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*A Case Analysis of NIFTY 50, National Stock  
Exchange of India*

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# Multi-factor Estimation of Stock Index Movement

## *A Case Analysis of NIFTY 50 , National Stock Exchange of India*

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### **Abstract**

Multi-index research in investment management attempted to predict change in share price based on market index, industry index and other variables. This model can be extended for predicting movements in the secondary capital market.

It has been studied in this paper whether Nifty can be predicted using bond index, future price of NYMEX Light Sweet Crude, US\$/ INR exchange rate, Nikkei 225 , benchmark index of Japanese capital market which captures US market sentiment and offers early morning market cues in Asian trading, S&500 , benchmark index of the US market. Observing the trend of betas, it is concluded that appreciation of Indian currency against US\$ has not affected the market growth; and also crude prices (although high crude price would affect national GDP) and stock index are not inversely related. Indian stock index is also influenced by the US market cues.

**Key words:** *market cues, multi-index model*

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## 1. Introduction

Having launched in June 2000 stock index futures and options, based on market benchmark S&P CNX Nifty, have emerged as major derivative instruments constituting a substantial portion of the stock market turnover of National Stock Exchange of India (see Table -1). S&P CNX Nifty is owned and maintained by India Index Services & Products Ltd. (IISL), which is a joint venture of NSE and CRISIL. IISL has a consulting and licensing agreement with Standard & Poor's (S&P), who are world leaders in index services.

Trading in stock index futures and options demands identification of parameters that would explain behaviour of stock index rather than movement in individual stock price. Research in stock price behaviour is primarily focussed on multi-index models that is characterised by independent variables linked to stock fundamentals like book value, dividend as well as macro-economic parameters mostly linked to interest rates, inflation and growth.

On the other hand, technical analysis theorists like Bollinger (1980) have developed standard deviation and moving average based parameters to predict the movement of the stock price (and is used for estimating index movement as well ) , which have the inherent limitations of depending upon historical volatility and prices to predict the future trend.

In addition to the technical analysis tools based on moving average and volatility, investment analysts popularly refer to ' *market check* ' taking cues from financial market , commodity market, and also look into the global stock market behaviour. Primarily, currency rate, crude price, bond yield , movement of major global indices like S&P 500 in the US or Nikkei 225 in Japan are seen for predicting short term price movement. These 'market check' are performed before a trader would initiate to build up short-term short or long position in stock index futures and options. Stock fundamentals might, of course, draw attention in case of major stock -specific signals provided the relevant stocks could move the index in either direction.

## 2. Research on Multi-Index Models for estimation of Stock Price Behaviour

In portfolio theory single index beta is popularly used for estimating stock return which was developed by Treynor (1962), Sharpe (1964), Lintner (1965) and Mossin (1966) independently based on the earlier work of Markowitz (1959) on modern portfolio theory. Interestingly, historical beta has its limitation in forecasting stock return as often beta is not statistically significant, and more importantly, stock is an important component of the index which influences and is influenced by the index.

King ( 1966) presented an evidence of the existence of the industry influences on the stock price behaviour which is the first important study proving that stock prices for firms in the same industry exhibit a common movement that goes beyond the market effect and that paper is considered as the origin of general multi-index model of estimating stock price behaviour. Subsequently, Cohen and Pogue (1967), Elton and Gruber (1970) , Roll and Ross (1980) , Sharpe (1982), Gibbons (1982), Chen, Roll and Ross (1986), Fama and French (1993) contributed on the development of multi-index model for estimating stock price behaviour. These studies attempted to determine factors other than the market index which affect security prices.

**Table 1: Annual Turnover of Index Futures and Options in National Stock Exchange , India**

Year	Rs. In Billion			% to Total Futures and Options Turnover
	Index Futures	Index Options	Total Options & Futures Turnover	
2001-02	214.83	37.65	1019.26	24.77
2002-03	439.52	92.46	4398.62	12.09
2003-04	5544.46	528.16	21306.1	28.50
2004-05	7721.47	1219.43	25469.82	35.10
2005-06	15137.55	32935.58	48241.74	99.65
2006-07	25395.74	7919.06	73562.42	45.29
2007-08	31084.71	11315.42	113700.46	37.29

Source: National Stock Exchange, [www.nseindia.com](http://www.nseindia.com)

Sharpe (1982) studied monthly returns for stocks of 2,197 firms from 1931 through 1979. His findings showed that the  $R^2$  for a regression model was significantly improved using dividend yield, company size, and bond beta in addition to a market index. Pari and Chen (1984) conducted a test of an Arbitrage Pricing Theory (APT) model for 2,090 firms for the period 1975 to 1980. Using this model, they found that factors such as the general market index, price volatility of energy, and interest rate risk, influence stock price. Chen, Roll, and Ross (1986) tested an APT model for significance of several factors in explaining security returns. Using monthly data for the period 1953-1983, their results indicate that spread between long and short interest rates, expected and unexpected inflation, industrial production, and the spread between returns on high- and low-grade bonds are significant factors in explaining the variability of a security return.

Gautam Dutta *et al* (2006) attempted to predict SENSEX (a benchmark stock index of the Mumbai Stock Exchange) using 52-week moving average of the weekly closing SENSEX values, 5-week moving average of the same, and the 10-week Oscillator for the past 200 weeks which can be classified as a model of technical analysis using historical parameters based on index the itself. In a growth oriented market moving average based levels do not properly capture market movements; often the market creates new resistance levels making the old resistance levels as illusory support levels, and frequently breaks down below those support levels causing substantial loss in the downside or loss of opportunity in the upside.

Suchismita (2007) studied volatility linkages between the spot and futures markets. Contemporaneous transmission effects across volatilities of the Indian (NSE) Stock and Index futures markets have been tested based on daily data, using an asymmetric (threshold) GARCH framework. An important conclusion was that the futures market plays a leading role in assimilating information and thus moderating, though to a small extent, the spot market volatility.

Although the future market has the theoretical characteristics of price discovery, this working paper does not attempt to use future index price as the predictor of spot index as that impact would be mostly having instantaneous effect which would be difficult to capture even for short-term decision making.

### **3. Research Objective**

Based on the principle of multi-index model it has been attempted in this paper to examine how far the popularly used 'market cues' are relevant in predicting the stock market index.

The model to be tested consists of five independent variables over the nine year period from January 1999 through December 2007 comprising of two different phases of the capital market – normal and growth ( Figure-1).

The short –term market cues model is developed using the following equation:

$$\text{Nifty 50} = a + b_1 \text{ Crude} + b_2 \text{ Currency} + b_3 \text{ Bond} + b_4 \text{ Nikkei 225} + b_5 \text{ S\&500} + e_i$$

Crude = Future price of NYMEX Light Sweet Crude as proxy of international crude price;

Currency = US\$/ INR exchange rate;

Bond = Principal return index of I-sec<sup>1</sup>;

Nikkei 225 = Benchmark index of Japanese capital market which captures US market sentiment and offers early morning market cues;

S&500 = Benchmark index of the US market.

It is traditionally believed that crude price movement is inversely related to stock index movement as higher crude price negatively affects the macro-economic parameters like balance of trade , inflation and GDP growth of a crude importing country like India (which constitute a substantial portion of import) on which stock index depends in the long run.

Currency is considered as an independent variable as appreciation of INR against US\$ affects export oriented industry and in particular software industry which carries a substantial weight in the index. That apart foreign institutional investment flow causes INR appreciation and also pushes up the index, and therefore, it is commonly believed that INR appreciation and stock index are positively correlated whereas influence of downward movement of software stocks might offset a portion of co-movement. On the other hand, foreign institutional investment outflow arising out liquidation of stock exposures would cause INR depreciation as well as decline in the stock index.

Researchers in multi-index models have established significant influence of bond rates on stock price movement. Essentially, in highly volatile market condition investors prefer to switch over to bond market to protect the invested capital signifying inverse relationship between bond price and stock index. For the purpose of this study i-bex principal return index<sup>1</sup> has been used as a proxy of the bond market.

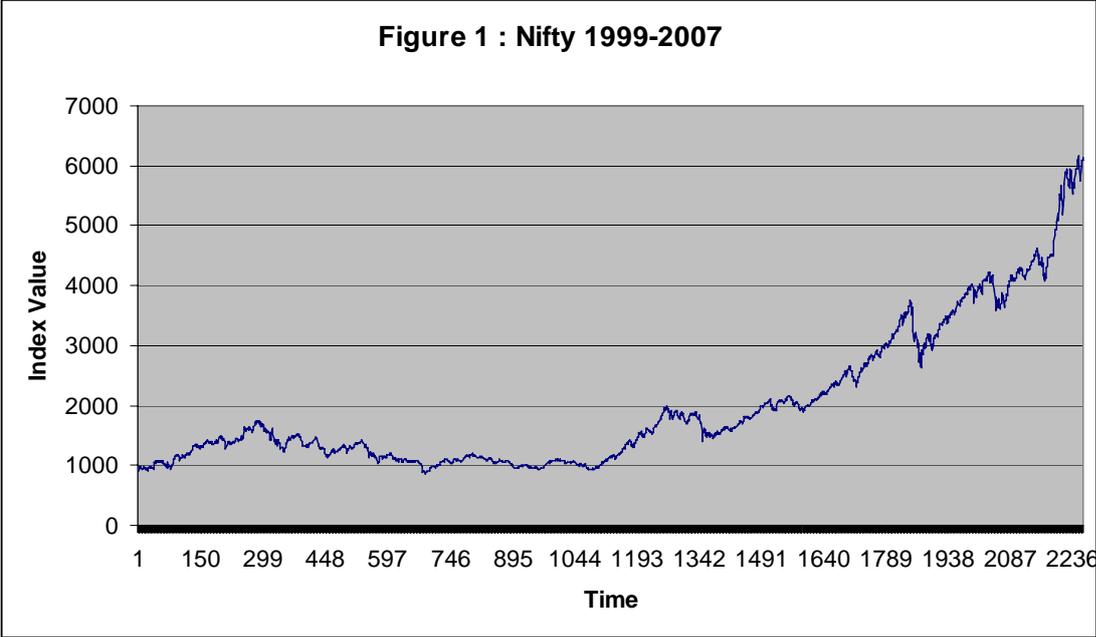
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1. i-Sec Sovereign Bond Index (i-BEX) is a family of bond indices that act as a metric to measure the performance of the government securities market. Launched in 1994, it has emerged as the preferred benchmark across all classes of market participants. Recommended by Association of Mutual Funds in India (AMFI), the index is used by fund managers to measure market performance, benchmark the performance of their portfolios, and also as a tool for quantifying risks in the sovereign bond market. It has also been extensively used by academia in India as a proxy representative of the bond markets.

Nikkei 225 and S&P 500 are introduced as global market cues – whereas Nikkei 225 of Japan opens before the Nifty of India there is some common trading hours but S&P 500 in the US opens after the Indian stock market closes. Therefore, same day indices are compared for Nikkei 225 and Nifty but previous day's index value of S&P 500 is compared to next day value of Nifty. In absence of matching paired days, latest value of market indices is used. Similarly, previous day price of crude in the NYMEX is paired with the value of Nifty in the earliest possible trading day.

Nifty 50 (Figure -1) is a popularly used index for futures and option trading in India. It hovers around 1000 mark during 1999 to 1100 in the early 2003, and thereafter during 2003-2007 it moved by phenomenal 457% to 6153. Therefore, Nifty movement are classified into two distinct phases – 1999 -2002: 4 stable years and 2003- 2007: 5 growth years. It is proposed

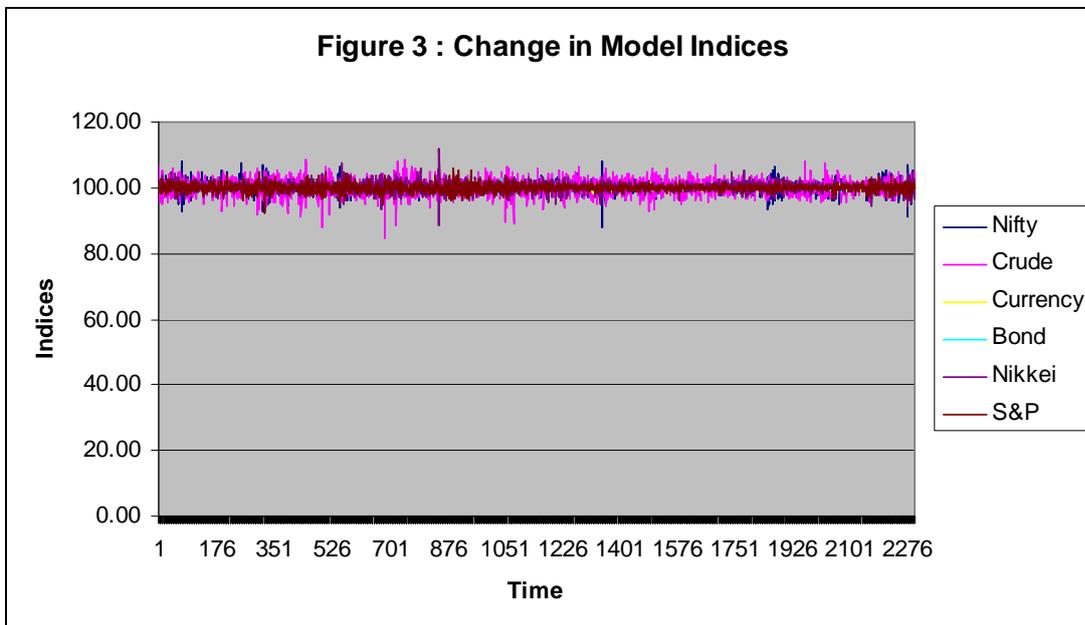
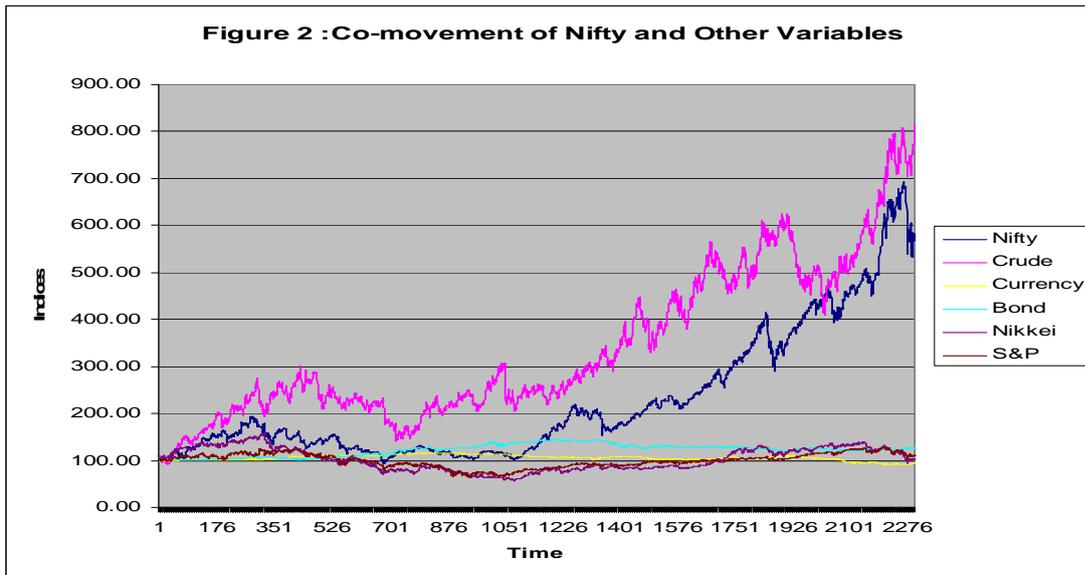
to verify if the relationships among the financial market variables are different in these two phases.



Phase -1	Phase - II
1999 0001- 0254	2003 1004- 1267
2000 0255- 0504	2004 1268 - 1511
2001 0505 - 0752	2005 1512 - 1761
2002 0753- 1003	2006 1762 - 2010
	2007 2011 - 2260

It is attempted to create a useful multi-index model applying basic multiple regression technique which would examine the independent variables that have significant relationships with Nifty such that a short term trader can use the model parameters to predict movement in the stock index movement. A market cues equation has been developed for each of the nine years (Tables 2 &3). As the market dynamic changes frequently, it might be appropriate to derive new parameters the models on monthly or quarterly basis.

Shown in Figure -2 is the co-movement of Nifty with other identified variables. For understanding the degree of association among the variables all variables are converted into common indices (1999=100). Since fundamentals of the Indian economy has remained very strong with higher growth opportunities, adverse impact of crude price could never affect the corporate growth resulting in mostly crude having positive co-movement with stock index. However, other independent variables show a mixed trend. Changes in these indices of dependent and independent variables are presented in Figure -3 to pre-verify the validity of the arguments of model building for predicting stock index using external parameters.



## 4. Empirical Results

Results of the multiple regression are shown in Tables 2 and 3. It has been observed that during the first phase when the Indian stock market was stable initially increase in crude price was not building negative market sentiment. However, at the later stage of Phase-I, crude price rise as well currency depreciation was having negative beta and also the stock index rise was negatively correlated to bond index rise. This signifies that crude, currency and bond have significant influence on the stock index and there was no supportive evidence to generalise that rise in crude price will negate the stock market growth or depreciation of domestic currency is good for the market as export earnings improve or when stock index falls bond index rises. However, observing the trend of betas, a fair generalisation would be currency appreciation does not affect the market growth and also crude prices and stock index are not inversely related. There is importance of global market cues and not necessarily that positive global cues only drove the Indian stock index rather it fared well even when Nikkei offered negative signals. However, positive US market cues signified by positive beta explains the direct relationship of US market cues on the Indian stock index.

**Table 2 : Multiple Regression Coefficients 1999-2002**

	1999	2000	2001	2002
Constant	-12601.30	3230.43	9266.37	-2183.81
Crude	10.09	4.78	-20.80	-2.95
Currency	199.24	-25.99	-162.84	28.79
Bond	5.21	-1.37	-0.85	1.02
Nikkei	0.01	0.07	-0.04	0.02
S&P	-0.37	-0.39	1.25	0.41
R <sup>2</sup>	0.891	0.756	0.864	0.803
F	401.90	151.10	304.66	200.24

**Table -3: Multiple Regression Coefficients 2003-2007**

	2003	2004	2005	2006	2007
Constant	1182.59	4737.36	260.02	-6209.13	-17926.83
Crude	25.12	4.26	10.41	4.66	47.54
Currency	-50.39	-95.90	-31.09	45.80	138.00
Bond	-0.59	0.34	-0.86	-2.22	5.99
Nikkei	0.08	-0.15	0.14	0.13	-0.24
S&P	1.76	2.13	1.83	6.05	6.69
R <sup>2</sup>	0.834	0.640	0.959	0.887	0.894
F	249.59	88.35	11140.92	382.51	409.92
P	0.00	0.00	0.00	0.00	0.00

Explained variation in all nine year were very high (above 80% except for two years) supported by high F- Values and zero p values which justifies significance of the regression model.

## 5. Further research

The scope of research can be extended by including historical index values or volatility as predictors expanding the scope of model and to carry out back testing applying external factor models with that historical value and volatility based internal factor models.

## 6. References

- Bose, S. (2007), "Characteristics and Transmission Effects in the Indian Stock Index and Index Futures Market", *Money & Finance*, pp. 139- 62
- Chen, N., Roll, R, and Ross, S.A. (1986), "Economic Forces and the Stock Market," *Journal of Business*, Vol. 59, No. 3, pp. 383-403.
- Cohen, K. and Progue, J. (1967), "An Empirical Evaluation of Alternative Portfolio Selection Models", *Journal of Business*, 46 (April), pp. 1166-193.
- Elton, E. and Gruber, M. J. (1970), "Homogenous Groups and the Testing of Economic Hypotheses", *Journal of Financial and Quantitative Analysis*, IV, No. 5 (Jan), pp. 581- 602.
- Fama, E. and French, K. (1993), "Common Risk Factors in the Returns of Stocks and Bonds", *Journal of Financial Economics*, 33, pp. 3-56.
- Dutta, G. et al., ( 2006), "Artificial Neural Network Models for Forecasting Stock Price Index in the Bombay Stock Exchange", *Journal Of Emerging Market Finance*, Vol. 5, No. 3. pp.207-15.
- Lintner, J. (1965), "The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets", *Review of Economics and Statistics*, Vol. 47, No. 1, pp. 13-37.

- Markowitz, H. M. (1952). "Portfolio Selection". *Journal of Finance*, Vol. 7, No. 1, pp. 77-91.
- Markowitz, H. M. (1959), *Portfolio Selection: Efficient Diversification of Investments*, John Wiley & Sons, Inc., New York & Chapman & Hall, Limited, London.
- Markowitz, H. M. (1976), Markowitz Revisited, *Financial Analysts Journal*, Vol. 32, No. 4, pp.47-52.
- King, B. (1966), "Market and Industry Factors in Stock Price Behaviour", *Journal of Business*, Vol. 39, pp. 1139-140.
- Mossin, J. (1966), "Equilibrium in a Capital Asset Market", *Econometrica*, Vol. 34, No. 4, pp. 768-783.
- Pari, R. A. and Chen, S. (1984), "An Empirical Test of the Arbitrage Pricing Theory," *Journal of Financial Research*, Vol. 7, No. 2, pp. 121-130.
- Roll, R. and Stephen, R. (1980), "An Empirical Investigation of the Arbitrage Pricing Theory", *Journal of Finance*, Vol. 35, pp. 1073-1103.
- Sharpe, W. F. (1964). Capital asset prices: A theory of market equilibrium under conditions of risk, *Journal of Finance*, Vol. 19, No. 3, pp. 425-442.
- Sharpe, W. F (1982), "Factors in New York Stock Exchange Security Returns, 1931-1979," *Journal of Portfolio Management*, Vol. 8, No. 4, pp. 5-19.
- Treynor, J. L. (1962), "Toward a Theory of Market Value of Risky Assets", Unpublished manuscript. A final version was published in 1999, in *Asset Pricing and Portfolio Performance: Models, Strategy and Performance Metrics*. Robert A. Korajczyk (editor) London: Risk Books, pp. 15-22.



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