International Journal of Management (IJM)
Volume 7, Issue 5, July–Aug 2016, pp.210–222, Article ID: IJM_07_05_020
Available online at
http://www.iaeme.com/ijm/issues.asp?JType=IJM&VType=7&IType=5
Journal Impact Factor (2016): 8.1920 (Calculated by GISI) www.jifactor.com
ISSN Print: 0976-6502 and ISSN Online: 0976-6510

THE SINGLE INDEX MODEL – AN EXOTERIC CHOICE OF INVESTORS IN IMBROGLIO – AN EMPIRICAL STUDY OF BANKING SECTOR IN INDIA

Prof. Suresh Kumar S
Associate Professor and Head
P G Department of Commerce, TKM College of Arts and Science,
(Affiliated to University of Kerala)
Kollam, Kerala, India 691005

Dr. Joseph James V
Associate Professor and Head, Research Department of Commerce
Fatima Mata National College, (Autonomous)
Kollam, Kerala, India 691001

Dr. Shehnaz S R
Assistant Professor
P G Department of Commerce, TKM College of Arts and Science,
(Affiliated to University of Kerala)
Kollam, Kerala, India 691005

ABSTRACT

The stock market analysis confined to esoteric jargons and dicey computations often scares the common investor away from such analysis, in spite of having access to personal computer and spreadsheets. The Single Index model though less complicated than Markowitz model fails to attract investors' analytical capability. This paper attempts to identify and explain the simple linear regression aspects of returns of a security in relation to a market index to which the security belongs. The security returns of two banks in India i.e. HDFC Bank and Bank of India are linearly regressed against NSE Nifty Bank Index to arrive at the systematic and unsystematic risks and their volatility to changes in index movements.

Key words: Single Index Model, Alpha, Beta, Risk free return, Excess Return, Systematic Risk, Unsystematic Risk, Linear Regression

Cite this Article Prof. Suresh Kumar S, Dr. Joseph James V and Dr. Shehnaz S R, The Single Index Model – An Exoteric Choice of Investors In Imbroglio – An Empirical Study of Banking Sector In India. *International Journal of Management*, 7(5), 2016, pp. 210–222.
http://www.iaeme.com/IJM/issues.asp?JType=IJM&VType=7&IType=5

1. INTRODUCTION

Investors have always been desperately confused when it comes to selection of appropriate choice of securities to be included or excluded in their portfolio. The conflicting interests of lower risk and higher returns, poses doldrums in the minds of a rational investor who will not be able to decide what to sacrifice at the cost of the other. The investors irrespective of the socio economic class to which they belong are averse of highly sophisticated computations and analysis for selecting their portfolio. Harry Markowitz (1952) published a portfolio selection model that maximized a portfolio's return for a given level of risk. A graph of these portfolios constitutes the efficient frontier of risky assets. However Markowitz model requires innumerous calculations which increase rapidly as number of securities in the portfolio increases. On the contrary, the simplified single-index model assumes that there is only one macroeconomic factor that causes the systematic risk affecting all stock returns and this factor can be represented by the rate of return on a market index, such as the S&P 500. According to this model, the return of any stock can be decomposed into the expected excess return of the individual stock due to firm-specific factors, commonly denoted by its alpha coefficient (α), which is the return that exceeds the risk-free rate, the return due to macroeconomic events that affect the market, and the unexpected microeconomic events that affect only the firm. Specifically, the return of stock i is $r_i = \alpha_i + \beta_i rm + e_i$

The term $\beta_i rm$ represents the stock's return due to the movement of the market modified by the stock's beta (β_i), while e_i represents the unsystematic risk of the security due to firm-specific factors. (Source: http://thismatter.com/money/investments/single-index-model.htm). A Single Index Model is a Statistical model of security returns (as opposed to an economic, equilibrium-based model). A Single Index Model (SIM) specifies two sources of uncertainty for a security's return: The Systematic (macroeconomic) uncertainty is assumed to be well represented by a single index of stock returns while the unique (microeconomic) uncertainty is represented by a security-specific random component. The only, but crucial assumption that underlies the single index model is the non existence of co-variance between the expected return on the security and that on the index.

2. STATEMENT OF THE PROBLEM

The investors in spite of their technical knowledge and financial background tend to avoid timid analysis of security prices and associated risk/ returns. Such a situation is the cumbersome result of high end technical jargons and indicators, whether it be interwoven intricately around fundamental or technical aspects of the trends in security returns or underlying risks. While the researchers on one hand try to resolve the issues, they are complicating the common beliefs of layman investors on the other. With commonly accessible spreadsheets available as part of office suites at the disposal of majority investors, a dearth in basic knowledge of risk return relationships of investments in securities and their volatility brought about by movements of its own prices and that of the general trends in market tends to drive them away from selection of scrips and portfolio composition by themselves. It is in this backdrop, an attempt is made to explain the basic concepts in simple index model which is believed to explain the common man how simple calculations using data analysis in commonly used spreadsheet like Microsoft Excel can enable them to understand the linear regression and simple statistics behind risk estimations.

The rest of the paper is attributed to discussions on earlier studies in this regard, objectives of this study along with methodology adopted and discussion on experimental results before concluding.

3. REVIEW OF LITERATURE

Mary Francis J and Rathika (2015) directed their study towards determination of efficient portfolios within an asset class (e.g., stocks) which can be achieved with the Single index (beta) model proposed by Sharpe. They applied Sharpe's single-index model on the monthly closing prices of 10 companies listed in NSE and CNX PHARMA price index for the period from September 2010 to September 2014. By applying the excess return to beta ratio to measure the additional return on a security (excess of the riskless assets return) per unit of systematic risk or non-diversifiable risk the relationship between potential risk and

reward of optimum portfolio when short sales are not allowed , they concludes that selection of scrips to be included in the portfolio may be limited since positive excess retun to beta may not be there for all the securities in spite of their ability to produce returns more than cut off rate fixed.

Keller, Wouter J (2014) combines the Modern Portfolio Theory (MPT) as developed by Markowitz (1952) model with generalized momentum (Keller 2012) in order to arrive at a "tactical" MPT before using the single index model (Elton, 1976) to arrive at an analytical solution for a long-only maximum Sharpe allocation and calls this the Modern Asset Allocation (MAA) model. The study relies on Single index model where the distinction between the systematic effect, which relates the return of an asset to the return of a single market index (like the EW index) through the so-called "beta" coefficient on the one side and the residual (or idiosyncratic or non-systematic) effect on the other. By using this simple model the study was able to reduce the number of parameter estimates from the N x N covariance matrix of the returns to the more manageable N beta's, where N is the number of assets in the universe. Allowing for maximum diversification and relying on a restricted co-variance matrix assumption of single index model, the momentum and shrinkage are handled in an appropriate way to run back tests over a 16 year period (1998-2013) to prove that the models experimented beat equal weights in terms of risk return statistics.

Nalini, R. (2014) examined the impact of a single market index on the different companies' stocks included in the index. Her empirical study aimed at applying Sharpe's single index model for constructing an optimal portfolio and understanding the effect of diversification of investments. The study based on secondary data of all the 30 companies listed in the BSE and Sensex being used as the benchmark index found that that even companies with high rates of return cannot be included in the portfolio as the risk involved in such companies was high. The study covering data for a 7- year period (2005-2012) showed that by using the single index model, the investors can minimize their overall risk and maximize the returns over a period of time and also proved that SIM has been useful to create an optimal portfolio by diversifying almost all the unsystematic risks. In spite of analyzing the single index model from different perspectives the study overlooked the simple explanation of linear regression of excess return on a security to the bench mark index, let alone be the unsystematic and systematic error representing the firm and the industry.

Gautam, Jayant and Singh, Saurabh, (2014) evaluated the performance of six Indian banks by using CAMEL Model. They rated HDFC Bank Ltd. as first and found it to be performing well among its peers. On the other hand, they found Bank of India though rated third needs attention of supervisors. The study inclined to discriminant analysis using the important ratios helped in predicting financially unstable banks. Though their results shows that discriminant analysis is useful in predicting bank failure one year prior to merger, this study undertaken from a different perspective, remain silent on share prices of banks and their volatility to sectoral indices pertaining to the banking sector. However since the study has highlighted both the banks currently having the highest and lowest market capitalization in the NSE Nifty bank sector paved way for identifying the research gap of single index model evaluation of HDFC Bank Stock and Bank of India Stock with Nifty Bank Index as the benchmark.

Sen, Tushar (2010) examines the scope of building an optimal portfolio using Sharpe Index model by designing a model that involves extensive mathematical explanation before applying them on 100 scrips of S&P CNX 500. He compares two different portfolios one by short selling and the other by sieving certain securities out of the investment basket. By setting a cut off rate for inclusion in portfolio and eliminating scrips with a negative beta optimal portfolios are created with and without allowing short sales. The major finding was that all scrips that were sieved out of the portfolio when short selling wasn't allowed are the scrips that are to be short sold when short selling is allowed. In spite of special reference being made of the scrip HDFC Bank that incurs a heavy reduction in weightage, when short selling is allowed compared to when short selling is not allowed, the study keeps a close eye on single index model in evaluating individual scrips before being selected or disregarded in inclusion to the portfolio.

Christoffersen Peter, Jacobs Kris and Vainberg Gregory (2008) in their work Forward-Looking Betas question the existing approaches on computation of market betas using historical data by calling such

methods as backward looking. They argue for employing information embedded in the prices of individual stock options and index options to compute a forward-looking market beta at the daily frequency which contain information relevant for forecasting future betas that is not contained in historical betas. Their discussion hovers over factor models, beta estimation and computation of moments of stock returns from option prices. They conclude by presenting a radically different approach that extracts beta from option data and rejects historical simple rolling regression and time varying approaches to beta. They are of the opinion that no matter however sophisticated the approach; historical betas implicitly assume that the past offers a good guide to the future. By focusing mainly on the forecasting of short term beta for calculation of abnormal returns and inclining to options than security returns, they undermine the use of single index model and its significance in determination of beta that signifies the systematic risk in investment in securities.

Ferguson, Robert (1975) explained how individual efforts of analysts at forecasting returns translate into improved portfolio performance by redefining respective roles of analysts and portfolio managers and quantifying aspects as activities and aggressiveness. Besides discussing security and portfolio characteristics, he differentiates talent from luck by examining results averaged over many periods. Though his empirical analysis contributes much to potentials of describing a portfolio that can beat index funds in terms of diversification, limitations of short selling, borrowing and the Sharpe ratio as well as transaction costs, the effectiveness of a single index model have not been pronounced in the study.

4. OBJECTIVES

The study is basically aimed at identification and explanation of the returns and risks associated with a particular security and its relationship to the general market which can be specifically benchmarked on its industry or sector often indicated by a sectoral index. The specific objectives are listed below.

1. To identify and explain the linear relationship, using single index model, between returns from a security and the general indicator of the sector to which it belongs, denoted by the sectoral index.
2. To analyse how far the returns of a high market capitalized and a low market capitalized security is sensitive to the movements in the sector index.
3. To examine and fit a trend line of predicted excess returns to the actual excess returns, excess being the return over and above risk free return in the market.

5. METHODOLOGY

The Single index model was experimented upon using the scrip with the highest market capitalization in a particular sector index of NSE. The chosen sectoral index was the Nifty Bank Index which is computed using free float market capitalization method of prices of 12 leading Public Sector and private sector banks in India, with base date of Jan 1, 2000 indexed to base value of 1000. The level of the index reflects total free float market value of all the stocks in the index relative to a particular base market capitalization value. The method also takes into account constituent changes in the index and importantly corporate actions such as stock splits, rights, new issue of shares etc. without affecting the index. The Nifty Bank Index represent about 15.6% of the free float market capitalization of the stocks listed on NSE and 93.3% of the free float market capitalization of the stocks forming part of the Banking sector universe as on March 31, 2016.

Table 1 depicts the composition of Nifty Bank Index and market capitalization of securities included all of them representing the financial services industry.

Table 1 Ranking of Banks comprising NIFTY BANK INDEX based on market Capitalization

Sl. No	Company Name	Series	ISIN Code	Market Capitalization on 26 Aug 2016 (Rs. Millions)	Rank
1	Axis Bank Ltd.	EQ	INE238A01034	1412.86	5
2	Bank of Baroda	EQ	INE028A01039	376.14	8
3	Bank of India	EQ	INE084A01016	107.09	12
4	Canara Bank	EQ	INE476A01014	148.10	10
5	Federal Bank Ltd.	EQ	INE171A01029	116.09	11
6	HDFC Bank Ltd.	EQ	INE040A01026	3200.48	1
7	ICICI Bank Ltd.	EQ	INE090A01021	1449.77	3
8	IndusInd Bank Ltd.	EQ	INE095A01012	712.00	6
9	Kotak Mahindra Bank Ltd.	EQ	INE237A01028	1424.57	4
10	Punjab National Bank	EQ	INE160A01022	248.49	9
11	State Bank of India	EQ	INE062A01020	1972.52	2
12	Yes Bank Ltd.	EQ	INE528G01019	566.42	7

HDFC Bank Ltd stood highest among the firms included in the index with a market capitalization of Rs. 3200.48 millions.. Being the top in market capitalization, the HDFC Bank Ltd was selected for single index model analysis using micro soft excel, while Bank of India with the lowest market capitalization was included to analyse the sensitivity of the model to different securities. The monthly historical price data of securities of both the HDFC Bank and Bank of India (BOI) as well as monthly historical data of Nifty Bank index were made available from http://in.investing.com/equities. The data pertaining to a five year ranging from 1st April 2011 to 31st March 2016 prefixed by a month's data of March 2011 was used in computation of raw return of both the selected scrips and index on a monthly basis. The raw return was computed as

$$R = (P_t/P_{t-1})-1,$$

where, R= Return, P_t= Price at time period t and P_{t-1}= Price at previous time period, the time period being month in this case, signifying current months price divided by earlier months price minus 1.

The risk free return for the period under study was taken as 0.0756 since Interbank Rate in India averaged 7.56 percent from 1993 until 2016, reaching an all time high of 12.97 percent in July of 1995 and a record low of 3.10 percent in July of 2009. Interbank Rate in India is reported by the Reserve Bank of India. (Source: http://www.tradingeconomics.com/india/interbank-rate). The tail of distribution of observed data, its skewness, moments and jarque-bera analysis etc. were keptout of the purview of discussion. However unit root tests to ensure the non existence of co-variance between the returns of the selected security and the benchmark index was ensured before experimenting the single index model.

The results of analysis of the security of the highly market capitalized HDFC Bank is detailed so as to explain the calculations involved and interpretations of the results in a comprehensible manner even to a layman investor. The repetitive analysis on low market capitalization security of Bank of India has only been summarized. In both the cases, the regression output, ANOVA results and test statistics have been presented along with graphical presentation of trend line of predicted excess return values fitted on actual excess returns plotted.

6. EXPERIMENTAL RESULTS

6.1 HDFC Bank Stock and Nifty Bank Index – Single Index Model

The excess return of both HDFC bank stock and Nifty Bank index was computed as the excess of raw return over risk free return before regression analysis of the single index model was applied. Table 2 depicts the descriptive statistical parameters of individual variables, pertaining to excess returns of HDFC Bank stock and Nifty Bank Index.

Table 2 Descriptive Statistics of Excess Returns (HDFC & Nifty Bank)

	Excess Returns (Raw Returns –Risk Free Returns)	
	HDFC BANK STOCK	**NIFTY BANK INDEX**
Mean	-0.070301	-0.067006
Median	-0.068146	-0.071312
Maximum	0.077264	0.169209
Minimum	-0.618478	-0.218303
Standard Deviation - monthly	0.092102	0.082284
Annualized SD (SD X √12)	0.31905	0.285039
Variance- monthly	0.008483	0.006771
Annualized Variance (Variance X 12)	0.101793	0.081247
Skewness	-3.372321	0.590528
Kurtosis	22.12844	3.378425
Jarque-Bera	1028.469	3.845243
Probability	0.000000	0.146223
Sum	-4.218087	-4.020346
Sum Sq. Dev.	0.500483	0.399464
Observations	60	60

It is worth noting that mean and median of observations for the selected security and index were negative, and the standard deviations accounted for less than 10% in both the cases. The single index model, which is arrived at when the excess return on the market is regressed at the excess return on the security, may be implemented now. However before implementation, the crucial assumption of zero covariance between the variables namely excess returns on a selected security and the single index selected is ensured through group unit root test using the software EViews 9. The results are shown in table 3.

Table 3 Group unit root test: Summary

Series: HDFC_EXR, NIBK_EXR Sample: 1 61 Exogenous variables: Individual effects Automatic selection of maximum lags Automatic lag length selection based on SIC: 0 Newey-West automatic bandwidth selection and Bartlett kernel				
Balanced observations for each test				
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-10.1352	0.0000	2	118
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-9.04433	0.0000	2	118
ADF - Fisher Chi-square	65.3508	0.0000	2	118
PP - Fisher Chi-square	65.1412	0.0000	2	118
** Probabilities for Fisher tests are computed using an asymptotic Chi				
-square distribution. All other tests assume asymptotic normality.				

The null hypotheses of existence of unit root for both the variables representing excess returns on HDFC Bank Stock (HDFC_EXR) and Nifty Bank Index (NIBK_EXR) were rejected since p values were 0 at 5% significance level that tended to be below 0.05. Thus the existence of co-variance and non stationary nature of both the data series were ruled out completely.

The results of the regression analysis are tabulated as table 4 below

Table 4 SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.61812097
R Square	0.38207353
Adjusted R Square	0.37141963
Standard Error	0.0730212
Observations	60

The regression statistics namely multiple R indicate that the security HDFC Bank stock tracks the NSE Nifty Bank Index fairly closely as is represented by a pretty high multiple R of 0. 61812097. The coefficient of determination R square standing at 0.38207353 throws light on the fact that 38.21% of the variations in excess returns of HDFC Bank's security is explained by variations in the excess returns of Nifty Bank Index. The adjusted R square that adjusts for estimation errors is slightly lower than R square which is obvious since the estimates would rather vary from actual values. The standard deviation of the residual return indicated by the standard error stood at 0.073. The same is checked for correctness by calculating the standard deviation of residual output provided by the regression analysis. Table 5 is devoted to tabular presentation of the residual output, its standard deviation and mean.

Table 5 RESIDUAL OUTPUT

Observation	Predicted Y	Residuals	Observation	Predicted Y	Residuals
1	-0.08935169	-0.00769043	31	0.05722103	0.015142888
2	-0.10413658	0.073841628	32	-0.0954966	-0.00874612
3	-0.06219768	0.034940076	33	-0.0619001	-0.0068195
4	-0.09784445	-0.01017391	34	-0.1459807	0.014287033
5	-0.16263978	0.056534444	35	-0.0406358	0.030429595
6	-0.08097218	-0.00373896	36	0.0508422	-0.00816263
7	-0.03815098	0.010343136	37	-0.0700684	-0.04225702
8	-0.17498037	0.002441593	38	0.02802764	-0.00457038
9	-0.12435288	0.013385647	39	-0.0552715	0.016000797
10	0.09313043	-0.01586643	40	-0.075081	0.014635285
11	-0.04173901	0.01694169	41	-0.0548218	-0.00932729
12	-0.08963113	0.01934925	42	-0.0915507	0.050447784
13	-0.07190845	0.039878708	43	-0.0019547	-0.02872465
14	-0.13251717	-0.00999527	44	-0.0166558	-0.00926497
15	-0.01031736	0.048012501	45	-0.0678949	-0.01350355
16	-0.07334043	0.040682496	46	-0.0353663	0.09191223
17	-0.1024726	0.039803264	47	-0.0815664	0.000258003
18	0.02529884	-0.04412551	48	-0.1284093	0.007532983
19	-0.08760095	0.020027648	49	-0.0712523	-0.03749522
20	-0.0215976	0.055978676	50	-0.0617879	0.048637418
21	-0.05830326	-0.05330782	51	-0.0919634	0.032164645
22	-0.06324951	-0.06473775	52	-0.0598451	0.02594496
23	-0.14273449	0.039609413	53	-0.1347344	-0.01660884
24	-0.08380641	0.008206408	54	-0.0734331	0.038078404
25	-0.00319214	0.018661141	55	-0.0706937	0.023911081
26	-0.08097889	0.032053374	56	-0.0732216	-0.02224919

Observation	Predicted Y	Residuals	Observation	Predicted Y	Residuals
27	-0.12385294	0.003998838	57	-0.0964199	0.024902532
28	-0.1716266	0.00678089	58	-0.1334795	0.028031533
29	-0.14301585	0.041585592	59	-0.1464943	-0.47198316
30	-0.03277399	-0.04442534	60	0.03265819	-0.15159965
Standard Deviation of Residuals			0.072399728		
Variance of Residuals			0.005241721		
Mean of Residuals			0.00		

The unsystematic risk is calculated as the variance of the residuals which stood at 0.005242 and the mean of the residuals turned out to be zero indicating that on an average, there is no residual return. Further results of ANOVAs are verified against the variance of excess returns of HDFC Bank stock. Table 6 depicts the results of ANOVAs.

Table 6 ANOVA

	df	SS	MS	F	Significance F	
Regression	1	0.19122119	0.191221	35.8623006	1.4237E-07	
Residual	58	0.30926151	0.005332			
Total	59	0.50048271				
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	-0.0239416	0.01219829	-1.96271	0.05448261	-0.04835920	0.00047
X Variable 1	0.6918773	0.11553406	5.988514	0.0000	0.46061079	0.92314

The monthly variance of excess returns of HDFC Bank stock earlier calculated in table 2 as 0.008483 is verifiable by dividing the Total Sum of Squares (Total SS) by degrees of freedom.

Variance = Total Sum of Squares/ degrees of freedom = 0.500482711/ 59 = 0.008483

Similarly the unsystematic risk calculated as variance of the residuals in table 5 amount to 0.005241 is verified from the ANOVA results as follows. Since the unsystematic risks arises from the residuals it can be calculated as

Unsystematic Risk = Sum of Squares of residuals/ degrees of freedom

= 0.309261514/ 59 = 0.005241721

The systematic risk for HDFC Bank Stock can be calculated using the index model. As per the index model the systematic risk of a security is Beta squared times the variance of the market. The Beta value from ANOVA table can be obtained as the coefficient of X variable 1 which is 0.69187734 and the variance of the market from table 2 is 0.006771

Systematic Risk = β^2 x Variance of the market = 0.69187734 ^ 2 x 0.006771 = 0.003241

Alternatively the systematic risk of a security can be calculated using ANOVA results as follows

Systematic Risk = Sum of Squares for the regression / degrees of freedom

= 0.191221197/ 59 = 0.003241

The single index model can be validated by further verifying the value of R squared from ANOVA results as follows

R Squared = Sum of squares of regression / Total Sum of Squares

= 0.191221197/ 0.500482711 = 0.382074

Alternatively, R Squared = 1 – (Sum of Squares of Residuals/ Total Sum of Squares)

= 1 – (0.309261514/ 0.500482711 = 0.382073531

Now it's time to move on to alpha and Beta estimates. The following hypotheses are formulated.

Null Hypothesis The intercept term $\alpha = 0$

Alternative Hypothesis The intercept term $\alpha \neq 0$

The p value (see table 5) of 0.054 indicates that there is a chance of getting a slightly higher than 5% intercept at a 5% significance level which favours acceptance of null hypothesis. This leads to the conclusion that alpha is insignificant and tends to be zero. The lower 95% to upper 95% range between which the actual alpha values lies observed as -0.048359209 to 0.000476 reflects the uncertainty of estimates which explains the lower adjusted R squared values.

The following hypotheses are tested to decide the significance the value of slope or Beta β in the regression equation.

Null Hypothesis The slope term, i.e. coefficient of X variable 1, $\beta = 0$

Alternative Hypothesis The slope term, i.e. coefficient of X variable 1, $\beta \neq 0$

The p value of 0.0000 at 5% significance level rejects the null hypothesis and states that β is significant. It may thus be concluded that HDFC Bank's excess return is obtained mostly from its sensitivity to a change in the excess market returns. Though alpha is preferable there is no significant alpha which indicates that there is no non market premium for HDFC for this range of period.

Figure 1 illustrates the actual and predicted excess returns on HDFC Bank Stock and the the linear trend of predicted excess returns.

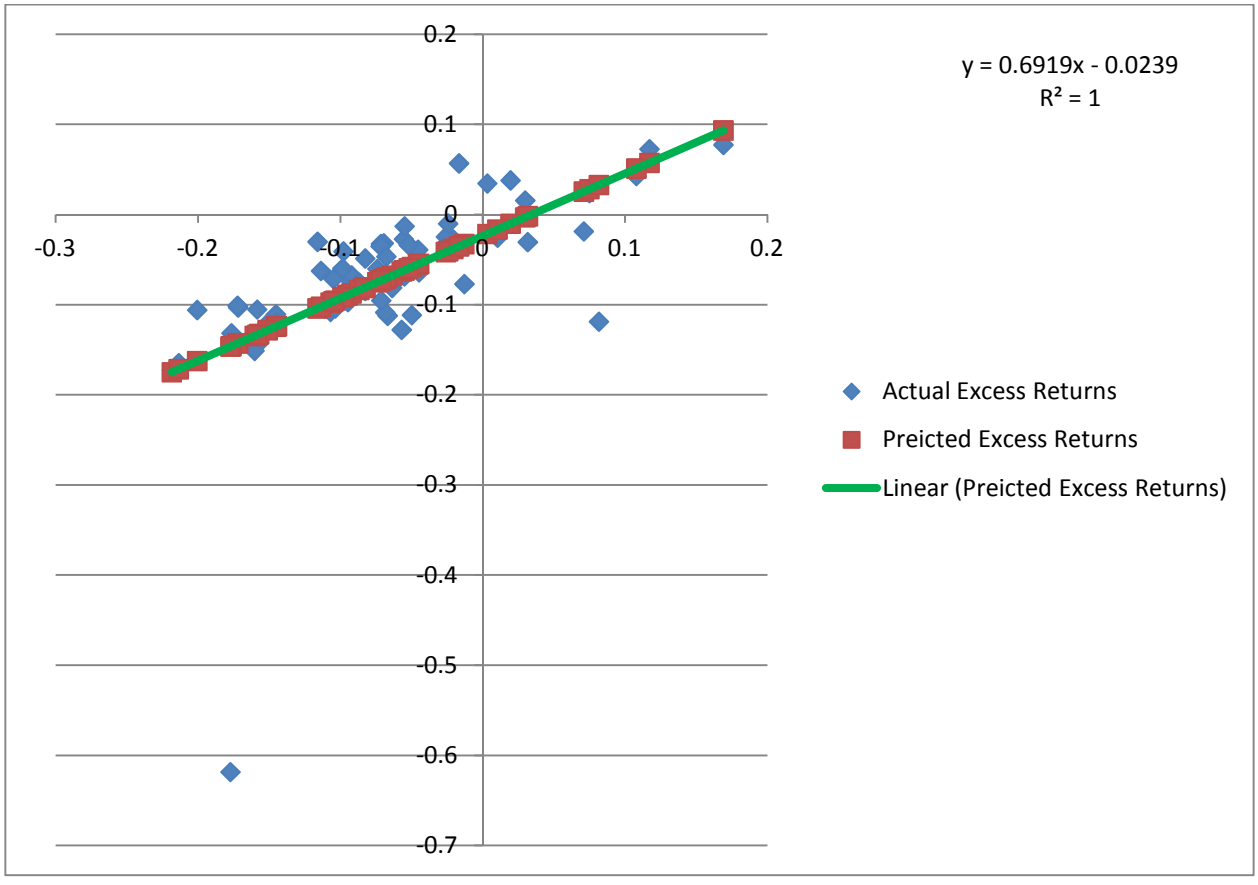

Figure 1 Actual and Linear trend Predicted Excess Returns of HDFC Bank Stock

It may be concluded that a linear regression equation y = 0.691x - 0.023 is applicable to HDFC Bank Stock and perfect fit is indicated by a $R^2 = 1$ value. A flattened or nearly still index movement of Nifty Bank Index can decrease the HDFC Bank Stock prices negligibly since the value is near zero at -0.023. A

β slope value of 0.691 indicates that a rise or fall in Nifty Bank Index will lead to a 69.1% change correspondingly in the HDFC Bank Stock prices.

6.2. Bank of India Stock and Nifty Bank Index – Single Index Model

The excess return of both Bank of India stock and Nifty Bank index was computed as the excess of raw return over risk free return before regression analysis of the single index model was applied. Table 7 depicts the descriptive statistical parameters of individual variables, pertaining to excess returns of Bank of India stock and Nifty Bank Index.

Table 7 Descriptive Statistics of Excess Returns BOI & Nifty Bank)

	Excess Returns (Raw Returns –Risk Free Returns)	
	BOI STOCK	**NIFTY BANK INDEX**
Mean	-0.092395	-0.067006
Median	-0.109348	-0.071312
Maximum	0.257928	0.169209
Minimum	-0.305161	-0.218303
Standard Deviation - monthly	0.140970	0.082284
Annualized SD (SD X □12)	0.488336	0.285039
Variance- monthly	0.019873	0.006771
Annualized Variance (Variance X 12)	0.238472	0.081247
Skewness	0.882239	0.590528
Kurtosis	3.233159	3.378425
Jarque-Bera	7.919358	3.845243
Probability	0.019069	0.146223
Sum	-5.543723	-4.020346
Sum Sq. Dev.	1.172486	0.399464
Observations	60	60

Table 8 below shows the results of group unit root test using the software E Views 9.

Table 8 Group unit root test: Summary

Series: BOI_EXR, NIBK_EXR				
Sample: 1 61				
Exogenous variables: Individual effects				
Automatic selection of maximum lags				
Automatic lag length selection based on SIC: 0				
Newey-West automatic bandwidth selection and Bartlett kernel				
Balanced observations for each test				
			Cross-	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-9.64168	0.0000	2	118
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-9.17237	0.0000	2	118
ADF - Fisher Chi-square	66.4216	0.0000	2	118
PP - Fisher Chi-square	66.0275	0.0000	2	118
** Probabilities for Fisher tests are computed using an asymptotic Chi				
-square distribution. All other tests assume asymptotic normality.				

The results of the regression analysis of BOI Stock and Nifty Bank Index are tabulated as table 9 below

Table 9 SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.823841
R Square	0.678715
Adjusted R Square	0.673175
Standard Error	0.080591
Observations	60

The regression statistics namely multiple R indicate that the security Bank of India stock tracks the NSE Nifty Bank Index very closely as is evident from a pretty high multiple R of 0.823841. The coefficient of determination R square standing at 0.678715throws light on the fact that 67.87% of the variations in excess returns of HDFC Bank's security is explained by variations in the excess returns of Nifty Bank Index. Again as in the case of HDFC Bank analysis, the adjusted R square that adjusts for estimation errors is slightly lower than R square which is obvious since the estimates would rather vary from actual values. The standard deviation of the residual return indicated by the standard error stood at 0.080591.

Table 10 depicts the results of ANOVAs of BOI and Nifty Bank Index.

Table 10 ANOVA

	df	SS	MS	F	Significance F	
Regression	1	0.795783	0.795783	122.524950	6.29476E-16	
Residual	58	0.376702	0.006495			
Total	59	1.172486				
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	0.002178	0.013463	0.161807	0.87201981	-0.024770327	0.02912
X Variable 1	1.411427	0.127511	11.0691	0.0000	1.156187149	1.66666

From the above ANOVA table it can be observed that alpha value of the intercept is not significant and the null hypothesis that $\alpha = 0$ cannot be rejected since its p value is 0.872 much above the 0.05 required for a 5% significance level. In the case of β value of 1.4111 the null hypothesis that $\beta = 0$ is rejected since p value is 0.0000 lesser than 0.05 corresponding to the significance level applicable. The unsystematic risk of the BOI stock calculated as the variance of residuals stands at 0.006384785.

Figure 2 below illustrates the actual and predicted values and trend line of BOI stock excess return predicted excess value and bank nifty excess returns

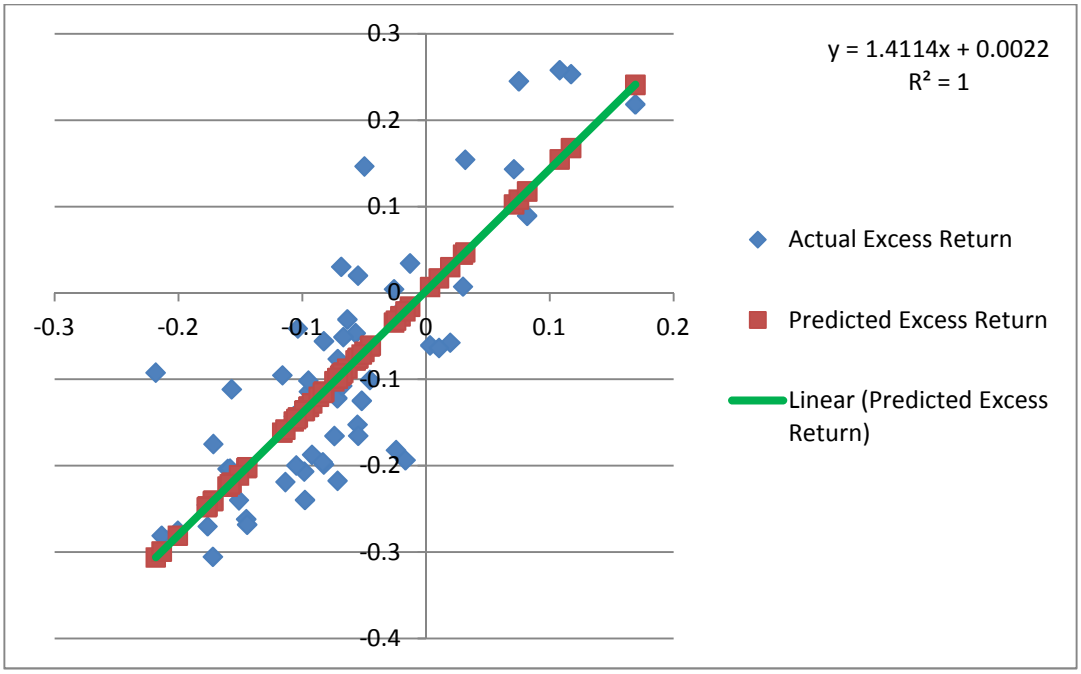

Figure 2 Actual and Linear trend Predicted Excess Returns of HDFC Bank Stock

7. CONCLUSION

The single index model applied on securities with highest and lowest market capitalization banking sector companies in India namely HDFC Bank and Bank of India (BOI) with the sector index to which they belong namely Nifty Bank Index revealed that the security of lowest market capitalization company BOI is more volatile to sector index changes. While a rise or fall in sectoral index is followed by a 141% change in BOI stock returns, the highly market capitalized bank sector stock namely HDFC Bank stock reported a 69.1% volatility to Nifty Bank Index changes. It was also observed that a flat or nearly still Nifty Bank Index causes HDFC Bank stock to decline by 2.3% such a situation could increase the BOI stock return though negligibly by 0.2%. The unsystematic risk and systematic risk amounts to be 0.005242 and 0.003241 respectively for HDFC Bank Stock while the same amounts to 0.006385 and 0.013488 respectively for BOI stock returns.

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