

Mutual Fund Performance Prediction

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Abstract—It is increasingly seen that non parametric frontier method has become a popular method in predicting the performance of investment fund. This paper uses the non-parametric method to analyze the efficiency and performance of mutual funds. The methodology uses Data Envelopment Analysis (DEA) to predict the performance of fund in coming years. Factor such as mutual fund returns, turnover rate, volatility, expense ratio are used to find the relative efficiency of funds using DEA. The end result not only provides funds with good return but at the same time these funds are consistent in performance and stable in nature. The methodology is applied to a sample of 46 Indian equity funds over the period 2006-2015. The time frame for implementing this analysis is three, five, and ten years evaluation respectively. The results are obtained on the basis of comparison with crisil and valueresearch rating system. Our results provide practical application for investor to choose the best fund among all. It also help fund manager in better management of funds.

Keywords—Mutual Funds, Data Envelopment Analysis, Quantile

I. INTRODUCTION

A mutual fund is a systematic approach for investment of pool of funds collected from various investor to be invested by fund managers in equity, bond, debt, government securities and similar asset.

Mutual fund was first introduced in India in 1963, when government of India launched Unit Trust of India (UTI). Until 1982, UTI was the only company in the Indian mutual fund market. Although mutual funds is available for so many years still only 10 percent of Indian household have invested in mutual funds. A recent survey by Boston Analytics on Mutual Fund Investment in India shows that investor are reluctant to invest their money into mutual funds due to lack of information as how mutual fund works and high risk factor[1].

Due to the vastness of funds offered (total number of funds in 2015 was 4300 available in India) and delicate nature of active management industry, selection of fund with respect to investor's choice has become an integral part of this industry. Under these scenarios fund rating agencies plays an important role in investor's choice in selection of funds.

Question regarding whether portfolios has any impact by the funds managers remains questionable. Classic performance measures comparison to the return of the examined portfolio with return of a properly defined unmanaged portfolio for all aspect of investment risk. The growth of financial theory has led to the evaluation of risk with performance of funds managers.

In this context, the single factor evaluation model introduced by [2] has been replaced by multi-factor models motivated mainly by the pioneer findings of asset pricing studies such

as [3]. In particular, the ability of mutual fund's managers to achieve superior risk-adjusted returns compared to passively managed portfolios has been extensively studied by a widespread authors [4] [2].

However, traditional performance measures comes with various short coming. These traditional performance measures are based on capital asset pricing model (CAPM). Since this model come with lot of disadvantage [5]. They also fail to consolidate cost factors. Therefore this model fails to workout with mutual funds. Such criticism led to evolution of better technique for production measurement techniques, this led to the discovery of frontier analysis which is explicitly known as Data Envelopment Analysis (DEA). This new tool will be used to predict mutual fund performance. This approach can handle traditional limitation as defined above and give more accurate predictive analysis.

DEA is used largely in various performance measure due to its property of supervising multiple outputs and inputs measures. Sometimes it is not possible to get the meaningful aggregations of inputs and outputs. For this reason DEA is used as it can handle both multiple inputs and outputs without any aggregations of various factors. Secondly, DEA is a non-parametric approach so it does not depend on data belonging to particular distribution and also it does not consider the model structure fixed. Models can grow in size to hold the data complexity [6] [7]. Already DEA is used to find the risk attributes in investment category [8]. But now what we are doing is using this method to find the best and efficient fund within the fund category.

Rest of the paper is organized as follows. Section II gives brief description about the theoretical background. Section III discusses the proposed work. Section IV discusses the results, and finally section V concludes the paper.

II. THEORETICAL BACKGROUND

DEA merge the estimation of the technology with the measurement of performance as related to this technology. It basically deal with two problems a) it estimates the performance against traditional standard, and b) it determine the technology.

DEA is established on linear programming technique without striking any assumptions. It also yield non-parametric estimates of the efficiency of each DMU [9].

Our general setting involves M input to produce N outputs for K funds. For fund Y , represent the data of all funds. We propose the technology set or production possibilities set,

$$T = \{(x, y) \in \mathbb{R}_+^m \times \mathbb{R}_+^n \mid \mathbf{x} \text{ can produce } \mathbf{y}\} \quad (1)$$

Then, fund efficiency θ_i is measured by,

$$\theta_i = \frac{u_i y_i}{v_i x_i} \in [0, 1] \quad (2)$$

where $u_i, v_i \geq 0$

DEA provide assessment on efficiency of fund using three different models. Every model depends on return to scale assumption. Here λ represent the weight.

Constant return to scale if any possible production combination can arbitrarily be scaled up or down, that is, if

$$(x, y) \in T, \lambda \geq 0 \Rightarrow (x, y) \in T. \quad (3)$$

Increasing returns to scale mean that the output will tend to grow faster than the input.

$$(x, y) \in T, \lambda \geq 1 \Rightarrow \lambda(x, y) \in T \quad (4)$$

If change in input does not result in a proportional change in outputs, a model which allows variable returns to scale (VRS) should be considered

$$(x, y) \in T, \lambda = 1 \Rightarrow \lambda(x, y) \in T. \quad (5)$$

Due to the two distinguish property of DEA, i.e. production function is not constrained to restrictive assumptions that relates inputs to outputs and possibility of using several inputs and outputs, which can be stated by different units of measurement, have made it popular analysis tool with various application in many domains.

A. Quantile

Quantile are values that partition a finite set of values into q subsets of (nearly) equal sizes. There are $m-1$ of the m -quantiles, one for every integer k satisfying $0 < k < m$. A quantile is where a sample is divided into equal-sized, adjacent, subgroups [10].

III. PROPOSED WORK

A. Data Source

The DEA approach is enforced to sample containing more than 46 no-load equity funds that were in existence for last three years. The sample belong from 2006-2015 period. Due to the variety of expenses present in different types of fund, and to avoid the complexity of different type of funds, only no load funds has been considered for analysis. The source of input/output database is the comprehensive Morningstar database. Source for expense ratio and capital flow is from www.moneycontrol.com. The sample has two different investment categories large cap equity fund and middle & small cap equity fund as defined in Morning star.

The data collected from sample funds contains annual returns, expense ratio, turnover rate for last 6 years, volatility factor of last three years and capital flow. For turnover ratio we took standard deviation of last six years of data.

In our study, for large cap for three year duration, we take input as expense and volatility factor and output as return of three year and capital flow. For large cap for five year duration, we take input as turnover ratio and volatility factor and output as return for 3, 5 year and capital flow. For large cap for 10 year duration, we take input as turnover ratio and volatility factor and output as return for 3, 5, 10 year and capital flow.

For small cap for three year duration, we take input as expense and volatility factor and output as return of three year and capital flow. For small cap for five year duration, we take input as turnover ratio and volatility factor and output as return for 3, 5 year and capital flow. For small cap for 10 year duration, we take input as turnover ratio and volatility factor and output as return for 3, 5, 10 years and capital flow.

DEA cannot be used for negative data, funds which has negative return has been excluded from the database. There were some funds whose data were not available in database those has also been excluded from analysis.

B. Steps of the process

- i We find the input and output weight.
- ii Perform DEA analysis on all fund using model CRS, VRS, IRS on 10, 5, 3 years.
- iii Using quantile, we select top 25% fund in every section i.e in CRS, VRS, IRS.
- iv We perform intersection of all 3 results to get best funds.
- v Funds which we get after intersection are our final funds.
- vi Ranking of funds is done according to volatility factor starting from least volatility to high volatility.

IV. RESULTS AND DISCUSSION

The rating and performance of fund shown here is after six month of analysis. After six months our prediction show very informative and positive results.

Table I summarize the comparison of our best fund to crisil and valueresearch rating in large cap three year horizon. For some fund we denote NA means Not Available, rating is not available for that particular fund. Five star represent the best fund and one star represent the worst fund according to fund rating agencies.

TABLE I. LARGE CAP 3 YEAR

Our Predictive Result	Crisil	ValueResearch
Peerless Equity Fund-Direct Plan-Growth Option	NA	**
Peerless Equity Fund-Normal Direct Plan-Dividend Option	NA	**
Tata Large Cap Fund -Direct Plan Dividend	NA	NA
HDFC Index Fund Sensex Plan-Direct Plan	***	***
Taurus Ethical Fund-Direct Plan-Dividend Option	NA	***
Taurus Ethical Fund-Direct Plan-Growth Option	NA	***
SBI Blue Chip Fund - Direct Plan - Dividend	*****	*****
SBI Blue Chip Fund-Direct Plan -Growth	*****	*****
SBI Bluechip Fund Dividend	*****	*****
SBI Bluechip Fund Growth	*****	*****
UTI Nifty Index Fund-Growth Option- Direct	****	**
Franklin India Prima Plus - Direct - Dividend	*****	*****
Franklin India Prima Plus - Direct - Growth	*****	*****

Figure 1 depicts the peer comparison of return of best fund with worst, best and category average. We can see that more than 76 % of our fund is above category average.

Figure 2 shows the peer comparison of volatility of best fund with least, average and highest volatility fund. We can see that none of our fund has high volatility suggesting that our best fund are not only good in return but also stable funds.

Table II summarizes the comparison of our best fund to crisil and valueresearch rating in large cap 5 year horizon.

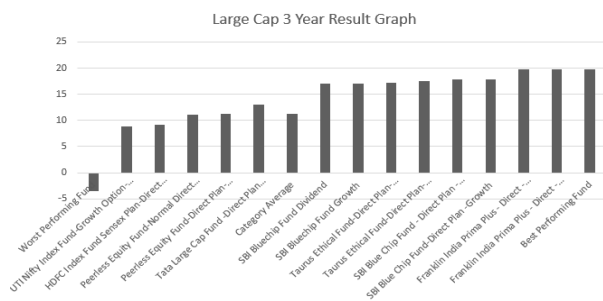


Fig. 1. Large Cap 3 year return graph

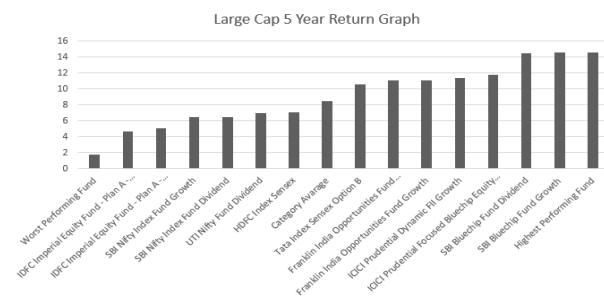


Fig. 3. Large Cap 5 year return graph

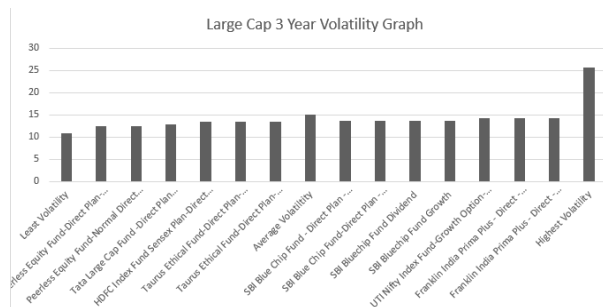


Fig. 2. Large Cap 3 year volatility graph

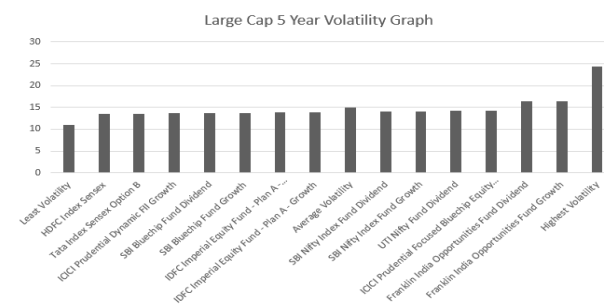


Fig. 4. Large Cap 5 year volatility graph

TABLE II. LARGE CAP 5 YEAR

Our Predictive Result	Crisil	ValueResearch
HDFC Index Sensex	***	****
Tata Index Sensex Option B	NA	NA
ICICI Prudential Dynamic FII Growth	**	****
SBI Bluechip Fund Dividend	*****	*****
SBI Bluechip Fund Growth	*****	*****
IDFC Imperial Equity Fund - Plan A - Dividend	NA	NA
IDFC Imperial Equity Fund - Plan A - Growth	NA	NA
SBI Nifty Index Fund Dividend	***	**
SBI Nifty Index Fund Growth	***	**
UTI Nifty Fund Dividend	*****	**
ICICI Prudential Focused Bluechip Equity Fund Institutional Growth	***	****
Franklin India Opportunities Fund Dividend	*****	****
Franklin India Opportunities Fund Growth	*****	****

Figure 3 shows the peer comparison of return of best fund with worst, best and category average. We can see that more 53 % of our fund is above category average.

Figure 4 depicts the peer comparison of volatility of best fund with least, average and highest volatility fund. We can see that none of our fund has high volatility suggesting that our best fund are not only good in return but also stable funds.

Table III summarize the comparison of our best fund to crisil and valueresearch rating in large cap 10 year horizon.

Figure 5 shows the peer comparison of return of best fund with worst, best and category average. We can see that more than 55 % of our fund is above category average.

Figure 6 shows the peer comparison of volatility of our best fund with least, average and highest volatility fund. We can see that none of our fund has high volatility suggesting that our best fund are not only good in return but also stable funds.

TABLE III. LARGE CAP 10 YEAR

Our Predictive Result	Crisil	ValueResearch
LIC Nomura MF Index Sensex Dividend	NA	*
LIC Nomura MF Index Sensex Growth	*	*
Tata Index Sensex Option A	NA	*
SBI Magnum Equity Fund Dividend	*****	*****
LIC Nomura MF Index Nifty Growth	*	**
Franklin India Prima Plus Fund Dividend	*****	*****
Franklin India Prima Plus Fund Growth	****	*****
Franklin India Flexi Cap Fund Dividend	**	*****
Franklin India Flexi Cap Fund Growth	***	*****

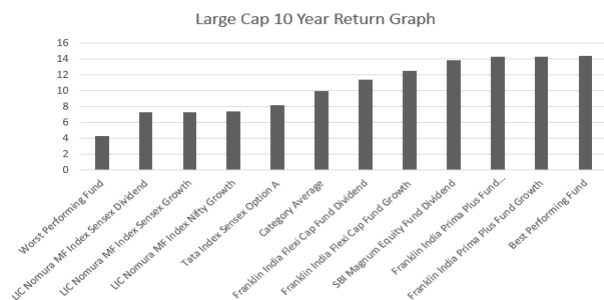


Fig. 5. Large Cap 10 year return graph

Table IV summarizes the comparison of our best fund to crisil and valueresearch rating in small cap 3 year horizon.

Figure 7 shows the peer comparison of return of best fund with worst, best and category average. We can see that 100 % of our fund is above category average.

Figure 8 depicts the peer comparison of volatility of our best fund with least, average and highest volatility fund. We can see that none of our fund has high volatility suggesting that our best fund are not only good in return but also stable

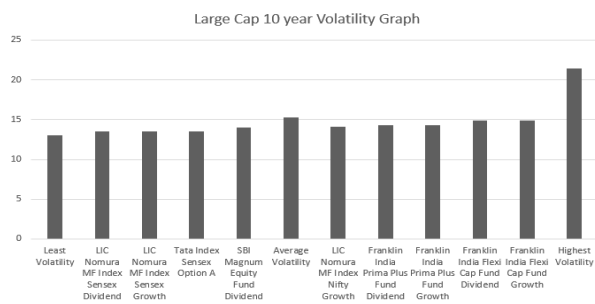


Fig. 6. Large Cap 10 year volatility graph

TABLE IV. SMALL CAP 3 YEAR

Our Predictive Result	Crisil	ValueResearch
DSP BlackRock Micro Cap Dividend	*****	*****
DSP BlackRock Micro Cap Fund Growth	*****	*****
Mirae Asset Emerging Bluechip Fund - Direct Plan - Dividend	*****	*****
Mirae Asset Emerging Bluechip Fund - Direct Plan - Growth	*****	*****
SBI Magnum Midcap Fund Dividend	*****	*****
SBI Magnum Midcap Fund Growth	*****	*****
SBI Small & Midcap Fund - Direct Plan - Dividend	NA	NA
SBI Small & Midcap Fund - Direct Plan - Growth	NA	NA
SBI Small & Midcap Fund - Regular Plan - Dividend	NA	NA
SBI Small & Midcap Fund - Regular Plan - Growth	NA	NA

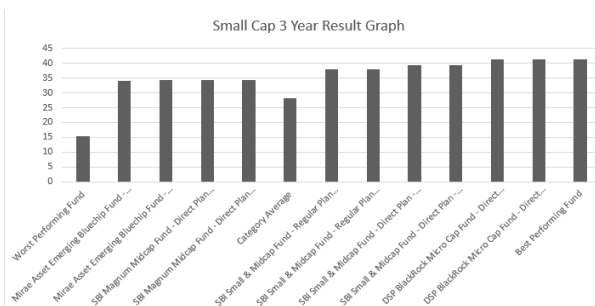


Fig. 7. Small Cap 3 year return graph

funds.

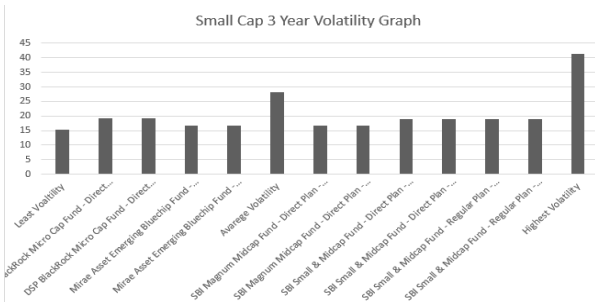


Fig. 8. Small Cap 3 year volatility graph

Table V summarizes the comparison of our best fund to crisil and valueresearch rating in small cap 5 year horizon.

Figure 9 shows the peer comparison of return of best fund

TABLE V. SMALL CAP 5 YEAR

Our Predictive Result	Crisil	ValueResearch
SBI Emerging Businesses Fund - Dividend	*	***
SBI Emerging Businesses Fund - Growth	*	***
Reliance Small Cap Growth	****	****
BNP Paribas Mid Cap Dividend	****	****
BNP Paribas Mid Cap Growth	****	****
SBI Magnum Midcap Fund Growth	****	****
SBI Magnum Midcap Fund Dividend	****	****
Mirae Asset Emerging Bluechip Dividend	****	****
DSP BlackRock Micro Cap Dividend	****	****
DSP BlackRock Micro Cap Fund Growth	****	****
Mirae Asset Emerging Bluechip Growth	****	****

with worst, best and category average. We can see that more than 95 % of our fund is above category average.

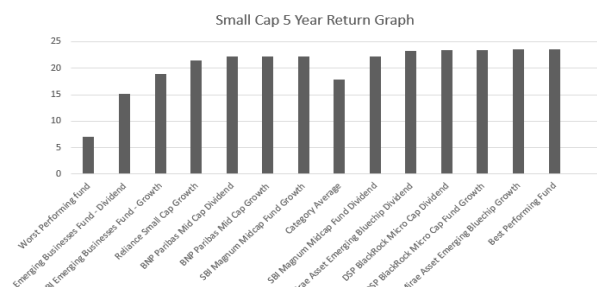


Fig. 9. Small Cap 5 year return graph

Figure 10 shows the peer comparison of volatility of our best fund with least, average and highest volatility fund. We can see that only one fund has high volatility otherwise other fund has stable volatility factor.

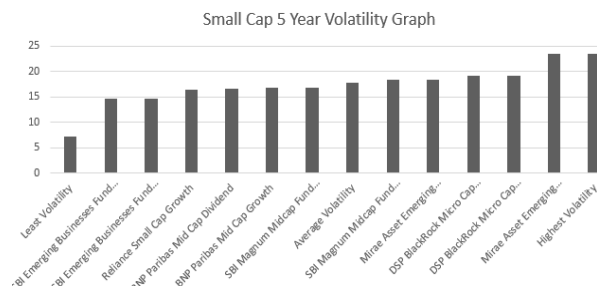


Fig. 10. Small Cap 5 year volatility graph

Table VI summarizes the comparison of our best fund to crisil and valueresearch rating in small cap 10 year horizon.

TABLE VI. SMALL CAP 10 YEAR

Our Predictive Result	Crisil	ValueResearch
SBI Emerging Businesses Fund - Dividend	*	***
SBI Emerging Businesses Fund - Growth	*	***
SBI Magnum Global Fund Dividend	****	****
SBI Magnum Global Fund Growth	****	****
SBI Magnum Midcap Fund Dividend	****	****
SBI Magnum Midcap Fund Growth	****	****
Birla Sun Life MNC Fund Dividend	****	NA
Birla Sun Life MNC Fund Growth	****	NA
Tata Mid Cap Growth Fund Regular Dividend	****	****
Tata Mid Cap Growth Fund Regular Growth	****	****

Figure 11 shows the peer comparison of return of best fund with worst, best and category average. We can see that more than 70 % of our fund is above category average.

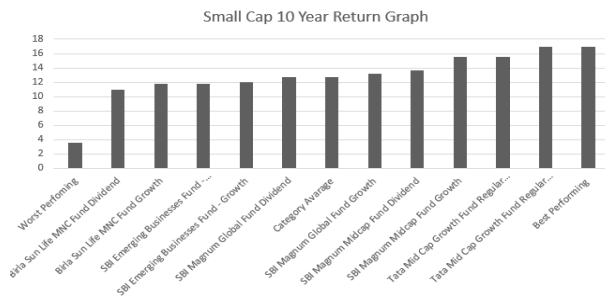


Fig. 11. Small Cap 10 year result graph

Figure 12 shows the peer comparison of volatility of our best fund with least, average and highest volatility fund. We can see that none of the fund has high volatility suggesting that that our best fund are not only good in returns but also stable funds.

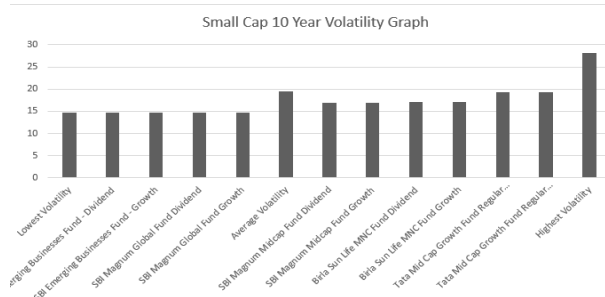


Fig. 12. Small Cap 10 year volatility graph

V. CONCLUSION

Due to the plethora of options available in mutual funds of different type has led to considerable research on development and implementation of mutual funds. In our paper, we have devised a mechanism in which DEA analysis can be successfully used for prediction of mutual funds performance. Other

mechanism provide models for predicting funds in investment categories. But we have done prediction of each entity as funds. Our result for a sample of 46 Indian equity funds has provided the best performing fund, and at the same time making sure those fund are stable in nature. Almost in all category in average 74 % of our fund is above category average and also all of them are found to be stable in nature. These funds found to have good track record throughout the year. Our finding implies that it can be used by investor for better selection of funds and fund manager can use it to for better portfolio of funds.

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