

An Empirical Analysis of Environmental and Financial Performance of BSE 100 Companies

* *Ruchika Bammi*

Abstract

India is one of the largest and fastest growing economies in the world; the large-scale growth of Indian industries resulted in placing India as the third biggest greenhouse gas emitter in 2011, behind only China and USA. Thus, with India's this growth came the international pressure to mitigate the greenhouse gas emissions. Indian companies are taking a cue from global competition and are demonstrating an increased awareness and understanding with regards to the risks and opportunities climate change presents to their businesses. The present study examines the differences in the financial and market performance of BSE 100 companies with a difference in the emission levels. The study uses greenhouse gas emissions' data in capturing the effect of environmental performance and constructs two industry balanced portfolios of low and high emission levels. The environmental performance is measured in terms of emission intensity, and the financial performance is measured in terms of PBDITA and ROCE, while market performance is measured as average market return.

Keywords: environmental performance, financial performance, greenhouse gases, low and high emission portfolios, BSE 100 companies, firm behavior

JEL Classification: G39, M14, Q52

India is one of the largest and fastest-growing economies in the world; the large-scale growth of Indian industries resulted in placing India as the third biggest greenhouse-gas emitter in 2011, behind only China and USA. Thus, with India's this growth came the international pressure to mitigate the greenhouse gas emissions. Though India, being a developing country is under no legal obligation to cut down on carbon emission under the Kyoto Protocol, but it has announced a voluntary plan to reduce emissions by 20-25% by the year 2020. In order to ensure that energy does not become a constraint on India's economic growth, it was necessary to participate in this voluntary plan.

Indian corporations are taking cue from global competition, and are demonstrating an increased awareness and understanding with regards to the risks and opportunities climate change presents to their businesses. Issues like investment in clean technology, energy conservation and savings, environmental management systems, etc. are gaining huge significance. It is against this backdrop that BSE has launched a first of its kind benchmark index, which assesses not only the financial performance, but also the environmental performance of companies, and the index is known as BSE-GREENEX, which is formed by ranking companies in the BSE 100 index on the financial and environmental front.

It is important to understand that economic activities are not isolated in nature. Every economic activity has an impact on the resources of the environment - be it in the form of use of raw material resources or generation of wastes or effluents. It is assumed that environmental preservation comes with some cost attached, and it is important to analyze whether both environmental and financial performance can be pursued simultaneously. Historically, a lot of firms believed that complying with environmental regulations will negatively impact the firm's profits as it will act as an extra burden for the firms. But certain environmentally proactive firms are of the thought that spending on environmental regulations or environment management systems will result in efficiency among firms, thus resulting in better financial performance. However, it is also important to analyze as to whether spending on environmental efficiency equipments results in profitability among firms or the truth is that only those firms which are profitable enough can afford to spend on cleaner technologies.

Research to devise a link between financial and environmental performance has been limited. The reasons for this may be many, the main being that until recently, not much emphasis was paid towards environmental reporting measures, which resulted in lack of data on environmental performance of firms. The situation of environmental reporting has improved in the developed countries with data on toxic release inventory (TRI) being available for public access. Various multinationals are now publishing separate annual environmental performance reports. Indian

* *Research Fellow*, Indian Institute of Forest Management, Po Box 357, Nehru Nagar, Bhopal - 462003, Madhya Pradesh.
E-mail : ruchikabammi@gmail.com

References

- Bhuyan, R., & Chaudhury, M. (2001, October 4). "Trading on the Information Content of Open Interest: Evidence from the US Equity Options Market." Working Paper, McGill University, pp.18-30.
- Chance, D. M., & Brooks, R. (2008). "Derivatives and Risk Management Basics." Cengage Learning India Pvt. Ltd, New Delhi, pp. 183-207.
- Damodaran, A., & Lim, J. (1991). "The Effects of Option Listing on the Underlying Stocks' Return Processes." *Journal of Banking and Finance*, 15 (3), pp. 647-664.
- Fodor, A., Krieger, K., & Doran, J. (2010). "Do Option Open-Interest Changes Predict Future Equity Returns?" Thesis, Ohio University, University of Tulsa and Florida State University, pp. 265-280.
- Garag, A., & Ramesh, B. (2010). "Relationship between Futures Price and Open Interest in Stock and Index Futures in the Indian Stock Markets: Empirical Analysis." International Conference on E-business, Management and Economics, IPEDR, Vol.3 (2011) © (2011) IACSIT Press, Hong Kong, pp.5 -8.
- Gupta, S. L. (2009). "Financial Derivatives: Theory, Concepts and Problems." Prentice Hall of India Pvt. Ltd, pp. 173- 226.
- Hull, J. (2009). "Options, Futures and Other Derivatives." 7th Edition, Prentice Hall India: New Delhi, pp. 197-216.
- Investopedia (2012). "Definition of 'Put- Call Ratio.'" Retrieved from <http://www.investopedia.com/terms/p/putcallratio.asp>
- Jorion, P. (2009). "Financial Risk Manager Handbook." 5th Edition, John Wiley & Sons, Inc., Hoboken, New Jersey, USA, pp. 111-127.
- Kuo, W.-H., & Lin, T.-Y. (2011). "Does the Put-Call Ratio Forecast Market Returns? Evidence from an Emerging Market." *International Research Journal of Finance and Economics*, Issue 69, June, p. 95.
- Maniar, H., & Maniyar, D. (2008). "Impact of Option Interest Information in Derivatives Markets- An Empirical Study of Stock Options Market, NSE." International Conference MAF 2008, University of Ca' Foscari & University of Salerno, Italy.
- Mukherjee, K. N., & Mishra, R.K. (2004). "Impact of Open Interest and Trading Volume in Option Market on Underlying Cash Market: Empirical Evidence from Indian Equity Option Market." Available at SSRN, Retrieved from <http://ssrn.com/abstract=695745> or <http://dx.doi.org/10.2139/ssrn.695745>
- National Stock Exchange of India Limited (2012). "Historical Contract-wise Price Volume Data." Retrieved from http://www.nseindia.com/products/content/derivatives/equities/historical_fo.htm
- National Stock Exchange of India Limited (2012). "NCFM Modules." Retrieved from http://www.nseindia.com/education/content/module_ncfm.htm
- Pan, J., & Poteshman, A. (2004). "The Information of Option Volume for Future Stock Prices." NBER Working Paper No. 10925, MIT Sloan School of Management, University of Illinois at Urbana-Champaign, p.2, pp.11-26.
- Ramchandra, M.T., Satish, Y.M., & Krishnamurthy, M.G. (2010). "Option Trading Strategies for Different Market Conditions for Hedging the Portfolio and Trading for Profits." *Indian Journal of Finance*, 4 (9), pp. 34 - 46.
- Srivastava, S. (2003, December). "Informational Content of Trading Volume and Open Interest - An Empirical Study of Stock Option Market in India." NSE Research Initiative Working Paper No. 29. Available at SSRN: <http://ssrn.com/abstract=606121> or <http://dx.doi.org/10.2139/ssrn.606121> Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=606121.
- Srivastava, S., Yadav, S. S., & Jain, P. K. (2008). "Significance of Non-Price Variables in Price Discovery: An Empirical Study of Stock Option Market in India." *Vikalpa : The Journal for Decision Makers*, 33 (2), pp. 15 -23.
- Stephan, J. A., & Whaley, R. E. (1990). "Intraday Price Change and Trading Volume Relations in the Stock and Stock Options Markets." *Journal of Finance*, 45 (1), pp.115-134.
- Stulz, R. M. (2003). "Risk Management and Derivatives." Thomson South Western: Cincinnati.

significant relationship between the sentimental indicators of future contracts and LTP of the underlying, whereas there was a moderate level of positive significance between PCR of option contracts and the underlying.

❖ During the month of December 2011, when the market was range bound by 400 points, there was no significant relationship between the sentimental indicators of future contracts and LTP of the underlying, whereas there was a moderate level of positive significance between PCR of option contracts and the underlying.

❖ Synthetic long call is a suitable strategy for the bullish market that yields maximum return with limited risk. The strategy yielded 60% returns for the month of January 2012.

❖ Synthetic long put is a suitable strategy for the bearish market that yields maximum return with minimum risk. The strategy yielded 57.8% return for the month of November 2011.

❖ Delta neutral strategy – short straddle yielded a better return when the market is less volatile and range-bound. The strategy yielded 26% returns for the month of September 2011; short straddle yielded 22% returns for the month of December 2011.

Suggestions

❖ Average risk takers can adopt synthetic long call strategy when the market is bullish and synthetic long put strategy when the market is bearish.

❖ Aggressive risk takers can make money even when the market does not show any movement by adopting short straddle strategy.

❖ Awareness programs on the benefit of using sentimental indicators in predicting the behaviour of the market can be conducted for equity dealers and clients at stock broking firms.

❖ The sentimental indicators can also be jointly used with technical indicators to find out profitable buying and selling points.

Conclusion

There are many indicators which can be used while trading in the derivatives market, but the widely used and most effective are open interest & put call ratio. The findings of this study have strengthened the argument of Bhuyan and Chaudhury (2001), Srivastava (2001), and Maniar and Maniyar (2008) that open interest and volume based predictors are significant in predicting the future movement of the underlying index.

The corollary of the present study concludes that the sentimental indicators of index futures (open interest, volume, and price) are efficient in predicting the future trend of the underlying (NIFTY). Whereas the sentimental indicator of option contract (index put/call ratio) is proved to be a contrarian indicator i.e. trading more put options are supposed to be the indication of bearishness, but in the present study, it was observed that more put options are traded when the market is bullish, which means when the market is bullish, the investors always take a long position in future contract and buy a put option to hedge their position. When the market is bearish, the investors always take a short position in the future contract, and buy a call option to hedge their position. Hence, it can be concluded that trading strategies based on sentimental indicators yield good results.

Scope for Future Research

❖ The present research is limited only to NIFTY index futures and options. Thus, stock specific futures and options could be analyzed.

❖ The research can be further extended to global markets like Dow Jones, Hang Seng, etc.

❖ Multi-leg strategies and their pay-off could be analyzed in future research.

❖ Gamma neutral strategies and their pay-off could also be analyzed.

❖ Similar studies can be applied to intra-day data also.

❖ Derivative contracts of the past 5 to 10 years could be analyzed for strong justification.

that this strategy could be held till the expiry and is subject to revision during the month thereby, adjusting the put position as per the movement of the NIFTY index.

- ❖ Total amount invested = PE premium + Margin required for future contract (₹ 7167.5 + ₹ 25,000 = ₹ 32,167.5).
- ❖ Break- Even Point = 4769.35 (Stock price + Put premium)
- ❖ Total profit earned = ₹19,442.5
- ❖ Return on Investment = 60%
- ❖ Risk is limited to the put premium paid = ₹ 7167.5

This is a low risk strategy which limits the loss in case of fall in the market, but the potential profit remains unlimited when the stock price rises.

Date	LTP	Put-4500	put-4600	Put-4700	put-4800	put-4900	put-5000
30-12-11	4626	77.95	114.05	162.95	225	297.05	385
03-01-12	4777.5	36	55.1	84	125.7	182.5	254
10-01-12	4871.65	10.5	19	34.45	61	103	163.2
16-01-12	4897	4.3	8.1	17.75	37.9	74	130
19-01-12	5020.35	1.2	1.6	2.35	4.45	13.25	38
24-01-12	5108	0.3	0.25	0.3	0.35	0.5	1.9
25-01-12	5158.2	0.05	0.05	0.05	0.05	0.05	0.05

Source : The present table was retrieved from
http://www.nseindia.com/products/content/derivatives/equities/historical_fo.htm

The Table 6 is included to support the data provided in the Table 5. The following inferences were drawn from the Table 6 :

- ❖ It should be noted that this strategy is held till the expiry and is subject to revision during the month by selling the inactive or out of the money put option and buying the in the money put option as per the movement of the underlying stocks.
- ❖ As per the Table 6, a put option with the strike price of ₹ 4500 was purchased for ₹ 77.95 on December 30, 2011, when the underlying stock was priced at ₹ 4626. On January 3, 2012, when the market moved to 4777.5, put option with strike price 4500 was sold for ₹ 36 and 4600 strike price was purchased at a premium of ₹ 55.1.
- ❖ Similarly, all the inactive put options were sold, and active put options were purchased throughout the month.

Findings

❖ During the month of January & February 2012, when the NIFTY index was bullish by 1000 points (4600-5600), there was a high degree of strong and positive correlation between the sentimental indicators of future and option contracts to the last traded price (LTP) of the underlying stocks.

Similar kind of analysis was done for the months of August, September, November, and December 2011 :

- ❖ During the month of August 2011, when the NIFTY index was bearish by 700 points (5500 – 4800), there was a high degree of negative correlation between the sentimental indicators of future contracts to the LTP of the underlying, whereas there was a strong and positive correlation between the put-call ratio (PCR) of option contracts to the LTP of the underlying.
- ❖ During the month of November 2011, when the market was bearish by 700 points (5500 – 4800), there was a high degree of negative correlation between the sentimental indicators of future contracts to the LTP of the underlying; whereas, there was a strong and positive correlation between PCR of option contracts to the LTP of the underlying.
- ❖ During the month of September 2011, when the market was range bound with very low volatility, there was no

Table 4 : Correlation between LTP and put-call Ratio of option-contracts for the months of January & February 2012		
Correlations		
	LTP	PCR
LTP		
Pearson Correlation	1	.613
Sig. (2-tailed)		.000
N	36	36
PCR	.613	1
Pearson Correlation	.000	
Sig. (2-tailed)		
N	36	36

Source : The Table 4 was created using SPSS

Table 5 : Synthetic Long Call Strategy and Pay- Off - Future Long & Buy Put (January 2012)					
PAY- OFF (₹)					
Date	LTP	Future Long	Long Put	Net Pay-off	Profit / Loss
30-12-11	4626	-	-	-	-
02-01-12	4650.3	24.3	-9.85	14.45	722.5
03-01-12	4777.5	151.5	-41.95	109.55	5477.5
04-01-12	4753	127	-36.4	90.6	4530
05-01-12	4753	127	-41.05	85.95	4297.5
06-01-12	4782.95	156.95	-51.95	105	5250
07-01-12	4766	140	-50	90	4500
09-01-12	4757.7	131.7	-52.05	79.65	3982.5
10-01-12	4871.65	245.65	-78.05	167.6	8380
11-01-12	4873.4	247.4	-79	168.4	8420
12-01-12	4867.95	241.95	-82.5	159.45	7972.5
13-01-12	4886	260	-90.5	169.5	8475
16-01-12	4897	271	-94.75	176.25	8812.5
17-01-12	4972.5	346.5	-117.6	228.9	11445
18-01-12	4947.8	321.8	-117.4	204.4	10220
19-01-12	5020.35	394.35	-128.45	265.9	13295
20-01-12	5058.65	432.65	-134.6	298.05	14902.5
23-01-12	5052.25	426.25	-138.15	288.1	14405
24-01-12	5108	482	-141.2	340.8	17040
25-01-12	5158.2	532.2	-143.35	388.85	19442.5

Source : Column No. 1 & 2 in the Table 5 were extracted from http://www.nseindia.com/products/content/derivatives/equities/historical_fo.htm

The following strategy is presented in the Table 5 :

❖ As per this strategy, a trader purchases a stock since he/she feels bullish about it. But what if the price of the stock goes down? The trader wishes he had some insurance against the price fall. So, he buys a put on the stock. This gives the trader the right to sell the stock at a certain price, which is the strike price. The strike price can be out-of-the money (OTM).

❖ This strategy consists of buying one lot of NIFTY futures and a PE option (OTM strike price). It should be noted

Table 3 : Relationship between put-call ratio (PCR) and the behaviour of NIFTY for the months of January and February 2012

Date	Expiry	LTP	Change in Price	cumulative Call (CE)	Cumulative Put (PE)	PCR
02-Jan-12	25-Jan-12	4,650.30		3.85	7.08	1.84
03-Jan-12	25-Jan-12	4,777.50	127.20	4.22	16.35	3.88
04-Jan-12	25-Jan-12	4,753.00	-24.50	5.88	18.79	3.20
05-Jan-12	25-Jan-12	4,753.00	0.00	7.80	22.75	2.92
06-Jan-12	25-Jan-12	4,782.95	29.95	8.11	22.96	2.83
07-Jan-12	25-Jan-12	4,766.00	-16.95	13.48	30.38	2.25
09-Jan-12	25-Jan-12	4,757.70	-8.30	15.77	32.32	2.05
10-Jan-12	25-Jan-12	4,871.65	113.95	17.05	41.67	2.44
11-Jan-12	25-Jan-12	4,873.40	1.75	19.93	45.35	2.28
12-Jan-12	25-Jan-12	4,867.95	-5.45	20.88	44.59	2.14
13-Jan-12	25-Jan-12	4,886.00	18.05	20.30	48.28	2.38
16-Jan-12	25-Jan-12	4,897.00	11.00	21.75	51.31	2.36
17-Jan-12	25-Jan-12	4,972.50	75.50	22.30	63.54	2.85
18-Jan-12	25-Jan-12	4,947.80	-24.70	22.07	65.47	2.97
19-Jan-12	25-Jan-12	5,020.35	72.55	18.91	69.44	3.67
20-Jan-12	25-Jan-12	5,058.65	38.30	17.21	73.22	4.25
23-Jan-12	25-Jan-12	5,052.25	-6.40	20.52	77.98	3.80
24-Jan-12	25-Jan-12	5,108.00	55.75	14.97	78.36	5.24
25-Jan-12	25-Jan-12	5,158.20	50.20	14.87	85.54	5.75
27-Jan-12	23-Feb-12	5,212.80	54.60	5.02	13.64	2.72
30-Jan-12	23-Feb-12	5,105.00	-107.80	8.16	12.52	1.53
31-Jan-12	23-Feb-12	5,230.00	125.00	10.09	23.36	2.32
01-Feb-12	23-Feb-12	5,269.75	39.75	11.79	28.92	2.45
02-Feb-12	23-Feb-12	5,273.30	3.55	11.44	33.45	2.92
03-Feb-12	23-Feb-12	5,339.00	65.70	9.43	39.69	4.21
06-Feb-12	23-Feb-12	5,360.80	21.80	10.14	45.30	4.47
07-Feb-12	23-Feb-12	5,357.95	-2.85	12.58	47.11	3.74
08-Feb-12	23-Feb-12	5,394.75	36.80	14.74	49.04	3.33
09-Feb-12	23-Feb-12	5,448.00	53.25	12.83	47.08	3.67
10-Feb-12	23-Feb-12	5,388.05	-59.95	14.61	48.21	3.30
13-Feb-12	23-Feb-12	5,415.00	26.95	14.74	47.62	3.23
14-Feb-12	23-Feb-12	5,452.20	37.20	12.52	49.88	3.98
15-Feb-12	23-Feb-12	5,551.40	99.20	8.76	55.06	6.28
16-Feb-12	23-Feb-12	5,529.50	-21.90	9.32	57.55	6.17
17-Feb-12	23-Feb-12	5,596.95	67.45	7.85	60.95	7.77
21-Feb-12	23-Feb-12	5,620.20	23.25	4.85	62.75	12.95

Source : Column Nos. 1, 2, and 3 in the Table 3 were extracted from http://www.nseindia.com/products/content/derivatives/equities/historical_fo.htm

Table 2 : Correlation between Last Traded Price and Cumulative % change in Open Interest of Future Contract for the months of January and February 2012

		LTP	Open Interest (Carry Forward contract)
LTP	Pearson Correlation	1	.976**
	Sig. (2-tailed)		.000
	N	35	35
Open Interest (Div Cnt)	Pearson Correlation	.976**	1
	Sig. (2-tailed)	.000	
	N	35	35

** . Correlation is significant at the 0.01 level (2-tailed).
 *Source : The Table 2 is formed using a statistical tool SPSS

The following inferences are drawn from the Table 3:

- ❖ Change in Price = Current day's Price – Previous day's Price.
- ❖ The change in open interest of active strike prices (in-the-money, at-the-money, and out-of-the money) of call and put options are added instead of taking the open interest of all the strike prices.
- ❖ The total number of contracts traded for the active strike prices (in-the-money, at-the-money, and out-of-the money) of call and put options are added instead of taking the volume of all the strike prices.

❖ Then, total % of call carry forward contract = $\frac{\text{Change in call open interest}}{\text{No. of call contracts traded}} \times 100$

❖ Total % of put carry forward contract = $\frac{\text{Change in put open interest}}{\text{No. of put contracts traded}} \times 100$

- ❖ Cumulate the % of call and put carry forward contracts.

❖ Put Call Ratio = $\frac{\% \text{ of put carry forward contract}}{\% \text{ of call carry forward contract}} \times 100$

- ❖ On January 3, 2012, when the market was up by 127.20 points, the put-call ratio rose to 3.88 from 1.84.
- ❖ On January 30, 2012, when the market was down by 107.80 points, the put-call ratio had fallen to 1.53 from 2.72.
- ❖ During the entire months of January and February, when the market rose by 1000 points, the put-call ratio was above 2 and it kept rising.

This indicates that the put-call ratio is a contrarian indicator, i.e. when there is an increase in the price of the underlying stocks, the put-call ratio also increases; similarly, when there is a fall in the price, the put-call ratio also decreases.

The following inferences were drawn from Table 4 :

- ❖ No of days taken for comparison - 36.
- ❖ The Karl Pearson's coefficient of correlation between the last traded price and put-call ratio is 0.613.
- ❖ The last traded price (LTP) and put-call ratio are positively correlated and there is a moderate level of significance between them.

Market Outlook for Table 5 :

- ❖ Since the beginning of 2012, foreign institutional investors (FIIs) have infused a total of ₹ 24,225 crores into the Indian stocks because of the turnaround in RBI's monetary policy, and the consequent impact on the improved liquidity position and, therefore, the market outlook is bullish.

Price	Open Interest	Market Trend
Rising (+)	Rising (+)	Market is Strong (Bullish)
Rising (+)	Falling (-)	Short Covering (Bullish)
Falling (-)	Rising (+)	Market is Weak (Bearish)
Falling (-)	Falling (-)	Profit Booking (Bearish)

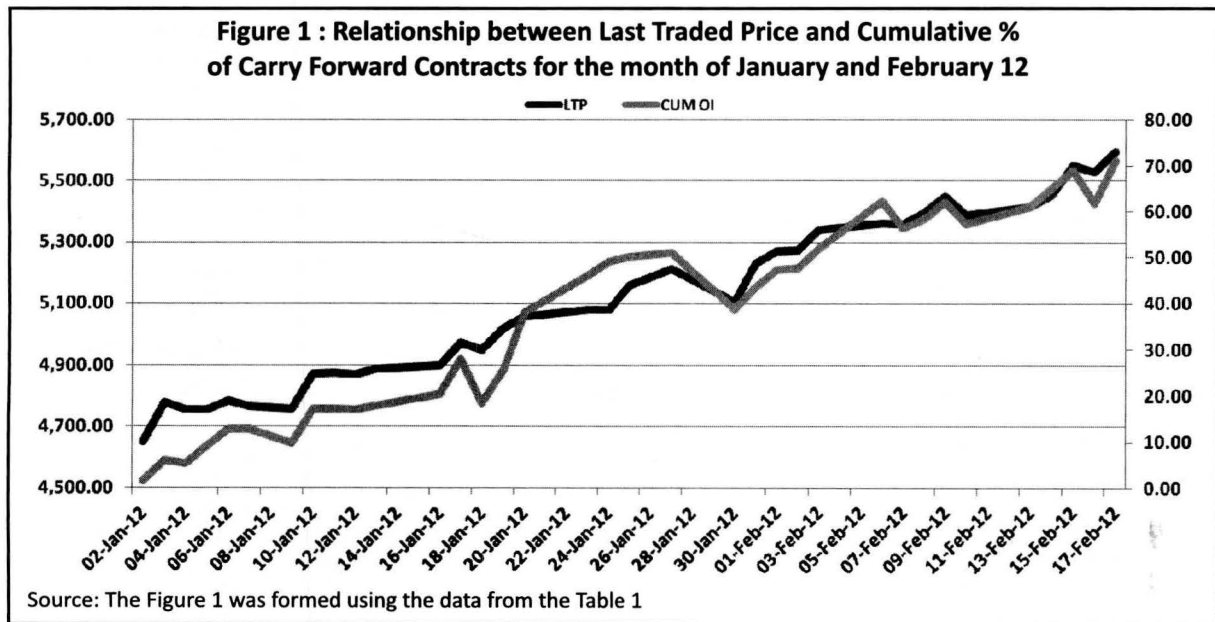
Retrieved from <http://www.investopedia.com/articles/technical/02/112002.asp#axzz2EuOJKmLB>

From the Table 1, after comparing the % change in price and % of carry forward contracts using the following test and predicting the trend of the market, it was found that :

- ❖ If the market trend is overall bullish, cumulate the % change in price and % of carry forward contracts by adding the bullish trends and subtracting the bearish trends.
- ❖ If the market trend is overall bearish, cumulate the % change in price by adding the bullish trend and subtracting the bearish trend. Then, cumulate the % of carry forward contracts by adding the bearish trends and subtracting the bullish trends.
- ❖ Draw a chart using the cumulative data and check if the sentimental indicators are efficient in predicting the trend of the market.

It can be inferred from the Table 1 that in the months of January and February 2012, the market was overall bullish by 1000 points. The market had moved from 4600-5600.

- ❖ The % of change in open interest to the number of contracts traded i.e. % of carry forward contracts was drastically built-up during the months of January and February, which indicated that the market is clear-cut bullish.
- ❖ Whenever the market showed a bearish trend, it was only an indication of profit booking and no new short positions were created.



The following inferences are drawn from the Table 2 :

- ❖ Number of days taken for comparison – 35.
- ❖ The Karl Pearson's coefficient of correlation between the last traded price and cumulative % change in open interest to the total number of contracts traded i.e. the cumulative % of carry forward contracts is 0.98.
- ❖ The last traded price (LTP) and open interest are positively correlated and there is a high level of significance between them.

Table 1 : Relationship between the Behaviour of NIFTY and the Sentimental Indicators of Future Contracts for the months of Jan & Feb '12

Date	LTP (Future contract)	% Change in Price	Cumulative % change in Price	(Volume) No. of contracts	Change In Open Interest Contracts	% of carry forward Contract	Cumulative % of cry frwd.cnt	Trend
02-Jan-12	4,650.30	0.53	0.53	2,77,565	4358	1.57	1.57	Bullish
03-Jan-12	4,777.50	2.74	2.74	3,62,152	15485	4.28	4.28	Bullish
04-Jan-12	4,753.00	-0.51	-0.51	3,53,400	-1948	-0.55	-0.55	Bearish
05-Jan-12	4,753.00	0.00	0.00	2,71,152	10166	3.75	3.75	Bullish
06-Jan-12	4,782.95	0.63	0.63	4,50,646	-16199	-3.59	3.59	Bullish
07-Jan-12	4,766.00	-0.35	-0.35	29,134	14	0.05	-0.05	Bearish
09-Jan-12	4,757.70	-0.17	-0.17	3,21,543	-9188	-2.86	-2.86	Bearish
10-Jan-12	4,871.65	2.40	2.40	3,92,413	28773	7.33	7.33	Bullish
11-Jan-12	4,873.40	0.04	0.04	2,66,376	267	0.10	0.10	Bullish
12-Jan-12	4,867.95	-0.11	-0.11	3,87,900	726	0.19	-0.19	Bearish
13-Jan-12	4,886.00	0.37	0.37	3,72,229	2913	0.78	0.78	Bullish
16-Jan-12	4,897.00	0.23	0.23	2,67,867	-6613	-2.47	2.47	Bullish
17-Jan-12	4,972.50	1.54	1.54	3,15,725	24353	7.71	7.71	Bullish
18-Jan-12	4,947.80	-0.50	-0.50	2,89,545	-27990	-9.67	-9.67	Bearish
19-Jan-12	5,020.35	1.47	1.47	2,90,059	-21608	-7.45	7.45	Bullish
20-Jan-12	5,058.00	0.75	0.75	5,05,947	62077	12.27	12.27	Bullish
23-Jan-12	5,078.00	0.40	0.40	3,23,377	26126	8.08	8.08	Bullish
24-Jan-12	5,080.00	0.04	0.04	5,91,320	17274	2.92	2.92	Bullish
25-Jan-12	5,159.00	1.56	1.56	5,33,204	-6035	-1.13	1.13	Bullish
27-Jan-12	5,212.80	1.04	1.04	2,49,035	2451	0.98	0.98	Bullish
30-Jan-12	5,105.00	-2.07	-2.07	3,07,899	-37721	-12.25	-12.25	Bearish
31-Jan-12	5,230.00	2.45	2.45	3,36,757	16075	4.77	4.77	Bullish
01-Feb-12	5,269.75	0.76	0.76	3,14,945	-11276	-3.58	3.58	Bullish
02-Feb-12	5,273.30	0.07	0.07	3,76,463	1825	0.48	0.48	Bullish
03-Feb-12	5,339.00	1.25	1.25	2,93,530	12528	4.27	4.27	Bullish
06-Feb-12	5,360.80	0.41	0.41	3,35,710	34393	10.24	10.24	Bullish
07-Feb-12	5,357.95	-0.05	-0.05	3,46,422	20361	5.88	-5.88	Bearish
08-Feb-12	5,394.75	0.69	0.69	3,92,016	7937	2.02	2.02	Bullish
09-Feb-12	5,448.00	0.99	0.99	3,22,410	11607	3.60	3.60	Bullish
10-Feb-12	5,388.05	-1.10	-1.10	4,24,467	-19773	-4.66	-4.66	Bearish
13-Feb-12	5,415.00	0.50	0.50	2,79,196	-10267	-3.68	3.68	Bullish
14-Feb-12	5,452.20	0.69	0.69	2,41,590	-9507	-3.94	3.94	Bullish
15-Feb-12	5,551.40	1.82	1.82	3,50,865	14459	4.12	4.12	Bullish
16-Feb-12	5,529.50	-0.39	-0.39	2,91,926	-21308	-7.30	-7.30	Bearish
17-Feb-12	5,596.95	1.22	1.22	3,66,610	-34172	-9.32	9.32	Bullish

*Source : Column Nos. 1, 2, 6, and 7 in the Table 1 were retrieved from http://www.nseindia.com/products/content/derivatives/equities/historical_fo.htm

$$\diamond \text{ \% of Carry Forward contracts} = \frac{\text{Change in Open Interest Contracts}}{\text{No. of contracts Traded (Volume)}} \times 100$$

Objectives of the Study

- ❖ To study the behaviour of the NIFTY index by examining the derivative contracts.
- ❖ To analyze the efficiency of sentimental indicators of future contracts in predicting the behaviour of the NIFTY index.
- ❖ To analyze the efficiency of sentimental indicators of option contracts in predicting the behaviour of the NIFTY index.
- ❖ To formulate and suggest suitable future and option strategies for different market conditions with their pay-off.

Methodology of the Study

❖ **Research Design** : The study aimed to actually test pre-planned hypothesis - The open interest and put-call ratio are indicators of future stock market trend based on the findings and ,therefore, the research design used is analytical in nature. Historical data of future and option (F&O) contract of the NIFTY index for 9 months was collected from the NSE website. The data was further refined based on the market condition. The period of the study is limited to 9 months from July 2011 – March 2012.

❖ Tools and Techniques Used for Data Analysis:

❖ **Percentage Analysis** : Percentage analysis is the method to represent raw streams of data as a percentage for better understanding of collected data.

$$\text{Percentage change} = \frac{\text{New value} - \text{Old Value}}{\text{Old Value}} \times 100$$

Percent increase and percent decrease are measures of percent change. Percent changes are useful to understand changes in a value over time.

$$\% \text{ of Carry Forward contracts} = \frac{\text{Change in Open Interest Contracts}}{\text{No. of contracts Traded (Volume)}} \times 100$$

❖ **Karl Pearson's Coefficient of Correlation** : Pearson's coefficient reflects the linear relationship between two variables. If the correlation coefficient is +1, then there is a perfect positive linear relationship between variables, and if it is -1, then there is a perfect negative linear relationship between the variables. 0 denotes that there is no relationship between the two variables. The degrees -1, +1, and 0 are theoretical results and are not generally found in normal circumstances. That means that the results cannot be more than -1, +1.

❖ **Put- Call Ratio** : The put/call ratio is a popular sentiment indicator based upon the trading volumes and open interest of put options compared to call options. The ratio attempts to gauge the prevailing level of bullishness or bearishness in the market.

$$\text{PCR} = \frac{\text{Open Interest of Put Options to No. of Put contracts traded}}{\text{Open Interest of Call Options to No. of Call contracts traded}}$$

- ❖ **Option Greeks** : The option Greeks were calculated using the software called “Options oracle”.
- ❖ Delta (Greek Symbol δ) - a measure of an option's sensitivity to changes in the price of the underlying asset.
- ❖ Gamma (Greek Symbol γ) - a measure of delta's sensitivity to changes in the price of the underlying asset.
- ❖ Vega - a measure of an option's sensitivity to changes in the volatility of the underlying asset.
- ❖ Theta (Greek Symbol θ) - a measure of an option's sensitivity to time decay.

Analysis and Discussion

$$\% \text{ change in Price} = \frac{\text{Current day's LTP} - \text{Previous day's LTP}}{\text{Previous day's LTP}} \times 100$$

Review of Literature

Wen and Lin (2011) in their paper titled “Does the Put-Call Ratio Forecast Market Returns? Evidence from an Emerging Market” investigated the predictability of popular market-based sentiment indicator, the put-call ratio, for future stock price movements using the non-publicly unique and publicly observed stock index option volume obtained from the emerging Taiwan Futures Exchange. They found that the non-public open-buy put-call ratio contains information content about future stock index movements, while the predictability of publicly observed put-call ratio is statistically insignificant.

Garg and Ramesh (2010) in their paper “Relationship between Futures Price and Open Interest in Stock and Index Futures in the Indian Stock Markets: An Empirical Analysis” revealed that open interest changes as and when the number of open positions increase or decrease in a given contract, and it has no bearing over the direction of the market. Thus, a change in open interest will not lead to a change in futures price in any direction. A corollary of the conclusion is that open interest is a measure of liquidity in the futures contract, and not a harbinger of the price direction of the futures contract.

Andy and Doran (2010) in their paper “Do Option Open-Interest Changes Predict Future Equity Returns?” found that information is first revealed in option markets. Specifically, changes in call and put open interest levels have predictive power for future equity returns. Large increases in put open interest are followed by poor equity returns. Call open interest increases precede relatively strong future returns, but the relationship is considerably less pronounced.

Ramchandra, Satish, and Krishnamurthy (2010) in their research paper on the topic “Option Trading Strategies for Different Market Conditions for Hedging the Portfolio and Trading for Profits” used multi – leg option strategies like condor, butterfly, guts, and spread for different market conditions, and analyzed the pay-off.

Maniar and Maniyar (2008) in their paper “Impact of Option Interest Information in Derivatives Markets - An Empirical Study of Stock Options Market, NSE (National Stock Exchange of India)” found that the prediction of stock price movement based on the distribution of options open interest to have reasonably good accuracy. In the sample, the open interest-based active trading strategies generated better returns as compared with the passive benchmarks.

Pan and Potesman (2004) in their research work on the topic “The Information of Option Volume for Future Stock Prices” presented strong evidence that option trading volume contains information about future stock price movements. Taking advantage of a unique dataset from the Chicago Board Options Exchange, they constructed put-call ratios from option volume initiated by buyers to open new positions. It was found that on a risk adjusted basis, stocks with low put-call ratios outperformed stocks with high put-call ratios by more than 40 basis points on the next day and more than 1% over the next week.

Mukherjee and Mishra in their research work (2004) on the topic “Impact of Open Interest and Trading Volume in Option Market on Underlying Cash Market: Empirical Evidence from Indian Equity Option Market” found that the open interest based predictors are significant in predicting the spot price index in the underlying cash market in both the periods, just after the initiation of the index option in the market and in the later sub-period. However, as far as the volume-based predictors are concerned, it shows some changing evidence. Though being insignificant just after the initiation, the volume-based predictors showed significant explanatory power in the later sub-period. Again, though both the predictors in the option market in the recent sub-period were significant at 1% level of significance, the trading volume showed more impact as compared to open interest in the matter of price prediction in the cash market. The value of adjusted R-square and F-statistics in two sub-periods also confirmed how the option market tends to improve its power in discovering the price index in the underlying cash market.

Bhuyan and Chaudhury (2001) in their working paper “Trading on the Information Content of Open Interest: Evidence from the US Equity Options Market” examined the role of option market's open interest in conveying information about the future movement of the underlying asset and showed that the trading strategies based on this predictor yield better results as compared to the buy-and-hold and passive covered call strategies.

Srivastava (2001) in his research work on the topic “Informational Content of Trading Volume and Open Interest – An Empirical Study of Stock Option Market in India” found that open interest based predictors are statistically more significant than volume-based predictors in the Indian context.