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Comparison of Performance Measures of Pakistani Islamic Mutual Funds using Data Analytics

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ABSTRACT The current study attempted to measure and evaluate the performance of 13 Pakistani Shariah compliant mutual funds from the time period (September 2009-August 2017) by using 18 performance measures. It followed the principle that mutual funds are used exclusively for diversification portfolio and mean-variance optimization, following the mutual fund theorem as an investing strategy. The results of few performance measures showed that many funds outperformed the benchmark, while others underperformed. The study also analyzed and compared the performance measures to characterize the relationship between them and investigated if they lead to an identical ranking by using three analysis techniques, namely Pearson's *r*, Spearman's *rho*, and Kendall's *tau* coefficient. The study concluded that there is a high level of correlation among performance measures which indicates that the performance measures classify mutual funds in a similar manner in three sub-periods, that is, 6 months, 1 year, and 3 years. Change of frequency doesn't disturb their classification ability.

INDEX TERMS adjusted performance, adjusted sharpe ratio, appraisal ratio, Kendal's *tau*, max drawdown, Modigliani Risk, moving average, Pearson's *r,* rank correlation, Spearman's *rho*, Sortino Ratio,

I. INTRODUCTION

Mutual funds can be introduced as a type of joint investment that authorizes the investors, having the same investment aspirations that put together their financial resources in a portfolio of script [1]. Mutual funds offer accessibility, liquidity, diversification, professional management, and tax credit on investment [2]. A fund manager makes investments out of the combined resources available in the portfolio reserves; specifically including categories, such as commodities, stocks, cash deposits, bonds, and real estate in consistent with fund's objectives [3]. Mutual funds are an attractive mode of investment for those who desire to make money from financial markets but don't have huge finance, sufficient information, expertise, or time to manage their own financial resources [4]. Different types of mutual funds have different investment objectives with different time horizons subject to the choice of the fund providers. Mutual funds are categorized as close and open-ended based on their structure [5]. Open-ended mutual funds recurrently generate new units or exchange the already distributed units on request. Units of open-ended mutual funds can be acquired and exchanged via any asset management company that regularly publicizes offer and redemption prices. Close-ended mutual funds float a limited quantity of shares through an IPO in the same manner as a public limited company does. After this, they are traded at current market price in secondary market, that is, stock exchange.

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In Pakistan, an Asset Management Company (AMC) controls and administers mutual funds in a manner that corresponds to a listed company established under the Companies Act 2017. The AMC floats new funds by entering into a trust deed between AMC and the trustee, with due approval from Securities and Exchange Commission of Pakistan (SECP) under non-banking finance companies (Establishment and Regulation) rules, 2003. The trustee acts as the custodian of the fund. The trustee/AMC makes certain that the investment decisions are taken by fund managers in line with AMC policies. According to law, banks and CDCs can act as trustee. Currently, Central Depositary Company (CDC) is the trustee of mutual funds in Pakistan. SECP acts as the regulatory authority of mutual funds and issues license to AMCs. The SECP continuously monitors mutual funds' activities and also ensures the on-site inspections. A fund's NAV denotes its unit price. The NAV is calculated by subtracting liabilities from the current market value of total assets of fund held in its portfolio and then dividing the answer by number of outstanding units.

The most suitable benchmark for Shariah compliant funds in Pakistan is KMI 30 index. This free-float capitalization-based index aims to serve as a standard guideline gauging the performance of Shariah compliant investment. Simultaneously, it calculates the procedure of asset allocation. The free-float index construction is believed to be the best practice. It permits the performance measurement of the securities that are easily available and well traded. Islamic finance rests on five focal standards, that is, forbidding and preventing from usury (Riba) or interest, speculation (Maysir), unwarranted ambiguity (Gharar), investing in illegal activities, and supporting returns and risks distribution [6]. Islam does not allow the application of interest on credits being inequitable and biased. Conventionally, the entire risk must be taken by the borrower, whereas the creditor can have agreed proceeds irrelevant of failure or success of the borrower's business [7]. However, given excessively high profit, the borrower would receive major, while the investor (lender) would take the minimal share of the profit. Shariah compliant funds undertake a strict and thorough scrutinizing procedure to select portfolios that are in line with the qualitative as well as quantitative standards laid out by Shariah guiding principle. [8] and [9] deduced that Shariah compliant mutual funds exhibited a robust performance in relevance to the S&P 500 index (conventional benchmark) and the FTSE Islamic Indices (Islamic benchmark) even during the recessionary period of 2000-02. Therefore, it is expected that the investors; especially the conventional investors can consider the Islamic funds while selecting their portfolio during the recession period. This tendency of the investors towards Islamic mode of financing demonstrates that Islamic finance is increasingly gaining popularity. In future, better performance is expected due to its present significant position in the market. As Islamic finance industry is showing a strong growth, compliant funds' progress would improve in future.

The growth and expansion of Pakistan's economy mainly depends on the level of investment in real sector. Mutual funds play a significant role in mobilizing the funds for long-term investments [10]. Islamic mutual funds have great potential in mobilizing, saving, and attracting the investors provided competitive returns. Islamic mutual funds have been in the financial market of Pakistan for the last twenty years. The current study aimed to determine

whether there exists any association among the mutual fund performance measures. The available literature, in the context of Pakistan, merely evaluated the mutual funds' performance based on the results of some performance measures. No attempts were made to analyze the correlation between mutual fund performance measures in order to identify the measures that best separate investment funds. Thus, the study attempted to overcome this gap by statistically analyzing mutual fund performance measures and helped to identify measurement criteria and tools to support the decisions most relevant for the analysis and classification of investment funds.

Shariah compliant investing is characterized as a low-risk, modest-return financial product [11]. In Pakistan, numerous Shariah compliant equity funds arrived in the 1990s [12]. Also, Shariah compliant financial markets have revealed yearly growth of 15 % [13]. While, the comparison of performance of ethical and traditional funds revealed that the former were better performers than the latter. [14] [15], and [16] found that conventional funds perform well in bear market, while Islamic funds perform well in bull market. [8] also gauged shariah compliant mutual funds' potential by using several performance measures. Overall, shari'ah compliant funds displayed far better performance during the recession.

There was hardly any variance among the performance of 8 Shar'iah compliant fund types when compared with that of the Shar'iah compliant indices and S&P 500 index, at both 5 and 10 % levels of significance. So far, very few researches have been conducted in Pakistan to evaluate Shariah compliant funds. The previously conducted studies covered considerably short time span and sample size. [17] studied fifteen mutual funds from the time period (2005-2009) and deduced that Pakistan's mutual fund performance was not satisfactory. Persistency existed in the performance of conventional funds, however, not in the case of Islamic funds [18]. After the analysis of Pakistani mutual fund industry, it was determined that this industry has very little stake as compared to financial industry and performance of this sector is satisfactory [19]. [20] evaluated the performance of Pakistani Islamic mutual funds from the time period (January 2009-December 2015) with the help of multiple tests for bringing reliable results. Applied techniques included ratio analyses, such as Sharpe, Sortino, Treynor, and Jenson Alpha. Overall, these tests proved that Islamic funds performed well even during the crisis period with few exceptions.

A. MUTUAL FUND PERFORMANCE MEASURES

Innumerable researches have been conducted on mutual fund performance analysis[21]. The academic literature is replete with countless newly invented measures that measure investments from different points of views be it, stability, consistency, or persistence [22]. It is imperative to evaluate these measures and identify the most pertinent measures to compare and rank mutual funds [23]. Although, a rank correlation comparison could not establish harmony among different rankings from measures calculated for 253 funds in their sample [7]. [24] discovered dearth of a difference in performance as evaluated by Treynor–Mazuy, Jensen's Alpha, and the [25] positive period weighting measure. The researchers noticed that the rankings gained by the Sharpe ratio were clearly dissimilar from that of the other measures.

Different asset classes, over the time period (1998-2003), [26] substantiated Sharpe ratio's dominance for ranking mutual funds, wherein most cases, rank correlations exceeded 90%. [27] and [28] came to the same decision. By utilizing the data from 2,763 hedge funds and 13 performance measures calculated over the time period (1994–2003), rank correlations were attained that were almost 95%. [29] recognized earlier results with a larger database that included seven classes and 39,000 funds over the time period (1996–2005). These findings implicitly indicated that the choice of performance measures did not disturb fund analysis, as the correlation between the Sharpe ratio and all other measures was greater than 90%. This finding provided a strong argument for using the Sharpe ratio to rank investment funds. In agreement with the earlier studies, it was suggested to extensively explore the applicability of identified performance measures [30]. Performance measures may be employed to select some assets for the direct application of portfolio allocation rules, for instance, the equally weighted allocation technique [31]. The financial economics literature also recommended the application of performance measures to determine the weight of an optimal portfolio [32].

Many reward-to-risk ratios are available including Sharpe, Sortino and Treynor indices, the Omega index [33], the Rachel ratio and the FT ratios [32] among countless others. Still, many are being introduced. Several researchers have by now well-thought-out assessment of alternate performances, employing rank correlations [34]. Predominantly, the studies of [27] and [29] have been alluded. Few studies focused on partial moments-based performance measures as in [35]. [29] and [35] based their work of performance measures' analysis on managed portfolios. Some studies extended the works of [29] and [36] that did not take into consideration the rolling approaches and assessed the rank correlations on full sample and on a 2- or 5-years' sample.

The current study added to the works on Islamic finance in many ways. Firstly, Pakistan's Shariah compliant mutual funds' performance from the time period (2009-2017) was gauged. After the global financial crunch, when Pakistan's stock market was trying to be stable and recover, the country entered a new state of security threats, energy crisis, and losing the trust of investors in the country. The country had not faced such challenges ever before. Therefore, it would be interesting to know how Pakistan's mutual funds performed in such an unforeseen economic condition. Secondly, some performance measures have been statistically analyzed to determine if they correlate with each other and were equally useful for funds classification and performance evaluation. The results would be helpful for investment decisions.

II. DATA AND METHODOLOGY

The current study used the sample of 13 Shariah compliant Pakistani equity funds listed at the Pakistan Stock Exchange (PSX). It utilized the time period from (September 2009-August 2017) by using 18 performance measures. These performance measures included Jensen's alphas, bear beta, beta, bull beta, absolute performance, relative performance (to benchmark), max drawdown, number of negative periods, number of positive periods, absolute risk (standard deviation), tracking error (relative risk), information ratio, Sharpe ratio, Sortino ratio, and Treynor ratio. The study used annual fund manager's reports of the sample funds' managers to collect

necessary data. The daily price data on 18 performance measures was extracted from web pages of PSX. The daily prices were converted to the returns by using the return history while removing the data inconsistency. The funds having no complete history over the sample period were also ignored to avoid origin and survivorship biases. The sample period was divided into three estimation sub-periods, that is, 6 months, 1 year, and 3 years with the corresponding three time horizons: short, medium, and long-term. The PSX100 index was used as a benchmark and the six-months' T-Bills' rate as the risk-free rate. The monthly rolling average of funds' returns was carried out over the sample period. This study presented two series by using 18 performance measures on 13 sample funds. Firstly, frequency distribution analysis-univariate statistics was used to detect the potential anomalies in their distribution. The purpose was to highlight some orders of magnitude that may likely be used for the comparison. General behavior of the sample funds was observed through examining the indicators, such as mean, standard deviation, skewness, and kurtosis coefficients. Secondly, in order to identify links between the performance measures, the study analyzed correlation between them. It used three correlation measurements: Pearson's r, rank correlation (Spearman's ρ), and coefficient of concordance (Kendall's τ). These bivariate statistics were examined to observe link or the degree of independence between the performance measures. In the academic literature, Spearman's ρ is used most commonly for comparing the performance measurements. It is preferred to use Pearson's r in as much as it is more reliable and better detects monotonous associations, even if they are not linear. It is a non-parametric measurement computed by replacing the values of variables by their rank. The Kendall's τ, helps in offsetting the presence of many tied ranks in the population under study. This presence, otherwise, might make the interpretation of the Spearman's ρ results more difficult. It assists in measuring the probability for the values observed that X and Y are both in the same order and different orders. It is the non-parametric measurement of relations based on the number of concordance or discordance between the two values. Concordance is said to be having both the observations vary in the same direction, and conversely.

III. RESULTS AND DISCUSSION

In terms of absolute performance, the same 4 funds, that is, MIIF, NIIF, MTPF(d), and MTPF (mm) outperformed the market in all three sub-periods, namely short, medium, and long-terms. Therefore, the outperformers were either the intensive income funds or pension funds. None of the equity funds could perform better than their benchmark in the period under consideration, that is, (September 2009-August 2017). On the other hand, the same 9 funds, that is, JS ISF, MTPF (equality), AASSF, POIAAF, MIF, AISF, AMMF, NIAAF, and MBF underperformed the benchmark in all three sub-periods. All these underperformers were mostly equity funds, whereas two were asset allocation funds. Comparing each fund's performance in each of the sub-periods; except POIAAF, MTPF(d), and MTPF (mm) whose performance worsened over time, all the other 10 funds performed better in the medium-term and even better in the long-term as compared to their short-term performance. Hence, the market remained at fifth position as compared to the funds in all three sub periods. In terms of standard deviation, all funds were riskier than the benchmark, AMMF being the riskiest. Afterwards, the less risky being AISF,

MTPF (eq), POIAAF, NIAAF, MBF, NIIF, MIIF, JS ISF, AASSF, MTPF (mm), MTPF(d), and MIF (in order from the most to the least risky). Most of the funds became less risky in long-term as compared to short-term. Only POIAAF, MIIF, MTPF (mm), and MBF became riskier in the long-term as compared to the short-term. Therefore, the CAPM theory that the higher the risk, the higher the returns was not visible in the case of current study because the riskier funds, in this sample were not returning proportionately higher and vice versa. Risk adjusted return in terms of Sharpe Index, of all the funds in the current study's sample period, was negative. This indicated that none of these funds performed better than the risk-free investment. Sharpe Index ranked KMI30 index to be the 14th, that is, the worst among the sample funds in all the three sub periods. MTPF(d) displayed the most superior return per total risk. Afterwards, comes the AMMF, AISF, NIAAF, POIAAF, MBF, JSISF, NIIF, AASSF, MIIF, MTPF (mm), MTPF (eq), MIF, and AISF in order from the most to the least efficient fund with respect to return per unit of total risk. Sharpe Index ranked each fund the same in the three sub periods. Treynor measure, return per unit of systematic or market risk ranked funds differently. Treynor measure marked MIIF, MTPF (mm), and MTPF(d) as the most efficient of all sample funds, placing the market at 6th position. The funds that performed better than the market were MIIF, MTPF (mm), MTPF(d), NIAAF, and ASSF. Therefore, an investor who measures the returns with respect to systematic risk would preferably invest in these 5 funds during the sample period. Some funds became a little less efficient in medium and long-terms as compared to short-terms, such as AISF ranked 9 instead of 8; MIF ranked 11 rather than 10. On the contrary, MTPF (eq) and AMMF became more efficient as they were ranked 10 and 8 instead of 11 and 9, respectively. Downside risk placed AMMF at the top of the list. Thus, the least decline in the value of the fund return would be suffered by AMMF in the three sub periods if the market conditions change. The second-best fund in this regard would be MTPF (mm), then MTPF(d) in the three sub periods. JS ISF being the worst in the short and medium periods, while POAAF the worst in the long period as it has the potential to suffer the most in bear market. KMI 30 would be at 5th, 4th, and 6th positions in the short, medium and long-terms, respectively. By using this measure, an investor may choose a fund if the potential loss suffered by the fund, in bad times, is bearable for him. Hence, downside risk is sensitive to periods and varies as well. Thus, MBF that was ranked 4th in short-period, was ranked 5th and 8th in the medium and long-terms, respectively. The downside risk was varying with the change in time span. Thus, an investor must calculate downside deviation before picking up a fund as it may differ with time. Downside potential, here, refers to the variance of negative returns from zero returns because no investor would like his investment to return to zero. Just like downward risk, downward potential has also ranked funds differently in each of the three sub periods. It means downward potential is also time sensitive. In short-period, funds are ranked (best to worst) as follows; KMI30 Index, AISF, MTPF (eq), MBF, MIF, NIIF, AASSF, JS ISF, NIAAF, POIAAF, MIIF, MTPF(d), AMMF, and MTPF (mm). KMI 30 index is ranked 1st, 6th, and 4th in the short, medium and long-period, respectively. The ranking of medium and long-terms matches largely. Adjusted Sharpe Ratio ranked all funds the same in each of the three sub-periods. The ranking 100% correlates with that of the

Sharpe Ratio. Hence, the market was given the lowest rank in the three periods. Max drawdown indicates downside risk for a specific time bracket. Thus, it is a very useful and informative tool to measure an investment. The ranking of the first two periods was exactly the same, whereas there were a few differences in the long-period. Hence, the fund with the least potential to suffer loss was NIIF, the second best being MIIF, then comes JSISF, POIAAF, AISF, MBF, MIF, AMMF, NIAAF, MTPF(d), MTPF (eq), MTPF (mm), KMI 30 Index, and lastly AASSF. Changes in the last period include MBF, MIF, AISF, and JSISF being at 3rd, 5th, 6th, and 7th positions, respectively. In short, all the funds except one performed better than the benchmark in three sub-periods. The number of negative periods conveys yet another important information. Hence, the funds that showed a record of the lowest number of negative periods included (from the best to the worst) MIIF, KMI 30 index, MTPF (mm), MTPF(d), NIIF, POIAAF, AISF, MTPF (eq), JSISF, MBF, MIF, AMMF, AASSF, and NIAAF. Moreover, 12 out of 13 funds underperformed the benchmark (in the three sub-periods) and had a greater number of negative periods than the market. Whereas, the rankings differed in the third period. The number of positive periods ranked the funds as; (from the best to the worst) MIIF, KMI 30 index, MTPF (mm), MTPF(d), NIIF, POIAAF, AISF, MTPF (eq), JSISF, MBF, AASSF, NIAAF, AMMF, and MIF. However, 12 funds still underperformed the market.

A. THE DESCRIPTIVE ANALYSIS

Table I presents a complete descriptive summary of the statistical characteristics of selected 18 performance measures used in the current study. The descriptive analysis provides a clear picture of the positioning and frequency distribution of the performance measures under consideration. It is clearly observable here that the mean and median of all the measures were different for the three different periods, that is, short, medium, and long-term, respectively. Likewise, the standard deviation of the measures was also different for the three sub periods. The interpretation of skewness and kurtosis further supports the position analysis. It was observed here that the skewness and kurtosis coefficients were non-zero values. Moreover, kurtosis coefficients were very high which indicates specialized distributions. This indicates that the performance measures follow a non-normal distribution. There are more outliers than there are in a normal distribution. With respect to the univariate statistics parameters, none of the performance measures appeared to possess any distinctiveness. In fact, each of them was laden with the information associated with the investment fund itself. Another important observation was that the measures produced different results for all three sub periods, that is, 6 months, 1 year, and 3 years. This implies that each measure conveyed some specific information about funds' behavior in each sub period. Thus, each measure was supportive when it came to classification of the investment funds into good and bad.

B. THE BIVARIATE ANALYSIS

In this series of analysis, correlation of the same measures calculated over three different periods has been considered. For instance, correlation between Jensen's Alpha was calculated over six months period with that calculated over one-year. Afterwards, correlation between Alpha was calculated over six months with one calculated over three years and finally correlation between one-year Alpha and three-year Alpha. Three relations per performance measure were calculated.

TABLE I
DESCRIPTIVE ANALYSIS

	SD	SI	TM	JA	FNS	DR	DP	MS	Apr.R	ASR	IR	SR	MDD	TE	Perp	B	N.P	P.P
6 Months																		
Mean	65	-1	-425	-6	496	1	0	9	-1	-2	0	3	1623	1	3	0	1	5
Median	40	0	-9	-6	234	0	0	9	0	0	0	0	203	1	2	0	1	5
Maximum	1394	0	29064	22	27768	14	5	24	1	2	5	106	383547	3	22	7	6	6
Minimum	1	-5	-116091	-98	-1834	0	0	-4	-71	-61	-5	-31	-51166	0	-9	0	0	0
St Dev	139	1	8547	6	1115	1	1	5	4	6	3	11	27324	1	4	0	1	1
Skewness	7	-3	-11	-5	14	6	3	1	-10	-5	0	4	14	2	2	9	1	-1
Kurtosis	60	9	139	69	312	52	13	2	139	35	-1	23	192	4	3	123	0	0
Observations	1248	1248	1248	1248	1248	1248	1248	1248	1248	1248	1248	1248	1248	1248	1248	1248	1248	1248
1 Year																		
Mean	34	-1	-463	-6	482	1	7	9	-1	-2	0	2	1787	1	3	0	3	9
Median	34	0	-11	-6	256	1	0	10	0	0	-1	0	-227	1	2	0	3	9
Maximum	1331	1	17163	11	13888	7	271	18	0	1	5	66	191681	3	18	4	11	12
Minimum	1	-23	-65286	-56	-728	0	0	-3	-42	-41	-5	-21	-25660	0	-6	0	0	1
St Dev	115	3	6736	5	756	1	21	4	3	5	3	9	19921	0	3	0	2	2
Skewness	8	-4	-7	-2	7	4	6	0	-6	-4	1	3	9	2	2	3	0	0
Kurtosis	73	19	61	16	104	20	54	0	46	19	0	14	87	3	3	2	1	1
Observations	1248	1248	1248	1248	1248	1248	1248	1248	1248	1248	1248	1248	1248	1248	1248	1248	1248	1248
3 Years																		
Mean	56	-1	-211	-6	1551	1	7	10	-1	-2	0	2	1666	1	3	0	8	28
Median	30	0	-11	-7	4	1	0	11	0	0	-1	0	-249	1	2	0	9	27
Maximum	625	0	5148	3	191681	3	136	14	0	0	5	35	63755	2	13	1	19	36
Minimum	1	-17	-27191	-25	-25660	0	0	1	-23	-29	-5	-7	-8652	0	1	0	0	17

	SD	SI	TM	JA	FNS	DR	DP	MS	Apr.R	ASR	IR	SR	MDD	TE	Perp	B	N.P	P.P
St.Dev	68	3	4189	4	15691	1	20	3	3	5	2	7	10976	0	3	0	4	4
Skewness	4	-3	-5	0	12	2	4	-1	-4	-3	1	3	5	2	-1	2	-1	1
Kurtosis	23	12	29	0	144	4	20	0	16	12	0	8	28	4	0	2	0	0
Observations	1248	1248	1248	1248	1248	1248	1248	1248	1248	1248	1248	1248	1248	1248	1248	1248	1248	1248

TABLE II
INTER-PERIOD CORRELATION

No.	Tools	Pearson Correlation			Spearman's Correlation			Kendall's tau		
		6m/1yr	6m/3yr	1yr/3yr	6m/1yr	6m/3yr	1yr/3yr	6m/1yr	6m/3yr	1yr/3yr
1	Standard Deviation	1.00	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00
2	Sharpe Index	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
3	Treynor Measure	1.00	0.99	0.99	0.99	0.99	1.00	0.95	0.85	0.95
4	Jenson Alpha	0.99	0.97	0.99	0.98	0.92	0.96	0.95	0.82	0.87
5	Famas Net Selectivity	1.00	0.99	0.99	1.00	0.99	0.99	1.00	0.97	0.97
6	Downside Risk	1.00	0.94	0.95	0.99	0.93	0.93	0.95	0.79	0.79
7	Downside Potential	0.16	0.08	0.98	0.32	0.30	0.99	0.21	0.21	0.95
8	M Square	1.00	1.00	1.00	1.00	0.99	0.99	1.00	0.97	0.97
9	Appraisal Ratio	1.00	1.00	1.00	0.99	0.95	0.96	0.97	0.87	0.90
10	Adjusted Sharpe Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
11	Information Ratio	1.00	0.99	0.99	0.99	0.96	0.97	0.95	0.87	0.92
12	Sortino Ratio	1.00	0.96	0.98	0.99	0.84	0.85	0.95	0.70	0.74
13	Max Drawdown	1.00	1.00	1.00	1.00	0.92	0.92	1.00	0.82	0.82
14	Tracking Error	1.00	0.99	0.99	0.95	0.87	0.95	0.90	0.74	0.85
15	Performance	1.00	0.98	0.99	0.99	0.90	0.94	0.95	0.82	0.84
16	Beta	1.00	0.99	1.00	0.99	0.97	0.98	0.97	0.90	0.95
17	Negative Period	1.00	0.97	0.98	0.99	0.95	0.96	0.97	0.82	0.85
18	Positive Periods	1.00	0.97	0.98	0.99	0.95	0.96	0.97	0.82	0.85

Here, not a weak, rather a strong relationship is expected naturally since each measure, by default, conveys the same information, irrespective of the frequencies calculated over. Moreover, the periods were expected to be closer to each other in frequency which showed a stronger relationship. Logically, each performance measure calculated over 6 months shows a stronger relationship with the one calculated over one-year than with the one calculated over three-years because three-year period is far in frequency from 6 months period than one-year period. This comparison is presented in Table II. Table III sums up the results (inter period Spearman's correlation) where the correlation results have been divided into three broad ranges based on the strength of their relation, that is,

1. 30% to 50% = weak correlation
2. 51% to 80% = moderate correlation
3. > 80% = strong correlation

Table III shows that the 6-month period has the highest correlation with one-year period because these two periods are nearest in frequency than the other two combinations of periods (that is, 6-month/3-year and 1-year/3-year). Moreover, the 6-month period has the lowest correlation with 3-year period because these periods are furthest in frequency than the other two combinations (that is, 6-month/1-year and 1-year/3-year).

The results have been classified so that they may be visualized clearly in a glance. Hence, higher correlation would indicate that the performance measures classify mutual funds in a similar manner irrelevant of the fact that they are calculated over different frequencies, that is, 6 months, 1 year, and 3 years. Change of frequency doesn't disturb their classification ability.

Here, it has been observed that with downward potential being an exception, all performance measures are highly correlated, that is, more than 90% correlation. This is true for all combinations of periods whether 6-month with one year, 6-month with 3-year or one year with three years. Hence, calculation period does not affect classification by performance measures. However, in the case of downward potential there is weak correlation, that is, less than 50% between 6-month/one year and 6-month/3-year periods. Therefore, in this case, it has been learned that the classification of funds by downward potential is greatly affected by the frequency of period which is calculated over. However, again, it shows the same strong correlation (just like the overall trend in the current study) when it comes to one-year relation with three-year period.

Moreover, the strength of the findings was confirmed by two other analysis tools, that is, Kendall's tau and Pearson's r. The results of both these techniques strongly approved of the results of Spearman's correlation that each of the 18 performance measures were equally useful for fund managers. The frequency with which they were calculated did not distort their ability to classify funds. Hence, performance measures calculated over 6 months can reliably and confidently be used to provide information about performance of funds and classify funds in place of the ones calculated over one or even three-year period. However, in case of downside potential, weak correlation indicates that the calculation period leaves a strong influence on fund classification. The second series of analysis focused on exploring if any relationship exists between two different performance measures of the same sub-period.

TABLE III
SPEARMAN'S CORRELATION AMONG MEASURES

Spearman's ρ	6 Months/1 Year	6 Months/ 3 Years	1 Year/3 Years
30% to 50 %	Downside Potential	Downside Potential	-
51% to 80%	-	-	-
> 80%	Standard Deviation, Sharpe Index, Traynor Measure, Jensen's Alpha, Fama's Net Selectivity, Downside Risk, M Square, Appraisal Ratio, Adjusted Sharpe Information/Sorting Ratio, Max Drawdown, Tracking Error, Performance, Beta, Negative/Positive Periods	Standard Deviation, Sharpe Index, Traynor Measure, Jensen's Alpha, Fama's Net Selectivity, Downside Risk, M Square, Appraisal Ratio, Adjusted Sharpe Information/Sorting Ratio, Max Drawdown, Tracking Error, Performance, Beta, Negative/Positive Periods	Standard Deviation, Sharpe Index, Traynor Measure, Jensen's Alpha, Fama's Net Selectivity, Downside Risk, M Square, Appraisal Ratio, Adjusted Sharpe Information/Sortino Ratio, Max Drawdown, Tracking Error, Performance, Beta, Negative/Positive Periods

TABLE IV
STRONGEST RANK CORRELATION

Rank Correlation (Spearman, best 5)	Time	1	2	3	4	5
1: Standard Deviation	6 months	Treynr R 0.53	App Ratio -0.76	F N S -0.99	Info.Ratio 0.52	Sortino R 0.47
	1 year	S I/M Sq/ASR -0.41	Tr M 0.50	F N S -0.99	Apprsl R -0.76	Sortino R 0.46
	3 years	Tr Measr 0.5	J. Alpha 0.45	F N Sel -1	App R -0.66	Per 0.42
2: Sharpe Index	6 months	St Dev -0.41	M Sqr 0.99	F N S 0.42	App R 0.43	Ad Shrp R 1
	1 year	St Dev -0.41	F.Net Sel 0.42	Dwn Pot 0.4	M Sqr 0.99	Ad Shrp R 1
	3 years	St Dev -0.41	F.Net Sel 0.41	M Sqr 1	Adj Shrp R 1	Beta 0.41

Rank Correlation (Spearman, best 5)	Time	1	2	3	4	5
3: Treynor Measure	6 months	St Dev 0.53	J. Alpha 0.48	F N S -0.56	Dwn Pot 0.34	Pos Per 0.40
	1 year	St Dev 0.50	J. Alpha 0.52	F N S -0.53	App Ratio -0.36	Pos Per 0.36
	3 years	St Dev 0.50	J. Alpha 0.55	F N S -0.50	Max Drw -0.33	Per 0.36
4: Jenson Alpha	6 months	Inf R 0.77	Sor Ratio 0.84	Tr Err -0.87	Per 0.79	Pos Per 0.53
	1 year	Treynr M 0.52	Info R 0.79	Sor R 0.84	Tr Err -0.88	Per 0.77
	3 years	F N Sel/D Pot -0.57	Info R 0.82	Sor R 0.88	Tr Err -0.90	Per 0.83
5: Famas Net Selectivity	6 months	St Dev -0.99	Shrp Indx 0.43	M Sqr 0.43	App Ratio 1	Pos Per -0.44
	1 year	St Dev -0.99	S I/M Sqr/ASR 0.38	Appr R 1	Sor R/Per -0.38	Pos Per -0.45
	3 years	St Dev -1	Dwn Pot -0.31	Appr R 1	Beta -0.35	Pos Per -0.32
6: Downside Risk	6 months	J. Alpha -0.33	Dwn Pot 0.34	Info R -0.32	Max DD -0.58	Tr Err 0.30
	1 year	Shrp I 0.27	Dwn Pot 0.54	Info R -0.29	Max DD -0.54	Adj Sh R 0.27
	3 years	Shrp I 0.29	Dwn Pot 0.33	M Sqr 0.29	Adj Sh R 0.29	Max DD -0.35
7: Downside Potential	6 months	Treynr R 0.34	Dwn Risk 0.34	Tr Err -0.31	Per 0.34	Beta 0.60
	1 year	Dwn Risk 0.54	Info R -0.60	Max DD0.51	Tr Err 0.53	Per -0.42
	3 years	J. Alpha -0.57	Info R -0.75	Sor R -0.75	Tr Err 0.68	Per -0.44
8:M Square	6 months	St Dev -0.41	Shrp Indx 0.99	F.N Sel 0.43	A Sh R 0.99	App R 0.43
	1 year	St Dev -0.41	Shrp Indx 0.99	F N Sel 0.43	A Sh R I 0.99	Beta 0.41
	3 years	St Dev -0.41	Shrp Indx 1	F N Sel 0.41	Dwn Pot 0.38	Adj Shrp I 1
9: Appraisal Ratio	6 months	St Dev -0.76	Shrp Indx 0.43	F.N Sel 0.81	M Sq/AS R 0.43	Pos Per -0.44
	1 year	St Dev -0.76	S I/M Sqr/ASh R 0.38	F.N Sel 0.81	Pos Per -0.45	Per -0.38
	3 years	St Dev -0.66	F.Net Sel 0.66	Dwn Pot0.31	Beta -0.35	Pos Per -0.32
10: Adjusted Sharpe Ratio	6 months	St Dev -0.41	Shrp Ind 1	F.N Sel 0.42	M Sq 0.99	App R 0.43
	1 year	St Dev -0.41	Shrp Ind 1	F N Sel 0.42	Dwn Pot 0.4	M Sqr 0.99
	3 years	St Dev -0.41	Shrp Ind 1	F N Sel 0.41	M Sqr 1	Beta 0.41

Rank Correlation (Spearman, best 5)	Time	1	2	3	4	5
11: Information Ratio	6 months	J. Alpha 0.77	F.Net Sel -0.53	Sor R 0.87	Tr Err -0.77	Per 0.77
	1 year	J. Alpha 0.79	Dwn. Pot -0.60	Sor R 0.87	Tr Err -0.84	Per 0.78
	3 years	J. Alpha 0.82	Dwn. Pot -0.75	Sor R 0.95	Tr Err -0.87	Per 0.78
12: Sortino Ratio	6 months	Inf R 0.87	Tr Err -0.88	Per 0.91	Neg Per 0.67	Pos Per 0.67
	1 year	J. Alpha 0.84	Info R 0.87	Tr Err -0.96	Per 0.92	Pos Per 0.72
	3 years	J. Alpha 0.88	Dwn Pot -0.75	Info R 0.95	Tr Err -0.88	Per 0.81
13: Max Drawdown	6 months	Dwn.Risk -0.58	Info R -0.29	Tr Err -0.34	Neg Per 0.32	Pos Per 0.29
	1 year	Tr Measr -0.28	Dwn Rsk -0.54	Dw Pot -0.51	Neg Per 0.32	Pos Per 0.30
	3 years	Tr Measr -0.33	Dwn Pot -0.35	M Sqr -0.33	Beta 0.41	Neg Per 0.25
14: Tracking Error	6 months	J. Alpha -0.9	Info R -0.77	Sor R -0.88	Per 0.97	Neg/Pos P-0.76
	1 year	J. Alpha -0.88	Info R -0.84	Sor R -0.96	Per -0.93	Pos Per -0.66
	3 years	J. Alpha -0.9	Dwn Pot 0.63	Info R -0.87	Sor R -0.88	Per -0.93
15: Performance	6 months	J. Alpha 0.79	Sortino R 0.91	Tr Err -0.97	Neg Per 0.80	Pos Per 0.79
	1 year	J. Alpha 0.77	Info R 0.78	Sor R 0.92	Tr Err -0.93	Pos Per 0.75
	3 years	J. Alpha 0.77	Info R 0.78	Sor R 0.92	Tr Err -0.93	Pos Per 0.75
16: Beta	6 months	Dwn.Pot 0.60	M.Sqr 0.36	Ad S R 0.32	Neg Per 0.55	Pos Per 0.46
	1 year	Shrp Indx 0.37	M Sqr 0.41	Ad S R 0.37	Neg Per 0.59	Pos Per 0.51
	3 years	Shrp Indx 0.37	Dwn Pot 0.36	Ad S R 0.37	Neg Per 0.59	Pos Per 0.51
17: Negative Period	6 months	J. Alpha 0.49	Sortino R 0.67	Tr Err -0.76	Per 0.80	Pos Per 0.98
	1 year	Beta 0.59	Sor R 0.69	Tr Err -0.66	Per 0.73	Pos Per 0.98
	3 years	Beta 0.59	Sor R 0.69	Tr Err -0.66	Per 0.73	Pos Per 0.98
18: Positive Periods	6 months	J. Alpha 0.53	Sortino R 0.67	Tr Err -0.76	Perf 0.79	Neg Per 0.98
	1 year	J. Alpha 0.46	Sor R 0.72	Tr Err -0.66	Per 0.75	Neg Per 0.98
	3 years	Beta 0.51	Sor R 0.72	Tr Err -0.66	Per 0.75	Neg Per 0.98

The current study attempted to explore the characteristics and significance of the relationship that unites two measures. The analysis was conducted over three sub periods one after the other. This verifies the conclusions that were drawn. Once again Kendall's tau (concordance coefficient) was also provided to confirm the strength of the connections between performance measures.

Table IV indicates the five strongest correlations for 18 performance measures calculated over three sub-periods. The strongest and the most prominent correlation (that is, 98 to 100%) exists between performance measures, such as Sharpe Index, M Square and Adjusted Sharpe Index; Standard Deviation and Fama's Net Selectivity and no. of positive periods and no. of negative periods. These performance measures are superior in fund classification process than others. Moreover, they can be safely used interchangeably with each other for investment fund classification purpose. Hence, Sharpe Index can safely be used instead of M Square and even Adjusted Sharpe Index; Standard Deviation can be used in place of Fama's Net Selectivity. Thus, Sharpe Ratio also represents the modern-day measures. Additionally, frequency measures such as no. of negative periods and no. of positive periods measures are a perfect replacement of each other for fund classification.

Although, the above measures are almost 100% associated with each other, however, Absolute Performance, Tracking Error and Sortino and Information Ratio are highly correlated with most of the measures, such as Sortino Ratio, Tracking Error, Information Ratio and Jensen's Alpha in the three sub periods. The association was about 77% to 97% which is quite meaningful. Such a high association with maximum measures signifies the relative superiority of Absolute Performance, Tracking Error, Sortino and Information Ratios. High correlation with many of the measures also points to the fact that Absolute Performance, Tracking Error and Sortino and Information Ratio carry all the information that is exhibited by the measures of risk-adjusted return (Sortino Ratio, Information Ratio, and Jensen's Alpha); measure of fund manager's skills to add value (Tracking Error); measures of persistency or frequency (Number of Positive/Negative Periods). In short, the four measures shed light on multiple important aspects of a fund's performance. It is noteworthy here that Alpha coefficient prevails among these 4 measures. It is 77 to 82% correlated with Information Ratio and Absolute Performance, 84 to 88% with Sortino, however, 88 to 90% correlated with Tracking Error (the strongest correlation). Information Ratio has the strongest correlation with Sortino (87 to 95%), Absolute Performance with Tracking Error (93 to 97%). Negative period has shown normal association with Absolute Performance, Tracking Error and Sortino in 6 months' period only (67 to 80%). While, positive period's correlation exists only with Sortino and Tracking Error in 6 months and one-year period (66 to 79%) which is not significant. Correlation between measures of market exposure, namely beta coefficient and Tracking Error, does not exist.

Standard deviation, widely used for fund classification, is perfectly correlated (99 to 100 %) with Fama's Net Selectivity, thus, proving theoretical closeness. Hence, the two can be substituted for each other for fund classification without the fear of crucial consequences. Standard deviation's correlation with appraisal ratio ranges from 66 to 76%. It decreases with the increase in

time span over which it is calculated. Its correlation with all other measures is insignificant, that is, around or less than 50%. Standard deviation is 50% correlated with Treynor Measure in all three sub periods. Its association with Sortino ratio exists in 6 months and one year period only and is of the order of 46 to 47%. Its correlation with Information Ratio, Jensen's Alpha, Absolute Performance, Sharpe Index, M Square and Adjusted Sharpe Index exists in only one of the three sub periods. Association with majority of the main measures explains why it is an important component in calculation of many measures.

Last of all, beta, a measure of systematic risk, is not significantly related with any major measure. The strongest relationship existed in only 6 months' period with downside potential which is 60%. Comparatively less significant correlation exists with negative and positive periods in all three periods, that is, 55 to 59% and 46 to 51%, respectively. All other measures, none of which are the major ones, are weakly (less than 40%) related with beta. This leaves beta's specificity, in the calculation of measures, such as Treynor Measure and Jensen's Alpha and in fund classification, unexplained. However, unlike the findings of Pedersen & Rudholm-Alfvin (2003) and Eling (2008) the current study, up till now, did not single out a measure to classify funds, within the scope of study. Therefore, the classification of a single performance measure cannot be relied on, however, should use other measures as well unlike most of the fund management companies that have been using only certain performance measures ever since.

C. CONCLUSION AND RECOMMENDATIONS

The time period (2009-2017) had been a much happening period that witnessed both political and economic turbulence and uncertain law and order situation as well as political stability and better law and order situation in Pakistan. These factors, along with the energy crisis, left a deep impact on mutual fund's performance. Moreover, the time period (2009-2010) has also seen the highest levels of T-bill rates, that is, around 13% which had never been the case before. In the light of these facts, no wonder mutual funds' performance experienced continuous fluctuation. The funds' performance, in comparison to KMI 30 index, kept varying throughout the research period. As per absolute performance, 4 funds outperformed the Shariah compliant index, while 9 (mostly equity funds) underperformed it. Absolute risk, no. of positive periods, and no. of negative periods declare all funds to have underperformed the market. While, standard deviation, beta coefficient, sharpe index, and max. drawdown declared that all funds outperformed the market. As per the descriptive analysis of the current study, the data was not normally distributed. Moreover, the performance measures produced different results for all three sub periods, that is, 6 months, 1 year, and 3 years. This implies that each measure conveyed some specific information about funds' behavior in each sub period. Thus, each measure was supportive when it came to classification of the investment funds into good and bad funds. Table IV presents the complete summary of descriptive statistical characteristics of the 18 selected performance measures. The descriptive analysis provides a clear picture of the positioning and frequency distribution of the performance measures under

consideration. It is clearly observable here that the mean and median of almost all measures were different for three different periods, that is, short, medium and long-term, respectively. Likewise, the standard deviation of the measures was also different for the three sub periods. The interpretation of skewness and kurtosis further supports the position analysis. It has been observed here that the skewness and kurtosis coefficients were non-zero values. Moreover, kurtosis coefficients were very high which indicated specialized distributions. This indicates that performance measures follow a non-normal distribution. There are more outliers than the normal distribution. With respect to the univariate statistics parameters, none of the performance measures appeared to possess any distinctiveness. In fact, each of them were laden with information associated with the investment fund itself. Another important observation was that the measures produced different results for all three sub periods, that is, 6 months, 1 year, and 3 years. This implies that each measure conveyed some specific information about funds' behavior in each sub period. Thus, each measure was supportive when it came to classification of the investment funds into good and bad. The bivariate analysis concluded that there was a high level of correlation among the performance measures which indicates that the performance measures classify mutual funds in a similar manner irrelevant of the fact that they are calculated over different frequencies, that is, 6 months, 1 year, and 3 years. Change of frequency doesn't disturb the classification. The strongest and the most prominent correlation (that is, 98 to 100%) exists between performance measures, such as Sharpe Index, M Square and Adjusted Sharpe Index; standard deviation and Fama's Net Selectivity and no. of positive periods and no. of negative periods.

D. RECOMMENDATIONS

It is recommended for future studies to:

(a) study the behavior or performance of maximum number of funds.

(b) include only one type of funds, for instance, only equity funds or debt funds or money market funds since each category has its own performance factors. Comparing one type's performance with the other type of funds is unfair.

(c) select longer time period to spot trends and confirm the repeated performance trends under different economic conditions.

(d) use additional analytical techniques, such as Principal Component Analysis (PCA) to communicate internal structure of the data in a way that best explains the discrepancy.

E. LIMITATIONS

Mutual funds in Pakistan are still in their infancy. However, there wasn't any Shariah compliant index in Pakistan till 2008 to measure the performance of funds. Therefore, the current study only included 13 mutual funds since consistent data for any other Shariah compliant mutual fund was not available. Secondly, because of the same reason, that is, unavailability of the data, this study couldn't confine itself to only one kind of mutual fund (equity funds were the point of interest for the author) which would have been a fair comparison. Unavailability of the data, again, forced the study to be confined to 8 years only.

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