Measurement of Risk Vs Return of Indian Sectoral Indices

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***Abstract*—The risk appetite of investors governs their investment in financial instruments. Persons who are minimum risk takers with return generally park their money in secure instruments but people with a higher risk appetite generally invest in a stock market financial instrument to achieve their financial goal. Investors with a higher risk appetite have to measure the market performance in the basis of risk and return so that they can alter their portfolio to keep pace with current market movement. In this research article we have discussed the risk in terms of beta of all sectoral indices of NSE with respect to nifty and their performance in different time horizon and ranked them accordingly in terms of return per unit of risk and found out the best performing sector in a given time frame. In the end linear relationship was established between Sectoral indices and nifty and factor analysis was performed among the eleven sectoral indices to determine the underlying influence of the sectoral indices on Nifty.**

***Index Terms*—sectoral index, nifty, risk and return, volatility**

I. Introduction

Risk and return are two sides of the same coin. Investors have a vested interested in the so called stock market to achieve high return. Now a day, even researches are taking keen interest in the market to use modern techniques which in turn can be beneficial for investors through their analysis.

Indian two major stock markets, National Stock Exchange better known as NSE and Bombay Stock Exchange (BSE) is a place where buyers and sellers of different financial instrument meet to achieve their financial goal, in short profit/loss from the transaction. Stock market in India has seen a major change after liberalization where the flow of information was the major driving force to carry the stock market index. India is an emerging economy, which has seen a drastic change in the capital market in last two decades. Foreign Institutional Investors or FII had taken a keen interest in India as a result India was fortunate enough to get a major share from foreign investors during this period. This opportunity has also a major drawback as it has increased the risk associated with this financial instrument. Hence, many investors are evaluating their investment in different techniques better know to them so that they can take a better decision. Evaluation of investment for common investors is a measurement of risk or volatility and return associated with it. Investors generally monitor up and down on index to get the sentiments of the market.

Indices in the stock market are considered as a barometer to judge the sentiment of the market. This index is being monitored by different persons, like researchers for providing accurate analysis, investors to purchase or sell financial assets, policy makers for future policy formulation etc.

Ref. [1]-[2] NSE has different kinds of indices one of such kind of index is Sectoral Index, which is being designed and maintained by team of India Index Services & Products Limited (IISL). The Sectoral index provides a value for the aggregate performance of a number of companies of a particular sector of an economy. NSE has eleven sectoral indices, namely CNX Auto Index, CNX Bank Index, CNX Energy Index, CNX Finance Index, CNX FMCG Index, CNX IT Index, CNX Media Index, CNX Metal Index, CNX Pharma Index, CNX PSU Bank Index, CNX Realty Index as tabulated in Table I showing number of companies in index, its base value, base date etc.

CNX Auto Index shows the performance of Automobile segment. It comprises fifteen listed companies related to manufacturers of four, two and three wheelers, Auto Ancillaries and Tyres. The index is re-balanced after six months.

The CNX Bank Index is composed of most liquid and large capitalized Indian Banking companies. It has twelve companies from banking sectors which are being traded in NSE. This index is re-balanced after six months.

The CNX Energy Index reflects the performance of companies related to petroleum, Gas and power Sector, comprising of ten companies traded in NSE. This index is re-balanced after six months.

The CNX Finance Index is designed to reflect the performance of banks, financial institutions, housing finance and other financial service companies. It comprises of fifteen companies which are listed and traded in NSE. This index is re-balanced after six months.

The CNX FMCG Index reflects the performance of Fast Moving Consumer Goods companies. It comprises of fifteen companies and is re-balanced after six months

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The CNX IT Index is a benchmark showing movement of twenty companies of IT companies. It is re-balanced after six months.

The CNX Media Index shows the performance of fifteen media & Entertainment sector companies including printing & publishing listed and traded in NSE. The Index is re-balanced after six months.

CNX Metal Index reflects the behavior of metal & mining companies. It consists of fifteen companies and the Index is re-balanced after six months.

CNX Pharma Index highlights the performances of pharmaceutical companies. It comprises ten listed & traded in NSE. The Index is re-balanced after six months.

CNX PSU Bank Index depicts the performance of PSU Banks comprising of twelve listed companies of NSE and is re-balanced after six months.

The CNX Realty Index shows the performance of ten Real Estate companies listed in NSE. The Index is re-balanced after six months.

TABLE I. SECTORAL INDEX OF NSE - AT A GLANCE

Sl. No.	Sectoral Index of NSE	No of Companies in Index	Base value	Base Date	Market Representation of companies in a particular index in	
					NSE as of Mar 31, 2014	Sector as of Mar 31, 2014
1	Auto	15	1000	Jan 1, 04	7.82%	94.29%
2	Bank	12	1000	Jan 1, 00	15.34%	91.08%
3	Energy	10	1000	Jan 1, 01	10.40%	86.63%
4	Finance	15	1000	Jan 1, 04	19.70%	79.18%
5	FMCG	15	1000	Dec, 95	5.43%	86.63%
6	IT	20	1000	Jan 1, 96	12.63%	97.73%
7	Media	13	1000	Dec 30, 05	-	84.98%
8	Metal	15	1000	Jan 1, 04	4.20%	91.35%
9	Pharma	10	1000	Jan 1, 01	5.00%	79.42%
10	PSU Bank	12	1000	Jan 1, 04	3.38%	93.00%
11	Realty	10	1000	Dec 29, 06	0.65%	75.63%

II. LITERATURE REVIEW

Ref. [1] Shanmugasundram, G. and Benedict, D. John (2013) studied risk factor in the Indian Sectoral indices and Nifty and also see the risk relationship in varied time period. Authors had selected five Sectoral indices (CNX Auto Index, CNX Bank Index, CNX FMCG Index, CNX Infrastructure index and CNX Information Technology) and Nifty Index for their study for eight years i.e. from 2004 to 2012. T-Test (two samples) and ANOVA (one way) was carried out to measure the risk difference between the sectors and Nifty and risk across time interval was measured using one-way ANOVA. At the end they concluded that there is no difference in standard deviation among various Sectoral Indices but there is a significant difference in the mean score at various time intervals.

Ref. [2] P. Swarna Lakshmi, (2013) measured the volatility pattern in various Sectoral Indices in Indian stock market using Autoregressive Conditional Heteroskedasticity, an econometric model. A study was conducted for the period starting 2008 till 2012. All eleven Sectoral Indices from MSE (CNX Auto, CNX Bank, CNX Energy, CNX Finance, CNX FMCG, CNX IT, CNX Media, CNX Metal, CNX Pharma, CNX PSU Bank, CNX Realty) was considered for research. At the end researcher concluded that the reality sector has highest volatility than any other sector what accounts to around 80% whereas Nifty measured around 20%. Whereas the banking sector has lowest volatility for test period which struggled around 12%.

Ref. [3] Mohandass S., Renukadevi. P, (2013) had modeled volatility of BSE Sectoral Indices. Their study involved data ranging from January 2001 to June 2012 from Bombay stock Index thirteen sector Indices. Normality test, Stationary & Heteroskedasticity of data was carried out and their result was positive. Later they summarized by using the Box-jenkinson methodology for modeling. ARMA (1,1) was found suitable, since it has ARCH effect also GARCH (1,1) model was also carried out and was found out the best model to predict the volatility of the return.

Ref. [4] Rawashdeh, M., Squalli J., (2005) studied the sectoral efficiency of Amman Stock Exchange. Data ranging from 1992 to 2004 was taken on a daily basis. Variance Ratio, Run test was carried out for all the four sectors. Their finding suggested that random walk hypothesis and weak-form of efficiency was rejected.

Ref. [5] Gupta, R., and Basu, P.K., (2007) had made an attempt to study the efficiency of Indian Stock market. In their research they explained the concept of market efficiency in terms of international diversified portfolios. Their research was carried out on Sensex (BSE Index) and Nifty (NSE Index) for the period ranging from 1991 to 2006. Market return was carried out to analyse the random walk process in data, Run test, LOMAC variance ratio test was carried out to test the weak form of efficiency and random walk hypothesis even Durbin-Watson test and Dickey-Fuller test was carried out with the data set. Their finding suggests that both BSE and NSE market shows no characteristics of random walk. Phillip-Perron test and KPSS test suggest that series were stationary which suggest that these markets are not a weak form of efficient.

Ref. [6] Cao, D., Long, W., and Yang, W., (2013) analyze correlation between the sectoral indices on the China Stock market. For their study two stage analysis were done, 2007 & 2008 was catogerised as drastic shock period and other as general ups and downs periods. Their finding suggests that in the first stage sectors in the study were highly correlated but in other period the sector shows less correlation.

Ref. [7] Rajamohan, S., Muthukamu, M., (2014) compared the performance of the sectoral indices of NSE. Their main objective was to measure the influence of banking sector vis-à-vis the other sectors. They concluded that there is a positive correlation of influence of the banking sector with other sectors. A study was conducted in two periods. Firstly, from Jan 2008 to October 2008 categorized as bear phase and from October 2008 to December 2013 for bull phase market movement.

Ref. [8] Srivastava, A. (2012), studied the stability of Bombay Stock Exchange Sectoral Indices. In his study eleven sectors were considered, namely BSEAUTO, BSEBANK, BSECD, BSECG, BSEFMCG, BSEEHC, BSEIT, BSEMET, BSEOIL, BSEPOWER and BSEREAL for the period ranging 2003 to 2012. In his research it is evident that FMCG, Healthcare and IT are least sensitive to market change w. r. t Sensex & BSE500 whereas reality and metal are most volatile.

III. Objective of Study

- To evaluate the performance of the different sector based index of NSE.
- To measure the sensitivity of different Sectoral Indices with respect to Nifty.
- To find a linear relationship between Nifty and other sectoral Index.

IV. Data Description

Monthly closing price of all the Sectoral Indices of National Stock Exchange, namely CNX Auto Index, CNX Bank Index, CNX Energy Index, CNX Finance Index, CNX FMCG Index, CNX IT Index, CNX Media Index, CNX Metal Index, CNX Pharma Index, CNX PSU Bank Index, CNX Realty Index was taken. Most of the Sectoral data are collected from January 2004 except for two sectors, Media sector and Reality Sector. In the first case, data were collected from December 2005 and other December 2006 as available from National Stock Exchange.

V. Research Methodology

The main objective of this research paper is to understand the risk and return associated with the NSE Sectoral Indices and to develop a linear regression model keeping Nifty index as dependent variable and other sectoral indices as independent variable. To satisfy our objective first monthly return of all twelve indices (eleven sectoral indices and nifty) was calculated using the formula below.

Ref. [3] Return = $\ln (P_1 / P_0)*100$ where P_1 is current month closing index value and P0 is previous closing month index value.

Then the standard deviation of all indices was calculated from the below mentioned formula to calculate the risk associate with the return of indices.

$$\sigma = \sqrt{((x_1-\mu)^2+(x_2-\mu)^2+..+(x_n-\mu)^2)/n)}$$

where $\mu = (x_1+x_2+..+x_n)/n$ (1)

Ref. [9] Beta (β) in financial world measures the volatility or systematic risk of the index. Beta is generally calculated by the below given formula.

$\beta = (\text{Cov}(r_a, r_m))/(\text{Var}(r_m))$ where r_a is the return of an index (in our case it is sectoral index return), and r_m is benchmark index return (in our case Nifty).

Beta calculated gives the volatility of particular sectoral index with respect to Nifty. If beta is 1.2 then that particular index movement will be 20% more than the benchmark index and that to in the same direction. In other words, it's more volatile than the benchmark index. This risk cannot be removed by diversification so it is known as systematic risk. Beta can attain any value. Index or security having zero beta indicates that it is un-correlated with the reference index. And beta attaining negative value suggests that security is moving in the opposite direction as compared to the reference index.

To predict the performance of Nifty with the help of sectoral data linear relationship was assumed keeping nifty as dependent variable and return of other sectors as independent variable. The formula used is given below

$R_{Nifty}=a+ \sum_{(i=1)}^{n} [\![b_i R_i]\!]$ Where R_{Nifty} = Return of Nifty Index

a = constant, R_i = Return of sectoral indices and bi is the coefficient of particular sectoral index.

Ref. [10] and finally factor analysis was performed among the eleven sectoral indices to determine the underlying influence of the sectoral indices on Nifty.

Software used for analysis is Microsoft Excel 2007 and SPSS 15 evaluation version.

VI. Result & Discussion

Beta of all sectoral indices was found out as discussed above.

TABLE II. Beta Coefficient of Different Sectoral Index with Reference to Nifty

Sl. No.	Sectoral Index of NSE	Beta	Rank
1	CNX Auto Index	0.952528	3
2	CNX Bank Index	1.211667	8
3	CNX Energy Index	1.017703	4
4	CNX Finance Index	1.194425	6
5	CNX FMCG Index	0.530308	1
6	CNX IT Index	1.327351	9
7	CNX Media Index	1.19125	5
8	CNX Metal Index	1.48367	10
9	CNX Pharma Index	0.626225	2
10	CNX PSU Bank Index	1.205825	7
11	CNX Realty Index	2.200132	11

The above table shows that FMCG is most defensive sector i.e. it is least sensitive to changes occurring to Nifty (benchmark index), its value being 0.530 means 1% change in Nifty Index result to 0.53% change to FMCG index in both direction (upward & downward) following it is Pharma and Auto. Whereas Realty is most sensitive sector its value being 2.2 which indicates 1% change in Nifty index will give 2% movement in Realty Index, then next to it is Metal and IT sectors.

TABLE III. Position of the Different Sectoral Index in Reference to Return Per Volatility

Sl. No.	Sectoral Index of NSE	Return / Beta	Rank
1	CNX Auto Index	1.61068721	3
2	CNX Bank Index	1.15762161	5
3	CNX Energy Index	0.82898971	7
4	CNX Finance Index	1.22876646	4
5	CNX FMCG Index	2.7852772	1
6	CNX IT Index	-0.4630169	10
7	CNX Media Index	0.61747882	9
8	CNX Metal Index	0.73615362	8
9	CNX Pharma Index	2.00656802	2
10	CNX PSU Bank Index	0.86451919	6
11	CNX Realty Index	-0.6723023	11

Table III shows the ranking of Sectoral Indices according to return per volatility measured in terms of beta. FMCG Index scores higher than other in terms of return per volatility and Realty Index has taken a backseat, which indicates that if investors have to choose between indices then FMCG has performed better than other index during the test period.

TABLE IV. POSITION OF DIFFERENT SECTORAL INDEX IN REFERENCE TO RETURN PER UNIT OF RISK

Sl. No.	Sectoral Index of NSE	Return / SD	Rank
1	CNX Auto Index	0.189606	3
2	CNX Bank Index	0.134208	5
3	CNX Energy Index	0.103759	6
4	CNX Finance Index	0.148867	4
5	CNX FMCG Index	0.246335	1
6	CNX IT Index	-0.02774	10
7	CNX Media Index	0.029438	9
8	CNX Metal Index	0.087572	8
9	CNX Pharma Index	0.192378	2
10	CNX PSU Bank Index	0.090524	7
11	CNX Realty Index	-0.0833	11

Ref. [3] Table IV indicates FMCG has performed well during the test period, but Realty sector has to improve a lot in the measure of return per unit of risk.

Considering both the measure (return per volatility & return per unit of risk) FMCG Index had performed better than other sectors which indicate that investors should take interest in FMCG Companies.

TABLE V. MODEL SUMMARY OF REGRESSION ANALYSIS

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.990(a)	0.981	0.978	1.13712
a. Predictors: (Constant), Realty, Media, IT, FMCG, Pharma, PSU Bank, Auto, Energy, Metal, Finance, Bank			

Ref. [10] Regression analysis was carried out using SPSS 15 and the result is tabulated in Table V and Table VI, In Table V value of adjusted R^2 is high (near to 1), suggest that the regression model for determining the dependent variable (Nifty) with the help of other sectoral indices is valid and sector index can be used to determine Nifty with an accuracy of 97.8% by linear regression model.

TABLE VI. COEFFICIENT TABLE OF ALL INDICES

	Unstandardized Coefficients		Sig.
	B	Std. Error	
(Constant)	-0.130	0.135	0.337
Auto	0.082	0.029	0.006
Bank	0.194	0.109	0.078
Energy	0.355	0.033	0.000
Finance	0.114	0.102	0.270
FMCG	0.071	0.031	0.023
IT	0.095	0.020	0.000
Media	-0.004	0.005	0.464
Metal	0.070	0.022	0.002
Pharma	0.091	0.029	0.003
PSU Bank	-0.086	0.036	0.019
Realty	0.014	0.017	0.418

Table VI as shown above is the coefficient table, with their significance level for regression analysis (Nifty being dependent variable and other eleven sectors been independent variable) suggest the Bank, Finance, Media & Realty is not significant in regression model of determining Nifty index so this sectors should be removed from our regression analysis as its significance value more than 0.05.

TABLE VII. MODEL SUMMARY OF REGRESSION ANALYSIS

R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
.976(a)	0.952	0.949	1.67397	2.170

Table VII and Table VIII is the model summary and coefficient table for regression analysis after removing four sectoral indices for determining Nifty. In Table VII Durbin Watson value is 2.170 also suggests that after removing four indices regression analysis can be carried out to form a model. And higher adjusted R^2 value suggests that considering seven indices in the model to determine Nifty can be explain to about 95%.

TABLE VIII. COEFFICIENT TABLE OF SEVEN INDICES

	Unstandardized Coefficients		Sig.	Collinearity Statistics	
	B	Std. Error		B	Std. Error
(Constant)	0.054	0.156	0.732		
Auto	0.164	0.036	0.000	0.269	3.716
Energy	0.371	0.039	0.000	0.228	4.392
FMCG	0.103	0.035	0.004	0.521	1.919
IT	-0.003	0.008	0.700	0.740	1.351
Metal	0.142	0.022	0.000	0.292	3.430
Pharma	0.121	0.033	0.000	0.491	2.037
PSU Bank	0.067	0.020	0.001	0.419	2.388

Table VIII gives the coefficient values and significance level for regression analysis to determine Nifty with the help of seven indices in consideration. But IT sector is not significant, hence it should not be considered in further regression analysis.

TABLE IX. MODEL SUMMARY FOR REGRESSION ANALYSIS

R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
.976(a)	0.952	0.949	1.66793	2.165
Predictors: (Constant), PSU Bank, FMCG, Pharma, Metal, Auto, Energy Dependent Variable: CNX Nifty Index				

Table IX and Table X shows the model summary and coefficient table for regression analysis taking six sectoral indices (Auto, Energy, FMCG, Metal, Pharma and PSU Bank). In Table IX adjusted R^2 value is around 0.95 indicates that taking six sectoral indices in regression analysis for determining Nifty can be done with an accuracy of 95%.

Table X as shown above gives the coefficient of all six sectors of regression model to determine nifty. Here all the significance values are less than 0.05 indicates all six sectors (Auto, Energy FMCG, Metal, Pharma and PSU Bank) are valid.

TABLE X. COEFFICIENT TABLE OF SIX INDICES

	Unstandardized Coefficients		Standard-ized	Sig.	Collinearity Statistics	
	B	Std. Error	Beta		B	Std. Error
(Constant)	0.060	0.155		0.698		
Auto	0.163	0.035	0.179	0.000	0.270	3.707
Energy	0.366	0.037	0.404	0.000	0.252	3.962
FMCG	0.103	0.034	0.083	0.004	0.521	1.919
Metal	0.144	0.022	0.243	0.000	0.297	3.364
Pharma	0.121	0.033	0.107	0.000	0.492	2.031
PSU Bank	0.067	0.020	0.104	0.001	0.419	2.388

TABLE XI. FACTOR ANALYSIS-COMMUNALITIES

	Initial	Extraction
Auto	1.000	0.822
Energy	1.000	0.808
FMCG	1.000	0.544
Metal	1.000	0.761
Pharma	1.000	0.595
PSU Bank	1.000	0.647

After regression analysis, factor analysis was carried out to know if there are any hidden factors within the six sectoral indices. Table XI, Table XII and Table XIII is summary for factor analysis. In Table XI Extraction values are more than 0.5 so all six sectoral indices are valid for further factor analysis.

TABLE XII. TOTAL VARIANCE EXPLAINED

Component	Initial Eigen values			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.177	69.621	69.621	4.2	69.62	69.62
2	0.689	11.483	81.104			
3	0.434	7.230	88.335			
4	0.299	4.975	93.310			
5	0.216	3.602	96.912			
6	0.185	3.088	100.000			

Table XII above shows total variance explained using the extraction method via principal component analysis the comunalities are computed. Table XII shows that Component 1 comprising of six sectoral indices can explain around 70.0% of Nifty index.

TABLE XIII. COMPONENT MATRIX

	Component
	1
Auto	0.907
Energy	0.899
FMCG	0.738
Metal	0.872
Pharma	0.772
PSU Bank	0.804

Table XII shows that latent root criterion for number of factors to be extracted from six indices is one i.e. six sectors are converging to one factor which can be used to predict Nifty Index. The respective value of six indices shows the partial correlation values with respect to Nifty. Since all the values are more than 0.7 indicates that particular index have high correlation with Nifty removing the effect of other indices.

VII. CONCLUSION

Sectors having higher sensitivity are Realty, Metal and IT whereas sectors which are defensive are FMCG, Pharma and Auto suggest that any change in Nifty will lead to higher changes in Realty, Metal and IT but least changes in FMCG, Pharma and Auto. All the changes in same direction of Nifty since the value of beta are positive.

FMCG, Pharma and Auto are top performer in terms of return per beta and return per unit of risk in same order suggest that FMCG sector Pharma and Auto are the sectors where investors should take keen interest sing there results are encouraging in terms of volatility (being defensive) and scores higher return per risk.

Predicting Nifty with the help of sectoral indices by assuming a linear regression model suggest that Nifty return can be explained to a tune of 95% from the six sectoral indices return out of eleven sectoral indices return (i.e. Auto, Energy, FMCG, Metal, Pharma and PSU Banks. Other sectoral indices are left out due to unsuitability of data analysis.

Further factor analysis suggest that there is one factor leading composing all the six mentioned sectoral indices.

VIII. LIMITATION

In our research paper we have considered the data to follow a linear pattern to develop a regression model and carry out factor analysis. But in reality the data may not follow as assumed.

IX. FUTURE SCOPE OF STUDY

No-linear forecasting techniques may be applied in determining Nifty.

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