EFFICIENCY ANALYSIS OF SELECT MUTUAL FUNDS IN INDIA- A DATA ENVELOPMENT ANALYSIS APPROACH

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The paper attempts to evaluate the relative efficiency of sixty Indian mutual funds under three categories namely equity, debt and hybrid funds using Data Envelopment Analysis (DEA). Specifically, the purpose of the paper is to evaluate the funds' scale efficiencies and to rank the sampled mutual funds on the basis of total productivity change using the DEA-based Malmquist Index. The results of efficiency analysis show that a majority of the funds in all categories are inefficient; the most efficient category of funds is hybrid fund category. However, substantial gains (greater than 10%) in funds' productivity in all categories of funds for the analyzed period has been observed. The results indicate improved managerial skills and better investment decisions as the underlying causes of improved productivity.

Key words: Mutual Funds, Efficiency, Data Envelopment Analysis, Malmquist Index, Productivity, India

INTRODUCTION

Mutual funds play a crucial role in the development of the financial system. The Securities and Exchange Board of India (SEBI) defines mutual fund as a ' fund established in the form of a trust to raise money through the sale of units to the public or a section of the public under one or more schemes for investing in securities, including money market instruments or gold or gold related instruments or real estate assets' (Pathak, 2014).Mutual funds are those vehicles of investment that pool resources from small investors leading to increased participation of the investors in financial markets. This also promotes financial inclusion in the economy. Since mutual funds are professionally managed and there is transparency in investment strategy adopted, individual investors are expected to benefit from such investments. Further, since net asset values (NAV) of the open ended funds are available, investors can easily assess the

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worth of their investments at any given point of time.

Performance evaluation of mutual funds has always attracted the interest of researchers as well as fund managers. In pioneering studies conducted by Sharpe in 1964 and 1966 (which involved measurement of return of portfolio adjusted for its variability usually proxied by the standard deviation), Treynor in 1965 and Jensen in 1968 and 1969, the performance evaluation of mutual funds has often been carried out using Capital Asset Pricing Model (CAPM). However, almost all the mentioned performance evaluation measures have significant deficiencies. The first relates to non-availability of a standard by which a benchmark for normal performance of a financial unit can be assessed. According to the theory of modern portfolio, the strategy of comparable risk combined with investment in risk free asset is what defines benchmark return. Roll (1977) and Lehman & Modest (1987) assessed the sensitivity of portfolio performance. The results showed that there was hardly any similarity between absolute and relative mutual fund rankings.

Another significant shortcoming in these performance evaluation measures is the incapability to take into account numerous costsassociated with the funds that are charged from the shareholders. Iinvestors' are usually charged with various direct and indirect costs that eventually reduce the final adjusted return. Sales costs which include front-end costs and back-end loads, administrative, operational, and certain marketing costs that are, in usual circumstances, proxied by the mutual fund's management expense ratio are some of the costs associated with the fund. Various researchers such as Malkiel (1995) and Babalos et al (2009) have examined the effect of various costs on the fund's eventual returns and observed a negative relationship between the fund's performance and various kinds of fund's costs.

The above inherent limitations of performance evaluation measures can be taken care of by using an alternative non-parametric method known as Data Envelopment Analysis (DEA that was first used by Murthi et al. (1997) for evaluating portfolio performance. This non-parametric method, popularized by Charnes et al (1998) and Bankers et al (1984) is widely used in operations management research to evaluate efficiency of decision making units.

The DEA approach assesses the performance by measuring the efficiency of the decision making unit (the individual fund here) vis-a-vis the efficiency of its peer group funds. This is carried out subsequent to the construction of an efficient frontier from a linear

combination of efficient funds and calculating fund deviations from the efficient frontier known as slacks or performance inefficiencies.

The present paper addresses the vital issue of fund performance evaluation using different input and output parameters. In particular, non-parametric DEA approach is employed to measure the performance of a sample of Indian mutual funds under three categories i.e. equity, debt and hybrid. We further evaluate the funds' total productivity change using Malmquist index and based on the Malmquist index results, mutual fund are ranked in their respective categories.

The DEA method allows us to compute inefficiency measures of the individual input and output factors in order to identify the source and extent of any performance inefficiency. DEA has gained momentum due to a number of factors like simplicity and use of a combination of multiple inputs and outputs. This encouraged its usage over several domains. The main advantage of DEA is its non-parametric nature i.e. it does not assume any functional form between the inputs and outputs. The remainder of the paper is organized as follows. Section II contains an overview of the relevant literature followed by methodology, data description and variables used in section III. Section IV presents and discusses the empirical results. Section V provides concluding observations with limitations and future scope of the study.

MUTUAL FUND PERFORMANCE EVALUATION: A REVIEW OF LITERATURE

In recent years, only a few studies have evaluated the performance of mutual funds. The methods used for performance evaluation have been either parametric or non-parametric approaches. Studies that employed parametric approach to performance evaluation of mutual funds include methods such as abnormal return measures or reward to volatility indices (Treynor 1965, Sharpe 1966) as in Romacho & Cortez (2006).

However, empirical evidence measuring the performance of mutual funds' using DEA is rather limited. DEA method was first employed by Murthi et al. (1997) for evaluation of mutual fund performance. A sample of 2083 US equity funds were considered. The input variables used were turnover, loads, management expense ratio and standard deviation of returns. A significant correlation was observed between the efficiency score and Jensen's alpha for all the categories. McMullen et al(1998) analyzed 135 stock funds based on DEA efficiency measure. The results revealed that only a small proportion of

funds were efficient; the most popular funds, by and large, registered dismal performance. A more generalized version of the DEA approach was used by Basso and Funari (2001) where they used stochastic dominance as one of their outputs and employed both single input-output formulations. Along with this, standard deviation, subscription costs, beta, standard semi-deviation and redemption costs were factored in as inputs whereas mean returns and percentage of periods whose funds are non-dominant were taken as outputs. Sample of 47 mutual funds were used in categories namely equity, bond and balanced funds. The period for analysis was from 1997 to 1999. It was observed that the ranking of funds had a significant impact on subscription and redemption costs.

Another study performed by Murthi and Choi (2001), described the relationship of cost-return efficiency and market value. This was based on Murthi et al. (1997) although this study combined the method of DEA and Sharpe ratio. A sample of 731 equity funds of U.S was considered and categorized in seven groups. The results indicated that over 90% of funds exhibited increasing returns to scale. This was mainly due to the turnover as well as the load of the funds. Galagedera and Silvapulle (2002) examined a sample of 257 Australian funds for the period of five years from 1995 to 1999. DEA based results showed that more funds were efficient in shorter time horizons as compared to when the long term growth of funds and distribution of income was considered. Similar study conducted by Sengupta (2003), investigated the performance of 60 mutual funds from U.S. The output variables used were raw returns, whereas the input variables were turnover, loads, risk proxied by standard deviation, expenses or expense ratio and skewness of returns from years 1988 to 1998. It was noted that more than 70 percent of funds were highly inefficient. Anderson et al. (2004) analyzed US based mutual funds of real estate. The sample size taken was from years 1997 (28 funds) to 2001 (110 funds). The input variables used were loads, costs like redemption costs, subscription costs and fund's risk proxied by standard deviation. The output variable used was raw returns. It was observed that the lack of operating efficiency of funds was caused by charges levied along with various loads that are deducted from the net return.

A study performed by Daraio & Simar (2006) gave a robust method for measuring the performance of the funds. The basis of this study was the theory of order-m frontier. Sample size of 3000 mutual funds of US was considered for the period 2001 to 2002. The input variables used were standard deviation, management expense ratio, turnover and size of fund, whereas the output variables used was raw returns. It was observed

that the economies of scale neither affected mutual fund's performance nor contributed to the unique structure of the fund. Lin and Chen (2008) studied 78 American mutual funds for the period of January 2001 to December 2003. The total time period was divided into three sub-periods of one calendar year each from 2001 to 2003. It was observed that year 2003 had larger number of efficient funds as compared to years 2001 and 2002.

Another study of efficiency analysis by Lozano & Gutierez (2008) was performed by using 108 mutual funds of Spain for the period of three years from 2005 to 2008. The approach involved six types of DEA-like programming methods. Input parameter taken was mean return whereas, the risk was observed as the output. The models integrated the stochastic dominance of second order in the proposed method. Zhao et al. (2011) suggested two models using quadratic-constrained DEA for assessment of mutual fund performance. On comparison with past studies, this study indicated two vital factors for mutual funds 'performance, i.e. return and risk, to define mutual funds' endogenous benchmarks and give certain insights and important suggestions for management. The most significant conclusion of the study was that the ranking of mutual funds in China primarily depends on system risk control. Soongswang and Sanohdontree (2011) assessed 138 open-ended equity funds in Thailand by employing Sharpe ratio, Treynor ratio, Jensen's alpha and DEA. Results revealed that the performance of the mutual funds measured by the three traditional methods comprehensively outperformed that of the market for all time periods. Whereas, those evaluated by DEA method, resulted in much more varied outcomes. Alexakis and Tsolas (2011) evaluated 15 of natural resources exchange traded funds over the period 2008–2010 by using DEA techniques. It was found that only 8 funds turned out to be efficient. Zhao and Yue (2012) implemented a multi-subsystem fuzzy DEA (MFDEA) model to assess mutual funds 'asset management companies' core competence which is characterized with qualitative as well as quantitative factors. The study was conducted using 32 mutual fund management companies in China.

Babalos et al. (2012) examined Greek equity-based funds for the productivity and efficiency evaluation using the DEA-based Malmquist productivity index over the period 2003–2009. Expected returns were considered as the output and the funds' capital, risk and expense ratio as the input. A vast majority of the funds exhibited significant operational inefficiencies. Major driver of the inefficiency was funds' expenses and incomplete risk diversification. A large number of funds experienced

significant productivity losses. Also, it was observed that asset size had a negative effect on funds' probability of being efficient. Tsolas (2014) analyzed 62 precious metal mutual funds. DEA and Tobit methods were used to evaluate fund performance. It was noted that only four funds turned out to be efficient and there was no scope for efficiency improvement for fifty eight precious metal funds. DEA-based performance was explained by fund size, persistence and beta coefficient.

Hence based on the review of literature, it can be concluded that the performance analysis of Indian mutual funds remains grossly unexplored in terms of their efficiency analysis. This becomes all the more important given the fact that the Indian mutual fund market is flooded with several mutual fund schemes now. Hence, focusing on three basic types of mutual funds namely equity, debt and hybrid (combination of debt and equity), this paper attempts to evaluate the performance of sixty mutual fund schemes using DEA approach. The efficiency scores are used to rank the mutual funds to identify the most efficient ones and the laggards.

METHODOLOGY

This paper evaluates the efficiency of sixty mutual funds in India i.e. twenty each from three categories of funds namely equity, debt and hybrid funds. Five year period from 1st January 2010 to 31^{st}December 2014 has been covered to gauge their performance. Due to non-availability of data, debt funds have been analyzed for only 3 years from 1st January 2012 to 31^{st}December 2014. For hybrid funds, analyzed period is the same as that of equity funds. The data for all categories of funds has been taken from Capital Line Database, reports on nseindia.com, mutualfundsindia.com and amfiindia.com. The funds were selected based on the highest annual returns in the period covered.

Input and Output Variable Specification for DEA

As far as identifying the input and output variables are concerned, there is no clear consensus among researchers. Keeping in mind the investor's perspective, the DEA input-oriented model is employed. It aims at minimizing the level of input for a given level of output. In our application of DEA approach, inputs used are funds' total expense ratio, assets size and risk (proxied by the standard deviation of returns). A fund's expense ratio refers to the overall costs including management fees and other operational and administrative costs incurred by the fund and are typically expressed as a ratio to its average net assets for the year. The annualized standard deviation of the returns is

included as an input because an investment's risk is a vital input consideration for the investor and an essential factor in interpreting returns. Asset size of a mutual fund is the total market value of all the securities held in its portfolio. Annualized returns have been taken as the output variable (Table 1).

Table 1: Input and Output Variables

Input Variables	Management expense ratio
	Standard deviation (as a measure of risk)
	Average asset size
Output Variable	Annualized returns

DEA Methodology

Data Envelopment Analysis (DEA) is a non-parametric approach which is widely used in a variety of benchmarking studies to evaluate the efficiency of a decision making unit (DMU). It measures how efficiently a unit can convert a set of inputs into its outputs. Risk and return of an investment unit can be analogous to inputs and outputs respectively. In DEA-environment, other factors that can form a part of the input can also be employed and a similar thing applies to outputs as well. The DEA measure for a DMU j can be defined as the ratio of weighted sum of its outputs to weighted sum of its inputs (equation 1):

$$h = \frac{\sum_{r=1}^{t} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \tag{1}$$

We define $j=1,2,....,n$ as the number of DMUs, $r=1,2,....,t$ as the number of its outputs and $I=1,2,.....,m$ as the number of its inputs. Additionally, y_{rj} can be defined as the amount of the output r for certain DMU j, whereas x_{ij} is defined as the amount of the input i for a certain DMU j, u_r as the weight that is assigned to the output r and v_i is the weight assigned to input i (Charnes et. al, 1994).

DEA forms a non-parametric efficient frontier over the data points to evaluate the efficiency of each DMU. This is done by constructing the frontier from linear combination of efficient funds and then measuring the inefficiencies by determining the fund deviations from the frontier. The most efficient units usually have an efficiency measure equal to 1: these DMUs cannot be dominated by the other ones in the specific group. Thus, the DEA efficiency measure leads to a Pareto efficiency method in which

the DMUs lie on the efficient frontier (Charnes et al., 1994).

A DEA model can be formed in two versions: input orientation and output orientation. Input orientation follows the concept of reduction of inputs while maintaining the output level, for the fund to be become DEA efficient. An output orientation, on the other hand, follows the concept of expansion of output levels while maintaining the input levels, for the fund to be DEA efficient.

Malmquist Productivity Index (MPI)

Malmquist Productivity Index is used for evaluating the change in productivity over time and ranking the mutual funds based on the productivity change. This approach is used with an assumption that the frontier can shift over the period of time. In this index, whenever there is a presence of inefficiency, then the movement of the unit over time will depend on its position relative to the frontier known as technical efficiency as well as position of frontier itself known as the technical change. If the inefficiency is ignored, then the productivity growth over the period of time will not be able to distinguish between the improvements that derive from a financial institution 'catching up' to its own frontier, or those that are a result from the frontier itself shifting up over the period of time. The Malmquist input-orientated productivity index can decompose the total productivity change between the two given periods into technical change and technical efficiency change. Input-orientation implies that there is emphasis on the equi-proportionate reduction of inputs, within the perspective of a certain level of output.

Positive total factor productivity growth between the two periods is indicated by a value greater than unity. While calculating the MPI using the DEAP software, the results present two main indices – technical efficiency change (TEC) and technical change (TC) and further we break down technical efficiency change (TEC) into pure efficient change and scale-efficient change which is related to fund size. The change in pure technical efficiency could be a sign of enhanced managerial skills or upgraded management structure resulting in a better balance between inputs and outputs, accurate reporting, effective decision making and so on.

RESULTS AND DISCUSSION

Using DEAP software by Tim Coelli, DEA scores were estimated and the results have been organized as follows. The first section covers the scale efficiency scores for all

categories of funds. The next section ranks the mutual funds in their respective category based on the MPI scores.

Scale Efficiency Score analysis using DEA

The scale efficiency score related to all three categories of mutual funds using DEA is presented in this section. Table 2 presents the scale efficiency score for Equity funds.

Table 2: Equity Funds- Scale Efficiency Scores (2010-2014)

Fund Scheme	2010	2011	2012	2013	2014
SBI Pharma Fund	0.810	1.000	1.000	0.814	0.629
UTI Transportation and Logistics Fund	0.666	1.000	0.720	1.000	1.000
Birla Sun Life MNC Fund	0.918	0.830	0.819	0.253	0.781
SBI FMCG Fund	1.000	1.000	1.000	0.528	0.451
UTI MNC Fund	0.752	0.886	0.597	0.263	0.801
ICICI Prudential FMCG Fund	0.576	1.000	0.764	0.498	0.455
Canara Robeco Emerging Equities	0.844	0.845	0.936	0.174	1.000
UTI Pharma and Healthcare Fund	1.000	0.861	0.585	0.754	0.516
Axis Long Term Equity Fund	0.987	0.937	0.648	0.415	0.742
Religare Invesco Mid N Small Cap Fund	1.000	1.000	1.000	0.556	0.781
Franklin India Smaller Companies Fund	0.455	0.771	0.997	0.334	1.000
Reliance Pharma Fund	0.965	0.886	0.705	0.524	0.548
JPMorgan India Mid and Small Cap Fund	0.711	0.701	0.830	0.218	0.920
ICICI Prudential RIGHT Fund	0.604	0.962	0.743	0.739	1.000
BNP Paribas Mid Cap Fund	0.702	0.921	1.000	0.526	0.745
HDFC Mid-Cap Opportunities Fund	0.945	0.925	0.866	0.273	0.935
Religare Invesco Mid Cap Fund	0.599	0.833	0.850	0.304	1.000
UTI Mid Cap Fund	0.503	0.748	0.796	0.252	1.000
ICICI Prudential Exports and Other Services Fund	0.463	1.000	0.644	1.000	0.558
ICICI Prudential Value Discovery Fund	0.887	0.908	1.000	0.237	0.920

In year 2010, only three of the twenty sampled equity funds were efficient. Among them, two were affiliated to public sector (SBI FMCG Fund and UTI Pharma and Healthcare Fund) and one to the private (Religare Invesco Mid and Small Cap Fund). SBI continued to be efficient for two more years till 2012 and then dipped in its performance to be categorized as inefficient in years 2013 and 2014. In 2011, six funds turned out to be efficient with three each from public and private sector. Among private players, ICICI

Prudential did well as two of their funds were efficient. SBI Pharma Fund, one of the public funds was efficient and continued to be so next year as well. Year 2013 for equity funds was not a good one as only two of the funds turned out to be efficient and most of the funds saw a decline in their efficiency with more than 50% of the funds having an efficiency score of less than 0.50. In 2014, with markets witnessing an upsurge, 6 funds turned out to be efficient. However, over the five year period, none of the funds lied on the efficient frontier for all the five years. Overall, years 2011 and 2014 were the years with maximum number of efficient funds. Further, 75% of the equity funds under study have been inefficient.

Table 3 presents the scale efficiency score of sampled Debt funds for the period 2012 to 2014.

Table 3: Debt Funds- Scale Efficiency Scores (2012-2014)

Fund Scheme	2012	2013	2014
Birla Sun Life MIP II - Wealth 25	0.996	0.709	1.000
ICICI Prudential MIP 25	0.848	0.607	0.973
Franklin India Monthly Income Plan	0.941	0.629	1.000
UTI - MIS - Advantage Fund	0.890	0.683	0.943
ICICI Prudential Long Term Plan	1.000	1.000	1.000
HSBC MIP - Savings Plan	0.906	0.454	0.977
Reliance Monthly Income Plan	0.318	0.364	0.993
IDFC Monthly Income Plan	0.999	0.421	0.972
Tata MIP Plus Fund	1.000	0.598	0.940
HDFC Monthly Income Plan - Long Term Plan	0.344	0.371	0.973
Canara Robeco Monthly Income Plan	0.990	0.669	0.972
SBI Magnum Monthly Income Plan - Floater	1.000	1.000	0.844
Axis Income Saver Fund	0.949	0.620	1.000
Kotak Monthly Income Plan	0.896	0.527	1.000
SBI Magnum Monthly Income Plan	0.868	0.430	0.943
ICICI Prudential MIP	0.821	0.561	0.982
BNP Paribas Monthly Income Plan	0.909	0.747	0.847
Birla Sun Life MIP II - Savings 5	0.741	0.393	0.990
HDFC Multiple Yield Fund -Plan 2005	1.000	0.706	0.979
Sundaram MIP - Aggressive	1.000	0.005	1.000

As observed in case of equity funds, 2014 was the best year for debt funds in terms of the number of efficient funds out of the sampled funds. Also, like equity funds, 2013

witnessed a decline in efficiency of almost all debt funds covered in the study. The most efficient fund throughout the sample period was ICICI Prudential Long Term Plan that displayed an efficiency score of one in all three years. Among public sector funds only SBI Magnum Monthly Income Plan – Floater was efficient in years 2012 and 2013, its efficiency registered a modest decrease to 0.844 in 2014. Between the two, debt funds were more efficient than equity funds.

The scale efficiency score of Hybrid funds is presented in Table 4.

Table 4: Hybrid Funds- Scale Efficiency Scores (2010-2014)

Fund Scheme	2010	2011	2012	2013	2014
HDFC Balanced Fund	1.000	1.000	0.905	1.000	1.000
Tata Balanced Fund	0.835	0.963	0.904	0.999	0.983
ICICI Prudential Balanced Fund	0.907	0.980	0.857	0.879	0.952
HDFC Prudence Fund	1.000	1.000	1.000	0.955	0.997
Canara Robeco Balance II	0.917	0.957	1.000	0.962	0.926
Birla Sun Life 95	0.937	0.954	0.786	0.986	0.980
Franklin India Balanced Fund	0.823	0.951	0.773	0.985	1.000
SBI Magnum Balanced Fund	0.728	0.859	1.000	0.879	0.929
Reliance Regular Savings Fund - Balanced	0.975	0.922	1.000	0.962	0.900
Edelweiss Absolute Return Fund	1.000	1.000	0.951	0.879	0.696
JM Balanced	0.770	0.969	1.000	0.944	0.656
DSP Black Rock Balanced Fund	0.889	0.959	0.824	0.925	0.926
Escorts Balanced Fund	0.505	1.000	1.000	1.000	1.000
Escorts Opportunities Fund	0.599	0.947	0.701	1.000	1.000
UTI Balanced Fund	0.870	0.940	0.876	1.000	0.710
Kotak balance	0.900	0.921	0.826	0.980	0.681
Baroda Pioneer Balance Fund	1.000	1.000	0.942	0.996	0.640
PRINCIPAL Balanced Fund	0.710	0.886	1.000	0.991	0.773
Birla Sun Life Dynamic Asset Allocation Fund	0.945	1.000	0.801	1.000	0.780
Sundaram Balanced Fund	0.860	0.825	0.943	0.967	0.658

As far as the best performer among the three categories is considered, hybrid funds score the maximum (Table 4). The most efficient fund out of the sampled funds was HDFC Balanced Fund, having efficiency score of one in four out of five years. Apart from that, Escorts Balanced Fund was also efficient in the last four sampled years. Some funds like

Baroda Pioneer Balance Fund and Edelweiss Absolute Return Fund's efficiency tapered off from being efficient to inefficient over the period of the analyzed years with the former ending the period on 0.640 and the latter ending on 0.696.

The public sector funds did not perform well and were nowhere on the efficient frontier. Further, none of the funds remained on the efficient frontier throughout the period of five years. Among the most inefficient funds was Kotak balance fund which in all five years has never been efficient.

Malmquist Productivity Index (MPI)

All categories of the funds are ranked according to the MPI i.e. change in total productivity over the analyzed period. Total productivity change of the fund can be segregated into a technical efficiency change(catch-up or diffusion term) which examines the extent the fund improves or worsens based on its efficiency, and a technological efficient change (driven by innovation or frontier-shift term) that reflects changes in estimated frontiers between given two periods.

Furthermore, technical efficiency change is decomposed into pure efficiency change and scale-efficiency change. The scale efficiency change is related to fund size. The change in pure technical efficiency could be a consequence of enhanced managerial skills or even upgraded management structure that results in a better balance between inputs and outputs, accurate reporting, effective decision making and so on. Equity mutual funds are ranked based on the values of the Malmquist total productivity index shown in column (7) of Table 5. Values of the MPI greater than one indicates total productivity gains for the relevant fund through the analyzed period.

Table 5: Average technical efficiency change and technological change of Equity funds: 2010-2014

	Fund	Technical efficiency change	Technological change	Pure technical efficiency change	Scale efficiency change	Malmquist Index (TFP change)
1	SBI Pharma Fund	0.928	1.058	0.989	0.939	0.983
2	UTI Transportation and Logistics Fund	1.14	1.017	1.03	1.107	1.158
3	Birla Sun Life MNC Fund	0.948	1.187	0.987	0.961	1.126

4	SBI FMCG Fund	0.79	1.006	0.964	0.82	0.794
5	UTI MNC Fund	1.006	1.207	0.99	1.016	1.214
6	ICICI Prudential FMCG Fund	0.971	1.046	1.03	0.943	1.015
7	Canara Robeco Emerging Equities	1.043	0.94	1	1.043	0.981
8	UTI Pharma and Healthcare Fund	0.83	1.1	0.979	0.848	0.913
9	Axis Long Term Equity Fund	0.93	1.276	0.999	0.931	1.186
10	Religare Invesco Mid N Small Cap Fund	0.922	0.921	0.981	0.94	0.849
11	Franklin India Smaller Companies Fund	1.231	1.277	1.01	1.218	1.571
12	Reliance Pharma Fund	0.868	1.145	1	0.868	0.994
13	JPMorgan India Mid and Small Cap Fund	1.081	1.157	1.013	1.067	1.251
14	ICICI Prudential RIGHT Fund	1.152	1.134	1.016	1.134	1.307
15	BNP Paribas Mid Cap Fund	1.005	0.961	0.99	1.015	0.966
16	HDFC Mid-Cap Opportunities Fund	0.996	1.178	0.999	0.997	1.173
17	Religare Invesco Mid Cap Fund	1.17	0.974	1.029	1.137	1.14
18	UTI Mid Cap Fund	1.208	1.185	1.017	1.187	1.431
19	ICICI Prudential Exports and Other Services Fund	1.062	1.233	1.013	1.048	1.309
20	ICICI Prudential Value Discovery Fund	1.009	1.184	1	1.009	1.194
Mean		1.008	1.104	1.002	1.006	1.112

From Table 5, it has been observed that equity funds have shown an average increase in total productivity of 11.2% during the period of study. This could be due to innovation enhancement in the form of better selection of securities in a fund. Further, better management of funds, adoption of new techniques may have also contributed towards

better productivity. Inter-se, equity funds experienced phenomenal productivity gain for the period under reference. It was further noted that the main driver of the total productivity increase was the technological change witnessed by the majority of sample funds. In particular, funds experienced average annual technological advancement of 10.4% but had an average technical efficiency change of only 0.2% per year. More than 50% of the funds exhibited a positive technical efficiency change indicating an improvement of technical efficiency in the period of analysis.

Decomposing technically efficiency change into pure technical efficiency change and scale efficiency change indicates positive pure technical efficiency change (for 11 out of 20 funds) although the gains are only marginal. However, the scale efficiency gains were marginal up to maximum extent of 0.6 percent.

Table 6 presents the findings of Debt funds

Table 6: Average technical efficiency change and technological change of Debt funds: 2012-2014

	Fund	Technical efficiency change	Technological change	Pure technical efficiency change	Scale efficiency change	Malmquist Index (TFP change)
1	Birla Sun Life MIP II - Wealth 25	1.099	1.059	1.097	1.002	1.165
2	ICICI Prudential MIP 25	1.03	1.013	0.961	1.071	1.043
3	Franklin India Monthly Income Plan	1.164	1.067	1.129	1.031	1.242
4	UTI - MIS - Advantage Fund	1.178	1.02	1.144	1.03	1.202
5	ICICI Prudential Long Term Plan	1	1.141	1	1	1.141
6	HSBC MIP - Savings Plan	1.026	1.19	0.988	1.039	1.221
7	Reliance Monthly Income Plan	1.766	0.737	1	1.766	1.301
8	IDFC Monthly Income Plan	0.986	0.883	1	0.986	0.871
9	Tata MIP Plus Fund	0.948	1.088	0.977	0.97	1.031

10	HDFC Monthly Income Plan - Long Term Plan	1.479	0.781	0.88	1.681	1.154
11	Canara Robeco Monthly Income Plan	1.212	1.009	1.223	0.991	1.223
12	SBI Magnum Monthly Income Plan - Floater	0.919	0.955	1	0.919	0.877
13	Axis Income Saver Fund	1.237	0.84	1.205	1.027	1.039
14	Kotak Monthly Income Plan	1.08	0.91	1.022	1.057	0.983
15	SBI Magnum Monthly Income Plan	1.043	1.02	1	1.043	1.064
16	ICICI Prudential MIP	1.219	0.855	1.114	1.094	1.042
17	BNP Paribas Monthly Income Plan	1	0.788	1.036	0.965	0.788
18	Birla Sun Life MIP II - Savings 5	1.406	1.252	1.217	1.156	1.761
19	HDFC Multiple Yield Fund -Plan 2005	1.096	1.221	1.108	0.99	1.339
20	Sundaram MIP - Aggressive	1	0.915	1	1	0.915
Mean		1.125	0.976	1.051	1.074	1.102

Debt funds, in general, experienced outstanding productivity gains for the sampled period. It was observed that debt funds show an average increase in total productivity of 10.2%; the total productivity gain was mostly driven by the technical efficiency change. In fact, the average technically efficiency advancement was substantial (12.5%). 70% of the sampled debt funds exhibited a positive technical efficiency change. Pure technical efficiency change made a significant contribution of 5.1% to technically efficiency change, with scale efficiency change doing even better with 7.4% increase. Overall, 75% of the sampled debt funds exhibited positive productivity change. Unexpectedly, debt funds experienced negative technological change of 2.4% which could be due to lack investment in new techniques of managing funds and in comparable managerial skill upgrade.

Table 7 presents the findings for Hybrid Funds.

Table 7: Average technical efficiency change and technological change of Hybrid funds: 2010-2014

	Fund	Technical efficiency change	Technological change	Pure technical efficiency change	Scale efficiency change	Malmquist Index (TFP change)
1	HDFC Balanced Fund	1	1.163	1	1	1.163
2	Tata Balanced Fund	1.132	1.106	1.086	1.042	1.251
3	ICICI Prudential Balanced Fund	1.044	1.098	1.032	1.012	1.147
4	HDFC Prudence Fund	0.989	1.128	0.99	0.999	1.115
5	Canara Robeco Balance II	1.089	1.105	1.087	1.002	1.203
6	Birla Sun Life 95	1.07	1.09	1.058	1.011	1.166
7	Franklin India Balanced Fund	1.171	1.078	1.116	1.05	1.263
8	SBI Magnum Balanced Fund	1.164	1.087	1.096	1.063	1.266
9	Reliance Regular Savings Fund - Balanced	0.999	1.13	1.019	0.98	1.129
10	Edelweiss Absolute Return Fund	0.882	1.207	0.966	0.913	1.065
11	JM Balanced	1.004	1.249	1.045	0.961	1.254
12	DSP Black Rock Balanced Fund	1.1	1.108	1.089	1.01	1.219
13	Escorts Balanced Fund	1.24	1.225	1.045	1.186	1.519
14	Escorts Opportunities Fund	1.137	1.164	1	1.137	1.324
15	UTI Balanced Fund	1.01	1.106	1.063	0.95	1.117
16	Kotak balance	1.027	1.152	1.101	0.933	1.182
17	Baroda Pioneer Balance Fund	0.84	1.09	0.939	0.894	0.916
18	PRINCIPAL Balanced Fund	1.09	1.207	1.067	1.022	1.316
19	Birla Sun Life Dynamic Asset Allocation Fund	0.953	1.248	1	0.953	1.19
20	Sundaram Balanced Fund	1.04	1.093	1.112	0.935	1.137
	Mean	1.049	1.142	1.046	1.003	1.191

The results for hybrid funds suggest that they exhibited an average increase in total productivity of 19.1% for the sampled period. It is plausible to attribute this to the investment made in newer technologies and in managerial skills upgrades. As was the case with equity funds, the main driver of total productivity increase is the increase in technological change. Particularly, the hybrid funds exhibited an average increase in annual technological advancement of the order of 14.2% whereas the average technical efficiency change was relatively low at 4.9% percent. Major contributor to the technical efficiency change is pure technical efficiency change with an increase of 4.6%. Funds observed a marginal increase in scale efficiency change which stands at 0.3%.

Table 8 ranks all the sampled mutual funds based on Total Factor Productivity (TFP) using Malmquist approach.

Table 8. Ranking of funds based on Malmquist index (TFP change)

Equity Funds			Debt Funds			Hybrid Funds		
Rank	Fund Name	Malmquist Index	Rank	Fund Name	Malmquist Index	Rank	Fund Name	Malmquist Index
1	Franklin India Smaller Companies Fund	1.571	1	Birla Sun Life MIP II-Savings 5	1.761	1	Escorts Balanced Fund	1.519
2	UTI Mid Cap Fund	1.431	2	HDFC Multiple Yield Fund Plan 2005	1.339	2	Escorts Opportunities Fund	1.324
3	ICICI Prudential Exports and Other Services Fund	1.309	3	Reliance Monthly Income Plan	1.301	3	PRINCIPAL Balanced Fund	1.316
4	ICICI Prudential RIGHT Fund	1.307	4	Franklin India Monthly Income Plan	1.242	4	SBI Magnum Balanced Fund	1.266
5	JP Morgan India Mid and Small Cap Fund	1.251	5	Canara Robeco Monthly Income Plan	1.223	5	Franklin India Balanced Fund	1.263
6	UTI MNC Fund	1.214	6	HSBC MIP - Savings Plan	1.221	6	JM Balanced	1.254
7	ICICI Prudential Value Discovery Fund	1.194	7	UTI - MIS - Advantage Fund	1.202	7	Tata Balanced Fund	1.251
8	Axis Long Term Equity Fund	1.186	8	Birla Sun Life MIP II-Wealth 25	1.165	8	DSPBlackRock Balanced Fund	1.219
9	HDFC Mid-Cap Opportunities Fund	1.173	9	HDFC Monthly Income Plan-Long Term Plan	1.154	9	Canara Robeco Balance II	1.203

10	UTI Transportation and Logistics Fund	1.158	10	ICICI Prudential Long Term Plan	1.141	10	Birla Sun Life Dynamic Asset Allocation Fund	1.19
11	Religare Invesco Mid Cap Fund	1.14	11	SBI Magnum Monthly Income Plan	1.064	11	Kotak balance	1.182
12	Birla Sun Life MNC Fund	1.126	12	ICICI Prudential MIP 25	1.043	12	Birla Sun Life 95	1.166
13	ICICI Prudential FMCG Fund	1.015	13	ICICI Prudential MIP	1.042	13	HDFC Balanced Fund	1.163
14	Reliance Pharma Fund	0.994	14	Axis Income Saver Fund	1.039	14	ICICI Prudential Balanced Fund	1.147
15	SBI Pharma Fund	0.983	15	Tata MIP Plus Fund	1.031	15	Sundaram Balanced Fund	1.137
16	Canara Robeco Emerging Equities	0.981	16	Kotak Monthly Income Plan	0.983	16	Reliance Regular Savings Fund-Balanced	1.129
17	BNP Paribas Mid Cap Fund	0.966	17	Sundaram MIP-Aggresive	0.915	17	UTI Balanced Fund	1.117
18	UTI Pharma and Healthcare Fund	0.913	18	SBI Magnum Monthly Income Plan-Floater	0.877	18	HDFC Prudence Fund	1.115
19	Religare Invesco Mid N Small Cap Fund	0.849	19	IDFC Monthly Income Plan	0.871	19	Edelweiss Absolute Return Fund	1.065
20	SBI FMCG Fund	0.794	20	BNP Paribas Monthly Income Plan	0.788	20	Baroda Pioneer Balanced Fund	0.916

Table 8 ranks the equity funds, debt funds and hybrid funds based on their TFP scores of Malmquist index. The results show that the most efficient fund in equity category is Franklin India Smaller Companies Fund with Malmquist score of 1.571. It means that this fund has an increased productivity by 57.1 percent over the sampled years. A close second is UTI Mid Cap Fund with Malmquist index score of 1.431. In general, funds from UTI have done well and so have funds from ICICI. The lowest score is of SBI FMCG Fund with a score of 0.794, which shows 20.4% decline in productivity.

The results for debt funds show that the best fund according to Malmquist index is Birla Sun Life MIP II - Savings 5with Malmquist score of 1.761. It means that this fund has an increased productivity of 76.1 percent over the sampled years. At distant second position

is a fund from the same HDFC AMC, HDFC Multiple Yield Fund -Plan 2005with Malmquist index score of 1.331. In general, sampled funds have done well though the sampled period as 15 of 20 sampled funds have shown an increase in productivity.

The ranking of hybrid funds show that the best fund according to Malmquist index is Escorts Balanced Fund with Malmquist score of 1.519. It means that this fund has an increased productivity of 51.9 percent over the sampled years. At second position is a fund from the same AMC, Escorts Opportunities Fund with Malmquist index score of 1.324. In general, sampled funds have performed well throughout the sampled period with the exception of Baroda Pioneer Balance Fund that witnessed a productivity decline of 8.4%.

CONCLUDING OBSERVATIONS, IMPLICATIONS AND FUTURE SCOPE OF WORK

The purpose of the present study is twofold. Firstly, it carries out efficiency analysis of select mutual funds using non-parametric DEA method. Management expense ratio (MER), standard deviation of the returns and funds' average assets are used as inputs whereas annualized returns are used as the output variable.

As far as the scale efficiency scores are concerned, only a small percentage of the funds in the sample have been observed to be operating on the efficient frontier based on DEA approach. As expected, the hybrid funds have been the most efficient as compared to the other two categories. The average efficiency during the period of study is highest for Hybrid funds, followed by debt funds and equity funds. The only fund that has been efficient throughout the analyzed period in all categories is ICICI Prudential Long Term Plan (debt fund). According to scale efficiency scores, 45% of the sampled funds in equity category witnessed a decline in efficiency; in the case of debt funds and hybrid funds, it was 30% and 45% respectively.

Total productivity change through estimation of a DEA-based Malmquist index provides some interesting evidence. Substantial productivity gain for all categories of funds was observed through the analyzed period. In particular, equity funds were observed to have more than 10% productivity gains through technological change over the analyzed period. Similar was the case with hybrid funds which made over 14% productivity gains. Unexpectedly, debt funds had a 2.4% technological deterioration. The technical efficiency change was observed to have maximum positive effect in debt funds (12.5%) followed by hybrid funds (4.9%). Equity funds had almost no

productivity gain through technical efficiency change.

The ranking of mutual funds of all three categories was based on the Malmquist index scores, with the top performers in equity, debt and hybrid categories being Franklin India Smaller Companies Fund, Birla Sun Life MIP II - Savings 5 and Escorts Balanced Fund respectively. The worst performers on the basis of Malmquist scores in equity, debt and hybrid are SBI FMCG Fund, BNP Paribas Monthly Income Plan and Baroda Pioneer Balance Fund respectively.

The study provides several managerial insights. Firstly, the major reason for contributing to decline in efficiency and productivity is the technical efficiency change. In particular, the pure efficiency change which has been the cause for concern as it has not yielded gains similar to the gains of technological changes. So, managerial skills concerning these funds needs to be enhanced, management structure could be upgraded, and reporting could be made more transparent. Secondly, in debt funds, lack of technological advancements is another matter of concern as far the productivity deterioration is concerned. Management needs to incorporate sufficient changes in strategy in order to enhance technology advancement. The only fund which has been observed to be efficient throughout the analyzed period is the ICICI Prudential Long Term Plan, a debt fund. Public funds may not be the best option as far as efficiency in mutual funds is concerned. Except UTI Mid cap Fund in equity fund category, no other public sector mutual fund has been among the top performers; this highlights the need to improve upon the efficiency and productivity of public sector funds.

Investors can look at opting for hybrid funds to get the benefits of improved returns and capital appreciation in the long run. This is justified by the average efficiency scores as well as the average number of efficient funds every year. Scale efficiency, as a single measure, cannot capture a mutual fund's performance in all dimensions. Hence, multiple measures must be adopted. Therefore, future studies must consider evaluating various other kinds of efficiency evaluation viz. technical efficiency, allocative efficiency and cost efficiency as these capture various aspects of a fund's performance.

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Appendix: Descriptive Statistics of Data

Table A1: Equity Funds- Summary Statistics of Input and Output Variables

Year	Summary Statistics	Management Expense Ratio (MER)	Standard Deviations (SD)	Average Asset Size (Rs. Crore)	Annualized Returns (%)
2010	Mean	2.369	6.424	5905.870	28.138
	Std. Dev.	0.165	1.523	419.781	7.093
	Min.	1.990	4.630	20.190	17.050
	Max.	2.500	9.420	5905.870	48.080
2011	Mean	2.368	6.538	302.907	85.402
	Std. Dev.	0.199	1.267	490.409	10.681
	Min.	1.820	3.750	16.760	74.090
	Max.	2.500	8.480	1700.350	114.960
2012	Mean	2.371	7.340	413.850	41.095
	Std. Dev.	0.183	2.871	710.799	7.535
	Min.	1.890	2.510	23.690	24.780
	Max.	2.500	10.700	2570.090	55.300
2013	Mean	2.798	10.461	485.042	14.331
	Std. Dev.	0.202	3.871	823.147	9.381
	Min.	2.330	3.280	37.830	3.160
	Max.	3.070	17.410	2830.350	43.590
2014	Mean	2.749	8.659	1377.737	67.883
	Std. Dev.	0.252	2.637	2318.273	19.921
	Min.	2.260	3.840	68.250	30.890
	Max.	3.210	13.090	8221.980	103.960

Table A2: Debt Funds- Summary Statistics of Input and Output Variables

Year	Summary Statistics	Management Expense Ratio (MER)	Standard Deviations (SD)	Average Asset Size (Rs. Crore)	Annualized Returns (%)
2012	Mean	1.862	1.515	633.116	14.648
	Std. Dev.	0.448	0.642	1261.058	2.436
	Min.	0.300	0.310	7.850	9.940
	Max.	2.250	2.740	5035.790	18.950
2013	Mean	2.201	2.732	577.397	5.458
	Std. Dev.	0.577	1.177	1072.115	1.972
	Min.	0.270	0.320	7.610	0.040
	Max.	2.710	4.790	4329.820	9.630
2014	Mean	2.241	2.067	527.912	20.841
	Std. Dev.	0.608	0.567	886.878	2.525
	Min.	0.330	1.520	15.550	17.310
	Max.	2.970	3.830	3641.380	27.700

Table A3: Hybrid Funds- Summary Statistics of Input and Output Variables

Year	Summary Statistics	Management Expense Ratio (MER)	Standard Deviations (SD)	Average Asset Size (Rs. Crore)	Annualized Returns (%)
2010	Mean	2.219	4.304	546.222	15.571
	Std. Dev.	0.353	1.077	1252.486	4.949
	Min.	1.250	2.060	1.010	8.180
	Max.	2.500	6.050	5708.950	26.320
2011	Mean	2.311	3.572	548.896	84.663
	Std. Dev.	0.202	1.042	1333.832	5.483
	Min.	1.790	2.330	1.690	75.550
	Max.	2.500	6.830	6100.410	97.740
2012	Mean	2.323	5.527	588.657	26.096
	Std. Dev.	0.212	1.797	1366.704	5.485
	Min.	1.800	2.230	1.360	12.030
	Max.	2.500	11.520	6239.170	35.030
2013	Mean	2.742	6.786	562.707	105.538
	Std. Dev.	0.262	2.518	1143.545	3.219
	Min.	2.250	1.370	0.950	99.630
	Max.	3.250	11.780	5201.110	111.860
2014	Mean	2.711	5.832	1006.367	39.644
	Std. Dev.	0.241	1.998	1697.862	10.123
	Min.	2.180	2.020	1.630	23.670
	Max.	3.190	10.880	7604.920	56.140

The summary statistics gives a clear picture of how the input and output variables have varied over the sample period. The MER has been the highest for the equity funds followed by hybrid and debt funds respectively. The size of average assets has reduced on an average, as compared to hybrid funds where it has increased over the years indicating the popularity of such funds in the market. Further, mean returns of all three categories shows a decline in 2013, which gets reflected in reduced efficiency scores. Risk, measured by standard deviation, is highest for equity, followed by hybrid and debt category respectively. 2013 witnessed turbulence in the markets and gets reflected in higher standard deviation across all categories.