International Journal of Business Analytics and Intelligence
8 (2) 2020, 23-28
http://publishingindia.com/ijbai/

A Study of the Identification of Efficient Mutual Funds - A Data Envelopment Analysis Approach

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Abstract

This paper attempts to identify efficient mutual funds, analysed on the basis of Data Envelopment Analysis (DEA). This is an endeavour to study the impact of parameters like expense ratio, asset under management, standard deviation, Sortino ratio, Sharpe ratio, beta, alpha, and R-Squared, on the performance of the mutual fund, and to identify efficient mutual funds which lie on the efficient frontier according to DEA. To specify the scope of the study, the above parameters of the open-ended equity schemes of the top 15 mutual funds were considered. A relationship between the funds' parameters was found using the linear programming methodology, which is the DEA. It was observed that only 37 mutual fund schemes implementing the constant return to scale (CRS) and 61 mutual fund schemes implementing the variable return to scale (VRS), out of the 188 mutual fund schemes under consideration, were efficient, as per the DEA approach.

Keywords: Data Envelopment Analysis, Efficient Mutual Fund

Introduction

Assessing the performance of mutual funds has been an important concern for mutual fund managers and financial sector investors. Credible metrics have emerged for assessing the performance of mutual funds. Investment managers have huge responsibilities, and their incentives in the future will be fantastic.

Professionally managed funds, global diversification risks, and market attractiveness are some of the developments experienced by global investors in recent decades. Due to the growing requirements in the financial services industry, organisations like Morningstar have developed their own fund performance metrics.

Three of the most primitive performance metrics in use today are the Treynor index, which measures the excess return per unit of systemic risk; the Sharpe index, which measures the excess return per unit of overall risk; and the Jensen's α index, which measures the gap between the estimated return on the portfolio and the anticipated benchmark return. Groundbreaking studies have focused on calculating efficiency into two dimensions, namely risks and returns on the grounds of the Capital Asset Pricing Model (CAPM).

The Data Envelopment Analysis, unlike other performance metrics, incorporates multiple variables related to mutual fund performance. This approach enables the development of performance indices for mutual funds that take different investment risk measures and expenses into account. The DEA method includes other output measures, in addition to the mean return considered by conventional indices. The DEA Portfolio Efficiency Index (DPEI), which incorporates transaction costs, was thus introduced by Murthi et al. (1997). In comparison with the best fund set, the DEA measures the performance of a mutual fund in the given target zone. It solves the problem of transaction cost endogeneity, by simultaneously taking account of transaction costs and returns in the analysis.

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A more recent, more modern risk assessment should be put in place to calculate the risk of the fund, and thereby assess the performance of the fund. The plethora of methods, on the other hand, often show that several risk indicators may be necessary to accurately assess its performance, this being the advantage of using the DEA method for determining the fund's benefit over other techniques. In addition, DEA demonstrates an efficient argument on how to get the mutual fund to its optimum performance. To date, most research on the framework of the DEA model was carried out by using mutual funds located in the United States, as the Indian market is still growing. Over a period, DEA-based studies of the Indian mutual fund will increase.

Literature Review

Murthi et al. (1997) analysed the mutual funds based on the CRS DEA model and used standard deviation, expense ratio, turnover, and loads as the inputs.

Morey and Morey (1999) analysed the mutual funds based on quadratic-constrained DEA and used variance as the input.

Choi and Murthi (2001) analysed the mutual funds based on CRS and VRS DEA model and used standard deviation, expense ratio, turnover, and loads as the inputs.

Galagedera and Silvapulle (2002) analysed the mutual funds based on the VRS DEA model and used standard deviation, operating expenses, and minimum initial investment as the inputs.

Wilkens and Zhu (2005) analysed the mutual funds based on the VRS DEA model and used standard deviation and lower partial moments of order 0 as the inputs.

Joro and Na (2006) analysed the mutual funds based on cubic restriction DEA and CRS, and used variance as the input.

Briec, Kerstens and Jokung (2007) analysed the mutual funds based on quadratic restriction DEA (extended) and used variance as the input.

Briec and Kerstens (2009) analysed the mutual funds based on cubic restriction DEA and used variance as the input.

Zhao et al. (2011) analysed the mutual funds based on quadratic restriction DEA and used standard deviation and variance as the inputs.

Matallín, Soler and Tortosa-Alsina (2014) analysed the mutual funds based on DEA and used beta, returns, expense ratio, and standard deviation as the inputs.

Need for the Study

It is observed that mutual fund investors are constantly looking for the well-performing mutual funds. Generally, the investors observe the returns of the mutual fund and take a decision. To have a better understanding of the well-performing mutual funds, it is necessary to identify efficient mutual funds based on various parameters, also called the input factors, that affect mutual fund performance, rather than blindly following the mutual fund performance over a period. In the search for such mutual funds, the need for the study was observed. The study was planned to be implemented using the data envelopment analysis model. This model indicates that efficient mutual funds lying on the efficient frontier are worth investing in, based on the various input parameters of the mutual fund considered in the study.

Objective of the Study

- To identify efficient mutual funds based on the data envelopment approach.

Methodology

The technique used is the DEA (Data Envelopment Analysis), which was essentially developed by Charnes, Cooper, and Rhodes (CCR) to determine the relative effectiveness of output units. This technique is proficient in using several inputs and outputs; the approach is non-parametric and is used to approximate the production frontiers in operational research and economics. It is used to calculate the performance of DMUs (decision-making units) and to benchmark operations management. Effective DMUs lead to a frontier of best practice. Based on the function of production, the maximum output that is achievable for any possible input combination can be displayed.

Mutual funds are considered production units in this research work. As the DEA technique can handle several inputs and outputs, it is beneficial. It incorporates multiple characteristics of investment and fund behaviours, which impact the performance of the mutual fund in addition to normal return and risk. The DEA technique generally reflects the effectiveness of the mutual fund by its position on the boundary of the mutual fund's best returns, numerically based on the proportion of the weighted output to the weighted input. The approximate edge of the best performance is also known as the wrapping surface.

The DEA model has the potential to be evaluated in two ways, namely the input and output orientations. The input orientation provides information as to how much input decrease is essential for an inefficient mutual fund to become DEA-efficient, while retaining its existing output levels. Similarly, an evaluation of the output orientation provides information on how much a DEA-inefficient mutual fund needs to considerably raise its output level such that the mutual fund is efficient.

Data Analysis and Interpretation

To find out the effect of various mutual fund parameters like expense ratio, asset under management, standard deviation, Sharpe ratio, Sortino ratio, beta, alpha, and R-Squared (input factors) on the returns of the mutual fund (out factor), the DEA model was applied on the open-ended Indian equity schemes of the top 15 mutual funds. The top 15 mutual funds houses, in terms of overall asset under management, were ABSL MF, AXIS MF, DSP MF, Franklin MF, HDFC MF, ICICI MF, IDFC MF, Kotak MF, L&T MF, Mirae MF, Nippon India MF, SBI MF, Sundaram MF, TATA MF, and UTI MF. The total schemes under consideration were 188. Secondary data with regards to mutual funds was taken from https://www.valueresearchonline.com/ and the data was collected in terms of five-year returns, with the term ending on January 11, 2020.

The Max DEA 7 basic model was used to implement the linear programming methodology, based on the factors mentioned earlier. Some of the data were negative in nature and were converted to positive numbers by the addition of a constant positive value as per the findings of Bowlin (1998). The 188 mutual funds under consideration formed the decision-making units (DMUs) of the DEA model. The total number of input factors considered was eight, and the five-year return was considered as the output factor. These factors were fed into the Excel sheet, which was subsequently imported into the Max DEA model; the envelopment model distance considered was Radial (CCR 1978, BCC 1984), input orientation, and both return to scale were considered separately, namely the constant return to scale (CRS) and variable return to scale (VRS). As shown in Table 1, when the model was run in the constant return to scale mode, we observed that 37 mutual funds were efficient and had a score of 1; in addition, the table contains a few of the mutual funds having a high score of above 0.9.

Besides the efficiency score, the results are identified by the benchmark lambdas. These are the raw weights assigned to the peer units while solving the DEA model. They are interpreted through the dual formulation of the DEA model. These statistics identify the relative efficiency score so that a mutual fund can achieve the highest optimum level of performance. The table provides information about the relative benchmark lambdas for every mutual fund, except the efficient ones. Efficient mutual funds have a score of 1. Let us consider the 8th mutual fund as mentioned in Table 1, which is the DSP Midcap fund. It has an efficiency score of 92.9%. The last column shows the benchmark lambdas of the efficient mutual funds that are closest in terms of input and output to the DSP Midcap fund. Each percentage indicated with a mutual fund is a statistic. The statistics, on the other hand, are multiplied by the entries for the same reference lambdas. A smaller number is generated throughout. This process is repeated for each input and output benchmark, leading to separate inputs and outputs. These new inputs and outputs will give nearly 100% efficient rectified input variables at the same output level.

This model was executed with VRS, a variable return to scale DEA model. Accordingly, 61 mutual fund schemes were found efficient. On using the CRS, a constant return to scale DEA model, 37 mutual fund schemes were found to be efficient. The difference in the number of efficient mutual funds based on CRS and VRS is because the envelopment surface will differ depending on the assumptions underlying the model.

Table 1: Showing the Sample DEA Output with a Constant Return to Scale

DEA_Results		
DMU (Name of the Mutual Fund)	*Score*	*Benchmark (Lambda)*
ABSL Digital India	1	ABSL Digital India (1.000000)
ABSL Dividend Yield	1	ABSL Dividend Yield (1.000000)
ABSL India GenNext	1	ABSL India GenNext (1.000000)
ABSL Infrastructure	1	ABSL Infrastructure (1.000000)
ABSL Midcap	1	ABSL Midcap (1.000000)
ABSL Nifty ETF	1	ABSL Nifty ETF (1.000000)
Axis Small Cap	1	Axis Small Cap (1.000000)
DSP Midcap	0.929566	DSP Natural Rsrcs and New Energy (0.213084); L&T Midcap (0.504005); Mirae Asset Emerging Bluechip (0.163760)
DSP Natural Rsrcs and New Energy	1	DSP Natural Rsrcs and New Energy (1.000000)
Franklin Prima	1	Franklin Prima (1.000000)
Franklin Technology	1	Franklin Technology (1.000000)
ICICI Pru Dividend Yield Eqt	0.914528	DSP Natural Rsrcs and New Energy (0.403835); Kotak Infra & Eco Reform (0.024287); Nippon India Consumption (0.018690)
ICICI Pru FMCG	0.979984	ABSL Digital India (0.348687); DSP Natural Rsrcs and New Energy (0.153277); ICICI Pru Sensex ETF (0.078687); Mirae Asset Great Consumer (0.297124)
ICICI Pru Nifty 100 ETF	1	ICICI Pru Nifty 100 ETF (1.000000)
ICICI Pru Nifty ETF	1	ICICI Pru Nifty ETF (1.000000)
ICICI Pru Sensex ETF	1	ICICI Pru Sensex ETF (1.000000)
ICICI Pru Value Discovery	1	ICICI Pru Value Discovery (1.000000)
IDFC Infrastructure	1	IDFC Infrastructure (1.000000)
Kotak Banking ETF	1	Kotak Banking ETF (1.000000)
Kotak Emrgng Eqt	0.9912	DSP Natural Rsrcs and New Energy (0.181175); L&T Midcap (0.588769); Mirae Asset Emerging Bluechip (0.133572); Nippon India ETF Junior BeES (0.041156)
Kotak India EQ Contra	1	Kotak India EQ Contra (1.000000)
Kotak Infra & Eco Reform	1	Kotak Infra & Eco Reform (1.000000)
Kotak Sensex ETF	1	Kotak Sensex ETF (1.000000)
L&T Midcap	1	L&T Midcap (1.000000)
Mirae Asset Emerging Bluechip	1	Mirae Asset Emerging Bluechip (1.000000)
Mirae Asset Great Consumer	1	Mirae Asset Great Consumer (1.000000)
Nippon India Consumption	1	Nippon India Consumption (1.000000)
Nippon India ETF Bank BeES	1	Nippon India ETF Bank BeES (1.000000)
Nippon India ETF Consumption	1	Nippon India ETF Consumption (1.000000)
Nippon India ETF Dividend Opp	1	Nippon India ETF Dividend Opp (1.000000)
Nippon India ETF Junior BeES	1	Nippon India ETF Junior BeES (1.000000)
Nippon India ETF Nifty 100	1	Nippon India ETF Nifty 100 (1.000000)
Nippon India ETF Sensex	1	Nippon India ETF Sensex (1.000000)
Nippon India ETF Shariah BeES	1	Nippon India ETF Shariah BeES (1.000000)
SBI Consumption Opportunities	1	SBI Consumption Opportunities (1.000000)
SBI ETF Sensex	1	SBI ETF Sensex (1.000000)
Sundaram Large & Midcap	1	Sundaram Large & Midcap (1.000000)
Sundaram Mid Cap Inst	1	Sundaram Mid Cap Inst (1.000000)
Sundaram Midcap	1	Sundaram Midcap (1.000000)
Sundaram Select Focus Inst	1	Sundaram Select Focus Inst (1.000000)
Templeton India Value	1	Templeton India Value (1.000000)

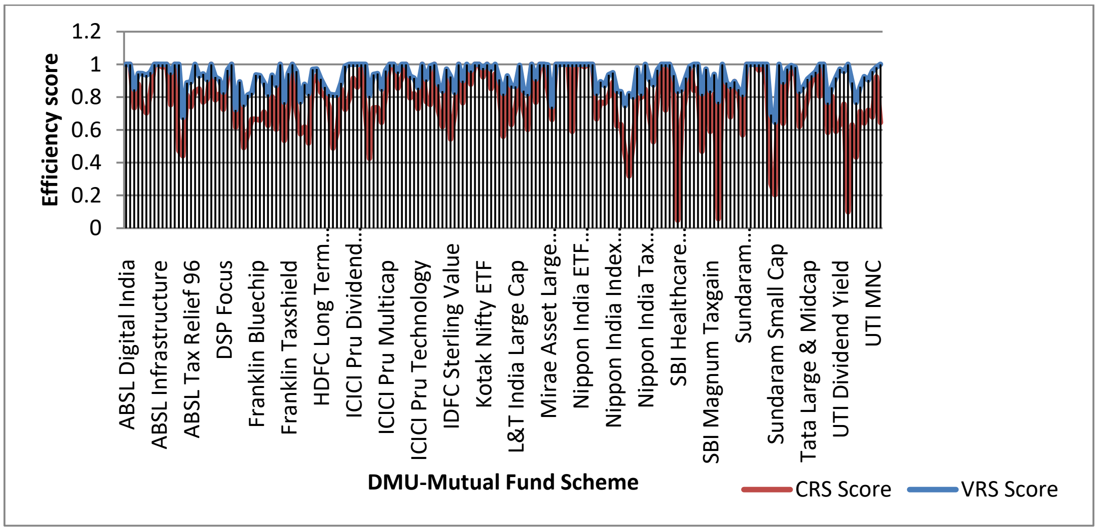

Fig. 1: Chart Showing the Output Graph using CRS and VRS

Conclusion

Out of 188 mutual fund schemes under study, only 37 mutual funds were found to be efficient as per the CRS-DEA model and 61 mutual funds were found to be efficient according to the VRS-DEA model. Since this was an input-oriented model, mutual funds were classified and generally evaluated based on comparable outputs and inputs charged. Hence, it can be assumed that all mutual fund schemes that are below the efficiency boundary need to be compared with industry benchmark efficient mutual funds. To achieve an optimal and high-efficiency score for these inefficient mutual funds, fund managers can inspect all inputs to evaluate the slack they can allow to decrease the input without reducing the outcome.

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Appendix

A brief explanation of the mutual fund parameters used as inputs in the DEA model:

1. Expense Ratio: An expense ratio is an annual fee expressed as a percentage of the investment — or, like the term implies, the ratio of the investment that goes toward the fund's expenses.
2. Asset under management: Assets under management are the overall market value of assets/capital that a mutual fund holds. The fund manager manages these assets and makes all investment-related decisions on behalf of the investors. AUM is an indicator of the size of a given fund house.
3. Standard deviation: Standard deviation is a statistical measurement that shows how much variation there is from the arithmetic mean, Investors, describe standard deviation as the volatility of past mutual fund returns.
4. Sharpe Ratio: The Sharpe Ratio is calculated by subtracting the risk-free return from the portfolio return; which is known as the excess return. Eventually, the excess return is divided by the standard deviation of the portfolio returns.
5. Sortino Ratio: The Sortino ratio measures the risk-adjusted return of an investment asset, portfolio, or strategy. It is a modification of the Sharpe ratio but penalizes only those returns falling below a user-specified target or required rate of return, while the Sharpe ratio penalizes both upside and downside volatility equally.
6. Beta: Beta, concerning mutual fund investing, is a measure of a particular fund's movement (ups and downs) compared to the overall market.
7. Alpha: Alpha is a measure of an investment's performance on a risk-adjusted basis. It takes the volatility (price risk) of a security or fund portfolio and compares its risk-adjusted performance to a benchmark index. The excess return of the investment relative to the return of the benchmark index is its alpha.
8. R-Squared: R-squared is a measure of the percentage of an asset or fund's performance as a result of a benchmark ... A hypothetical mutual fund with an R-squared of 0 does not correlate its benchmark at all. A mutual fund with an R-squared of 100 matches the performance of its benchmark precisely.