COMPARATIVE PERFORMANCE ANALYSIS OF KMI 30 AND KSE 30 INDICES IN PAKISTAN STOCK EXCHANGE: AN EMPIRICAL ANALYSIS

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Abstract

The purpose of the paper is to study the comparative performance of KMI-30 and KSE-30 indices of Pakistan stock exchange. The first index describes the Shariah Compliant index where the faith investors are interested in investing in Islamic financing mode, whereas the other index represents the conventional index. This research empirically tests the results on a secondary source of data. For this purpose, data has been extracted from July 1 to 2009 to June 30, 2019, and the flow of frequency is daily. KMI-30 and KSE-30 indices closing values are considered independent variables whilst KMI-30 and KSE-30 indices return on the difference of today's and yesterday's index being considered dependent variables. There is strong evidence for cointegration relationship between KMI-30 and KSE-30 indices in the long run but KSE-30 index does not have Granger cause over KMI-30 index. Finally, the efficient market hypothesis does not prevail over KMI-30 index and KSE-30 index and investors can predict the movement of the index and price of the share in

the foreseeable future. Hence, shareholders can outperform from the market and earn the abnormal profit from both of the indices.

***Keywords**: Efficient Market Hypothesis, KMI-30 index, KSE-30 index, PSE, Returns, Volatility*

1. Introduction

Comparative performance of the Shariah index and the conventional index has become debatable for investors for several years. The literature from the various articles shows that the Shariah index has multiple restrictions such as short selling, T2 or T3 issues, transferring of the shares after two or three days once the transaction is executed on the stock exchange, limited Meezan index and future contracts being limits to its expansion. Furthermore, the Shariah compliance product not recognized fully by ethical investors than a conventional market-based index. Besides this, it is generally constructed consensus that most of the Islamic index companies are an integral part of conventional stock indices. Hence from the empirical findings, it is proved that the Islamic Shariah index produces better returns against conventional indexes from the last two decades.

KMI-30 index was introduced in 2009, where 30 most liquid companies had opted to meet the requirement of Islamic Shariah Compliance. First of all, this base index was commenced on June 30, 2008, by collaborating the Al-Meezan investment fund and Karachi stock exchange. This index follows the strategy of free-float market capitalization. The volatility of the index depends on the shares price of these 30 Islamic Shariah Compliance companies. The momentum of an index exclusively relies on price and the volume of the outstanding stocks. KMI-30 index is a revised semiannual basis, and the index touched the level of 54,118.51 as of the date of 28-06-2019.

The Karachi Stock Exchange (KSE), now the Pakistan Stock Exchange (PSX), was established on September 18, 1947, and began operations on March 10, 1949. The first index introduced was the KSE 50, which had 50 companies registered. As the number of listed companies and trades increased, there was a need for a good representative index. Thus, on November 1, 1991, the KSE 100 index was introduced with a base value of 1000 points. In total, 579 companies from 36 different sectors of the economy are listed on the KSE 100 index. Listing on the KSE is subject to the rules and regulations of the Security and Exchange Commotion of Pakistan (Rehman *et al.*, 2021). At the elementary stage, total capitalization worth 37 million Pak Rupees. This PSX attained the title of "Corporation" in 1949 after completion of two years, and the index system was inaugurated with 50 index systems for which 50 companies were elected. The Karachi Automated Trading System (KATS) was in operational mode in 2002, where investors

began their operational transactions with computer access, and the transaction takes place without any further delay. Table 1 shows the detail of KMI 30 & KSE 30 Sector-wise Information.

Table 1: Sector-wise *KMI 30 & KSE 30 Index*

S. No	Sectors	List of Companies	
		KMI 30	KSE 30
1	Power Generation & Distribution	2	2
2	Oil & Gas Exploration Companies	4	4
3	Transport	1	
4	Chemical	2	2
5	Cement	4	4
6	Fertilizer	2	3
7	Oil & Gas Marketing Companies	5	2
8	Cable & Electrical Goods	1	1
9	Textile Composite	1	1
10	Pharmaceuticals	1	1
11	Refinery	3	
12	Paper & Board	1	
13	Engineering	2	
14	Food & Personal Care Products	1	
15	Commercial Banks		8
16	Technology & Communication		1
17	Automobile Assembler		1
	Total	**30**	**30**

Source: Author's work

This study's essential purpose is to examine the empirical findings for risk and returns of the Islamic Shariah Compliance index with the conventional trading stock index and try to identify which index performs better. To facilitate faith conscious investors, PSX launched an exclusive Islamic index gauging Halal stocks' performance in Pakistan. This study aims to compare the performance of the Islamic index with its counterparts-conventional index regarding returns, risk, volatility, co-movement, and bi-directional causality.

The following points can elaborate the objective of the study:

- To investigate the risk and returns comparisons under the KMI-30 index, which strictly follows the Shariah compliance to the KSE-30 index, it is known as an unrestricted index.
- To explore efficiency and random walk behavior in KMI-30 and KSE-30 indices.
- To examine the long run relationship in KMI-30 and KSE-30 indices.
- To discover one-directional and bidirectional causality between KMI-30 and KSE-30 indices.
- To explore volatility clustering in KMI-30 and KSE-30 indices.
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Considering the dual market where there are faith-conscious and faith-neutral and Halal and non-Halal stocks, this study examines KMI-30 and KSE-30 indices. In this context, empirical tests have to be performed and analyzed through time-series data to explore cointegration, causality, volatility clustering, and co-movement.

2-Research Questions

- Q1. Is the profitability of the KMI-30 index relatively better as compared to the KSE- 30 index?
- Q2. Do efficiency and random walk behavior observe in KMI-30 and KSE-30 indices?
- Q3. Do KMI-30 and KSE-30 indices have a long run relationship?
- Q4. What is the extent of one-directional and bidirectional causality between KMI- 30 and KSE-30 indices?
- Q5. Does it indicate to explore volatility clustering in KMI-30 and KSE-30 indices?

Researchers have recently done comparative studies related to Shariah compliance and conventional finance on the stock market. Several assumptions would be taken into account by different researchers, but Shariah compliance indices are usually available on Muslim dominance countries and indices based increased year after year. The indices' performance has been explored when the global financial crisis (GFC) in 2006 and 2008 has occurred. Besides this, first and foremost, Indonesia and Malaysia are known as pioneer countries for comparing Shariah compliance and conventional funds in the stock market mainly for the ordinary equity market and evaluating the financial performance for both of the indices by the religious scholars. The researchers empirically investigated with the help of different testing approaches named volatility of market indices, efficient market hypotheses, comparative results

3. Literature Review

Aloui et al., (2014) explored the relationship of Shariah stocks and Sukuk of Islamic financing and checked the co-movement results and the trend of both the investments. Considering the perspective of conventional bonds and Sukuk has the same

tendency but conventional bonds related to a fixed income rate. As Sukuk investment meets Shariah investments' criteria, and the investors could obtain the returns under certain conditions, it will be Halal (lawful).

Efficient market hypothesis (EMH) terminology introduced by Jensen (1978) where chances of economic profit are minimal or at a meagre rate. EMH describes that investors get the returns as per the risks are borne by them and the moment of the share prices fluctuates without any bias adjustment. The study summarizes forecast prices of the stock and the market pattern rather than identified trend analysis under the fictional ground. However, Eugene Fama (1970) described that stock price should not be in a specific direction but applies the random walk. Another research depicts the idea that investors cannot accurately predict stock prices under EMH. Investors may also have a kind of awareness for financial crises before it begins to eradicate the world.

Bin Mahfouz and Hassan (2013); Guyot (2011); Hassan, Antoniou, and Paudyal (2005) have mutually agreed that there is no significant difference between Islamic and conventional finance approach. Studies prove that the Shariah index performed undoubtedly well than the conventional index (Milly & Sultan, 2012). Kok, Giorgioni, & Laws, 2009 analyzed the performance of the conventional approach. Reddy and Fu (2014) studied the Australian stock exchange (ASX) and checked Islamic and conventional finance stocks performance. The study was based on the results from 2001 to 2013, where both of these indices showed a significant change in terms of risk on the ASX market. Besides this, there was a similarity observed between the Shariah Compliance index and the conventional stock index.

Salman (2017) studied KMI 30 and KSE 30 indices' performance, emphasizing that most investors have' switched from conventional stocks to Islamic Shariah finance stocks, especially from the last decade. The data was extracted daily from March 21, 2012, to September 7, 2015. The results indicated that the KMI 30 index performed better in terms of the least risk and higher returns than the KSE 30 index. Net margin returns were negatively significant for KSE 30 index, but the debt-to-equity ratio is negative for KMI 30 index but insignificant impact.

Abro et al., 2021, investigated the impact of seasonality on the GCC stock market during the month of Ramadan. This helps to find opportunities for stock market investors to make abnormal returns (returns) by investing during Ramadan in the GCC stock markets. This study used stock returns for the Gulf countries (Saudi Arabia, Bahrain, Qatar, Kuwait, Dubai and the UAE) from January 2004 to November 2019. The ARCH-GARCH model was used to study the impact of the month of Ramadan on the returns and

volatility of the stock market in the Gulf countries. The results showed that the month of Ramadan has a significant impact on the stock market in Saudi Arabia and the United Arab Emirates. However, Ramadan does not significantly affect the market prices of Bahrain and Oman shares. The study found no evidence of serial correlation between residuals in Kuwait; This means that stock returns were independent of previous Kuwait stock returns, so we cannot make predictions. ARCH-LM test statistics for Qatar do not meet the requirement of a good regression model; therefore, we cannot go for forecasting or testing the Qatar hypothesis.

This study relates to Sharia versus conventional stock market indices. For this purpose, several theories have already been built, but the researcher takes over those theories to make a conceptual framework.

3-Theoretical Framework

3.1- Modern Portfolio Theory (MPT)

Modern portfolio theory (MPT) is a theory of risk-averse investors who try to maximize their returns with low risk. The Nobel prize winner and pioneered of MPT "Harry Markowitz" published this theory in his paper of "portfolio selection" in 1952. MPT relates to an efficient frontier that deals with constructing portfolios with the highest returns and the least risk. It is anticipated that investors are risk-averse and may take risks if they yield the highest returns against their investments. MPT also called mean-variance analysis and has a diversification of the portfolio, is considered a systematic risk and variance of stock prices are used as a proxy for portfolio risk. The weak form of efficiency contains no technical analysis. Therefore, it is complicated to outperform from the market, mainly for a short-term basis.

3.2- Behavioral Portfolio Theory (BPT)

People have motives, so they use the investible wealth in multiple ways to satisfy various motives. It means that there can be an investment motive, a social motive or a combination of the two. Socially responsible investment (SRI) caters to those investors who have a dual motive, i.e., doing good and doing well. Doing good implies fulfilling a social motive or contributing to a social cause. Doing well means earning a competitive return on investments. Halal investments are an example of the use of BPT, whereby the faith conscious investors seek two objectives simultaneously. Complying with faith (i.e. doing good) and earning Halal returns on investment (i.e. doing well).

4-Methodology

4.1- Research Design

The philosophy of this paper is positivism. The existing theories have already been built and checked the hypotheses of rejecting or failing to reject the assumptions regarding KMI 30 and KSE 30 index returns and which index performs better in Pakistani stock market.

4.2- Data Source

The nature of data source is secondary and collection from July 1, 2009, to June 30, 2019, where the index frequency is daily. Initially, the data will be extracted from Thomson Reuter's software, Yahoo finance website, and PSX exchange website as the need arise.

4.3- Selection of Variables

For this study, the independent variables are KMI-30 index and KSE-30 index of daily closing values. In contrast, the dependent variables are KMI-30 and KSE-30 indices returns on the difference of today's and yesterday's index level. The lagged returns are also studied for KMI-30 and KSE-30 indices. S) because of longitudinal data and reducing the residuals error by the sum of the square method.

4.4- Variable Returns Selection

KMI-30 and KSE-30 indices daily returns are calculated based on the following formula:

$$\boldsymbol{R_{t=l_n}}\left(\frac{\boldsymbol{p_t}}{\boldsymbol{p_{t-1}}}\right)$$

$\boldsymbol{R_t}$ = It is the daily return on KMI-30 and KSE-30 indices returns.

$\boldsymbol{p_t}$ = It is the daily price of KMI-30 and KSE-30 indices at time period t.

$\boldsymbol{p_{t-1}}$ = It is the daily price of KMI-30 and KSE-30 indices at one day before time period of t

Under EMH, the stock market behaves abruptly or randomly, or it has a particular pattern and trend, so the empirical results are checked with the help of runs test. A formula for runs test is stated here as under:

$$Z = \frac{R-\bar{R}}{\boldsymbol{S_R}}$$

As 'R' is used as the observed number of runs above or below the standard or comparison criteria, $\bar{R}$ is a symbol for the expected number of runs and lastly $\boldsymbol{S_R}$ for a standard deviation for the number of runs.

Expected number of runs $=\bar{R} = \frac{\boldsymbol{2n_1\,n_2}}{\boldsymbol{n_{1+}\,n_2}} + 1$

The standard deviation for the number of runs = $\boldsymbol{S^2{}_R} = \frac{\boldsymbol{2n_1n_2(2n_1n_2-n_1-n_2)}}{\boldsymbol{(n_{1+}\,n_{2)^2}+(n_{1+}\,n_{2-1})}} + \mathbf{1}$

Apart from this, it is assumed that the series is stationary. For this purpose, some unit root tests are applied to check the stationarity of the data series. As per the efficient

market hypothesis, it is believed that the data is stationary and the data distribution is normal, and there will be no prediction for considering the past data and predicting future stock prices. But if the series of KMI-30 index and KSE-30 index is non-stationary, then the abnormality of data will be reconciled for running "runs test for randomness". To check the data stationarity the Augmented Dickey-Fuller test; Phillips-Perron test; and Kwiatkowski-Phillips-Schmidt-Shin test will be used.

4.5- Hypothesis Testing

Some important hypotheses have been constructed after considering the objectives, problem statement and research gaps. Alternative hypotheses are stated under the following points:

H_A01 There is a significant difference in the risk and returns of KMI-30 and KSE-30 indices on PSX market.

H_A02 KMI-30 and KSE-30 indices do not follow the efficient market hypothesis and random walk model.

H_A03 KMI-30 and KSE-30 indices have long run co-integrating relationships.

H_A04 KMI-30 and KSE-30 indices have bidirectional causality.

H_A05 There is a volatility clustering in KMI-30 and KSE-30 indices.

5-Data Analysis and Findings

This section describes the empirical part of the results and findings concerning objectives, research questions, and hypotheses built for this study. Results are broadly elaborated in two different blogs. i.e., descriptive and inferential statistics. Furthermore, data normality is checked with unit root tests as defined by several authors and verified the results on levels and at first difference as the case may be for the closing values of the KMI-30 and KSE-30 indices. Stock returns on Shariah-compliant like the KMI-30 index are compared with the KSE-30 index, which is considered a conventional stock. Cointegration between KMI-30 and KSE-30 indices are taken into account to see whether the long run relationship is witnessed based on daily data. Causality will be observed between KMI-30 and KSE-30 indices and evaluated based on uni-directional or bi-directional impact. The cluster volatility will be determined by Autoregressive conditional heteroskedasticity (ARCH) and Generalized autoregressive conditional heteroskedasticity (GARCH) tests.

5.1- Testing Efficient Market Hypothesis (EMH)

EMH concept is derived by Eugene Fama in 1970, who describes the stock market. He insists that an investor cannot beat the market consistently and unable to outperform returns over the stock market. The weak form indicates the price before the period t is not ideal for predicting period t under the EMH.

$$\boldsymbol{R_t = \beta_0 + \beta_{R\,t-1} + \mu_t}$$

Where $\boldsymbol{R_t}$ *is the return of the current period of KMI-30 and KSE-30 indices on a daily basis and* $\boldsymbol{R_{t-1}}$ *is the return of one day before the current day.*

H_O. $\beta_{1=0}$ → EMH holds.

H_A $\beta_{1\neq0}$ → EMH does not hold.

Table 2: *Linear regression of KMI-30 Index*

Return_i	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
L.Return_i	0.104	0.020	5.21	0.000	0.065	0.143	***
Constant	0.001	0.000	2.63	0.009	0.000	0.001	***

Mean dependent var	0.001	SD dependent var	0.011
R-squared	0.011	Number of obs	2475.000
F-test	27.098	Prob > F	0.000
Akaike crit. (AIC)	-15407.130	Bayesian crit. (BIC)	-15395.502

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 2 indicates the regression results of KMI-30 returns (Return_i) where L is the log-returns as L.Return_i denotes it. The coefficient of L.Return_i is 0.104, and the P-value is 0.000, which is significant. It does not hold EMH assumptions, and one can predict the future market of the KMI-30 index as the rooms are available for the investors to forecast the PSX market and earn the abnormal profit. R-squared has a low value as it is witnessed by 0.011 as the predictors explained regressed variable at a very short percentage.

Table 3: *Linear regression of KSE-30 Index*

Return_c	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
L.Return_c	0.117	0.020	5.88	0.000	0.078	0.156	***
Constant	0.000	0.000	1.12	0.262	0.000	0.001	

Mean dependent var	0.000	SD dependent var	0.011
R-squared	0.014	Number of obs	2475.000
F-test	34.586	Prob > F	0.000
Akaike crit. (AIC)	-15401.335	Bayesian crit. (BIC)	-15389.707

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 3 applies a single variable linear regression for KSE-30 index returns. The empirical findings indicated that L.Return_c value is 0.117, which is not equal to $\beta_1 = 0$. The p-value is significant and rejects the null hypothesis. Concerning market efficiency, EMH does not hold the assumptions in the Pakistani market, and the historical price can be used to forecast the foreseeable price in the recent future. F-test value is 34.586 showing the overall fitness of the model.

5.2- Checking Heteroskedasticity

This terminology is used in econometrics where the disturbance term is not the same as the period changes. A significant slope points out the heteroskedasticity, and the volatility is observed in KMI-30 and KSE-30 indices. The equation is:

$$\hat{\epsilon}_t^2 = \beta_0 + \beta_{1R\,t-1} + \mu_t$$

Table 4: *Linear regression of KMI-30 Index*

Rsq	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
L.Return_i	-0.003	0.000	-6.20	0.000	-0.004	-0.002	***
Constant	0.000	0.000	24.11	0.000	0.000	0.000	***

Mean dependent var	0.000	SD dependent var	0.000
R-squared	0.015	Number of obs	2475.000
F-test	38.433	Prob > F	0.000
Akaike crit. (AIC)	-34191.071	Bayesian crit. (BIC)	-34179.443

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 4 represents the heteroskedasticity in the data as the predictor variable is L.Return_i, which has a coefficient value of -0.003, but the p-value shows 0.000. The R-squared for this regression is 0.015 and F-test indicates 38.433, representing the model's overall fitness. The variability of residuals square (rsq) is unequal in the range of the series and clarifies heteroskedasticity in the data. Hence, volatility is related to stock returns.

Table 5: *Linear regression of KSE-30 Index*

r2asq	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
L.Return_c	-0.002	0.000	-5.34	0.000	-0.003	-0.001	***
Constant	0.000	0.000	25.18	0.000	0.000	0.000	***

Mean dependent var	0.000	SD dependent var	0.000
R-squared	0.011	Number of obs	2475.000
F-test	28.551	Prob > F	0.000
Akaike crit. (AIC)	-34436.097	Bayesian crit. (BIC)	-34424.469

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 5 shows the results of the KSE-30 index error term. The test gives evidence of heteroskedasticity of error term as the L.Return_c coefficient value is -0.002 and p-value is 0.000 showing volatility in the data. As $\boldsymbol{\beta_1}$ *is not equal to zero; it may seem the volatility on the KSE-30 index is unpredictable, and the market fluctuates on an abrupt basis. Similarly,* $\boldsymbol{\beta_0}$ *value being 0.000, which is the coefficient of the residual square (r2asq) of the KSE-30 index, represents the credibility of regression results.*

5.3- Autoregressive Conditional Heteroskedasticity-ARCH Effects

This test is applied when the time series data is available and current period variance is taken into account compared to period $\boldsymbol{t-1}$. *The ARCH model supports volatility and volatility clustering for time series data. The equation for this data is as under:*

$$\hat{\epsilon}_t^2 = \boldsymbol{\beta_0} + \boldsymbol{\beta_{1\hat{\mu}^2 t-1}} + \boldsymbol{\mu_t}$$

H_O. $\beta_{1=0} \rightarrow$ No ARCH effect

H_A $\beta_{1\neq0} \rightarrow$ ARCH effect

Table 6: *Linear regression of KMI-30 Index*

Rsq	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
L.rsq	0.169	0.020	8.51	0.000	0.130	0.208	***
Constant	0.000	0.000	17.98	0.000	0.000	0.000	***

Mean dependent var	0.000	SD dependent var	0.000
R-squared	0.028	Number of obs	2474.000
F-test	72.398	Prob > F	0.000
Akaike crit. (AIC)	-34209.587	Bayesian crit. (BIC)	-34197.960

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 6 evaluates the result of ARCH effect for KMI-30 index disturbance term. As the coefficient of the residual square (L.rsq) is 0.169 and p-value is 0.000 showing the significant slope or β_1 value is not equal to zero. Since ARCH effect is witnessed on PSX. The estimation of variances is unexplained by the log of the residual square (L.rsq). The variance is not affecting KMI-30 index on current data but it has a severe effect of its prior value being known as autoregression. Hence, ARCH effect is there on KMI-30 index and accepts the alternative hypothesis.

Table 7: *Linear regression of KSE-30 Index*

r2asq	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
L.r2asq	0.135	0.020	6.76	0.000	0.096	0.174	***
Constant	0.000	0.000	19.44	0.000	0.000	0.000	***

Mean dependent var	0.000	SD dependent var	0.000
R-squared	0.018	Number of obs	2474.000
F-test	45.686	Prob > F	0.000
Akaike crit. (AIC)	-34438.227	Bayesian crit. (BIC)	-34426.600

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 7 shows the regression result of the residual square (r2asq) and log of the residual square (L.r2asq) of KSE-30 index. ARCH effect is noticed as L.r2asq coefficient

value is 0.135 and p-value 0.000 respectively. The significant slope indicates and rejects the null hypothesis. Variance is so volatile that current variation per the disturbance terms does not have the element of homoskedasticity. As per the literature review, the researchers' consensus denotes that volatility is the main element in an emerging market where Pakistan falls under the emerging market criteria. Hence, the error term's randomness may fluctuate on an instant basis and proves to be having an ARCH effect.

Table 8: *LM test for autoregressive conditional heteroskedasticity (ARCH), KMI 30*

LM test for autoregressive conditional heteroskedasticity (ARCH) chi2	Df	Prob>Chi2
62.306	1	0.000
99.816	2	0.000
113.226	3	0.000
118.628	4	0.000
148.422	5	0.000
157.758	6	0.000
164.822	7	0.000
168.323	8	0.000
169.932	9	0.000
176.277	10	0.000

H0: no ARCH effects vs H1: ARCH(p) disturbance

Lagrange Multiplier (LM) test is used to verify the ARCH effect by using lag value. Table 8 draws the output up to 10 lags because the number of trading sessions in a bimonthly is 10. So, it is a kind of benchmark for using LM test. From lag 1 till 10 supports the alternative hypothesis and the disturbance term creates a problem of volatility on KMI-30 index and may warrant evidence of volatility clustering from July 2009 to June 2019.

Table 9: *LM test for autoregressive conditional heteroskedasticity (ARCH), KSE 30*

LM test for autoregressive conditional heteroskedasticity (ARCH) chi2	Df	Prob>Chi2
34.698	1	0.000
79.619	2	0.000
89.041	3	0.000
93.395	4	0.000
120.879	5	0.000
132.687	6	0.000
137.962	7	0.000
141.912	8	0.000
144.201	9	0.000
154.307	10	0.000

H0: no ARCH effects vs H1: ARCH(p) disturbance

Table 9 refers to the LM test for KSE-30 index. Lags results are up to 10 and in every lag, the p-value is <0.05, so it supports the ARCH effect and showing the valid argument for serial correlation. The error term variance for KSE-30 index shows the randomness of the data. The data may indicate the positive and negative pattern repeatedly and lead to a volatility clustering.

5.4- ARCH and GARCH family

Autoregressive conditional heteroskedasticity (ARCH) was, firstly, introduced by Engle (1982). ARCH model is the error term's square, and GARCH is the model of a square of variance. But both of the models are having conditional mean and conditional variance. The equation is as under;

$$\boldsymbol{R_i = \widehat{\beta}_0 + \widehat{\beta}_{1(R_{i\,t-1}\ -\hat{R}_i)} + \mu_t}$$

$$\boldsymbol{\sigma_t^2 = \tau\mu_{t-1}^2 + \phi\mu_{t-1}^2}$$

Where $\boldsymbol{\tau}$ *is a tau notation being used for ARCH parameter and* $\boldsymbol{\phi}$*is used for GARCH parameter.*

Table 10: *ARCH family regression -- AR disturbances- KMI-30 index*

Return_i	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Constant	0.001	0.000	5.14	0.000	0.001	0.002	***
L.ar	0.139	0.022	6.24	0.000	0.096	0.183	***
L.arch	0.126	0.012	10.23	0.000	0.102	0.150	***
L.garch	0.824	0.016	52.85	0.000	0.793	0.854	***
Constant	0.000	0.000	6.91	0.000	0.000	0.000	***

Mean dependent var	0.001	SD dependent var	0.011
Number of obs	2476.000	Chi-square	38.899
Prob > chi2	0.000	Akaike crit. (AIC)	-15717.171

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 10 describes the result of ARCH family where $\hat{\beta}_0$ value is 0.001 and estimated value of $\hat{\beta}_1$ is 0.139. As $\hat{\beta}_0 = \bar{R}_i$ which is an estimated value of an average mean of KMI-30 index returns. The results have been drawn at order 1 or lag value for ARCH family. P-value is very significant for every parameter and indicates significant evidence for variation in the data and changes as per the time variability.

σ_t^2=0.126μ_{t-1}^2+ 0.824μ_{t-1}^2 +

Figure 1: *Volatility clustering for KMI 30 Index returns*

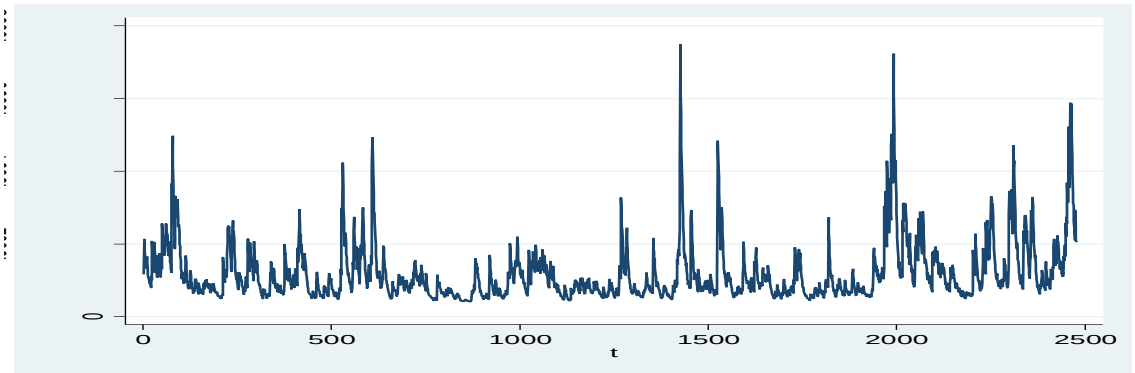

Figure 1 represents the KMI-30 index variance where conditional variance output has been drawn the significant result of volatility clustering over July 1, 2009, to June 30, 2019. PSX market over a particular decade follows the pattern of the same nature which

has either a positive sign or an adverse sign. The volatility is identified by range-bound of narrow and widens movement.

Table 11: *ARCH family regression -- AR disturbances- KSE-30 index*

Return_c	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Constant	0.001	0.000	3.23	0.001	0.000	0.001	***
L.ar	0.156	0.022	7.13	0.000	0.113	0.200	***
L.arch	0.120	0.012	10.31	0.000	0.097	0.143	***
L.garch	0.839	0.014	60.02	0.000	0.811	0.866	***
Constant	0.000	0.000	6.41	0.000	0.000	0.000	***
Mean dependent var		0.000	SD dependent var			0.011	
Number of obs		2476.000	Chi-square			50.805	
Prob > chi2		0.000	Akaike crit. (AIC)			-15692.094	

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 11 shows the results of ARCH and GARCH family business of KSE-30 index returns. Bollerslev (1986) formed the GARCH model, having a feature of conditional variance. KSE-30 index returns estimated $\hat{\beta}_0$ value is 0.001 and estimated $\hat{\beta}_1$ value is 0.156. ARCH (1,1) and GARCH (1,1) models are used. The first one represents the result on error term and later one deals with the square of residual using the OLS method. The P-value of KSE-30 index return is significant for every parameter and proves to be heteroskedasticity and fails to assume EMH at the Pakistani stock market.

σ_t^2=0.120μ_{t-1}^2+ 0.839μ_{t-1}^2

Where 0.120 is a parameter of ARCH and 0.839 for GARCH.

Figure 2: *Volatility clustering for KSE-30 Index returns*

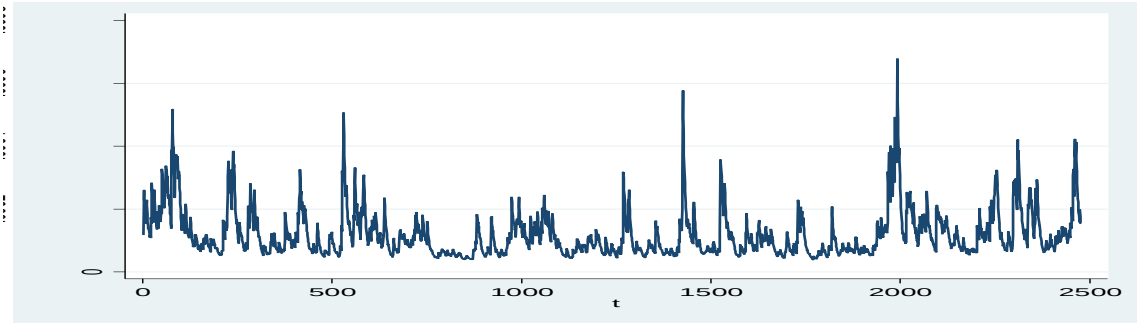

Figure 2 indicates the pictorial presentation of the KSE-30 index, and it proves that as time passes on volatility is witnessed in Pakistan stock market. The gaps are relatively higher than the KMI-30 index, but volatility clustering is found most of the time and the momentum of narrow and widens spans is also there. Volatility clustering is also proved empirically by ARCH and GARCH models. Hence, KSE-30 index follows several clusters which are the proof of heteroskedasticity in the data.

5.5- Co-integration Test

Co-integration test is used to check the relationship among the variables for a time series data. If the order of the series is co-integrated at a point less than a difference, it builds the relationship. As time series has the feature of deterministic or stochastic Behaviour and shows the long run relationship for the variables. Apart from this, the relationship between KMI-30 and KSE-30 indices are checked by applying the following tests. The equation is:

$$\widehat{R}_i = \beta_0 + \beta_1 R_c + \widehat{\mu}_t$$

Table 12: *Regression Result – KMI 30 and KSE 30 indices*

Return_i	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Return_c	0.943	0.007	144.98	0.000	0.930	0.955	***
Constant	0.000	0.000	5.28	0.000	0.000	0.001	***
Mean dependent var		0.001	SD dependent var			0.011	
R-squared		0.895	Number of observations			2476.000	
F-test		21018.116	Prob > F			0.000	
Akaike crit. (AIC)		-20952.680	Bayesian crit. (BIC)			-20941.052	

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 12 shows that a 1-unit change in KMI-30 index brings about the change of 0.943 in KSE-30 index. H, both of the indices have a relationship with their returns. Likewise, the p-value of KMI-30 and KSE-30 indices have less than 0.05 value that leads to a significant effect. R- squared value is 0.895, which indicates that the KSE-30 index represents the explanatory power of the regressed variable of KMI-30 index.

Table 13: *Augmented Dickey-Fuller (ADF) test for KMI 30 and KSE 30 indices*

Augmented Dickey-Fuller test for unit root Number of observations = 2465

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		---------- Interpolated Dickey-Fuller ---------		
Z(t)	-16.120	-3.430	-2.860	-2.570

MacKinnon approximate p-value for Z(t) = 0.0000

H_O: μ_t is non-stationary.

H_A : μ_t is stationary.

Table 13 shows that the ADF test is applied to see the unit root in the series as statistics value or calculated value is greater than the critical value. Hence, it indicates the series is stationary. It is further empirically found that the KMI-30 index and KSE-30 index have the long run relationship and cointegrates over time.

6-Conclusion

This study is all about the comparative performance of KMI-30 and KSE-30 indices on the PSX market. The results have been drawn on empirical testing from July 1, 2009, to June 30, 2019. The frequency of data is daily, and for this purpose, several tests have applied for KMI-30 index and KSE-30 index. Statistics results have been divided into two categories i.e. descriptive and inferential analysis. Modern portfolio and behavioral portfolio theories have been taken into account. For this purpose, the Efficient Market Hypothesis (EMH) assumption of weak form is checked on KMI-30 index and KSE-30 index.

PSX market is so much volatile and the market behaves unpredictable way. The

random walk behavior and EMH hypothesis tests have been checked by several tests like heteroskedasticity, ARCH, GARCH, cointegration, causality, cluster volatility, etc. Every test identifies that the data flow is not normal, and EMH market does not hold in Pakistan stock market. The randomness of the data is tested by using runs test and consensus has been built for the pattern of the sign either following the positive or negative direction. As a result, the data is non-stationary, and it is confirmed by the graphs and tables in the descriptive analysis.

KMI-30 index is a Shariah Compliant index, and KMI-30 index is a conventional index. Both of the indices have a significant value for their expected values of returns on their mean. The residual errors are checked and reveal the answer of heteroskedasticity with the assistance of the OLS model. The error term has evidence that errors are not homoskedasticity and changes as time moves. ARCH and GARCH effects are also witnessed on KMI-30 and KSE-30 index, and it rejects the assumption of EMH weak form. The past prices predict the prices of the KMI-30 index, and KMI-30 index for the foreseeable future, and investors make the outperform returns.

Volatility clustering is observed for both the indices by using ARCH family and graphical presentations. So, it indicates the particular behavior of serial correlation on PSX. Engle and Granger (1987) test is checked through EG-ADF test to check the unit root for cointegration between KMI-30 and KSE-30 indices. It is found that the cointegration is there between KMI-30 and KSE-30 indices and has the long run relationship between them. Granger causality test indicates KSE-30 index returns do not have either one direction or bi-directional causality on KMI-30 index returns.

Summing up from the above, Shariah Compliant investors invest on the KMI-30 index though it has some trading restrictions because of Islamic laws. Similarly, conventional investors invest on KSE-30 index and KMI-30 index as their main aim is to get maximum returns on their portfolios. Lastly, EMH assumption does not hold on Pakistan stock market because of emerging market nature. That is why investors earn high profit and heavy losses.

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