# PREDICTING PAKISTANS' MUTUAL FUND PERFORMANCE: AN EVALUATION OF TRADITIONAL AND MODERN MEASURES

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**Abstract.** Mutual Funds enable small investors to benefit from the capital market with minimal investments, thanks to the expertise of professional managers. This study focuses on the Pakistani Mutual Fund industry and evaluates the suitability of traditional and multifactor asset pricing models in assessing Mutual Fund performance. Since multifactor models are rarely used in Pakistani research, this study employs the CAPM, Fama French, and Carhart models to assess the performance of Pakistan Mutual Funds. Data from 100 open-end Mutual Funds between 2005 and 2017 was collected from the Mutual Fund Association of Pakistan, while risk-free rates data was gathered from the State Bank of Pakistan and stock data from the Pakistan Stock Exchange. Ratio analysis, CAPM, Fama French-3 Factor, and Carhart-4 Factor models were used to analyze the data and determine which model was most suitable. The results indicate that the CAPM affects the market factors of the majority of portfolios. Conversely, the size factor, value factor, and momentum factor in the Fama French and Carhart models have an insignificant effect on the majority of portfolios. The Gibbon Rose Shanken test reveals that the CAPM model is the most suitable for evaluating Mutual Fund performance in Pakistan. The findings of this study have implications for asset management company managers and investors alike. It provides valuable insights into which funds perform better and which types of funds are ideal for investment.
**Keywords**: *mutual fund, risk-adjusted performance, CAPM, fama french-3 factor, carhart-4 factor, grs*

## Introduction

Asset management companies provide an opportunity for investors who lack financial expertise or are unable to diversify their investments. Mutual Funds act as a bridge between investors and their investment objectives by pooling their investments and having financial experts manage them in a diverse portfolio of securities (Arif et al., 2019). Investors become shareholders of the Mutual Fund by purchasing units, and the responsibility of making investment decisions rests on the Mutual Funds AMC's. Mutual Funds generate income and capital gain for both themselves and investors through obtaining dividends and increasing security prices. Open-end funds issue shares as demanded by investors without restriction or limitation, continuously creating and redeeming units, while closed-end funds have a fixed number of units and are floated like public companies through an IPO before being sold on the stock exchange. Mutual Funds provide the opportunity for pooling investments to fund large projects (Chizema et al., 2020). Mutual Funds have professional management that evaluate investment opportunities and make decisions on behalf of investors who may lack financial expertise. The concept of pooling investments in Mutual Funds was introduced by Dutch merchant Abraham van Ketwich in 1774. The 19th century saw advancements in Mutual Funds in Europe, while the first close-ended fund was introduced in the US in

1893. In Pakistan, National Investment Trust introduced open-ended Mutual Funds in 1962, while Investment Corporation of Pakistan launched the first closed-end fund in 1966. The privatization of government-owned entities in the 1990s led to financial sector reforms in Pakistan, which included allowing private individuals and groups to do business on a corporate level (Jan et al., 2019). In 2000, investors in Pakistan started investing through financial experts or professional managers in Mutual Funds, which were considered non-banking financial institutions.

A survey conducted in 2006 revealed that the Pakistan fund industry was worth PKR 171 billion and has since rapidly grown to PKR 385 billion, with various funds attracting investors such as fixed income funds, money market, balanced, equity, Islamic, fund of funds, and tracker funds. The number of Mutual Funds increased from 135 in 2010 to 220 in 2018, indicating a sharp growth in the industry. However, the number of AMCs in Pakistan is increasing at a low rate. Mutual Funds play a vital role in the effective utilization of savings collected from individuals or institutions. Traditional measures have been mostly used to evaluate Mutual Fund performance in developing countries, but modern methods have been widely used in developed countries (Climent et al., 2020). This study aims to evaluate Mutual Fund performance in Pakistan using both traditional and modern methods to fill the existing gap. The research study aims to evaluate the performance of Pakistan's Mutual Fund using traditional measures (Ratio Analysis) and modern methods (CAPM, Fama French 3 factors, and Carhart 4 factors models) to test whether the assumptions of better returns and less risk associated with Mutual Funds are valid. The study has the objective of investigating the suitability of traditional measures and modern methods in predicting the performance of Pakistan's Mutual Fund, validating which method or model better explains the fund's performance, and identifying the procedures and practices adopted by the fund managers in capturing market variations. The research hypotheses developed from the literature review are focused on whether ratios or models better predict the mutual fund's performance and whether fund managers capture market variations in Pakistan. The study's contributions include academic validation of modern methods, offering lessons for fund managers and policymakers to improve the function and operational parameters of Mutual Funds in Pakistan, and providing a set of recommendations for investors to better understand investing destination and market factors (Ansari and Shah, 2016).

## Materials and Methods

### *Research design*

The research design is a logical plan that outlines the steps and methods for conducting a research study. It serves as a guide from data collection to analysis in order to solve a problem. In this quantitative research study, various sources of secondary data were analyzed through ratio and modern model methods to test a hypothesis. The study was casual, and descriptive, and investigated correlations between variables. The results reflected the performance of the Mutual Fund, and the impact factors that affect its performance were explained to fund managers and investors interested in the Mutual Fund industry. Additionally, the study explained performance indicators and the best-fitted measurement model.

### *Research population*

The population of a research study refers to the entire units, people, or things of research interest. For this particular research study, the population was the entire Pakistani fund industry, which was analyzed for performance using ratios and modern models. Secondary data was collected from all the open-ended funds traded through AMCs, and the daily performance results NAV were obtained from the MUFAP website. The total number of open-ended Mutual Funds traded on MUFAP was considered as the population for this research study.

### *Research sample study and research techniques*

The use of sampling as a technique to study a subset of a population when resources and time are limited. The study focuses on analyzing the performance of mutual funds in Pakistan using various models and ratios. The sample size consists of 100 open-ended mutual funds selected from 211 funds that existed between July 2005 and June 2017, and data was collected for a 12-year period. The sampling technique used was random sampling, and missing data were added by taking the average of subsequent years. The study concludes that a larger sample size yields better results, and 60 observations are commonly used to estimate beta.

### *Data sources and collection methods*

For analyzing the performance of Pakistani funds, secondary data has been collected through financial reports and annual reports of the Mutual Fund, as well as from the Pakistan Stock Exchange and MUFAP websites. The data covers the period from 2005 to 2017 and includes monthly data for Mutual Fund analysis and Fund characteristics data. To calculate adjusted returns, three different asset pricing models were used: CAPM, Fama French 3-factor, and Carhart 4-factor. These adjusted returns were then regressed against the fund characteristics to analyze their relationship.

### *Performance analysis*

The process of data preparation, portfolio construction, and data management involves several steps. The main theme is to collect and merge various types of data related to mutual funds, T-bills, the KSE-100 index, and KSE-listed firms' daily share prices. The collected data is then cleaned by removing irrelevant data, such as futures contracts and firms with less than 60 observations, and by dropping observations with negative equity and zero stock returns. The remaining data is used to generate monthly returns and unique identifiers for each stock. The data is merged to create factors such as SMB and HML and to create market-to-book ratio and market capitalization. Outlier observations are dropped, and the final data set contains 567 firms.

### *Calculation of SMB and HML factors*

To begin with, rankings for firm size and BM are generated for each year. Firm size is categorized as either Big or Small, while BM is divided into three groups - Low, Medium, and High. This is followed by the creation of six portfolios' monthly returns, namely BL, BM, BH, SL, SM, and SH, where B represents Big size, S represents Small size, L represents Low B/M ratio, M represents Medium B/M ratio, and H represents High B/M ratio. Additionally, the factors of SMB and HML are generated using the

following formulas: SMB is calculated as (SL+SM+SH)/3 - (BL+BM+BH)/3, while HML is calculated as (SH+BH)/2 - (SL+BL)/2.

### *Calculation of monthly momentum*

The Carhart model is used to calculate monthly momentum, whereby the cumulative 11-month returns of each stock are ranked based on their returns. The momentum returns for each month are then calculated by finding the difference between the returns of the top 30% and the bottom 30% of the ranked stocks. The results are saved in a file along with the SMB and HML factors and full monthly data. Ten portfolios of Mutual Funds are created based on their yearly returns, with the lowest-return portfolio placed at P1 and the highest-return portfolio placed at P10. Each year's portfolio contains an average of 10 funds. The CAPM, 3 Factor Fama French, and Carhart models are applied to these portfolios, and a GRS test is used to determine the best-fit model. The results show that the CAPM is the best-fitted model among the three modern models. Finally, risk-adjusted alphas for each Mutual Fund are derived by applying the CAPM.

### *Single factor CAPM model*

The performance analysis of Pakistani Mutual Funds on the 10 decile portfolios is carried out using the single-factor CAPM model, represented as in Eq. (1):

$$(Ri - Rf) = \alpha + \beta(Rm - Rf) + \epsilon \ldots 1 \qquad \text{Eq. (1)}$$

Where, (Ri – Rf ) represents the actual risk premium, Beta(Rm – Rf) represents the expected risk premium, α represents the intercept, and ϵ represents the error term. It is worth noting that used the same model in the study on Mutual Fund performance analysis.

### *Fama french 3-factor model*

The Fama-French three-factor model was employed for the analysis of Mutual Fund performance. The model is expressed as follows: $(Ri – Rf) = \alpha + \beta_1(rm – Rf) + \beta_2(SMB) + \beta_3(HML) + \epsilon$, where (Ri – Rf) represents the actual risk premium, SMB represents the monthly premium for the "size factor" (difference in return on a portfolio consisting of small caps funds and large caps funds), HML represents the monthly premium for the "book-to-market factor" (difference in return on a high book-to-market portfolio to market stocks and a low book-to-market portfolio to market stocks), α represents the intercept, and ϵ represents the error term. The Fama-French three-factor model was introduced in 1993 and has been widely used in the analysis of stock portfolios and Mutual Funds. However, there has been limited research on this model in Pakistan. This model can be used for evaluating the performance of funds.

### *Carhart 4-factor model*

The Carhart four-factor model was utilized for determining the risk-adjusted return of mutual funds. The model is represented by the equation $(Ri – Rp) = \alpha + \beta_1(rm – rf ) + \beta_2(SMB) + \beta_3(HML) + \beta_4(MOM) + \epsilon$, where (Ri – Rf) is the actual risk premium, SMB is the monthly premium of the size factor, HML is the monthly premium of the book-to-market factor, and MOM is the difference in portfolio return between past winners and

losers. The intercept of the model is represented by α. The first researcher to introduce this model for evaluating mutual fund performance persistence, and it has since been employed by many researchers in developing countries for evaluating fund performance.

### *Gibbons Ross Shanken (GRS) test*

The model, expressed as GRS = F (N, T – N – 1), was originally employed to identify the disparities in the alphas of style portfolios. This same model has been examined and validated in studies regarding mutual fund performance,.

### *Jensen ratio*

Jensen introduced the Jensen alpha in 1968 as a measure of portfolio performance, also referred to as the Jensen ratio. This ratio compares the actual return of a portfolio to its expected return at a systematic risk level, as determined by its beta. The Jensen alpha can be calculated using the Eq. (2):

$$\alpha = r_p - [r_f + \beta_p(r_m - r_f)] \quad \text{Eq. (2)}$$

Where, α represents the parameter of the model, $r_p$ is the expected total portfolio return, $r_f$ is the risk-free rate, $\beta_p$ is the beta of the portfolio, and $r_m$ is the return on the market index.

### *Treynor ratio*

The Treynor ratio, also known as the reward-to-volatility ratio, was developed by Treynor in 1965. This ratio measures the excess return of a portfolio per unit of market risk that cannot be obtained through risk-free investments. The Treynor ratio is calculated as Eq. (3):

$$\text{Treynor Ratio} = (r_p - r_f)/\beta \quad \text{Eq. (3)}$$

Where, $r_p$ is the portfolio return, $r_f$ is the risk-free rate, and β is the beta of the portfolio.

### *Sharp ratio*

William Sharpe introduced the Sharpe ratio as a risk-adjusted performance measure for portfolio evaluation. This ratio takes into account the overall risk of the portfolio by using its standard deviation. The Sharpe ratio is calculated as Eq. (4):

$$\text{Sharpe Ratio} = (r_p - r_f)/\sigma \quad \text{Eq. (4)}$$

Where, $r_p$ is the portfolio return, $r_f$ is the risk-free rate, and σ is the standard deviation of the portfolio return.

### *Proxies for risk free rate*

To calculate mutual fund returns, the dividend payout and the Net Asset Value of the Month end (NAV) have been utilized. The market return has been based on the KSE

100 index. As proxies for the risk-free rate, six months of treasury bills returns have been used. The historical data for KSE 100 has been sourced from Yahoo Finance, while the data for T-bills has been obtained from Statistical Bulletins issued by the State Bank of Pakistan.

### *Gibbon Ross Shanken test*

The Gibbons-Ross-Shanken (GRS) test has been highlighted as a crucial factor for empirical research on asset pricing models. The GRS test is used to evaluate the ex-ante unconditional efficiency of a portfolio based on unconditional moments, not conditional moments. It also serves as a test for the conditional efficiency of a portfolio given changes in the risk-free rate. The GRS test will be utilized to determine the most appropriate and validated model out of the three available models.

### *Return*

The returns of a fund are calculated by deducting the expenses of the fund, including management fees. Monthly returns for each fund are suggested in Eq. (5):

$$R_p = (NAV_t + DIST_t - NAV_{t-1})/NAV_{t-1} \quad \text{Eq. (5)}$$

Where, $R_p$ represents the fund return, $NAV_t$ represents the closing net asset value of the fund on the last trading day of the month, $NAV_{t-1}$ represents the previous month's last day net asset value and $DIST_t$ represents the capital gain or income distributed in the form of a cash dividend. The market portfolio's monthly returns are calculated using the KSE 100 index as the basis for calculations. The returns on the market portfolio are calculated as in Eq. (6):

$$R_m = (\text{KSE100 index}_t - \text{KSE100 index}_{t-1})/\text{KSE100 index}_{t-1} \quad \text{Eq. (6)}$$

Where, $R_m$ represents the market return, KSE100 $\text{index}_t$ represents the closing value of the KSE 100 index on the last working day of the month, and KSE100 $\text{index}_{t-1}$ represents the previous month's last working day closing value.

### *Risk*

In order to measure the total risk of a portfolio, variance and standard deviation of returns are commonly used. The variance of returns is considered a proxy for total risk, and it can be calculated using the formula of Eq. (7):

$$Var(R) = \frac{1}{n-1}\sum_{t=1}^{n}(R_t - \bar{R})^2 \quad \text{Eq. (7)}$$

Where, n is the number of observations, $R_t$ is the return at time t, and $\bar{R}$ is the average return. The standard deviation, σ, can then be calculated as the square root of the variance in Eq. (8):

$$\sigma = \sqrt{Var(R)} \quad \text{Eq. (8)}$$


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Accordingly, these measures are widely accepted for measuring the total risk of a portfolio.

## Results and Discussion

### *Assessment of the data and insights*

The present research study aimed to assess the performance of Pakistan's mutual funds using both traditional and modern measures. To obtain accurate individual and sector results, the study divided portfolios based on their nature and sector. Specifically, firms in the same sector were grouped into a single portfolio. Mutual funds have emerged as a popular investment tool for small investors as they offer the opportunity for diversified investment. As demand for mutual funds increases, assets under management are growing and mutual funds are becoming more diversified. Consequently, assessing the performance of mutual funds has become an area of interest for academic researchers and investors/managers (Simons and Stavins, 1998). The historical performance of mutual funds is often crucial in investment decision-making (Tripathy, 2017).

### *Open-ended mutual fund performance*

The popularity of open-ended mutual funds in Pakistan is on the rise due to their investment flexibility and safety. The performance of these funds over a 12-year period (2005-2017) is presented in the *Table 1* and *Figure 1*. A chronological analysis of the data revealed that the number of open-ended funds increased from 14 to 35 during this period, representing a growth of 255% (*Figure 1*). Next, The performance of Pakistan's open-ended mutual funds is presented in the *Table 2*, which provide a detailed breakdown of the total net asset value of these funds from 2005 to 2017, covering a period of 12 years. A chronological analysis reveals that the initial net asset value of the open-ended fund was only 87 billion, but it grew to 574 billion during the aforementioned period.

***Table 1***. *The numbers of open-ended mutual funds.*

| Year (20-) | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Open-ended funds | 19 | 29 | 49 | 67 | 81 | 105 | 119 | 133 | 138 | 152 | 164 | 184 | 211 |

***Table 2***. *Total net asset value of open-ended mutual funds.*

| Year (20-) | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Billions (in USD) | 87 | 116 | 249 | 288 | 153 | 168 | 224 | 354 | 332 | 386 | 411 | 452 | 574 |

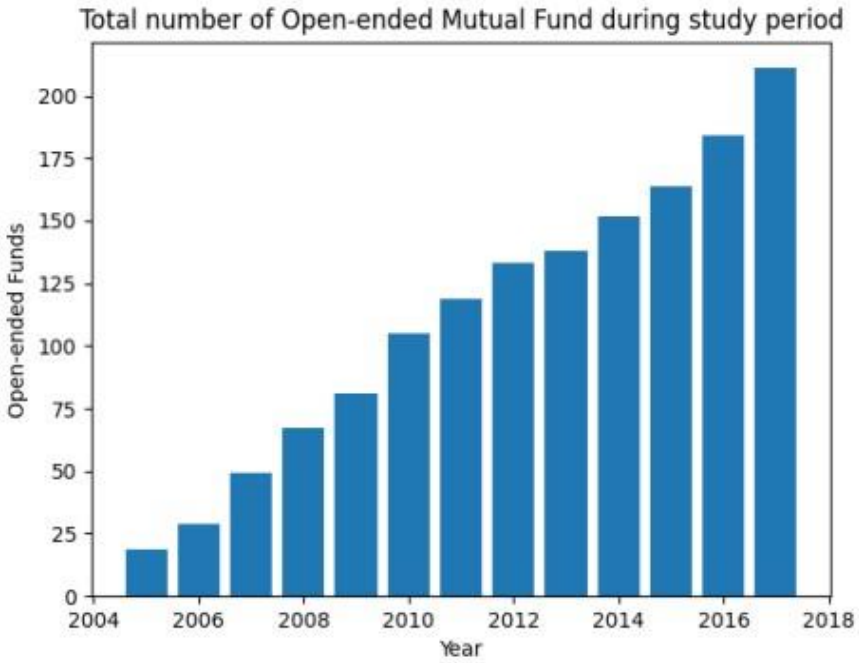


***Figure 1.*** *The total number of open-ended mutual fund over the study period.*

### *Open-ended mutual fund return*

The performance of open-ended mutual funds during the study period is presented in *Table 3*. The table includes various categories of Pakistani mutual funds operating under MUFAP between 2005 to 2017 and indicates their return on investment. According to the analysis, the majority of the portfolios indicate that the market factor (rm-rf) is a crucial factor that affects the performance of Mutual Funds. This is because the portfolios with significant betas generated to evaluate Mutual Fund performance demonstrate that riskier portfolios have a more substantial intercept compared to the low performing return portfolio. As per the methodology, the portfolios are ranked based on their return, with the lower return portfolio placed in P1 and the highest in P10 (*Table 4*). The results show that the high return portfolios have intercepts that are not close to zero compared to the low return portfolios, indicating that high return portfolios are not capturing the market variation well based on their expected return. In general, the results indicate that CAPM does explain Mutual Fund performance and that the returns of portfolios from P1 to P10 are related to market factors. However, the high return portfolios are not efficiently explained by the CAPM model, indicating that it poorly predicts their performance. CAPM can effectively explain those portfolios whose intercept is zero or very near to zero, meaning that these portfolios are better explained by the market factor. But, CAPM cannot efficiently predict the funds whose returns are high.

***Table 3****. Open-ended mutual fund retrun.*

| Category of fund Year (20-) | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Equity fund | 38.9 | 27.6 | 43.8 | -4.01 | -73.9 | 18.8 | 25.0 | 9.1 | 56.4 | 47.3 | 21.7 | 9.1 | 33.4 |
| Balanced | 21.4 | 28.8 | 27.7 | 2.0 | -24.9 | 15.3 | 16.4 | 13.4 | 36.7 | 23.7 | 19.9 | 7.1 | 25.3 |
| Asset allocation | 0.6 | 65.4 | 19.5 | -7.9 | -21 | 17.9 | 12.2 | 6.8 | 23.4 | 14.8 | 20 | 6 | 17.3 |
| Fund of | 0 | 6.6 | 17 | 10.8 | -25.7 | 14 | 31.7 | 14.7 | 36 | 40.1 | 20.4 | 6.2 | 11.7 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| fund | | | | | | | | | | | | | |
| Islamic Sharia fund | 0 | 0 | 0 | 0 | 8.1 | 10.1 | 11 | 10.7 | 8.1 | 8.7 | 7.1 | 4.6 | 5.1 |
| Capital protected | 0 | 0 | 4.7 | 9.9 | 3.3 | 7.2 | 9.7 | 3.3 | 11.4 | 0 | 4.3 | 3.8 | 3.3 |
| Index tracker fund | 0 | 0.5 | 41.1 | -15.7 | -42.2 | 29.8 | 22.5 | 7.3 | 44.8 | 35.4 | 12.6 | 4.7 | 20.8 |
| Income fund | 9.3 | 10.8 | 10.6 | 9.8 | 8.43 | 9.4 | 11 | 11.1 | 9.7 | 9.3 | 14 | 7.7 | 5.9 |
| Aggressive income | 0 | 11.1 | 11.6 | 9.8 | 5.8 | 8.4 | -2.1 | 1.5 | 8.1 | 5.9 | 12.4 | 9.1 | 6 |
| Money market fund | 0 | 0 | 0 | 8.5 | 10.5 | 10.6 | 11.9 | 11.2 | 9.1 | 8.2 | 8.8 | 5.7 | 7 |
| Commodity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -17.1 | 0 | -5 | 13.3 | -3.3 |

***Table 4***. *CAPM demonstration for mutual fund performance.*

| Variables | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 | P9 | P10 |
|---|---|---|---|---|---|---|---|---|---|---|
| rm_rf | 1.055[a] | 1.787[a] | 1.345[a] | 0.467[a] | 0.766[a] | 2.908[a] | 1.865[a] | 3.900[a] | 3.675[a] | 9.456[a] |
| | (0.220) | (0.356) | (0.320) | (0.122) | (0.177) | (0.389) | (0.366) | (0.981) | (0.442) | (1.761) |
| Constant | 0.020 | 0.017 | 0.019 | 0.029[a] | 0.048[a] | 0.012 | 0.078[a] | 0.065[b] | 0.122[a] | 0.180[b] |
| | (0.021) | (0.019) | (0.022) | (0.007) | (0.011) | (0.027) | (0.019) | (0.029) | (0.031) | (0.087) |

*Notes: ***p<0.01; **p<0.05; *p<0.1; ***=a; **=b; *=c.*

*Table 5* presents the application of the Carhart-4 factor model to evaluate the performance of Pakistani mutual funds. The findings reveal that the market factor (Rm-Rf) significantly impacts the funds' returns, as evidenced by significant betas for many portfolios. However, the size factor (SMB), value factor (HML), and momentum factor (MOM) do not provide a satisfactory explanation for the funds' returns. Moreover, most intercepts are significant, indicating that the Fama-3 factor model is not suitable for predicting mutual fund performance in Pakistan. Therefore, the results suggest that the Carhart model is a weak model compared to other advanced models for evaluating mutual fund performance. The Carhart model's results indicate that the market factor significantly explains the mutual fund return sorted in ten portfolios, ranging from portfolio 1 (P1) to portfolio 10 (P10), with P10 representing the highest-performing portfolio and P1 representing the lowest-performing portfolio. However, the SMB and HML factors' insignificant coefficients with the majority of the portfolios indicate inadequate explanatory power. Similarly, the momentum factor exhibits weak explanatory power compared to the market factor. The flow from P1 to P10 shows a significant increase in size, SMB, and HML, along with MOM, suggesting a weak explanation for fund returns. Based on this analysis, the Carhart model is not as suitable for evaluating the performance of Pakistani mutual funds as the CAPM model. Therefore, the Carhart factors, such as size, value, and momentum premiums, do not provide an adequate explanation of the overall market premium in Pakistan. In order to determine the best model for predicting Mutual Fund performance in Pakistan, *Table 6* utilizes GRS, which examines the combined intercepts of all portfolios to determine which model aligns best with risk and expected return. The model with a mean absolute value closer to zero is considered the superior model in comparison to the others. The findings in this table indicate that the CAPM model performs better than the other two models, as it maintains a mean absolute value closer to zero.

***Table 5***. *The carhart-4 factor model for mutual fund performance.*

| Variables | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 | P9 | P10 |
|---|---|---|---|---|---|---|---|---|---|---|
| rm_rf | 0.922[a] | 1.543[b] | 1.422[a] | 0.534[a] | 0.456[a] | 2.433[a] | 2.137[a] | 3.897[a] | 5.098[a] | 10.900[a] |
| | (0.222) | (0.478) | (0.567) | (0.145) | (0.312) | (0.544) | (0.518) | (0.765) | (0.772) | (2.310) |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| SMB | 0.047 | 0.039 | 0.054 | 0.315 | -0.051 | 0.377 | 1.003[b] | 1.908[c] | 0.411 | 1.612 |
| | (0.254) | (0.650) | (0.498) | (0.149) | (0.253) | (0.688) | (0.472) | (0.876) | (0.821) | (1.897) |
| HML | -0.980[a] | -1.865[b] | -1.456[a] | -0.234 | -0.411 | -1.860[b] | -0.175 | 0.112 | 0.423 | -0.877 |
| | (0.276) | (0.866) | (0.522) | (0.130) | (0.335) | (0.744) | (0.550) | (0.887) | (0.816) | (1.984) |
| MOM | 0.511[a] | 0.887 | 0.987[b] | 0.311[c] | 0.082 | 1.331[b] | 0.511 | 0.312 | -0.899 | -0.213 |
| | (0.242) | (0.662) | (0.531) | (0.213) | (0.290) | (0.678) | (0.412) | (0.700) | (0.713) | (2.111) |
| Constant | 0.015 | 0.021 | 0.053c | 0.068a | 0.065a | 0.030 | 0.055b | 0.113b | 0.150a | 0.425a |
| | (0.014) | (0.029) | (0.024) | (0.007) | (0.016) | (0.029) | (0.032) | (0.052) | (0.050) | (0.130) |

*Notes: ***p<0.01; **p<0.05; *p<0.1; ***=a; **=b; *=c.*

***Table 6**. GRS for suitability of the model.*

| Factor | GRS f-test | p-value | Mean abs. alpha |
|---|---|---|---|
| rm_rf | 8.980 | 0 | 0.04321 |
| rm_rf SMB HML | 12.67 | 0 | 0.07665 |
| rm_rf SMB HML MOM | 13.98 | 0 | 0.07689 |

*Table 7* indicates the Mutual Fund Performance analysis through traditional measures. Meanwhile, *Table 8* presents the performance analysis of Pakistan Mutual Fund using the Sharpe ratio. The results reveal a positive Sharpe ratio for equity funds, with a value of 0.792. This indicates that the recurring Sharpe ratio value is above the benchmark (market return), indicating that these funds outperform the market. Similarly, the Capital Protected Fund and Aggressive Fixed Income Fund also demonstrate positive results with values of 0.231 and 0.312, respectively, indicating outperformance from the current market scenario. On the other hand, the Balanced Fund, Asset Allocation Fund, Income Scheme, Index Tracker Fund, Commodity, and Islamic Sharia Fund demonstrate a negative Sharpe ratio value, indicating that the return is less than the benchmark (market return). The results presented in *Table 9* provide insights into the performance analysis of Pakistan Mutual Fund using the Treynor ratio. The analysis indicates a positive Treynor ratio for equity funds, with a value of 0.080, indicating that these funds outperform the market return. The Capital Protected Fund also shows a positive value of 0.020, indicating that these funds have performed better than the market normal return. On the other hand, the Balanced fund, Asset Allocation Fund, Income Scheme, Index Tracker Fund, Commodity Fund, and Islamic Sharia fund show a negative Treynor ratio, indicating that the returns are below the market benchmark. The results presented in *Table 10* show the performance analysis of Pakistan Mutual Funds using Jensen Alpha. The results indicate a positive Jensen Alpha for equity funds with a value of 0.058. Out of the 20 selected funds, 17 funds have a positive alpha value while 3 funds have negative alpha values. The recurring Jensen Alpha value is higher than the benchmark (Market return), which means that these funds have outperformed the market return. The Capital Protected Fund has a positive alpha value of 0.001, and the Aggressive Fixed Income Fund has a positive alpha value of 0.060. This positive sign indicates that these funds have performed better than the market normal return, even in the current market scenario. On the other hand, the Balanced Fund, Asset Tracking Fund, Income Scheme, Index Tracking Fund, Commodity Fund, and Islamic Sharia Fund have negative Jensen Alpha values. This indicates that the returns on these funds are lower than the benchmark (Market return). The findings from *Table 11* demonstrate that the risk-adjusted performance of the portfolio (test value) in terms of Sharpe, Treynor's, and Jensen Alpha is significantly higher than the 10% confidence level. This suggests that the benchmark portfolio outperforms the mutual fund portfolio.

***Table 7**. Mutual fund performance analysis through traditional measures.*

| Fund category | Excess return over benckmark (%) | Excess return over risk free (%) | ὸ | Coeff. Of variation (%) | β |
|---|---|---|---|---|---|
| Equiry | -0.191 | -0.190 | 0.681 | 4.091 | 0.321 |
| Asset allocation fund | -0.901 | 0.013 | 0.071 | 7.001 | 0.199 |
| Fund of fund | -0.649 | 0.199 | 0.051 | 3.601 | 0.089 |
| Capital protected | -0.691 | 0.023 | 0.023 | 2.321 | 0.210 |
| Income scheme | -1.199 | -0.361 | 0.019 | 1.901 | 0.071 |
| Index tracker fund | -0.799 | 0.071 | 0.080 | 7.501 | 0.332 |
| Agressive fixed fund | 1.719 | -0.860 | 0.031 | 20.999 | 0.110 |
| Commodity | -0.701 | -0.392 | 0.021 | 3.091 | 0.210 |
| Islamic Sharia fund | -1.287 | -0.438 | 0.013 | 3.130 | 0.039 |
| Balanced | 0.849 | -0.004 | 0.039 | 5.000 | 0.310 |

***Table 8**. Sharpe ratio.*

| Fund category | Sharpe ratio | Number of funds with negative Sharpe ratio | Number of funds wuth positive Sharpe ratio |
|---|---|---|---|
| Equity | 0.792 | 0 | 20 |
| Asset allocation fund | -0.682 | 12 | 2 |
| Fund of fund | -0.381 | 2 | 0 |
| Capital protected fund | 0.231 | 0 | 3 |
| Income scheme | -0.212 | 18 | 0 |
| Index tracker fund | -0.341 | 2 | 1 |
| Aggressive fixed fund | 0.312 | 2 | 17 |
| Commodity | -0.214 | 3 | 0 |
| Islamic Sharia fund | -0.003 | 4 | 2 |
| Balanced | -0.002 | 10 | 2 |

***Table 9**. Treynor ratio.*

| Fund category | Treynor ratio | Number of funds with negative Treynor ratio | Number of funds wuth positive Treynor ratio |
|---|---|---|---|
| Equity | 0.080 | 0 | 20 |
| Asset allocation fund | -0.031 | 12 | 2 |
| Fund of fund | -0.021 | 2 | 0 |
| Capital protected fund | 0.020 | 0 | 3 |
| Income scheme | -0.008 | 17 | 1 |
| Index tracker fund | -0.018 | 2 | 1 |
| Aggressive fixed fund | -0.031 | 0 | 19 |
| Commodity | -0.002 | 3 | 0 |
| Islamic Sharia fund | -0.023 | 4 | 2 |
| Balanced | -0.907 | 12 | 0 |

***Table 10**. Jenson Aplha.*

| Fund category | Jenson Alpha | Number of funds with negative Jenson Alpha | Number of funds wuth positive Jenson Alpha |
|---|---|---|---|
| Equity | 0.058 | 3 | 17 |
| Asset allocation fund | -0.052 | 12 | 2 |
| Fund of fund | 0.004 | 0 | 2 |
| Capital protected fund | 0.001 | 0 | 3 |
| Income scheme | -0.050 | 18 | 0 |
| Index tracker fund | -0.041 | 0 | 3 |
| Aggressive fixed fund | -0.060 | 2 | 17 |
| Commodity | -0.009 | 0 | 3 |
| Islamic Sharia fund | -0.007 | 4 | 2 |
| Balanced | 0.003 | 5 | 7 |

***Table 11**. Risk adjusted performance: Mutual fund vs Benchmark portfolio.*

| Measure | Test value | Mean | Standard error | t-value | Significant |
|---|---|---|---|---|---|
| Sharpe ratio | 0.119 | -0.320 | 0.91 | -8.04 | 0.000 |
| Treynor ratio | 0.009 | -1.065 | 0.001 | -1.30 | 0.000 |
| Jensen Alpha | 0.012 | 0.000 | 0.010 | -0.030 | 0.979 |

## Discussion

The findings of this study have important implications for asset management companies and investors. Firstly, asset management companies can use these findings to improve the performance of their mutual funds by adopting suitable pricing models. They can use these models to identify the key factors that drive mutual fund performance and design investment strategies that align with these factors. Secondly, investors can use the results of this study to make informed decisions about their investment choices. The positive Sharpe, Treynor, and Jensen alpha values for certain categories of mutual funds indicate that these funds outperform the benchmark, which makes them a good investment option for investors. On the other hand, the negative values of these measures for certain categories of funds indicate that these funds underperform the benchmark, and therefore may not be a good investment option. Moreover, this study has opened up avenues for future research in this field. The application of more sophisticated and advanced performance measures such as the Fama French-5 factor model can provide a more comprehensive understanding of the mutual fund performance in Pakistan. Additionally, the comparison of conventional and Islamic mutual funds in Pakistan can be made using the same models. Furthermore, the multi-level techniques can be applied to better comprehend the mutual fund performance in Pakistan. By using these techniques, researchers can analyze the mutual fund performance at various levels, such as fund level, asset level, and market level, which can provide a more holistic view of the mutual fund industry in Pakistan.

In general, this study has contributed to the existing literature on the application of multifactor asset pricing models to mutual fund performance in Pakistan. The results have demonstrated the effectiveness of these models in explaining mutual fund performance and have provided insights for asset management companies and investors. There have been several studies conducted on the performance evaluation of mutual funds in various markets around the world. A study conducted by Nicolescu et al. (2020) on the performance of mutual funds in Pakistan also used the CAPM, Fama French-3 factor, and Carhart-4 factor models to evaluate the performance of mutual funds. The results of their study showed that all three models were able to explain mutual fund performance, with the CAPM model performing the best among the three models. There have been many studies conducted on mutual funds and their performance in different countries. Some studies have shown that mutual funds provide small investors with the opportunity to benefit from the capital market with minimal investments. For example, a study conducted by Dupuy et al. (2016) on the Brazilian mutual fund industry found that mutual funds provided small investors with access to the capital marke.t and allowed them to diversify their portfolios with minimal investments. In terms of the use of traditional and multifactor asset pricing models to assess mutual fund performance, there have been varying findings in different studies. For example, a study conducted by Sha and Gao (2019) on the Chinese mutual fund industry found that the Fama-French model was more suitable for assessing mutual fund performance than the CAPM model. Similarly, a by Sehrawat et al. (2020) on the Indian mutual fund industry found that the Fama-French model outperformed the CAPM model in evaluating mutual fund performance.

However, the findings of the Pakistani study discussed above indicate that the CAPM model is the most suitable for evaluating mutual fund performance in Pakistan. The study found that the CAPM model affected the market factors of the majority of portfolios, while the Fama French and Carhart models had an insignificant effect on the

majority of portfolios. These findings suggest that the Pakistani mutual fund industry may be different from other countries mutual fund industries in terms of the factors that drive mutual fund performance. While there are some inconsistencies in the findings of different studies, the general consensus is that mutual funds provide small investors with the opportunity to benefit from the capital market with minimal investments. The use of traditional and multifactor asset pricing models to assess mutual fund performance may vary depending on the country's mutual fund industry, and further research is needed to determine which models are most suitable for each country. Similarly, the performance of mutual funds in Nepal also used the CAPM, Fama French-3 factor, and Carhart-4 factor models to evaluate the performance of mutual funds. The results of his study also showed that all three models were able to explain mutual fund performance, with the CAPM model performing the best among the three models (Aggarwal, 2017). However, a study on the performance of mutual funds in India found that the Fama French-3 factor model was the best model to evaluate mutual fund performance. Their study also showed that the Carhart-4 factor model outperformed the CAPM model in explaining mutual fund performance (Tripathy, 2017). Overall, these studies suggest that different markets may have different models that perform better in ex- plaining mutual fund performance. Therefore, it is important for investors and asset management companies to consider the specific market and use appropriate models for evaluating mutual fund performance.

## Conclusion

In conclusion, the study analyzed the performance of various categories of open-end mutual funds in Pakistan using CAPM, Fama French-3 factor, and Carhart-4 factor models. The results showed that all models explained the mutual fund performance in Pakistan, with CAPM being the most suitable model. Equity funds, fund of funds, and balanced funds outperformed the benchmark while the rest of the style funds fell short. The study has implications for asset management company managers and investors, who can benefit from this research. The study can be extended to use more sophisticated performance measures, and the same models can be tested for comparing conventional and Islamic mutual funds in Pakistan and other emerging economies. The study recommends that fund managers analyze market variations properly and give more attention to funds that are not performing up to the benchmark. The findings remain mixed, but the study offers valuable insights into the performance of mutual funds. Future research can examine the performance of mutual funds in emerging markets using advanced market-based methods for estimating output.

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## Conflict of interest

The authors confirm that there is no conflict of interest involve with any parties in this research study.

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