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Measures of mutual fund performance: Risk, return and risk adjusted, performance persistence and forecasting ability

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Abstract
The landscape of investment vehicles has expanded significantly in recent decades, with mutual funds emerging as a preferred choice for investors seeking a balance between diversification and professional management. This research paper delves into the multifaceted realm of "Measures of Mutual Fund Performance," aiming to unravel the diverse measures employed to evaluate the effectiveness and success of mutual funds. These measures are broadly classified as measurement of risk, return, risk adjustment performance, persistence, and forecasting ability of the fund managers. For the analysis of risk-adjusted performance different measures i.e. Treynor's ratio, Sharpe's ratio, information ratio and Stock selection measures i.e. Jensen alpha, Fama and French Model and Carhart models are discussed. The study also discussed the performance persistence approaches i.e. parametric approach and non-parametric approach. Additionally, the study delves into forecasting ability measures, focusing on stock selection (micro forecasting) and market timing (macro forecasting) skills of fund managers. For that purpose, Treynor and Mazuy (1966) and Henriksson and Merton (1981) models are discussed in both their conditional and unconditional versions. The findings of the study can be crucial for investors, fund managers, and policymakers in making informed decisions regarding mutual fund investments.

Keywords: Forecasting ability, mutual funds, performance persistence, parametric tests, risk-adjusted performance

1. Introduction

The landscape of investment vehicles has expanded significantly in recent decades, with mutual funds emerging as a preferred choice for investors seeking a balance between diversification and professional management. Mutual funds are a financial intermediary that pools the savings of a large number of investors mainly small investors and invests them in optimally diversified portfolios with the objective of return maximisation. The main essence behind the mutual fund is to provide maximum return to investors by reducing the risk through diversification which is associated with capital market investment (Rompotis, 2008) [27].

Apart from these above benefits mutual funds also offer various benefits like tax deduction, economies of scale, liquidity in security and professional management of funds at lower costs for retail investors who are interested in the capital market but do not have the time, expertise and experience in market forecasting (Mishkin & Eakins, 2012; Ramesh & Dhume, 2014) [23, 26].

Management Expertise is one of the beneficial features of any of the mutual funds. Investing in the capital market requires knowledge, expertise, and experience in market forecasting (Mishkin & Eakins, 2012) [23]. It is not possible that every single investor is well familiar with the financial market and can time the market and select the stock. But in a mutual fund, every scheme is managed by experienced and expert investment managers who are well acquainted with the market. These mutual fund managers know the market and have better investment management skills in picking the right stocks at the right time, ensuring a higher return to the investor.

The main objectives of these mutual fund schemes are return maximisation and risk diversification through constructing an efficient portfolio (A portfolio that earns the highest return at a given level of risk).

These objectives depend on the performance of mutual fund schemes (Tomer, 2012; Pandey, 2017; Avadhani, 2009; Bhalla, 2011; Singh, 2006) [32, 25, 1, 3, 31]. So, the performance evaluation of these schemes becomes essential for the investors as well as for the portfolio managers (Zabiulla, 2014) [36]. Because of its obvious impact on wealth, understanding mutual fund performance is a crucial area of financial research for both investors and portfolio managers, (Deb, 2019) [8]. Also, as the popularity of mutual funds continues to grow, the assessment of their performance becomes a critical endeavour for investors, financial analysts, and researchers alike.

Over the period, various models & measures have been developed to assess the performance of mutual funds. Firstly, attention to the performance evaluation of mutual funds has been taken into account after the Markowitz (1952) [22] model of portfolio selection. After Markowitz (1952) [22], other contributors like Fama (1972) [11], Sharpe (1966) [30], Treynor (1965) [33], Jensen (1968) [17], Henriksson and Merton (1981) [16], Treynor and Mazuy (1966) [34], etc. models play a key role in the performance evaluation of MF schemes. Their contribution has been widely adopted by academicians and as well as professionals. These are broadly classified as measurement of risk, return, risk adjustment performance, persistence, and forecasting ability of the fund managers.

This research paper delves into the multifaceted realm of "Measures of Mutual Fund Performance," aiming to unravel the diverse measures employed to evaluate the effectiveness and success of mutual funds. By dissecting these measures, the research aims to provide a comprehensive overview of how investors can critically assess and compare the performance of mutual funds, enabling more informed decision-making. The remainder of this paper is arranged as follows: the next section discusses the risk, return and risk-adjusted measures of performance evaluation, section 3 discusses the measure of performance persistence, Section 4 discusses the models of forecasting ability, and finally, section 5 concludes the study.

2. Performance Evaluation Measures

A person or entity invests their money in mutual funds to earn maximum return at minimum risk. Return and capital appreciation are the rewards that an investor or entity receives for bearing risk in this investment process. This return and capital appreciation depend on the success and performance of these mutual fund schemes (Avadhani, 2009; Sadhak, 2009; Tomer, 2012) [1, 28, 32]. So, the concept of performance evaluation of these mutual funds has become essential in the current scenario. Understanding mutual funds' performance is an important field of research in finance for both investors and portfolio managers because of its obvious impact on wealth, (Deb, 2019) [8].

In this section, different performance measures i.e. risk-based, return-based, risk-adjusted and stock selection are discussed.

2.1 Risk-Based Performance Measure

Risk is a very important factor that affects the performance evaluation of mutual fund schemes, it is defined as the variation from the average expected return over a certain period. Different schemes of mutual funds have different degrees of risk. Therefore, the degree of mutual funds varies according to the preferences of the funds. The following are the two types of risk which are associated with the portfolio:

I. Total risk/ Standard deviation

The total risk is also denoted by the standard deviation which computes by measuring the variability of a fund return from its mean return. While beta compares the variability of a scheme return from its benchmark return and standard deviation compares the scheme return with its average return. The standard deviation shows how much the scheme's return can deviate from the average return of that scheme. If the scheme has a 12% average return and the standard deviation is 5% then it indicates the range of this scheme is between 7%-17%. A lower value of the standard deviation is treated as good for the investment. The standard deviation is the square root of the variance. Total risk is calculated by using the standard deviation as follows:

$$\sigma = [\,\Sigma(R_{pt} - AR)^2/t]^{\frac{1}{2}} \ldots \quad (1)$$

Where R_{pt} is a fund portfolio return in period t, AR is the mean return on the portfolio, and t is the number of days/months for a period for which the standard deviation of the portfolio is calculated.

II. Systematic risk/ market risk/ non-diversifiable risk/ Beta

Beta **(**β) is also known as systematic risk, which is a tool to measure the volatility of the security or schemes from its benchmark. It is a parameter to compare the volatility of a fund with the market benchmark. More than 1 value of the beta indicates more volatility in schemes as compared to the market benchmark whereas a beta value of less than one depicts less volatility in the schemes as compared to the market benchmark. For example, if the market value increases by 10% schemes with a beta value of 1.2 would increase by 20% and if comes down by 10% the scheme's return will decrease by 20%. In case of less than 1 beta value of the fund, the market performs the reverse of the above. Systematic risk is a non-diversifiable risk in nature. It is denoted by the beta Coefficient 'β' which can be calculated as follows:

$$Beta\ (\beta) = \frac{Cov(R_p, R_m)}{Var(R_m)} \quad (2)$$

Beta (β) is systematic risk, R_p is the return of individual fund p, and R_m is overall market return, $Cov(R_p,R_m)$ shows how changes in a stock's returns are related to changes in the market's returns, $Variance(R_m)$ is a variation of market's return from their average return. The beta (Market risk) of a fund portfolio can also be obtained by using the CAPM (Capital Asset Pricing Model) as per the following equation:

$$ER_{pt} = R_f + \beta_p(\,R_m - R_f) + e_{pt\ldots} \quad (3)$$

Where ER_{pt} is the expected return on the fund portfolio in period t, R_m is the return on a market portfolio, R_f is the

Risk-free rate, β_p = slope or beta coefficient, e_{pt} = error term and t indicates the time period.
This model is discussed in detail in the next section. Here beta value indicates the variability of the fund portfolio returns in comparison to market portfolio return. When β is greater than 1, it means that the fund is more volatile and favourable for investment during the bull market phase whereas in the case when β is less than 1, indicates that the fund is less volatile and favourable for investment during the bear market phase.

2.2 Return Based Performance Measure
Return is the most important factor that affects the investment decision of the investors. It is a reward that is received for sacrificing wealth for a certain period. This reward can be in the form of interest, dividend or capital appreciation. The return in mutual fund schemes has been computed by using NAV (Net Asset Value). There are the following measures used to evaluate the performance evaluation in literature based on the return:

I. Total Return
The total return is the simplest measure of the performance of a portfolio. The return of the mutual fund schemes will be computed on the basis of log values of Net Asset Value (NAV) as follows:

$$R_{pt} = \left(\ln NAV_{pt} - \ln NAV_{pt-1}\right) \times 100 \ldots \quad (4)$$

Where R_{pt} is the return on fund p in time t, NAV_{pt} is calculated by the (Value of Assets - Value of Liabilities)/ Numbers of units, NAV_t is NAV at the end of the time t, NAV_{t-1} is NAV at the beginning of the time t and ln is the natural log

II. Average Return
The most common measure of calculating return is the average simple return, which is easy to compute and understand. Therefore, funds can be evaluated by comparing the average return generated by the fund in the study period. The average return can be calculated by the following equation:

$$AR_{pt} = \frac{\sum Rpt}{n} \quad (5)$$

Where, AR_{pt} is the average of fund p for time t, R_{pt} return of fund p for time period t and n is the number of observations or frequencies.

III. Compounded Annual Growth Rate (CAGR)
This is a very useful method of measuring performance, it is a year-over-year growth rate of return on an investment over a specified period of time, calculated on the basis of NAV. Following is the equation for calculating the CAGR:

$$CAGR = \left\{\left(\frac{FV}{IV}\right)^{\frac{1}{n}} - 1\right\} \times 100 \quad (6)$$

Where FV is the final value of NAV, IV is the initial value of NAV and n is the number of years.

IV. The Benchmarks adjusted Return
Benchmarks adjusted returns is another measure to test the performance of fund managers, which can be calculated by the following equation:

$$R_{at} = R_{pt} - R_{bt} \quad (7)$$

Where R_{at} is the benchmark adjusted return of fund p for time t, R_{pt} is the raw return of the fund portfolio p for the time t, and R_{bt} is the return on benchmark index for time t.

2.3 Risk- Adjusted Performance Measure
Apart from the risk and return, risk-adjusted performance is another measure of mutual fund scheme evaluation that compares the excess return in the fund portfolio (Fund's return-risk free return) with the excess return in the market portfolio for a given level of risk. This concept is derived from the CAPM model introduced by William Sharpe in 1964.

I. Treynor Ratio (1965) [33]
Firstly, Treynor (1965) [33] introduced the "Reward-to-Volatility ratio", also known as Treynor's ratio. This ratio measures the excess return of the fund (Return earned over the risk-free rate) with an adjustment to the volatility in the market which is the Beta coefficient (Systematic risk) of the portfolio.

$$\text{Treynor's ratio} = \frac{Rp - Rf}{\beta p} \quad (8)$$

Where, R_p Mutual fund schemes' average return, R_f is the risk-free rate, and β_p is the Systematic risk of the schemes Treynor (1965) [33] argued that the fund performance should be compared with the relevant benchmark and he used Security market line (SML) for comparing the expected return of fund with the rate of return of the market benchmark. If Treynor's ratio of the portfolio is above market excess return, the return of the portfolio is over-performing the market and if it is below market excess return, then the portfolio has under-perform the market benchmark. The higher the Treynors ratio better it is for investors.

II. Sharpe Ratio (1966) [30]
On the other side, Sharpe (1966) [30] developed the "Reward to Variability ratio" known as the Sharpe ratio. This ratio is based on the capital market line (CML) instead of the security market line (SML) used in Treynor's ratio (1965) [33], which measures the portfolio's excess return by relative to total risk (Standard deviation).
The equation of the Sharpe ratio can be expressed as:

$$\text{Sharpe ratio} = \frac{Rp - Rf}{\sigma p} \quad (9)$$

Where, R_p, R_f already explained above and σ_p is a total risk of the fund's portfolio. Here, a higher ratio indicates the best-performing funds and a lower Sharpe ratio indicates an underperforming fund about risk. Hence, the Sharpe ratio in terms of funds' performance is ranked from best (The higher risk-adjusted returns) to worst (The lowest risk-adjusted returns).

III. Information Ratio

The "information ratio (IR)" compares the volatility of portfolio returns to returns that are above the of a benchmark's returns. The IR is commonly used to evaluate the manager's performance and performance consistency by including a tracking error or standard deviation component in the computation. The consistency with which a portfolio "tracks" an index's performance is measured by the tracking error. A low tracking error indicates that the portfolio consistently outperforms the benchmark over time and vice versa. So, schemes with higher IR ratios are considered better performers.

$$IR = \frac{R_p - R_f}{\text{Tracking Error}} \quad (10)$$

Where IR is the information ratio, tracking error is σ of the difference between R_p and R_m.

2.4 Stock Selection Measures

In this sub-section, different stock selection measures are discussed. The explanation of these models is as follows:

I. Jensen (1968) [17]

Jensen (1968) [17] evolved risk-adjusted single factor regression absolute measure for performance evaluation which compares the actual average return with the predicted return by the CAPM. The mathematical equation of Jensen is:

Jensen's Alpha (α)= $R_{pt} - \{R_f + \beta(R_m - R_f)\}$ (11)

Here, positive and significant Jensen α (alpha) indicates that funds over-perform the market benchmark and vice versa. Jensen (1968) [17] measured underperformance and over performance by using 115 open-ended mutual funds for the period 1945-1964. Jensen not only calculated the expected return on a given level of risk but also extended the CAPM model by comparing the actual return with the expected or calculated return. He concluded in his study that there were very few funds exhibited significant positive evidence of stock selection ability.

II. Fama and French (1992, 1993) [13, 13]

Treynor's ratio (1965) [33], Sharpe's ratio (1966) [30] and Jensen's (1968) [17] alpha considered risk and return factors while evaluating mutual fund performance. In addition to that, Fama and MacBeth (1973) [13] argued in their study that besides the risk and return of mutual funds investors should consider other factors such as the size of the stocks and book-to-market ratio.

In this regard Fama and French (1992, 1993) [12, 13] introduced a three factors model and argued that return cannot be adequately explained by a single risk factor, So in addition to the CAPM model, Fama and French (1993) [12] proposed a three-factor model comprising two additional factors (beside return on market portfolio) which are risk of firm size and style risk associated with high book-to-market ratio firms known as Small minus Big (SMB) and High minus Low (HML) respectively.

The Fama and French (1993) [12] regression can be expressed as:

$$(R_p - R_f)_t = \alpha + \beta_1(R_m - R_f)_t + \beta_2(SMB)_t + \beta_3(HML)_t + e_{pt} \quad (12)$$

Where $(R_P\text{-}R_f)_t$ is excess portfolio return over risk-free security in time t, $(R_m\text{-}R_f)$ excess market return over risk-free security, R_f is return of risk-free security, $SMB_{(t)}$ (Small minus Big) measured the 'size factor' of the scheme (the difference between the return of small stock and big stock), $HML_{(t)}$ (High minus low) measured the 'value factor' on the scheme (the difference between the return on high B/M ratio and low B/M ratio. $WML_{(t)}$ (Winner minus Loser) is the factor that measures the 'momentum or persistence'.

III. Carhart (1997) [7]

Carhart (1997) [7] introduced a four-factor model by adding one more factor to Fama and French's (1992, 93) [12, 13] Model which is winner minus Loser (WML), which captures momentum strategy to earn an abnormal return. The three-factor model of Fama and French 1992, 93 [12, 13] captures most of the anomalies captured in the cross-section asset return variation except short-term momentum, which is pointed out by Jagdeesh and Titman (1993) [39]. To overcome this problem Carhart introduced a four-factor model. The Four factor Carhart (1997) [7] regression can be expressed as:

$$(R_p - R_f)_t = \alpha + \beta_1(R_m - R_f)_t + \beta_2(SMB)_t + \beta_3(HML)_t + (WML)_t + e_{pt} \quad (13)$$

3. Performance Persistence Measures

Performance persistence means how much consistent the performance of the mutual funds' schemes is. In other words, it is defined as the same ranking status in the initial period and the subsequent period. Persistence in the performance of a fund can be positive or can be negative. It's called positive when the performance of any scheme continuously over-performs and called negative when any scheme continuously under-performs over the period. Over and under-performance is evaluated based on the median fund performance. For this purpose, different parametric and non-parametric approaches are widely used in literature to test whether mutual funds can repeat their performance over time or not.

3.1 Parametric test

After evaluating the performance of mutual funds, Bollen and Busse (2005) [5] suggested the cross-sectional regression approach to the performance of its lagged value for testing the performance persistence. This simple linear regression model is used to check whether the future performance of mutual funds is related to past performance, i.e. whether mutual funds that have outperformed in the past continue to outperform in the future too. The cross-section regression equation can be expressed as:

$$\text{Perf}_{pt} = \alpha + \beta_1(\text{Perf}_{p,t-1}) + e_{pt} \quad (14)$$

Where, Perf_{pt} is abnormal return of fund p in time t, $\text{Perf}_{p,t-1}$ is abnormal return of fund p in time t-1 and α, β, e_{pt} is already explained above. A positive and statistically significant value of slope coefficient β indicates that past performance is related to the subsequent period's performance. This approach is widely applied in the literature (See Bollen and Busse, 2005; Kahn and Rudd, 1995; Javier Vidal Garcia, 2013; Soumya Guha, 2019; Drosos Koutsokostas, 2019) [5, 18, 35, 37, 38].

3.2 Non-Parametric Contingency Table approach

To analyse the performance persistence, the non-parametric 2*2 contingency table approach is widely used in literature. Studies like Brown *et al*., (1992) [6], Goetzmann & Ibbotson (1995) [6], Kahn and Rudd (1995) [18], Malkiel (1995) [19], Babalos *et al*., (2008) [2], Javier Vidal Garcia 2013 [35], Drosos koutsokostas 2019, Deb 2019) [38] used this approach. This is a common test for persistence to measure the frequency with which winners' and losers' funds maintained that category over consecutive time periods.

In this approach, firstly we have to sort funds as winner (W) and loser (L) in each formation period according to the abnormal return above/below the median return. Winner (W) is funds that obtain abnormal returns over the median return of each period and the Loser (L) is funds that obtain below the median return. According to these categories winner and loser of funds we have documented different combinations in two (formation and testing) consecutive periods: winner-winner (WW), loser-loser (LL), winner-loser (WL), and loser-winner (LW).

The numbers of funds that are winners in both the periods (Formation and Testing) are denoted as (Winner-Winner) WW and the funds that are loser in both periods are denoted as (loser-loser) LL. On the other side, winner-loser (WL) is the fund that are winner in the formation period and loser in the subsequent testing period and loser-winner (LW) is the fund that are Loser in the formation period and winner in subsequent testing period. Thus, the contingency table presents the frequencies with which winners and losers repeat. There is performance persistence if statistical evidence shows a significantly larger number of repeat winners (WW) and losers (LL) frequencies than in the other two. To avoid the possibility that a high proportion of funds remain in the top ranks by chance, we test all available data and also use different statistical tests to establish the robustness of the possible performance persistence effect contingency table estimates were examined in literature by the use of the repeat winner approach Z test of (Malkiel, 1995) [19], the odd ratio or cross product ratio of (Brown and Goetzman, 1995) [6], and the chi-square statistic of (Kahn and Rudd, 1995) [18] approaches. The null hypothesis for all the above three approaches is that there is no persistence in the performance of mutual funds in India. The explanation of these models is given below:

I. Malkiel (1995) [6] z test

The first test is the repeat winner approach or z test proposed by Malkiel (1995) [6]. In the case of Malkiel 1995 [6], no persistence means that a winner in the formation period will be either a winner or loser in subsequent testing periods with equal probabilities of p=0.5, this test presents the percentage of repeat winners (WW) to winners- losers (WL). He uses the binomial test of p>1/2 to check the significance of the proportion of WW to (WW+WL):

$$Z = \frac{(y - np)}{\sqrt{np(1-p)}} \quad (15)$$

Where Z is the statistical variable distributed as normal with zero mean and standard deviation of one, y is the number of repeat winners (winner in both formation and testing period) (WW), and n is the number of repeat winners and winner/losers (WW+WL). A percentage of winner portfolio to the number of repeat winners and winner/losers above 50% and a Z-statistics above zero show performance persistence.

II. Brown and Goetzman (1995) [6] odd ratio or cross-product ratio

Second, for test statistics we have used cross-product ratio (CPR) also known as odd ratio. It can be expressed as:

$$CPR = \frac{(WW * LL)}{(WL * LW)} \quad (16)$$

Where, WW, LL, WL and LW are already explained above. Under the null hypothesis of no persistence, the CPR is equal to unity. The CPR value above unity indicates performance persistence (WW or LL) while a value less than unity shows reversals (WL or LW). The statistical significance of the CPR is checked through the following Z statistics:

$$Z = \frac{\ln CPR}{\sigma \ln CPR} \quad (17)$$

Where Z is already explained above, ln CPR is a log of the cross-product ratio and the standard deviation of lnCPR is calculated as follows:

$$\sigma \ln CPR = \sqrt{\frac{1}{WW} + \frac{1}{WL} + \frac{1}{LL} + \frac{1}{LW}} \quad (18)$$

III. Kahn and Rudd (1995) Chi-square statistic

To investigate the statistical significance of the persistence in the contingency table through the chi-square test of Kahn and Rudd (1995) [18] by comparing the actual and the expected number of observations for every category (WW, WL, LL and LW). The null hypothesis of no persistence is checked by the following statistics:

$$x^2 = \frac{(WW-N/4)^2+WL-N/4)^2+LL-N/4)^2+LW-N/4)^2}{N/4} \quad (19)$$

Where, WW, WL, LL and LW are already explained above and N is the number of funds (WW+WL+LW+LL).

$\chi 2$ follows the chi-square distribution with one degree of freedom [(R-1)*(C-1)] in 2*2 (Raw*Column) contingency table. For checking the statistical significance of the chi-square test we have checked whether $\chi 2$ calculated value is equal to or greater than the table value of the chi-square at 1 degree of freedom with a significant level of significance. If the calculated value of the chi-square is equal to or greater than the table value of the chi-square at a 5% level of significance then we reject the null hypothesis of no persistence which means that the alternative hypothesis is accepted and performance persistence is existed.

On 1 degree of freedom the critical value at 0.05(5%) level is 3.841, in 0.01 (1%) level it is 6.635 and at 10% it is 2.706. With the Chi-square test is not possible to detect reversals in performance, as it is always positive. However, carpenter and Lynch (1999) showed that the chi-squared test is well-specified, powerful and more robust to the presence of survivorship bias when compared to other test performances.

4. Forecasting ability Measures

Fund managers' forecasting is an important aspect of a fund's performance. Selection of the fund and timing the market in the right direction are the two major forecasting skills of the fund managers to generate superior performance in the market, (Deb., 2007) [10]. These are the two types of forecasting ability that are discussed below:

4.1 Stock Selection Skill/ Micro Forecasting

Stock selection can also be termed micro forecasting refers to the process of predicting the future price of the individual stock and choosing individual stocks or securities to include in an investment portfolio based on fundamental and technical analysis. It's a critical aspect of portfolio management and investment strategy.

4.3 Market Timing Skill/Macro forecasting

Market timing or macro forecasting is defined as the fund manager's skill of correctly accessing the direction of the market to earn superior returns from the portfolio. In simple words, market timing is to predict the rise and fall of the market in advance and adjust their portfolio investment according to these fluctuations. A fund manager is called skilled in timing the market if he/ she raises the beta coefficient and shifts from cash to stocks in the bull market (Rising market) and decreases the beta coefficient by shifting to cash from stocks in the bear market (fallen market). A successful market timer is an individual who can strategically adjust their portfolio's allocation to equities by increasing it before a market upturn and decreasing it before a market downturn, effectively capitalizing on market movements (Bollen and Busse, 2001; Deb. SG, 2007) [5, 10].

4.4 Unconditional Models

The unconditional models of forecasting ability are explained as follows:

I. "Treynor and Mazuy's 1966 [34] (Unconditional) model"

The first multifactor model for evaluating stock selection and market predicting skill of fund manager was introduced by Treynor & Mazuy (1966) [34], they added the quadratic term to the CAPM model and claimed that the connection between market return and fund return should not be linear as suggested by the traditional CAPM model. The curvature in this model captures the market timing ability, they argue that fund managers can adjust fund beta value according to the private information for generating superior stock picking and market timing ability (Zabiulla, 2014) [36]. A fund manager is called skilled if he/ she raises the beta coefficient and shifts from cash to stocks in the bull market (Rising market) and decreases the beta coefficient by shifting to cash from stocks in the bear market (Fallen market) (Bollen & Busse, 2001; Deb *et al*., 2007) [4, 10].

The regression equation of "The Treynor and Mazuy (1966) [34]" model is expressed as:

$$"R_{pt} - R_{ft} = \alpha + \beta(R_{mt} - R_{ft}) + \gamma(R_{mt} - R_{ft})^2 + e_{it} \quad (20)$$

Where R_{pt} is the Daily return from the mutual fund portfolio, R_{mt} is the Daily return from the market portfolio, R_f is the Daily risk less security's rate of return and e_{pt} is the error term.

II. Henriksson & Merton's 1981 [16] (Unconditional) model

Henriksson & Merton (1981) [16] introduced a similar methodology as Treynor and Mazuy (1996) [34] to measure the market predicting skill of fund managers. "Treynor and Mazuy (1996) [34]" consider the square of both positive and negative market returns in the second parameter. However, Henriksson and Merton (1981) [16] feel that the dummy variable should be used to separate positive and negative market returns. They argue that a market timer divides capital between risk-free securities and stocks based on predictions of future excess market returns. When the market is expected to perform well market timers will choose a higher value of beta ($R_m \geq R_f$) shifting from risk-free securities to stocks, and when the market is anticipated to perform poorly, choose a lower value of beta ($R_m \leq R_f$) by shifting from stocks to risk-free assets. The dummy variable is used to estimate the relationship.

The regression equation of the "Henriksson and Merton (1981) [16]" model is expressed as:

$$"R_p - R_f = \alpha + \beta(R_m - R_f) + \gamma[D\,(R_m - R_f)_t] + e_{pt} \quad (21)$$

Where R_{it} is the Daily return from the mutual fund portfolio, R_m is the Daily return from the market portfolio, R_f is the Daily risk less security's rate of return, e_{it} is the error term and D is a dummy variable with a value of -1 in down markets ($R_m < R_f$) and 0 in up markets ($R_m > R_f$).

In the unconditional version of both Treynor and Mazuy (1966) [34] and Henriksson and Merton's (1981) [16] model the parameters are, α, β and γ. The 'α' coefficient is a measure of a fund manager's stock-picking ability. A positively significant alpha (α) coefficient depicts the superior skill of the fund managers in selecting the undervalued securities (Selection ability) and vice-versa.

The intercept 'γ' of quadratic regression captures the market timing skill of the fund manager. A positive and statistically significant γ coefficient depicts the superior market timing abilities of the fund manager. The negative and statistically insignificant gamma coefficient indicates the inability of the fund managers to time the market, and the statistically significant negative γ coefficient indicates the perverse market timing abilities of the fund manager. The hypothesis is tested at a 5% level of significance and t-statistics are adjusted for heteroscedasticity and autocorrelation according to the Newey and West (1987) [24] test.

4.5 Conditional Models

For evaluating the forecasting abilities of mutual fund managers two important methodologies evolved by "Treynor and Mazuy (1966) [34] and Henriksson and Merton (1981) [16]". These are also known as the traditional or unconditional model of evaluation. The traditional model is grounded on the assumption that any information correlated with future market returns is considered superior information. In other words, these models are unconditional, as they do not take into account specific conditions or contingencies that may affect market behaviour. However, Ferson and Scadt's (1996) [15] approach used in addition a "semi-strong form of market efficiency" which states that obtaining confidential information and predicting equity company price swings appropriately are the keys to achieving real selectivity and market timing and building a portfolio of undervalued companies. Fund managers can provide better stock selection and market timing performance over time by adjusting their alpha and beta based on confidential information. The literature proves that macroeconomic factors like money supply, crude oil prices, consumer price index, export, import, gold prices, exchange rates, interest rates, gross domestic product, and unemployment affect the market price of the stock.

So, can take one day lagged values of various independent macroeconomic variables that are confirmed for conditioning the alpha and betas in the literature on finance and economics. These variables can be repo rate (RR), "dividend yield on nifty 500 (DY), fluctuations on foreign exchange rate INR v/s USD (FX), Mumbai Inter-Bank Offer Rate (MIBOR), CPI inflation (IF), growth rate of index of industrial production (IIP) and growth in gold prices (GG). The explanation of these conditional models is as below:

I. "Treynor and Mazuy 1966 [34] (Conditional Model)

The equation of Treynor and Mazuy (1966) [34] under the conditional model is given as follows:

$$R_{it} - R_{ft} = \alpha_0 + \alpha_1 * (DY_{t-1}) + \alpha_2 * (RR_{t-1}) + \alpha_3 * (FX_{t-1}) + \alpha_4 * (MIBOR_{t-1}) + \alpha_5 * (IF_{t-1}) + \alpha_6 * (IIP_{t-1}) + \alpha_7 * (GG_{t-1}) + \beta_0(R_m - R_f) + \beta_1 * (DY_{t-1}) * (R_m - R_f) + \beta_2 * (RR_{t-1}) * (R_m - R_f) + \beta_3 * (FX_{t-1}) * (R_m - R_f) + \beta_4 * (MIBOR_{t-1}) * (R_m - R_f) + \beta_5 * (IF_{t-1}) * (R_m - R_f) + \beta_6 * (IIP_{t-1}) * (R_m - R_f) + \beta_7 * (GG_{t-1}) * (R_m - R_f) + \gamma(R_{mt} - R_{ft})^2 + e_{it} \tag{22}$$

II. Henriksson and Merton Model 1981 (Conditional Model)

The equation of the H&M 1981 conditional model is given below:

$$R_{it} - R_{ft} = \alpha_0 + \alpha_1 * (DY_{t-1}) + \alpha_2 * (RR_{t-1}) + \alpha_3 * (FX_{t-1}) + \alpha_4 * (MIBOR_{t-1}) + \alpha_5 * (IF_{t-1}) + a_6 * (IIP_{t-1}) + a_7 * (GG_{t-1}) + \beta_0(R_m - R_f) + \beta_1 * (DY_{t-1}) * (R_m - R_f) + \beta_2 * (TB_{t-1}) * (R_m - R_f) + \beta_3 * (FX_{t-1}) * (R_m - R_f) + \beta_4 * (BR_{t-1}) * (R_m - R_f) + \beta_5 * (INF_{t-1}) * (R_m - R_f) + \beta_6 * (IIP_{t-1}) * (R_m - R_f) + \beta_7 * (GG_{t-1}) * (R_m - R_f) + \gamma * (R_m - R_f) * D + e_{it}\ldots \tag{23}$$

$\alpha_0, \alpha_1, \alpha_3, \alpha_4, \alpha_5, \beta_0, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ and γ are the parameters in both the above conditional version of T&M (1966) and H&M (1981) models and calculated by using the regression analysis. D is a dummy variable with a value of -1 in down markets ($R_m < R_f$) and 0 in up markets ($R_m > R_f$).

The coefficients obtained from the conditional version of "Treynor and Mazuy (1966) [34]" and Henriksson and Merton (1981) [16]" models demonstrate the fund manager's capability to generate returns using timing and selection strategies based only on private information. Positive and statistically significant alpha (α) shows the abnormal skill of the fund manager in the selection of under-valued securities in the portfolio. The intercept of the quadratic regression 'γ' captures the market timing skills of the fund managers. The hypothesis is tested at a 5% level of significance and t-statistics are adjusted for autocorrelation and heteroscedasticity according to the Newey and West (1987) [24] test.

5. Conclusion

In conclusion, this research paper has provided a comprehensive exploration of the multifaceted realm of mutual fund performance evaluation. The significance of assessing mutual fund performance has been underscored since the seminal work of Markowitz in 1952 [22], and subsequent contributors like Fama, Sharpe, Treynor, Jensen, and others have enriched the field. The study is structured around key dimensions: risk-based, return-based, risk-adjusted, stock selection, performance persistence and forecasting ability measures.

Risk-based performance measures, including total risk and systematic risk, highlight the importance of understanding a fund's volatility about its benchmark. Return-based measures, such as total return, average return, CAGR, and benchmarks adjusted return, offer insights into the reward investors receive for their investment. Meanwhile, risk-adjusted performance measures like Treynor and Sharpe ratios, along with the information ratio, provide a nuanced understanding of returns relative to risk.

The stock selection measures, exemplified by Jensen's

Alpha, Fama-French Three-Factor Model, and Carhart Four-Factor Model, delve into the intricacies of evaluating performance beyond traditional risk and return metrics. These models introduce factors like size, value, and momentum to capture additional dimensions of mutual fund performance.

Furthermore, the study explores the performance persistence and forecasting ability of mutual fund managers through parametric and non-parametric tests, as well as unconditional and conditional models respectively. Performance persistence can be evaluated through a cross-sectional regression approach and a contingency table approach, utilizing parametric tests like the Bullen and Busse (2005) [5] cross-sectional regression model and non-parametric tests including the Malkiel (1995) [19] z test, Brown and Goetzman (1995) [6] cross-product ratio, and Kahn and Rudd (1995) [18] chi-square statistic. The findings of these tests help determine whether mutual funds exhibit consistent performance over time.

Additionally, the study delves into forecasting ability measures, focusing on stock selection (micro forecasting) and market timing (Macro forecasting) skills of fund managers. Two unconditional models, Treynor and Mazuy (1966) [34] and Henriksson and Merton (1981) [16] assess stock selection and market timing abilities based on historical data. The study further extends these models to conditional versions by incorporating macroeconomic factors, emphasizing the impact of variables like repo rate, dividend yield, foreign exchange rates, and others on fund managers' forecasting capabilities.

In navigating the complex landscape of mutual fund investments, investors and portfolio managers can leverage these diverse measures to make more informed decisions. Each measure or model brings a unique perspective to the evaluation process, allowing stakeholders to tailor their assessments based on specific investment goals and risk tolerances. This research equips market participants with valuable tools to critically analyze and compare mutual fund performance, fostering a more sophisticated approach to wealth management.

The results of the study aim to contribute to the understanding of mutual fund performance and the factors influencing fund managers' abilities to persistently outperform the market and make accurate forecasts. The findings can be crucial for investors, fund managers, and policymakers in making informed decisions regarding mutual fund investments. Moreover, by incorporating conditional models, the study recognizes the importance of considering macroeconomic factors in evaluating fund managers' forecasting abilities.

6. References

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