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Feedback Trading and the Ramadan Effect in Frontier Markets

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Abstract

We examine the presence of the Ramadan effect in feedback trading drawing on a sample of eleven majority Muslim markets for the period of 29/6/2001 to 1/8/2016. Feedback trading is significant in several of these markets, appearing stronger outside, rather than within, Ramadan. These results hold for the full sample period, including before and after the global financial crisis raising the possibility that Ramadan's widely documented lower volatility is related to the reduced presence of feedback trading during that month. We attribute our findings to Ramadan's traditionally documented low volumes rendering feedback trading less feasible during that month.

Keywords: Feedback trading, Ramadan effect, frontier markets

1. Introduction

The role of religion in investors' behaviour has to date been investigated for a wide cross section of investment decisions, including saving (Guiso et al., 2003; Keister, 2003; Renneboog and Spaenjers, 2012), equity investing (Kumar, 2009; Kumar et al., 2011; Louche et al., 2012; Renneboog and Spaenjers, 2012), herding (Gavriilidis et al., 2016) and risk taking (Kumar, 2009; Dohmen et al., 2011; Kumar et al., 2011; Renneboog and Spaenjers, 2012; Noussair et al., 2013).In the above context, this study investigates for the first time the effect of religion over feedback trading, by exploring whether the latter is subject to the well-documented Ramadan effect (Białkowski et al., 2012). Feedback trading is a behavioural investment pattern with established popularity among investors internationally (Choi and Skiba, 2015) and the rationale underlying the study of its relationship with the Ramadan effect in this paper is that the month of Ramadan has been found to affect factors (social mood; volatility) that have been shown to interact significantly with feedback trading. Our study addresses this issue in the context of eleven majority Muslim markets, by first assessing whether they accommodate significant feedback trading and whether the latter manifests itself asymmetrically contingent on market performance. Second, we examine whether the presence of feedback trading in these markets varies within, compared to outside, Ramadan, in view of the growing literature on the Ramadan effect in stock exchanges of majority Muslim countries. Third, we investigate whether the presence of the Ramadan effect in these markets' feedback trading varies before and after the recent global financial crisis.

From a theoretical perspective, feedback trading refers to the universe of strategies relying on the identification of patterns in historical data, the latter mainly (but not exclusively) pertaining to price-series.[1] Key to feedback trading is the notion that prices exhibit inertia in their

[1]Technical analysis, perhaps the best-known facet of feedback trading practice, includes strategies often based on the combination of prices with other aggregate gauges, such as volume (Lo et al., 2000).

formation by generating trends over time (Farmer, 2002) and, as such, runs counter to the weak form of market efficiency (Fama, 1991). This is both because it views prices as entailing predictability in their structure (it is based on pattern recognition in price trends) and because it enhances it (trading on price trends can amplify serial correlation in the returns' structure; Cutler et al., 1990). Depending on the direction of its response to price trends, feedback trading can be positive (the case when investors choose to track a trend) or negative (the case of investors choosing to trade against a trend) and can be driven by a variety of factors. On many occasions, investors opt to feedback trade as a means of mitigating some risk or uncertainty in their environment. Feedback trading, for example, is often employed as a response to *information risk* when the past price sequences of stocks for which information is hard to either access or process are viewed as informative enough; this is the case, for instance, when trading small capitalization stocks (their publicly available information is scarce due to limited analysts' following)[2] and foreign stocks (foreign investors may view themselves at an informational disadvantage when trading overseas).[3]Widely employed strategies, including portfolio insurance (Kodres, 1994), margin trading (Sentana and Wadhwani, 1992; Watanabe, 2002; Hirose et al., 2009) and stop loss orders (Osler, 2005), which are triggered as a response to increased *downside risk* upon the violation of specific price thresholds during market declines, have also been found to be conducive to feedback trading. What is more, fund managers often resort to "window-dressing" by including recently outperforming stocks in their portfolios (in effect, positive feedback trading) in an attempt to improve their image as regards their stock selection skills and minimize the *career-/reputation-related risks* associated with holding losing stocks (Lakonishok et al., 1992).Aside from risk-mitigating considerations, feedback trading can also be driven by *rational speculators* (De Long et al., 1990) taking

[2] See, for example, Lakonishok et al. (1992), Wermers (1999), Sias (2004) and Voronkova and Bohl (2005).
[3] See, for example, Brennan and Cao (1997), Kang and Stulz (1997), Choe et al. (1999), Dahlquist and Robertson (2001), Froot et al. (2001), Kim and Wei (2002a, b), Kalev et al. (2008) and Lin and Swanson (2008).

advantage of their informational superiority by trading ahead of anticipated news' arrival and launching trends in the market, in order to induce their noise counterparts to ride on those trends with the intention of preying on them. Finally, feedback trading can also be motivated through price-based strategies, including *technical analysis* (Lo et al., 2000) and *style investing*, in particular momentum and contrarian trading (Galariotis, 2014).

Empirically, feedback trading has been found to constitute a very frequently encountered strategy among institutional investors internationally (Choi and Skiba, 2015). Evidence from the US denotes the presence of widespread (mostly positive) feedback trading among fund managers there (Lakonishok et al., 1992; Grinblatt et al., 1995; Nofsinger and Sias, 1999; Wermers, 1999; Sias, 2004; Froot and Teo, 2008; Choi and Sias, 2009;Frijns et al., 2016), with the evidence growing more extensive in studies covering more recent decades. Similar tendencies have been reported for fund managers in other markets, including Germany (Walter and Weber, 2006; Kremer and Nautz, 2013), Taiwan (Hung et al., 2010) and the UK (Wylie, 2005). Retail investors have also been found to feedback trade, yet evidence on the latter appears more mixed.[4]The effect of the Asian financial crisis over feedback trading in Asian markets is rather unclear. Evidence in support of stronger positive feedback trading among foreign funds in South Korea before (after) the Asian crisis' outbreak has been reported by Choe et al. (1999) (Kim and Wei, 2002a, b), while Bowe and Domuta (2004)showed that feedback trading was largely insignificant among both foreign and domestic investors in Indonesia both within and outside the Asian crisis. At the market level, a multitude of studies (Sentana and Wadhwani, 1992; Koutmos, 1997; Koutmos and Saidi, 2001; Watanabe, 2002; Koutmos et al., 2006; Bohl and Siklos, 2008) have showcased that positive feedback trading is

[4] Significant negative feedback trading has been reported for retail investors in Australia (Colwell et al., 2008) and Finland (Grinblatt and Keloharju, 2000), no feedback trading has been discovered among retail traders in China (Feng and Seasholes, 2004), while Dorn et al. (2008) found that German retail investors' market orders (executed limit orders) were associated with positive (negative) feedback trading.

prolific internationally, giving rise to negative first-order autocorrelation, whose magnitude rises with volatility. As a result, positive feedback trading increases during high volatility periods, with most of the above studies also finding that it appears stronger during down, compared to up, markets (i.e. is directionally asymmetric). In addition, the significance of feedback trading has been found to vary with changes in the institutional environment; the introduction of index (Antoniou et al., 2005) and single stock futures (Chau et al., 2008) has been found to dampen positive feedback trading in the underlying spot segments of developed markets internationally, while the ownership liberalization reforms in Chinese equity markets[5] have led to a reduction in their positive feedback trading (Schuppli and Bohl, 2010). Recent evidence further indicates that positive feedback trading is more prevalent during periods of optimistic sentiment in index futures (Kurov, 2008), ETF(Chau et al., 2011)and equity (Hu et al., 2015) markets, while Chau and Deesomsak(2015) produced evidence in support of its presence growing more significant during periods of economic expansion in developed equity markets.

We now turn to the Ramadan month and how it has been found to affect stock markets in majority Muslim countries. To begin with, Ramadan is the ninth month of the Islamic (also known as "Hegirian") calendar, the latter consisting of twelve months whose identification is based strictly on lunar cycles.[6]As a result, the Islamic calendar is shorter than the Gregorian one (the one used by most countries internationally, based on solar cycles) by around eleven days, leading the mapping of each month of the Islamic calendar on the Gregorian one to shift by around two weeks each year.[7] Ramadan is a month during which Muslims practice fasting

[5] These reforms pertain to the opening of A-shares to Qualified Foreign Institutional Investors (QFIIs) in November 2002 and B-shares to domestic investors in February 2001.
[6] The twelve months are: Muharram, Safar, Rabi I, Rabi II, Jumada I, Jumada II, Rajab, Sha'ban, Ramadan, Shawwal, Dhu al-Qa'da and Dhu al-Hijja; see Al-Khazali (2014).
[7] With each lunar cycle lasting approximately 29-30 days, the Islamic year contains354 days (as opposed to 365 of the Gregorian one); as a result, each month of the Islamic calendar falls around eleven days earlier in each successive solar year (i.e. year of the Gregorian calendar). For more on this, see Al-Hajieh et al. (2011).

during day light, while also refraining from smoking and other sensual pleasures. Praying is central to this month (with mosques holding special prayers, known as “Tarawih”, every night during the Ramadan) as is reading the entire Qur’an (Al-Hajieh et al., 2011). The atmosphere permeating Ramadan entails spiritual uplifting, euphoria and enhanced social interactions (Daradkeh, 1992; Knerr and Pearl, 2008; Białkowski et al., 2012), culminating in a state of positivity in the emotions experienced and the overall social mood. Owing to the unique nature of Ramadan, a series of studies has investigated whether it confers a special effect over return dynamics in majority Muslim markets. As a general observation, most studies have recorded positive equity returns during Ramadan (Oğuzsoy and Güven, 2004; Al-Hajieh et al., 2011;Białkowski et al., 2012, 2013; Al-Khazali, 2014), with evidence from other studies (Seyyed et al., 2005;Almudhaf, 2012) being rather mixed. A rather more consistent picture emerges with respect to Ramadan’s effect over volatility and volume, with the general consensus[8] being that both decline in-Ramadan (Seyyed et al., 2005, Ariss et al., 2011; Białkowski et al., 2012, 2013; Alrashidi et al., 2014). It is likely that the lower volatility reported during Ramadan is the result of the slowdown of trading activity(courtesy of the day long fasting and lack of productivity),and the shorter trading hours[9]leading to lower volumes of trade in-Ramadan, in line with the established positive relationship between volatility and volume (Karpoff, 1987).[10,11]

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[8]Conversely, Al-Hajieh et al. (2011) document increased volatility during Ramadan for six majority Muslim markets (Bahrain, Egypt, Jordan, Kuwait, Saudi Arabia and Turkey).

[9] Significant reductions in the duration of trading sessions are observed in several majority Muslim countries’ markets during Ramadan. As reported on their respective stock exchanges’ websites, the duration of equity trading sessions is found to decrease in-Ramadan by 16% in Indonesia, Malaysia and Pakistan, 28% in Egypt, 33% in Morocco, 37% in Tunisia and 50% in Turkey; on the other hand, no such reduction is observed in-Ramadan for stock markets in Jordan, Saudi Arabia and the UAE.

[10] On the contrary, recent evidence (Lai and Windawati, 2017) suggests that Ramadan brings forth higher volatility in Indonesia, whereas volatility in Malaysia exhibits variations across that month; what is more, trading activity appears to be picking up in-Ramadan.

[11] Other Islamic celebrations are also found to affect majority-Muslim markets; Wasiuzzaman (2018), for example, demonstrated that the Hajj pilgrimage is associated with elevated volatility in the Saudi market.

The aforementioned effects of Ramadan specifically with respect to social mood and volatility raise the issue of Ramadan possibly also affecting feedback trading, given the interactions that feedback trading has been found to maintain with these two factors. However, these interactions do not manifest themselves homogeneously. While, in theory, Ramadan can boost positive feedback trading as a result of the positive social mood (and, potentially, positive sentiment) accompanying that month, its widely reported lower volatility levels (compared to other months of the Islamic calendar) would be expected to confer the exact opposite effect (since positive feedback trading tends to be associated with high volatility).Drawing on these two opposite potential effects of Ramadan over feedback trading, we form two competing hypotheses, which we term "sentiment hypothesis" and "volatility hypothesis", respectively, and which we shall now discuss in more detail.

The sentiment hypothesis relies on the fact that Ramadan promotes positive social mood in majority Muslim markets and it is possible that this translates into optimistic sentiment among their investors[12], rendering them less averse to selecting risky investment options (Wright and Bower, 1992). This reduction in risk aversion can further be encouraged by the fact that returns during Ramadan are expected to be, on average, positive. Armed with this knowledge, investors may grow in overconfidence[13] and trade on the anticipated uptrend of prices during Ramadan, either by choosing to ride on it (positive feedback trade) or buck it (negative feedback trade).[14]The enhanced social interactions observed during Ramadan are expected to render such

[12] For more details on how social mood relates to investors' sentiment, see Nofsinger (2005).
[13] Upward trending markets are more likely to lead to the realization of profits, prompting investors to trade more aggressively, as they tend to ascribe these profits to their superior trading skills (due to self-attribution, one of the constituent biases of overconfidence – see Barber et al., 2007).
[14]Evidence (Grinblatt and Keloharju, 2001; Lamont and Thaler, 2003) indicates that price upswings tend to encourage noise trading in the market, something relevant here since feedback trading does not rely on fundamentals (in effect being a noise trading strategy).

a pattern more widespread among investors[15], leading feedback trading to appear stronger during, compared to outside, Ramadan.

The volatility hypothesis relates to the fact that majority Muslim markets exhibit low volatility during Ramadan compared to other months of the Islamic calendar. The crux of this hypothesis hinges on the wealth of evidence (see previous discussion) on the interactive relationship between volatility and feedback trading, according to which positive feedback trading grows in magnitude as volatility rises. As a result, this would suggest that feedback trading is expected to be weaker in-Ramadan compared to non-Ramadan days. An additional avenue of support to this hypothesis emanates from the fact thatnoise trading in general (Black, 1986), and feedback trading in particular (Kodres, 1994; Miwa and Ueda, 2011), have been traditionally associated with increased volumes of trade. As a result, the typically low volumes observed during Ramadan would suggest that feedback trading is less pronounced during that month, while at the same time being (courtesy of the positive volatility-volume relationship) in line with the lower volatility levels reported during Ramadan.

In view of the above, our study empirically tests for the effect of Ramadan over feedback trading in a set of eleven majority Muslim markets (Egypt; Jordan; Indonesia; Malaysia; Morocco; Oman; Pakistan; Saudi Arabia; Tunisia; Turkey; United Arab Emirates) for the 29/6/2001 – 1/8/2016 period. Our study addresses the following research questions:

i. Do investors feedback trade in majority Muslim markets?
ii. Does their feedback trading exhibit asymmetric properties contingent on market performance?
iii. Is their feedback trading subject to the Ramadan effect?

[15] This is possible, more so considering the evidence reported in Gavriilidis et al. (2016) in support of herding being stronger during, compared to outside, Ramadan in majority Muslim markets.

iv. Does this Ramadan effect vary before and after the global financial crisis?

Overall, our results for the full sample period indicate that six of our sample markets present us with significant positive feedback trading, with little evidence of the latter manifesting itself asymmetrically during up versus down markets. Controlling for Ramadan, we find that feedback trading is more evident outside (positive feedback trading is present in eight markets) as opposed to within Ramadan (positive feedback trading is present in three markets) for the full sample window, withsimilar patterns emerging both before and after the global financial crisis period. Our results, therefore, confirm the presence of a Ramadan effect in feedback trading by showing that feedback trading appears weaker within Ramadan, thus lending support to the volatility hypothesis proposed above.With feedback trading appearing strong in most of our sample markets outside Ramadan only, the dissipation of its presence during Ramadan may possibly be due to the generalized slowdown in business and financial activity in majority Muslim countries during that month fostering the decline of investors' transactions in their stock exchanges. Another possibility is that the low volumes typifying Ramadan increase frictions in the trading process (e.g. by delaying the timely execution of orders), rendering it more difficult for feedback traders to implement their strategies, and thus culminating in the reduction of their presence during that month.

These results are presented for the first time in the literature and entail very interesting implications for researchers, as they denote that the lower volatility that has been widely documented within Ramadan may also be behaviourally motivated, being related to a reduced presence of feedback traders during that month. This is an important finding, as it offers novel insight into the effect of Ramadan over majority Muslim markets' trading dynamics, while suggesting that Ramadan is a month that should be controlled for when testing for feedback trading (as well as other forms of behaviourally motivated trading[16]) in these markets. From the perspective of the investment community, these findings are notably interesting, as they allow those investing in these markets (particularly those practicing feedback style strategies) the opportunity to use the interaction between feedback trading and the Ramadan effect documented in this study as input for their strategies (for example, by conditioning their feedback trading on the observed/anticipated feedback trading within/outside Ramadan). What is more, with some of the market indices utilized in our study constituting the underlying benchmarks for index-based products[17] in their respective markets, our results are also particularly relevant to those investing in those products, as they allow them direct insight into these benchmarks' trading dynamics which they can use to inform their trades. From a regulatory viewpoint, the presence of significant feedback trading in our sample markets suggests the potential for destabilizing market outcomes, more so given the association of feedback trading with volatility. As a result, it would be useful for regulators and policy makers in emerging and frontier markets (the two categories to which our sample markets belong) to consider measures aiming at reducing the footprint of feedback trading in their stock exchanges. One such possibility would be to introduce initiatives aiming at fostering information transparency and financial literacy, in order to improve investors' understanding of investing and trust toward public information, thus, in effect, reducing their reliance on past price patterns.

The rest of our study is organized as follows: section 2 presents the data employed in this study alongside a series of descriptive statistics, before introducing the empirical design implemented

[16] The only other study we are aware of that explores the Ramadan effect in investors' behavioural trading is the one by Gavriilidis et al. (2016), who tested for the Ramadan effect over herding in seven majority Muslim markets.

[17] Exchange-traded products that use our sample's indices as benchmarks include the EFG-Hermes Egypt Fund (Egypt), the Next Funds FTSE Bursa Malaysia KLCI ETF (Malaysia), the ICBC Equity Fund (Turkey), the iShares MSCI Saudi Arabia Capped ETF (Saudi Arabia) and the Indonesia VanEck Vectors Indonesia Index ETF (Indonesia).

to test for the aforementioned research questions. Section 3 presents and discusses the results and section 4 concludes.

2. Data-Methodology

Our data includes daily closing prices for the following domestic indices of eleven majority Muslim countries' stock exchanges: EFG Index (Egypt), Amman Stock Exchange General Index (Jordan), IDX Composite (Indonesia), FTSE Bursa Malaysia KLCI (Malaysia), CFG 25 (Morocco), MSM 30 (Oman), KSE 100 (Pakistan), Tadawul All Share (Saudi Arabia), Tunindex (Tunisia), Borsa Istanbul 100 (Turkey) and ADX General Index (United Arab Emirates). The data covers the period between June 29th, 2001 and August 1st, 2016 and was obtained from the Thomson-Reuters DataStream database.

Table 1, Panel A presents a series of descriptive statistics for our sample indices' log-differenced returns, including their mean, standard deviation, skewness, excess kurtosis, the Jarque-Bera test statistic and the Ljung-Box test statistics for returns and squared returns for ten lags. As the table indicates, all eleven markets' indices posted positive average returns during our sample period, with the largest (smallest) mean value being detected for Pakistan's KSE 100 (Morocco's CFG 25) index. The most volatile index (as indicated by the largest standard deviation value) is Turkey's BIST 100, while Tunisia's Tunindex is the least volatile one. With the exception of the UAE, the rest ten indices exhibit negative skewness, while all eleven indices are leptokurtic, suggesting substantial departures from normality, something further supported by the significant values of the Jarque-Bera normality test statistic. To test whether the non-normality evident in our sample indices is due to temporal dependencies in their structure, we first perform the Ljung-Box test on returns and find that all but one (Jordan's) of its statistics generate significant values. This denotes the presence of significant autocorrelation in our indices' returns, without, however, allowing us to assert its source; autocorrelation could be due to market inefficiencies (such as non-synchronous trading) or feedback traders fomenting price-trends. With feedback trading being traditionally associated with high volatility (Koutmos, 2014), we perform the Ljung-Box test on squared returns, to gauge whether there exist dependencies at the second moment of returns. Our results confirm this, as the statistics we obtain are significant for all eleven market indices, with their values appearing always higher compared to the Ljung-Box test statistics previously reported on index-returns, thus denoting the presence of time-variance for our indices' volatility. Panel B in Table 1 further shows that our sample indices exhibit considerable correlations among themselves, with the correlation coefficient, in most cases, exceeding 0.5 and the average correlation standing at 0.61.

Our empirical design hinges on the model proposed by Sentana and Wadhwani (1992), which postulates that the market is populated by two types of investors (rational speculators and feedback traders), each basing their trades on a different notion of price formation. On the one hand, rational speculators maximize their utility by relying on a mean-variance framework, with their demand function being the following:

$$Q_t = \frac{\mathbb{E}_{t-1}(r_t) - \alpha}{\theta \sigma_t^2} \tag{1}$$

In the above equation, $\mathbb{E}_{t-1}(r_t)$is the expectation formulated in period $t-1$ regarding period t's return;α is the risk-free rate of return;θ is the time-invariant coefficient of risk-aversion; and σ_t^2 is the conditional variance at period t.

On the other hand, feedback traders view returns as trend-prone, with their demand adhering to the following function:

$$Y_t = \gamma r_{t-1} \tag{2}$$

The demand of feedback traders in period t depends on the performance of returns in the previous period. If $r_{t-1} > 0$ and they are positive (negative) feedback trading, then $\gamma > 0$ ($\gamma < 0$) and they will buy (sell); conversely, if $r_{t-1} < 0$ and they are positive (negative) feedback trading, then $\gamma > 0$ ($\gamma < 0$) and they will sell (buy).

In equilibrium all shares must be held and, given the joint presence of the two aforementioned trader-types, the following must hold:

$$Q_t + Y_t = 1 \tag{3}$$

Equation (3) can then be expanded by substituting each trader-type's demand function (Equations (1) and (2)) as follows:

$$\mathbb{E}_{t-1}(r_t) = \alpha - \gamma r_{t-1}\theta\sigma_t^2 + \theta\sigma_t^2 \tag{4}$$

Converting the expected return into a realized one by assuming its rational expectation [$r_t = \mathbb{E}_{t-1}(r_t) + \varepsilon_t$], we obtain the following equation, where ε_t follows a stochastic process:

$$r_t = \alpha - \gamma r_{t-1}\theta\sigma_t^2 + \theta\sigma_t^2 + \varepsilon_t \tag{5}$$

Equation (5) shows that accounting for the presence of traders whose conduct deviates from the strictly rational paradigm can give rise to versatile market dynamics. At first glance, the term $\gamma r_{t-1}\theta\sigma_t^2$ indicates that autocorrelation rises with volatility (σ_t^2); however, the sign of this autocorrelation depends on the sign of the feedback trading prevailing in the marketplace. If positive (negative) feedback traders dominate, $\gamma > 0$ ($\gamma < 0$) and the autocorrelation will be negative (positive). Considering evidence (Le Baron, 1992; Campbell et al., 1993; Säfvenblad, 2000; Faff and McKenzie, 2007) showcasing that autocorrelation decreases as volatility increases, we would expect positive feedback trading to grow in significance during rising volatility periods.[18] However, feedback trading is only one possible driver of return autocorrelation, since the latter can also be motivated by market frictions (such as thinness in trading activity). With γ not allowing us to disentangle between the two possibilities, Sentana and Wadhwani (1992) proposed the following *ad hoc* modification of Equation (5):

$$r_t = \alpha + \theta\sigma_t^2 + (\phi_0 + \phi_1\sigma_t^2)r_{t-1} + \varepsilon_t \tag{6}$$

In the above equation, the part of autocorrelation due to market frictions is represented by ϕ_0 and that due to feedback trading by ϕ_1.As$\phi_1 = -\theta\gamma$, the presence of positive (negative) feedback trading will be reflected through significantly negative (positive) values ofϕ_1.

With investors' risk aversion growing during market declines, positive feedback trading can be promoted during down markets via strategies such as portfolio insurance and stop loss orders, which aim at minimizing losses following negative market performance. We test for the possibility of positive feedback trading being stronger during market slumps using the following specification proposed by Sentana and Wadhwani (1992):

$$r_t = \alpha + \theta\sigma_t^2 + (\phi_0 + \phi_1\sigma_t^2)r_{t-1} + \phi_2|r_{t-1}|\varepsilon_t. \tag{7}$$

In the above equation, the coefficient ofr_{t-1}now becomes:

$$\left.\begin{array}{l} \phi_0 + \phi_1\sigma_t^2 + \phi_2, \text{if } r_{t-1} > 0 \\ \phi_0 + \phi_1\sigma_t^2 - \phi_2, \text{if } r_{t-1} < 0 \end{array}\right\} \tag{8}$$

[18] This is because, as mentioned above, positive feedback trading ($\gamma > 0$) would lead to negative first-order return autocorrelation, which, as the studies cited here have shown, is associated with increased volatility levels.

Equation (8) suggests that significantly positive values of $\phi_2$denote the presence of stronger positive feedback trading during down markets.

To empirically investigate whether feedback trading varies within, as opposed to outside, Ramadan, we employ the following modified version of the Sentana and Wadhwani (1992) model, based on Chau et al. (2011):

$$r_t = \alpha_0 D_t + \alpha_1(1 - D_t) + \theta_0 D_t \sigma_t^2 + \theta_1(1 - D_t)\sigma_t^2 + D_t(\phi_{0,0} + \phi_{1,0}\sigma_t^2)r_{t-1} + (1 - D_t)(\phi_{0,1} + \phi_{1,1}\sigma_t^2)r_{t-1} + \varepsilon_t \quad (9)$$

Equation (9) allows us to gauge how the variables of Equation (6) vary within, as compared to outside, Ramadan, with the dummy variable $D_t$being equal to one for all days falling within Ramadan each year, zero otherwise.[19]

To estimate Equations (6), (7) and (9), we define the conditional variance (σ_t^2) equation as following an asymmetric GARCH specification (Glosten et al., 1993):

$$\sigma_t^2 = \omega + \beta\varepsilon_{t-1}^2 + \lambda\sigma_{t-1}^2 + \delta I_{t-1}\varepsilon_{t-1}^2, (10)$$

Utilizing an asymmetric GARCH specification allows us to formally test for asymmetric volatility, i.e. capture potential asymmetries in volatility in the aftermath of positive (ε_{t-1}>0) versus negative ($\varepsilon_{t-1} < 0$) shocks. In the above equation, I_{t-1}equals one if the lagged shock is negative and zero otherwise; if the value of δ is significantly positive, this will indicate that volatility rises more following negative shocks than positive ones.

To assess the effect of the global financial crisis over our estimations, we partition our sample period into a pre (29/6/2001 – 9/10/2007) and a post (10/10/2007 – 1/8/2016) crisis' outbreak sub period and re-estimate Equations (9) and (10) for each. The choice of October 9th, 2007 as

[19] The identification of Ramadan days follows the procedure outlined in Al-Khazali (2014).

the cut-off point here is motivated by the fact that the Dow Jones Industrial Average index in the US reached its peak (14,164.53 units) on that day, prior to embarking on a descending course afterwards that continued unabated throughout the ground-breaking events of 2008, before reaching its bottom on the 6th of March, 2009 (Guney et al., forthcoming). For robustness purposes and to factor out the effect of the crisis period (10/10/2007 – 6/3/2009), we also re-estimate Equations (9) and (10) for the period between 9/3/2009 and 1/8/2016.[20]

To get an initial overview of the return dynamics of our sample indices within versus outside Ramadan, we estimate the following set of equations for the full sample period:

$$r_t = \omega_1 D_t + \omega_2 (1 - D_t) + \varepsilon_t \tag{11}$$

$$\sigma_t^2 = \alpha_1 D_t + a_2 (1 - D_t) + \beta \sigma_{t-1}^2 + \gamma \varepsilon_{t-1}^2 + \delta I_{t-1} \varepsilon_{t-1}^2 \tag{12}$$

Similar to Equation (9) above, D_t is equal to one for all days falling within Ramadan each year, zero otherwise. Equation (11) is the conditional mean equation, where the constant term is conditioned upon the presence of Ramadan (coefficients ω_1 and ω_2), while Equation (12) is the equivalent of Equation (10) above, with its unconditional volatility term conditioned on Ramadan's presence (coefficients α_1 and α_2). Results are presented in Table 2 and they show that average index returns are higher inside (ω_1) compared to outside Ramadan (ω_2) for nine markets, with the difference between ω_1 and ω_2 being insignificant in most cases. On the other hand, we notice that $\alpha_1 < \alpha_2$ in all eleven markets, with the difference between the two coefficients being significant in the majority (eight) of cases. These results are interesting, as they are in line with prior findings (see the discussion in the previous section) showcasing that

[20] In theory, we could perform our estimations separately for the crisis sub period (10/10/2007 – 6/3/2009) and the post crisis one (9/3/2009 – 1/8/2016). However, the 10/10/2007 – 6/3/2009 sub period entails 367 trading days in total, only 26 of which fall within Ramadan. 23 of those days belong to the Ramadan of year 2008 (1-30/9/2008) and the remaining 3 are the last three days of the immediately previous Ramadan (13/9-12/10/2007). Estimating a model using such a small number of Ramadan days (essentially corresponding to a single Ramadan) is bound to raise estimation issues, while the fact that Ramadan in 2008 corresponded to a very turbulent period for global financial markets (September 2008) would render disentangling the Ramadan effect from the effect of the events of September 2008 very difficult.

majority Muslim markets tend to maintain higher returns and lower volatility during Ramadan compared to other months of the Islamic calendar.

3. Results – Discussion

We begin our discussion with the presentation of the results from the estimation of Equations (6) and (10) for our eleven markets' indices for the full sample period. As the results reported in Table 3 indicate, six of our sample markets (Jordan, Morocco, Oman, Saudi Arabia, Tunisia and Turkey) accommodate positive feedback trading, as the significantly[21] negative values of ϕ_1 indicate. The coefficient ϕ_0 is significantly positive across all eleven markets, denoting the prevalence of significantly positive first-order autocorrelation in their indices' return structure. With all eleven markets being either emerging or frontier in designation[22], these results are in line with evidence reported in the literature (Chaudhuri and Wu, 2003; De Groot et al., 2012) confirming the presence of inefficiencies for these categories of markets. Volatility is highly persistent across all eleven markets (β is always significant) and responds significantly to news (γ assumes significant values in all cases), more so when the news is negative (as denoted by the significantly positive values of the coefficient δ for most – eight - of our sample markets).

Table 4 presents the results from the estimation of Equations (7) and (10), where we test for directional asymmetry in the estimated feedback trading of our sample markets. Results suggest again the presence of positive feedback trading in the same six markets as in Table 3 with evidence of directional asymmetry surfacing for only two of them (ϕ_2 is significantly positive for Jordan and Tunisia).An interesting (and, perhaps, counterintuitive) findings that two of our

[21] For brevity purposes, we are using the 10 percent significance level to determine significance in this study (i.e. any estimate with a p-value less than 0.1 shall be deemed statistically significant).
[22] An example of such classification is the FTSE Country Classification List of September 2015 in the following link: http://www.ftserussell.com/sites/default/files/research/ftse_country_classification_process_final.pdf. All eleven markets (except Saudi Arabia, which is not included) are classified there as emerging or frontier.

sample markets (Indonesia; Malaysia) present us with insignificant positive feedback trading (ϕ_1 is insignificantly negative), yet ϕ_2 is significantly positive for both of them.This has been documented before in the literature[23] and a possible explanation for it is that ϕ_1 is insignificant because of the presence of countervailing positive and negative feedback trading forces in the market (whose interaction leads feedback trading to appear, on average, insignificant across the full sample period), while ϕ_2 is significantly positive because market downturns prompt the emergence of strong positive feedback trading (due e.g. to portfolio insurance, stop loss orders, panic selling etc.).As per volatility, it again appears highly persistent for all markets and asymmetric for most (eight) of them.

We now turn to examining the effect of Ramadan over feedback trading in majority Muslim markets by presenting the results from the estimation of Equations (9) and (10) in Table 5 for the full sample period. The findings reported are indicative of the presence of notable inefficiencies among our sample's eleven market indices, particularly outside Ramadan ($\phi_{0,1}$ is significantly positive for all of them) and for several of them within Ramadan as well ($\phi_{0,0}$ is significantly positive for five of them).[24] Evidence of feedback trading is mainly concentrated outside Ramadan, with $\phi_{1,1}$ being significantly negative (indicative of positive feedback trading) for eight indices; conversely, positive feedback trading is detected for only three indices within Ramadan.[25]Considering the interactive relationship between feedback trading and volatility in the Sentana and Wadhwani (1992) framework, our results lend support to the volatility hypothesis outlined earlier in this study, by showcasing that positive feedback trading bears limited presence during (as opposed to outside) Ramadan, when volatility is lower (compared to non-Ramadan days, as we showed in Table 2). This is a very interesting finding,

[23] Exploring feedback trading for a sample of eighteen currencies, Laopodis (2005) came across two cases (French franc; Portuguese escudo) wherebyϕ_2 was significantly positive, yetϕ_1 was insignificant.
[24] The hypothesis $\phi_{0,0} = \phi_{0,1}$ is rejected on three occasions (Jordan; Pakistan; UAE).
[25] The hypothesis $\phi_{1,0} = \phi_{1,1}$ is rejected on four occasions (Egypt; Pakistan; Saudi Arabia; UAE).

which we believe is related to the traditionally documented low volumes during Ramadan in majority Muslim countries. With feedback trading appearing strong in most of our sample markets outside Ramadan only, itis possible that its dissipation in-Ramadan is due to the generalized slowdown in business and financial activity in these countries during that month fostering the decline of investors' transactions in their stock exchanges. It is also possible that Ramadan's low volumes increase frictions in the trading process (e.g. by delaying the timely execution of orders), rendering it more difficult for feedback traders to implement their strategies, and thus resulting in their reduced presence during Ramadan. Again here, volatility appears highly persistent for all markets and asymmetric for most (eight) of them.

Table 6 presents the results from the estimation of Equations (9) and (10) for the period prior to the outbreak of the global financial crisis (29/6/2001 – 9/10/2007). Similar to the results presented in Table 5, the first-order autocorrelation appears more prolific outside, as opposed to within, Ramadan, with $\phi_{0,1}$ ($\phi_{0,0}$) being significantly positive in nine (two) markets. As for feedback trading, more evidence in support of its presence surfaces outside ($\phi_{1,1}$ is significant in five markets)[26], compared to within, Ramadan ($\phi_{1,0}$ is significant in Oman only), thus providing evidence in favor of the volatility hypothesis, in line with the full sample period results reported in Table 5.Volatility is again shown to be persistent and responding significantly to news for all markets[27], yet appears less asymmetric as the fewer significantly positive values of δ suggest.[28]

The period following the outbreak of the global financial crisis (10/10/2007 – 1/8/2016) is characterized by mixed evidence regarding the occurrence of feedback trading within versus

[26] $\phi_{1,1}$is significantly negative (indicative of positive feedback trading) for Morocco, Saudi Arabia, Turkey and the UAE, with its value being significantly positive (indicative of negative feedback trading) for Tunisia.

[27] The sole exception here is Indonesia, where volatility autocorrelation (i.e. the response of volatility to news) is insignificant, as the insignificant γ-value for that market indicates in Table 6.

[28] δ is significantly positive for five markets only.

outside Ramadan. As the results from the estimation of Equations (9) and (10) in Table 7 indicate, both $\phi_{1,0}$ and $\phi_{1,1}$ are significant in three markets each, thus showing that the previously documented (full sample period; pre crisis' outbreak) pattern of prevalent feedback trading outside Ramadan dissipates following the crisis' outbreak. Conversely, the significant temporal dependencies in our sample indices persist, particularly outside Ramadan[29], while volatility manifests itself persistently and asymmetrically for all eleven market indices.[30] An issue, however, arising with the post outbreak period is that it encompasses the 10/10/2007 – 6/3/2009 window, which saw the climax of the crisis' impact internationally. To factor out that window's effect from our estimations (and given the discussion in footnote 20 above), we repeat the estimation of Equations (9) and (10) for the 9/3/2009 - 1/8/2016 period. Results are presented in Table 8 and provide us with a rather different picture compared to Table 7, with positive feedback trading being evident in six markets outside Ramadan and completely absent in-Ramadan, in line with the evidence presented in Tables 5 and 6 in support of the volatility hypothesis. Similar to previous tables, our sample indices exhibit more evidence of first-order autocorrelation outside, compared to within, Ramadan[31], with their volatility being strongly persistent and asymmetric.[32]

Overall, our results showcase that feedback trading manifests itself for the majority of our sample markets outside Ramadan, with its presence during Ramadan appearing rather limited; this finding holds both for the full sample period, as well as before and after the global financial crisis period of 10/10/2007 – 6/3/2009. The evidence presented here lends little support to the sentiment hypothesis proposed in the beginning of this study, thus denoting that the positive mood permeating majority Muslim countries during Ramadan does not translate into stronger

[29] $\phi_{0,1}$ ($\phi_{0,0}$) is significantly positive in nine (four) markets.
[30] The sole exception here is Jordan, where no volatility asymmetry surfaces (δ is insignificant).
[31] $\phi_{0,1}$ ($\phi_{0,0}$) is significantly positive in eight (two) markets.
[32] The sole exception here is Jordan, where no volatility asymmetry surfaces (δ is insignificant).

feedback trading on their investors' behalf for that month. On the contrary, our evidence is more supportive of the volatility hypothesis, as feedback trading manifests itself less strongly during Ramadan (compared to non-Ramadan days), whose volatility is lower (compared to the rest of the months of the Islamic calendar, something that has both been established in the relevant literature and empirically confirmed in our study).Our findings are very interesting from a research perspective, as they raise, for the first time, the possibility that the lower volatility that has been widely documented in-Ramadan by several studies may well be the result of the reduced presence of feedback traders during that month. A possible explanation for this is that the generalized slowdown of the overall business and financial activity characterizing Ramadan in majority Muslim countries foments a decline in their investors' transactions (reflected through lower volumes) during that month, leading feedback traders to appear less active during (compared to outside) Ramadan. An alternative explanation here is that the reduced feedback trading in-Ramadan may be due to Ramadan's traditionally observed low volumes increasing frictions in the trading process, leading feedback traders (indeed, any trader at all) to face difficulties in the implementation of their strategies during that month; if so, the low volatility observed during Ramadan could be ascribed to feedback traders being discouraged by Ramadan's low volumes from trading as actively during that month, compared to outside it.

An interesting issue here pertains to the fact that, with investors being aware of Ramadan's positive expected returns, one would anticipate some evidence of profit taking, reflected through negative feedback trading on their behalf during that month. As we have shown, this is not the case, since the limited evidence of feedback trading documented during Ramadan pertains almost always to positive feedback trading.[33]Although we cannot be certain of the

[33] The sole exception here relates to $\phi_{1,0}$, which assumes a significantly positive value for the UAE in Table 7, testing for the Ramadan effect during the 10/10/2007 – 1/8/2016 period.

reasons underlying the absence of profit taking during a month traditionally associated with positive market performance, it is possible that the low volumes observed during that month are partially responsible for this, as they render profit taking less feasible by increasing the frictions in the trading process.

4. Conclusion

This study examines whether feedback trading is subject to the Ramadan effect, in view of extensive evidence on the role of religion in investment decision making in several markets internationally. Drawing on a set of indices from eleven majority Muslim markets for the 29/6/2001-1/8/2016 period, we report evidence showing that feedback traders are active in several of these markets, with their presence appearing stronger outside, rather than within, Ramadan. With volatility during Ramadan being traditionally lower compared to the rest of the months of the Islamic calendar, our findings raise, for the first time, the possibility that the lower volatility that has been widely documented in-Ramadan by several studies may well be the result of the reduction in the presence of feedback traders during that month. This is a very interesting finding, which we believe is related to the traditionally documented low volumes during Ramadan in majority Muslim countries, since the generalized slowdown in business and financial activity in these countries during that month fosters the decline of investors' transactions in their stock exchanges and this may well produce an adverse effect over the presence of feedback trading in-Ramadan. It is also possible that this is due to Ramadan's low volumes increasing frictions in the trading process (e.g. by delaying the timely execution of orders), thus rendering it more difficult for feedback traders to implement their strategies and resulting in their reduced presence during Ramadan.

These results bear very interesting implications for researchers, as they offer novel insights into Ramadan's effect over investors' behaviour in majority Muslim markets by showcasing that the lower volatility/volume widely reported during that month is related to their investors' feedback trading, while further suggesting that Ramadan's effect should be controlled for when studying behavioural investment patterns in these markets. The findings presented here are also of particular relevance to those investing in these markets (especially those subscribing to feedback trading styles), as the interaction between feedback trading and the Ramadan effect documented in this study can be used to inform their strategies, by allowing them, for example, the opportunity to condition their trades on the observed/anticipated feedback trading within/outside Ramadan. With some of the market indices in our sample constituting the underlying benchmarks for index based products in their respective markets, our results also allow those investing in these products additional insight into their benchmarks' trading dynamics which they can use as input when formulating their trading strategies. From a regulatory viewpoint, the presence of significant feedback trading in our sample markets suggests the potential for destabilizing market outcomes, more so given the association of feedback trading with volatility. As a result, it would be useful for regulators and policy makers in emerging and frontier markets (the two categories to which our sample markets belong) to consider measures aiming at reducing the footprint of feedback trading in their stock exchanges. One such possibility would be to introduce initiatives aiming at fostering information transparency and financial literacy, in order to improve investors' understanding of investing and trust toward public information, thus, in effect, reducing their reliance on past price patterns.

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Table 1: Descriptive statistics and correlations for the returns of our sample markets' indices

Panel A: Descriptive statistics

	Mean	Standard deviation	Skewness	Excess kurtosis	Jarque-Bera	LB(10)	$LB^2(10)$
Egypt (EFG)	0.0673	1.6678	-0.5153***	7.8074***	10171.0461***	101.012***	346.631***
Indonesia (IDX)	0.0637	1.3434	-0.7123***	7.6005***	9806.8446***	55.872***	779.858***
Jordan (ASE GI)	0.0264	1.1310	-0.3657***	56.0854***	515961.9578***	10.060	925.387***
Malaysia (FTSE BM KLCI)	0.0262	0.7513	-0.8637***	12.2423***	25068.6756***	82.090***	400.185***
Morocco (CFG 25)	0.0200	0.7801	-0.1546***	7.2899***	8731.2032***	153.760***	853.701***
Oman (MSM 30)	0.0321	0.9939	-0.8062***	22.8336***	85921.1127***	156.888***	1926.727***
Pakistan (KSE 100)	0.0856	1.3133	-0.3468***	4.2218***	3001.8856***	77.152***	1647.236***
Saudi Arabia (TADAWUL AS)	0.0242	1.5592	-0.5995***	12.0475***	24039.0598***	41.235***	1696.720***
Tunisia (TUNINDEX)	0.0355	0.5237	-0.4266***	11.7798***	22876.6949***	345.126***	1367.604***
Turkey (BIST 100)	0.0488	1.9018	-0.1523***	4.3794***	3160.5687***	28.995***	555.457***
UAE (ADX GI)	0.0382	1.4436	1.1183***	253.5177***	10541299.9540***	36.548***	953.789***

Panel B: Correlation matrix

	Egypt (EFG)	Indonesia (IDX)	Jordan (ASE GI)	Malaysia (FTSE BM KLCI)	Morocco (CFG 25)	Oman (MSM 30)	Pakistan (KSE 100)	Saudi Arabia (TADAWUL AS)	Tunisia (TUNINDEX)	Turkey (BIST 100)	UAE (ADX GI)
Egypt (EFG)	1.00										
Indonesia (IDX)	0.72	1.00									
Jordan (ASE GI)	0.67	0.14	1.00								
Malaysia (FTSE BM KLCI)	0.77	0.98	0.19	1.00							
Morocco (CFG 25)	0.83	0.60	0.65	0.64	1.00						
Oman (MSM 30)	0.92	0.61	0.77	0.66	0.89	1.00					
Pakistan (KSE 100)	0.71	0.88	0.12	0.85	0.43	0.52	1.00				
Saudi Arabia (TADAWUL AS)	0.60	0.23	0.73	0.27	0.27	0.50	0.34	1.00			
Tunisia (TUNINDEX)	0.68	0.94	0.17	0.91	0.69	0.60	0.76	0.11	1.00		
Turkey (BIST 100)	0.78	0.97	0.25	0.97	0.64	0.65	0.87	0.35	0.91	1.00	
UAE (ADX GI)	0.78	0.50	0.68	0.53	0.43	0.69	0.67	0.83	0.36	0.56	1.00

Panel A contains the following descriptive statistics for the log-differenced returns of our eleven sample markets' indices for the 29/6/2001 – 1/8/2016 period: mean; standard deviation; skewness; excess kurtosis; Jarque-Bera normality test-statistic; Ljung-Box test statistics for returns and squared returns for ten lags. *, ** and *** indicate significance at the 10, 5 and 1 percent levels, respectively. Panel B contains the correlation matrix depicting correlation coefficients for each pair of our sample indices.

Table 2: Maximum likelihood estimates from the augmented Glosten et al. (1993) model (full sample period)

Parameters	Egypt	Indonesia	Jordan	Malaysia	Morocco	Oman	Pakistan	Saudi Arabia	Tunisia	Turkey	UAE
ω_1	0.1818	0.1211	0.0084	0.0326	0.0647	0.1014	0.1639	0.0838	0.0349	0.1643	0.1696
	(0.0076)	(0.0271)	(0.7700)	(0.2730)	(0.0308)	(0.0005)	(0.0006)	(0.0995)	(0.0932)	(0.0539)	(0.0000)
ω_2	0.0869	0.0744	0.0088	0.0289	0.0087	0.0478	0.1153	0.0885	0.0254	0.0660	0.0257
	(0.0007)	(0.0001)	(0.4804)	(0.0047)	(0.4363)	(0.0000)	(0.0000)	(0.0000)	(0.0007)	(0.0125)	(0.0441)
α_1	0.0610	0.0267	0.0087	0.0100	0.0356	0.0171	0.0534	0.0369	0.0169	0.0574	0.0148
	(0.0001)	(0.0003)	(0.0006)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0012)	(0.0003)
a_2	0.1629	0.0632	0.0092	0.0127	0.0624	0.0460	0.0824	0.0476	0.0194	0.0909	0.0285
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
β	0.8354	0.8643	0.9123	0.8735	0.6694	0.8018	0.7858	0.8373	0.7463	0.8879	0.8023
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
γ	0.0735	0.0578	0.1143	0.0759	0.2566	0.1256	0.1087	0.0827	0.1608	0.0564	0.1753
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
δ	0.0757	0.0856	-0.0509	0.0620	-0.0116	0.0536	0.1186	0.1306	0.0527	0.0642	0.0855
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.4979)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
$H_0: \omega_1 = \omega_2$	1.7729	0.6737	0.0002	0.0144	3.1018	3.2069	0.9740	0.0085	0.1926	1.2235	24.7481
	(0.1830)	(0.4118)	(0.9887)	(0.9045)	(0.0782)	(0.0733)	(0.3237)	(0.9267)	(0.6608)	(0.2687)	(0.0000)
$H_0: a_1 = a_2$	45.2866	20.5398	0.0329	1.4767	25.6894	257.3701	9.5620	3.6006	2.6673	3.4800	10.9156
	(0.0000)	(0.0000)	(0.8560)	(0.2243)	(0.0000)	(0.0000)	(0.0020)	(0.0578)	(0.1024)	(0.0621)	(0.0010)

The table presents the maximum likelihood estimates from the following set of equations for the 29/6/2001 – 1/8/2016 period for our eleven markets' indices:

$r_t = \omega_1 D_t + \omega_2(1 - D_t) + \varepsilon_t,$

$\sigma_t^2 = \alpha_1 D_t + a_2(1 - D_t) + \beta\sigma_{t-1}^2 + \gamma\varepsilon_{t-1}^2 + \delta I_{t-1}\varepsilon_{t-1}^2$

D_t is a dummy variable assuming the value of unity in-Ramadan, zero otherwise. Parentheses include p-values. The bottom two rows contain the chi-squared test values from testing the hypotheses $\omega_1 = \omega_2$ and $a_1 = a_2$, respectively. The indices comprising our sample are: EFG Index (Egypt), Amman Stock Exchange General Index (Jordan), IDX Composite (Indonesia), FTSE Bursa Malaysia KLCI (Malaysia), CFG 25 (Morocco), MSM 30 (Oman), KSE 100 (Pakistan), Tadawul All Share (Saudi Arabia), Tunindex (Tunisia), Borsa Istanbul 100 (Turkey) and ADX General Index (United Arab Emirates).

Table 3: Maximum likelihood estimates from the original Sentana and Wadhwani (1992) model (full sample period)

Parameters	Egypt	Indonesia	Jordan	Malaysia	Morocco	Oman	Pakistan	Saudi Arabia	Tunisia	Turkey	UAE
ω	0.0605	0.0472	-0.0126	0.0125	0.0014	0.0480	0.1204	0.0896	0.0017	0.1061	0.0270
	(0.1645)	(0.1186)	(0.4114)	(0.4199)	(0.9286)	(0.0302)	(0.0000)	(0.0000)	(0.8660)	(0.0203)	(0.0406)
θ	0.0050	0.0144	0.0405	0.0281	0.0309	-0.0140	-0.0228	-0.0248	0.1022	-0.0163	0.0124
	(0.7832)	(0.4845)	(0.0307)	(0.4359)	(0.3364)	(0.5221)	(0.1792)	(0.0385)	(0.0227)	(0.2797)	(0.3040)
ϕ_0	0.1738	0.1100	0.0692	0.1580	0.1954	0.2262	0.1212	0.1403	0.2763	0.0774	0.1906
	(0.0000)	(0.0000)	(0.0001)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0072)	(0.0000)
ϕ_1	-0.0058	-0.0050	-0.0147	-0.0193	-0.0359	-0.0107	-0.0078	-0.0088	-0.0603	-0.0100	-0.0024
	(0.1477)	(0.4725)	(0.0001)	(0.5086)	(0.0119)	(0.0563)	(0.2636)	(0.0055)	(0.0022)	(0.0526)	(0.1065)
α	0.1647	0.0598	0.0087	0.0120	0.0588	0.0429	0.0808	0.0451	0.0189	0.0852	0.0264
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0546)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
β	0.8277	0.8643	0.9124	0.8758	0.6855	0.8037	0.7836	0.8393	0.7555	0.8892	0.8004
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
γ	0.0742	0.0526	0.1162	0.0704	0.2339	0.1128	0.0968	0.0728	0.1344	0.0538	0.1861
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
δ	0.0783	0.0947	-0.0521	0.0681	-0.0132	0.0723	0.1487	0.1522	0.0685	0.0694	0.0677
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.4067)	(0.1703)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)

The table presents the maximum likelihood estimates from the following set of equations for the 29/6/2001 – 1/8/2016 period for our eleven markets' indices:

$$r_t = \omega + \theta\sigma_t^2 + (\phi_0 + \phi_1\sigma_t^2)r_{t-1} + \varepsilon_t,$$

$$\sigma_t^2 = \alpha + \beta\sigma_{t-1}^2 + \gamma\varepsilon_{t-1}^2 + \delta I_{t-1}\varepsilon_{t-1}^2$$

Parentheses include the p-values of the estimates. The indices comprising our sample are: EFG Index (Egypt), Amman Stock Exchange General Index (Jordan), IDX Composite (Indonesia), FTSE Bursa Malaysia KLCI (Malaysia), CFG 25 (Morocco), MSM 30 (Oman), KSE 100 (Pakistan), Tadawul All Share (Saudi Arabia), Tunindex (Tunisia), Borsa Istanbul 100 (Turkey) and ADX General Index (United Arab Emirates).

Table 4: Maximum likelihood estimates of the Sentana and Wadhwani (1992) model controlling for directional asymmetry

Parameters	Egypt	Indonesia	Jordan	Malaysia	Morocco	Oman	Pakistan	Saudi Arabia	Tunisia	Turkey	UAE
ω	0.0629	0.0307	-0.0273	0.0003	-0.0012	0.0407	0.1181	0.0824	-0.0032	0.1010	0.0192
	(0.1481)	(0.3291)	(0.0787)	(0.9822)	(0.9404)	(0.0277)	(0.0000)	(0.0000)	(0.7581)	(0.0297)	(0.1879)
θ	0.0089	-0.0026	0.0240	-0.0041	0.0001	-0.0286	-0.0271	-0.0308	0.0269	-0.0203	0.0089
	(0.6698)	(0.9070)	(0.2586)	(0.9180)	(0.9968)	(0.2122)	(0.1755)	(0.0202)	(0.6434)	(0.2217)	(0.5160)
ϕ_0	0.1753	0.1029	0.0732	0.1519	0.1963	0.2213	0.1178	0.1360	0.2657	0.0755	0.1876
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0089)	(0.0000)
ϕ_1	-0.0060	-0.0040	-0.0161	-0.0173	-0.0366	-0.0101	-0.0074	-0.0086	-0.0589	-0.0098	-0.0025
	(0.1407)	(0.5787)	(0.0001)	(0.5513)	(0.0092)	(0.0878)	(0.3025)	(0.0076)	(0.0026)	(0.0586)	(0.1026)
ϕ_2	-0.0118	0.0534	0.0622	0.0633	0.0436	0.0428	0.0119	0.0258	0.0712	0.0148	0.0273
	(0.6469)	(0.0480)	(0.0017)	(0.0166)	(0.1490)	(0.2879)	(0.6843)	(0.2992)	(0.0111)	(0.5805)	(0.3053)
α	0.1650	0.0576	0.0078	0.0122	0.0589	0.0436	0.0806	0.0451	0.0182	0.0852	0.0262
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0383)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
β	0.8275	0.8672	0.9170	0.8753	0.6853	0.8011	0.7842	0.8398	0.7614	0.8893	0.8020
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
γ	0.0743	0.0518	0.1132	0.0690	0.2358	0.1130	0.0966	0.0721	0.1311	0.0538	0.1848
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
δ	0.0785	0.0926	-0.0541	0.0703	-0.0160	0.0751	0.1480	0.1518	0.0686	0.0693	0.0651
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.3155)	(0.1727)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)

The table presents the maximum likelihood estimates from the following set of equations for the 29/6/2001 – 1/8/2016 period for our eleven markets' indices:

$r_t = \omega + \theta\sigma_t^2 + (\phi_0 + \phi_1\sigma_t^2)r_{t-1} + \phi_2|r_{t-1}| + \varepsilon_t,$

$\sigma_t^2 = \alpha + \beta\sigma_{t-1}^2 + \gamma\varepsilon_{t-1}^2 + \delta I_{t-1}\varepsilon_{t-1}^2$

Parentheses include the p-values of the estimates. The indices comprising our sample are: EFG Index (Egypt), Amman Stock Exchange General Index (Jordan), IDX Composite (Indonesia), FTSE Bursa Malaysia KLCI (Malaysia), CFG 25 (Morocco), MSM 30 (Oman), KSE 100 (Pakistan), Tadawul All Share (Saudi Arabia), Tunindex (Tunisia), Borsa Istanbul 100 (Turkey) and ADX General Index (United Arab Emirates).

Table 5: Maximum likelihood estimates of the extended Sentana and Wadhwani (1992) model, controlling for Ramadan-effect

Parameters	Egypt	Indonesia	Jordan	Malaysia	Morocco	Oman	Pakistan	Saudi Arabia	Tunisia	Turkey	UAE
ω_0	-0.3744	-0.2149	-0.0375	-0.0175	0.0400	0.0957	0.2217	0.0793	-0.0250	0.0642	0.1438
	(0.0002)	(0.0060)	(0.4434)	(0.7553)	(0.5200)	(0.0858)	(0.0370)	(0.2327)	(0.5706)	(0.6767)	(0.0260)
ω_1	0.1058	0.0475	-0.0118	0.0137	-0.0011	0.0428	0.1128	0.0911	0.0016	0.1148	0.0253
	(0.0225)	(0.1362)	(0.4588)	(0.3975)	(0.9484)	(0.0043)	(0.0000)	(0.0000)	(0.8776)	(0.0180)	(0.1519)
θ_0	0.2199	0.2546	0.0951	0.1317	0.0388	-0.1026	-0.1167	-0.0318	0.3359	0.0232	0.0527
	(0.0000)	(0.0000)	(0.2411)	(0.4019)	(0.7309)	(0.2843)	(0.2492)	(0.6111)	(0.1637)	(0.5303)	(0.0000)
θ_1	-0.0156	0.0126	0.0389	0.0241	0.0263	-0.0084	-0.0179	-0.0254	0.0965	-0.0223	-0.0104
	(0.4324)	(0.5591)	(0.0425)	(0.5161)	(0.4538)	(0.7286)	(0.2993)	(0.0364)	(0.0367)	(0.1795)	(0.1097)
$\phi_{0,0}$	0.1271	0.0498	-0.0715	0.2603	0.1426	0.3036	0.3370	0.2562	-0.3400	0.0939	-0.0273
	(0.2087)	(0.6262)	(0.3912)	(0.0189)	(0.0570)	(0.0041)	(0.0045)	(0.0002)	(0.1785)	(0.3832)	(0.8214)
$\phi_{1,0}$	0.0225	0.0271	0.0420	-0.1842	0.0380	-0.0272	-0.1296	-0.0586	-0.3400	-0.0096	-0.0013
	(0.1262)	(0.4398)	(0.3852)	(0.3507)	(0.4897)	(0.5744)	(0.0582)	(0.0002)	(0.1785)	(0.5566)	(0.0347)
$\phi_{0,1}$	0.1754	0.1195	0.0772	0.1564	0.2004	0.2165	0.1139	0.1373	0.2797	0.0775	0.2030
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0094)	(0.0000)
$\phi_{1,1}$	-0.0066	-0.0049	-0.0156	-0.0183	-0.0433	-0.0098	-0.0053	-0.0083	-0.0609	-0.0106	-0.0052
	(0.0427)	(0.4950)	(0.0000)	(0.5303)	(0.0040)	(0.0776)	(0.4566)	(0.0118)	(0.0026)	(0.0527)	(0.0008)
α	0.2779	0.0878	0.0089	0.0120	0.0582	0.0426	0.0798	0.0452	0.0188	0.0848	0.0261
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
β	0.7383	0.8264	0.9111	0.8760	0.6875	0.8046	0.7862	0.8390	0.7572	0.8897	0.8024
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
γ	0.0962	0.0570	0.1181	0.0702	0.2332	0.1132	0.0947	0.0718	0.1332	0.0534	0.1744
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
δ	0.1245	0.1246	-0.0530	0.0679	-0.0134	0.0702	0.1479	0.1540	0.0673	0.0693	0.0856
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.4023)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.1387)
H₀: $\phi_{0,0} = \phi_{0,1}$	0.2173	0.4445	3.0723	0.8345	0.5408	0.6535	3.4192	2.6681	0.1732	0.0218	3.1119
	(0.6410)	(0.5049)	(0.0796)	(0.3609)	(0.4620)	(0.4188)	(0.0644)	(0.1023)	(0.6772)	(0.8825)	(0.0777)
H₀: $\phi_{1,0} = \phi_{1,1}$	3.7485	0.8028	1.4078	0.6896	2.0634	0.1263	3.2809	9.7014	1.2061	0.0035	6.9578
	(0.0528)	(0.3702)	(0.2354)	(0.4062)	(0.1508)	(0.7222)	(0.0700)	(0.0018)	(0.2720)	(0.9527)	(0.0083)

The table presents the maximum likelihood estimates from the following set of equations for the 29/6/2001 – 1/8/2016 period for our eleven markets' indices:
$r_t = \omega_0 D_t + \omega_1(1-D_t) + \theta_0 D_t \sigma_t^2 + \theta_1(1-D_t)\sigma_t^2 + D_t(\phi_{0,0} + \phi_{1,0}\sigma_t^2)r_{t-1} + (1-D_t)(\phi_{0,1} + \phi_{1,1}\sigma_t^2)r_{t-1} + \varepsilon_t$,
$\sigma_t^2 = \alpha + \beta\sigma_{t-1}^2 + \gamma\varepsilon_{t-1}^2 + \delta I_{t-1}\varepsilon_{t-1}^2$
D_t is a dummy variableassuming the value of unity in-Ramadan, zero otherwise.Parentheses include p-values. The bottom two rows contain the chi-squared test values from testing the hypotheses $\phi_{0,0} = \phi_{0,1}$ and $\phi_{1,0} = \phi_{1,1}$, respectively. The indices comprising our sample are: EFG Index (Egypt), Amman Stock Exchange General Index (Jordan), IDX Composite (Indonesia), FTSE Bursa Malaysia KLCI (Malaysia), CFG 25 (Morocco), MSM 30 (Oman), KSE 100 (Pakistan), Tadawul All Share (Saudi Arabia), Tunindex (Tunisia), Borsa Istanbul 100 (Turkey) and ADX General Index (United Arab Emirates).

Table 6: Maximum likelihood estimates of the extended Sentana and Wadhwani (1992) model, controlling for Ramadan-effect, pre-crisis (29/6/2001 – 9/10/2007)

Parameters	Egypt	Indonesia	Jordan	Malaysia	Morocco	Oman	Pakistan	Saudi Arabia	Tunisia	Turkey	UAE
ω_0	0.2273	0.5359	0.1881	-0.1119	0.1083	-0.1485	0.6929	-0.0751	-0.0308	0.2530	0.1387
	(0.6169)	(0.4003)	(0.3263)	(0.3801)	(0.3415)	(0.8138)	(0.0045)	(0.6897)	(0.8386)	(0.4425)	(0.1257)
ω_1	0.1576	0.0964	0.0429	0.0246	0.0283	0.0936	0.2122	0.1497	-0.0172	0.1803	0.0349
	(0.0250)	(0.1581)	(0.3648)	(0.4484)	(0.2225)	(0.1471)	(0.0000)	(0.0000)	(0.4614)	(0.0805)	(0.0803)
θ_0	-0.0528	-0.3576	-0.0481	0.4216	0.0438	0.5786	-0.3398	0.0789	0.6643	-0.0031	0.0027
	(0.8339)	(0.5232)	(0.8429)	(0.1756)	(0.8468)	(0.6576)	(0.0545)	(0.6001)	(0.0624)	(0.9611)	(0.9922)
θ_1	-0.0077	0.0041	0.0265	0.0249	0.0084	-0.0366	-0.0250	-0.0227	0.2600	-0.0235	0.0203
	(0.8230)	(0.9292)	(0.4941)	(0.7063)	(0.8355)	(0.6947)	(0.3224)	(0.1112)	(0.0999)	(0.3755)	(0.4173)
$\phi_{0,0}$	0.2222	0.0469	-0.3319	0.4053	0.2273	1.2880	0.2770	0.2025	-0.5255	0.0043	0.1080
	(0.5378)	(0.9368)	(0.2920)	(0.1361)	(0.0810)	(0.0381)	(0.2224)	(0.2579)	(0.1367)	(0.9787)	(0.5938)
$\phi_{1,0}$	-0.0063	-0.0448	0.3059	-0.4796	-0.0044	-2.0111	-0.1096	-0.0848	3.5237	0.0038	-0.0480
	(0.9694)	(0.9250)	(0.1864)	(0.3332)	(0.9775)	(0.0594)	(0.2777)	(0.2333)	(0.1758)	(0.8587)	(0.8551)
$\phi_{0,1}$	0.1889	0.1807	0.0724	0.1926	0.3344	0.1407	0.0105	0.1044	0.1425	0.1423	0.2433
	(0.0000)	(0.0000)	(0.1864)	(0.0000)	(0.0000)	(0.0209)	(0.8172)	(0.0045)	(0.0085)	(0.0077)	(0.0000)
$\phi_{1,1}$	-0.0149	-0.0148	-0.0284	-0.0294	-0.0552	-0.0385	-0.0009	-0.0068	0.4592	-0.0181	-0.0209
	(0.1690)	(0.3218)	(0.1802)	(0.5133)	(0.0074)	(0.1476)	(0.9258)	(0.0882)	(0.0235)	(0.0271)	(0.0720)
α	0.1845	0.2734	0.0172	0.0195	0.0770	0.0284	0.1607	0.0486	0.0113	0.1041	0.0209
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.1690)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
β	0.7887	0.6800	0.9428	0.8654	0.5855	0.9296	0.7502	0.8194	0.8128	0.9000	0.8210
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
γ	0.1318	0.0180	0.0590	0.0706	0.4330	0.0451	0.1157	0.1270	0.1293	0.0606	0.1928
	(0.0000)	(0.3275)	(0.0000)	(0.0000)	(0.0000)	(0.0803)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
δ	0.0051	0.2575	-0.0265	0.0606	-0.1682	-0.0505	0.1231	0.0998	-0.0229	0.0364	-0.0270
	(0.7943)	(0.0000)	(0.0000)	(0.0001)	(0.0000)	(0.0200)	(0.0000)	(0.0000)	(0.2488)	(0.0100)	(0.1008)
H₀: $\phi_{0,0} = \phi_{0,1}$	0.0083	0.5214	1.6063	1.7983	0.6476	3.6780	2.5659	0.2878	3.5141	0.6321	0.4322
	(0.9270)	(0.4702)	(0.2050)	(0.1799)	(0.4209)	(0.0551)	(0.1091)	(0.5916)	(0.0608)	(0.4265)	(0.5108)
H₀: $\phi_{1,0} = \phi_{1,1}$	0.0026	0.0478	2.0711	4.2747	0.1006	3.5097	3.1126	1.1977	1.3824	0.9122	0.0106
	(0.9591)	(0.8268)	(0.1501)	(0.0386)	(0.7510)	(0.0610)	(0.0776)	(0.2737)	(0.2396)	(0.3395)	(0.9179)

The table presents the maximum likelihood estimates from the following set of equations for the 29/6/2001 – 9/10/2007 period for our eleven markets' indices:

$r_t = \omega_0 D_t + \omega_1(1 - D_t) + \theta_0 D_t \sigma_t^2 + \theta_1(1 - D_t)\sigma_t^2 + D_t(\phi_{0,0} + \phi_{1,0}\sigma_t^2)r_{t-1} + (1 - D_t)(\phi_{0,1} + \phi_{1,1}\sigma_t^2)r_{t-1} + \varepsilon_t,$

$\sigma_t^2 = \alpha + \beta\sigma_{t-1}^2 + \gamma\varepsilon_{t-1}^2 + \delta I_{t-1}\varepsilon_{t-1}^2$

D_t is a dummy variableassuming the value of unity in-Ramadan, zero otherwise.Parentheses include p-values. The bottom two rows contain the chi-squared test values from testing the hypotheses $\phi_{0,0} = \phi_{0,1}$ and $\phi_{1,0} = \phi_{1,1}$, respectively. The indices comprising our sample are: EFG Index (Egypt), Amman Stock Exchange General Index (Jordan), IDX Composite (Indonesia), FTSE Bursa Malaysia KLCI (Malaysia), CFG 25 (Morocco), MSM 30 (Oman), KSE 100 (Pakistan), Tadawul All Share (Saudi Arabia), Tunindex (Tunisia), Borsa Istanbul 100 (Turkey) and ADX General Index (United Arab Emirates).

Table 7: Maximum likelihood estimates of the extended Sentana and Wadhwani (1992) model, controlling for Ramadan-effect (10/10/2007 – 1/8/2016)

Parameters	Egypt	Indonesia	Jordan	Malaysia	Morocco	Oman	Pakistan	Saudi Arabia	Tunisia	Turkey	UAE
ω_0	-0.4711	-0.1146	0.0013	0.0099	-0.0649	0.0476	0.1070	0.0520	-0.0319	-0.0409	-0.0260
	(0.0003)	(0.2458)	(0.9803)	(0.8874)	(0.4620)	(0.1970)	(0.3894)	(0.4103)	(0.6116)	(0.8358)	(0.5476)
ω_1	0.0144	0.0160	-0.0245	0.0077	-0.0452	-0.0042	0.0817	0.0600	0.0071	0.1042	0.0538
	(0.8177)	(0.6371)	(0.1611)	(0.6809)	(0.1057)	(0.7576)	(0.0029)	(0.0225)	(0.6290)	(0.0761)	(0.0374)
θ_0	0.2168	0.1853	-0.0107	0.0233	0.1717	-0.0382	-0.0732	0.0076	0.1787	0.0414	0.2062
	(0.0000)	(0.0000)	(0.9365)	(0.9169)	(0.3648)	(0.6826)	(0.5867)	(0.9030)	(0.5348)	(0.5758)	(0.0000)
θ_1	0.0000	0.0111	0.0274	0.0198	0.0748	-0.0078	-0.0217	-0.0355	0.0536	-0.0336	-0.0546
	(0.9971)	(0.6411)	(0.1114)	(0.6724)	(0.2441)	(0.7379)	(0.4249)	(0.0647)	(0.3063)	(0.1779)	(0.0240)
$\phi_{0,0}$	0.1955	0.0792	-0.0296	0.2242	0.0101	0.3285	-0.3126	0.3066	0.5437	0.1632	-0.0631
	(0.1368)	(0.5644)	(0.7575)	(0.1136)	(0.9246)	(0.0032)	(0.0562)	(0.0002)	(0.0001)	(0.2838)	(0.1941)
$\phi_{1,0}$	-0.0152	0.0089	0.0016	-0.1219	-0.1415	-0.0395	-0.1302	-0.0462	-0.6294	-0.0239	0.0110
	(0.5186)	(0.8441)	(0.9807)	(0.6556)	(0.1070)	(0.3714)	(0.2952)	(0.0893)	(0.0692)	(0.4136)	(0.0000)
$\phi_{0,1}$	0.1766	0.0428	0.0958	0.1330	0.1108	0.3237	0.1710	0.1498	0.2896	0.0517	0.1650
	(0.0000)	(0.1721)	(0.0019)	(0.0000)	(0.0025)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.1832)	(0.0000)
$\phi_{1,1}$	-0.0024	0.0055	-0.0060	-0.0154	-0.0185	-0.0131	0.0025	-0.0078	-0.0694	-0.0090	-0.0072
	(0.6291)	(0.5254)	(0.0000)	0.7029	(0.6361)	(0.0162)	(0.8302)	(0.1731)	(0.0000)	(0.3376)	(0.3775)
α	0.2943	0.0304	0.0418	0.0112	0.0421	0.0165	0.0624	0.0365	0.0276	0.1174	0.0509
	(0.0000)	(0.0000)	(0.0033)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
β	0.7473	0.8976	0.7109	0.8709	0.7775	0.7766	0.7900	0.8583	0.7161	0.8663	0.8504
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
γ	0.0488	0.0403	0.3046	0.0638	0.1014	0.1667	0.0467	0.0252	0.1314	0.0315	-0.0182
	(0.0000)	(0.0000)	(0.0139)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0018)	(0.0000)
δ	0.1953	0.0849	-0.0623	0.0911	0.0749	0.1321	0.2339	0.2094	0.1297	0.1170	0.2798
	(0.0000)	(0.0000)	(0.4178)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
H0: $\phi_{0,0} = \phi_{0,1}$	0.0197	0.0667	1.2979	0.3920	0.7942	0.0018	0.7248	3.4314	3.1478	0.5115	18.5118
	(0.8883)	(0.7962)	(0.2546)	(0.5312)	(0.3728)	(0.9664)	(0.3946)	(0.0640)	(0.0760)	(0.4745)	(0.0000)
H0: $\phi_{1,0} = \phi_{1,1}$	0.2840	0.0055	0.0130	0.1486	2.6908	0.3525	1.1324	1.9158	2.6069	0.2397	4.9337
	(0.5941)	(0.9409)	(0.9094)	(0.6999)	(0.1009)	(0.5528)	(0.2873)	(0.1663)	(0.0000)	(0.6244)	(0.0263)

The table presents the maximum likelihood estimates from the following set of equations for the 10/10/2007 – 1/8/2016 period for our eleven markets' indices:

$r_t = \omega_0 D_t + \omega_1(1 - D_t) + \theta_0 D_t \sigma_t^2 + \theta_1(1 - D_t)\sigma_t^2 + D_t(\phi_{0,0} + \phi_{1,0}\sigma_t^2) r_{t-1} + (1 - D_t)(\phi_{0,1} + \phi_{1,1}\sigma_t^2) r_{t-1} + \varepsilon_t,$

$\sigma_t^2 = \alpha + \beta\sigma_{t-1}^2 + \gamma\varepsilon_{t-1}^2 + \delta I_{t-1}\varepsilon_{t-1}^2$

D_t is a dummy variableassuming the value of unity in-Ramadan, zero otherwise.Parentheses include p-values. The bottom two rows contain the chi-squared test values from testing the hypotheses $\phi_{0,0} = \phi_{0,1}$ and $\phi_{1,0} = \phi_{1,1}$, respectively. The indices comprising our sample are: EFG Index (Egypt), Amman Stock Exchange General Index (Jordan), IDX Composite (Indonesia), FTSE Bursa Malaysia KLCI (Malaysia), CFG 25 (Morocco), MSM 30 (Oman), KSE 100 (Pakistan), Tadawul All Share (Saudi Arabia), Tunindex (Tunisia), Borsa Istanbul 100 (Turkey) and ADX General Index (United Arab Emirates).

Table 8: Maximum likelihood estimates of the extended Sentana and Wadhwani (1992) model, controlling for Ramadan-effect, post crisis (7/3/2009 – 1/8/2016)

Parameters	Egypt	Indonesia	Jordan	Malaysia	Morocco	Oman	Pakistan	Saudi Arabia	Tunisia	Turkey	UAE
ω_0	-0.0072	0.0460	-0.0469	-0.0281	-0.1034	0.0397	0.1528	0.1304	-0.0127	0.0929	0.1109
	(0.9845)	(0.7472)	(0.4826)	(0.7710)	(0.6079)	(0.5374)	(0.1937)	(0.2666)	(0.8676)	(0.7367)	(0.2408)
ω_1	-0.0250	-0.0208	-0.0335	-0.0371	-0.0676	-0.0104	0.0695	0.0459	-0.0060	0.1410	0.0022
	(0.7497)	(0.5985)	(0.1549)	(0.1433)	(0.1090)	(0.4670)	(0.0361)	(0.1213)	(0.7084)	(0.1218)	(0.9311)
θ_0	0.0048	0.0290	0.1328	0.2513	0.3185	0.0395	-0.0790	-0.0963	0.0650	-0.0305	0.0594
	(0.9802)	(0.8250)	(0.3535)	(0.4886)	(0.5738)	(0.9019)	(0.5562)	(0.5965)	(0.8875)	(0.8154)	(0.6365)
θ_1	0.0255	0.0776	0.0340	0.2069	0.1532	0.0151	0.0093	-0.0187	0.1101	-0.0388	0.0064
	(0.4454)	(0.0277)	(0.3610)	(0.0114)	(0.1773)	(0.6877)	(0.8209)	(0.4983)	(0.0811)	(0.4038)	(0.8445)
$\phi_{0,0}$	0.2451	0.0927	-0.1962	0.1066	0.1244	0.2665	0.2982	0.2940	0.5001	0.1439	0.1292
	(0.2601)	(0.5814)	(0.2676)	(0.5943)	(0.6785)	(0.1778)	(0.0636)	(0.1807)	(0.0003)	(0.4403)	(0.4171)
$\phi_{1,0}$	-0.0486	-0.0165	0.1228	0.2759	-0.1455	0.1303	-0.1293	-0.0608	-0.5618	-0.0242	-0.1220
	(0.5078)	(0.8282)	(0.2632)	(0.6002)	(0.8110)	(0.8029)	(0.3053)	(0.8198)	(0.2162)	(0.5851)	(0.4506)
$\phi_{0,1}$	0.1893	0.0549	0.0432	0.1252	0.1678	0.3320	0.2422	0.1443	0.2900	0.0839	0.1675
	(0.0001)	(0.2005)	(0.1912)	(0.0047)	(0.0011)	0.0000	(0.0000)	(0.0000)	(0.0000)	(0.2001)	(0.0000)
$\phi_{1,1}$	-0.0093	-0.0084	-0.0058	-0.0250	-0.1348	-0.0393	-0.0774	-0.0162	-0.0525	-0.0277	-0.0154
	(0.4226)	(0.6798)	(0.0001)	(0.7758)	(0.0774)	(0.0111)	(0.0027)	(0.0738)	(0.0188)	(0.2511)	(0.2241)
α	0.3124	0.0410	0.0876	0.0126	0.0551	0.0238	0.0531	0.0449	0.0277	0.1520	0.0245
	(0.0000)	(0.0000)	(0.0183)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
β	0.7429	0.8678	0.5397	0.8798	0.7458	0.7167	0.7943	0.8442	0.6957	0.8494	0.8509
	(0.0000)	(0.0000)	(0.0001)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
γ	0.0601	0.0716	0.4185	0.0496	0.0905	0.1590	0.0539	0.0204	0.1259	0.0333	0.0755
	(0.0000)	(0.0000)	(0.0913)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0006)	(0.0000)	(0.0034)	(0.0000)
δ	0.1512	0.0583	-0.1450	0.0641	0.0558	0.1781	0.2055	0.2106	0.1620	0.0951	0.1222
	(0.0000)	(0.0003)	(0.4656)	(0.0000)	(0.0005)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	((0.000)	(0.0000)
H0: $\phi_{0,0} = \phi_{0,1}$	0.0624	0.0477	1.9534	0.0082	0.0202	0.1075	0.1154	0.4548	2.2033	0.0926	0.0559
	(0.8026)	(0.8270)	(0.1622)	(0.9277)	(0.8868)	(0.7429)	(0.7341)	(0.5000)	(0.1377)	(0.7607)	(0.8129)
H0: $\phi_{1,0} = \phi_{1,1}$	0.2792	0.0104	1.3749	0.3179	0.0003	0.1054	0.1635	0.0277	1.2549	0.0045	0.4315
	(0.5971)	(0.9186)	(0.2409)	(0.5728)	(0.9860)	(0.7454)	(0.6860)	(0.8676)	(0.2626)	(0.9461)	(0.5112)

The table presents the maximum likelihood estimates from the following set of equations for the 7/3/2009 – 1/8/2016 period for our eleven markets' indices:

$$r_t = \omega_0 D_t + \omega_1(1 - D_t) + \theta_0 D_t \sigma_t^2 + \theta_1(1 - D_t)\sigma_t^2 + D_t(\phi_{0,0} + \phi_{1,0}\sigma_t^2)r_{t-1} + (1 - D_t)(\phi_{0,1} + \phi_{1,1}\sigma_t^2)r_{t-1} + \varepsilon_t,$$

$$\sigma_t^2 = \alpha + \beta\sigma_{t-1}^2 + \gamma\varepsilon_{t-1}^2 + \delta I_{t-1}\varepsilon_{t-1}^2$$

D_t is a dummy variable assuming the value of unity in-Ramadan, zero otherwise.Parentheses include p-values. The bottom two rows contain the chi-squared test values from testing the hypotheses $\phi_{0,0} = \phi_{0,1}$ and $\phi_{1,0} = \phi_{1,1}$, respectively. The indices comprising our sample are: EFG Index (Egypt), Amman Stock Exchange General Index (Jordan), IDX Composite (Indonesia), FTSE Bursa Malaysia KLCI (Malaysia), CFG 25 (Morocco), MSM 30 (Oman), KSE 100 (Pakistan), Tadawul All Share (Saudi Arabia), Tunindex (Tunisia), Borsa Istanbul 100 (Turkey) and ADX General Index (United Arab Emirates).