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Static Systematic Risk Profile of Nifty 100 Stocks: A Year on Year Analysis of Beta

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Abstract:

Beta Coefficient, as a measurement statistic of systematic risk of securities, was initially explained by Sharpe as a slope of simple linear regression function using rate of return on a market index as independent variable and a security's rate of return as dependent variable. National Stock Exchange (NSE), the leading stock exchange of India, practice this ordinary least square (OLS) regression based single index market model for disseminating beta coefficients of prominent NIFTY 100 stocks. OLS regression based index model presumes that beta coefficients of securities should remain stable for accuracy of predicted returns. Brenner and Smidt (1977) emphasized the importance of having accurate beta forecast mainly because of (i) understanding risk-return relationships in capital market theory and (ii) extensive usage of beta in making investment decisions. The objective of this paper is to examine year on year stability of beta coefficients of NIFTY 100 index stocks.

Keywords: Systematic Risk, Beta, Single Index Market Model, NIFTY 100 Index

JEL Classification: E44, C12, C58, G11

Introduction

Risk is a complex concept and its implications have long been discussed and debated in academic and corporate communities. In the domain of portfolio management, risk of holding stocks is associated with a deviation of realised return from earlier anticipated return by a portfolio manager. Portfolio managers and traders, while making position in the capital market, are exposed to broadly two types of risk i.e., systematic and unsystematic. In finance literature, systematic risk is unpredictable in nature and driven by economic wide uncertainties that affect the overall market. Unlike unsystematic or firm specific risk, diversification of portfolio fails to reduce systematic risk as it affects the market as a whole. Economic, political and even social events those are external to the firm affect almost all the industries simultaneously and, therefore, investors cannot mitigate the risk arising out of those events. Elton, Gruber, Brown, and Goetzmann (2003) mentioned, "For every well-diversified portfolio, non-systematic risk tends to go to zero and the only relevant risk is systematic risk measured by beta". Sharpe (1963), the originator of beta coefficient in a single index market model (SIMM), explained beta as the slope term in the simple linear regression function using rate of return on a market index as independent variable and a security's rate of return as dependent variable. Markowitz (1959) and Sharpe (1963) initially suggested that single-period stock price changes could be explained by single index market model as per following equation:

$$R_{it} = \alpha_i + \beta_i R_{mt} + e_{it} \quad \ldots\ldots (1)$$

where,

R_{it} is one period rate of return without compounding for i^{th} stock for time period t.

R_{mt} denotes one period rate of change in stock market index for time period t.

α_i is alpha, a regression intercept for the ith stock.

β_i reflects beta, regression coefficient of ith stock, which measures its systematic risk.

e_{it} denotes residual error with zero expectation.

As per SIMM, residuals are simply the difference between the actual and estimated values of stock returns. The term eit , as a non-systematic component, is a proxy for all the omitted or neglected variables which may affect dependent variable (return on stock) but cannot be taken

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into account explicitly. As SIMM is based on ordinary least square (OLS) regression, it envisages the following econometric properties:

- The conditional mean value of residuals equals zero with homoscedasticity.
- α_i and β_i are the regression parameters to be estimated in such a way that minimises sum of squared residuals. OLS explains the sum of squared residuals, for the line, is minimised for which:

$$\beta i = \frac{n\sum R_{mt} R_{it} - \sum R_{mt} \sum R_{it}}{n\sum R_{mt}^2 - (\sum R_{mt})^2} \quad \text{.....(2)}$$

or $\beta_i = Covar_{i,m} / (\sigma_m)^2$ .....(3)

where, $Covar_{i,m}$ is covariance of stock i and market returns, and σ_m is standard deviation of market returns.

- β_i, as a slope of linear regression line, is a constant statistic or systematic risk of a stock is constant through time.

The last mentioned property of SIMM attracted a lot of criticism and debate in finance community since its inception by Sharpe. Rosenberg and Guy (1976a, 1976b) emphasised that the systematic risk of the stock of company to vary through time. Such variation may take place due to the influence of either microeconomic factors or macroeconomic factors. Jacob (1971), Mandelker (1974), Blume (1975), Fabozzi and Francis (1978), Keim and Stambaugh (1986), Ferson (1989), and Breen, Glosten, and Jagannathan (1989) also supported for the hypothesis that systematic risk varies through time.

On the contrary, Ghysels (1998) examined various parametric time varying beta models, including models proposed by Ferson (1989), Ferson and Harvey (1991, 1993), and Ferson and Korajczyk (1995), and concluded that these well-known alternative models are less precise than the constant beta model.

Roll and Ross (1994) pointed out that the choice of market index that is used for beta estimation affects beta values of stocks. Daves, Ehrhardt, and Kunkel (2000) proposed that daily return intervals should be used for beta estimation as this practice increases the precision of beta. Sanghi and Bansal (2011) proved that beta estimation practice of NSE had reliability biasness towards aggressive stocks. Brenner and Smidt (1977) emphasized the importance of having accurate beta forecast mainly because of two counts: (i) understanding risk-return relationships in capital market theory and (ii) extensive usage of beta in making investment decisions.

Beta Estimation Practice of National Stock Exchange (NSE)

According to NSE website, "The National Stock Exchange (NSE) is the leading stock exchange in India and the fourth largest in the world by equity trading volume in 2015, according to World Federation of Exchanges (WFE). NSE was the first exchange in India to implement electronic or screen-based trading. It began operations in 1994 and is ranked as the largest stock exchange in India in terms of total and average daily turnover for equity shares every year since 1995, based on annual reports of SEBI" (NSE, n.d. –a).

NSE describes beta as "....the systematic risks of various securities differ due to their relationships with the market. The beta factor describes the movement in a stock's or a portfolio's returns in relation to that of the market returns. For all practical purposes, the market returns are measured by the returns on the index (NIFTY, mid-cap etc.), since the index is a good reflector of the market" (NSE, n.d. –b).

NSE further suggests that beta coefficient should be estimated as per equation 3 mentioned above and, therefore, it is precisely evident that NSE uses SIMM for disseminating beta values of prominent stocks on its official website.

NSE regularly publishes beta coefficients of NIFTY 50 and NIFTY Next 50 indices stocks (collectively known as NIFTY 100 index stocks) on its website and revises them on monthly intervals. Beta coefficients, as a standard practice of NSE, are estimated on the basis of daily paired observations of return on market index and stock's return over a period of one year.

Objective of the Study

As mentioned above, NSE disseminates beta coefficients of NIFTY 100 stocks for different stakeholders like traders, investors, members, practitioners and academicians. Stakeholders use this information for making position in stocks or designing portfolio as per their inherent systematic risk. Stakeholders presume that future volatility of stocks is likely to be in line with their respective historic beta coefficients and the values of beta coefficients are not going to change significantly at least in near future.

It, therefore, becomes important to investigate year on year stability in beta coefficients of NIFTY 50 and NIFTY Next 50 stocks. The following six hypotheses have been developed in this context:

Hypothesis 1:

Null hypothesis (Ho): $\mu (\beta_{NIFTY50\ FY2013} - \beta_{NIFTY50\ FY2014}) = 0$

Alternate hypothesis (H1): $\mu (\beta_{NIFTY50\ FY2013} - \beta_{NIFTY50\ FY2014}) \neq 0$

where, $\beta_{NIFTY50\ FY2013}$ is beta coefficient of NIFTY 50 stock estimated for financial year 2012-13 and $\beta_{NIFTY50\ FY2014}$ is beta coefficient of NIFTY 50 stock estimated for financial year 2013-14. $\mu (\beta_{NIFTY50\ FY2013} - \beta_{NIFTY50\ FY2014})$ is population mean of the difference between paired beta coefficients of NIFTY 50 stocks estimated for financial year 2012-13 and 2013-14.

Likewise,

Hypothesis 2:

Null hypothesis (Ho): $\mu (\beta_{NIFTY50\ FY2014} - \beta_{NIFTY50\ FY2015}) = 0$

Alternate hypothesis (H1): $\mu (\beta_{NIFTY50\ FY2014} - \beta_{NIFTY50\ FY2015}) \neq 0$

and,

Hypothesis 3:

Null hypothesis (Ho): $\mu (\beta_{NIFTY50\ FY2015} - \beta_{NIFTY50\ FY2016}) = 0$

Alternate hypothesis (H1): $\mu (\beta_{NIFTY50\ FY2015} - \beta_{NIFTY50\ FY2016}) \neq 0$

whereas,

Hypothesis 4:

Null hypothesis (Ho): $\mu (\beta_{NIFTY\ Next50\ FY2013} - \beta_{NIFTY\ Next50\ FY2014}) = 0$

Alternate hypothesis (H1): $\mu (\beta_{NIFTY50\ Next50\ FY2013} - \beta_{NIFTY\ Next50\ FY2014}) \neq 0$

where, $\beta_{NIFTY\ Next50\ FY2013}$ is beta coefficient of NIFTY Next 50 stock estimated for financial year 2012-13 and $\beta_{NIFTY\ Next50\ FY2014}$ is beta coefficient of NIFTY Next 50 stock estimated for financial year 2013-14. $\mu (\beta_{NIFTY\ Next50\ FY2013} - \beta_{NIFTY\ Next50\ FY2014})$ is population mean of the difference between paired beta coefficients of NIFTY Next 50 stocks estimated for financial year 2012-13 and 2013-14.

Similarly,

Hypothesis 5:

Null hypothesis (Ho): $\mu (\beta_{NIFTY\ Next50\ FY2014} - \beta_{NIFTY\ Next50\ FY2015}) = 0$

Alternate hypothesis (H1): $\mu (\beta_{NIFTY\ Next50\ FY2014} - \beta_{NIFTY\ Next50\ FY2015}) \neq 0$

and,

Hypothesis 6:

Null hypothesis (Ho): $\mu (\beta_{NIFTY\ Next50\ FY2015} - \beta_{NIFTY\ Next50\ FY2016}) = 0$

Alternate hypothesis (H1): $\mu (\beta_{NIFTY\ Next50\ FY2015} - \beta_{NIFTY\ Next50\ FY2016}) \neq 0$

Data Collection and Methodology

- The population for this study is NIFTY 100 index stocks. Those stocks are prominent in nature as NSE mentions, "NIFTY 100 is a diversified 100 stock index representing major sectors of the economy. NIFTY 100 represents top 100 companies based on full market capitalisation from NIFTY 500. This index intends to measure the performance of large market capitalisation companies. The NIFTY 100 tracks the behaviour of combined portfolio of two indices viz. NIFTY 50 and NIFTY Next 50. The NIFTY 100 Index represents about 77% of the free float market capitalisation of the stocks listed on NSE as on March 31, 2016. The total traded value for the last six months ending March 2016 of all index constituents is approximately 61% of the traded value of all stocks on the NSE" (NSE, n.d. –c).
- SIMM based beta coefficients of 72 sample stocks have been compiled from official website of NSE for four years i.e., financial year 2012-13 to 2015-16.
- The sample included those stocks which have been the constituents of either NIFTY 50 or NIFTY Next 50 (earlier known as NIFTY Junior) indices in all four years consecutively. The sample of 72 stocks has been divided into two subsets i.e., (i) 42 stocks of NIFTY 50 index and (ii) 30 stocks of NIFTY Next 50 index (Table1).
- The beta coefficients of stocks, for both the sample subsets, have been compared on year on year basis and for that six hypotheses, as mentioned above, have been tested through paired t test to ascertain stability in beta.

Table 1: Beta Coefficients of NIFTY 50 and NIFTY Next 50 Sample Stocks

Beta Coefficients of NIFTY 50 Sample Stocks					
S. No.	**Stock Symbol**	**βNIFTY50 FY2013**	**βNIFTY50 FY2014**	**βNIFTY50 FY2015**	**βNIFTY50 FY2016**
1	ACC	0.78	0.93	1.11	0.82
2	AMBUJACEM	0.94	0.96	1.35	1.00
3	ASIANPAINT	0.65	0.84	0.90	0.86
4	AXISBANK	1.52	1.72	1.44	1.43
5	BAJAJ-AUTO	0.63	0.78	0.52	0.91
6	BANKBARODA	1.49	1.61	1.45	1.58
7	BHARTIARTL	0.77	1.14	0.56	0.65
8	BHEL	1.50	1.39	1.66	1.28
9	BPCL	0.67	1.19	1.31	0.85
10	CAIRN	0.70	0.40	1.06	1.55
11	CIPLA	0.53	0.46	0.73	0.98
12	COALINDIA	0.58	0.68	1.05	0.85
13	DRREDDY	0.19	0.47	0.37	0.78
14	GAIL	0.71	0.69	1.02	1.17
15	GRASIM	0.90	0.85	1.12	0.73
16	HCLTECH	0.78	0.33	0.37	0.82
17	HDFC	0.94	1.29	1.30	1.15
18	HDFCBANK	0.97	1.28	0.97	0.80
19	HEROMOTOCO	0.73	0.72	0.83	0.85
20	HINDALCO	1.63	1.20	1.61	1.64
21	HINDUNILVR	0.41	0.61	0.26	0.58
22	ICICIBANK	1.68	1.56	1.55	1.49
23	INFY	0.77	0.47	0.46	0.82
24	ITC	0.63	0.90	0.52	0.83
25	KOTAKBANK	0.98	1.31	0.87	1.09
26	LT	1.56	1.46	1.47	1.21
27	LUPIN	0.17	0.38	0.48	0.74
28	M&M	0.85	0.84	0.80	1.00
29	MARUTI	0.9	0.88	0.97	0.87
30	NTPC	0.63	0.73	1.06	0.86
31	ONGC	0.92	1.21	1.34	1.19
32	PNB	1.47	1.65	1.44	1.44
33	POWERGRID	0.66	0.60	0.90	0.61
34	RELIANCE	0.95	1.08	1.22	1.13
35	SBIN	1.52	1.15	1.57	1.47
36	SUNPHARMA	0.44	0.61	0.42	0.92
37	TATAMOTORS	1.58	1.03	1.46	1.53
38	TATAPOWER	1.16	0.98	1.56	1.08
39	TATASTEEL	1.46	1.26	1.43	1.62
40	TCS	0.48	0.51	0.51	0.61

41	ULTRACEMCO	0.40	0.92	1.24	1.00
42	WIPRO	0.66	0.26	0.51	0.61
Beta Coefficients of NIFTY Next 50 Sample Stocks					
S. No.	**Stock Symbol**	**βNIFTY Next50 FY2013**	**βNIFTY Next50 FY2014**	**βNIFTY Next50 FY2015**	**βNIFTY Next50 FY2016**
1	APOLLOHOSP	0.35	0.53	0.78	0.91
2	BAJAJHLDNG	0.41	0.25	0.43	0.41
3	BANKINDIA	1.40	1.96	1.85	1.67
4	BHARATFORG	0.93	0.82	1.10	1.22
5	CANBK	1.45	0.46	1.93	1.57
6	COLPAL	0.20	0.39	0.42	0.49
7	CONCOR	0.31	1.18	0.70	0.73
8	CUMMINSIND	0.55	0.48	0.77	0.82
9	DABUR	0.50	0.47	0.46	0.63
10	DIVISLAB	0.56	0.70	0.49	0.69
11	EXIDEIND	0.45	1.37	1.04	0.79
12	FEDERALBNK	0.78	0.73	1.37	1.15
13	GLAXO	0.06	0.36	0.17	0.44
14	GLENMARK	0.10	0.57	0.28	1.01
15	GODREJCP	0.21	1.12	0.85	0.82
16	GSKCONS	0.07	0.05	0.36	0.30
17	HINDPETRO	0.51	1.28	1.43	1.14
18	JSWSTEEL	1.63	1.63	1.41	1.00
19	LICHSGFIN	1.39	0.91	1.52	1.44
20	OFSS	0.67	0.67	0.48	0.63
21	PETRONET	0.47	1.64	0.69	0.76
22	PFC	1.57	1.74	2.04	1.48
23	RCOM	2.20	1.45	1.47	1.68
24	RECLTD	1.72	1.08	1.78	1.41
25	RELCAPITAL	2.29	1.33	1.88	1.68
26	SAIL	1.35	0.69	1.41	1.45
27	SRTRANSFIN	0.79	0.98	1.48	0.95
28	TATACHEM	0.54	0.34	1.10	1.18
29	TITAN	0.78	0.76	0.87	0.62
30	UPL	0.81	1.91	0.90	1.17

Source: www.nseindia.com

Statistical Analysis and Results

As this is the study of taking 'repeated measurements of beta coefficients' from same set of stocks (related populations), the paired t test has been used for the mentioned hypotheses.

Testing of Hypothesis 1

Table 2: Paired t Test Results for Hypothesis 1

	$\beta_{NIFTY50\ FY2013}$	$\beta_{NIFTY50\ FY2014}$
Mean	0.9021	0.9362
Variance	0.1711	0.1493
Observations	42	42
Pearson Correlation	0.788	
Hypothesized Mean Difference	0	
df	41	
t Stat	-0.8445	
P(T<=t) one-tail	0.2016	
t Critical one-tail	1.6829	
P(T<=t) two-tail	0.4033	
t Critical two-tail	2.0195	

Table 2 indicates that sample means of $\beta_{NIFTY50\ FY2013}$ and $\beta_{NIFTY50\ FY2014}$ are 0.9021 and 0.9362 respectively. In the table, t test statistic is -0.8445. For hypothesis 1, as a two-tail test, upper and lower critical values from t distribution with 41 degrees of freedom and 0.05 level of significance are 2.0195 and -2.0195 respectively. Since $t = -0.8445 > t_{41} = -2.0195$ and p-value = 0.4033 > 0.05, we accept null hypothesis. It, therefore, may be concluded that mean of the difference between paired beta coefficients of NIFTY 50 stocks estimated for financial year 2012-13 and 2013-14 is statistically zero.

Testing of Hypothesis 2

Table 3 exhibits the Microsoft Excel results of paired t test for this purpose.

Table 3: Paired t Test Results for Hypothesis 2

	$\beta_{NIFTY50\ FY2014}$	$\beta_{NIFTY50\ FY2015}$
Mean	0.9362	1.0183
Variance	0.1493	0.1723
Observations	42	42
Pearson Correlation	0.7508	
Hypothesized Mean Difference	0	
df	41	
t Stat	-1.8722	
P(T<=t) one-tail	0.0342	
t Critical one-tail	1.6829	
P(T<=t) two-tail	0.0683	
t Critical two-tail	2.0195	

It is seen from Table 3 that sample means of $\beta_{NIFTY50\ FY2014}$ and $\beta_{NIFTY50\ FY2015}$ are 0.9362 and 1.0183 respectively. The null hypothesis is accepted because $t = -1.8722 > t_{41} = -2.0195$ and p-value = 0.0683 > 0.05. We, thus, conclude that mean of the difference between paired beta coefficients of NIFTY 50 stocks estimated for financial year 2013-14 and 2014-15 equals zero.

Testing of Hypothesis 3

Table 4 shows the Microsoft Excel results of paired t test for this hypothesis.

Table 4: Paired t Test Results for Hypothesis 3

	$\beta_{NIFTY50\ FY2015}$	$\beta_{NIFTY50\ FY2016}$
Mean	1.0183	1.0333
Variance	0.1723	0.0975
Observations	42	42
Pearson Correlation	0.7584	
Hypothesized Mean Difference	0	
df	41	
t Stat	-0.3593	
P(T<=t) one-tail	0.3606	
t Critical one-tail	1.6829	
P(T<=t) two-tail	0.7212	
t Critical two-tail	2.0195	

As per Table 4, sample means of $\beta_{NIFTY50\ FY2015}$ and $\beta_{NIFTY50\ FY2016}$ are 1.0183 and 1.0333 respectively. As $t = -0.3593 > t_{41} = -2.0195$ and p-value = 0.7212 > 0.05, null hypothesis is rejected and it becomes evident that mean of the difference between paired beta coefficients of NIFTY 50 stocks estimated for financial year 2014-15 and 2015-16 is zero.

Testing of Hypothesis 4

Table 5: Paired t Test Results for Hypothesis 4

	$\beta_{NIFTY\ Next50\ FY2013}$	$\beta_{NIFTY\ Next50\ FY2014}$
Mean	0.835	0.9283
Variance	0.3864	0.2733
Observations	30	30
Pearson Correlation	0.4980	
Hypothesized Mean Difference	0	
df	29	
t Stat	-0.8818	
P(T<=t) one-tail	0.1926	
t Critical one-tail	1.6991	
P(T<=t) two-tail	0.3851	
t Critical two-tail	2.0452	

Table 5 displays that sample means of $\beta_{NIFTY\ Next50\ FY2013}$ and $\beta_{NIFTY\ Next50\ FY2014}$ are 0.835 and 0.9283 respectively. In the table, t test statistic is -0.8818. For hypothesis 4, upper and lower critical values from t distribution with 29 degrees of freedom and 0.05 level of significance are 2.0452 and -2.0452 respectively. Since $t = -0.8818 > t_{29} = -2.0452$ and p-value = 0.3851 > 0.05, we accept null hypothesis. It, therefore, may be concluded that mean of the difference between paired beta coefficients of NIFTY Next 50 stocks estimated for financial year 2012-13 and 2013-14 is statistically zero.

Testing of Hypothesis 5

Table 6 exhibits results of paired t test for this purpose.

Table 6: Paired t Test Results for Hypothesis 5

	βNIFTY Next50 FY2014	βNIFTY Next50 FY2015
Mean	0.9283	1.0487
Variance	0.2733	0.3041
Observations	30	30
Pearson Correlation	0.5397	
Hypothesized Mean Difference	0	
df	29	
t Stat	-1.2773	
P(T<=t) one-tail	0.1058	
t Critical one-tail	1.6991	
P(T<=t) two-tail	0.2116	
t Critical two-tail	2.0452	

From Table 6, sample means of $\beta_{\text{NIFTY Next50 FY2014}}$ and $\beta_{\text{NIFTY Next50 FY2015}}$ are 0.9283 and 1.0487 respectively. The null hypothesis is accepted as $t = -1.2773 > t_{29} = -2.0452$ and p-value = 0.2116 > 0.05. It is, therefore, concluded that mean of the difference between paired beta coefficients of NIFTY Next 50 stocks estimated for financial year 2013-14 and 2014-15 equals zero.

Testing of Hypothesis 6

Table 7 shows the Microsoft Excel results of paired t test for this hypothesis.

Table 7: Paired t Test Results for Hypothesis 6

	βNIFTY Next50 FY2015	βNIFTY Next50 FY2016
Mean	1.0487	1.008
Variance	0.3041	0.1662
Observations	30	30
Pearson Correlation	0.8782	
Hypothesized Mean Difference	0	
df	29	
t Stat	0.8110	
P(T<=t) one-tail	0.2120	
t Critical one-tail	1.6991	
P(T<=t) two-tail	0.4240	
t Critical two-tail	2.0452	

As per Table 7, sample means of $\beta_{\text{NIFTY Next50 FY2015}}$ and $\beta_{\text{NIFTY Next50 FY2016}}$ are 1.0487 and 1.008 respectively. As $t = .8110 < t_{29} = 2.0452$ and p-value = 0.4240 > 0.05, null hypothesis is rejected and it becomes evident that mean of the difference between paired beta coefficients of NIFTY Next 50 stocks estimated for financial year 2014-15 and 2015-16 is zero.

Conclusion

This study empirically proves that no significant shift has been observed in beta coefficients of NIFTY 50 and NIFTY Next 50 indices stocks recently on year on year bases. Since NIFTY 100 tracks the behaviour of collective portfolios of NIFTY 50 and NIFTY Next 50 indices, it may be concluded that NIFTY 100 stocks have static systematic risk profile at least in short run.

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