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Lunar Effect on Stock Returns and Volatility: An Empirical Study of Islamic Countries*

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Abstract

The main objective of this article is to investigate the existence of the lunar effect during the full moon period (FM period) and the new moon period (NM period) on the selected Islamic stock market returns and volatilities. For this purpose, the Ordinary Least Squares model, Autoregressive Conditional Heteroscedasticity model, Generalised Autoregressive Conditional Heteroscedasticity model and Generalised Autoregressive Conditional Heteroscedasticity-in-Mean model are employed using the mean daily returns data between January 2010 and December 2019. Next, the log-likelihood, Akaike Information Criterion and Schwarz Information Criterion value are analyzed to determine the best models for explaining the returns and volatility of returns. The empirical results have deduced that, during the NM period, excluding Malaysia, the total mean daily returns for all of the selected countries have increased mean daily returns in contrast to the mean daily returns during the FM period. The volatility shocks are intense and conditional volatility is persistent in all countries. Subsequently, the volatility behavior tends to have lower volatility during the FM period and NM period in the Islamic stock market, except Malaysia. This article also concluded that the ARCH (1) model is the preferred model for stock returns whereas GARCH-M (1, 1) is preferred for the volatility of returns.

Keywords: Behavioral Finance, Calendar Anomaly, Islamic Stock Market, Lunar Effect, Autoregressive Conditional Heteroscedasticity

JEL Classification Code: C01, C51, C58, G14, G40

1. Introduction

Fama in 1970 proposed a theory known as the efficient market hypothesis (EMH), which is somewhat similar to the random walk theory. It states that, since the investors are rational and stock prices reflect all the appropriate information, it is impossible to beat the market and earn the abnormal returns by just knowing the past prices (Camba & Camba, 2020). Simply, no technical or fundamental analysis would help investors to have an edge over other investors. However, some past studies showed that EMH theory was criticized for stating that the behavior of investors is rational in making an investment decision. But, the fact is that there are many examples in the real market showing the factors affecting the decisions of investors, which make them behave in an irrational way such as attitude, behavior and anomalies.

Calendar anomaly (also called calendar effect) is the uneven behavior of the stock market with particular calendar occasions (Hungry Ghost Festival and cultural festival months), periods (January, moon phase and holiday) and times (hours, daily, weekend and monthly). From the perspective of financial markets, various calendar effects

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have been studied in terms of security market returns, where the returns are considered higher or lower depending on the forms of calendar anomalies. They also explain the tendency of the stock prices to follow a certain pattern to deviate from its criterion and hence affecting the decision of investment made by investors. The presence of the lunar effect is different from other calendar anomalies. Its relation with the trading behavior of investors creates conflicting consequences because it is linked with emotions, attitudes, psychological biases and beliefs. This is because investors tend to behave absurdly, i.e., they become temperamental, aggressive and depress during the full moon period (FM period) as compared to the new moon period (NM period) in which they become quieter, analytical and contemplative. This change in behavior is mostly seen when the new moon changes to the full moon instead of the shift of the full moon to the new moon.

Until now, it has been proven by psychological data that lunar phases influence mood changes. However, the significance of the lunar effect can also be analyzed through various aspects that will contribute to the stock market returns. The average returns around the new moon, during a lunar effect, are considered higher in comparison with the average returns around the full moon. A study was conducted by Dichev and Janes (2003), which showed that in the fifteen days of the new moon dates, the stock market returns are double as compared to that of full moon dates. A research study was also carried out by Yuan et al. (2006) showing the significant relationship between phases of the moon and investors' behavior, i.e., during the NM period, most investors tend to invest more than in the FM period. Moreover, due to the abnormal sleeping practice, the full moon enhances the tendency of feeling depressed and frightened (Lingaraja, 2013), which keeps the investors away from the market and they do not sell out their positions during that period.

The impacts of the lunar phases on investment activities may cause unpredictable consequences on stock market volatilities and returns. Therefore, investors evaluate the mean-variance of returns to seek help for making decisions regarding their investment in stocks, which is based on their will to meet any kind of risk. Sewraj et al. (2012) maintained that variance (risk) or volatility of returns along with mean returns must be considered by an analytical financial decision-maker. It is generally assumed that the stock associated with higher risk gives higher potential returns. However, recent studies suggest that stocks with low volatility can also give higher returns to investors. High volatile stocks are those whose prices fluctuate rapidly. In order to measure the stocks' volatility and the mean-variance of returns, different methods have been adopted. For example; descriptive statistics, paired *t*-test and OLS models were used by Dichev et al. (2003), Yuan et al. (2006) and Munyasia et al. (2017), whereas Floros and Tan (2013), Yuan and Gupta (2014) and Robiyanto and Puryandani (2015) used ARCH and GARCH analysis. Robiyanto and Puryandani (2015) also used GARCH-M analysis. Besides ARCH, GARCH and GARCH-M analysis, several other related ARCH family models are widely used in examining returns and volatility of return, including Exponential GARCH (EGARCH), Threshold GARCH (TARCH) and Smooth-Transition ARCH (STARCH).

Based on the matter discussed above, two main objectives have been outlined. The first is to investigate the returns and volatility of returns for the duration of the lunar phases by using the OLS, ARCH, GARCH and GARCH-M analysis. For the time-varying volatility of the stock market returns, the ARCH-GARCH dummy models have been used. These are also used to adjust the heteroscedasticity concerns of the time series. The second objective is to compare and contrast all the models for explaining the returns and volatility of returns in the stock market returns of Islamic countries. The elements that lead to the investors' behavior and emotions are avoided because the emphasis of this study is on the empirical outcomes of the lunar effect on stock market returns and volatility.

2. Literature Review

2.1. Calendar Anomalies and the Lunar (Moon) Effect

With the introduction of the random walk theory and EMH theory, a wide body of literature has been developed globally, which assumes that abnormal returns exist for various stock markets. In stock market returns, the existence of calendar anomalies offers the investors and market professionals the opportunity to formulate their trading strategies in the future such as risk and return optimization. These strategies are planned based on seasonal patterns. Over the years, interest has been developed for studying the lunar effect, i.e., the new moon and full moon effect on the volatility and stock market returns.

Generally, the phases of the moon have a significant impact on investors' behavior, be it optimistic or pessimistic. During the NM period, investors behave optimistically and show positive energy, whereas, during the FM Period their behavior becomes pessimistic. Wu and Lu (2020) conducted a study that proved that the pessimistic behavior of an individual investor decreases the volatility and liquidity of stock market returns. This will ultimately decrease the stock returns. On the contrary, an individual investor's behavior is always optimistic during the NM Period. This will help in bidding up the firms' stock prices and generating higher stock returns. The empirical results from previous studies proved that during the new moon dates the stock returns were considerably higher than the full moon dates

(Dichev et al., 2003; Yuan et al., 2006; Liu and Tseng, 2009; Hosseini et al., 2013). A study was also conducted by Munyasia et al. (2017) in the Nairobi Securities Exchange, which established that around the full moon and new moon dates, the lunar cycle has a positive effect on the decision of investors as compared to the regular trading days. Moreover, this study also concluded that the stock market returns are considerably higher during the new moon days rather than the full moon days.

Likewise, the study carried out by Gao (2009) was contradicting to preceding literature, which stated that in Chinese stock indexes, the returns are greater during the full moon days as compared to the new moon days. Floros et al. (2013) supported this study by maintaining that the stock returns from 59 international mature and emerging markets displayed positive outcomes during an FM period instead of an NM period. Whereas, regarding the volatility, Brahman et al. (2012) and Liu et al. (2009) stated that for some markets, during the FM period, the volatility of the stock market returns becomes higher.

2.2. The Existence of the Islamic Calendar Anomalies

The calendar that is used worldwide is the Gregorian calendar, whereas the lunar calendar (the Hijri calendar) is generally used to find the dates of religious events and holidays. Stock markets are developed based on different calendars in different countries. For example, the stock market in Iran is set up based on the Gregorian calendar that is why Sarafnejad (2019) stated that the lunar days and months do not affect the events happening in the stock market. For the Islamic calendar anomalies, several studies have been conducted to analyze how the stock market returns affect only the holy month of Ramadhan and not the whole of the Hijri calendar (Seyyed et al., 2005; Al-Ississ, 2015; Nassir et al., 2017; Ozlem et al., 2018; Hassan et al., 2019).

Białkowski et al. (2012) examined the stock market returns of 14 Muslim countries during the holy month of Ramadhan between 1989 and 2007 and concluded that the stock returns are nearly nine times greater and less volatile as compared to the remaining year. Furthermore, Al-Ississ (2015) studied the effects of Ramadhan and Ashoura on the daily stock market returns of 10 Muslim countries and concluded that the stock returns increase significantly in the last two days of the month and the level of the holy day effect becomes constant. Ozlem et al. (2018) also concluded that out of 16 Muslim financial markets, 13 countries had significant stock returns during the month of Ramadhan. Only Bahrain Stock Exchange, Casablanca Stock Exchange and Bursa Malaysia had negative and insignificant outcomes. Moreover, Salman Irag Al-Najaf et al. (2018) studied the stock exchanges of Iran and Iraq and analyzed the Hijri calendar effects on the stock prices specifically in the sacred months, i.e., Muharram, Rejab, Zulkaedah and Zulhijjah. The study concluded that no substantial difference was seen in the stock prices of the sacred and other non-sacred months. Nevertheless, it was significantly noted that the stock prices in the holy months of Rejab and Zulkaedah have a huge difference as compared to other months in the Iranian stock exchange. Researches on the Islamic calendar have been extensively presented, but there is still a gap found in the researches on the Hijri calendar based on the lunar effect, i.e., the full moon and new moon effect specifically on the stock returns of the Islamic countries.

2.3. Empirical Studies on Return and Volatility Measurement

Studies conducted in the past to explain the presence of calendar anomalies on the stock market returns, mostly used descriptive statistics for empirical analysis (Dichev et al., 2003; Yuan et al., 2006; Nur Liyana et al., 2014; Arora et al., 2017; Munyasia et al., 2017; Xiong et al., 2019). However, for this study, it is not only focusing on the stock market returns, but also on the analysis of stock volatility. There is a probability for a stock to have time-varying volatility that is subjected to different factors, one of which is calendar anomalies. According to Engle (2001), for making a financial decision, the applications of the ARCH/GARCH method can be used to measure time-varying volatilities. Berument and Kiymaz (2001) used the OLS and modified-GARCH (*M*-GARCH) models to study the existence of the day-of-the-week effect in stock volatility and concluded that this effect exists in the stock market returns as well as the volatility equation. GARCH and OLS methods were used by Nasir et al. (2017) to analyze how the month of Ramadhan affects the stock market and its volatility behavior. From the study, it was concluded that on the stock market, the month of Ramadhan has a slightly positive impact and has shown limited volatility behavior. A model from the ARCH family, i.e., GJR GARCH (p, q) model was used by Hassan et al. (2019) to study the relationship of the month of Ramadan with time-varying volatility and stock market return of the Dhaka Stock Exchange (DSE). The outcomes of the study concluded that there is no considerable relationship of stock market return with the month of Ramadhan and it has a negative effect on the daily trade volume. The GARCH (1, 1) and EGARCH (1, 1) models were used to analyze the holiday effect by Chancharat et al. (2020) between 01-01-1992 and 31-12-2016. The statistical outcomes of the study indicated that the return rates are significantly higher in pre-holidays as well as post-holidays as compared to the normal days.

Dichev et al. (2003) maintained that from the perspective of the lunar effect, the stock returns volatility and trading volume have no indication of the lunar phases' effect. Later, Yuan et al. (2016) supported this study and stated that there is only a slight indication of the relation of volatilities and trading volume with the lunar phases. Nevertheless, Wang et al. (2010) explained the significant outcomes showing that stock returns have negative whereas stock volatility has a positive effect on lunar cycles in Taiwan. Despite the fact that the outcomes of the past studies have contradictions with the random walk theory and EMH, the proof for the predictability of the stock market returns does not indicate the incompetence of the market (Brook, 2008).

3. Data and Methodology

As the Islamic capital markets are growing remarkably around the world, they are also competing with conventional markets. They propose different modes of investment and offer to finance the products for the economic growth of the Islamic countries. There is an increase in the number of transactions, which shows that it is gaining recognition among the players. Performance-wise, Islamic indexes outperform conventional indexes and are more effective (Ho et al., 2014; Rejeb and Arfaou, 2019). Because of these circumstances, there is a limitation associated with the study on the time series, which affects the returns from the major markets of the top five Islamic countries, which include Malaysia, Indonesia, Bahrain, UAE and Saudi Arabia. The observations from the major markets of these countries includes Bahrain (Bahrain All Shares Index) = 2,461, Indonesia (Jakarta Stock Exchange Composite Index) = 2,451, Malaysia (FTSE Bursa Malaysia KLCI or FBMKLCI) = 2,471, UAE (Dubai Financial Market) = 2,513 and Saudi Arabia (Tadawul All Share Index) = 2,516.

The Hijri Calendar from the website of Jabatan Kemajuan Islam Malaysia (JAKIM) was used for this study to obtain the lunar phases. A full (or new) moon period is described as N days before the full (or new) moon day + the full (or new) moon day + N days after the full (or new) moon day ($N = 4$). According to Yuan et al. (2006), during the full (or new) moon period the Lunar dummy was equal to one and on other days it was zero. Furthermore, an extensive variety of lunar effects were taken into account and the most consistent data was preferred for evidence and then analyzed to check its effectiveness for forecasting. The formula introduced by Brook (2008) was used to convert the daily index data for each observation, into the daily rate of return. Five different observations were used for each week excluding public holidays and weekends.

The preliminary step for the analysis was basic descriptive statistics, which include mean, minimum, maximum, standard deviation and the Jarque-Bera test. The behavior of index returns was analyzed using these statistics, during the new moon and FM periods. The Schwarz Information Criterion (SIC) also called the Bayesian Information Criterion (BIC) was then used for the unit root testing by using the Augmented Dickey-Fuller (ADF) test. It is the unit root test that is used for analyzing the stationarity of the data and providing proof if the series follows the random walk. The existence of the lunar effect was calculated by using the return equation (Eq. 1) from the OLS model.

$$R_t = \alpha + \gamma_1 R_{t-1} + \beta_1 D_{\text{NM}} + \beta_2 D_{\text{FM}} + \varepsilon_t \quad (1)$$

In written, 'R' is the data on returns, α is an intercept constant, 't' is the time, 'β' is the coefficient of dummy variables (NM and FM), 'γ' is the coefficient of return on the '$t-1$' day 'R_{t-1}' and 'ε' is an error term.

The ARCH method was then used to investigate the existence of the ARCH effects in the residual. If the observed R-Squared probability is less than $\alpha = 5\%$, then no ARCH effect is possible in the time series. A time series is described by the ARCH model in which the returns of the present day are dependent on the returns from the previous day, whereas, the parsimonious alternative to the ARCH model is the GARCH model. An ARCH/GARCH model also describes the phenomenon of volatility clustering which is defined as the tendency of huge changes in the costs of financial assets to cluster together. For this study, the equation of the ARCH (1) (Eqs. 2 and 3), GARCH (1, 1) (Eqs. 4 and 5) and GARCH-M (1, 1) (Eqs. 6 and 7) models were used.

ARCH (1)

$$R_t = \omega + \pi_1 R_{t-1} + \Phi_1 D_{\text{NM}} + \Phi_2 D_{\text{FM}} + \varepsilon_t \quad (2)$$

$$\sigma_t^2(\theta) = \omega + \alpha_1 \varepsilon_{t-1}^2 \quad (3)$$

GARCH (1, 1)

$$R_t = \omega + \pi_1 R_{t-1} + \varepsilon_t \quad (4)$$

$$\sigma_t^2(\theta) = \omega + \Phi_1 D_{\text{NM}} + \Phi_2 D_{\text{FM}} + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2 \quad (5)$$

GARCH-M (1, 1)

$$R_t = \omega + \pi_1 R_{t-1} + \lambda_1 \sigma_t^2 + \varepsilon_t \quad (6)$$

$$\sigma_t^2(\theta) = \omega + \Phi_1 D_{\text{NM}} + \Phi_2 D_{\text{FM}} + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2 \quad (7)$$

Where *'ω'* is the constant, *'Φ'* is the coefficient of dummy variables and *'π'* is the coefficient of return on the $t-1$ day. The coefficient of ARCH is represented by *'α', 'β'* represents the coefficient of GARCH and *'λ'* represents the risk premium coefficient in the mean equation. Because the existence of the leverage effect could not be explained by the GARCH model, the GARCH-M model is used in the conditional mean equation to allow the heteroscedastic term. A negative λ shows that the stock return has a negative relation with its volatility, whereas, a positive λ indicates that the stock return has a positive relation with its volatility.

For the model selection, the model with the lowest Akaike Information Criterion (AIC) and SIC value was considered. These indicators are designed for the selection of the model. The smaller the SIC and AIC values, the fit the model, i.e., the model with the lowest SIC and AIC value is treated as a best-fit model. To investigate the presence of any ARCH effect, the diagnostic checking procedure was then executed.

4. Empirical Results and Discussion

4.1. Descriptive Statistics

In other countries, apart from Malaysia, the total mean daily returns during the NM period are greater than the mean daily returns during the FM period. The highest and the lowest return are recorded in UAE (μ = 0.071) and Bahrain (μ = −0.004), during the new moon and FM period, respectively. These findings are in line with the past research studies executed by Dichev et al. (2003), Yuan et al. (2006), Liu et al. (2009), Hosseini et al. (2013) and Munyasia et al. (2017), stating that the return in the new moon days was considerably greater than the return in the full moon days. In this paper, the standard deviation reflects the risk of the stock returns. The market volatility is often measured using the standard deviation. It is measured by predicting future price movements based on its previous performance. The outcomes from daily standard deviation show that during the new moon as well as the full moon phase, the Bahrain index return is least volatile ($\sigma_{newmoon}$ = 0.434, $\sigma_{fullmoon}$ = 0.444) and the UAE index return is most volatile ($\sigma_{newmoon}$ = 1.242, $\sigma_{fullmoon}$ = 1.252). The kurtosis coefficient shows that there are large skewness and higher peak of returns of all the stocks. Secondly, the skewness value shows that the mean returns are negatively skewed being values of the right tail of the distribution more concentrated as compared to the left tail indicating fewer chances of earning returns. The Jarque-Bera test is then performed for each period and at 0.01 (α < 1%) level, the null hypothesis of normality is rejected. This indicates that the error term of stock returns of each country is not normally distributed.

4.2. Unit Root Test

To examine the random walk process in the data series, the time series must be stationary. A unit root test is conducted to avoid false outcomes and develop an appropriate model. Since the unit root testing is done by the ADF test, it rejects the null hypothesis that means no unit root exists in the time series of stock returns. For all scenarios at the level $I(0)$, the index return for all countries is stationary having a level of significance less than 0.01 (α < 1%). These scenarios are with no trend and no intercept (None), the intercept and trend (Intercept and trend) and the intercept, but no trend (Intercept).

4.3. Results of the OLS Model, ARCH (1) Model, GARCH (1, 1) Model and GARCH-M (1, 1) Model

Objective 1: To investigate the returns and volatility of returns during the lunar phases using the OLS, ARCH, GARCH and GARCH-M.

The existence of the lunar effect is estimated by using the return equation after conducting stationarity of the series, by using the OLS model. The results of the non-existence of the lunar effect in all countries are shown in Table 1. It shows that except for Indonesia, all countries have a significant relationship between previous returns (one-day lag) and current returns.

Subsequently, the Lagrange Multiplier test for the ARCH model, also known as ARCH-LM, is used for all log returns. It is one of the evident and standard tests to determine the existence of heteroscedasticity in variance. Before volatility modelling, it is essential to examine the ARCH effect by using the GARCH model. The observed R-squared and F-statistics have a level of significance of 0.01(α < 1%). This indicates the existence of a heteroscedastic issue with the stock returns of all countries, where the residuals or error term indicate conditional heteroscedasticity. Furthermore, for a long period, the period of high volatility tends to follow the period of high volatility and the same scenario is for the period of low volatility, which proves the existence of volatility clustering.

Table 1: Results of Ordinary Least Square Regression Using Mean Equation

	UAE	Malaysia	Saudi Arabia	Indonesia	Bahrain
α	(0.0060)	0.0118	0.0208	(0.0008)	(0.0004)
γ_1	0.0800***	0.0924***	0.1227***	0.0286	0.0538*
β_1	0.0684	(0.0021)	0.0065	0.0379	0.0066
β_2	0.0144	0.0127	(0.0479)	0.0215	0.0003

Note: *, ** and *** represent the level of significance at 10%, 5% and 1% respectively.

This existence of heteroscedasticity and volatility clustering proves the presence of the ARCH effect. The results also conclude that the OLS is not adequate for the daily return modelling.

Table 2 shows the outcomes of coefficient estimation of the ARCH (1) model, AIC and SIC value. The results from the mean return equation show that there are no significant dummy coefficients, hence proving that there is no significant difference in the daily returns of all stock indexes during the new moon and FM period and other periods (in days). Furthermore, the results also show that the coefficient of the returns is significant for all countries, with a one-day lag (R_{t-1}) excluding Indonesia. This shows that the stock returns of the present day are dependent on the stock returns of the previous day.

Table 3 represents the outcomes for the full moon and NM period, obtained from the variance and mean return equations of the GARCH (1,1) model. The results from the mean return equation show that the pattern is identical to the ARCH (1) model with the coefficient of return of a one-day lag (R_{t-1}) having a level of significance of 0.01 ($\alpha < 1\%$) in all countries excluding Indonesia. The results of the variance equation show that the FM period (Φ_2) has significant negative effect in Indonesia and Saudi Arabia. Meanwhile, the NM period (Φ_1) has significant negative effect in Saudi Arabia and Bahrain, but positive effect in Malaysia. Saudi Arabia is the only country showing the significant volatility effect during both FM and NM periods. In contrast, there was no volatility effect shown in the UAE. Malaysia has the highest significant result of volatility during a new mood period, i.e., 0.0243, whereas Saudi Arabia has the lowest value during an FM period, i.e., −0.0707. Though not consistent for all countries, the significant negative effect indicates that during the FM or NM periods the Islamic stock market tends to have lower volatility except for Malaysia. The findings of the FM effect are supporting the study of Liu et al. (2009) and Brahman et al. (2012) for some observed markets. Furthermore, the β values for all countries are higher than α values, which indicates that the volatility from previous conditions has a huge influence on the current volatility as compared to the past market shocks. The sum of the coefficients of ARCH and GARCH ($\alpha_1 + \beta_1$) is found to be positive without a constant term (ω). This shows that it is statistically significant because the coefficients possess no negative values ($\alpha_1 > 0$, $\beta_1 > 0$) and the values are near to one. Hence, proving that, in all countries, the conditional

Table 2: Regression Results for the ARCH (1) Model

		UAE	Malaysia	Saudi Arabia	Indonesia	Bahrain
Mean Equation	ω	0.0458	0.0127	0.0229	0.0280	(0.0081)
	π_1	(0.0158)*	0.1112***	0.2566***	0.0087	0.0989***
	Φ_1	(0.0060)	(0.0143)	0.0058	(0.0111)	0.0126
	Φ_2	(0.0315)	0.0076	(0.0785)	(0.0186)	0.0016
Variance Equation	ω	1.1720***	0.2074***	0.6984***	0.5841***	0.1594***
	α_1	0.3404***	0.1715***	0.4141***	0.3766***	0.1964***

Note: *, ** and *** represent the level of significance at 10%, 5% and 1% respectively.

Table 3: Regression Results for the GARCH (1, 1) Model

		UAE	Malaysia	Saudi Arabia	Indonesia	Bahrain
Mean Equation	ω	0.0091	0.0149	0.0530***	0.0101	(0.0047)
	π_1	0.0878***	0.0997***	0.1709***	0.0330	0.0705***
Variance Equation	ω	0.0308**	0.0037	0.0769***	0.0217***	0.0367***
	Φ_1	0.0181	0.0243***	(0.0523)***	(0.0016)	(0.0168)***
	Φ_2	0.0353	0.0071	(0.0707)***	(0.0258)**	(0.0039)
	α_1	0.1213***	0.0818***	0.1546***	0.1012***	0.1250***
	β_1	0.8534***	0.8749***	0.8118***	0.8842***	0.7152***
	$\alpha_1 + \beta_1$	0.9747	0.9567	0.9664	0.9854	0.8402

Note: *, ** and *** represent the level of significance at 10%, 5% and 1% respectively.

volatility is constant and the volatility shocks are extreme. This means that huge modifications in the conditional variance tend to follow the huge modifications, and the same scenario goes with the small modifications (Mandelbrot, 1963; Fama, 1965).

Table 4 represents the results for the full moon and NM period obtained from the mean return and variance equations of the GARCH-M (1, 1) model. The results from the mean return equation show that the pattern is identical to the ARCH (1) and GARCH (1, 1) models. In accordance with the GARCH (1, 1) model, the results from the variance equation show that effect of the full and new moon days on volatility is present. Similarly, the significant negative effect appears in Saudi Arabia, Indonesia and Bahrain for the FM or NM periods, but positive effect for the NM period in Malaysia. It means that Islamic stock market tends to have lower volatility during the full or new moon, except for Malaysia. As for the risk premium, all studied countries have positive and statistically significant risk premium values except Bahrain. This shows that for the additional risk exposure, the investors demand a high-risk premium. Furthermore, the β values for all countries are greater as compared to α values, which indicates that the volatility from previous conditions has a huge influence on the current volatility as compared to the past market shocks. Without the constant term (ω), the sum of the coefficients of ARCH and GARCH ($\alpha_1 + \beta_1$), came out to be positive. This shows that it is statistically significant because the coefficients possess no negative values ($\alpha_1 > 0$, $\beta_1 > 0$) and the values are near to one. Hence proving that, in all countries, the conditional volatility is constant and volatility shocks are extreme.

4.4. Model Selections

Objective 2: To compare and contrast all models for analyzing the returns and volatility of returns for the stock market returns of Islamic countries.

Model for returns is determined by using the outcomes of the AIC, SIC and log-likelihood for OLS and ARCH (1) models as represented in Table 5. The analysis of model selection is conducted on OLS and ARCH (1) models for comparison.

The outcomes from the log-likelihood indicate that the ARCH (1) model has a greater value than the OLS model, showing that the model is fit for all countries.

Table 4: Regression Results for the GARCH-M (1,1) Model

		UAE	Malaysia	Saudi Arabia	Indonesia	Bahrain
Mean Equation	ω	(0.1397)**	(0.1065)**	(0.0568)	(0.1167)**	(0.0293)
	π_1	0.0833***	0.0998***	0.1714***	(0.0317)	0.0700***
	λ	0.1527**	0.2755***	0.1402**	0.1814***	0.0594
Variance Equation	ω	0.0343***	0.0040	0.08162***	0.0240***	0.0362***
	Φ_1	0.0107	0.0229***	(0.0568)***	(0.0029)	(0.0171)***
	Φ_2	0.0297	0.0064	(0.0748)***	(0.0224)*	(0.0043)
	α_1	0.1206***	0.0828***	0.1575***	0.1127***	0.1238***
	β_1	0.8536***	0.8746***	0.8060***	0.8702***	0.7195***
	$\alpha_1 + \beta_1$	0.9742	0.9574	0.9635	0.9829	0.8433

Note: *, ** and *** represent the level of significance at 10%, 5% and 1% respectively.

Table 5: Results of AIC, SIC and Log-likelihood for OLS and ARCH (1) Model

Model		UAE	Malaysia	Saudi Arabia	Indonesia	Bahrain
OLS	AIC	3.3790	1.4474	2.9507	2.7069	1.2252
	SIC	3.3883	1.4568	2.9600	2.7104	1.2346
	Log-likelihood	(4,239.9980)	(1,783.5150)	(3,706.4470)	(3,311.9990)	(1,502.946)
ARCH (1)	AIC	3.2684	1.4187	2.7896	2.6038	1.1741
	SIC	3.2823	1.4328	2.8035	2.6180	1.1882
	Log-likelihood	(4,099.0710)	(1,746.0880)	(3,501.9640)	(3,183.6860)	(1,438.8247)

Table 6: Results of AIC, SIC and Log-likelihood for the GARCH (1, 1) and GARCH-M (1, 1) Model

Model		UAE	Malaysia	Saudi Arabia	Indonesia	Bahrain
GARCH (1, 1)	AIC	3.0515	1.3267	2.6230	2.4328	1.1439
	SIC	3.0678	1.3431	2.6289	2.4494	1.1605
	Log-likelihood	(3,825.7280)	(1,631.4250)	(3,291.3840)	(2,973.1900)	(1,400.0370)
GARCH-M (1, 1)	AIC	3.0503	1.3243	2.6219	2.4306	1.1446
	SIC	3.0688	1.3432	2.6402	2.4496	1.1635
	Log-likelihood	(3,823.0550)	(1,627.4550)	(3,289.0020)	(2,969.5080)	(1,399.9150)

The AIC and SIC support this result showing that the ARCH (1) model is the ideal model for all countries. Hence, it is summarized from the results of both AIC and log-likelihood that for returns, the ARCH (1) model is considered the best-fit model.

For volatility model, GARCH (1, 1) and GARCH-M (1, 1) are compared as in Table 6. The outcomes from the log-likelihood indicate that the addition of the risk premium coefficient in the GARCH-M (1, 1) equation makes the value of the GARCH-M (1, 1) model higher as compared to the GARCH (1,1) model. This makes the model the best fit for all countries. Based on the results of AIC, GARCH-M (1, 1) model is the ideal model for all countries, whereas, the GARCH (1, 1) model is the ideal model for all countries depending on the results of SIC. Hence, it is summarized from the results of both AIC and log-likelihood that for returns, the ARCH (1) model is considered as the best-fit model.

Finally, the ARCH-LM test is conducted again for the validation of the OLS, ARCH (1), GARCH (1, 1) and GARCH-M (1, 1) models. The test results show that no ARCH effect exists for the level of significance of 1%, 5% and 10% for ARCH (1), GARCH (1, 1) and GARCH-M (1, 1) models, respectively. Hence, it is clear that the ARCH (1), GARCH (1, 1) and GARCH-M (1, 1) models have eliminated the presence of the ARCH effect in residual series.

5. Conclusion

The purpose of this article is to examine how the presence of the lunar effect influences the stock market returns and volatilities of the selected Islamic countries. By using the OLS, ARCH, GARCH and GARCH-M, similar with Nguyen and Nguyen (2019), it can be concluded that the ARCH-GARCH family can be better used in measuring return and risk forecasting compared to the OLS. In terms of return, the outcomes of this article are persistent with the studies conducted in the past, which show that the mean daily returns during the NM period are higher as compared to the returns during the FM period for all of the selected countries excluding Malaysia. As far as the volatility is concerned, the results show that the conditional volatility is consistent and volatility shocks are extreme in all countries. This finding indicates that Islamic stock market tends to have lower volatility during the full or new moon, except for Malaysia. The reason for this is the dependability of stock market returns on different factors. For instance, trade difference between sellers and buyers causes the stock prices to rise or fall, which ultimately results in the variability of returns. The number of active investors reduces in a country where the volatility of stock returns is higher as compared to a country having lower volatility of stock returns. There is an irregular relationship between the stock returns and volatility, which is classified into two terms, i.e., short-term and longer-term relations. Longer-term fluctuations establish a positive relationship between the returns and volatility because they require a risk premium to bear more risks. The relationship between stock volatility and returns is negative when there is a short-term fluctuation. This is because of two reasons. Firstly, the level of uncertainty is high, which decreases the number of trainee investors because the risk consciousness is at its peak. Secondly, high levels of negative emotions in the market lead to a decrease in returns. Most of the investors are now taking benefits of the calendar anomalies (including the lunar effect, weekend effect and the turn-of-the-year effect), which help in reducing the abnormal returns.

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