Optimum Portfolio Construction Using Sharpe Index Model With Reference to Infrastructure sector and Pharmaceutical Sector

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Abstract- In the current fluctuating market, it is very essential to select an optimal portfolio for an investor to minimize the risk and rather reap maximum benefits, from the available set of assets. A comparison between the various available assets is prima facie. A most commonly used modus operandi is the expected return-to-risk trade off as measured by the Sharpe Index Model. This study illustrates an analysis of four years' asset value, from 2008 to 2012, of companies picked from Infrastructure & Pharmaceutical sectors. In this regard, Sharpe Index Model is used, which is regularly employed to assess the performance of mutual funds and portfolio strategies. This study aims at evaluating the portfolio performance, thereby bringing out the optimal combination of assets to be invested in afore said two sectors. It is done basically by ranking the picked assets based on excess return to beta ratio and then finding out the cut off point (Ci), thereby the optimal combination of the assets.

Index Terms- Investor, Infrastructure & Pharmaceutical sectors, Sharpe Index Model, Portfolio performance, beta ratio, cut off point (Ci), Optimal combination of the assets.

I. INTRODUCTION

With the pace of growing economy, and the increasing disposable income to spend, along with the rising health consciousness among the people, pharmaceutical industry is one such industry that holds an immense growth potential. Infrastructure remains to be the backbone of any nation, employing a huge chunk of its people. As far as India is concerned infrastructure is the second largest employer next to agriculture. This study is based on these two important sectors Pharmaceuticals and Infrastructure that form a crucial role in the global economy, as though they may have faced a huge volatility, but nevertheless remain to be key sectors for the growth and development of a country. Thus, investors always look into them from bird's eye view, especially when the global market is seeing a huge shift in the economy, driving them to invest continually in these aforesaid sectors.

The global pharmaceutical industry is expanding at a brisk pace with the emerging markets leading global health spending due largely to health care reforms. With the patent expiration wave making its way through the industry, there lays an immense increasing pressure to cut costs and improve productivity and innovation. As *The Wall Street Journal* said on June 15, 2011, "white-knuckled investors have been hoping that drug makers would have found replacement products by now or adequately diversified themselves to withstand the impact." Thereby we see that companies can survive and thrive if they adopt highly differentiated strategies. Differentiation goes beyond a shift from cliché products to novel breakthroughs. As far as India is concerned, India's pharmaceutical sector is gaining its position as a global leader. India is the world's third largest in this field in terms of volume and fourteenth in terms of value. The Indian pharmaceutical market is poised to grow to US$ 55 billion by 2020 from the 2009 levels of US$ 12.6 billion, as per a McKinsey & Company report titled "India Pharma 2020: Propelling access and acceptance realising true potential". The industry further holds potential to reach US$ 70 billion, at a compound annual growth rate (CAGR) of 17 per cent.

Infrastructure sector, not only is the backbone of an economy, but also plays vital role in India's social and cultural segments. It contributes significantly to the growth of gross domestic product (GDP), while creating opportunities for employment and investment. The Government of India is laying intense focus on infrastructure development in the country, to make it more attractive to global investors. According to a report 'Real Estate and Construction Professionals in India by 2020´ by realty consultant Jones Lang LaSalle, India's infrastructure sector will require investment of about US$ 1 trillion in the 12th Five Year Plan (2012-17). The report, prepared for Royal Institution of Chartered Surveyors (RICS), states that about 97 million jobs are likely to be created over 2012-22 across different sectors in the country due to which, India would potentially need to build an average of 8.7 billion square feet (sq ft) of real estate space every year. This would be a great attraction for investors looking for opportunities in the infra segment.

II. NEED FOR STUDY

In this fluctuating market, it is of foremost importance to diversify the investment judiciously so as the risk is minimised and a maximum return for the amount of risk levied is obtained. This study is aimed at helping investors to build upon the optimal portfolio from the twenty companies picked up from pharmaceutical and infrastructure industries. This is required so as the investors can pool in their funds in the best proportion possible, thereby diversifying the risk, and maximizing the return from the selected set of companies.

III. OBJECTIVES

The main objectives of this study are as follows:

- To study the asset value of twenty different stocks listed in NSE picked from Infrastructure & Pharmaceutical industries.
- To find out the excess return to beta ratio, rank the stocks based on it, and then evaluate the cut off point.
- Keeping Sharpe Model calculation as base, to choose the optimal stocks and construct a portfolio, thus helping the investors take an appropriate investment decision.

IV. LIMITATIONS

The key limitations of this study are:

- Only twenty stocks from two sectors, i.e., Infrastructure & Pharmaceutical industries are taken for consideration into the study.
- Portfolio construction is restricted to risk and return alone, thereby neglecting the remaining factors affiliated to the stocks.
- Asset value of the stocks for just four years is taken into the study.
- The future uncertainty is not considered as only the historical data is taken for the calculations.

V. THEORETICAL FRAMEWORK

A Bilbao, M Arenas, M Jimenez, B Perez Gladish and MV Rodrıguez, 2005, in this paper presents an approach to the portfolio selection problem based on Sharpe's single-index model and on Fuzzy Sets Theory. Here, Value, ambiguity and fuzziness are three basic concepts involved, representing information on expert Betas. Here, a real portfolio selection problem is presented. In order to select an optimal portfolio, a Goal Programming model has been proposed including imprecise investor's aspirations concerning assets proportions of both, high-and low-risk assets. ***Francis in, Sangbae Kim, Vijaya Marisetty, Robert Faff, 2007,*** examines the performance of funds using wavelet analysis and applies it to an Australian dataset. This method, applied to a multi-horizon Sharpe ratio, shows that the wavelet variance at the short scale is higher than that of the longer scale, implying that an investor with a short investment horizon has to respond to every fluctuation in the realized returns, while for an investor with a much longer horizon, the long-run risk associated with unknown expected returns is not as important as the short-run risk. This is supported by a set of six groups of study. ***Hendrik Scholz, 2006,*** discussed on overcoming the problems in evaluating fund performance based on ex post Sharpe ratios during periods of declining markets and measure fund performance. This paper presents sample data from US equity mutual funds and establishes refinements to the Sharpe ratio and compares them with the original Sharpe ratio and show normalised Sharpe ratio produces meaningful results, not only for bear markets, but for any other market period as well. ***Robert E Hopkins, and Michael J. Acton, 1999,*** describes a new measure of Risk-adjusted performance of portfolio of assets based on Sharpe ratio, a widely used methodology for evaluating portfolios. A graphical representation of the risk-adjusted portfolio is presented that clearly explains the slope of the line drawn from the Sharpe Ratio to portfolio's risk and return point. These measures are implemented in the equity segment of real estate funds. ***Youguo Liang and Williard Mcintosh, 1998,*** emphasize on the concept of Sharpe alpha, invented by them but based on Dr. William F. Sharpe's contribution for analysis of investment performance and measures the excess returns. But they differ in the selection and construction benchmarks of the portfolio, based on the real estate sector funds. ***William F. Sharpe, 1963,*** describes about the advantages of using a particular model for analysing the securities that is using a computerized model, where 2000 securities can be analyzed. This model emphasizes on low-cost analysis with little amount of the basic information to make it an attractive tool for investor's portfolio selection. It deals with probabilistic estimates of the future performances of securities, analysing them, and then selecting the optimum portfolio from them. This paper extends the work of Markowitz in portfolio analysis. ***Hal Varian, 1993,*** compares the quantitative revolution in the field of finance done by the three pioneers and Nobel laureates, namely, Markowitz, Miller and Sharpe. It emphasizes on the varied contribution of the three in the fundamental concepts of risk and return before analysing a portfolio. Finally the paper throws light on the fact that it is not enough just to look into capital market equilibrium, rather, a theory on the relationship amongst these variables of risk, return, plays a firm role. ***Nafiseh Behrad Mehr, 2008,*** throws light on an investor needs to estimate a set of statistical characteristics from the underlying securities in the portfolio of interest, as well as the weight assigned to each portfolio; however, the noise present in the underlying securities may distort the estimated statistical characteristics of securities and in turn the resulting portfolio allocation strategy. Different combinations of smooth and non smooth series are employed to estimate the optimal portfolio weights, where each combination leads to different risk and return for investor. It is observed that the allocation decision with highly smoothed variance matrix and non smoothed mean provides the highest Sharpe ratio. ***Hsu Wen Peng And Graeme Newell, 2007,*** The purpose of this paper is to assess the significance of the infrastructure funds in Australia; particularly highlighting the leading infrastructure funds, types of infrastructure investment and superannuation fund investment in infrastructure. The investment characteristics and performance of infrastructure over 1995-2006 is also assessed, as well as the potential role of infrastructure in portfolios. All this is done with the help of Sharpe Index tool for portfolio management. ***Meenakshi Rani, Dr. Sarita Bahl, 2012,*** The purpose of this paper is to construct an optimal portfolio based on secondary data and study the impact when using the procedure of short sales and without the same by applying Sharpe's single-index model. A sample of thirty stocks listed on Bombay Stock Exchange (BSE) was selected for this study out of which eleven have expected return greater than risk free rate of return and these eleven stocks have been used for optimal portfolio construction. In the study the expected return of optimal portfolio is15.96 and the risk of optimal portfolio is 3.048 when the short sales are not allowed and when the short sales are allowed it is 14.17 and 2.98 respectively. The study concluded that the Sharpe's single index model is of great importance and the framework of Sharpe's single index model for optimal portfolio

construction is very simple and useful for investors and practically related for the purpose of investing. ***Dominique Achour, Robert Brown, Yvon Roy, 2006,*** In this paper the investment performance of a Canadian portfolio of Canadian public real estate companies is analyzed over the period 1971–79. Using Sharpe's index of performance, it appears at first sight that the portfolio exhibited remarkable superior performance. Moreover, this conclusion is not due to some peculiarity of the Sharpe measure: results using Treynor's measure suggest a similar conclusion. This was followed by applying the significance tests recommended by Jobson and Korkie (1981). When their preferred test is applied, rejecting the null hypothesis that the real estate portfolio did not exhibit superior investment performance could not be rejected. This result illustrates the necessity of performing adequate statistical significance tests whenever investment performance is being evaluated. ***R. A. Maller, R. B. Durand and P. T. Lee, 2005,*** In this paper it has been illustrated that the maximum Sharpe ratio obtained via the Markowitz optimization procedure from a sample of returns on a number of risky assets is, under commonly satisfied assumptions, biased upwards for the population value. Thus investment advice, decisions and assessments based on the estimated Sharpe ratio will be overly optimistic. The bias in the estimator is shown theoretically and illustrated using a data set of Spiders and iShares. The paper also discusses on how the authors have obtained bounds on the difference between the sample maximum Sharpe ratio and its population counterpart and shown that the sample estimator is consistent for the population value; thus the bias disappears asymptotically, under some reasonable assumptions. However, the bias can be significant in finite samples and persist even in very large samples. This is illustrated with simulations based on portfolios formed from normally and t–distributed returns. As expected, the over-optimistic risk-return trade-off predicted by the procedure is not reflected in corresponding good out-of-sample portfolio performance of the Spiders and I Shares. ***Ross A. Maller, Robert B. Durand, Hediah Jafarpour, 2010,*** Choosing a portfolio from among the enormous range of assets now available to an investor would be facilitated if we could locate the return–risk ratio of a particular allocation along a spectrum of possibilities. A comparison between portfolio choices can tell us, for example, whether it is better to select a sub-optimal portfolio from a large class of assets or to perform a Markowitz optimal procedure on a subset of the assets. A common criterion for this assessment is the expected return-to-risk trade-off as measured by the Sharpe ratio. Given that the ideal, maximized Sharpe ratio must be estimated, in this paper, an approach that enables to assess ex ante how close a given portfolio is to this ideal. For this purpose, in this paper it has been illustrated on the applications of the theory by analyzing a large sample of US companies, comparing constant-correlation and momentum strategies with the optimal strategy. Simulations based on this data are also given for illustration. **Gregory H. Chun, J. Sa-aadu, James D. Shilling, 2004,** This paper is an attempt to provide some new insights into the asset allocation paradox. The key conclusion of this paper is several: Unlike other assets, it would appear that the real estate and real asset diversification pays off at every time when the benefits are most needed. The real estate returns are predictable. Infact the amount of predictability in real estate return appears to be same as in stock returns. The real estate performs well in asset liability framework. The chance of experiencing a large loss on real estate over a longer horizon is quite small. **Caruso, David, 2007,** Making the wrong technology investment choices--or even stalling when the time comes--can cause a downward spiral that eventually affects the entire enterprise. And as businesses seek to wire together complex supply chains, every IT action had better be a good one. But that mandate may be more insidious than it seems on the surface. At the end of 2005, Boston-based AMR Research polled IT pros for their biggest challenges in managing systems. The responses cite integration, response times, and sheer cost. Clearly, most IT organizations would agree that gaining better visibility and control over their planning processes would help IT make better investment decisions. IT organizations are constantly tasked with doing more work than their resources allow. Manufacturing execs are continually examining ways to get closer to customers, reduce costs, and improve competitiveness. These business issues often collide with diverse application landscapes that are often poorly integrated and difficult to maintain. Companies must maximize the impact of two scarce IT resources--money and talent--on the business, because when done well, this can generate high returns on existing processes and new business ventures. The method of choice, for CIOs and business execs alike, is portfolio management. **McKee, John, 2008**, In an effort to even out the impact that market swings have on their portfolio, more and more Americans -- especially affluent Americans -- are looking to alternative investment options such as real estate, currencies and hedge funds. As a result, financial advisors are playing an increasingly important role in managing and protecting these assets. The decision of how much real estate a firm allocates to its clients' portfolios depends on its methodology. While a firm's methodology may dictate an amount of allocation, wealth management firms can benefit greatly from education of how the different types of real estate offerings fit within their allocation. When advising high net worth clients, real estate professionals should advise their clients to buy right, consider their long-term objectives, and consider all the risks of 1031 exchanges versus paying any relevant taxes now.

VI. RESEARCH METHODOLOGY

This study follows the following research methodology:

Category	**Present Study Methodology**
Research Design	› Descriptive › Quantitative
Sources of Data	› Secondary, from NSE, RBI, etc. websites, and databases like Proquest › Four consecutive years' data from September 2008 to September 2012
Data Collection Method	› The companies are picked based on the asset value ranking
Sample Population	› Pharmaceutical sector: 83 › Infrastructure sector: 30

Sample Size	› Pharmaceutical sector: 10 › Infrastructure sector: 10

Tools used in data analysis:

The various tools used in the study are discussed below:

- **Beta Coefficient** – It is a measure of a security's or portfolio's volatility, compared with rates of return on the market as a whole. It is given by the following formula:

$$\beta = \text{Correlation Coefficient Between Market and Stock} \times \frac{\text{Standard Deviation of Stock Returns}}{\text{Standard Deviation of Market Returns}}$$

- **Return** – It is defined as the total gain or loss over a stipulated period of time. It is calculated by:

Return= ((Today's market price – Yesterday's Market price) / Yesterday's Market price)*100

- **Correlation** – It is a statistical tool that in simple terms defines how two securities move in relation to each other.

- **Risk Free rate of return –** It is the rate of return that is free from any risk and is sure to give a promised rate of return. Here, we have taken the government bond rate taken from the RBI website as the risk free rate of return.

- **Excess Return to Beta Ratio** – It measures the additional return on a security per unit of systematic risk or non-diversifiable risk and is calculated as follows:

Excess Return to Beta = $(R_i-R_f) / \beta_i$

Where:

R_i: the expected return on stock

R_f: the return on a riskless asset

β_i: the expected change in the rate of return on stock associated with one unit change in the market return.

- **Cut-off point -** The highest value of is taken as the cut-off point that is C*. It is calculated using the following formula:

$$\frac{\square m \sum (R_i - R_f)\,\beta / \sigma^2 ei}{1+\sigma^2 m \sum (\beta^2/\sigma^2 ei)}$$

- **Proportion of allotment in each security** –It is done by evaluating the cut off point then estimating the proportion to be invested in each security using the following formula:

$$Xi=\frac{Zi}{\sum Zi}$$

$$Zi=\frac{\beta i[Ri-Rf\ ]}{\sigma ei2}-\frac{C^*}{\beta i}$$

VII. ANALYSIS & INTERPRETATION

Based on the tools of Sharpe Index Model, the various calculations are done for the stocks picked. Tables on the calculations are presented below.

TABLE 1: Return, Beta and Variance of Individual Stock

Securities	Ri	Beta	σ^2ei
Aurobindo	37.67	0.17	16.34
Cadila	51.82	0.05	12.77
Cipla	64.36	0.43	3.52
Dr Reddy	130.6	0.34	3.8
Gammon	-119.21	0.24	10.82
Glaxo	-29.46	0.01	11.79
Gmr	85.59	0.26	13.81
Gvk	-57.93	0.3	13.38
Hindustan Cons	-85.46	0.26	16.8
Jayaprakash	1.99	0.32	16.98
L & T	-7	0.38	9.28
Lanco	-96.95	0.18	26.64
Lupin	86.47	0.13	10.79
Punj Lyod	-122.35	0.34	13.17
Ranbaxy	51.54	0.29	7.94
Reliance	-11.2	0.36	13.32
Simplex	-146.55	0.09	19.74
Sun Pharma	23.27	0.13	10.77
Ivrcl	-81.76	0.24	22.54
Ipca	-21.77	0.03	21.31

Table 1 depicts the return, Beta and Variance of Individual stock, which forms the first step in the portfolio evaluation. It clearly shows that Pharma companies like Dr.Reddy, Cipla, Cadila have produced higher returns. GMR is the only infrastructure company that shows a pretty high return.

Table 2 shows the Excess to Beta Ratio calculation which measures the additional return on a security per unit of systematic risk or non-diversifiable risk. As per Sharpe Model, based on this calculation the ranking of the assets is arrived at. The New Order column in the table shows this newly sorted out order. Cadila ranks first with the Excess to Beta Ratio value as 873.60 and Glaxo is the last with a value of -3760.

TABLE 2: Excess Return to Beta Ratio

Scrip	Ri - Rf/Beta	New Order
Aurobindo	173.71	Cadila
Cadila	873.60	Lupin
Cipla	130.74	Dr Reddy
Dr Reddy	360.18	Gmr
Gammon	-530.63	Aurobindo
Glaxo	-3760.00	Ranbaxy
Gmr	297.88	Cipla
Gvk	-220.23	Sun Pharma
Hindustan Con	-360.00	Jayaprakash
Jayaprakash	-19.22	L & T
L & T	-39.84	Reliance
Lanco	-583.83	Gvk
Lupin	602.54	Hindustan Cons
Punj Lyod	-383.79	Ivrcl
Ranbaxy	149.66	Punj Lyod
Reliance	-53.72	Gammon
Simplex	-1718.78	Lanco
Sun Pharma	116.38	Ipca
Ivrcl	-374.58	Simplex
Ipca	-997.00	Glaxo

TABLE 3: Cut - off Point Caonlculati

Scrip	(ri-Rf)β/σ2ei	σ2m∑(Ri-RF)β/σ2ei	β2/σ2ei	∑β2/σ2ei	1+σ2m∑β2/σ2ei	CI
Cadila	0.171	1.312	0.000	0.029	1.088	1.20
Lupin	0.944	4.190	0.002	0.031	1.093	3.83
Dr Reddy	10.957	37.609	0.030	0.061	1.186	31.71
Gmr	1.458	42.056	0.005	0.066	1.201	35.02
Aurobindo	0.307	42.993	0.002	0.068	1.206	35.64
Ranbaxy	1.585	47.828	0.011	0.078	1.239	38.61
Cipla	6.868	68.774	0.053	0.131	1.399	49.16
Sun Pharma	0.183	69.331	0.002	0.132	1.404	49.39
Jayaprakash	-0.116	68.978	0.006	0.138	1.422	48.51
L & T	-0.620	67.087	0.016	0.154	1.469	45.65
Reliance	-0.523	65.493	0.010	0.164	1.499	43.69
Gvk	-1.481	60.975	0.007	0.170	1.520	40.12
Hindustan Cons	-1.449	56.556	0.004	0.174	1.532	36.92
Ivrcl	-0.957	53.637	0.003	0.177	1.540	34.83
Punj Lyod	-3.369	43.362	0.009	0.186	1.567	27.68
Gammon	-2.825	34.747	0.005	0.191	1.583	21.95
Lanco	-0.710	32.581	0.001	0.192	1.586	20.54
Ipca	-0.042	32.452	0.000	0.192	1.587	20.45
Simplex	-0.705	30.301	0.000	0.193	1.588	19.08
Glaxo	-0.032	30.204	0.000	0.193	1.588	19.02

Table 3 displays the cut-off point calculations for the newly ranked companies. The cut off point for this portfolio is at 49.39 of Sun Pharma. Stocks greater than the cut-off point are included in the portfolio. Here the top five companies according to excess return to beta ratio is taken for calculating the proportion of investment.

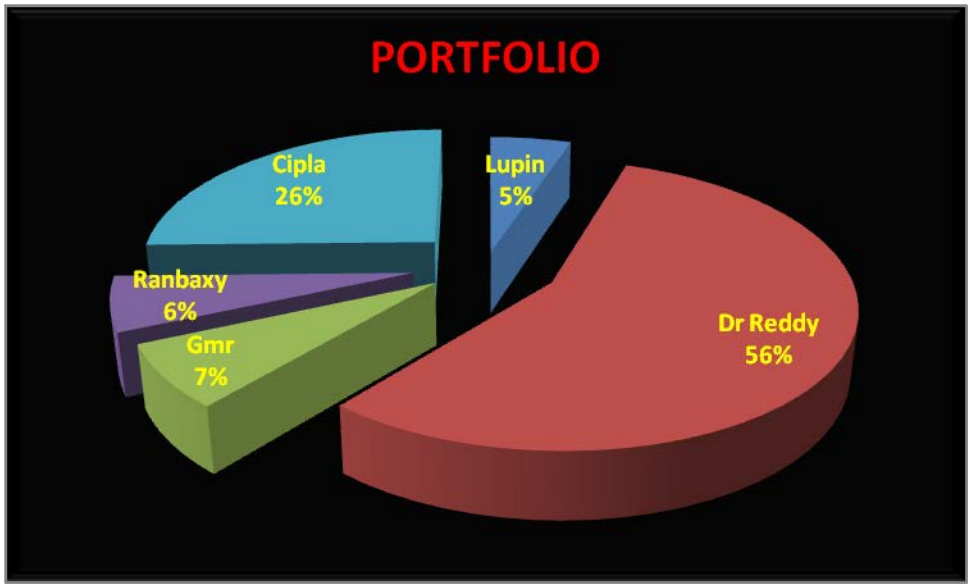
TABLE 4: Selection of stock among 20 scrip and proportion percentage

Scrip	CI	% Proportion
Lupin	3.83	5%
Dr Reddy	31.71	56%
Gmr	35.02	7%
Ranbaxy	38.61	6%
Cipla	49.16	25%

Table 4 shows the proportion of investment that can be pooled in each stock amongst the 20 different stocks selected on a percentage basis. The proportions of portfolio allotment would be Dr Reddy with 56%, Cipla with 25%, GMR Infra with 7%, Ranbaxy with 6% and Lupin with a proportion of 5% of the total investment.

VIII. FINDINGS

The stock performance of 20 companies from Infrastructure and Pharmaceuticals, 10 from each are taken and calculated. It is found that Pharmaceutical sector performs 80% better than that of Infrastructure sector. Performance of Infrastructure sector is comparatively poorer than Pharma as only one company is selected for the portfolio, i.e., GMR, which constitutes just 7% of the investment share. The pie chart best represents graphically the optimal portfolio stocks from the chosen two sectors.



IX. RECOMMENDATIONS

From the analysis done in this study, Dr Reddy from pharmaceutical sector occupies the maximum proportion of 56% of the total investment being the most suggested stock amongst the 20 companies picked. Second to it stands Cipla again from pharma with a proportion of 26% of the investment. The lower proportion in the portfolio would be for Lupin in pharma sector constituting 5% of the total investment.

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