

Testing of Performance Measures on Mutual Fund Equity Schemes: An Empirical Evidence in India



DOI: 10.26573/2022.16.3.5
Volume 16, Number 3
September 2022, pp. 193-203

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We examine the performance of private and public mutual fund equity schemes in India. We use yearly NAVs of one eighty-nine equity schemes, Sensex and Treasury bill yield for the study period from April 2006 to March 2021. We apply time series plot, Quandt likelihood ratio (QLR) test, cumulative sum (CUSUM) test, compounded annual growth rate (CAGR using Geo-mean), performance measures and comparison with Sensex. The time series plot QLR test shows no structural break in the data and no change in parameter. Further results show no significant difference between private and public sector mutual fund equity schemes.

Keywords: NAV, CAGR, Sharpe, Treynor, Jensen, Sortino and Time Series Plot

1. Introduction

A mutual fund collects money from investors and invests systematically in various investment avenues. Investment in a mutual fund is made to maximise returns with minimum risk. For ascertaining whether Investors' objectives are achieved, it is essential to analyse the performance of Mutual Fund Schemes. Research studies by Sharpe (1966) argue that funds have a higher aggregate profit attached to a higher variability. Treynor (1965) argue that fund managers translate their ability in outguessing the market by determining mutual fund reward per unit of systematic risk. Jensen (1968) found that financial advisers were not able to forecast stock prices effectively to outperform the market. Fama (1972) argues that the return could be attributed to the ability of financial advisers to collect the best securities at a given level of risk. Grinblatt and Titman (1989) argue that superior output between growth funds and even between funds with the lowest net asset values. Barua and Verma (1991) found that the performance of the fund was satisfactory in terms of systematic risk, but not in the terms of total risk. Gupta (2001) found that the selected schemes were not appropriately diversified and couldn't meet their scheme's risk return trade-off. Elango (2004) argue that public service funds were less volatile than private sector funds. Sondhi and Jain (2004) found that the performance of equity mutual funds was subpar in terms of risk & return. Sondhi and Jain (2005) found that lack of consistency in the funds' performance. Bodla and Garg (2005) found that there was a rapid decrease in funds' return when compared to the market. Muthappan and Damodharan (2006) found that the majority of the schemes outperformed the market in terms of returns,

but did not outperform the 91-day Treasury bill. Soumya *et.al* (2009) argue that mutual funds generated positive monthly returns on an average for the study period. Susheel (2010) found that the rate of return for selected mutual funds was better when compared to the BSE National index. Prabhakaran and Jayabal (2010) argue that all the performance measures had superior performance over the benchmark. Susheel (2010) argue that the preference of UTI & SBI mutual funds has been better in 2007–09. SBI performance was good in both years. Kalpesh and Mahesh (2012) argue that the performance of Indian mutual funds and found that most of the mutual funds earned positive returns between 2007 and 2011. Mohamed *et.al* (2013) found the other investment options available to risk-averse investors other than mutual funds. Vikas and Preethi (2014) found that the majority of the funds chosen for the study have increased Sharpe Ratio and Treynor Ratio. Ashraf and Sharma (2014) found that the benchmark market has a statistically important effect on the return of mutual funds. Jitendra and Anindita (2015) argue that the private sector has performed well during the study period. Muralidhar's (2016) results show that the Reliance Small Cap Fund of the selected funds is considered to be a fund with medium risk as well as medium returns against the Reliance Bank Fund. Shruthi and Manjunatha (2018) argue that 10 per cent of the schemes have a high return and lower risk, 10 per cent of the schemes have a negative return and 80 per cent of the schemes have a high risk and lower return. Chitra and Hemalatha (2018) argue that Sharpe, Treynor and Jensen's measures found that results were useful for investors. Shruthi and Manjunatha (2019) argue that investing in equity schemes would be more beneficial for investors during the study period. Antoch *et.al* (2019) found that the testing procedure works well in the framework of the four factors CAPM model and estimates the breaks in the monthly returns of US mutual funds.

The literature survey shows that many researchers are focused on risk return analysis and performance measures. Our study is particularly focused to know the performance of private and public mutual fund equity schemes in India using structural break, CAGR and performance measures and comparison of schemes with the benchmark. Hence, to evaluate the CAGR of mutual fund schemes in India we consider 189 equity schemes in private and public sectors in India for the study period of fifteen years and we use annual return, average return, CAGR, beta and hypothesis testing to find the significant differences between private and public mutual funds equity schemes.

2. Objectives and Methodology

We have set the following objective based on the evidence of the review of literature.

- To measure and compare the performance of private and public sector mutual fund equity schemes in India.

Data Sample and Methodology

This paper focuses on the analysis and comparison of performance of equity schemes both for private and public sector mutual funds. There are numerous techniques both qualitative and quantitative to analyze the performance of mutual funds. We use the annual NAV of 121 equity schemes of private sector mutual funds and 68 equity schemes of public sector mutual funds for 15 years study period from 2006-07 to 2020-21 to calculate CAGR, Sensex returns as market proxy and 91-day treasury bill rate are considered as risk-free rate. The time-series plot of the CAGR suggests the

possibility of a structural break. Hence, Quandt Likelihood Ratio (QLR) test and Cumulative Sum (CUSUM) test for structural break were applied, which indicated that there was no structural break. Therefore, the entire 15-years window is considered for analysis. Kolmogorov-Smirnov test and Shapiro-Wilk test are used for testing the normality of the CAGR data. Further, Mann-Whitney test is performed to check whether there is a significant difference in the returns of equity schemes of public and private mutual funds. We calculate the performance of selected 189 equity schemes by using Sharpe, Treynor, Jensen and Sortino measures and tested for their normality. Mann-Whitney test is performed for ascertaining whether there is a significant difference in these performance measures for equity schemes of public and private equity mutual funds. Sensex returns are identified as a benchmark and the CAGR of return is calculated for the same 15-year window. Classification of public and private sector schemes is made on the basis of their CAGR as 'above' and 'below' benchmark. Chi-square test of independence is used for ascertaining whether there is significant relationship between 'type of mutual fund scheme' and 'performance against benchmark'.

Tools for Analysis

Calculation of Rate of Return and Average Return

$$\text{Return} = \frac{\text{NAV}^1 - \text{NAV}^0}{\text{NAV}^0} \quad \dots (1)$$

Average Return (AR)

$$\text{AR} = \frac{\text{Sum of return}}{\text{No of returns}} \quad \dots (2)$$

As a first criterion to check the Performance of Mutual Fund We calculated CAGR using Geomean: it is calculated using annual returns of the schemes and to plot time series for testing structural break in sample data. For time series plot we used QLR test and CUSUM test. If there is no structural break then entire 15-year data can be considered as single window for analysis. Formula for CAGR:

$$\text{CAGR} = \left(\frac{\text{Ending Value}}{\text{Beginning Value}} \right)^{\frac{1}{n}} - 1 \quad \dots (3)$$

- Kolmogorov-Smirnov Test and Shapiro-Wilk test have been used for testing the normality of the CAGR Data.
- Non-parametric test: Mann Whitney test is used for testing hypothesis for private and public mutual fund equity schemes.
- Parametric test: Independent sample T-test used for testing hypothesis for private and public mutual fund equity schemes.

The second criteria were performance measures viz: Sharpe, Treynor, Jensen and Sortino are calculated. Related formulae are listed below:

- **Sharpe Measure (SM):** It shows an excess of the return on portfolio over the risk-free rate in relative to its standard deviation.

$$S = \frac{R_i - R_f}{\sigma} \quad \dots (4)$$

- **Standard Deviation (SD):** It is the square root of the variance & measures the spreading of a dataset comparative to its mean. The square root of variance is determined by calculating the variation between each data point values from the mean.

$$SD = \sqrt{\frac{\sum (X - \bar{X})^2}{N}} \quad \dots (5)$$

- **Treynor Measure (TM):** If the measure is higher than the benchmark and the portfolio has overtaken the market & it indicates high risk adjusted performance.

$$T_i = \frac{R_i - R_f}{\beta_i} \quad \dots (6)$$

- **Beta(β):** It is mainly related to volatility with the schemes compared with benchmark.

$$\beta = \frac{\text{A security covariance of market portfolio}}{\text{variance of market portfolio}} \quad \dots (7)$$

- **Jensen Measure (JM):** To determine scheme is making a Systematic return for its risk. If it is positive than the scheme, it is earning more returns.

$$JM = (R_i - R_f) - [\beta(R_m - R_f)] \quad \dots (8)$$

- **Sortino Measure (SoM):** Total volatility by using the assets standard deviation of negative portfolio returns

$$S_{id} = \frac{R_i - R_f}{d\sigma^2} \quad \dots (9)$$

- **Kolmogorov-Smirnov Test and Shapiro-wilk Test** are used for testing the normality of the CAGR data which is helpful in deciding whether to use Parametric or Non-parametric test.
- **Non-parametric test:** Mann Whitney test is used for testing hypothesis for private and public mutual fund schemes.
- **Parametric test:** Independent sample T-test used for testing hypothesis for private and public mutual fund schemes.

For the calculation of these measures, annual 91-day T-bills (treasury bill) rate is considered as risk-free rate (R_f) wherever required. Sensex is identified as a benchmark for equity schemes, drawn from BSE India.

The Third Criterion used to Compare the Performance of Mutual Fund Schemes was Market Proxies: Chi-square test of independence is used for ascertaining whether there is a significant relationship between ‘type of mutual fund scheme’ and ‘performance against a benchmark.’ A post Hoc test is used if there is a significant relationship between ‘the type of mutual fund scheme’ and ‘performance against benchmark.

3. Results and Analysis

Graph 1 indicates a possibility of structural break of the data. For confirmation, we use the QLR test and the CUSUM test. The test results are QLR test for structural break shows there is no structural break test statistic: chi-square (1) = 1.76855 at observation 2010 with asymptotic p-value = 0.828336. CUSUM test for parameter stability shows no change in parameters. The test statistic: Harvey-Collier t (13) = 0.534783 with p-value = P (t (13) > 0.534783) = 0.601827. Both tests suggest that there was no structural break (p-value exceeding 5%). Hence, the entire 15-year period has been considered as a single window for analysis of the growth rate of equity mutual fund schemes. We calculate CAGR for each scheme for the 15 years. The summarised results are presented in graph 1.

Graph 1 Time Series Plot of the Average Returns of all the Schemes



Note: X axis indicate years i.e., from 2008-2021. Y Axis Indicates Average Return of all 189 Schemes of Private and Public Sector Equity Mutual Fund.

Source: Drawn by Researcher using Gretel Software

Table 1 CAGR of Equity Schemes of Private and Public Sector Mutual Fund

PVTMFE	CAGR	PSMFE	CAGR
Average CAGR of PVTMFE Schemes	7.8	Average CAGR of PSMFE schemes	7.6
Maximum CAGR of PVTMFE schemes	17.62	Maximum CAGR of PSMFE schemes	13.25
Minimum CAGR of PVTMFE schemes	-2.78	Minimum CAGR of PSMFE schemes	-0.68

Source: CAGR of private and public sector mutual funds equity schemes computed in MS-Excel.

Note 1: Column and rows indicates the codes (for private sector schemes we coded as PVTMFE-001to Pvt. MFE -121 and for public sector schemes coded as PSMFE-001 to PSMFE-068).

Table 1 shows suggest that the performance of both public and private sector schemes is similar, however, the maximum and minimum returns of both the schemes indicate a contrary outcome. Hence, there is a need to check whether the performance of the public sector and private sector mutual fund equity schemes are same or different. For enabling testing of the above, it is essential to check whether the data has been normally distributed or not. Kolmogorov-Smirnov and Shapiro-Wilk tests were applied to check for the normality of the CAGR data.

Table 2 indicates that the CAGR data is not normally distributed (being significant at 1%). Hence, for ascertaining whether there is a significant difference in the returns of public and private sector mutual fund schemes, a non-parametric test has to be applied. Since the variable ‘type of mutual fund’ is nominal data and has only two classifications (public sector and private sector), and the other variable ‘CAGR’ is a scale data, the Mann-Whitney U test has been used.

Table 2 Tests of Normality of CAGR

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
CAGR	.118	189	.000	.955	189	.000
a. Lilliefors Significance Correction						

Note: We have Computed Test of Normality by using SPSS 22 Software.

Table 3 results show that the null hypothesis ‘there is no significant difference in the returns of public and private sector mutual fund schemes’ is accepted (sig. value having exceeded 5%).

Table 3 Mann-Whitney Test Result of CAGR

	CAGR
Mann-Whitney U	3911.000
Wilcoxon W	6257.000
Z	-.562
Asymp. Sig. (2-tailed)	.574
a. Grouping Variable: Scheme	

For enabling testing of the above, it is essential to check whether the data has been normally distributed or not. Kolmogorov-Smirnov and Shapiro-Wilk tests were applied to check for the normality of the performance measures data, results of which are shown in Table 4.

Table 4 Performance Measures of Equity Schemes of Private and Public Mutual Funds

PVTMFE	SM	TM	JM	SoM	PSMFE	SM	TM	JM	SoM
Average performance of PVTMFE Schemes	40	26	23	96	Average performance of PSMFE schemes	41	9	21	88
Maximum performance of PVTMFE schemes	442	273	41	118	Maximum performance of PSMFE schemes	265	45	36	156
Minimum performance of PVTMFE schemes	5	-9.80	3	10	Minimum performance of PSMFE schemes	12	-138	3	23

Table 5 The test result indicates that the performance measures data is not normally distributed for Sharpe, Treynor and Sortino measures (being significant at 1%) and for the Jensen measure the data is normally distributed. Hence, for ascertaining whether there is a significant difference in the performance of public and private sector mutual fund schemes, a non-parametric test has to be applied for Sharpe, Treynor and Sortino measures and a parametric test for Jensen measure. Since the variable ‘type of mutual fund’ which is nominal data and has only two classifications (public sector and private sector), and the other variable ‘SM, TM and SoM’ is a scale data, Mann-Whitney U test and for Jensen Measure one sample T-test has been used.

Table 5 Tests of Normality of Performance Measures

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
SM	.315	189	.000	.390	189	.000
TM	.473	189	.000	.096	189	.000
JM	.034	189	.200*	.994	189	.657
SoM	.073	189	.017	.981	189	.011
*. This is a lower bound of the true significance.						
a. Lilliefors Significance Correction						

Note: We have Computed Test of Normality by using SPSS 22 Software

Table 6 results indicate that the null hypothesis ‘there is no significant difference in the performance of public and private sector mutual fund equity schemes with regards to Sharpe, Treynor and Sortino measures’ is accepted (sig. value having exceeded 5%). Jensen’s measure for public and private sector equity mutual fund schemes is normally distributed. Hence, for ascertaining whether there is a significant difference in the performance of public and private sector equity mutual fund schemes, an independent sample T-test is applied.

Table 6 Mann Whitney test of Performance Measures

	SM	TM	SoM
Mann-Whitney U	4024.000	4073.000	3676.000
Wilcoxon W	11405.000	6419.000	6022.000
Z	-.249	-.114	-1.214
Asymp. Sig. (2-tailed)	.803	.910	.225
a. Grouping Variable: Scheme			

Table 7 results indicate that there is no significant difference in the performance of public and private sector Equity mutual funds about Jensen measure (p-value having exceeded 5%). Another criterion for evaluating the performance of mutual funds is the ‘comparison of mutual fund returns with benchmark return’. Since the schemes under consideration are equity schemes, BSE Sensex is considered a benchmark. For the 15 years under consideration, Sensex had a CAGR of 10.18%.

Table 7 One Sample Test for Performance Measures

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
JM	43.132	188	.000	.226693201472085	.216325355345440	.237061047598731

Note: We have Computed test of Normality by using SPSS 22 Software

Table 8 indicates for ascertaining whether ‘performance against benchmark’ is dependent upon the type of scheme, the Chi-square test is applied (since both criteria in the above Table are nominal data).

Table 8 Comparison Analysis of Schemes CAGR and Benchmark CAGR

	PVTMFE	PSMFE
Above average (Benchmark)	77 (64%)	42(62%)
Below average (Benchmark)	44 (36%)	26 (38%)
Total schemes	121	68

Table 9 results indicate that there is no significant relationship between types of schemes and benchmark returns of public and private sector Equity mutual funds with regard to performance against benchmark (since p value for Pearson Chi-square test has exceeded 5%).

Table 9 Chi Square Test of Schemes CAGR and Benchmark CAGR

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.634 ^a	1	.426		
Continuity Correction	.410	1	.522		
Likelihood Ratio	.639	1	.424		
Fisher's Exact Test				.439	.262
N of Valid Cases	189				
a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 25.54.					
b. Computed only for a 2x2 table					

4. Summary and Conclusion

We examine the growth rate of equity schemes in private and public mutual funds. Firstly, we used a time series plot to check structural break in data, CAGR, Performance Measures and benchmark comparison. The results indicate that no structural break in the data and no parameter stability. The average CAGR and Performance measures suggest that the performance of both public and private sector schemes is similar, however, the maximum and minimum returns of both schemes indicate a contrary outcome. Hence, we test the hypothesis to check whether the performance of the public sector and private sector mutual fund schemes are the same or different. The results show that there is no significant difference between private and public sector mutual fund equity schemes.

5. Implication and Scope for Further Research

The results of the study may be used by researchers to compare with other foreign mutual funds equity schemes which will help for an investment decision. We have analysed only the equity schemes and further studies can include debt and hybrid

schemes in private and public sector mutual funds. Further studies can be undertaken to test the relationship between mutual fund schemes' return and risk by applying asset pricing models.

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