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PERFORMANCE EVALUATION OF MUTUAL FUNDS IN INDIA: DEA APPROACH

Nikhat Afshan,

PhD Candidate, IBS Hyderabad, Dontanpally, Hyderabad, India
E-mail: nikhat.84@gmail.com

Abstract:

This study has made an attempt to measure the relative performance of mutual fund dividend and growth plan under balanced category for the year 2009 to 2012 using the non parametric approach (Data Envelopment Analysis).To better evaluate performance the new risk measures value at risk and conditional value at risk have been included as the input variable apart from the standard deviation of return, residual return and imputed cost. While the annual return and residual returns are considered as output variables. The result showed that the overall performance of both types of funds has increased over a period of time and some of the firms remained 100% efficient throughout the period of study. The study has implications for both investors and managers, as investors can choose the fund found to be consistently 100% efficient through the period of study while managers of inefficient funds can identify the source of inefficiency and improve them to become 100% efficient.

Keywords: Performance Evaluation, Mutual Funds, Efficiency, Data Envelopment Analysis

Introduction

The performance of mutual fund had always been a great concern for investors as well as managers which in turn initiated the research in this area for decades. Several researchers developed different indices to measure the fund and portfolio performance, some of the widely used indices for performance measures are Sharpes ratio, Jensen's alpha and Treynors index. These indices had been widely used by the researchers for

performance assessment of mutual fund using parametric approach. Although these indices provide a great deal of information they are not free from criticism. Murthy et al. (1997) first highlighted the advantages of non parametric approach (Data Envelopment Analysis) over parametric approach and proposed an index commonly known as DPEI index for performance assessment of mutual funds. Sequentially a number of studies were performed using the same approach. This paper also attempts to apply non-parametric approach- Data Envelopment Analysis to evaluate the relative performance of mutual funds in India. The rest of the paper is organized as follows: Section I gives an overview of mutual fund in India. Section II presents the literature review. Section III discusses the model used and data description followed by the result and analysis in Section IV. Finally Section V concludes the paper with suggestion.

Overview of mutual fund in India

The mutual fund industry started in India way back in 1963 with the formation of Unit Trust of India (UTI), a joint initiative of Reserve Bank of India (RBI) and government of India with the primary motive of attracting small investors.UTI enjoyed a monopoly for almost 30 years which ended with the entry of other players like LIC, GIC and Public sector bank. The Classification of almost five decades of mutual fund into six phases has been done by the Association of Mutual Fund in India (AMFI). According to the classification in the first phase (1964-87) UTI enjoyed its monopoly and at the end of 1988 had Rs 67000 millions of assets under management.

The second phase (1987-1993) marked the entry of non UTI, sponsored by public sector bank and financial institution. The asset under management of mutual fund reached to 470040 million by the end of 1993. The third phase (1993-2003) started with the entry of private sector funds (both Indian and foreign) offering investors with a wider choice of fund families. The SEBI regulation also started in this period. By the end of 2003, the number of mutual funds rose to 33 with total assets of Rs. 1218050 million. The fourth phase (2003 onwards) the mutual fund is consolidating its growth. There are 36 assets management companies covering the private sector, Indian public sector and joint ventures with foreign players. The asset under management grew to 4173000 million by the 2009.

Literature Review:

The performance measurement of mutual fund is an old phenomenon due to its academics and practical importance. There had been a proliferation of literature in the past four decades dedicated to performance measurement of mutual fund due to its attractiveness to the investors. Further some of the organizations (Morningstar

incorporated) have also attempted to develop their own fund performance measures. Due to its popularity and increasing demand in financial industry the researchers have highlighted the need of a robust performance measure of this financial instrument.

The earliest measure of performance measure of mutual fund was given by Treynor (1965) commonly known as Treynor index, defined as excess return per unit of systematic risk. A year later Sharpe gave index to access the performance of mutual fund commonly known as Sharpe's ratio which is the excess return per unit of total risk. Another index which has been widely used for this purpose is Jenson's alpha given by Jensen (1968) which is defined as the difference between actual portfolio return and benchmark return. Although these indices have been widely used by researchers to measure the performance of mutual fund, they are not free from criticism. The researchers have accessed the performance of mutual funds considering several factors besides risk and return which is a traditional way of performance measurement. Many researchers highlighted the importance of the non parametric approach for performance measurement of mutual funds.

The non parametric approach- DEA proposed by Charnes et al was first introduced by Murthi et al (1997) to measure fund and portfolio performance. They highlighted several shortcomings of the traditional approach and proposed the new index for a performance measure that has a number of advantages. Establishing the relationship between return (output) and expense ratio, turnover, risk and loads (cost) a new index was developed called DEA portfolio efficiency index (DEPI).

$$\text{DEPI} = \frac{\mathbf{R}}{\mathbf{v\sigma} + \sum_i \mathbf{wiXi}},$$

Where, R is the difference between actual return and risk free return (risk premium)

$\mathbf{Xi}$ refers to transaction cost such as expense ratio, loads and turnover

wi and v are the weights associated with variables Xi and σ

The main advantage of this index is that it avoids the benchmark problem that exists in the traditional method using Jensen index. Further it also captures the source of inefficiency which is not captured in traditional approach. Although this index offers much flexibility as it does not require any assumption of functional form this measure is also consistent with traditional indices in following way:

a) The index can be considered as a generalization of Sharpe index because when the transaction cost input variable are dropped the index becomes conceptually equivalent to Sharpe index.

b) A positive correlation between DPEI and Jensen index indicates that it can be used as an alternative portfolio performance measure.

Besides these advantages this index was useful in finding strong evidence that the mutual funds are all approximately mean variance efficient which provides the empirical support for mean variance efficiency theory. These findings by Murthi et al initiated several studies in this direction. Basso and Funari (2001) proposed an improved DPEI index named I_{DEA-1} which can be seen as a generalization of DPEI index which allows considering different risk measures with a slight difference in transaction cost taken into consideration. In particular this took into account only the subscription cost and redemption fee that directly burden the investors but not the other expense that have already been deducted from the fund quotation.

Further in another attempt to improve the existing DEA index Chen, Z. and Lin, R. (2006) included two more measures of risk VaR and CVaR and measured the performance of Chinese mutual funds employing this new indicator. The inclusion of these two measures of risk was found to be very helpful for comprehensively describing return distribution properties and fund characteristics such as asset allocation structure which in turn can better evaluate the overall performance of mutual fund.

DEA has also been applied to measure the performance persistence of equity funds. Hsu, S.C and Lin, R.J (2007) applied data envelopment analysis to measure the performance persistence of Taiwan's domestic equity fund during the period 1999 to 2003 by using transaction cost and excess return simultaneously. It was found that the technical efficiency measured by DEA was positively correlated to the Sharp's index. The important finding of their study suggested that there exists a significant 'hot hand' effect in Taiwan's domestic equity funds under the technical efficiency measure, which indicates that funds which performed well in recent years continue to perform well in the subsequent years. The implication of their study was that the investors can benefit from chasing the past winners and avoiding the past losers. Further it was found that the transaction cost plays an important role in determining the performance of mutual fund while management fee, load fee and turnover ratio have a negative impact on fund performance.

As the traditional index like Jensen index have been widely criticized due to need for benchmark to evaluate performance this problem is eliminated by using DEA approach. Kuosmanen, T. (2007) presented the method which compares the mutual fund performance to an endogenously selected benchmark using DEA approach. Since the DEA approach not only measures the relative efficiency of fund it also help in identifying the sources of existing efficiency providing a great deal of information to managers and investors. Further this information can help in identifying portfolio strategies that can achieve such performance.

Hu,L.J. and Chang, P.T (2008) applied a three stage DEA model to decompose fund underperformance and to re-evaluate pure performance. In the first stage they accessed fund performance using constant return to scale (CRS) DEA model followed by

stochastic frontier regression to effect of fund, manager attribute and noise. The regression result suggested that the performance of the fund with larger fund size, higher prior performance and younger age is outstanding. Further the performance of fund significantly increased with manager's tenure and education and decreased with the number of managed funds. Finally a DEA model with adjusted data was run to obtain a pure managerial frontier and a positive relationship was found between the pure efficiency score and original score.

Hence all the above literature advocates the use of DEA in measuring the performance of portfolio and fund and highlights the advantages of this approach over the traditional measures. Despite these advantages this approach has not been employed in measuring the performance of mutual fund in India this has particularly provoked the current study.

Methodology:

Data envelopment analysis (DEA) is a linear programming technique developed by Charnes, Cooper and Rhodes (1978, 1979, 1981) (CCR model) to evaluate the relative efficiency of public sector not for profit organization where financial and accounting ratios were of little value. The DEA technique identifies the efficient unit in a given set of identical or homogenous business units. It compares the observed outputs and inputs, identifies the relatively best practice units to define the efficient frontier and then measure the degree of inefficiency of the other units relative to the efficient frontier thus defined (Oral,M. and Yolalan, R, 1990). The unit with an efficiency score of 1 (with no slack) is considered to be efficient while a score less than 1 indicates that the unit is inefficient. The relative efficiency in DEA means that the companies are efficient with respect to other companies in the sample. The CCR model allows the companies to adjust its own weight respectively so that it becomes relatively efficient. Hence the efficiency score is the weighted set of inputs to the weighted set of output.

The CCR model is illustrated below:

Let there be N companies to be evaluated. Each company consumes I different inputs to produce R different outputs. More precisely company j uses Xij of ith input to produce Yrj of jth output (where j = 1,2,3,…n). Further it is assumed that Xij ≥ 0 and Yrj ≥ 0. The model is formulated as below:

Max $E_B = \left\{\sum_{r=1}^{R} u_{rB} y_{rB}\right\} \Big/ \left\{\sum_{i=1}^{I} v_{iB} x_{iB}\right\}$

Subject to

$\left\{\sum_{r=1}^{R} u_{rB} y_{rj}\right\} \Big/ \left\{\sum_{i=1}^{I} v_{iB} x_{ij}\right\} \leq 1$

For j = 1,2…….N

$u_{rB}, v_{iB} \geq \varepsilon > 0 \quad \forall \quad r, i.$

where,

E_B = efficiency of a particular company B.

y_{rB} = amount of rth output produced by the company B

x_{iB} = amount of ith input consumed by the company B

y_{rj} = amount of rth output produced by the jth company

x_{ij} = amount of ith input consumed by the jth company

u_{rB} = the weight assigned to the rth output of the company B

v_{iB} = the weight assigned to the ith input of the company B

ε is a sufficiently small number

The above fractional form can be reduced to the following linear form:

$$\text{Max } E_B = \sum_{r=1}^{R} u_{rB} y_{rB}$$

Subject to

$$\sum_{r=1}^{R} v_{iB} x_{iB} = 1$$

$$\sum_{r=1}^{R} u_{rB} y_{rj} - \sum_{r=1}^{R} v_{iB} x_{ij} = 1$$

For j = 1,2…….N

$u_{rB}, v_{iB} \geq \varepsilon > 0 \quad \forall \quad r, i.$

As one of the requirement in using DEA model is that input h(x_{ij}) and output t(y_{rj}) must be non negative. However it is very likely that returns on some fund are negative to overcome this problem we follow Murthi et al (1997) adjustment procedure by adding the value of 1 to each fund's excess return. This helps in meeting the non- negative outputs by DEA technique.

Sample selection:

The DEA models are applied to evaluate the relative efficiency of comparable and identical decision making units or organizations. Thus it makes little sense to compare different types of mutual fund. Hence the sample consists of two types of balanced category mutual funds: a) dividend plan and b) growth plan. The sample consist of 15 funds in each of the dividend and growth plan, 15 units are sufficient for the study pertaining to the rule of thumb given by banker et al (1986) that the DMU's should be at least twice the sum of input and output (Chu et al., 2008).

Selection of input and output variables:

The appropriate selection of input and output are very important for the successful application of the DEA technique as the improper variable may result in biased DEA evaluation results (Valdmanis, 1992 & Hughes et al., 2004). Hence our choice of the input and output variables comes from the earlier literature on performance evaluation of mutual funds. In the input value at risk (VaR), conditional value at risk (CVaR), standard deviation of return, residual risk and imputed cost have been included to better evaluate performance. The modern risk variables VaR and CVaR were first included in the performance evaluation of mutual fund by Lin chen (2006). The variables included as output in the study are annual return and residual return. Annual return has been considered as major output variables in various studies (Murthi et al, 1997 and Lin Chen, 2006).

The input and output considered in the study are as follows:

Table 1

Input	Output
Standard deviation of return	Annual return
Value-at- risk	Residual return
Conditional value-at-risk	
Imputed cost	

Results

The efficiency scores for both dividend and growth plan are calculated using output oriented CCR model. The score of 1 indicates that the fund is efficient relative to the other fund evaluated and the score less than 1 indicates that the fund is inefficient relative to the efficient funds.

Table 2

	Dividend Plan			Growth Plan		
year	2009-10	2010-11	2011-12	2009-10	20010-11	2011-12
Average	0.930877	0.939507	0.95918	0.874414	0.955867	0.923477
Std. Dev	0.07101	0.040445	0.069931	0.09588	0.044313	0.086099
Max	1	1	1	1	1	1
Min	0.734149	0.861568	0.768847	0.697441	0.829105	0.741316
Number of efficient funds	5	2	9	3	5	7
Total number of	15	15	15	15	15	15

DMUs						

The figures in the table suggest that the average efficiency of the mutual fund for both dividend and growth plan have increased except for the year 2011-2012 of growth plan where the average shows the decrease. The average performance of dividend fund has increased by 0.863% from year 2009-10 to 2010-11 while for the growth plan increment is 8.14%. Further from the year 2010-11 to 2011-12 the efficiency has increased by 1.9673% for the dividend while it has decreased by 3.23%for the growth plan.

In the dividend plan, Birla Sun Life 95 Fu plan remained efficient for all three years while in the category of growth plan, LICMF balanced fund remained efficient for all three years. Baroda pioneer balanced fund showed improved performance from the year 2009-10 and appeared hundred percent efficient in the year 2010-11 and 2011-12 respectively while Birla Sun Life Fred was also found to be 100% efficient for two years. In the growth plan LICMF was found to be 100% efficient for all the three years while Baroda Pioneer and SBI magnum showed improvement in performance and finally appeared to be 100% efficient in the subsequent years.

Identification of sources of inefficiency:

The above mentioned results shows the funds which were found to be efficient employing output oriented CCR model. However further investigation is required to find the sources of inefficiency which can be either because of inefficient operation of DMUs itself or due to disadvantageous conditions under which the DMU's are operating. For identifying the sources of inefficiency the scale efficiency (ratio of efficiency score of CCR and BCC model) and mix technical efficiency (ratio of SBM efficiency and CCR efficiency) scores are calculated. The following table gives fund which were found to be efficient in BCC model but was not found 100% efficient in CCR and SBM models.

Table 3

year	**Fund Type : Dividend**	CCR efficient	BCC efficient	SBM efficient	Mix efficiency	Scale efficiency
2007	Escort Balanced fund	0.97674	1	0.976742	1	0.97674209
2008	DSP Black Rock fund	0.93726	1	0.960241	0.976068	0.976068011
2009	Escort Balanced fund	0.967159	1	0.952848	0.985202661	0.967159074
	Fund Type : Growth					
2007	Birla Sun Life Freedom	0.920566	1	0.485682	0.52759075	0.982895
2008	FT India Balanced growth fund	0.961535	1	0.94277	0.98048444	0.961535
2009	HDFC Prudence	0.946277	1	0.942312	0.99580892	0.946277

Hence it can be inferred from the above table that in the Dividend category, Escort Balanced fund, DSP Black Rock fund and Escort Balanced fund were found to be BCC efficient but not 100% efficient in the CCR and SBM models. Here the Escort Balanced fund shows the scale inefficiency. Further in the Growth category Birla Sun Life Freedom, FT India Balanced growth fund and HDFC Prudence Growth option were found to be BCC efficient but not CCR and SBM efficient. Hence it can be concluded that CCR and SBM model are robust measures of efficiency because even if some DMU's have scale inefficiency it can be shown to be BCC efficient.

Suggestion for Improvement:

The overall efficiency has been increased over time for both dividend and growth plan funds. Further the funds which have been inefficient regularly as compared to the other funds can also become efficient if they provide better returns to the investors at a given level of risk.

Further, this analysis is useful for the investors as they can take the decision to invest in funds which are found to be efficient for two or more years. Further it will be fruitful for investors to invest in funds which have been either performing well for all years of analysis or which have improved and finally became equally efficient as their peer funds (Birla SunLife and SBI magnum can be considered worthwhile investing.

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