IOSR Journal of Engineering (IOSRJEN) **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
Vol. 09, Issue 5 (May. 2019), ||S (XIII) || PP 37-42

M^2 – An Inclusive Measure of Portfolio Risk Adjusted Return

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Abstract: *The aim of this study is to determine whether M^2 is the most comprehensive risk adjusted return measure for evaluating portfolio performance or not. To conduct this study, the researcher has compared four risk adjusted return measures to evaluate risk adjusted returns of portfolios as given in the top10 Indian diversified equity mutual fund schemes (2009-2018). The measures are Sharpe Ratio, Treynor Ratio, Jensen's Alpha and Modigliani and Modigliani Measure (M^2).*
In the Indian mutual fund industry, there are 53 diversified equity mutual fund schemes according to a CRISIL report as on 31st March 2018. The data for this study spans over a 10 year period i.e. from January 2009 to December 2018. The researcher has selected top 10 diversified equity mutual fund schemes based on AUM and age of funds. To test the hypothesis student t-test has been applied on the selected ratios. The uniqueness of this study is the use of rolling period returns which is a robust measure for return calculations as it negates any bias or manipulation.
The paper advocates the use of Total Returns Index (TRI) as a mandatory benchmark for mutual funds and Portfolio Management Services (PMS).
Key words: *Sharpe Ratio, Treynor Ratio, Jensen's Alpha, M-squared, Rolling Returns, Total Returns Index (TRI)*

I. Introduction

It is well documented and generally accepted that risk and return go hand in hand. At the same time, every rational investor strives to bring down the risk exposure by simultaneously striving to maximise the total returns. This is the reason why risk adjusted returns were conceptualized. Starting with the Sharpe Ratio, where standard deviation was taken as the measure of risk; researchers conceptualised Treynor Ratio where Beta is the measure of risk. Eventually Jensen's Alpha was conceptualised where Actual and expected returns are compared to identify outperformance. Then came the Modigliani and Modigliani measure or the M-squared, which aimed at overcoming the shortcomings of Sharpe Ratio's Standard Deviation and Treynor Ratio's Beta.

In recent years, the demand of "reliable and admissible" performance measures has increased as investment in mutual funds and exchange traded funds has improved in popularity among small investors across the globe. Four ratios are commonly used in performance evaluation – Sharpe Ratio, Treynor Ratio, Jensen's Alpha and M^2.

This study, thus aims to determine whether M^2 is the most comprehensive risk adjusted return measure for evaluating portfolio performance or not. In other words, is it sufficient to check the M^2 and leave aside the other measures.

To conduct this study, the researcher has compared four risk adjusted return measures to evaluate risk adjusted returns of portfolios of the top10 Indian diversified equity mutual fund schemes (2009-2018) as per Crisil. The measures are Sharpe Ratio, Treynor Ratio, Jensen's Alpha and Modigliani and Modigliani Measure (M^2). The following section explains these ratios and how they have been implemented in this study. It also explains the concept of rolling returns and why it is a robust measure for return calculations.

Standard Deviation: Standard deviation is a measure of risk, which is calculated by using the historical returns. The researcher has computed standard deviation by using rolling period returns of the selected top 10 diversified equity mutual fund schemes and for the market, denoted by NIFTY 500 (TRI).
Beta: Beta measures the volatility or systemic risk of a portfolio or stock in comparison to the market or the selected benchmark index. The researcher computed the beta by using rolling period returns of the selected top 10 diversified equity mutual fund schemes and for the market, denoted by NIFTY 500 (TRI). It is noteworthy that Beta measures the sensitivity of an asset (stock or portfolio) to changes in the benchmark index. This is where beta has a different perspective than standard deviation. Where standard deviation talks about total risk of an individual asset, beta talks about the market risk only.

Sharpe Ratio: Sharpe ratio is a risk-adjusted measure of return used to evaluate a portfolio's returns. In this study, Sharpe ratio has been computed for the selected top 10 diversified mutual fund schemes using 1 to 9-year rolling returns. Sharpe ratio is calculated by dividing the excess of portfolio returns over the risk free return with the portfolio standard deviation. Rolling returns of mutual funds are taken as portfolio returns (R_p). Average of SBI Fixed Deposit rates has been taken as the Risk free rate (R_f) and standard deviation is computed by using rolling returns. Highest Sharpe ratio is best and lowest Sharpe ratio is worst.

Treynor Ratio: The Treynor Ratio is a portfolio performance measure that adjusts for systematic risk. . In this study, Treynor ratio has been computed for the selected top 10 diversified mutual fund schemes using 1 to 9-year rolling returns by dividing the excess of portfolio returns over the risk free return with the portfolio beta. For computing Treynor ratio the researcher required portfolio returns, risk free return and beta of the portfolio. Rolling returns of mutual funds were taken as portfolio returns (R_p), average of SBI Fixed Deposit rate was taken as Risk free rate (R_f) and beta of the portfolio was computed by calculating the slope.

Jensen's Alpha: The Jensen's alpha measure is a risk-adjusted performance measure that represents the average return on a portfolio or investment, above or below that predicted by the capital asset pricing model (CAPM), given the portfolio's or investment's beta and the average market return. The researcher has computed Jensen's alpha for the top 10 diversified mutual fund schemes from 1 to 9-year rolling period .For computing Jensen's alpha the researcher first computed expected return by using CAPM model and deducted the value of expected return from average portfolio return. If α_p is positive, then the portfolio has outperformed the market; if α_p is negative, the portfolio has underperformed the market.

Modigliani and Modigliani (M^2): Modigliani and Modigliani risk-adjusted performance measure (M^2) is a relatively new technique which is closely linked to the Sharpe ratio. In the study the researcher has computed M^2 for the top 10 diversified mutual fund schemes from 1 to 9-year rolling period. For computing M^2 the requirements are portfolio returns, market return, risk free return, standard deviation of the portfolio and the market. All rates except risk free rate were computed on the basis of rolling returns. Risk free rate was computed by using the average of SBI FD rates.

Rolling Returns: Rolling returns are useful for examining the behaviour of returns for holding periods, similar to those actually experienced by investors. The researcher has calculated rolling return of the sample top 10 mutual fund schemes. There were 9 rolling returns of different durations possible during a period of 10 years, considering full year returns and a sufficiently large number of observations for robustness of calculations. The 1 year rolling return calculations started from 31st December, 2009; 2 year rolling return calculations started from 31st December, 2010; the 3 year rolling return calculations started from 31st December, 2011; 4 year rolling return calculations started from 31st December, 2012; 5 year rolling return calculations started from 31st December, 2013; 6 year rolling return calculations started from 31st December, 2014; 7 year rolling return calculations started from 31st December, 2015; 8 year rolling return calculations started from 31st December, 2016 and 9 year rolling return calculations started from 31st December, 2017.

Significance and Rationale of Study:

This research is beneficial for investors, who are looking for a measure to evaluate the risk adjusted returns from a portfolio. As M^2 (Modigliani and Modigliani Measure) considers both systematic risk and non-systematic risk, it is expected that M^2 shall serve as a comprehensive measure.

II. Literature Review

The view that the Sharpe ratio may be too difficult for the average investor to understand is shared by Modigliani and Modigliani (1997), who propose a somewhat different measure of risk-adjusted performance. Their measure expresses a fund's performance relative to the market in percentage terms and they believe that the average investor would find the measure easier to understand.

Agarwal and Mirza (2017) studied the risk adjusted performance of the mutual fund industry in India. It was a study of 100 mutual fund schemes over a period of 1st January, 2013 to 30th June, 2016 using various risk adjusted measures. The performance was evaluated and ranked using the Sharpe ratio, Treynor ratio, Jensen alpha and value at risk. The results of Sharpe ratio and Treynor ratio reflected that 90 percent of the schemes had performed better than their benchmarks which reflect that during the period the funds had done fairly well and had outperformed the market. As per Jensen's Alpha, the returns generated by 79 schemes compensated adequately over the average market return given the beta of the schemes. The researcher concluded that it was important for the investor to not only identify the category of funds for his investment but also pick up the best fund in that category.

Hasan and Ahsan (2016) primarily analyzed the fund managers' ability to outguess the market in Bangladesh. To serve the research objective, the author tested both selection and market timing skills of the fund

managers. the author used six measures – average return, Sharpe ratio, Treynor ratio, Information ratio, Jensen's alpha and M squared; to confirm the selection skill of fund managers and found no selection skill to be persistent among most of the fund managers. The author surveyed the performance of 25 mutual funds during 16th May, 2010 to 28th April, 2016 on a weekly basis. The author found evidence that unlike Aims 1st M.F, ICB AMCL 2nd NRB M.F. and 6th ICB M.F., most of the fund managers can show neither skill. The three funds' managers; Aims 1st M.F, ICB AMCL 2nd NRB M.F. and 6th ICB M.F; become able to show their assets selection skill but fail to demonstrate market timing skill. Thus, with a few exceptions, the author can conclude that neither skill is persistent among the funds' managers in Bangladesh.

Marhfor, A.(2016) measured the portfolio performance and reviewed the literature and identified avenues of future research. The author distinguished between traditional performance measures and more recent conditional performance measures. The study consisted of Sharpe ratio, Information ratio, M squared ratio, Sortino ratio and Treynor ratio. The author showed that traditional performance measures do not control for risk-time variations associated with the state of the economy and do not consider multiple risk factors. On the other hand, when the author controlled for risk-time variations and included additional risk factors, the average performance of funds looked better.

Duda and Batyuk (2009) evaluated performance and risk of Danish Mutual and Hedge Funds. The author analysed selectivity of the Danish mutual funds applying single index model of Jensen's alpha (1968) and multi-index model of Elton et al. (1993). In order to analyse timing abilities of the Danish mutual funds, the author used two models: Treynor & Mazuy (1966) and Henriksson & Merton (1981). Further, the author analysed downside risk using Value-at-Risk concept (1994) based on constant as well as variable variance models. The author concluded that on an average Danish mutual equity funds perform neutrally, they posses no timing abilities and their risk adjusted performance is fairly poor over 9 year (2000-2008) period of data analyzed. The risk within hedge funds is much higher than the risk within mutual funds in the Danish market. After assessing risk adjusted performance using Sortino (2001) the author found that hedge funds did not outperform mutual funds over the sample analyzed.

Using Modigliani and Modigliani (m squared) performance measure, Arugaslan and Ajay (2008) evaluated 50 extensive us global equity funds during a ten-year period of 1994-2003. the results showed that risk effected the attractiveness of the fund as even though the funds had greater returns, they did lose attractiveness amongst the investors due to superior risk whereas the lesser return funds were attractive due to the minority of the risk.

M. C. Jensen (1967) measured the predictive ability of 115 mutual fund managers during the period 1945 to 1964 – that was their ability to earn returns which were higher than those the author would expect given the level of risk of each of the portfolios. The evidence on mutual fund performance indicates not only that these 115 mutual funds were on an average not able to predict security prices well enough to outperform a buy-the-market and-hold policy, but also that there is very little evidence that any individual fund was able to do significantly better than that which the author expected from mere random chance. It is also important to note that these conclusions hold even when the author measures the fund returns as a gross of management expenses (that was assume their book-keeping, research, and other expenses except brokerage commissions were obtained free). Thus, on an average the funds apparently were not quite successful enough in their trading activities to recoup even their brokerage expenses. Evidence reported elsewhere (cf. Jensen (1967)) indicates the funds on an average have done an excellent job of minimizing the "insurable" risk borne by their shareholders.

Research Gap: A good number of research papers based on risk adjusted return performance was reviewed. None of the papers reviewed have concluded that M-squared is the best or the most comprehensive risk adjusted return measure for evaluating portfolio performance. Theoretically, it is suggested that M-squared provides robust results and is more comprehensive as compared to other risk adjusted return measures. This paper aims at exploring the extent of the applicability of M-squared in the developing market of India, whereas most of the research has been conducted in developed markets.

III. Research Methodology

Statement of Problem: M^2 was created by Franco Modigliani and his granddaughter, Leah Modigliani—hence the name M-squared. M^2 is an extension of the Sharpe ratio in that it is based on total risk, not beta risk. M-squared is a risk adjusted return measuring tool for evaluating portfolio performance. Whether it is the most comprehensive and robust risk adjusted return measure is the main-stay of this study.

Objectives of the study:

To study Sharpe Ratio, Treynor Ratio, Jensen's Alpha and M^2 in order to ascertain the benefits and shortcomings associated with each of these individual measures of risk adjusted returns.
To compare Sharpe Ratio, Treynor Ratio, Jensen's Alpha and M^2 so as to identify whether there are differences in the results given by a combination of Sharpe Ratio, Treynor Ratio and Jensen's Alpha on one side and M^2 on the other side.
To Evaluate Sharpe Ratio, Treynor Ratio, Jensen's Alpha and M^2 so that a comprehensive and robust risk adjusted measure is identified.

Hypothesis:

H_0: There is no significant difference in the results given by a combination of risk adjusted measures such as Sharpe Ratio, Treynor Ratio, Jensen's Alpha on one side and M^2 on the other side.

Different diversified schemes would be evaluated using Sharpe Ratio, Treynor Ratio, Jensen's Alpha and Modigliani &Modigliani Measure (M2). The initial premise is that all these measures of risk adjusted return should give the same set of top 10 performing funds. In this study the aim of the researcher is to determine whether M^2 is the best risk adjusted return measure for evaluating portfolio performance or not, in the developing market – India. A sample of 10 Indian diversified equity mutual fund schemes which have been operating for a period of ten years or more and performing significantly well during the period were shortlisted for the study using the Crisil's list of Indian Diversified Equity Mutual Fun Schemes, in its publication in March 2018. The time frame of the study was taken as 1st January 2009 to 31stDecember 2018 to study the Regular Growth Plans of mutual funds. There were 53 diversified equity funds that were actively participating in the Indian mutual fund industry. The diversified equity mutual funds were sorted based on Assets under Management (AUM) and Age of Funds. The top 10 Indian diversified equity mutual fund schemes in terms of age at the initial level followed by AUM at the second level were short-listed for the purpose of this study.

Table 1: List of Shortlisted Diversified Equity Mutual Fund Schemes

Sr. No.	Scheme Name	Inception Date	AUM (in Rs. Crores)
1.	ICICI Prudential Value Discovery Fund	16-08-04	16,187.19
2.	Franklin India Equity Fund (FIEF) (Erstwhile Franklin India Prima Plus)	29-09-94	11302.11
3.	Reliance Multi Cap Fund (formerly known as Reliance Equity Opportunities Fund)	28-03-05	10658.01
4.	Aditya Birla Sun Life Equity Fund	27-08-98	9,696.08
5.	Mirae Asset India Equity Fund	04-04-08	8,632.72
6.	SBI Magnum Multi Cap Fund	29-09-05	6,199.87
7.	Tata Equity PE Fund	29-06-04	4,722.51
8.	HDFC Capital Builder Fund	01-02-94	4,016.90
9.	IDFC Core Equity Fund (Erstwhile IDFC Classic Equity Fund)	09-08-05	2,813.23
10.	L&T Equity Fund	01-03-05	2,652.98
11.	DSP Equity Fund (Erstwhile DSP Black Rock Equity Fund)	07-06-07	2,531.50

The above table shows the list of the shortlisted diversified mutual fund schemes based on Inception date and Assets under Management (AUM). One of the previously shortlisted fund, SBI Magnum Multi Cap Fund was dropped and replaced by DSP Black Rock Equity Fund as the NAV of SBI Magnum Multi Cap Fund was not available for the given 10 year period 2009 to 2018 on the AMFI website.

IV. Data Analysis:

The following process was followed in order to conduct the data analysis:

1. The Net asset Values (NAVs) of the short-listed mutual fund schemes, for the 10 year period was downloaded from the AMFI website – www.amfiindia.com.
2. These NAVs were used to calculate the rolling period returns for 1 year, 2 years, 3 years and so on for 9 years.

3. These rolling period returns were averaged out to arrive at portfolio returns specific to the rolling periods.
4. The rolling returns were then used for the calculation of Standard deviations.
5. Similar to the shortlisted portfolios, rolling returns were calculated for the NIFTY TRI as well and it was used as a representative of the market portfolio.
6. Individual rolling returns of shortlisted schemes were then combined with the NIFTY TRI to arrive at Portfolio beta of individual schemes.
7. At the next level, Sharpe Ratio, Treynor Ratio, Jensen's alpha and the M^2 were calculated where the SBI Fixed Deposit rates for the given period was averaged out to arrive at the risk free rate.
8. Now the rankings were given to individual funds as per Sharpe Ratio, Treynor Ratio, Jensen's alpha and the M^2.
9. The table below denotes the rankings which have been arrived at by combining Sharpe Ratio, Treynor Ratio, and Jensen's alpha on one side and the M^2 rankings on the other side.

Higher Ratios (Best Performers) Lower Ratios (Worst Performers)

	1-YR ROLLING		2-YR ROLLING		3-YR ROLLING		4-YR ROLLING		5-YR ROLLING		6-YR ROLLING		7-YR ROLLING		8-YR ROLLING		9-YR ROLLING	
Scheme Name	**Overall**	**M^2**	**Overall**	**M^2**	**Overall**	**M^2**	**Overall**	**M^2**	**Overall**	**M^2**	**Overall**	**M^2**	**Overall**	**M^2**	**Overall**	**M^2**	**Overall**	**M^2**
ICICI Prudential Value Discovery	2.00	4.00	4.00	7.00	6.00	8.00	3.00	5.00	1.67	2.00	8.00	9.00	10.00	10.00	10.00	10.00	10.00	10.00
Franklin India Equity	4.00	3.00	2.00	2.00	3.00	3.00	2.00	1.00	2.33	1.00	1.00	1.00	2.00	4.00	2.00	2.00	1.00	1.00
Reliance Multi Cap	4.00	5.00	3.00	5.00	3.00	5.00	3.00	6.00	3.00	7.00	10.00	10.00	9.00	9.00	9.00	9.00	8.00	8.00
Aditya Birla Sun Life Equity	8.00	8.00	7.00	6.00	9.00	10.00	8.00	9.00	8.00	8.00	2.00	2.00	3.00	2.00	7.00	5.00	7.00	6.00
Mirae Asset India Equity	1.00	1.00	1.00	1.00	1.00	1.00	3.00	2.00	4.00	3.00	4.00	5.00	8.00	8.00	8.00	8.00	6.00	7.00
Tata Equity P/E	6.00	6.00	5.00	4.00	7.00	7.00	10.00	10.00	9.00	9.00	4.00	3.00	1.00	1.00	4.00	4.00	9.00	9.00
HDFC Capital Builder Value	3.00	2.00	5.00	3.00	4.00	2.00	4.00	3.00	6.00	5.00	5.00	4.00	6.00	6.00	3.00	3.00	3.00	4.00
IDFC Core Equity	10.00	10.00	9.00	9.00	7.00	6.00	8.00	8.00	10.00	10.00	6.00	6.00	3.00	3.00	1.00	1.00	3.00	3.00
L&T Equity	7.00	7.00	8.00	8.00	5.00	4.00	5.00	4.00	4.00	4.00	7.00	7.00	7.00	7.00	5.00	6.00	3.00	2.00
DSP Equity	9.00	9.00	10.00	10.00	10.00	9.00	8.00	7.00	7.00	6.00	9.00	8.00	5.00	5.00	6.00	7.00	5.00	5.00

Table 2: Overall Rankings and M^2 Rankings

In the above table 'Overall' denotes a combination of Sharpe, Treynor and Jensen's Alpha. Looking at the table, it can be concluded that M^2 is the most comprehensive risk adjusted return measure for evaluating portfolio performance amongst the four techniques evaluated viz., Sharpe Ratio, Treynor Ratio, Jensen's Alpha and M^2. For evaluating the comprehensiveness of M^2 as a measure of risk adjusted return the researcher first combined the ranks of other three ratios (named above) and calculated their average. At the next level, ranks as per M^2 were noted. Then the combined ranking of the other three ratios was compared with the $M^2$for the selected top 10 diversified equity mutual fund schemes for 1 to 9 year rolling periods. The researcher observed that rankings as per M^2 and Overall (Excluding M^2) are almost the same. It can thus be concluded that M^2 is the most comprehensive risk adjusted return measure.

Hypothesis Testing:

Table 3: Results of student t-test

Sr. No.	Correlation	P(T<=t) two-tail	Accept / Reject
1	0.96	0.73	Accept
2	0.89	0.83	Accept
3	0.90	1.00	Accept
4	0.88	0.83	Accept
5	0.87	1.00	Accept
6	0.97	0.68	Accept
7	0.97	0.68	Accept
8	0.96	1.00	Accept
9	0.98	1.00	Accept

H_0: There is no significant difference in the results given by risk adjusted measures such as Sharpe Ratio, Treynor Ratio, Jensen's Alpha and M^2.

In order to test the above hypothesis, the rankings as per Sharpe Ratio, Treynor Ratio and Jensen's Alpha were averaged and compared with M^2. The iteration of 1 year rolling return figures was repeated for 2 year rolling return figures, 3 year rolling return figures, 4 year rolling return figures, 5 year rolling return figures, 6 year rolling return figures, 7 year rolling return figures, 8 year rolling return figures and 9 year rolling return figures.

As can be observed in each of the iterations, the correlation between the two rankings is not less than 87%. The test of significance at 95% confidence interval is also never seen to be less than 0.05. It can thus be concluded the null hypothesis cannot be rejected. In other words, it can be said that there is in fact no significant difference between the two categories of risk adjusted returns. M2, which considers systematic as well as unsystematic risk is a comprehensive measure of risk adjusted return and at the same time is easier to understand and interpret by common investors due to its ability to express the risk adjusted returns on a percentage basis.

V. Conclusion

This study assesses the performance of Indian diversified mutual fund schemes using Sharpe Ratio, Treynor Ratio, Jensen's Alpha and M-squared for a sample of 10 Indian diversified mutual fund schemes. The study period was from 1st January, 2009 to 31st December, 2018. In essence, for a fund with any given risk and return, the Modigliani measure is equivalent to the return the fund would have achieved if it had the same risk as the market index. Thus, the fund with the highest Modigliani measure, like the fund with the highest Sharpe ratio, would have the highest return for a given level of risk. Since the M^2 measure is expressed in percentage points, Modigliani and Modigliani believe that it can be more easily understood by average investors.

The study specifically observed the following:

On the basis of Sharpe ratio, it can be suggested that Mirae Asset India Equity Fund may be good for short term (1 to 3 year) and Franklin India Equity Fund may be good for long term (over 4 years).
On the basis of Treynor Ratio, over 1 to 9 year rolling periods the researcher has observed that Franklin India Equity Fund provided good results over the long term period. Also, after comparing all funds in the 1 to 9 year rolling periods the researcher has observed that Franklin India Equity Fund has provided better results in the long term.
The Mirae Asset India Equity Fund was the best fund for the short term.
The ICICI Prudential Value Discovery Fund was found to be struggling over the long term period.

M^2 is a measure of portfolio performance evaluation. The researcher compared M^2 of top 10 Indian diversified mutual fund schemes with the overall ranking (including Sharpe Ratio, Treynor Ratio and Jensen Alpha). The rankings as per the combined average of the three Sharpe Ratio, Treynor Ratio and Jensen Alpha and M^2 were found to be very similar. The lowest correlation between the two ranking mechanisms was found to be as high as 87%.

Recommendations

Through this study, it is recommended that SEBI should incorporate the following guidelines in the reporting parameters by Asset Management Companies:

- ✓ Equity base funds should essentially use relevant Total Return Indices and not market price based indices.
- ✓ Portfolio risk adjusted returns should be denoted by M^2 also if not only M^2 along with Sharpe and other measures

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