stock options market data and formulate the profitable trading strategies based on it. Finally, it provides support to the view that presence of option market improves the price discovery in underlying asset market.

Keywords: option market, options, price discovery, open interest.

JEL: G13, G14 and D83.

I. INTRODUCTION

Over the past three decades, option contract – defined as a contract that gives the holder (known as option buyer) the right to buy or sell an underlying asset in future at a pre-agreed price – has been widely accepted as one of the most useful derivative securities. While valuing the option contracts, Black and Scholes (1973), in their seminal work, assume these securities as redundant assets and value them with a no-arbitrage relation. They argue that a portfolio comprising of the stock and (riskless) bond would replicate the option position. Does it mean that option contracts are redundant securities? Several research studies have been conducted to examine the role of option market and its contribution in improving the quality of underlying asset market. Extending the argument of Black and Scholes (1973) and Black (1975), Manaster and Rendleman (1982) contend that option market plays an important role as a trading vehicle which provides high liquidity, low trading costs, leverage and least restrictions (uptick' rule for short sales). Bhattacharya (1987) adds upper bound on the loss if long in the option, as another factor that makes informed investors prefer option market. All these studies have argued that prices of stock options may reflect additional information not captured by observed stock prices leading to price discovery.

Grossman (1988) argues against the notion that a real security is redundant when it can be synthesized by a dynamic trading strategy. He observes that such notion essentially ignores the informational role of real securities markets. Further, he contends that the absence of put options would prevent the transmittal of information to market participants about the future price volatility leading to the higher volatility when market players resort to the dynamic hedging strategies[1]. Detemple and Selden (1991) question the accuracy of arbitrage based option valuation model, such as Black and Scholes Model, as there exists a robust interaction between option and stock market. They conclude that, in an incomplete market, the valuation of derivative securities cannot be treated independently from the valuation of primary securities, say equity shares. They observe that the increase in stock prices consequent upon the introduction of option contracts is a result of some economies with the diversity in preferences. Complementing these results, Cassano (2001) concludes that the existence of option contracts reduces the gap between incomplete and complete markets to negligible.

Extending the model of continuous insider trading given by Kyle (1985) to demonstrate the role of options, Back (1993) concludes that option is not redundant when it is actually traded. The existence of option market affects the prices of underlying assets and thus affects the flow of information. He, further, contends that the volatility of underlying asset becomes stochastic when the option is traded on such asset. Cao (1999) concludes that when the assumptions relating to complete, competitive and frictionless markets are relaxed, the introduction of option contracts effect the prices of underlying assets.

Empirical studies, more often, involve investigation of options' effects on stock prices behaviour at two points in time separated by an event that might affect this behaviour. The common event studies include option listing and option expiration effects. The volume of trading witnessed in the option and stock market has been found to be of relevance in understanding the price discovery function. The study conducted by Blume, Easley and O'Hara (1994) contends that volume provides information about the quality of trader's information that cannot be deduced from the price statistic. They investigate the role of volume and trade information in Brown and Jennings Model (1989) and Grundy and McNichols Model (1989), and emphasized upon the changes that need to be brought about in these models. They support complementarity in price and volume information and conclude that a trader who ignores volume would face penalty because the price impounds information about the average level of trader's private information while volume captures signals relating to the quality of trader's information.

Extending the above mentioned study to establish the interlinkage between the option and stock market, Easley, O'Hara and Srinivas (1998) argue against the widespread belief that price in option market is unilaterally derived from the underlying stock prices. They developed a model using the technique of causality testing proposed by Granger (1969) and Granger and Newbold (1977) to investigate the relationship between

[1] Black and Scholes (1973) have shown that the dynamic hedging strategy in a stock and a risk-free asset can reproduce a European call or put option on the stock.

the option volume and stock price changes to predict the informational content of option market and information lead-lag between markets. The conclusions drawn from this study are two fold: (1) stock prices lead option volumes; and (2) option volumes lead stock price changes. The first conclusion is in line with the hedging argument while the second indicates the fact that option market is an important venue for information based trading. They have put in an asymmetric information based theory where the informed traders would trade in call and put options based on their private information which would convey information to the other market participants resulting in an impact (positive or negative) on the price of the underlying asset. This has been probably the first study, to my knowledge, that has given significant evidence of impact of option volumes on stock prices.

Bhuyan and Chaudhury (2001) have examined the role of option market's open interest in conveying information about the future movement of the underlying asset and have shown 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) have developed several price predictors from the open interests and volumes of individual stocks from the option market and conclude that they exhibit significant explanatory and predictive power for the future stock prices. Their results have been the driving force for the present study which is among one of the earlier attempts to study the role of option market in determining the underlying share prices in Indian context.

The author is in agreement with the basic premise drawn by Bhuyan and Chaudhury (2001) and Bhuyan and Yan (2002) that as against the total volume considered by Easley, O'Hara and Srinivas (1998), net open interest of call options and put options together should provide a better indication of the future stock price movement. The present study examines the informational role of stock option market in Indian context.

This study contributes to the previous literature by analyzing the stock option introduction effects in context of India, a developing economy. It examines the informational efficiency of option trading volume and open interest in predicting underlying stock prices. Furthermore, the Indian stock market is relatively highly volatile and lacks market-making system. These factors make National Stock Exchange an interesting laboratory for studying the stock option listing effects and its contribution in making underlying stock market more efficient. It also complements the efforts of Bhuyan and Chaudhury (2001) and Bhuyan and Yan (2002), and provides support for their hypothesis in Indian context. Finally, the evidence also expands our knowledge of informational role of open interest and trading volume in stock option market.

The remainder of the study is organized as follows. Section II contains detailed literature survey on the subject. In section III, data and methodology used in this study has been explained. The empirical analysis has been carried out in Section IV. Finally, conclusion alongwith the direction for future research has been given in Section V.

II. LITERATURE SURVEY

There is an availability of diverse literature on the subject relating to the inter-linkages between option market and stock market. These studies entail a plethora of issues that include option expiration effects, listing effects of options on volatility, bid-ask spread, liquidity of underlying stocks, lead-lag effects in prices and volumes, and price discovery. Some studies have also attempted to document the volume effect of option market on stock price, stock market volume and bid-ask spread. The author has made an attempt to survey the literature on this subject however, some of the studies may not have been included due to constraints in terms of their availability. The literature survey beginning from the next paragraph is given in accordance to time sequence. However, whenever there is a common issue addressed by different studies, they may have been clubbed.

CBOE (1975) was the first study to examine the relationship between option listing and underlying stock price volatility and it conclude that volatility of stock return decreased after the listing of options. The study was based on the data for first four months of 1975 and was difficult to interpret as no test of significance was conducted.

Klemkosky (1978) analyses the option expiration effects based on weekly return data and finds the evidence of negative return on underlying stocks in expiration week and positive return in the week following expiration. His results seem to contradict the statistical implications of the 'weak form' of efficient market hypothesis that the average residual returns were predictable in the expiration and subsequent weeks.

Hayes and Tennenbaum (1979) investigate the impact of option listing on the volume of underlying shares traded in the cash market. They conclude that listing of options does result in increase in the volume of trading in underlying shares. According to them, this effect is caused by the variety in option trading strategies and linkage between cash market and option market as it results in continuous feedback to each of these markets.

Supporting the findings of Klemkosky (1978), Officer and Trennepohl (1981) analyse the price behaviour of equities near option expiration dates and conclude that optionable stocks may experience some downward pressure two days before expiration, however, the abnormal price effect is too low after accounting for taxes, transaction expenses and search costs. Similarly, unexplained stock price volatility was slightly greater than predicted volatility nearing expiration. They note that abnormal price behaviour induced by options doesn't threaten market efficiency.

Whiteside, Dukes and Dunne (1981) examine the price activity of the underlying security in the interim period between the announcement to list and the actual commencement of option trading. They do not find any predictable change in price performance from preceding nine weeks during the interim period. It indicates that announcement to list options does not contain significant market related information other than the availability of additional trading strategy, which can be based on option trading.

Manaster and Rendleman (1982) document the evidence in support of option market leading the stock market. They contend that an option trader is likely to be more informed than the average stock investor, and option prices may reflect additional information not captured by observed stock prices. The closing prices of listed call options contain information about the equilibrium stock prices that is not contained in the closing prices of underlying stocks.

Continuing with their earlier efforts, Whiteside, Dukes and Dunne (1983) examine the short-term impact of option trading on underlying securities before and after the 3-year moratorium lasted from mid-1977 until early 1980 that was called by Securities Exchange Commission (SEC) to investigate the market implications of option trading. The study do not find any clear evidence of impact of option trading on the volatility of underlying security or average daily trading volumes. However, when the results are evaluated by the year of trading, post-moratorium period witnessed a trend towards decreased variability in the number of shares traded daily.

Bhattacharya (1987) contends that option prices do contain some information not already contained in contemporaneous stock prices. However, they acknowledge the insufficiency of such information to overcome bid-ask spread and search costs.

Anthony (1988) empirically investigates the relation between common stock and call option trading volumes using Granger-Newbold Causality test and Multivariate Causality tests. The study concludes that option trading volume "leads" stock volume with a one-day lag. However, the results support the dependence between the two series though the leading role for option volume was less strongly supported, i.e. 48 per cent of cases based on both the tests.

Vijh (1988) examines the potential biases from trade prices and concludes that more trades in the option market occur at ask than at bid. He observes that it may lead to option trade prices to be upward biased estimates of the corresponding true prices. He, further, adds that this bias and non-synchronous trading may create an impression that option prices contain information not reflected in the contemporaneous stock prices even during times when the two prices are in equilibrium.

Conard (1989) investigates the effect of option introduction from 1974 to 1980 and concludes that it has positive permanent price effect on the underlying security beginning slightly before the introduction date. She suggested that timing of price effect just before the introduction of options (not announcement) may be due to the traders building inventory for hedging purposes in anticipation of trading volumes in options. She also concludes that the variance of average excess return has also declined after the introduction of options while the systematic risk has remained the same.

Skinner (1989) concludes that option listing is associated with a decline in stock return variance and an increase in trading activity in underlying stock but didn't find any impact on non-diversifiable risk (beta) of the stock. However, he was unable to find the evidence whether the decline in variance of observed returns is attributable to the changes in trading noise.

Extending the conclusions of his earlier study, Vijh (1990) did not find the evidence to suggest that large option trades are motivated by superior information about the future stock prices. Rather, he contends that what seems to be a superior information may just be the difference of opinion. He finds no evidence of temporary or permanent price effect surrounding large option trades on CBOE.

Detemple and Jorion (1990) contend that an option written on a stock cannot be replicated by a trading strategy in the stock and bonds as it expands the opportunity set of investors by enabling them to achieve payoff patterns that could not be achieved in its absence. They note that the introduction of option market increases the speed at which information is released to the market because investors with private information prefer to take position in option market as against the stock market. Therefore, the introduction of options has price effects, volatility effects, cross effects, announcement effects and persistence effects on the market for underlying shares. For the first time, they investigated the impact of delisting of options and found it to be just reverse of the listing effect.

Rejecting the claims of earlier studies, Stephan and Whaley (1990) conclude that price changes in the stock market leads price changes in the option market for CBOE call options traded during the first quarter of 1986 by about fifteen to twenty minutes on an average. To supplement the findings of price changes relationship between stock market and option market, they investigate the trading in both these market and conclude that trading activity in stock market leads the one in option market by even longer period of time, i.e. five to ten minutes longer than in price change results.

Damodaran and Lim (1991) document the potential explanation for the observed variance decline after listing of option contracts. They conclude that option listing does not lead to shift in intrinsic variance rather it expedites the price adjustment process. It also leads to decline in the noise term that can be attributed to decline in either bid-ask spread (as market makers face more competition) or in noise in the information process as institutional activity increases in optioned stocks. However, they were unable to find the relation of trading volume with the event of option listing.

Chan, Chung and Johnson (1993) reexamine the lead-lag behaviour of stock market and stock option market consequent upon the findings of Stephen and Whaley (1990). They note that the typical tick size in stock and option market is one-eight. Therefore, small moves in the stock prices will usually not be immediately reflected in the option price because the change in theoretical value is smaller than the tick size in the option market and hence it does not trade. Therefore, the option prices would only move once the stock prices have moved more in the same direction and hence stock prices lead option prices. Though their results are in line with the conclusions of Stephan and Whaley (1990), they provides tick rule as an explanation for the leading effect of stock prices. This leading effect vanishes as one uses average of bid-ask prices instead of the transaction prices.

Consistent with the findings of Back (1993) model of informed trading in option markets, Sheikh and Ronn (1994) observe the systematic patterns in option returns even after adjusting for patterns in the means and variances of the underlying assets. They conclude that mean stock returns, adjusted call returns and adjusted put returns are, on an average, positive and largest towards the end of the trading day while their variances exhibit an intraday U-shaped pattern. They also find some of the patterns not common between stock and option market that includes negative returns on adjusted put and call between 9 and 10 a.m. The same has been found to be significantly positive on Tuesdays and Thursdays.

Though most of the studies have been conducted in context of USA, some research studies have also been carried out in Canada, UK and Finland. Elfakhani and Chaudhury (1995) examine the effects of the Canadian option listings on the volatility of underlying stocks. They conclude that option listing had a stabilizing effect on the underlying stocks in total risk as well as non-diversifiable risk sense during 1970s. However, there has been an increase in non-diversifiable risk surrounding the market crash of 1987. As opposed to the outcome of several other studies like Conard (1989) and Kim and Young (1991), they note that the put option listings tend to reduce the total as well as the non-diversifiable risk. In a study that was focused on listing effect of put options, Chaudhury and Elfakhani (1997) conclude that listing of put options have 'stabilizing effect' as the systematic risk (beta) of underlying stocks has declined in post listing period in Canada. They, further, analyse the cross sectional variations in the volatility effect of put options listing and found indirect support for the hypothesis that option listing enhances liquidity and thus has a stabilizing influence on the stock variance. They attribute regulatory environment in Canada for beta stabilization effect

as Canada restricts institutional investors from speculative trading in derivatives. In context of Finland, Sahlstorm (2001) examines the stock option listing effects and concludes that it benefits the efficiency and operation of stock market in Helsinki Stock Exchange. More specifically, this study documents the impact of stock option listing on underlying stocks' volatility, bid-ask spread, and autocorrelation structure of return series. It finds the evidence of decrease in volatility and bid-ask spread levels, and smaller positive first-order autocorrelation after option initiation and thus concludes increase in efficiency of underlying asset market. Some studies have also been conducted in UK. Watt, Yadav and Draper (1992) report increase in efficiency of underlying asset market caused by option listing as a result of temporary price increase immediately prior to listing, lower unsystematic and total risk, better price adjustment to new information, and significant decline in skewness of returns. Later on, Hamill, Opong and McGregor (2002) analyse the stock option listing effect in UK using a number of market based research methodologies. They find that the impact of option listing event has diminished over time and thus support the market completion hypothesis. According to this study, option listings no longer affect the underlying equity market.

Kumar, Sarin and Shastri (1998), in a comprehensive analysis, investigate the impact of option listings on the market quality of underlying stocks in terms of liquidity, information asymmetry and pricing efficiency. Consistent with the findings of earlier studies, they find that option listings have beneficial impact on the market quality of underlying shares. More specifically, they observe a decrease in the spread and increase in quoted depth, trading volume, trading frequency and transaction size after option listing that simply means higher liquidity, lower information asymmetry and greater pricing efficiency.

Cao (1999) studies the effect of derivative assets on information acquisition and price behavior in a rational expectation equilibrium. Firstly, his results show that introduction of options performs market completion function, however, additional new option trading will have less effect on the price of underlying asset. Secondly, he concludes that introduction of derivatives reduces price volatility as price becomes a less biased estimate of the asset payoff due to more information collection. Thirdly, the informational content of future earnings announcements decreases after the introduction of option trading as information collection is more intensive before public announcement. This can be proved from the fact that there is an increase in the number of analysts covering the stock and rise in institutional holding after the listing of options. Finally, as regards the volume effect of options, he cautioned that the effect on trading volume in underlying asset market would depend upon the kind of derivative asset introduced in the market. He expects the liquidity of underlying asset to increase after the commencement of option trading.

Interestingly, Sorescu (2000) document the evidence of mixed effects consequent upon the listing of option contracts. He found the positive abnormal returns in underlying stocks for options listed during the period 1973 to 1980 and negative abnormal returns for the options listed in 1981 and later. He attributes three reasons for the same; (1) introduction of index options supporting the market completion hypothesis as given by Ross (1976); (2) regulatory changes; and (3) ability of options to expedite the dissemination of negative information.

Chan, Chung and Fong (2002) extend the work of Easley, O'Hara and Srinivas (1998) by examining the information content of option trades after adding stock trades into the analysis. They contend that the interrelationship between NYSE stocks and their CBOE traded options results from three effects, namely information effects, inventory control effects and hedging effects. According to them, information effects emanate from the tendency of informed investors to prefer the option market over stock market or vice versa. Inventory control effects emanate from the tendency of market makers to adjust the bid-ask spread based on the orders arriving from informed traders, and the tendency of option dealers to cover their inventories by dealing in cash market leads to hedging effects. They conclude that information in the stock market is contained in both quote revision and trades while information in option market is contained only in quote revision.

III. DATA AND METHODOLOGY

Securities and Exchange Board of India (SEBI) introduced stock options on 31 shares in July 2001. The trading interest in these contracts has been consistently increasing since then as shown in figure 1. The option contracts on ICICI Ltd. and Reliance Petrochemicals Ltd. ceased to exist after their merger with ICICI Bank

and Reliance Industries Ltd. respectively that left the total number of optioned stocks to 29. Not all the option contracts are liquid at NSE. Therefore, our sample consists of options on 15 individual stocks that are most liquid based on the trading volume. Table 1 shows the list of stocks included in this study alongwith their lot sizes. Later on, SEBI expanded the list to include 12 more stocks but that has been excluded in this study, as the data on these stock options is not available for the entire period of study.

The data for this study was taken from the daily bhavcopy posted on the NSE website. It provides all the market information on call and put options traded on different stocks during the day that include option premium (open, high, low and close), trading volume and open interest at each strike price. This study covers stock option contracts for four months, namely November 2002, December 2002, January 2003 and February 2003, comprising a total of 77 trading days (excluding the expiration day).

Currently, we have stock option contracts available in Indian market for one-, two- and three- month maturity. As the present study attempts to decipher the price-volume relationship, the liquidity of stock options becomes an important issue. Keeping this in view, we have included one-month contracts only because they are most liquid. Further, the expiration day data has been excluded from the study to avoid the biasness due to expiration effect.

As mentioned earlier, this study investigates the significance of net open interest and trading volume in stock option market to predict the underlying stock prices. The methodology used here has been taken from Bhuyan and Chaudhury (2001) and Bhuyan and Yan (2002). The notations used are the same as have been used in these studies.

We have assumed a stock with a set of call and put options maturing at T, the current time being T_0. The stock price at time t would be S_t and X^C_i and X^P_i are the set of strike prices for call and put options such that X^C_i, i = 1,2,……,k; X^P_i, i = 1,2,……,m and $t \in [T_0, T]$. Let O^C_{it} and O^P_{it} be the net open interest for a call and put option with the strike prices of X^C_i and X^P_i respectively.

The call option open interest based predictor (COP) is defined by:

$$O^C_t = \sum_{i=1}^{k} w^C_{it} X^C_i \qquad \text{Equation 1}$$

$$w^C_{it} = \frac{O^C_{it}}{\sum_{i=1}^{k} O^C_{it}} \qquad \text{Equation 2}$$

where, O^C_t is COP at time t, k is the number of different types of call options having non-zero open interests, w^C_{it} is the weight of call options with strike of X^C_i. Similarly, put option open interest based predictor (POP) is defined as:

$$O^P_t = \sum_{i=1}^{m} w^P_{it} X^P_i \qquad \text{Equation 3}$$

$$w^P_{it} = \frac{O^P_{it}}{\sum_{i=1}^{m} O^P_{it}} \qquad \text{Equation 4}$$

where, O^P_t is POP at time t, m is the number of different types of put options having non-zero open interests, w^P_{it} is the weight of put options with strike of X^P_i.

Similarly, volume based predictors for both call options, V^C_t, and put options, V^P_t, are defined as follows:

$$V^C_t = \sum_{i=1}^{k} q^C_{it} X^C_i \qquad \text{Equation 5}$$

$$q^C_{it} = \frac{V^C_{it}}{\sum_{i=1}^{k} V^C_{it}} \qquad \text{Equation 6}$$

$$V^P_t = \sum_{i=1}^{m} q^P_{it} X^P_i \qquad \text{Equation 7}$$

$$q^P_{it} = \frac{V^P_{it}}{\sum_{i=1}^{m} V^P_{it}} \qquad \text{Equation 8}$$

where q^C_{it} is the weight of call options with exercise price, X^C_i, and q^P_{it} is the weight of put options with exercise price, X^P_i, for non-zero volume.

Based on the two open interest based predictors and two volume based predictors, the following regression model is used to see relative significance of each of these predictors.

$$\log S_T = \alpha_0 + \alpha_1 \log (T-t) + \alpha_2 \log S_t + \alpha_3 \log O^C_t + \alpha_4 \log O^P_t + \alpha_5 \log V^C_t + \alpha_6 \log V^P_t + \varepsilon_t \qquad \text{Equation 9}$$

Where, S_T is the stock price at maturity date T, T-t is the time to maturity, S_t is the current stock price, O^C_t and O^P_t are open interest based predictors, V^C_t and V^P_t are volume based predictors and ε_t is the error term. The natural logarithms of variables have been used to rescale data to 'pull in' extreme observations and thereby enable us to handle heteroscedasticity.

To find out the relative significance of the open interest based predictors and volume based predictors, the following regression equations have been used:

$$\log S_T = \alpha_0 + \alpha_1 \log (T-t) + \alpha_2 \log S_t + \alpha_3 \log O^C_t + \alpha_4 \log O^P_t + \varepsilon_t \qquad \text{Equation 10}$$

$$\log S_T = \alpha_0 + \alpha_1 \log (T-t) + \alpha_2 \log S_t + \alpha_3 \log V^C_t + \alpha_4 \log V^P_t + \varepsilon_t \qquad \text{Equation 11}$$

The notations used in above equations are the same as have been used in equation 9.

IV. EMPIRICAL RESULTS

This study includes the data for 15 most liquid options on individual shares traded at NSE. To bring the data in standardized form, all price related information, namely spot price, spot price at expiration, call and put

option open interest based predictors and volume based predictors, are divided by the average daily closing price of the stock for the sample period. Through this process, the data for all the 15 shares has been brought into the standardized form for the purpose of conducting regression analysis. However, while carrying out the regression analysis for individual stock options separately, there is no need to adjust the data. For this study, I have carried out the regression analysis for all the 15 shares in a consolidated form as well as separately. This has been done to check if there is a significant variation in the results while taking each stock option independently.

Table 2 illustrates the results of regression analysis (equation 9). The table is divided into two parts, Panel A and B. An examination of the results of regression analysis in Panel A reveals that both the open interest and volume based predictors are significant explanatory variables for estimating the future spot price of underlying shares. However, as against the findings of Bhuyan and Yan (2002), the coefficients of call as well as put option open interest based predictors are negative and statistically significant. On the other hand, the coefficients of volume based predictors for call and put options are positive and statistically significant. Bhuyan and Yan (2002) find the positive coefficient for COP and negative coefficient for POP. They argue that when investors expect the price of underlying stock to increase they would be willing to buy call options at higher strike price and in case of anticipated decline in stock prices they would prefer to buy put options. However, the findings in table 2 contradict their conclusions. Still, the coefficient of POP is highly negative and more statistically significant as compared to the coefficient of COP. The adjusted R^2 is 0.271 and it is comparatively lower than the one found in US context. It indicates that the model could explain around 27 per cent of the variations in spot price of underlying shares. The findings have been identical even when the data for the last five days upto expiration was excluded from the analysis as shown in Panel B.

To examine the informational content of trading volume and open interest in more detail, the study has been extended to include the regression analysis of 15 individual stock options separately. These results are quite insightful and are summarized in Table 4 for open interest based predictors while the detailed results are given in Table 3. Out of the total 15 stock options covered in this study, 8 are found to have positive coefficients for COP and negative coefficients for POP. They are statistically significant at 95% and 99% confidence interval for both COP and POP except for Satyam Computer Services Ltd. Also, the adjusted R^2 for all these 8 stock options is high that reflects the considerable explanatory power of the model in these cases. On the other hand, 6 stock options have negative coefficients for COP and positive coefficients for POP. However, the results are statistically significant at 95% as well as 99% confidence interval only for Mahanagar Telephone Nigam Ltd. and Tata Iron and Steel Company Ltd. One stock option, on Digital Globalsoft Ltd., has negative coefficient both for COP and POP but it is neither statistically significant at 99% nor at 95% confidence interval.

These findings provide support in favour of the argument that the coefficient should be positive for COP and negative for POP. This is because of the fact that informed investors would buy out-of-the-money call options (at higher strike price level) in anticipation of rise in stock prices leading to increase in COP. Similarly, they would prefer to buy put options at higher strike price when they have specific information about the decline in stock prices, which would lead to higher POP. Another possibility may be that the informed investors may like to write put options when they expect the stock prices to increase and call options when they expect stock prices to decline.

It may be argued that the model used in this study is based on the basic premise that informed investors are expected to go long only either on call options or put options. However, it is to be noted that I have not ruled out the option writing by the informed investors but I believe that such transactions are going to be less. The reason is that while writing options one would take exposure to the unlimited risk potential. When informed investors are acting on the basis of information that would materialize in future, they are already undertaking the calculated risk. They would avoid multiplying their risk exposure by going short in the option market. Further, given the high degree of volatility in Indian stock market, the probability of informed investors buying options rather than writing options would be more. Therefore, the COP is expected to have positive coefficient while the same is expected to be negative for POP. It should be noted that the study emphasizes upon the COP and POP and not the net open interest alone and hence it needs to be seen in the light of both net open interest and strike prices. There is a likelihood that the open interest based predictors

may increase even when the net open interest declines. This is due to the fact that investors may be dealing in the call or put options at higher strike price that leads to increase in these predictors. The reverse would happen in case of increase in net open interest but the options are entered at lower strike price.

To draw the comparative analysis of predictive ability of call and put options open interest based predictors and volume based predictors, the regression analysis is conducted for them separately and the results are given in Table 5. Panel A gives the results of regression analysis with open interest based predictors while Panel B summarizes the results of analysis with volume based predictors. The explanatory variables, namely call and put options open interest based predictors and call option volume based predictor, are found to be having negative coefficients. These are statistically significant only for the call option predictors. The put option volume based predictor has positive coefficient but is not statistically significant. These results do not offer much explanation of the price discovery behaviour except for the fact that net open interest based predictors serve as better parameters for predicting future spot price of underlying asset in comparison to the volume based predictors, which has been considered in the previous studies including Easley, O'Hara and Srinivas (1998). It is worth noting that the adjusted R^2 has declined to 0.200 when I excluded the volume based predictors from the equation 9 as shown in Panel A of Table 5. It further declines to 0.159 after excluding the open interest based predictors (Panel B). In both these cases, the adjusted R^2 is lower than the one observed in Table 2 with both open interest and volume based predictors included. It clearly reflects the decline in explanatory power of the model with any of these parameters excluded.

V. CONCLUSION AND DIRECTION FOR FUTURE RESEARCH

This study has strengthened the argument forwarded by Bhuyan and Yan (2002) that net open interest of stock option is one of the significant variables in determination of the future spot price of underlying share. The results clearly indicate that open interest based predictors are statistically more significant than volume based predictors in Indian context too. However, there are certain differences in the outcome of this study and Bhuyan and Yan (2002). According to their study, the coefficient of COP has positive sign and the coefficient of POP possesses negative sign. Based on these findings, they argue that the informed investors would buy out-of-the-money call options when they expect the market to rise and put options when they expect it to decline. The reasoning, as mentioned in the previous section, does support their contention. However, I have given the additional explanation for this to happen which would be more relevant in context of volatile markets like India. This explanation is with regard to the trading behaviour of informed investors in Indian market.

In this study, both the coefficients of COP and POP are found to have the negative sign. This finding is not as per the expectations. However, when I investigated the same for the 15 individual stock options separately the evidence in favour of the above-mentioned argument is clearly visible. The coefficient for COP is found to be positive while the same for POP is negative for majority of stock options and it is statistically significant. Therefore, the results of this study show that option markets, more specifically the net open interest, are likely to be informative about the future movement of stock prices. Investors who do not possess the specific information about the future price movement can use these predictors for deciding upon their trading strategies. Even the sophisticated investors can explore these estimates and further refine their trading strategies with more informational inputs.

There may be a number of reasons for the difference in results arrived in US context and India. Firstly, the exchange traded stock derivative market in India is of recent origin and it takes time for the investors to realize the true potential of these instruments. Secondly, the participation of institutional investors in Indian stock derivative market is extremely limited. It can be attributed to the regulatory restrictions wherein such investors are allowed to use derivative securities for hedging purposes only. It can be proved from the fact that cumulative foreign institutional investor's position as percentage of total gross market position in the derivative segment was 12.39 per cent as on August 5, 2003. The story of mutual funds is not significantly different from this. Therefore, the investors who have better access to information and can be classified in the category of informed investors are constrained to deal in the derivative securities. Though there are some positive developments taking place in this direction, these securities are yet to gain significance in the portfolio of institutional investors in India. Lastly, there are some issues relating to the accounting and

tax treatment of profit arising from dealing in derivative securities that further prohibit the wider participation of such investors in derivative segment.

Our research contributes to the existing literature by providing some evidence of option market activity and the impact of non-price variables on the future spot price of underlying asset in context of a developing nation like India where derivatives have been recently introduced in stock market. As the market activity progresses further, I hope that more evidence would come in support of my findings. It would not only benefit the investor community but also provides support for the hypothesis that derivative securities enhance the quality of underlying asset market. This study also complements the earlier evidence documented in Srivastava, Yadav and Jain (2002) with regard to the efficiency of stock index futures market in India. It would definitely help the regulatory bodies in policy-making and further strengthening the efforts to promote the derivative market in India. There are many areas which are still unexplored and can be addressed by the future studies.

First and the foremost is the use of intraday data in determining the significance of net open interest because many profitable opportunities are utilized within a course of day and hence future studies may take up this aspect into consideration. I have used a sample of 15 near-month stock options for the present study because they are most liquid. As the number of shares in stock option segment has been increased to 41, the future study may be conducted with larger sample size and longer duration data. Lastly, the significance of daily change in open interest in predicting the future spot price may be another area that can be explored by the future studies.

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Figure 1: Trends in Stock Option Market in India

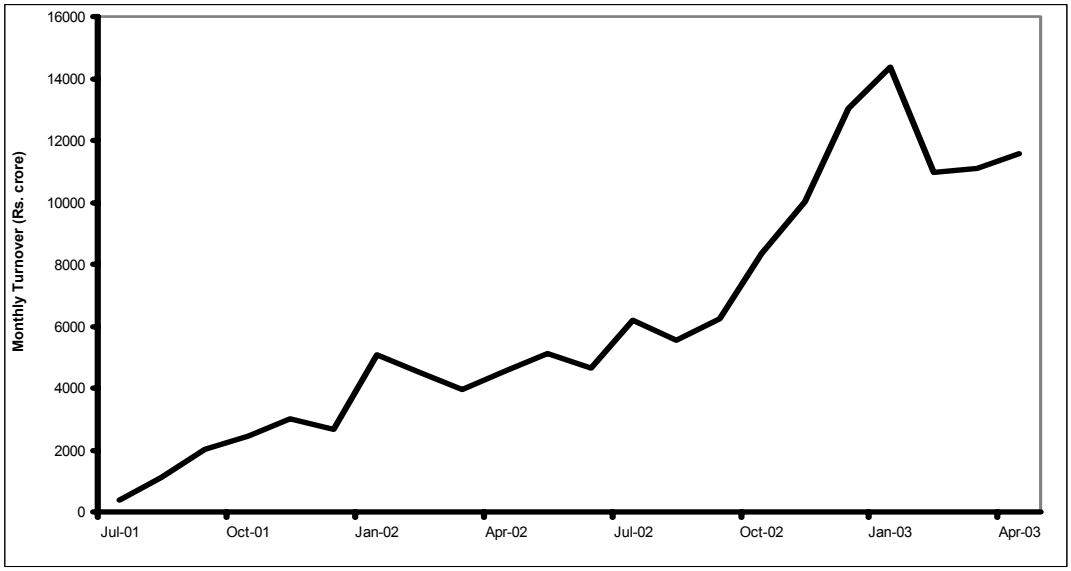

Table 1: Sample Firms and Lot Sizes in Stock Option Market

No.	Underlying Stock	Contract Size (No. of shares)
1.	Associated Cement Company Ltd.	1500
2.	Bharat Petroleum Corporation Ltd.	1100
3.	Digital Globalsoft Ltd.	400
4.	Hindustan Lever Ltd.	1000
5.	Hindustan Petroleum Corporation Ltd.	1300
6.	Infosys Technologies Ltd.	100
7.	Larsen & Toubro Ltd.	1000
8.	Mahindra & Mahindra Ltd.	2500
9.	Mahanagar Telephone Nigam Ltd.	1600
10.	Reliance Industries Ltd.	600
11.	Satyam Computer Services Ltd.	1200
12.	State Bank of India	1000
13.	Sterlite Optical Technologies Ltd.	600
14.	Tata Engineering and Locomotive Co. Ltd.	3300
15.	Tata Iron and Steel Company Ltd.	1800

Table 2: Results based on the Regression with Open Interest based Predictors and Volume based Predictors (Consolidated)

The statistics mentioned in the table are based on the regression equation: $\log S_T = \alpha_0 + \alpha_1 \log (T-t) + \alpha_2 \log S_t + \alpha_3 \log O^C_t + \alpha_4 \log O^P_t + \alpha_5 \log V^C_t + \alpha_6 \log V^P_t + \varepsilon_t$ (Equation 9) where S_T is stock price at maturity, T-t is time to maturity, S_t is stock price at time 't', O^C_t and O^P_t are call and put option open interest based predictors and V^C_t and V^P_t are call and put option volume based predictors.

Panel A: Sample of Options on 15 Individual Shares excluding Expiration Day N = 1155; $R^2_{Adjusted}$ = 0.271			
	α_i (Coefficient)	**Standard Error**	**t – statistic**
Intercept	– 0.005	0.009	– 0.519
T – t	– 0.002	0.003	– 0.558
S_t	0.119	0.068	1.752
O^C_t	– 0.591	0.118	– 4.999
O^P_t	– 0.753	0.108	– 6.952
V^C_t	0.736	0.148	4.963
V^P_t	0.713	0.112	6.365
Panel B: Sample of Options on 15 Individual Shares excluding last 5 days upto Expiration N = 990; $R^2_{Adjusted}$ = 0.222			
	α_i (Coefficient)	**Standard Error**	**t – statistic**
Intercept	0.014	0.016	0.908
T – t	– 0.008	0.005	– 1.625
S_t	0.018	0.078	0.230
O^C_t	– 0.726	0.141	– 5.141
O^P_t	– 0.795	0.128	– 6.203
V^C_t	0.928	0.178	5.221
V^P_t	0.725	0.131	5.536

Table 3: Results based on the Regression with Open Interest based Predictors and Volume based Predictors for Individual Stock Options (excluding Expiration Day)

The statistics mentioned in the table are based on the regression equation: $\log S_T = \alpha_0 + \alpha_1 \log (T\text{-}t) + \alpha_2 \log S_t + \alpha_3 \log O^C_t + \alpha_4 \log O^P_t + \alpha_5 \log V^C_t + \alpha_6 \log V^P_t + \varepsilon_t$ (Equation 9) where S_T is stock price at maturity, T-t is time to maturity, S_t is stock price at time 't', O^C_t and O^P_t are call and put option open interest based predictors and V^C_t and V^P_t are call and put option volume based predictors.

Panel A: ASSOCIATED CEMENT COMPANY LTD. N = 77 ; $R^2_{Adjusted}$ = 0.838			
	α_i (Coefficient)	**Standard Error**	**t – statistic**
Intercept	5.776	0.367	15.726
T – t	– 0.010	0.003	– 3.147
S_t	0.517	0.176	2.936
O^C_t	3.796	0.459	8.274
O^P_t	– 5.602	0.467	– 11.987
V^C_t	0.716	0.249	2.868
V^P_t	0.368	0.194	1.897
Panel B: BHARAT PETROLEUM CORPORATION LTD. N = 77 ; $R^2_{Adjusted}$ = 0.335			
	α_i (Coefficient)	**Standard Error**	**t – statistic**
Intercept	6.952	1.239	5.609
T – t	– 0.005	0.009	– 0.501
S_t	1.019	0.324	3.145
O^C_t	– 0.437	0.715	– 0.611
O^P_t	0.008	0.241	0.032
V^C_t	– 1.063	0.790	– 1.346
V^P_t	0.173	0.257	0.675
Panel C: DIGITAL GLOBALSOFT LTD. N = 77 ; $R^2_{Adjusted}$ = 0.417			
	α_i (Coefficient)	**Standard Error**	**t – statistic**
Intercept	7.118	0.689	10.336
T – t	– 0.009	0.008	– 1.214
S_t	0.359	0.268	1.343
O^C_t	– 0.384	0.516	– 0.744
O^P_t	– 0.552	0.327	– 1.685
V^C_t	1.947	0.660	2.949
V^P_t	– 1.497	0.564	– 2.656

Table 3: Results based on the Regression with Open Interest based Predictors and Volume based Predictors for Individual Stock Options (excluding Expiration Day) (contd.)

Panel D: HINDUSTAN LEVER LTD.			
			$N = 77$; $R^2_{Adjusted} = 0.776$
	α_i (Coefficient)	**Standard Error**	**t – statistic**
Intercept	3.623	0.262	13.836
$T - t$	0.005	0.003	1.789
S_t	0.351	0.161	2.176
O^C_t	1.450	0.262	5.534
O^P_t	– 1.784	0.180	– 9.910
V^C_t	0.248	0.225	1.104
V^P_t	0.011	0.188	0.060
Panel E: HINDUSTAN PETROLEUM CORPORATION LTD.			
			$N = 77$; $R^2_{Adjusted} = 0.855$
	α_i (Coefficient)	**Standard Error**	**t – statistic**
Intercept	2.044	0.312	6.541
$T - t$	– 0.008	0.013	– 0.642
S_t	0.687	0.271	2.533
O^C_t	– 2.756	0.605	– 4.553
O^P_t	1.071	0.498	2.149
V^C_t	1.337	0.542	2.469
V^P_t	0.325	0.534	0.610
Panel F: INFOSYS TECHNOLOGIES LTD.			
			$N = 77$; $R^2_{Adjusted} = 0.437$
	α_i (Coefficient)	**Standard Error**	**t – statistic**
Intercept	8.562	0.759	11.278
$T - t$	– 0.021	0.009	– 2.260
S_t	– 0.242	0.339	– 0.714
O^C_t	– 2.284	0.629	– 3.632
O^P_t	0.104	0.533	0.195
V^C_t	2.225	0.656	3.393
V^P_t	0.187	0.842	0.222
Panel G: LARSEN AND TOUBRO LTD.			
			$N = 77$; $R^2_{Adjusted} = 0.873$
	α_i (Coefficient)	**Standard Error**	**t – statistic**
Intercept	11.030	0.306	36.045
$T - t$	0.005	0.002	1.864
S_t	– 0.140	0.135	– 1.041
O^C_t	1.106	0.325	3.405
O^P_t	– 2.033	0.244	– 8.332
V^C_t	– 0.046	0.224	– 0.207
V^P_t	0.008	0.159	0.052

Table 3: Results based on the Regression with Open Interest based Predictors and Volume based Predictors for Individual Stock Options (excluding Expiration Day) (contd.)

Panel H: MAHINDRA & MAHINDRA LTD. N = 77 ; $R^2_{Adjusted}$ = 0.258			
	α_i (Coefficient)	**Standard Error**	**t – statistic**
Intercept	6.299	0.412	15.285
T – t	– 0.012	0.007	– 1.713
S_t	– 0.002	0.316	– 0.006
O^C_t	– 0.866	0.483	– 1.791
O^P_t	0.590	0.622	0.950
V^C_t	0.347	0.575	0.604
V^P_t	– 0.416	0.389	– 1.068
Panel I: MAHANAGAR TELEPHONE NIGAM LTD. N = 77 ; $R^2_{Adjusted}$ = 0.887			
	α_i (Coefficient)	**Standard Error**	**t – statistic**
Intercept	7.763	0.245	31.713
T – t	0.002	0.003	0.522
S_t	– 0.086	0.085	– 1.012
O^C_t	– 0.726	0.172	– 4.214
O^P_t	0.395	0.100	3.950
V^C_t	– 0.076	0.166	– 0.459
V^P_t	– 0.171	0.106	– 1.618
Panel J: RELIANCE INDUSTRIES LTD. N = 77 ; $R^2_{Adjusted}$ = 0.565			
	α_i (Coefficient)	**Standard Error**	**t – statistic**
Intercept	2.466	0.649	3.803
T – t	0.023	0.005	4.249
S_t	0.200	0.269	0.744
O^C_t	2.907	0.428	6.798
O^P_t	– 3.694	0.442	– 8.367
V^C_t	0.892	0.357	2.497
V^P_t	0.200	0.383	0.521
Panel K: SATYAM COMPUTER SERVICES LTD. N = 77 ; $R^2_{Adjusted}$ = 0.702			
	α_i (Coefficient)	**Standard Error**	**t – statistic**
Intercept	3.578	0.634	5.642
T – t	– 0.034	0.016	– 2.060
S_t	0.490	0.508	0.964
O^C_t	0.101	0.678	0.150
O^P_t	– 2.252	0.706	– 3.189
V^C_t	3.499	0.950	3.685
V^P_t	– 1.511	1.002	– 1.508

Table 3: Results based on the Regression with Open Interest based Predictors and Volume based Predictors for Individual Stock Options (excluding Expiration Day) (contd.)

Panel L: STATE BANK OF INDIA			
			N = 77 ; $R^2_{Adjusted}$ = 0.824
	α_i (Coefficient)	**Standard Error**	**t – statistic**
Intercept	3.500	0.322	10.872
T – t	0.009	0.004	2.494
S_t	0.122	0.200	0.609
O^C_t	1.390	0.495	2.809
O^P_t	– 1.924	0.535	– 3.598
V^C_t	0.347	0.325	1.066
V^P_t	0.426	0.273	1.563
Panel M: STERLITE OPTICAL TECHNOLOGIES LTD.			
			N = 77 ; $R^2_{Adjusted}$ = 0.599
	α_i (Coefficient)	**Standard Error**	**t – statistic**
Intercept	– 0.525	0.786	– 0.669
T – t	– 0.011	0.014	– 0.773
S_t	0.589	0.258	2.284
O^C_t	2.053	0.699	2.936
O^P_t	– 3.023	0.615	– 4.919
V^C_t	0.620	0.554	1.121
V^P_t	0.827	0.437	1.892
Panel N: TELCO LTD.			
			N = 77 ; $R^2_{Adjusted}$ = 0.822
	α_i (Coefficient)	**Standard Error**	**t – statistic**
Intercept	8.936	0.323	27.681
T – t	– 0.001	0.004	– 0.145
S_t	0.184	0.179	1.027
O^C_t	2.764	0.399	6.923
O^P_t	– 3.837	0.422	– 9.099
V^C_t	0.693	0.241	2.875
V^P_t	– 0.618	0.266	– 2.320
Panel O: TATA IRON AND STEEL COMPANY LTD.			
			N = 77 ; $R^2_{Adjusted}$ = 0.953
	α_i (Coefficient)	**Standard Error**	**t – statistic**
Intercept	4.176	0.153	27.336
T – t	0.002	0.002	1.094
S_t	– 0.215	0.028	– 7.678
O^C_t	– 1.381	0.140	– 9.836
O^P_t	1.624	0.178	9.132
V^C_t	– 0.159	0.182	– 0.874
V^P_t	0.310	0.147	2.114

Table 4: Summarized Results of Regression based on Open Interest based Predictors for Individual Stock Options (excluding Expiration Day)#

S. No.	Positive Coefficient for Call Option Open Interest based Predictor and Negative Coefficient for Put Option Open Interest based Predictor	Negative Coefficient for Call Option Open Interest based Predictor and Positive Coefficient for Put Option Open Interest based Predictor	Negative Coefficients for both Call option and Put Option Open Interest based Predictors
1.	Associated Cement Company Ltd.*	Bharat Petroleum Corporation Ltd.**	Digital Globalsoft Ltd.**
2.	Hindustan Lever Ltd.*	Hindustan Petroleum Corporation Ltd.@	
3.	Larsen & Toubro Ltd.*	Infosys Technologies Ltd. @@	
4.	Reliance Industries Ltd.*	Mahindra & Mahindra Ltd. **	
5.	Satyam Computer Services Ltd.$	Mahanagar Telephone Nigam Ltd.*	
6.	State Bank of India*	Tata Iron and Steel Company Ltd.*	
7.	Sterlite Optical Technologies Ltd.*		
8.	Tata Engineering and Locomotive Co. Ltd.*		

#Detailed results are shown in Table 3.
* COP and POP are statistically significant at 95% and 99% confidence interval.
** COP and POP are statistically not significant at 95% and 99% confidence interval.
@COP is statistically significant at 99% while POP is significant at 95% confidence interval.
@@COP is statistically significant at 99% confidence interval while POP is not significant at these intervals.
$POP is statistically significant at 99% confidence interval while COP is not significant.

Table 5: Comparative Analysis of Results based on the Regression with Open Interest based Predictors and Volume based Predictors Separately (Consolidated)

The statistics mentioned in the table are based on the regression equation: $\log S_T = \alpha_0 + \alpha_1 \log (T-t) + \alpha_2 \log S_t + \alpha_3 \log O^C_t + \alpha_4 \log O^P_t + \varepsilon_t$ [Equation 10] (Panel A) and $\log S_T = \alpha_0 + \alpha_1 \log (T-t) + \alpha_2 \log S_t + \alpha_3 \log V^C_t + \alpha_4 \log V^P_t + \varepsilon_t$ [Equation 11] (Panel B) where S_T is stock price at maturity, T-t is time to maturity, S_t is stock price at time 't', O^C_t and O^P_t are call and put option open interest based predictors and V^C_t and V^P_t are call and put option volume based predictors.

Panel A: Results based on the Regression with Open Interest based Predictors N = 1155; $R^2_{Adjusted}$ = 0.200			
	α_i (Coefficient)	**Standard Error**	**t – statistic**
Intercept	0.013	0.007	1.740
T – t	– 0.003	0.002	– 1.168
S_t	0.675	0.042	15.996
O^C_t	– 0.325	0.058	– 5.647
O^P_t	– 0.064	0.042	– 1.509
Panel B: Results based on the Regression with Volume based Predictors N = 1155; $R^2_{Adjusted}$ = 0.159			
	α_i (Coefficient)	**Standard Error**	**t – statistic**
Intercept	0.005	0.007	0.831
T – t	– 0.001	0.003	– 0.563
S_t	0.606	0.062	9.833
V^C_t	– 0.260	0.075	– 3.460
V^P_t	0.012	0.045	0.272