Portfolio Return, Risk and Market Timing: A Non-Parametric Approach

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Abstract

The present study extends the portfolio evaluation framework provided by Sharpe (1964) and Treynor (1965) by including the parameter of market timing with the help of a non-parametric framework. Data envelopment analysis has been used in the present exercise to evaluate the performance 79 mutual funds schemes operating in India for three different phases using two different models. Estimation of technical efficiency on the basis of both the models suggests that period 2 performance is substantially divergent from period 1 and 3. Also, higher moments framework gives a better measure of performance as it accounts not only the standard risk measure but also for skewness and kurtosis characteristics of returns.

Keywords: Mutual Funds, Market Timing, Higher Moments, Data Envelopment Analysis

Introduction

Mutual funds play a dynamic role in mobilizing savings by issuing units and channeling the funds in the capital market into productive investment. In this way they further the process of financial disintermediation and also provide depth to the market. The enormous growth in the mutual funds industry throughout the world has raised the demand for performance evaluation of mutual funds from both investors and fund managers perspectives.

In the empirical literature of performance evaluation several indices regarding performance of mutual funds per unit of risk have been proposed. The most important among these are Sharpe index (1966), Treynor index (1965) and Jensen measure (1968) – all are based on the Capital Asset Pricing Model (CAPM). However, these models suffer from two major shortcomings- one is the benchmark selection process and another is the use of linear factor models such as CAPM. Moreover, the asset-pricing models assume constant beta coefficient over the sample period under study. But if fund managers change their strategy by changing their asset allocations, known as market timing (Treynor and Mazuy (1966); Henriksson and Merton (1981)) an estimation bias will occur in case of benchmark models which in turn will make computed measures unreliable. To overcome these problems a non-parametric approach namely, Data Envelopment analysis (DEA) has been applied by researchers in finance for performance evaluation of mutual funds.

Traditional performance evaluation methods mentioned above depend on first order moment (mean) and second order moment (variance) of return which are based on the CAPM hypothesis that portfolio returns are normally distributed. However, according to different studies of the performance evaluation of mutual funds portfolio returns are not always normally distributed (Lau et al.(1990),Cambell et al.(1992)), besides, return distributions have the leptokurtic problem which also has to be taken into account in mutual funds performance evaluation. Moreover, there are studies which have shown that investors prefer skewness and disgust kurtosis (Hwang et al.(1999)). This is why the present study has made an attempt to evaluate the market timing abilities of Indian fund managers applying the DEA approach in both mean-beta (Mβ) and higher moments(HM) framework over the period 2008-2012. The remainder of the paper is organised as follows. Section 2 deals with the related literature. Section 3 describes data and estimation. Section 4 presents results and Section 5 shows concluding observations.

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Related Literature

One of the earliest attempt towards fund evaluation was by Murthi, Choi, and Desai (1997) who put forward a portfolio performance measurement method based on DEA in 1997, called DEA portfolio efficiency index (DPEI), with standard deviation and transaction loads as inputs, and excess return as output, to investigate performance of 2083 mutual funds in the third quarter of 1993.In the first phase of empirical analysis, they compared the DPEI measure with traditional measures of performance corresponding to 731 mutual funds belonging to seven categories: aggressive growth, asset allocation, equity-income, growth, growth-income, balanced and income. In the second phase, they used all 2083 mutual fund for computing DPEI for each fund. They also used a regression analysis to test for the source of variation in efficiency.

Basso and Funari (2001) used several risk measures (standard deviation, standard semi-deviation and beta) and subscription and redemption costs as inputs, and the mean return and the fraction of periods in which the mutual fund was non-dominated as outputs. They proposed two DEA measures for the evaluation of performance. In the first measure mutual fund return has been taken as the output and the standard deviation and transaction cost have been taken as the inputs. In the second DEA measure they built a stochastic dominance indicator which reflects both the investors' preference structure and the time occurrence of returns assigning a higher score to mutual funds which are not dominated by other mutual funds in the higher number of sub-periods. The study was based on weekly return data corresponding to the Italian financial market for the period January 1997 to June 1999. In a later study (2003), Basso and Funari used an ethical score of mutual funds in place of the stochastic dominance indicator.

In a study on 257 Australian mutual funds, Galagedera and Silvapulle (2002) used data envelopment analysis (DEA) to measure the relative efficiency of, and logistic regression for examining the dependence of efficiency on fund attributes, management strategy and the operating environment. The study investigated the sensitivity of DEA efficiency to various input-output variable combinations. More funds are found to be efficient when DEA captures fund's long-term growth and income distribution than a shorter time horizon. DEA ranking of funds, however, is contingent of the time horizon used. Fund's efficiency depended, to a significant extent, on the 'asset allocation score' that they constructed from the fund's wealth distribution to various asset classes. In general, the study revealed that the overall technical efficiency and the scale efficiency are higher for risk-aversive funds with high positive net flow of assets.

Sengupta (2003) developed a set of nonparametric tests which includes the convex hull method and the stochastic dominance criteria for evaluating the performance of mutual fund portfolios.

His study focused on four major groups: (a) growth funds which emphasize capital growth (gt) in their stock composition, (b) balanced funds which place more weight on risk minimization through diversification, (c) income funds which emphasize more on dividends and hence on cash earnings, and (d) technology funds, which play a major role in NASDAQ composite index .For the study, a total of 60 funds (out of a total of 120) were selected for the period 1988-1998.The empirical results supported the hypothesis that some groups of funds based on new technology tend to outperform the others. In most cases, the investor exhibited a preference for skewness , thus emphasizing an asymmetry in the mean variance relationship. Technology funds tend to exhibit second order stochastic dominance over the income and growth funds.

Santos et.al. (2005) evaluated the performance of 307 Brazilian stock mutual funds employing stochastic frontiers. They listed managed funds and the bottom ten for the period April 2001−July 2003, and showed that a fund's efficiency increases with management skill to beat the market. They also found that portfolios with low volatility tend to be more efficient. Yet they did not find any significant relationship between fund size and performance, though this might be blurred by a survivorship bias

Gregoriou, Sedzro, Zhu (2005) used DEA to appraise the performance of 168 hedge funds for the period 1997-2001.They initially used the BCC model to classify the hedge funds into efficient and inefficient categories. Then they used cross efficiency and super-efficiency models to further analyse the efficiency of funds.

Using the Morningstar database of mutual funds, Daraio ans Simar (2006) evaluated performance of six categories of mutual funds (asset allocation, aggressive growth, balanced, equity income, growth and growth income) in terms of conditional input oriented order-m efficiency, Free Disposal Hull (FDH) method and DEA, Jensen's α and Sharpe Index. Total return has been taken as the output in the study while Expense Ratio, Loads and Turnover Ratio have been taken as the inputs. The study also compared the simple traditional indicators (Jensen's α and Sharpe Index) with their non-parametric counterparts(order m efficiency, DEA and FDH) using the Pearson, Spearman and Kendall's tau-b measures of correlation. The results indicate that while indicators based on nonparametric and robust approaches (DEA, FDH, order-m) are highly positively correlated, they are weakly correlated with the traditional indicators (Sharpe ratio and Jensen's alpha.

Zhao, Wang and Lai (2011) proposed two quadratic-constrained DEA models for evaluation of mutual funds performance, from a perspective of evaluation based on endogenous benchmarks. They decomposed two vital factors for mutual funds performance, i.e. risk and return, in order to define mutual funds' endogenous benchmarks and give insights and suggestions for managements. Of the two quadratic-constrained DEA models, one is a partly controllable quadratic-constrained programming.

The approach is illustrated by a sample of twenty-five actual mutual funds operating in the Chinese market corresponding to the years 2005 and 2006. The results show that although the market environment in year 2006 was much better than that in 2005, average efficiency score declined in year 2006 due to relaxing of system risk control. The majority of mutual funds do not show persistence in efficiency ranking. The results indicate that mutual fund ranking in China depends mostly on system risk controls.

Pendaraki (2012) evaluated the performance of 43 domestic equity funds in Greece for the period January 2007 to December 2010 using BCC model of data envelopment analysis. The study applied input oriented DEA model twice for analyzing the effect of inclusion of higher moments as variables in the performance risk – return framework. In the first run, standard deviation is considered as input, and returns and assets as outputs (mean-variance framework). In a second run, the kurtosis is included as a second input and skewness as the third output variable (high moment framework).

In the present study an attempt has been made to develop a performance frontier of Indian mutual funds which can be used for performance benchmarking of mutual funds. However, this performance frontier differs from the earlier approaches firstly, because it incorporates market timing indicator in to the analytical framework and secondly, it tries to evaluate the timing abilities not only in Mβ framework but also in HM framework.

Data & Estimation

Data

The present study uses a sample of seventy nine mutual fund schemes both from the public as well as from private sector for performance evaluation. Out of seventy nine schemes fifty five belong to private sector while twenty four belong to the public sector, so far as ownership pattern of the schemes are considered. According to the investment objective, the sample comprises of sixty five growth schemes and fourteen equity linked savings schemes (ELSS). The details of the sample schemes are given in Appendix I.

This study covers the period January 1, 2008 to March 31, 2012. Since the concept like 'market-timing' is more relevant in case of equity based schemes the present study has considered all the schemes mainly of equity in nature.[1] These schemes are from both public as well as private sector. Out of these seventy nine schemes sixty five are growth schemes and fourteen are equity linked savings schemes (ELSS). Since balanced schemes of the sample are basically equity oriented they are also treated as equity schemes.[2]

The data used in the study mainly comprise of monthly net asset values (NAV). These NAV data are collected

1 The authors constructed a database of 404 equity schemes. However, majority of those schemes disappeared within the period of study. Only 79 schemes were left with data for entire study period.

2 It is found from the websites of the different mutual funds that the balanced schemes of the sample invest 60-70% of their fund in equity and the rest in the debt security. So, they are very much exposed to equity. Besides, it is also found that such balanced schemes use CRISIL Balanced Fund Index as the benchmark index which is the benchmark for equity oriented hybrid portfolios and is a blend of the CNX Nifty Index (65%) and the CRISIL Composite Bond Fund Index (35%). This is why the study has treated these schemes as equity schemes.

from www.mutualfundsindia.com . In order to explore 'market-timing' skills this study has used Sensex as the market proxy. The monthly Sensex data are collected from the Prowess database of CMIE. Generally, treasury bills of different durations have been used as a surrogate for risk-free asset in studies of developed as well as emerging economies(Elton et al. (2011) , Gupta and Sehgal (2001), Chander (2006),Tripathy (2006), Guha Deb et al. (2007), Ahmad and Samajpati (2010)etc.).Hence, in this study the monthly yield on 91day treasury bills of GOI is used as a proxy for risk-free return. These data are collected from RBI website.

Estimation

The monthly returns for each of the sample schemes have been computed by using the following equation:

$$R_t = (NAV_t - NAV_{t-1} + D_t) / NAV_{t-1} \qquad (1)$$

where,

NAV_t = Net asset value of the scheme at the end of the month t

D_t = Dividend paid during the month t.

Similarly, the returns for the market index (Sensex) have been computed. The return on the risk-free asset, i.e., the yields on 91-day T-bills is given on annual basis in the RBI website which is converted to the monthly basis.

The total risk of investing in a portfolio is measured by the standard deviation of the monthly returns of the portfolio and the systematic risk (Beta) of the portfolio is measured by the following market model:

$$R_{pt} = \alpha + \beta R_{mt} + \varepsilon_{pt} \qquad (2)$$

where,

R_{pt} = monthly return of the scheme 'p' for period t

R_{mt} = monthly return on the market index for period t

ε_{pt} = random error term

β = measure of systematic risk

α = a constant term

Higher value of β indicates high sensitivity of fund returns against market returns, the lower value indicates a low sensitivity.

Ratio Approach for Portfolio Benchmarking

The traditional approach of portfolio benchmarking was developed by Markowitz (1952) with his mean-variance (M-V) model. The mean-variance approach can be represented by the following:

Given two discrete return distributions F(x) and G(x) , investors will prefer F(x) over G(x) if $\mu_F \geq \mu_G$ and $Var_F \leq Var_G$ (not both equalities holding simultaneously). However, for using the criterion the investor has to proceed with either a target rate of return or a target rate of variance. This is because the investor can either select the minimum variance portfolio (in the context of a given rate of return) or a maximum return portfolio (corresponding to given variance).

Later, Sharpe (1966), Treynor(1965) and Jensen (1968) provided indices of performance evaluation based on CAPM based benchmarks.

(1) Sharpe ratio: It is defined as the ratio of the excess return of the portfolio (over the risk-free return) to the total risk of the portfolio measured in terms of standard deviation. This is also known as reward to variability ratio (RVAR).

(2) Treynor ratio: This ratio measures the relationship between fund's excess return (over risk- free return) and fund's volatility (market risk) measured by beta. This is alternatively known as reward to volatility ratio (RVOL).

(3) Jensen measure: Unlike Sharpe and Treynor measures, Jensen method studied the absolute measure of performance. Jensen's measure known as Jensen alpha is the differential return (the difference between actual portfolio return and the estimated benchmark return) out of the ability of fund manager in selection of securities.

Unconditional Models of Market timing

The models used for measuring market timing ability actually depends on the beta coefficient as the expected return on a managed portfolio is a linear function of its beta. Now, beta actually measures sensitivity of a security's returns to changes in the return on the market. Given this importance of beta, two popular and time-tested models to know the market timing abilities have emerged: one from Treynor-Mazuy(1966) and another from Henriksson-Merton (1981).

Treynor and Mazuy (TM) have argued that if the fund manager successfully forecasts the market upswing and changes the fund beta accordingly then fund beta would be higher (high equity-debt ratio) than normal values and the fund would be performing better than otherwise. Similarly, when the market declines, the fund has a lower beta value and it declines less than it would otherwise. In these situations, plots of fund returns against market returns would lie above the straight line and give a curvature to the scatter of points. So, their suggestion was to examine the market timing abilities of fund managers a quadratic or squared term should be added to the excess return version of the market model. Thus the model is specified as the following:

$$R_{pt}-R_{ft} = \alpha + \beta (R_{mt}- R_{ft}) + \gamma (R_{mt}-R_{ft})^2 + \varepsilon_{pt} \quad (3)$$

where,

R_{pt} = monthly return on the fund'p' for period t

R_{mt} = monthly return on the market index for period t

R_{ft} = risk-free return

ε_{pt} = random error term

α, β, γ are the parameters of the model and can be estimated by the standard OLS technique while all other symbols have their usual meanings. According to Treynor and Mazuy γ is the measure of market timing. A significantly positive value of γ denotes the presence of market timing ability.

Extension of Ratio Approach and Integration of Market Timing

The objective of the present study is to develop a performance frontier of Indian mutual funds which can be used for performance benchmarking of mutual funds. However, the performance frontier differs from the earlier approaches as it incorporates market timing indicator in to the analytical framework. The frontier is constructed by applying data envelopment analysis and by using the concept of distance function.

The Distance Function Approach

In the context of multi-criteria evaluation, Shephard's (1953, 1970) distance function approach provides a sound conceptual basis for the derivation of evaluation criteria. The idea is invoked from a multi-input multi-output production system where distance function provides a functional characterisation of the structure of production technology. The input set of the production technology is characterized by the input distance function while the output set is characterized by the output distance function.

In order to elaborate the concept of distance function, we consider a technology T using a nonnegative vector of inputs $X=(x_1,x_2,......,x_n) \in R^n_+$ to produce a nonnegative vector of outputs $Y=(y_1,y_2,......,y_m) \in R^m_+$. In functional terms, they can be related as: Y=P(X) and X=L(Y)

Given this, an input distance function can be defined as $D_{input}= Max[\lambda:X/\lambda \in L(Y)]$.Intuitively speaking, an input distance function gives the maximum amount by which the producer's input vector can be radially contracted and yet remain feasible for the output vector it produces. The reciprocal of the input distance function can be considered as the radial measure of input oriented technical efficiency.

In an analogous fashion, the output distance function is defined as: $D_{output}= Min [\mu: Y/\mu \in P(X)]$. Intuitively speaking, an output distance function gives the minimum amount by which the producer's output vector can be deflated and yet remain feasible for a given input vector. The radial measure of output oriented technical efficiency coincides with the output distance function.

Data Envelopment Analysis

The performance of a mutual fund can be evaluated using Data Envelopment Analysis (DEA) in the context of a return-risk framework without requiring knowledge about either the risk free rate and return on market portfolio .Data Envelopment Analysis is a non-parametric mathematical programming tool often used for comparing the relative performances of economic units with minimal prior assumption on input-output relation. The DEA method is a generalisation of Farrell's Single input single output technical efficiency measure to the multiple output- multiple input case. The methodology was originally developed by Charnes, Cooper and Rhodes (1978) and was later further extended by Banker, Charnes and Cooper (1984).

The DEA approach constructs the efficiency frontier of mutual funds out of piecewise linear stretches thereby forming a convex production possibility set. In DEA frontier, efficient observations are those for which no other decision making unit or linear combination of units has as much or more of every output (given inputs) or as little or less of every input (given outputs). It envelops data sets and therefore makes no room for noise.

Evaluation of Portfolio Performance by DEA: Alternative Approaches

The Output Expanding Approach

Assume that the mutual funds under observation are output maximisers and they produce at the optimal scale. Under the circumstances, the problem for any particular mutual fund is :

$$\text{Max } \phi_{crs} \quad (1)$$

subject to $\phi\, y^o \leq \lambda\, Y, \quad X^o \geq \lambda X, \lambda j \geq 0$

Technical Efficiency(CRS) = $1/\phi_{crs} = \theta_{crs}$

The assumption of constant returns to scale is appropriate when all the productive units under consideration are producing at an optimal scale.However, because of the presence of various factors like competition related imperfections,government regulations, financial constraints etc. firms may not be producing at the optimal scale.In this case it is essential to modify the CCR DEA model to account for variable returns to scale :

$$\text{Max } \phi_{vrs} \quad (2)$$

subject to $\phi\, y_o \leq \lambda\, Y, \quad X_o \geq \lambda X,\ \Sigma\, \lambda\, j = 1,\ \lambda j \geq 0$

Technical Efficiency (VRS) = $1/\phi_{vrs} = \theta_{vrs}$

ccoutlined in (2) with that in (1), we find that in the second case there is an additional convexity condition $\Sigma\,\lambda$ j = 1. This approach provides a convex hull of intersecting planes that envelope the data points more tightly than the conical hull obtained under the CRS model.The technical efficiency scores obtained under DEA is more than or equal to the scores obtained under the CRS model.(1) and (2) give identical technical efficiency scores if the concerned firm is on the optimal scale of production.

The Input Conserving Approach

This implies minimization of portfolio risk subject to a given level of return (Minimum Acceptable Return).In this case the problem for particular mutual fund is:

Minimise μ

Subject to: $\mu x_0 - X\lambda \geq 0,\ y_0 \leq Y\lambda, \lambda \geq 0$

In the VRS case we add the additional convexity condition $\Sigma\,\lambda$ j=1

Scale efficiency can be calculated in the similar fashion.

The Input-Output Framework

Construction of performance frontier using DEA requires the specification of inputs and outputs. In our present study, we make use of monthly mean return of the funds as the output indicator. For benchmarking purposes, we have used two models-Model 1 and Model 2. In Model 1, portfolio beta and gamma (measure of Treynor-Mazuy market timing) have been used as the two input indicators. Since, beta is a measure of systematic risk here we have used beta instead of variance in the MV (mean-variance) framework and got Mβ framework. In Model 2 the kurtosis is included as the third input and skewness as the second output variable (higher moments framework). So, the first model may be termed as excess return- systematic risk-market timing frontier while the second one may be called excess return-higher moments-market timing frontier.

For estimation purposes, we have taken an output oriented approach and assumed that the funds operate under variable returns to scale.. The chosen model (output oriented radial DEA) is translation invariant. Consequently, this has not affected the outcome.

This non-parametric estimation has been carried out separately for three time periods: Period 1(January2008 –January2009), Period 2 (March2009 – December 2010) and Period 3 (January2011 –March 2012). While period 2 is a bull period, other two periods are bear periods so far as performance of Sensex is concerned.

Results

Table I depicts the basic descriptive statistics of the returns of the sample mutual funds schemes during January 2008 to March 2012. During this period Indian capital market has experienced major fluctuations, a significant decline in stock indices and high liquidity conditions. More precisely, the examined period contain both bull and bear market sub periods due to the 2008 world wide financial crisis triggered by sub-prime crisis in US and 2010 European crisis. Now, it can be seen from the table that during period 1(Jan.2008-Jan.2009) average

Table I. Basic Descriptive Statistics of Returns of Sample Mutual Funds schemes

Sl.No.	Period1				Period 2				Period 3			
	Mean	S.D.	Skew	Kurto	Mean	S.D.	Skew	Kurto	Mean	S.D.	Skew	Kurto
1	-0.0715	0.11532	-0.134531	1.8319	0.0243	0.048	-0.0629	2.271	-0.0184	0.0836	0.4831	2.0399
2	-0.0489	0.09836	-0.110377	1.937	0.0547	0.1048	3.05046	11.37	-0.0024	0.0405	0.3546	2.2907
3	-0.0765	0.00019	0.168296	1.8605	0.0591	0.0003	3.12451	11.95	-0.0106	9E-05	0.3642	2.258
4	0.05888	0.10449	-0.44229	2.0944	0.0589	0.1045	2.6089	10.1	-0.0099	0.0612	-0.116	1.8022
5	-0.0742	0.09829	-0.006598	1.766	0.0571	0.1342	3.21281	12.67	-0.0127	0.0705	0.345	2.1462
6	-0.086	0.09761	0.179802	2.1051	0.0651	0.1295	3.01672	11.83	-0.0111	0.0683	0.034	2.2864
7	-0.0517	0.08484	-0.526045	2.246	0.0623	0.0848	2.37562	8.814	0.00638	0.0574	0.1487	1.78079
8	-0.0773	0.09571	0.151792	2.0367	0.0582	0.1279	2.50177	9.725	-0.0117	0.0634	-0.282	2.42877
9	-0.0447	0.08807	0.007886	1.7173	0.0453	0.0947	3.04428	12.11	0.00098	0.0382	0.007	1.83023
10	-0.0413	0.07355	-0.091114	1.974	0.0421	0.0781	2.87838	11.31	-0.0029	0.0513	0.6471	2.65176
11	-0.068	0.0968	0.002909	1.8694	0.0567	0.1065	2.99929	11.69	-0.0122	0.0591	0.2667	2.03059
12	-0.0809	0.10402	0.092242	2.2762	0.0639	0.1286	2.49296	9.492	-0.0137	8E-05	-0.427	2.51596
13	-0.0854	0.08385	-0.306342	2.1342	0.045	0.1275	3.02739	11.84	-0.019	0.0943	0.481	3.00117
14	-0.0562	0.09579	-0.276289	1.9775	0.0563	0.1161	3.20474	12.63	-0.0036	0.0606	0.3006	2.07554
15	-0.0739	0.11017	0.214993	2.1397	0.0489	0.1134	3.08819	12.15	-0.0093	0.0636	0.3608	2.08666
16	-0.0882	0.1044	-0.131819	1.9484	0.0679	0.0003	3.22898	12.75	-0.0067	8E-05	0.0017	2.0283
17	-0.0571	0.09699	-0.196867	2.0438	0.0508	0.1008	2.88957	11.43	-0.0018	0.0591	0.3076	1.9214
18	-0.0594	0.09574	-0.035796	1.978	0.0552	0.1106	3.20041	12.61	-0.0008	0.0573	0.1972	1.9447
19	-0.0528	0.12199	0.520949	2.0804	0.073	0.1119	2.30407	8.309	-0.0056	0.0734	-0.587	2.8597
20	-0.0429	0.06873	-0.101878	2.0033	0.0378	0.0814	3.02726	11.96	-0.0009	0.0453	0.168	1.9469
21	-0.0396	0.07507	-0.535485	2.7859	0.0512	0.0899	3.33686	13.14	0.00373	0.0484	0.1479	2.01395
22	-0.0697	0.09579	-0.427735	2.1202	0.063	0.1153	3.16065	12.3	-0.0075	0.0619	0.0608	1.8976
23	-0.0624	0.09919	-0.27158	2.1145	0.0707	0.1375	3.38073	13.36	-0.0076	0.0736	0.4094	2.46559
24	-0.0594	0.09489	-0.269001	2.0691	0.0507	0.114	3.04548	12.34	-0.0046	0.0675	0.1941	2.18124
25	-0.0512	0.08031	-0.417637	2.4038	0.0599	0.1113	3.43123	13.6	-0.0004	0.0524	0.4771	2.39585
26	-0.0638	0.09706	-0.444419	2.4019	0.0646	0.1212	3.15674	12.36	-0.0068	0.0603	0.2182	2.07787
27	-0.0533	0.09681	-0.180756	2.1087	0.0631	0.1315	3.27101	12.86	-0.0063	0.0731	0.4182	2.36924
28	-0.05	0.08396	-0.096982	1.5933	0.0381	0.0648	2.61913	10.06	0.00281	0.0424	0.28	1.86726
29	-0.0719	0.10575	0.300842	2.6824	0.0722	0.1237	2.96421	11.34	-0.0059	0.0699	0.3834	2.50313
30	-0.0538	0.09698	-0.306958	1.9007	0.0471	0.0871	2.53426	9.771	-0.0017	0.0741	0.5329	2.56754
31	-0.0674	0.10689	-0.260384	1.8274	0.0579	0.1069	2.94412	11.19	-0.0086	0.0798	0.3605	2.23612
32	-0.0822	0.1078	-0.226498	2.5032	0.0789	0.1266	2.75108	10.6	-0.0043	0.0761	-0.949	3.71158
33	-0.0507	0.07549	-0.173159	1.9182	0.0389	0.0842	3.1073	12.16	-0.0038	0.0467	0.3775	2.31128
34	-0.0693	0.1036	-0.160335	1.9382	0.052	0.11	2.83699	10.79	-0.0066	0.0696	0.5486	2.47685
35	-0.0745	0.11177	0.027226	1.8462	0.0332	0.1146	2.84618	11.57	-0.0056	0.0532	0.1579	1.92585
36	-0.1184	0.14944	-0.628948	3.1993	0.0578	0.2363	3.3739	13.39	-0.0185	0.101	0.8702	3.37789
37	-0.0841	0.12309	-0.09423	1.9873	0.049	0.1415	3.26268	12.84	-0.0227	0.0708	0.0703	2.01925
38	-0.06	0.097	-0.270879	2.0831	0.0453	0.093	2.7528	10.53	-0.0077	0.0551	0.0543	2.18008
39	-0.0622	0.09474	-0.540519	2.4179	0.0279	0.0819	2.62333	10.46	-0.0069	0.0443	0.5248	2.22436
40	-0.0769	0.13789	-0.06346	1.9303	0.0638	0.1618	3.30557	13.14	-0.0128	0.0664	0.2454	2.20565
41	-0.0686	0.13316	0.167923	1.835	0.0481	0.1231	2.98512	11.72	-0.0115	0.0727	0.3073	2.02227
42	-0.0679	0.12248	0.041846	1.9558	0.0541	0.1419	3.21555	12.69	-0.0112	0.0707	0.3323	2.03548

Sl.No.	Period1				Period 2				Period 3			
	Mean	S.D.	Skew	Kurto	Mean	S.D.	Skew	Kurto	Mean	S.D.	Skew	Kurto
43	-0.0702	-0.0702	0.01687	1.7704	0.0449	0.0449	2.63195	10.36	-0.0105	-0.01	0.3496	2.10591
44	-0.0526	0.07463	-0.013352	1.8577	0.0414	0.0943	3.05173	11.93	-0.0065	0.0525	0.3939	2.31736
45	-0.062	0.11042	-0.287947	2.1146	0.0487	0.1037	2.46503	9.525	-0.0084	0.0753	0.2906	2.0441
46	-0.0839	0.10144	-0.146702	2.0047	0.0478	0.0988	2.9557	11.49	-0.0112	0.0759	0.4693	2.27749
47	0.0993	-0.0105	0.236645	2.2097	-0.0085	0.1371	3.26153	12.9	-0.0085	0.0736	0.4384	2.41771
48	-0.0645	0.09989	0.064225	1.6729	0.0533	0.1163	2.7633	10.72	-0.0073	0.0805	0.6292	2.94296
49	-0.0593	0.10351	0.153637	1.6947	0.0587	0.124	3.06727	12.05	-0.0049	0.0647	0.708	2.8264
50	-0.0523	0.08049	-0.128297	1.7179	0.0427	0.0987	3.14622	12.41	-0.0087	0.0529	0.1441	2.16895
51	-0.0705	0.10949	0.110576	1.9299	0.0568	0.126	3.22986	12.72	-0.0038	0.0624	0.4286	2.06688
52	-0.0967	0.11081	-0.179091	2.4361	0.073	0.1659	3.35661	13.29	0.00147	0.0561	-0.71	2.56985
53	-0.07	0.09264	-0.189573	1.9318	0.0556	0.1068	3.20523	12.6	-0.0092	0.0658	-0.026	2.04097
54	-0.0439	0.10421	-0.552391	2.1729	0.0423	0.1275	2.57489	10.16	-0.0787	0.2843	-2.885	9.99244
55	-0.0601	0.12633	-0.435843	3.0587	0.0632	0.0003	2.88554	11.32	0.00329	8E-05	-0.059	1.60494
56	-0.0682	0.09823	-0.126164	2.0163	0.0521	0.1161	3.06243	11.96	-0.0067	0.0641	0.2587	2.02528
57	-0.0487	0.0768	-0.282843	2.1663	0.0453	0.1017	2.91432	11.24	-0.0092	0.0561	0.2275	2.3382
58	-0.0763	0.11066	0.104084	1.7573	0.0543	0.1279	2.94428	11.46	-0.0112	0.0703	0.4343	2.34358
59	-0.0583	0.08595	0.135769	1.8556	0.0484	0.115	2.72766	10.52	-0.008	0.0662	0.5231	2.4344
60	-0.0567	0.08738	-0.051235	1.5743	0.0433	0.0631	2.54803	9.904	0.00033	0.0457	0.076	1.85746
61	-0.0879	0.1121	-0.365417	2.0327	0.062	0.1093	2.53551	9.731	-0.0035	0.0519	-0.038	2.39528
62	-0.0614	0.10346	0.35536	2.8228	0.0613	0.0904	2.1167	7.656	-0.0043	0.0493	-0.362	1.90128
63	-0.0595	0.09883	-0.106384	1.771	0.0477	0.0746	2.30127	8.835	-0.0069	0.0603	0.0767	1.90346
64	-0.0704	0.10059	-0.332956	2.0991	0.0387	0.0825	1.64131	6.838	-0.0117	0.0575	0.2274	1.96066
65	-0.081	0.11522	-0.204742	2.4937	0.0532	0.14	3.12298	12.33	-0.0118	0.0577	0.1646	1.90048
66	-0.1197	0.12412	0.084849	3.0938	0.0638	0.175	3.26209	12.56	-0.0157	0.0621	-0.168	2.26732
67	-0.0932	0.11221	-0.036666	2.414	0.0644	0.1802	3.4142	13.57	-0.0088	0.058	0.1158	1.88457
68	-0.0641	0.13014	0.336515	1.9674	0.0603	0.1414	3.22595	12.81	-0.0103	0.0585	0.2598	2.06436
69	-0.0605	0.10453	0.058954	1.7722	0.0627	0.1175	2.70527	10.52	-0.0102	0.0785	0.8993	3.23381
70	-0.047	0.07766	0.044454	1.633	0.0433	0.0842	2.74598	10.68	-0.0054	0.051	0.3562	2.04585
71	-0.0711	0.11416	-0.094657	1.831	0.041	0.095	2.57573	10.24	-0.0144	0.0625	0.7728	2.75741
72	-0.0519	0.08461	-0.36397	2.1341	0.053	0.0887	2.48756	9.296	-0.0038	0.0608	0.2837	2.00369
73	-0.0675	0.0936	-0.030303	1.8844	0.048	0.0966	2.58362	10.02	-0.0089	0.0607	0.2153	1.94912
74	-0.0662	0.09539	-0.065296	1.7315	0.0474	0.109	2.87576	11.18	-0.0061	0.0641	0.2668	1.91743
75	-0.0468	0.08382	-0.485946	1.8654	0.0529	0.0733	2.06423	7.696	0.00968	0.0493	-0.149	1.57618
76	-0.0281	0.10018	-0.572472	2.6682	0.0556	0.0546	0.14159	2.578	-0.0018	0.0462	-0.075	1.60473
77	-0.0607	0.11136	-0.293957	2.0901	0.0491	0.105	2.48722	9.622	-0.009	0.0754	0.2846	2.04581
78	-0.0665	0.10338	0.063492	1.7484	0.0038	0.0866	-2.4955	9.406	-0.0043	0.0545	0.1738	1.93866
79	-0.0786	0.10208	0.140258	1.9308	0.0555	0.1238	2.96494	11.6	-0.007	0.0776	0.4233	2.36833

Source: Calculated

return for the 77 schemes are negative out of 79 schemes under consideration. However, there is a striking change in results in period 2(Feb. 2009-Dec. 2010) over period 1, where, 78 schemes out of 79 have shown positive returns going by the bull run of the market. Nevertheless, during period 3(Jan. 2011- Mar. 2012) which is again a bear period performance on average return of the schemes again deteriorated from its previous period.

So far as higher moments are concerned, Table I unveils that return distributions are skewed on the left during period 1 while it is much skewed on the right during period 2 which is no doubt obvious. However, the return of sample schemes has shown moderate positively skewed distributions during period 3. This means during period 1 probability of occurrence of extremely small return values of the sample schemes under consideration is relatively large reflecting Indian fund managers are not so efficient in timing the market. If we consider kurtosis values Table I reveals that there are significant differences in maximum kurtosis values during the periods. Among the three periods under consideration period 2 presents excessive kurtosis values. Large kurtosis means occurrence probability of extreme fluctuations is large, which is quite possible during the bull period.

In the present study, we have computed technical efficiency scores for the observed schemes using two models. Table II provided below presents the descriptive statistics of technical efficiency scores for Model 1 while table III presents the same for Model 2.

Table II: Descriptive Statistics of Technical Efficiency (Model 1)

Particulars	Period 1	Period 2	Period 3
Mean Technical Efficiency	0.9581	0.6908	0.9952
Standard Deviation	0.0124	0.1403	0.0024
Maximum	1	1	1
Minimum	0.9359	0.5040	0.9905

Source: Calculated

Table III: Descriptive Statistics of Technical Efficiency (Model 2)

Particulars	Period 1	Period 2	Period 3
Mean Technical Efficiency	0.9637	0.9918	0.9978
Standard Deviation	0.0140	0.0072	0.0019
Maximum	1	1	1
Minimum	0.9466	0.9729	0.9922

Source: Calculated

If we compare technical efficiency scores of Tables II and III then it can be argued that average efficiency is much better in model 2 than in model1during period 2, while it is slightly better during periods1 and 3.Moreover, this efficiency figure is more stable for model 2 than in model 1 during period 2.

The detailed DEA results, the scheme wise technical efficiency scores are given in Table IV. The traditional Mβ and HM results are quite different. On the average, the mean efficiency score for the whole period is 0.88136667 and 0.98443967 in the Mβ and HM framework respectively. Besides, the average number of efficient schemes for the total period is 3.66 in the Mβ framework and 15.33 in the HM framework, while the number of inefficient schemes are 22.66 and 11 in the Mβ and HM framework respectively.

The total number of efficient schemes in the Mβ framework is only six. This number rises to 32 in the higher moment framework. Thus, 26 inefficient schemes in Mβ framework find themselves in the high moments efficient frontier (e.g. MF1, MF2, MF7 etc.). Among these there are 8 schemes which are efficient in at most two periods. There are six schemes which are found efficient in at least one of the three periods under both the framework. On the contrary, 47 schemes are inefficient in both evaluation measures for all the periods indicating that they are the worst performers of the sample. These schemes have low skewness and high kurtosis values thus

Table IV. DEA Efficiency Results

Mutual fund s schemes	Mβ FRAMEWORK			HM FRAMEWORK		
	Period 1	Period2	Period3	Period 1	Period2	Period3
MF1	0.9612	0.5594	0.990658	0.9611875	1	1
MF2	0.9571	0.7292	0.997364	0.957135	1	0.9986544
MF3	0.9433	0.7411	0.993272	0.96305	0.99570203	0.995861
MF4	0.9990	0.5382	0.993991	0.9989756	0.97789531	0.9942652
MF5	0.9505	0.6395	0.992575	0.9504838	0.99185447	0.9959029
MF6	0.9481	0.6419	0.993096	0.9841803	0.98123353	0.9947391
MF7	0.9608	0.7339	0.998902	0.960762	1	1
MF8	0.9565	0.5230	0.996752	0.9948131	0.98210408	1
MF9	0.9574	0.7585	0.99913	0.957449	0.98495515	0.9994256
MF10	0.9628	0.7175	0.996769	0.9627948	0.98632229	1
MF11	0.9507	0.5924	0.99295	0.9507043	0.98258942	0.9957937
MF12	0.9448	0.5143	0.99568	0.9567736	0.98701701	0.9957635
MF13	0.9490	0.9041	0.990477	0.948996	1	0.9947873
MF14	0.9641	0.7056	0.99561	0.9640608	0.99045067	0.9979772
MF15	0.9449	0.6009	0.993703	0.9745598	0.99190221	0.9972615
MF16	0.9484	0.7368	0.994761	0.9484077	0.99043894	0.9958796
MF17	0.9593	0.5967	0.996436	0.9592999	0.97342964	1
MF18	0.9535	0.6628	0.996915	0.9535124	0.99133188	0.9996506
MF19	0.9611	0.5106	1	1	1	1
MF20	0.9643	0.7728	0.997732	0.9643088	0.99612941	0.9984474
MF21	0.9667	0.8515	0.999374	0.9667251	1	0.9998405
MF22	0.9617	0.6542	0.994529	0.9617138	0.99199984	0.9978081
MF23	0.9601	0.7401	0.994259	0.9601285	0.99815469	0.9977306
MF24	0.9658	0.6852	0.995261	0.9658131	0.9729412	0.9970995
MF25	0.9649	0.9098	0.997497	0.9649444	1	1
MF26	0.9659	0.6449	0.994697	0.9658509	0.98960112	0.9973959
MF27	0.9630	0.6494	0.994699	0.9629531	0.99442476	0.9984207
MF28	0.9567	0.7058	0.999296	0.9567248	1	1
MF29	0.9450	0.6333	0.994829	0.9869242	0.98700972	0.9988438
MF30	0.9583	0.6002	0.996222	0.9582908	0.98929978	0.9997797
MF31	0.9590	0.5118	0.99394	0.9590181	0.9898893	0.997624
MF32	0.9509	0.6009	1	0.9508673	0.98083493	1
MF33	0.9590	0.7824	0.996671	0.9589769	1	0.9983149
MF34	0.9574	0.5641	0.994578	0.9573969	0.99432412	0.9985829
MF35	0.9557	0.6879	0.995606	0.9670435	0.99983557	0.9979221
MF36	0.9546	0.9999	0.99062	0.9545686	1	1
MF37	0.9516	0.9983	0.990706	0.9515919	0.99904423	1
MF38	0.9549	0.6566	0.994781	0.9548685	0.99661679	0.9959458
MF39	0.9543	0.9993	0.995872	0.9543272	1	1
MF40	0.9549	0.6845	0.992521	0.9548759	0.99292149	0.995668
MF41	0.9458	0.6458	0.992963	0.9593761	0.98545277	0.9954087
MF42	0.9524	0.7696	0.993067	0.9575729	0.99154003	0.9956443

Mutual fund s schemes	Mβ FRAMEWORK			HM FRAMEWORK		
	Period 1	Period2	Period3	Period 1	Period2	Period3
MF43	0.9496	0.5436	0.993303	0.9496315	0.98988169	0.9959577
MF44	0.9585	0.7314	0.995494	0.9584979	0.99532374	0.9978624
MF45	0.9554	0.5645	0.994001	0.95542	0.99313668	0.9966606
MF46	0.9528	0.5818	0.993065	0.9528295	0.99094514	0.9968255
MF47	1.0000	0.6883	0.993958	1	0.9919147	0.9973459
MF48	0.9525	0.5300	0.994359	0.9596381	0.98374109	0.99862
MF49	0.9509	0.6142	0.995168	0.9685376	0.98382526	1
MF50	0.9568	0.7545	0.994595	0.9567913	0.99538408	0.996082
MF51	0.9452	0.8393	0.995556	0.9508842	0.99227013	1
MF52	0.9468	0.7841	0.999733	0.9467928	0.99624431	0.9997327
MF53	0.9574	0.6489	0.993739	0.9574124	0.99325317	0.9950573
MF54	1.0000	1.0000	1	1	1	1
MF55	0.9684	0.7655	1	0.9684153	0.9813351	1
MF56	0.9574	0.5994	0.994561	0.9573512	0.98725443	0.9971584
MF57	1.0000	0.6530	0.994787	1	1	0.9970306
MF58	0.9451	0.5872	0.993077	0.9567111	0.98420211	0.9966934
MF59	0.9545	0.5414	0.994125	0.9625517	0.99549518	0.9976682
MF60	0.9821	0.6912	0.998173	0.9950932	0.98597102	0.9985668
MF61	0.9566	0.5040	0.996618	0.9565653	0.98119982	0.9967705
MF62	0.9491	0.5810	0.99793	1	1	0.9986319
MF63	0.9639	0.9520	0.994635	0.9639306	1	0.9956665
MF64	0.9649	1.0000	0.993365	0.9649037	1	0.9947977
MF65	0.9547	0.6614	0.993161	0.9547332	0.98694436	0.9957051
MF66	0.9359	0.9990	0.99215	0.959071	1	0.9921501
MF67	0.9466	0.9978	0.994219	0.9465941	1	0.9964818
MF68	0.9473	0.6700	0.993597	0.9804242	0.98934869	0.9964976
MF69	0.9543	0.5880	0.993399	0.9604628	0.97691475	1
MF70	0.9596	0.6519	0.995851	0.9612054	0.98850404	0.9978287
MF71	0.9582	0.6389	0.992107	0.9582359	0.98726678	1
MF72	0.9668	0.5321	0.995611	0.9667972	0.99464724	0.9984539
MF73	0.9539	0.5176	0.993966	0.9538918	0.98680732	0.9964514
MF74	0.9550	0.6039	0.994763	0.9550383	0.9879012	0.9969798
MF75	0.9582	0.5930	1	0.9582125	1	1
MF76	0.9824	0.6336	1	0.9824478	1	1
MF77	0.9560	0.5698	0.993778	0.9559858	0.99191653	0.9964242
MF78	0.9523	0.9983	0.995983	0.9603359	0.9993571	1
MF79	0.9438	0.6080	0.994445	0.9577821	0.98061893	0.9976193

Source: Calculated

adding these variables do not make a difference for them. However, the additional 26 inefficient schemes which are transformed into efficient schemes have high skewness and low kurtosis values thereby implying that they have the greater ability to seize market opportunity to obtain excess returns. Accordingly, the fund managers of these schemes have shown superior market timing ability in the HM framework compared to Mβ framework.

Concluding Observations

The present study extends the portfolio evaluation framework provided by Sharp (1964) and Treynor (1965) by including the parameter of market timing with the help of a non-parametric framework. Data envelopment analysis has been used in the present exercise to evaluate the performance 79 mutual fund schemes operating in India for three different phases- Period 1(January2008 – January2009), Period 2 (March2009 - December2010) and Period 3 (January2011 –March2012). Two different models have been used; the first model may be termed as excess return- systematic risk-market timing frontier while the second one may be called excess return-higher moments-market timing. Estimation of technical efficiency on the basis of both the models suggests that period 2 performance is substantially divergent from period 1 and 3. This is because period 2 is basically a bull period while other periods are bear periods. In addition to this, since mutual fund returns are not normally distributed the DEA in higher moment framework gives a better measure of performance as it accounts not only the standard risk measure but also for skewness and kurtosis characteristics of returns.

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Appendix I

Sample Mutual Fund Schemes

Sl. No.	*Name of the Scheme*	*Aim*
1.	Baroda Pioneer ELSS 96	TP
2.	Birla Sun Life 95	G
3.	Birla Sun Life Advantage Fund	G
4.	Birla Sun Life buy India Fund	G
5.	Birla Sun Life Equity Fund	G
6.	Birla Sun Life India Opportunities Fund	G
7.	Birla Sun Life MNC Fund	G
8.	Birla Sun Life New Millennium	G
9.	Canara Robeco Balance	B
10.	DSP BlackRock Balanced Fund	B
11.	DSP BlackRock Opportunities Fund	G
12.	DSP BlackRock Technology.com Fund	G
13.	Escorts Tax Plan	TP
14.	Franklin India Bluechip	G
15.	Franklin India Opportunity Fund	G
16.	Franklin India Prima Fund	G
17.	Franklin India Prima Plus	G
18.	Franklin India Taxshield	TP
19.	Franklin Infotech Fund	G
20.	FT India Balanced Fund	B
21.	HDFC Balanced Fund	B
22.	HDFC Capital Builder Fund	G
23.	HDFC Equity Fund	G
24.	HDFC Growth Fund	G
25.	HDFC Prudence Fund	B
26.	HDFC Taxsaver	TP
27.	HDFC Top 200	G
28.	ICICI Prudential Balanced	B
29.	ICICI Prudential Taxplan	TP
30.	ICICI Prudential Top 100 Fund	G
31.	ICICI Prudential Top 200 Fund	G
32.	ICICI Prudential Technology Fund	G
33.	ING Balanced Fund	B
34.	ING Core Equity Fund	G
35.	JM Balanced	B
36.	JM Basic Fund	G
37.	JM Equity	G
38.	Kotak 50	G
39.	Kotak Balance	B
40.	L&T Opportunities Fund	G

Sl. No.	Name of the Scheme	Aim
41.	LIC Nomura Equity Fund	G
42.	LIC Nomura MF Growth Fund	G
43.	LIC Nomura Tax Plan	TP
44.	PRINCIPAL Balanced Fund	B
45.	PRINCIPAL Index Fund	G
46.	PRINCIPAL Growth Fund	G
47.	Reliance Growth	G
48.	Reliance Vision	G
49.	Sahara Taxgain	TP
50.	SBI Magnum Balanced Fund	B
51.	SBI Magnum Equity Fund	G
52.	SBI Magnum Global Fund 94	G
53.	SBI Magnum Multiplier Plus 93	G
54.	SBI Magnum Sector Funds Umbrella – Contra	G
55.	SBI Magnum Sector Funds Umbrella – Pharma	G
56.	SBI Magnum Tax Gain Scheme 93	TP
57.	Sundaram Balanced Fund	B
58.	Sundaram Growth Fund	G
59.	Sundaram Taxsaver	TP
60.	Tata Balanced Fund	B
61.	Tata Ethical Fund	G
62.	Tata Life Sciences and Technology Fund	G
63.	Tata Pure Equity Fund	G
64.	Tata Tax Saving Fund	T P
65.	Taurus Bonanza Fund	G
66.	Taurus Discovery Fund	G
67.	Taurus Starshare Fund	G
68.	Taurus Taxshield	TP
69.	Templeton India Growth Fund	G
70.	UTI Balanced Fund	B
71.	UTI Energy Fund	G
72.	UTI Equity Fund	G
73.	UTI Equity Tax Savings Plan	TP
74.	UTI Masterplus Unit Scheme 91	G
75.	UTI MNC Fund	G
76.	UTI Pharma and Healthcare Fund	G
77.	UTI Nifty Fund	G
78.	UTI Top 100 Fund	G
79.	UTI Services Industries Fund	G

G-Growth, B-Balanced,TP- Tax Planning