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Informational Role of Non-Price Variables: An Empirical Study of the Indian Options Market

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Abstract

The 'Informational role of the options market in predicting the future price index in the underlying cash market in India' is studied in this paper by applying the method of open interest and volume-based predictors (Bhuyan and Yan, 2002). Daily data for both price as well as non-price variables for four different sub-periods (2005 to 2008) have been employed to explore the above said relationship and its changes (if any) in the subsequent period. 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, which can be used by the uninformed investors to predict the price of underlying shares using index options market data and formulate the profitable trading strategies based on it.

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I. INTRODUCTION

Price discovery is the main aspect of the financial markets. The relative efficient price signals, which prevail in the market place, are important for enhancing productive efficiency and economic growth through superior capital allocation. These signals also facilitate the ability of relatively uninformed investors to make suitable portfolio choices. As illustrated in Grossman (1988), derivative securities enhance price discovery by pricing a static payoff pattern that represents the value of an otherwise dynamic investment strategy. Other literature also documents the evidence of increased informational efficiency consequent upon the introduction of derivatives. They are expected to increase the flow of information into the market resulting in better price discovery of the underlying asset. An option – 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 a predetermined date – is one of the important hedging instruments traded in derivative exchanges all over the world. It is well known that trading in options (as suggested by Black, 1975) may be more attractive than trading in underlying equity market due to the economic incentives provided by reducing transaction cost, capital requirements and trading restrictions, commonly seen in the equity market. Options can be used both for hedging as well as for speculation. If the assumptions (as suggested by Cao, 1999) relating to complete, competitive and frictionless markets are relaxed, the introduction of options contracts can affect the prices of underlying assets. It is well documented that not only the options prices, but also the non-price variables, such as 'open interest', trading volume, etc., from the options market can affect the stock prices in the underlying equity market.

The study investigates the impact of the non-price (i.e., other than asset price) variables viz. open interest and trading volume from the options 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, as suggested by Bhuyan and Yan (2002) and recently applied by Srivastava (2003), and RK Misra (2007), this study empirically investigates the hypothesis that the above non-price variables in the option market cannot be used to predict the future price index in underlying cash market. This study is based on daily data for both price as well as non-price variables over four different sub-periods, July 2005 to December 2005, January 2006 to June 2006, June 2007 to December 2007 and January 2008 to June 2008. It reveals that the open interest-based predictors are significant in predicting the underlying spot price index in all four the sub-periods. But as far as the volume-based predictors are concerned, it shows some changing nature.

II. REVIEW OF LITERATURE

A considerable amount of literature deals with the interrelationship between the derivatives market, viz., options market, and the underlying cash market. different issues addressed in those studies include (1) the effect of options 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 and underlying cash market; (4) the role of the options 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. Extending the argument of Black and Scholes (1973) and Black (1975), Manaster and Rendleman (1982) contend that option market plays an important role as trading vehicle that provides high liquidity, low trading costs, leverage, and least restrictions. Bhattacharya (1987) adds upper bound on the loss if long in the option, as another factor that makes informed investors prefer option market. Skinner (1989), Damodaran and Lim (1991), Kumar (1995), Kumar et al. (1998), Bollen (1998), Cao (1999), Shenbagaraman (2002), Thomas and Thenmozhi (2003), Joshi (2003) etc., have tried to examine the options listing effect on the volatility, liquidity etc., of the underlying cash market all over the world. Studies by Klemkosky (1978), Officer and Trennepohl (1981), Bollen and Whaley (1999) have documented the options expiration effect on the prices of the underlying cash market at the time of maturity., Since the main aim of the study is to examine whether the open interest and trading volume from the options market are significant in explaining the future movement of prices in the underlying cash market, it could not explain the previous studies discussed here –which covers all the aspects of the interrelationship between the options and the cash market.

The impact of open interest and/or trading volume from the options market in discovering prices in the underlying cash market is studied by Blume et al.(1994), Bhuyan and Chaudhury (2001), Bhuyan and Yan (2002), Srivastava (2003). Blume et al. (1994) concludes that the trading volume in the options market provides information about the quality of trader’s information that cannot be discovered from the price variables. They support the view that price and volume information are complementary to each other so that a trader ignoring volume would be penalized because any private information is impounded in prices while, the trading volume captures the quality of trader’s information. So, their findings suggest that both price and volume information is essential to discover the future price. By using the causality test (Granger, 1969 and Granger and Newbold, 1977), Easley et al. (1998) have tried to investigate the relationship between the trading volume in options market and the stock price change in the underlying cash market. They concluded that the stock price lead options volumes and options volumes lead stock prices changes. Bhuyan and Chaudhury (2001) have investigated the role of open interest from option market in discovering the future price movement in the underlying cash market. They suggested that the trading strategy based on this predictor (open interest-based predictor) yield better results than the buy and hold strategy. Apart from this, Bhuyan and Yan (2002) and in another study have tried to examine the relative importance of open interest and trading volume from both call and put in stock options market in predicting the future stock prices. They concluded that the price predictors developed from the open interest and trading volume in the stock options market can significantly predict the future stock prices in the underlying cash market. In order to find out the impact of open interest and trading volume from the stocks option market on the stock price in India, Srivastava (2003) has used the same predictors as suggested by Bhuyan and Yan (2002) and concluded that the open interest-based predictors are comparatively more significant than the volume-based predictors.There are a few studies that have examined the impact of price as well as non-price variables from the options market in predicting the future price movement in the underlying cash market with respect to countries where the option market is well established. As far as the Indian derivative market is concerned, the index option in this market was introduced during June 2001. Therefore, it has not yet been well documented whether the non-price variables from the options market are that much significant (as reported in the literature) in the Indian scenario. Though the study by Srivastava (2003) tried to answer the question, the main shortfall of this study of the very limited sample period within which the findings drawn by him could not be well established. This study contributes to the previous literature by examining the impact of those non-price variables during the four-periods, just after the instrument (index option) and in a recent sub-period, so that it will be easy to know their impact in all the periods – when the options market was not properly established. Generalization of fact is possible only when the investigation is conducted in a market is already established, otherwise there may be some possibility of bias.

III. SOURCES OF DATA:

The National Stock Exchange (NSE) India has commenced trading in S&P CNX Nifty Index Options from June 4, 2001. This study covers four different sub-periods (Total 473 trading days): July 2005 to December 2005, January 2006 to June 2006, June 2007 to December 2007 and January 2008 to June 2008. Daily data relating to the price as well s non-price variables such as spot price index in the underlying cash market, and open interest, trading volume, different strike price, etc. in the options market, have been collected for all the sub-periods. There are different types of options contracts available in the Indian Market – which gets matured in one month, two months and three months contracts early, subsequently these contracts extended to one year, two year and three year too. Since the options price on the first nearest contract is characterized by a high level of activity, all the data for both price and non-price variables of the 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 the possible bias expected to be occurred due to the expiration effect. All the relevant data have been collected from the NSE website and all the calculations have been made by using MS-Excel and SPSS (Version 11.0).

IV. METHODOLOGY OF THE STUDY:

The interrelationship between the net open interest and trading volume in the options market and the price in underlying cash market can be measured by various techniques like the Granger's Causality test. But, in the present study, a simple methodology used by Bhuyan and Chaudhury (2001), Bhuyan and Yan (2002) and Srivastava (2003) have been taken into consideration to investigate the significance of net open interest and trading volume from the index option market in explaining the price index in the underlying cash market. The terms and notations applied in the methodology are the same as used in the above-mentioned studies.Let 'T' be the time of maturity of a set of call and put option. The current price of cash index is assumed to be I_t ; while, X^c_i and X^p_j are assumed to be the set of strike price for call and put options, where i=1, 2,………., k; j=1, 2,…….., m. Let O^c_{it} and O^p_{jt} be the net open interest at the current time 't' for a call and put option with the strike price X^c_i and X^p_j respectively. Similarly, V^c_{it} and V^p_{jt} are assumed to be the trading volume for a call and put option at time t with the strike price X^c_i and X^p_j respectively.New the two predictors – open interest-based predictor and volume-based predictor-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:

$$O_t^C = \sum_{i=1}^{k} w_{it}^C X_i^C \text{ …….(1)}$$

In the above equation, O^c_t represents the call option open interest-based predictor at time t; while k denotes the number of different types of call options showing some non-zero open interest. W^c_{it} is the weight of call options with strike price of X^c_i. The above concept can also be applied to calculate the Put Option Open interest-based predictor (POP), such that:

$$O_t^p = \sum_{j=1}^{m} w_{jt}^p X_j^p \text{ ……(2)}$$

O^p_t is the out option open interest-based predictor at time t; m represents the number of different types of put options having some non-zero open interests. Again, W^p_{jt} denotes the weight of put options with strike price X^p_j. Similarly, the volume-based predictor for both call and put options can be calculated by using the trading volume data in the options market, i.e., V^c_{it} and V^p_{jt} corresponding to the strike price X^c_i and X^p_j respectively, such that:

$$V_t^C = \sum_{i=1}^{k} q_{it}^C X_i^C \text{ ……(3)}$$

$$V_t^p = \sum_{j=1}^{m} q_{jt}^p X_j^p \text{ ……(4)}$$

V^c_t from equation (3) and V^p_t from equation (4) represent the call option and put option volume-based predictor respectively at time t; while q^c_{it} is the weight of call option with exercise price X^c_i and q^p_{jt} is the weight of put option with exercise price X^p_j. k and m bear the same meaning, but for some non-zero trading volume in option market. A brief description of the important steps followed while calculating the above predictors has been mentioned in the Appendix. Based on the open interest and volume-based predictors for both call and put Options, it is easy to find out the relative significance of each of these predictors by using a multiple regression model such that:

$$\mathbf{\ln I_T = \alpha_0 + \alpha_1 \ln(T\text{-}t) + \alpha_2 \ln I_t + \alpha_3 \ln O^c_t + \alpha_4 \ln O^p_t + \alpha_5 \ln V^c_t + \alpha_6 \text{In } V^p_t + \varepsilon_t} \text{ ……(5)}$$

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^c_t and O^p_t are open interest-based predictors; while, V^c_t and V^p_t are volume-based predictors. ε_t denotes the error term assumed to be 'white noise'. The natural logarithms of the entire variable have been used to account for the hetroscedasticity, i.e., unequal variance among the variables. It is to be noted here that, since the variable (T-t) is unable to improve the overall explanatory power (as shown by adjusted R square) and thus reduce the joint significance (represented by F-test), the study removed the variable from the above equation such that:

$$\ln I_T = \alpha_0 + \alpha_1 \ln I_t + \alpha_2 \ln O^c_t + \alpha_3 \ln O^p_t + \alpha_4 \ln V^c_t + \alpha_5 \ln V^p_t + \varepsilon_t \quad \ldots\ldots(6)$$

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

$$\ln I_T = \alpha_0 + \alpha_1 \ln I_t + \alpha_2 \ln O^c_t + \alpha_3 \ln O^p_t + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots(7)$$
$$\ln I_T = \alpha_0 + \alpha_1 \ln I_t + \alpha_2 \ln V^c_t + \alpha_3 \ln V^p_t + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots(8)$$

All the above regression equations (equation 6, 7 and 8) have been solved for four different sub-periods, July 2005 to December 2005, January 2006 to June 2006, June 2007 to December 2007 and January 2008 to June 2008. To remove the influence of expiration of options contract at the data of maturity, all the equations have been estimated by excluding the expiration day.

V. RESULTS

The hypothesis – that the non-price variables viz., open interest and trading volume in the options 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 (equations 6 to 8). Though the price index (I_T and I_t) in the underlying cash market both at the time of maturity of option contract (i.e., at the time T) and at the current time (i.e., at time t) can be directly observable, the value of the other independent variables have been calculated in the same way as mentioned under 'Data and methodology'.

Table 1.a: Regression Results for the 1st Sub-period
1-07-2005 to 12-12-2005
Excluding the Expiration Day

$R^2_{Adjusted}$ = 0.634; F = 41.524

Variable	Coefficient	Value	t-statistic	Prob.
Intercept	α_0	1.265**	2.069	0.041
S_t	α_1	0.795***	10.176	0.000
O^C_t	α_2	-0.173	-1.346	0.181
O^p_t	α_3	0.220**	1.989	0.049
V^c_t	α_4	-0.254	-1.578	0.117
V^p_t	α_5	0.202	1.516	0.132

Note:*** significant at 1%, **Significant at 5% *Significant at 10%

Table 1.b: Regression Results for the 1st Sub-period
1-07-2005 to 12-12-2005
Excluding the Expiration Day

$R^2_{Adjusted}$ = 0.632; F = 67.944

Variable	Coefficient	Value	t-statistic	Prob.
Intercept	α_0	1.314**	2.268	0.025
S_t	α_1	0.791***	10.722	0.000
O^C_t	α_2	-0.241**	-2.296	0.024
O^p_t	α_3	0.225**	2.058	0.042

Note: *** significant at 1%, **Significant at 5% *Significant at 10%

Table 1.c: Regression Results for the 1st Sub-period
1-07-2005 to 12-12-2005
Excluding the Expiration Day

$R^2_{Adjusted}$ = 0.628; F = 66.740

Variable	Coefficient	Value	t-statistic	Prob.
Intercept	α_0	0.853	1.510	0.134
S_t	α_1	0.851***	12.000	0.000
V^C_t	α_2	-0.271*	-1.985	0.050
V^p_t	α_3	0.188	1.440	0.153

Note:*** significant at 1%, **Significant at 5% *Significant at 10%

It can be observed from Table 1, the open interest-based and volume-based predictors for both call and put options are significant at conventional level of significance (i.e., at 1% or 5%level of significance) the volume-based predictors shows some more impact in predicting the future price index in the underlying cash market. It is found that the COP and POP are showing negative and positive coefficient respectively during the period.

Table 2.a: Regression Results for the 2nd Sub-period
30-12-2005 to 29-06-2006
Excluding the Expiration Day
$R^2_{Adjusted}$ = 0.601; F = 36.225

Variable	Coefficient	Value	t-statistic	Prob.
Intercept	α_0	4.344***	10.450	0.000
S_t	α_1	0.577***	8.119	0.000
O^C_t	α_2	0.164	1.566	0.120
O^p_t	α_3	0.196**	2.067	0.041
V^c_t	α_4	-0.419**	-2.973	0.004
V^p_t	α_5	0.357**	3.371	0.001

Note:*** significant at 1%, **Significant at 5% *Significant at 10%

Table 1.b: Regression Results for the 1st Sub-period
30-12-2005 to 29-06-2006
Excluding only the Expiration Day
$R^2_{Adjusted}$ = 0.567; F = 52.127

Variable	Coefficient	Value	t-statistic	Prob.
Intercept	α_0	4.684***	11.797	0.000
S_t	α_1	0.522***	7.820	0.000
O^C_t	α_2	-0.048	-0.730	0.467
O^p_t	α_3	0.396***	5.531	0.000

Note:*** significant at 1%, **Significant at 5% *Significant at 10%

Table 2.1.c: Regression Results for the 2nd Sub-period
30-12-2005 to 29-06-2006
Excluding only the Expiration Day
$R^2_{Adjusted}$ = 0.532; F = 45.341

Variable	Coefficient	Value	t-statistic	Prob.
Intercept	α_0	4.118***	10.504	0.000
S_t	α_1	0.638***	9.729	0.000
V^C_t	α_2	-0.374***	-4.131	0.000
V^p_t	α_3	0.409***	4.436	0.000

Note:*** significant at 1%, **Significant at 5% *Significant at 10%

Table 2 reveals that, open interest-based and volume-based predictors for both call and put options are significant at any conventional level of significance. The volume based predictors shows some more impact in predicting the future price index in the underlying cash market.

Table 3.a: Regression Results for the 3rd Sub-period
29-06-2007 to 27-12-2007
Excluding the Expiration Day
$R^2_{Adjusted}$ = 0..903; F = 223.157

Variable	Coefficient	Value	t-statistic	Prob.
Intercept	α_0	1.787***	6.328	0.000
S_t	α_1	0.925***	26.048	0.000
O^C_t	α_2	0.043	0.776	0.440
O^p_t	α_3	-0.121	-1.777	0.078
V^c_t	α_4	-0.098*	-1.913	0.058
V^p_t	α_5	0.142**	2.478	0.015

Note:*** significant at 1%, **Significant at 5% *Significant at 10%

Table 3.b: Regression Results for the 3rd Sub-period 29-06-2007 to 27-12-2007				
Excluding only the Expiration Day				
				$\mathbf{R}^2_{Adjusted}$ = 0.900; F = 356.286
Variable	**Coefficient**	**Value**	**t-statistic**	**Prob.**
Intercept	α_0	1.734***	6.072	0.000
S_t	α_1	0.935***	26.103	0.000
O^C_t	α_2	-0.009	-0.227	0.821
O^p_t	α_3	-0.039	-0.867	0.387
Note:*** significant at 1%, **Significant at 5% *Significant at 10%				

Table 3.c: Regression Results for the 3rd Sub-period 29-06-2007 to 27-12-2007				
Excluding only the Expiration Day				
				$\mathbf{R}^2_{Adjusted}$ = 0.901; F = 362.142
Variable	**Coefficient**	**Value**	**t-statistic**	**Prob.**
Intercept	α_0	1.410***	6.301	0.000
S_t	α_1	0.963***	31.591	0.000
V^C_t	α_2	-0.089	-1.742	0.084
V^p_t	α_3	0.098*	1.971	0.051
Note:*** significant at 1%, **Significant at 5% *Significant at 10%				

It can be observed from Table 3, the open interest predictors are not at all significant in predicting the future prices during the period. But volume based predictors are significant levels of 1% or 5%.

Table 4.a: Regression Results for the 4th Sub-period 28-12-2007 to 25-06-2008				
Excluding the Expiration Day				
			$\mathbf{R}^2_{Adjusted}$ = 0..884; F = 177.006	
Variable	**Coefficient**	**Value**	**t-statistic**	**Prob.**
Intercept	α_0	5.308***	20.081	0.000
S_t	α_1	0.578***	13.772	0.000
O^C_t	α_2	0.490***	9.309	0.000
O^p_t	α_3	0.304***	3.987	0.000
V^c_t	α_4	-0.716***	-12.711	0.000
V^p_t	α_5	-0.447***	-5.793	0.000
Note:*** significant at 1%, **Significant at 5% *Significant at 10%				

Table 4.b: Regression Results for the 4th Sub-period 28-12-2007 to 25-06-2008				
Excluding only the Expiration Day				
				$\mathbf{R}^2_{Adjusted}$ = 0.488; F = 37.905
Variable	**Coefficient**	**Value**	**t-statistic**	**Prob.**
Intercept	α_0	6.004***	10.963	0.000
S_t	α_1	0.444***	5.131	0.000
O^C_t	α_2	0.109	1.494	0.138
O^p_t	α_3	-0.381***	-4.355	0.000
Note:*** significant at 1%, **Significant at 5% *Significant at 10%				

Table 4.c: Regression Results for the 4th Sub-period 28-12-2007 to 25-06-2008				
Excluding only the Expiration Day				
				$\mathbf{R}^2_{Adjusted}$ = 0.731; F = 105.918
Variable	**Coefficient**	**Value**	**t-statistic**	**Prob.**
Intercept	α_0	6.921***	20.276	0.000
S_t	α_1	0.348***	6.233	0.000
V^C_t	α_2	-0.312***	-5.409	0.000
V^p_t	α_3	-0.413***	-6.449	0.000
Note:*** significant at 1%, **Significant at 5% *Significant at 10%				

Table 4 reveals that, open interest-based and volume-based predictors for both call and put options are significant at any conventional level of significance. The volume based predictors shows some more impact in predicting the future price index in the underlying cash market.

VI. CONCLUSION:

By applying daily data on both price as well as non-price variables from equity and option markets, an effort has been made in this paper 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 observed that though being insignificance during the first 2 six months, just after the initiation of option trading in the Indian capital market, the trading volume in the option market has become significant in predicting the future price movement in the underlying cash market during the subsequent period, that is from January 2008 to June 2008. Further, the study identified that neither the open interest nor the trading volume in the options market alone could explain future price movement in the cash market more than whatever they can do in a combined way.

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