Ramadan Effect: A Structural Time-Series Test

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Abstract

This study investigates whether religious belief creates stock market return seasonality, focusing on the Muslim holy month “Ramadan". We use long-term data from 12 stock markets in countries with a high Muslim majority. Using a structural time-series model that takes into account a “trend component" and a stochastic “seasonal component”, we find no significant evidence of Ramadan return seasonality for the 12 stock markets over the long-term. This result suggests that there is no trend component for Ramadan effect and that Ramadan returns seasonality vanish in the long-term.

Keywords: religiosity, seasonality, Ramadan, risk, returns

1. Introduction

Religion can influence investors’ behaviour (e.g., Durand et al. 2013, Canepa and Ibnrubbian, 2014, Al-Awadhi and Dempsey, 2017) and may lead to stock market return seasonality (e.g., Frieder and Subrahmanyam, 2004, Białkowski et al., 2012).

Earlier research show that stock markets in Muslim societies experience returns sesonality associated with the Islamic holy month of “*Ramadan*" (Al-Hajieh et al., 2011, Bialkowski et al., 2012, Al-Khazali, 2014). It is stated that the religious experience of Muslim investors during *Ramadan* leads to a positive sentiment and moves the market to higher returns. However, there are two main issues with this argument. First, the findings are inconsistent in relation to the appearance of “*Ramadan*" return seasonality with long-term data (Note 1) in markets with a Muslim majority, such as Bahrain, Turkey, Egypt, Jordan, Kuwait, Qatar, Malaysia, Oman, Pakistan, Saudi Arabia, United Arab Emirates and Indonesia (e.g., Almudhaf, 2012, Bialkowski et al., 2012, Al-Khazali, 2014, Al-Awadhi, 2019). This inconsistency could be an outcome of not paying attention to the changes in market trends during financial crises (Hui, 2005, Al-Khazali, 2014). Second, previous studies suggest that “*Ramadan*" seasonality is an outcome of investors’ positive sentiment (Al-Hajieh et al., 2011, Białkowski et al., 2012, Al-Khazali, 2014). However, these studies lack of methodological tests for investors’ sentiment, which can result in incorrect conclusions (Shefrin, 2010).

Our study investigates stock market performance during *Ramadan* using a robust methodology for long-term data. This is achieved by applying a structural time-series model that takes into account a “trend component" and a stochastic “seasonal component". As far as we know, this is the first study of *Ramadan* return seasonality to use a structural time-series model. In addition, our research contributes to the Islamic calendar seasonality literature by revealing the truth of *Ramadan* seasonality using robust econometric techniques, covering a comprehensive data set of 12 major Muslim countries for the period 1995–2014.

Our main results are summarized as follows. Using long-term data and a structural time-series model, we find that none of the 12 markets in countries with a Muslim majority provide significant evidence of *Ramadan* return seasonality in terms of absolute returns.

The structure of this paper is divided as follows. The next section presents the literature review and hypotheses development. Section 3 illustrates the research methodology. Section 4 shows our data, and Section 5 discusses the results. Section 6 provides a further analysis. Lastly, Section 7 is the conclusion.

2. Literature Review and Hypothesis Development

The influence of religious days on stock market outcomes has been well-known in the finance literature. For example, in Christian and Jewish contexts, Frieder and Subrahmanyam (2004) find that a positive return on the S&P500 index is associated with Catholic Irish and Jewish religious days. (Note 2) In the Islamic context, studies have been conducted to understand stock market returns and volatility during *Ramadan*. For example, Husain (1998) examines *Ramadan* seasonality by studying the market volatility and Pakistani equity market returns. He finds that a significant drop in stock market volatility during *Ramadan* is not associated with a significant change in average returns. In addition, Seyyed et al. (2005) find that a decline in volatility in the Saudi Arabian stock market is not associated with a significant change in average returns during *Ramadan*. They argue that the decline in market volatility during *Ramadan* is associated with religious belief factors, because during *Ramadan*, people devote their time to socio-religious activities. Al-Hajieh et al. (2011) study stock markets in the Middle East by inspecting whether *Ramadan* is associated with positive calendar anomalies. They find positive calendar anomaly in six out of eight countries during *Ramadan* for the period 1992–2007, stock markets yield significant positive returns.

Recent studies have been conducted on *Ramadan* seasonality with longer-term data sets and wider contexts by including several stock markets with a Muslim majority. These cover the following 12 markets: Bahrain, Egypt, Jordan, Kuwait, Malaysia, Morocco, Oman, Pakistan, Qatar, Saudi Arabia, Turkey, and Indonesia (Almudhaf, 2012, Białkowski et al., 2012, Al-Khazali, 2014). In his study on the period 1996–2007, Almudhaf (2012) finds that *Ramadan* return seasonality exists in four of the 12 markets: Jordan, Kuwait, Pakistan, and Turkey. In contrast, Białkowski et al. (2012) find evidence of *Ramadan* return seasonality in the period 1989–2007 for nine of the 12 above-mentioned markets (the exceptions are Bahrain, Saudi Arabia, and Indonesia). However, Białkowski et al. (2012) derive their results without testing for the statistical significance of absolute returns. Shahid et al (2019) examine the returns of 107 firms listed on Pakistan stock exchange for a period of 20 years using GARCH (1,1) model and find that *Ramadan* effect develops gradually overtime. In their study on Palestine Stock Exchage, Hijazi and Tabash (2020) find that during Ramadan stocks retruns are remarkably affcted. In addition, they find a positive relationship between market values and stock returns during this holy month especially for investment and industrial firms. Munusamy (2019) studies the effect of *Ramadan* on return and volatility of the Shariah index in India using ordinary least squares method as well as GARCH modified models. He finds that the returns in the last ten days of *Ramadan* are positive and statistically significant. In terms of volatility, he finds that Ramadan effect does exist and affect volatility especially during the first ten days of Ramadan. On the other hand, Al-Khazali (2014) finds a weak existence of *Ramadan* return seasonality for the 12 markets during the period 1989–2012. Moreover, Hassan and Kayser (2020) find no effect of *Ramadan* on returns and volatility in Dhaka Stock Exchange.

Previous studies that have examined *Ramadan* seasonality suffer from a number of limitations, making it difficult to generalize their results. Firstly, none of the studies uses a model that specifically captures the consequences of financial crises on return seasonality. The failure to report for such consequences may guide to biased results of seasonality tests and, consequently, premature conclusions (Al-Khazali, 2014, Hui, 2005). Secondly, some previous studies examine the *Ramadan* seasonality effect using a single-country data set, which cannot be generalized to the Islamic world (Husain, 1998, Seyyed et al., 2005, Halari et al., 2015). Finally, a number of previous studies examine *Ramadan* seasonality effects for various markets by pooling the countries into one test, where different countries have different length data. Hence, the results may be adversely affected by outliers and cannot be generalized to all Islamic countries (Białkowski et al., 2012, Al-Ississ, 2015). To overcome these limitations, we test for the *Ramadan* seasonality effect using a model that captures changes in market trends due to financial crises (a structural time-series model) for each Muslim country and using a long-term data set.

Previous studies provide mixed results on whether countries with a Muslim majority yield positive stock market returns during Ramadan (Al-Hajieh et al., 2011, Almudhaf, 2012, Białkowski et al., 2012, Al-Khazali, 2014). Some of these studies claim that the holy month of Ramadan can have a optimistic impact on Muslim psychology (e.g., Al-Hajieh et al., 2011, Białkowski et al., 2012, Al-Khazali, 2014), and that investors' sentiment influences stock market outcomes (Edmans et al., 2007). However, there is no clear method of capturing Ramadan investors' sentiment yet. In fact, we lack a comprehensible description of sentiment in the field of behavioral finance. Shefrin (2010) recognizes that behavioral finance assumptions lack a unified and systematic testing approach, because this science is relatively new and, thus, certain results might be incorrect. This guides us to study the following hypothesis.

Hypothesis: Stock markets in countries with a Muslims majority have a positive absolute return seasonality associated with Ramadan.

3. Data

We avail of data from stock markets of countries with a Muslim majority and high levels of religiosity. Specifically: UAE, Bahrain, Egypt, Jordan, Kuwait, Malaysia, Oman, Pakistan, Qatar, Saudi Arabia, Turkey, and Indonesia. As shown in Table 1, these countries have a Muslim majority population and high levels of religiosity.

Table 1. Religious indicators in countries with a Muslim majority

Country	*Religiosity Index (2009)*	*Muslims to Total Total Population (%)*	*Total Population (million)*
Malaysia	96	61.4	28.4
Indonesia	99	87.2	239.87
Saudi Arabia	93	97.1	27.45
Turkey	68*	98	72.75
Qatar	95	77.5	1.76
Kuwait	91	86.4	2.74
UAE	91	76.0	7.51
Egypt	97	94.9	81.12
Pakistan	92	96.4	173.59
Jordan	93*	97.2	6.19
Oman	-	85.9	2.78
Bahrain	94	81.2	1.26

This table presents a religiosity index from the Gallup Survey in 2009 for countries with a Muslim majority. The table also presents the ratio of Muslims to the total population, and the total population, in millions, taken from the PEW Research Center 2011 report, "The Future of the Global Muslim Population". *The data for the religiosity index for Turkey and Jordan are taken from the World Values Survey 2010–2014.

Table 2 presents the summary statistics of the stock markets in our study for 2012. In terms of total market capitalization, Malaysia, Indonesia, and Saudi Arabia are the largest markets. Saudi Arabia has the highest trading value and turnover ratio of the 12 countries, while Malaysia has the greatest number of listed national firms of the 12 countries.

Table 2. Summary statistics of stock markets in countries with a Muslim majority

Country	*Market Cap ($bn)*	*Market Cap (% of GDP)*	*Trading Value (% of GDP)*	*Stock Turnover Ratio (%)*	*Number of Listed Companies*
Malaysia	476	156	40.8	28.6	921
Indonesia	397	43	10.0	23.3	459
Saudi Arabia	373	51	70.1	144.4	158
Turkey	309	39	44.2	136.5	405
Qatar	126	67	8.1	12.2	42
Kuwait	97	56	13.2	23.2	189
UAE	68	18	4.7	25.3	102
Egypt	58	22	7.7	37.8	234
Pakistan	44	19	5.3	31.3	573
Jordan	27	87	9.0	10.3	243
Oman	20	26	3.5	13.3	124
Bahrain	16	52	1.0	1.9	43

This table compares the stock markets in countries with a Muslim majority population in 2012. The market capitalization of listed companies is expressed in USD billion, and are based on listed domestic companies. The market capitalization of listed companies as a percentage of GDP is also based on listed domestic companies. The stocks traded value is calculated as the total value of shares traded during the year divided by the GDP for the year. The stocks traded turnover ratio is calculated as the total value of shares traded in the year divided by the average market capitalization for the year, and the number of listed companies includes only domestic companies. Data are taken from the World Bank database.

We use S&P index prices taken from Thomson Datastream for the 12 countrires of our study. These indices have different establishmnet dates (Table 3). We transform the daily data from the *Gregorian* to the Islamic calendar to facilitate our tests. Islamic calendar consists of 12 months: (1) Muharram, (2) Safar, (3) Rabia Awal, (4) Rabia Thani, (5) Jumaada Awal, (6) Jumaada Thani, (7) Rajab, (8) Sha'ban, (9) Ramadan, (10) Shawwal, (11) Dhul-Qi'dah, (12) Dhul-Hijjah.

Table 3. The dates S&P indices were established

Country	*Date Established (Gregorian)*	*Date Established (Islamic Lunar)*	*Number of Ramadan Observations*
Bahrain	01/05/2000	26/01/1421	14
UAE	03/01/2005	22/11/1425	9
Egypt	14/07/2006	18/06/1427	8
Jordan	30/06/1995	02/02/1416	19
Kuwait	03/01/2005	22/11/1425	9
Malaysia	30/06/1989	27/11/1409	25
Oman	19/04/2000	14/01/1421	14
Pakistan	30/06/1995	02/02/1416	19
Qatar	31/12/2004	19/11/1425	9
Saudi Arabia	31/12/1997	02/09/1418	17
Turkey	17/07/2006	21/06/1427	8
Indonesia	17/07/2006	21/06/1427	8

This table presents the dates each of the S&P indices were established, following both the *Gregorian* and the Islamic lunar (*Hijri*) calendars, and the number of *Ramadan* months available in our data for each index, from the date the index was established to 30/12/1435 *Hijri* (25/10/2014 *Gregorian*).

The equality tests of means, medians, and variances for the annualized *Ramadan* days returns and for the rest of the year are shown in Table 4. Panel A of Table 4 shows that Jordan and Pakistan are the only countries that exhibits significantly higher returns during *Ramadan* at the mean level. At the median level, Panel B of Table 4 shows that during *Ramadan*, UAE, Jordan and Pakistan exhibit significantly higher returns.

Table 4. Summary statistics and equality tests

Panel A: Mean Equality Test			
Country	*Ramadan Days (%)*	*Rest of the Year (%)*	*P-Value (t-test)*
Bahrain	3.38	44.08	(0.77)
UAE	61.10	-1.04	(0.13)

Egypt	27.67	6.47	(0.61)
Jordan	43.82	3.28	(0.04)
Kuwait	22.32	-2.63	(0.42)
Malaysia	2.17	5.25	(0.84)
Oman	13.92	8.68	(0.80)
Pakistan	66.29	4.80	(0.01)
Qatar	34.18	7.88	(0.48)
Saudi Arabia	21.14	9.68	(0.69)
Turkey	23.82	10.42	(0.69)
Indonesia	28.40	12.69	(0.64)
Panel B: Median Equality Test			
Country	*Ramadan Days (%)*	*Rest of the Year (%)*	*P-Value (Wilcoxon/Mann-Whitney)*
Bahrain	2.49	2.78	(0.92)
UAE	79.72	18.19	(0.02)
Egypt	80.76	28.50	(0.50)
Jordan	17.55	-5.61	(0.04)
Kuwait	35.04	5.79	(0.17)
Malaysia	7.91	8.23	(0.61)
Oman	28.18	12.03	(0.32)
Pakistan	30.91	16.72	(0.02)
Qatar	50.00	19.75	(0.28)
Saudi Arabia	22.45	26.53	(0.53)
Turkey	54.61	15.77	(0.79)
Indonesia	40.92	32.52	(0.44)

Summary statistics and equality tests of the index annualized returns (in percent), based on the 12 Islamic lunar calendar months, from the date each index was established to 30/12/1435 *Hijri* (25/10/2014 *Gregorian*). The column *Ramadan Days* shows the percentage for the days of the ninth month of the Islamic lunar calendar. The p-values of the median equality test in Panel B correspond to a Wilcoxon/Mann-—Whitney signed rank median test.

4. Methodology

Previous studies suggest that changes in a market trend component (e.g., a financial crisis) may affect seasonality tests that cover long-term data, leading to incorrect conclusions if the model is not able to capture the trend movement (Al-Khazali, 2014, Hui, 2005). To avoid this problem, we test for long-term *Ramadan* return seasonality, while allowing for trend elements to be captured using a structural time-series model. Several studies have tested for stock market seasonality using structural time-series models (e.g., Fraser, 1992, Priestley, 1997, Al-Saad, 2005). Structural time-series models contain four elements: trend, cycle, season, and a random element. Here, we are interested in testing the trend and the seasonal elements of stock market returns, which is achieved by applying the structural time-series model with an autoregressive element (Harvey, 1990, Harvey, 1997) and a maximum likelihood estimation, while updating the state vector by applying a Kalman filter:

$$R_t = \mu_t + \alpha_t R_{t-1} + \gamma_t + \varepsilon_t, \tag{1}$$

where R_t is the average continuous return of an index for month t, μ_t is the trend element that captures the long-term movement, α_t is the coefficient of the first-order autoregressive component, R_{t-1}, γ_t is the seasonal element, and ε_t is a random variable, assuming $\varepsilon \sim NID(0, \sigma_\varepsilon^2)$. The trend μ_t is a random walk with a drift factor:

$$\mu_t = \mu_{t-1} + \beta_{t-1} + \eta_t, \tag{2}$$

where

$$\beta_t = \beta_{t-1} + \xi_t, \tag{3}$$

with $\eta \sim NID(0, \sigma_\eta^2)$ and $\xi \sim NID(0, \sigma_\xi^2)$. Here, β_t is derived from an autoregressive process, as in equation (3). In this model, the trend is deterministic if the variances of η and ξ are equal to zero. In structural time-series models, a seasonal element γ_t may have several specifications (Harvey, 1990). For a direct interpretation of the seasonal element, we use the specification of stochastic dummies, following (Al-Saad and Moosa, 2005):

$$\gamma_t = -\sum_{j=1}^{s-1} \gamma_{t-j} + \kappa_t, \tag{4}$$

where s is the number of seasons in each year (12 months), and $\kappa_t \sim NID(0, \sigma_\kappa^2)$.

5. Results

To allow for a possible change in a "trend component", while examining for a "seasonal component" that can be stochastic, we apply a structural time-series seasonality test, as in (Harvey and Scott, 1994). Here, we apply the average continuous daily returns for each Islamic lunar calendar month for each index between the date the index was established and 30/12/1435 *Hijri* (25/10/2014 *Gregorian*).

The figures for the trend and seasonal components using the *Hijri* calendar are presented in Appendix I. Figures 2–13 confirm that the stock market return trend has been changing in the majority of the markets in our study, especially during the period 1429–1430 *Hijri* (2008–2009 Georgian). Table 5 shows the estimation results of the final state vector using a structural time-series model, where $Level$ is the estimated level of the trend in the series, α_t is the coefficient of the first-order autoregressive component, $Slope$ is similar to the coefficient of the intercept in classic models, $S1$ is the seasonal term corresponding to the 12th month of the Islamic calendar, *Dhul-Hijjah*, $S2$ is the seasonal term corresponding to the 11th month of the Islamic calendar, *Dhul-Qi'dah*, and so on, and $S4$ is the seasonal coefficient for *Ramadan*. Panel B in Table 5 reports the results of the goodness of fit measures. Thus, R_s^2 is the seasonal mean coefficient of determination, *SE* is the standard error of the estimates, *DW* is the Durbin–Watson autocorrelation test, and Q is Ljung1978's (Ljung1978) autocorrelation test.

The results of the goodness of fit measures suggest that the model is fairly determined. The results of the structural time-series seasonality test are consistent with the classic dummy variable test for all markets, except Jordan and Pakistan. Thus, over the long term, no significant evidence of *Ramadan* return seasonality for any of the 12 markets. These results contrast with those of (Białkowski et al., 2012), but are similar to those of (Al-Khazali, 2014). We conclude that the trend component does not significantly impact our results, and that *Ramadan* return seasonality does not appear to influence absolute returns in the markets of countries with a Muslim majority.

Table 5. Results of the structural Time-Series Model

Panel A: Final-State Vector												
	Bahrain	**UAE**	**Egypt**	**Jordan**	**Kuwait**	**Malaysia**	**Oman**	**Pakistan**	**Qatar**	**Saudi Arabia**	**Turkey**	**Indonesia**
Level	0.02	0.08	0.03	-0.07	0.06	0.05	-0.05	0.13	0.13	0.22	0.04	0.02
	(0.05)	(0.10)	(0.08)	(-0.24)	(0.14)	(0.45)	(-0.12)	(0.57)	(0.21)	(0.60)	(0.16)	(0.07)
α_t	-0.26	0.00	-0.22	0.00	0.00	0.00	-0.21	0.00	0.00	0.00	0.00	-0.01
	(-0.53)	(0.00)	(-0.31)	(.NaN)	(0.00)	(.NaN)	(-0.56)	(0.00)	(0.00)	(0.00)	(.NaN)	(-0.03)
Slope	0.00	-0.02	0.00	0.00	-0.01	0.00	0.00	0.00	-0.01	0.00	0.00	0.00
	(0.15)	(-0.44)	(-0.25)	(0.01)	(-0.37)	(-0.15)	(0.21)	(0.29)	(-0.51)	(0.21)	(-0.47)	(-0.41)
S1	-0.10	-0.30	-0.15	-0.01	-0.19	0.02	-0.02	0.00	-0.16	0.04	-0.24	-0.22
	(-1.20)	(-1.55)	(-0.63)	(-0.08)	(-1.34)	(0.24)	(-0.18)	(0.03)	(-0.86)	(0.27)	(-1.51)	(-1.17)
S2	0.09	0.17	0.19	0.01	0.11	-0.10	0.14	-0.17	0.08	0.19	0.06	0.17
	(1.09)	(0.90)	(0.79)	(0.18)	(0.80)	(-1.35)	(1.20)	(-1.31)	(0.45)	(1.33)	(0.39)	(0.90)
S3	-0.11	-0.35**	-0.25	-0.16	-0.17	0.01	-0.08	-0.16	0.22	0.01	0.03	0.03
	(-1.50)	(-2.27)	(-1.27)	(-1.96)	(-1.27)	(0.17)	(-0.78)	(-1.27)	(1.28)	(0.07)	(0.17)	(0.18)
S4	0.02	-0.02	-0.01	-0.06	0.05	-0.07	-0.05	-0.06	-0.11	0.03	-0.06	-0.10

	(0.24)	(-0.13)	(-0.06)	(-0.73)	(0.41)	(-1.02)	(-0.44)	(-0.43)	(-0.64)	(0.19)	(-0.38)	(-0.61)
S5	0.13	-0.06	0.2	0.15*	0.10	0.04	0.16*	-0.02	0.23	0.15	0.22	0.33**
	(1.8)	(-0.44)	(1.09)	(1.92)	(0.77)	(0.55)	(1.66)	(-0.15)	(1.31)	(1.07)	(1.38)	(2.26)
S6	-0.03	0.06	-0.2	0.04	0.08	0.03	0.05	0.03	0.03	0.25*	-0.07	-0.08
	(-0.34)	(0.4)	(-1.06)	(0.45)	(0.64)	(0.40)	(0.48)	(0.21)	(0.18)	(1.76)	(-0.44)	(-0.54)
S7	0.03	-0.15	0.27	0.11	0.12	-0.09	-0.15	0.15	0.13	-0.20	0.03	0.07
	(0.44)	(-1.07)	(1.5)	(1.31)	(0.89)	(-1.25)	(-1.5)	(1.12)	(0.73)	(-1.4)	(0.16)	(0.49)
S8	-0.04	0.01	-0.12	0.12	-0.13	-0.03	-0.05	-0.03	-0.08	0.12	0.07	-0.11
	(-0.49)	(0.06)	(-0.69)	(1.56)	(-1)	(-0.37)	(-0.54)	(-0.23)	(-0.48)	(0.88)	(0.44)	(-0.76)
S9	0.07	-0.07	-0.24	0.17**	0.10	0.10	-0.09	-0.09	0.11	0.23	-0.09	-0.12
	(0.97)	(-0.50)	(-1.33)	(2.08)	(0.75)	(1.31)	(-0.89)	(-0.65)	(0.65)	(1.63)	(-0.58)	(-0.84)
S10	0.01	-0.36**	-0.13	-0.02	-0.08	0.06	-0.15	-0.04	-0.39**	-0.24*	-0.16	-0.20
	(0.13)	(-2.53)	(-0.7)	(-0.27)	(-0.57)	(0.81)	(-1.54)	(-0.34)	(-2.26)	(-1.74)	(-0.99)	(-1.37)
S11	0.02	-0.25**	0.08	-0.04	0.03	-0.02	-0.10	-0.13	-0.05	0.05	-0.1	-0.16
	(0.3)	(-2.48)	(0.62)	(-0.78)	(0.31)	(-0.30)	(-1.29)	(-1.41)	(-0.41)	(0.46)	(-0.84)	(-1.54)
Panel B: Goodness-of-Fit Measures												
T	179	122	102	239	122	314	180	239	122	208	103	103
p	5	5	5	5	5	5	5	5	5	5	5	5
Std Error	0.76	1.29	1.33	0.90	1.06	0.89	0.93	1.39	1.40	1.42	1.06	1.07
Normality	3.77	1.55	2.13	40.44	8.00	88.32	39.53	92.59	5.82	27.42	2.53	45.09
H(55)	0.96	0.56	0.63	1.96	0.24	0.39	0.54	1.05	0.26	2.01	0.29	0.13
DW	1.79	1.79	1.88	1.86	1.79	1.71	2.13	1.80	1.92	1.83	1.95	1.96
r(1)	0.10	0.07	0.00	0.07	0.09	0.14	-0.08	0.10	0.00	0.08	0.00	0.01
q	24	24	24	24	24	24	24	24	24	24	24	24
r(q)	0.04	0.05	-0.04	0.07	-0.10	0.09	0.00	-0.02	0.07	0.10	-0.05	-0.16
Q(q, q-p)	15.80	40.84	14.65	27.92	17.87	85.42	34.81	31.29	13.43	62.69	21.31	15.00
R_s^2	0.35	0.28	0.48	0.43	0.41	0.43	0.37	0.46	0.42	0.46	0.54	0.48

The table shows the results of the final state vector using a structural time-series model. Here, $Level$ is the estimated level of the trend in the series, α_t is the coefficient of the first-order autoregressive component, $Slope$ is similar to the coefficient of the intercept in classic models, $S1$ is the seasonal term corresponding to the first Islamic calendar month (Muharram), $S2$ is the seasonal term corresponding to the second Islamic calendar month (Safar), and so on. Panel B reports the results of the goodness of fit measures. Here, R_s^2 is the seasonal mean coefficient of determination, *SE* is the standard error of the estimates, *DW* is the Durbin–Watson autocorrelation test, and Q is Ljung's (1978) autocorrelation test.

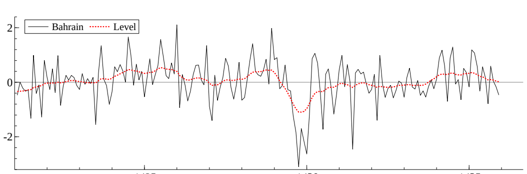

Figure 1. Observed returns and trend for Bahrain

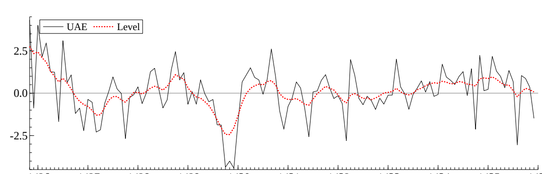

Figure 2. Observed returns and trend for UAE

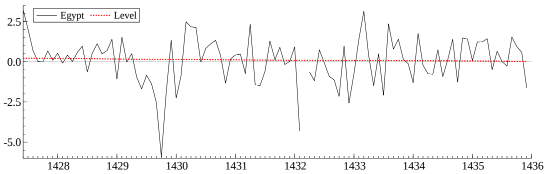

Figure 3. Observed returns and trend for Egypt

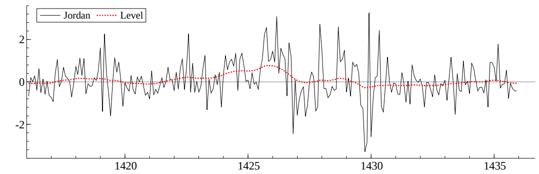

Figure 4. Observed returns and trend for Jordan

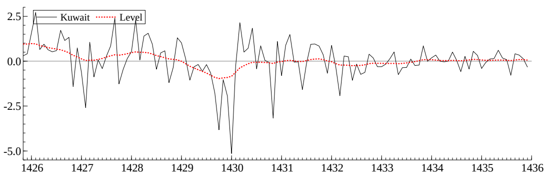

Figure 5. Observed returns and trend for Kuwait

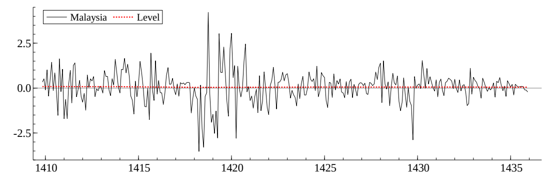

Figure 6. Observed returns and trend for Malaysia

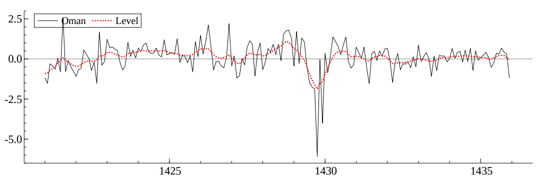

Figure 7. Observed returns and trend for Oman

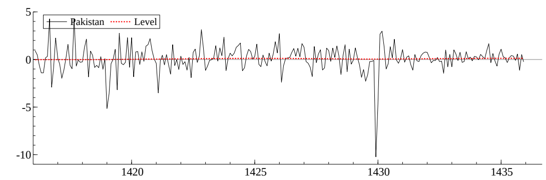

Figure 8. Observed returns and trend for Pakistan

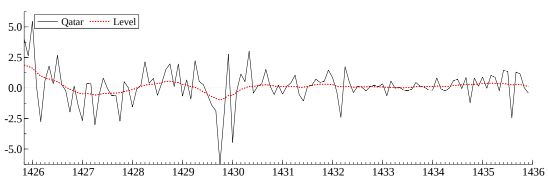

Figure 9. Observed returns and trend for Qatar

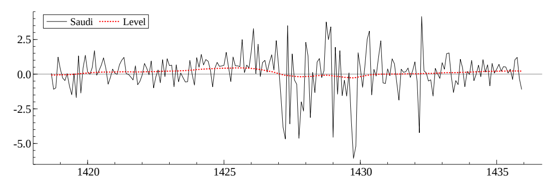

Figure 10. Observed returns and trend for Saudi

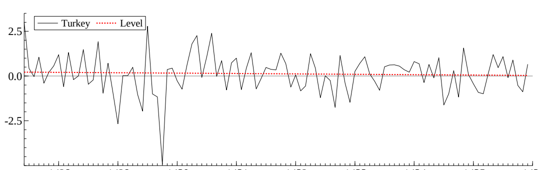

Figure 11. Observed returns and trend for Turkey

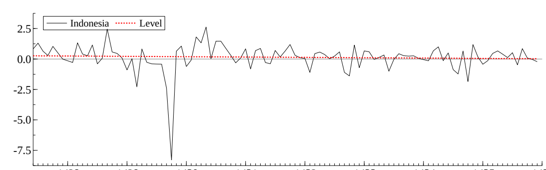

Figure 12. Observed returns and trend for Indonesia

6. Conclusion

Our study examines the existence of absolute *Ramadan* return seasonality, based on long-term data. Using annualized returns and standard seasonlaity test structural time-series model that takes into account a “trend component" and a stochastic “seasonal component”, we find that none of the 12 markets in countries with a Muslim majority provide significant evidence of *Ramadan* return seasonality in terms of absolute returns. These results lead us to conclude that i) there is no change in stock prices during *Ramadan* and ii) reject the hypothesis of positive investors’ sentiment or positive equity evaluations during *Ramadan*, as suggested by previous studies. The main weakness of this study is that it does not consider subperiods of the holy month, and future researchers may take this issue into account by implementing a structural time-series model on sub-periods of *Ramadan* such as first 10 days, next 10 days and last 10 days.

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Notes

Note 1. Studies examining the Ramadan return seasonality using long-term data (the whole period of the available data set) and/or short-term data (that divide the data set into sub-periods).

Note 2. Specifically, they tested the holy days of *Rosh Hashanah* and *Yom Kippur* for the Jewish religion, and St. Patrick's Day for the Catholic Irish.