Political Uncertainty and Stock Market Volatility in the Middle East and North African (MENA) Countries

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Abstract

This paper examines the impact of political uncertainty (caused by the civil uprisings in the Arab World i.e., "Arab Spring") on the volatility of major stock markets in the MENA region. Our main findings are as follows. First, by distinguishing between conventional and Islamic stock market indices, we find that these two groups of investments react heterogeneously to the recent political turmoil. Specifically, we document a significant increase in the volatility of Islamic indices during the period of political unrests whereas the uprisings have had little or no significant effect on the volatility in conventional markets. Such difference is confirmed by further analysis in a multivariate GARCH model. Second, regardless of its impact on volatility, there is little evidence to suggest that MENA markets have become more integrated with international markets after the political revolution. Third, similar results are not found for the benchmark indices which indicate that the changes are the result of political tensions. In general, these results are robust to model specification and consistent with the notion that political uncertainty contributes to financial volatility. Overall, the findings are important in understanding the role of political uncertainty on stock market stability and are of great significance to investors and market regulators.

Keywords: Arab spring; political uncertainty; stock market volatility; MENA countries

JEL classification: G12, G15

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1. Introduction

On December 18th, 2010, a young vegetable vendor from a small town in Tunisia set himself ablaze in protest of the alleged police corruption and ill treatment. This incident reignited the political activism of the entire region, triggering a revolutionary wave of demonstrations and protests firstly in Tunisia and then elsewhere in the Arab world. These widespread protests and demands for reforms (the so-called "Arab Spring" movements) have led to varying degrees of political changes with rulers being forced from power in some countries along with changes of domestic and foreign policies in many governments.[1]

The opportunity for political reforms in the Middle East and North African (MENA) region brought along by Arab Spring is enormous and unprecedented. However, a major political event like this can also have an explosive effect on stock market volatility because of its economic and social implications. On the one hand, the revolutionary movements provide an opportunity for MENA countries to develop a more transparent and effective governance to unleash their economic potential. On the other hand, political uncertainty caused by the unrest could manifest itself in stock market cycles and volatility reactions shaking international investor confidence in the region.[2] It is, therefore, imperative and informative to examine whether these political movements have indeed changed the political, social, and financial landscape of MENA countries. Several studies have looked at the effects of Arab Spring on the economic performance as well as the social or political environment (e.g., O'Sullivan et al. 2012; World Bank, 2011). Yet, two years on, it remains relatively unclear whether, and to what extent, the recent political turmoil has affected the overall financial market. In this paper, we attempt to fill this gap by examining the change (if any) in MENA

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[1] The *Foreign Affairs*, published a special issue, "The New Arab Revolt" (May / June 2011, Vol 90, no. 3), including several articles on the causes and timeline of key events that have led to "Arab Spring".
[2] The political unrest has taken a toll on financial markets in many MENA countries since early January 2011. For example, the Egyptian stock exchange (North Africa's second-largest exchange) fell by 16% to the lowest level in two years shortly after reopening of its stock market closure as political unrest led to the overthrown of the country's president. The Tunisia stock exchange has also declined substantially following the unrest.

stock market stability and integration during the Arab Spring movements. Specifically, we seek to address the following questions:

1) Have the civil uprisings in the Arab World, i.e., "Arab Spring", affected the financial volatility and integration of major MENA stock markets, and if so to what extent?
2) Are there any differences in the effect across two major types of investment vehicles i.e., conventional and Islamic stock indices?

Given the growing importance of MENA countries in the world economy in general and the Shariah-compliant Islamic financial assets in particular, there is a pressing need for a rigorous research to examine the effects of Arab Spring conflicts in order to better understand the relationship between political uncertainty and financial volatility.[3] In addition, the results of our analyses are of direct interest to financial authorities and policymakers who wish to evaluate the role of major political events in triggering or exacerbating stock price movement, and to the investors who wish to invest in emerging MENA stock markets and/or Islamic indices. Furthermore, this paper adds to the growing literature studying the determinants of stock market volatility in a number of ways. Firstly, whilst increasing evidence showing that standard economic variables perform poorly in capturing stock price movements and political uncertainty is emerging as a new avenue to explore the forces driving market movements (Erb et al., 1996; Mei and Guo, 2004), most prior studies in this field have been primarily concerned with political events such as presidential elections, military invasions/wars and terrorists attacks. Little research has been conducted on the potential influence of an important source of political uncertainty arising from overthrown or changes in government

[3] In the years that the world leading economies are still suffering from the most severe financial crisis since the great depression, many economists predict that MENA region has the potential to become an emerging market leader and engine of world growth (e.g., the *World Economic Forum* on "the Middle East and North Africa", Winter 2010). In addition, MENA region has vast reserves of oil and natural gas that make it a vital source of global economic stability. Nevertheless, it is also recognised that a better cooperation and increased economic integration is necessary to unlock its potential.

as a result of civil uprisings.[4] Using Arab Spring as a unique testing environment, this paper represents the latest attempt in assessing the effect of political turbulence on the stability of financial markets.[5]

Secondly, from a methodological standpoint, this paper modifies and extends on the methodology used in prior studies. In particular, following Gulen and Mayhew (2000) and Antoniou et al. (2005), we employ a GARCH-based analytical framework to account for nonsynchronous trading, conditional heteroscedasticity in returns, and an asymmetric response to positive and negative news. Moreover, rather than selecting a univariate GARCH model ad hoc (like many prior studies have done), we carry out an extensive specification tests to determine the appropriate model, and then test the robustness of our results using a multivariate GARCH model. Finally, our study also takes into account a unique characteristic of Islamic financial markets, namely, the existence of both conventional and Islamic indices, and directly compares the reaction of these two groups of investments to the political turmoil.

The main findings of our investigation can be summarized as follows. First, our results indicate that Arab Spring conflicts and the associated political uncertainty have increased the volatility of MENA stock markets. Second, both univariate and multivariate analyses demonstrate that the impact on stock market volatility is mainly through Islamic (not conventional) indices. Third, regardless of its impact on volatility, there is little evidence to suggest that MENA markets have become more integrated with international markets after Arab Spring.

[4] See Mei and Guo (2004) for a discussion on the impact of national elections on stock markets. For a critical review of the literature on terrorism and financial markets, the reader is referred to Karolyi (2006).

[5] Whilst political uncertainty takes many different shapes and forms (e.g., elections, wars, terrorist's attacks), in many emerging countries such as MENA countries, civil protests and revolutionary movements are the major political events that have direct implications for the future political and economic course of the country. As a result, they present the major sources of risk and uncertainty to both domestic and foreign investors.

The remainder of this paper is structured as follows. Section 2 presents the research background, reviewing the related literature and key events in Arab Spring movements. Section 3 describes the data, descriptive statistics and methodologies employed; section 4 presents and discusses the empirical results and robustness checks within both univariate and multivariate frameworks. Finally, section 5 concludes the paper with a summary of main findings and their practical implications.

2. Research background

2.1 Political uncertainty and market volatility

The effects that world events have on stock prices have intrigued financial economists for decades, especially after the dramatic rises and falls of stock markets in recent years. Intuitively, in times of political and civil unrests, it is not uncommon for stock markets to experience increased levels of volatility as the occurrences of major political events signal potential shift in policy which may cause market-wide valuation changes (Karolyi, 2006). Several studies consider specific political events and test the changes in market volatility during these periods and find that political uncertainty is closely linked to market volatility. Lobo (1999) examines markets during the U.S. midterm elections in 1998 after a political scandal had been revealed and finds there was a great deal of insecurity amongst investors. Brooks et al. (1997) conduct a similar study in South Africa after a significant political change and find comparable results indicating that stock market volatility is closely linked to political instability. Leon et al. (2000) monitor volatility in Trinidad and Tobago during a period of political uncertainty and show a significant "calming of the markets" once political stability was achieved. Alexakis and Petrakis (1991) conduct a broader study on the Greek market and document a link between the behavior of stock market index and political factors.

Using an event-study analysis, it has been found that when a country is undergoing a change in its political structure, stock prices react with a great deal of uncertainty and adjust negatively during the unrests. However, the market recovers after the initial shocks are over. Using the Hang Seng index in Hong Kong, Chan and Wei (1996) show that favorable political news produces positive returns whereas unfavorable news causes negative returns. They also note that certain type of stocks and sectors are more vulnerable to political risk than the others. Specifically, their results indicate that political news has an impact on stock market volatility, mainly through the blue-chip (and not the red-chip China-related) shares. Furthermore, Perotti and Oijen (2001) conduct a study in a number of emerging markets to determine whether political shocks have any effect on stock markets; their findings show drastic changes in excess returns when political risk increased or decreased, indicating political risk is an important pricing factor in the cross-section of stock returns.

Jackson (2008) looks at the world economy after 9/11, one of the biggest events in the 21st century, and shows that although the attack took place in the U.S., markets across the world were affected. As the U.S. is a very large part of the world economy, it is not surprising to observe that the effects of 9/11 attack be far greater than other events that were analyzed in prior studies. Chesney et al. (2011) further investigate the effects of 77 terrorist attacks that occurred in 25 countries on the world economy and confirm that majority of the events had a negative effect on financial markets.

Nevertheless, most prior studies in this field have been primarily concerned with political events such as elections, wars and terrorist attacks, little research has been conducted on the impact of political uncertainty arising from civil uprisings (e.g., Arab Spring) on the stability and efficiency of financial markets. This lack of research is, perhaps, surprising given the growing importance of MENA countries and Islamic assets in the world economy in terms of both the volume and the value of trade (O'Sullivan et al. 2012). This study represents the latest attempt of such efforts to address these important issues.

2.2 Arab spring

It all started out in Tunisia in December 2010 with the tragic suicide of a young vegetable seller from a small town; the political turmoil in certain Arab countries has quickly spread into the neighboring countries and the entire world. The Arab Spring is undoubtedly a historic moment in the politics of the MENA region but its long-term impact remains unpredictable. Some argue that the recent political unrest has increased existing tensions in the region because the economic conditions of the majorities of Arab countries were already under a challenge of increasing food and energy prices, high unemployment and corruption rates, weak economic reforms, etc. These were believed to in fact be among the causes of the unrest and thus countries such as Tunisia, Egypt, Libya, Yemen, Syria and Bahrain were more likely to involve conflicts and revolutions than others (*Foreign Affairs,* May/June 2011). The effect however has spread to other countries in the same region including the wealthy countries in the Gulf Cooperation Council (GCC) who should be less affected by Arab Spring. It is expected that it will take several years for the current political uncertainty to be resolved. However, for the short-term, this turmoil will hinder economic activity and growth especially through the decline of tourism and foreign investments in the region (World Bank, 2011).

Although the uprising of Arab nations has given hope for freedoms in the Middle East, it has come with significant financial costs. The stock exchanges have already been weakened by the effect of the global financial crisis of 2007-09 and with the start of Arab Spring, the market indices all over the region have fallen. The levels of investments in the region from other markets such as foreign direct investment also declined due to the uncertainty from the unrests. Against this background, this paper aims to shed some light on the extent to which this political turmoil has impacted on the stability and integration of MENA stock markets.

3. Data and methodology

3.1 Data

Our dataset consists of daily closing prices for both conventional and Islamic stock indices from six MENA countries, namely Bahrain, Kuwait, Oman, Egypt, Jordan, and Lebanon. These countries were chosen to ensure that our sample represents a spectrum of emerging and developed equity markets from both Gulf Cooperation Council (GCC) and non-GCC countries, making it the broadest possible indicator for MENA market movement.[6] In addition, we also consider three international benchmark indices (the Arab countries, the Developed markets, and the World) to proxy for the regional, global and world influences. The dataset is obtained from Datastream which contains several sources for MENA data; Morgan Stanley Capital International (MSCI), Standard and Poor's IFC, Dow Jones, FTSE, and national indices. Taking the viewpoint of an international investor and based on the availability of datasets maintained by these prominent providers, we collect our daily data on conventional and Islamic stock indices from MSCI database for the period of June 1, 2009 - June 29, 2012 with a total of 805 observations for each series.[7]

A major distinction between conventional and Islamic stock indices is that they reflect a different sample of industries and firms. Islamic indices exclude certain "unethical" sectors and firms that derive significant income from interest or that have excessive leverage.[8] Forte and Miglietta (2007) compare between the FTSE Islamic and conventional index and find

[6] It would have been optimal to include more countries, but we were constrained by the availability and length of datasets maintained by Datastream. In addition, the stock market indices of Morocco, Tunisia, Israel, Saudi Arabia, Turkey, Algeria and Syria are not included in this study due to the size of their stock markets.

[7] See MSCI Barra's homepage (http://www.mscibarra.com/products/indices) for the details on their standard indices and Islamic indices. The sample period is chosen on the basis that it represents approximately one-and-a-half year period before and after the political turmoil started in Arab nations in December 2010.

[8] Specifically, Islamic stock index screening requires that companies with over 33% of total debt to assets are excluded. Further financial ratio filters can be applied to exclude companies whose cash and interest bearing securities exceed 33% of assets, companies whose receivables and cash account for over 45% to 50% of assets, as well as companies with the sum of non-operating interest income plus other "impure" income divided by revenues equal or greater than 5% (Zaher and Hassan, 2001).

that the Islamic index shows unique characteristics due to the inclusion of certain industries, such as oil and gas industries, and the exclusion of other industries, such as conventional financial companies. Based on these unique characteristics as well as the high degree of exposure in Islamic or *Shari'ah*-compliant financial assets, we hypothesise that the impact of Arab Spring (if any) on Islamic indices are higher than that of their conventional counterparts.

All stock market indices are expressed in US dollar terms. The continuously compounded returns are calculated as logarithmic price relatives$R_t = 100 \times ln(P_t \,/\, P_{t-1})$, where P_t is the daily closing price. Figure 1 presents a time-series plot of conventional stock market returns for selected MENA countries and three international benchmark indices during the sample period. To facilitate the comparison, we also add a solid line to denote the starting date of Arab Spring. Several interesting facts emerge; (1) although the return series appear to be stationary as expected, but they fluctuate substantially over time; (2) Bahrain, Oman and Lebanon are generally less 'volatile' markets than others (as indicated by the magnitude of their price movements); (3) all the return series are rather persistent and display a significant heteroscedasticity in their time-varying fluctuations.

[FIGURE 1 ABOUT HERE]

3.2 Methodology

We adopt a four-step empirical methodology within the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) framework to examine whether, and to what extent, the political turmoil has affected the stability and integration of MENA stock markets. Following Gulen and Mayhew (2000), the first step in our analysis is to remove the influence of worldwide movements and potential autocorrelation associated with thin-trading problem.[9] Next, using a technique similar to the one employed by Cappiello et al. (2006), we carry out an extensive model selection procedure for the most appropriate GARCH specification for each return series. Then, we examine the impact of Arab Spring on MENA stock markets' volatility using the carefully selected GARCH models that account for nonsynchronous trading, conditional heteroscedasticity, and asymmetric volatility responses. Finally, a multivariate GARCH model is used to further investigate the impact of political conflicts on the interdependence and transmission mechanism of volatility between MENA and world markets. This richer framework not only allows us to test whether the conditional covariance between a country's and the world's market return changed with the event, but it also allows us to more carefully control for the movements in international markets.

3.2.1 Preliminary tests

Our pre-whitening procedure follows that of Gulen and Mayhew (2000), in which they generate return innovations by estimating an autoregressive model:

$$R_t = \omega_0 + \alpha_0 R_{Wt-1} + \sum_{j=1}^{5} \alpha_j R_{t-j} + \sum_{\iota=MON}^{THUR} \beta_\iota DAY_\iota + u_t \qquad (1)$$

where R_t is the daily return on the MENA country's stock index and R_{wt} is the daily return on the world market index on day t, R_{t-j} is the lagged daily return on the country's stock index, and DAY_ι are day-of-the-week dummies for Monday through Thursday.[10] We use the residual

[9] There is a need for these thin-trading and world market adjustments because the emerging nature of MENA stock exchanges and the stocks that are being traded in these exchanges tend to be not the most frequently traded. For example, Lagoarde-Segot and Lucey (2008) investigate informational efficiency of MENA stock markets and find heterogeneous levels of efficiency in the MENA stock markets. The MENA markets are generally less developed than other emerging markets and suffer from a thin-trading problem.

[10] It is important to note that the MENA stock markets covered in this study usually close on Fridays, we therefore include the dummy variables for Monday to Thursday only.

$\{u_t\}$ as our new filtered return series in an effort to remove the effect of worldwide price movements and any predictability associated with lagged returns or day-of-the-week effects.

3.2.2 Model specifications

Having generated the filtered return series $\{u_t\}$, we then conduct extensive model specification tests to see which form of the conditional volatility equation best fits the series. The search and application of an appropriate GARCH model specification is important to ensure that 'non-convergence' problem is reduced to minimal. Most univariate GARCH models should encounter few convergence problems if model is well-specified and fits data reasonably well (Alexander, 2001). Thus, we compare three alternative specifications capable of capturing the common features of financial asset return variance; the standard symmetric GARCH model, the asymmetric GARCH (GJR-GARCH) model of Glosten, Jagannathan and Runkle (1993) and the exponential GARCH (EGARCH) of Nelson (1991):

$$h_t = \omega + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1} \qquad \text{[GARCH]}$$

$$\log(h_t) = \omega + \alpha\frac{|\varepsilon_{t-1}|}{\sqrt{h_{t-1}}} + \gamma\frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}} + \beta\log(h_{t-1}) \qquad \text{[EGARCH]}$$

$$h_t = \omega + \alpha\varepsilon_{t-1}^2 + \gamma I\left[\varepsilon_{t-1} < 0\right]\varepsilon_{t-1}^2 + \beta h_{t-1} \qquad \text{[GJR-GARCH]}$$

where h_t is the conditional volatility at time t, ε_{t-1} is the innovation at time t-1 and I is a dummy variable which assumes a value of one in response to bad news ($\varepsilon_{t-1}<0$) and zero in response to good news ($\varepsilon_{t-1}\geq 0$). If the coefficient γ is positive and statistically significant, then it would indicate that a negative shock has a greater impact on future volatility than a positive shock of the same size. The 'best-performing' model is selected for each individual series using several information criteria, including the log-likelihood functions (Log L), Akaike Information Criterion (AIC) and Heteroscedastic Mean Squared Error (HMSE).

3.2.3 Volatility effect of the political unrest

To determine whether the recent political uprisings in Arab world has led to an increase or decrease in MENA stock price volatility, the period under investigation can be partitioned into two sub-periods relating to before and after the turmoil began; comparisons can then be made on the estimated coefficients to draw conclusions about whether differences exist between pre- and post-event in terms of the level of volatility. However, it is rather difficult to obtain reliable GARCH estimates in sub-periods with a small number of observations.[11] Thus, the entire sample was utilized in this study to minimize the risk that the small sample will lead to inconsistent GARCH estimates. The estimation of full sample rather than two sub-periods also has an advantage of improving efficiency (Antoniou et al., 2005). Therefore, to test the impact of political uprisings, we incorporate a multiplicative dummy variable into the *best* conditional variance equation according to the selection procedure outlined above. For instance, in the case of GJR-GARCH conditional volatility equation:

$$h_t = (1+\lambda_d D_t)(\omega + \alpha\varepsilon_{t-1}^2 + \gamma I[\varepsilon < 0]\varepsilon_{t-1}^2 + \beta h_{t-1}) \qquad (2)$$

where D_t is an event dummy variable takes on a value of unity after the start of Arab Spring and zero otherwise. A significant positive-parameter estimate for λ_d would indicate an increase in MENA stock market volatility during the period of political uncertainty.[12]

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[11] A number of authors have acknowledged difficulty of obtaining reliable GARCH estimates in small sample. For example, Hwang and Pereira (2006) suggest using at least 500 daily data for proper GARCH estimation.
[12] This analytical framework is similar to that adopted by Gulen and Mayhew (2000) in the context of the impact of equity index futures trading on stock market volatility in twenty-five countries.

3.2.4 Joint dynamics of MENA country and world volatility

The final stage of our empirical analysis consists of fitting a multivariate GARCH model to examine the joint dynamics of each MENA country's return with the world's return. This framework allows us to test directly whether the start of political revolution in Arab countries has any impact on the conditional covariance between country's and world's returns (a measure of the country's financial integration with international markets). In addition, the univariate models we employ above may not fully allow for time-varying conditional covariance between the country's and world's returns so if the conditional covariance changes systematically with the political protests, then our previous analysis might be biased. To address these issues, we use the BEKK specification of Engle and Kroner (1995) which allows conditional variances and covariance to influence each other:[13]

$$\begin{aligned} \mathrm{H}_t = C'C &+ \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}' \begin{bmatrix} \varepsilon_{1,t-1}^2 & \varepsilon_{1,t-1}\varepsilon_{2,t-1} \\ \varepsilon_{2,t-1}\varepsilon_{1,t-1} & \varepsilon_{2,t-1}^2 \end{bmatrix} \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \\ &+ \begin{bmatrix} g_{11} & g_{12} \\ g_{12} & g_{22} \end{bmatrix}' \mathrm{H}_{t-1} \begin{bmatrix} g_{11} & g_{12} \\ g_{12} & g_{22} \end{bmatrix} + \begin{bmatrix} d_{11} & d_{12} \\ d_{12} & 0 \end{bmatrix} D_t \end{aligned} \qquad (3)$$

The innovations in equation (3) are estimated from the following bivariate process:

$$R_{it} = \omega_0 + \sum_{j=1}^{5} \alpha_j R_{i,t-j} + \sum_{\iota=MON}^{THUR} \beta_\iota DAY_\iota + \varepsilon_{i,t} \qquad (4)$$

$$R_{wt} = \omega_0 + \sum_{j=1}^{5} \alpha_j R_{w,t-j} + \sum_{\iota=MON}^{THUR} \beta_\iota DAY_\iota + \varepsilon_{w,t} \qquad (5)$$

where C represents a matrix of constant coefficients; the error terms are assumed to be multivariate normal. Because we wish to capture the impact of Arab Spring on the country-specific volatility and conditional covariance (not to test whether this event influenced

[13] For a comprehensive review of the widely used multivariate GARCH models, see Bauwens et al. (2006).

world's market volatility), we do not include a dummy variable in the conditional variance equation for world returns in equation (3); i.e., d_{22} of the matrix of dummy coefficients is set to be zero. Analogous to the dummy variable in the univariate GARCH equations analyzed above, the interpretation of the dummy coefficient d_{11} is that a significant and positive estimate confirms an increase in MENA stock market volatility during the political uprisings. Similarly, a significant estimate for d_{12} would indicate that political revolution has impacted on the extent to which the individual MENA stock market is integrated with the world market.

4. Empirical results

4.1 Pre-whitening and summary statistics

The first stage of our analysis consists of fitting the autoregressive equation (1) to each individual stock return series (i.e., conventional and Islamic indices) to remove the effect of worldwide price movements on volatility and to correct for spurious autocorrelation induced by nonsynchronous trading. A number of studies on individual MENA stock markets have found the existence of market contagion and anomalies such as day-of-the-week effects (e.g., Yu and Hassan, 2008; Cheng et al., 2010). In order to concentrate only on the unpredictable part of return series when estimating the conditional variance, adjustments are made to the data along the lines of Engle and Ng (1993) and Gulen and Mayhew (2000). Results for the autoregressive coefficients (α_1 to α_5) reported in Table 1 show that there are significant autocorrelations and the coefficients are mostly negative. The β coefficient estimates confirm the presence of day-of-the-week effects for Bahrain, Kuwait, and Lebanon. This is perhaps not very surprising given the relatively small and inactive equity markets of these nations.[14] It

[14] It is now widely recognized that the thin-trading problem and inactive stock markets are the major sources of spurious autocorrelation commonly observed in financial asset returns (Engle and Ng, 1993).

is also interesting to note that, for both conventional and Islamic indices, the impact of lagged world market index (as reflected by α_0) is positive and highly significant, indicating that MENA stock markets are largely influenced by the price movements of global markets.

[TABLE 1 ABOUT HERE]

Using the residuals from equation (1) as our new return series, we proceed to test the effect of Arab Spring on the conditional volatility of MENA stock market using a variety of GARCH specifications. Summary statistics for these unpredictable returns $\{u_t\}$ are given in Table 2. The table shows a clear evidence of departures from normality as implied by excessive skewness and kurtosis statistics. Interestingly, both conventional and Islamic stock indices display similar standard deviation estimates (an unconditional measure of financial volatility). All the Ljung-Box statistics for the returns are not statistically significant, indicating that our 'filtered' return series are no longer serially correlated. The significant ARCH test statistics, however, show that in all cases there are still temporal dependencies in the higher moment of return distribution. The JOINT test of asymmetries in conditional volatility suggests there are significant asymmetries in volatility responses. Taken together, the statistical nature of return distribution supports the use of autoregressive conditional heteroscedasticity (ARCH) model for the variance processes of returns.

[TABLE 2 ABOUT HERE]

4.2 Volatility effect of the political uprisings

Having demonstrated the need to account for conditional heteroscedasticity in filtered returns, we now address the main research question of this paper relating to the impact of recent political turmoil in Arab countries (i.e., Arab Spring) on the MENA stock markets.

The *best* conditional variance equation (as selected by model specification tests) is estimated for both conventional and Islamic market returns and the returns on the international benchmark indices.[15] Specification tests reported in Table 3 indicate that (according to Log L, HMSE and AIC) asymmetric GARCH models fit the data better than symmetric model in 14 (out of 16) cases, with GJR-GARCH performing relatively better than EGARCH.[16,17]

[TABLE 3 ABOUT HERE]

To investigate the impact of Arab Spring on the level of volatility, a multiplicative dummy is incorporated in the best volatility model in a similar fashion as in equation (2). Table 4 contains the specifications of selected GARCH processes and estimated parameters. Consider first the results for the conventional stock indices given in panel A. It can be seen that the coefficients describing the conditional variance process, ω, α, β, γ are not unusual. Specifically, they are highly significant (except a few γ) for returns. In all cases, the moving average parameters α are close to 0 and autoregressive parameter β tend to be close to 1, suggesting that the conditional volatility is a highly persistent process. The significance of γ means that conditional variance is an asymmetric function of the past squared residuals. This is consistent with the widespread evidence that of the stock market volatility is highly persistent and asymmetric (Engle and Ng, 1993; Bauwens et al., 2006).

[TABLE 4 ABOUT HERE]

[15] The Berndt-Hall-Hall-Hausman (BHHH) optimization algorithm is employed to obtain maximum likelihood estimates of the GARCH parameters. The standard diagnostic tests of the residual from the selected model confirm the absence of any further ARCH effects, suggesting an appropriate model specification. In the interest of brevity, results of these diagnostic tests are not reported but available from the authors on request.

[16] The superiority of GJR-GARCH model is consistent with the previous findings of Engle and Ng (1993) for Japanese market and that of Kim and Kon (1994) for US market indices and individual stocks.

[17] It is also interesting to note that, as widespread as the evidence of asymmetric volatility is in the conventional market indices, this phenomenon is equally present in the Islamic stock indices. While it is beyond the scope of this paper, it will be interesting in future work to understand better the time-series properties of Islamic indices.

Of the greatest interest in this table is the coefficient estimates obtained for the dummy variable λ_d, providing an indication of whether or not the MENA stock market volatility has changed during the period of political uncertainty. The evidence suggests that the conditional variance for 3 of the 6 conventional indices (i.e., Kuwait, Egypt and Lebanon) experienced significant changes in their volatility around the starting date of the major political uprisings. As this change was not generally present in the control benchmark indices (Arab and Developed markets), there is support for the change being induced by the recent revolution. Similarly, the results for the Islamic indices in panel B indicate that the relevant coefficients in the variance equation have significantly increased in 5 of the 6 countries at the 5% level (only Oman produces an insignificant dummy coefficient). Once more, no significant λ_d coefficient was found for the control benchmark indices (Arab and Developed markets); indicating that the changes are due to the political revolution.

One possible explanation for the volatility increases could be because of the widespread political protests have seriously threatened the older order in the Middle East, and rating agencies have been downgrading their sovereign ratings for many MENA countries to account for the increased political risk. Furthermore, sovereign Credit Default Swap (CDS) spreads widened and countries' borrowing cost in international financial markets have substantially increased, adding stress and instability in the stock markets in MENA region (World Bank, 2011). Another reason is the political and regional uncertainty created by the uprisings has undermined the business confidence of international investors in the region, causing serious nervousness and panic in the stock markets.[18] These findings further imply that it is imperative for new governments to restore both domestic and international investors' confidence in order to promote the region's financial stability and economic growth. Finally, in support to our hypothesis, the results show that Arab Spring has a bigger impact on Islamic

[18] For a recent review of the economic and social impact of the Arab Spring on MENA countries, see Charafeddine (2012).

indices than on conventional investments. It appears that the unique composition of Islamic indices (and their substantial exposure to Arabian or *Shari'ah*-compliant financial assets) may have made them more sensitive to such events than their conventional counterparts.

4.3 Robustness checks and additional tests

To summarize the results so far, the evidence presented above suggests that there is a significant increase in volatility of MENA stock markets, particularly for the Islamic indices. These results are consistent with the notion that political uncertainty contributes to financial volatility, probably because of the panic and instability brought by the uprisings and protests. In this section, we examine the robustness of our results by implementing different econometric specifications, data currency and alternative assumptions for GARCH errors. First, we investigate the effect of Arab Spring on volatility by adding an *additive* dummy variable in the selected 'best' GARCH specification and repeat our earlier analysis. In general, the findings (not reported here but are available upon request) are qualitatively similar to the results documented in Table 4, confirming our main conclusion that the volatility of major MENA stock markets has increased roughly the same time as Arab Spring movements. Second, consideration is also given to the possible changes to our results when daily closing prices are denominated in their local currency instead. Overall, results for the US dollar denominated returns carry over to the same return series denominated in the local currency.

4.4 The multivariate GARCH approach

A study by the International Monetary Fund (IMF) indicates that greater integration with international markets could provide a substantial boost to income and economic growth for MENA countries.[19] Thus, in this final section, we extend our analysis to a multivariate GARCH framework to allow for the possibility that the conditional covariance between MENA country's and world's returns (a measure of financial integration) is time-varying and may be simultaneously affected by the political uprisings. To keep the discussion compact, we concentrate on interpreting those coefficients that are most relevant to the issues at hand. That is, the parameters for conditional variance equation of individual MENA countries' returns as well as the estimate for dummy variable d_{12}, which indicate the extent to which level of integration between MENA and world stock markets has been impacted by the recent political movements. An inspection of the d_{11} results in Table 5 shows that the volatility impact of Arab Spring is largely consistent with those reported in univariate GARCH models. It should however be noted that under this specification the volatility effect for Jordan is no longer significant. Although the results are not as consistent as those from the univariate analysis, we still observe a propensity for volatility to increase in Islamic indices during the Arab Spring movements.

On the contrary, examining the dummy coefficients d_{12} in the conditional covariance equation, we find little evidence to support Gilpin's (2001) notion that political revolution would encourage the financial activities and better integrate the country's stock market with the world market. Although the revolutionary movements provide an unprecedented opportunity for MENA countries to develop necessary conditions for the creation of a truly global economy and to promote a greater integration with international markets, the developments of domestic economies and national policies still appear to be the main driving forces behind the movements of MENA stock markets.

[TABLE 5 ABOUT HERE]

[19] "Regional Economic Outlook: Middle East and Central Asia" IMF World Economic and Financial Surveys (October 2010), available at http://www.imf.org/external/pubs/ft/reo/2010/mcd/eng/mreo0510.pdf

5. Conclusion

In this paper, we have examined the effect of civil uprisings in the Arab World i.e., "Arab Spring" (and the associated political uncertainty) on the volatility and integration of major stock markets in the MENA region. We begin our analysis by modeling the unpredictable returns of both conventional and Islamic stock indices using various GARCH models to account for nonsynchronous trading, conditional heteroscedasticity and asymmetric volatility responses. Our results indicate that the Arab Spring (and the associated political turbulence) has contributed to volatility of MENA stock markets, especially for the Islamic indices; however there is little or no significant impact on their interaction and integration with the World market. These results appear to be robust to model specifications and are consistent with prior studies such as Bailey and Chung (1995) and Boutchkova et al. (2012) on other stock markets, in that political uncertainty contributes to financial volatility. This in turn suggests that financial asset price movement is driven, at least in part, by political events in addition to the common financial and economic factors (Gilpin, 2001).

Overall, these findings complement to the growing literature on the relationship between political risk and asset price, providing evidence on the financial impact of Arab Spring movements. We deem our results very important in contributing to the current debate on the role of political risk in asset pricing and volatility behavior, and are of great significance to regulators and international investors who wish to invest in MENA stock markets and/or Islamic stocks. Constantly erupting political scandals tend to shake investor confidence, creating unnecessary nervousness and turbulences in the financial markets. It is, therefore, imperative for the new governments to restore business confidence in order to promote the region's financial stability and economic growth. On a more general note, our findings might have implications for studies on the determinants of time-varying stock return volatility (e.g., Campbell et al., 2001; Kearney and Poti, 2008). Our evidence suggests that political tension and uncertainty can trigger or exacerbate the volatility of financial markets. We suggest two directions for future research. First, the multivariate GARCH modelling framework used in this paper could be extended in an effort to identify the contagion effect among the MENA, the developed, and the World stock markets. Furthermore, since a number of studies have documented the impact of other political events (e.g., elections, wars and terrorist attacks) on market volatility, a comparative assessment of the stock market reaction to different political events would also be an interesting area for future research.

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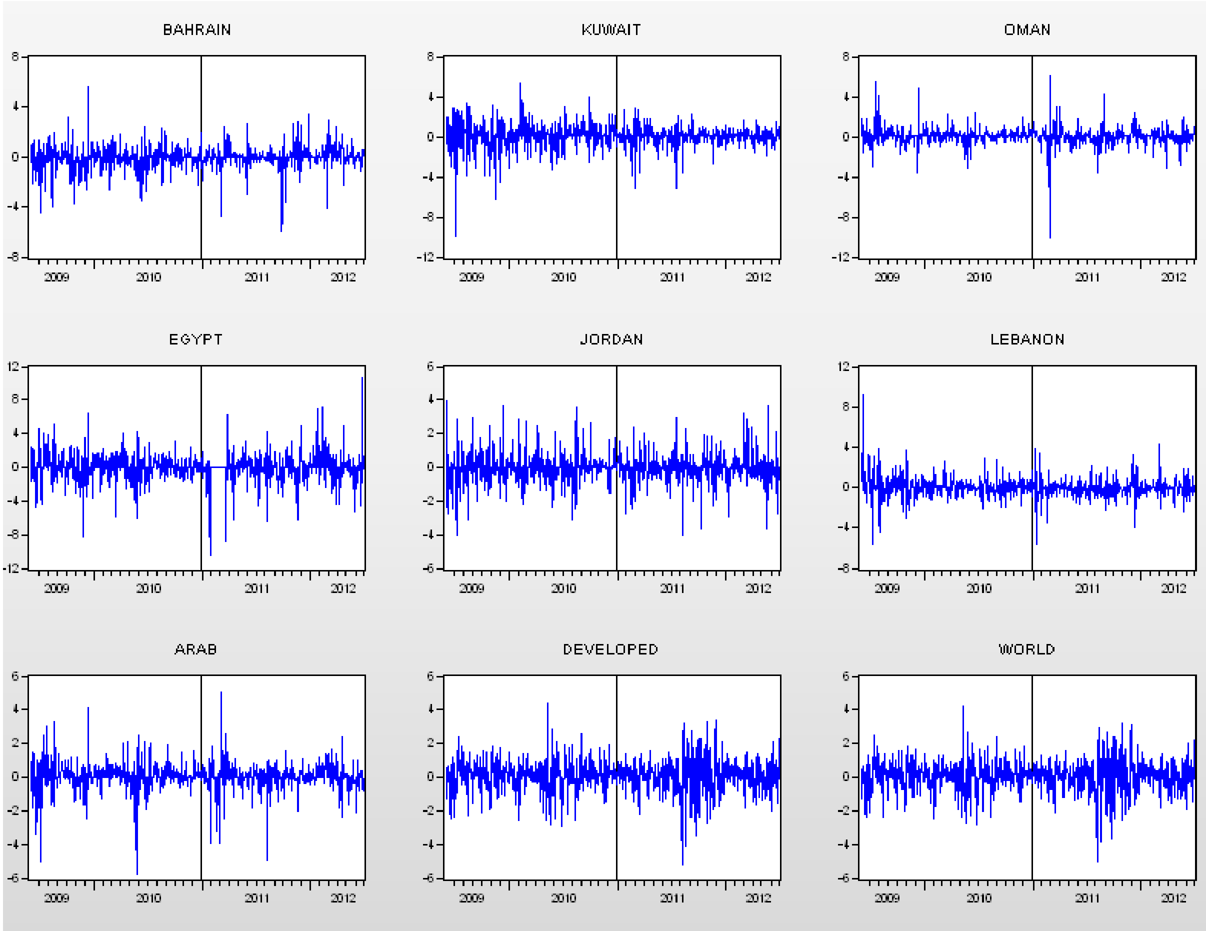
Figure 1: A time-series plot of MENA and World stock return movements, 2009-2012



Note:
This figure presents a time-series plot of conventional stock market returns for selected MENA countries and three international benchmark indices (Arab, Developed, World indices) during the entire sample period from June 1 2009 through June 29, 2012. The solid line denotes the starting date of Arab Spring.

Table 1: Results from the preliminary regression

	Constant	α_0	α_1	α_2	α_3	α_4	α_5	β_{Mon}	β_{Tue}	β_{Wed}	β_{Thur}
Panel A : Conventional											
Bahrain	-0.2647 ***	0.0247	0.1412 ***	0.0671 *	0.0054	-0.0336	0.0233	0.1907 *	0.2363 **	0.3083 ***	0.2554 **
	(-3.430)	(0.676)	(3.970)	(1.870)	(0.151)	(-0.936)	(0.660)	(1.750)	(2.160)	(2.820)	(2.340)
Kuwait	-0.1817 *	0.1042 **	0.0170	-0.0252	-0.0028	0.0068	0.0187	0.3080 **	0.1475	0.2232 *	0.1773
	(-1.920)	(2.310)	(0.476)	(-0.711)	(-0.078)	(0.192)	(0.537)	(2.300)	(1.100)	(1.670)	(1.320)
Oman	0.0405	0.2441 ***	-0.0897 ***	0.0987 ***	0.0461	0.0638 *	0.0199	-0.0443	-0.0878	-0.0214	-0.0462
	(0.592)	(7.450)	(-2.590)	(2.870)	(1.340)	(1.860)	(0.579)	(-0.458)	(-0.906)	(-0.220)	(-0.477)
Egypt	-0.0952	0.3071 ***	0.0741 **	0.0037	0.0160	-0.0132	-0.0508	0.0605	0.0044	0.2392	0.0692
	(-0.706)	(4.770)	(2.100)	(0.104)	(0.456)	(-0.376)	(-1.430)	(0.317)	(0.023)	(1.250)	(0.363)
Jordan	-0.1126	0.1257 ***	0.0018	-0.0143	0.0466	-0.0255	0.0475	0.0082	-0.0553	0.2190 **	0.1053
	(-1.540)	(3.640)	(0.052)	(-0.405)	(1.330)	(-0.733)	(1.380)	(0.079)	(-0.534)	(2.110)	(1.020)
Lebanon	-0.1819 **	0.0638 *	0.1144 ***	-0.1070 ***	0.0337	0.0351	-0.0661 *	0.2158 *	0.2643 **	0.1407	0.2323 **
	(-2.250)	(1.660)	(3.230)	(-3.020)	(0.947)	(0.991)	(-1.870)	(1.880)	(2.310)	(1.230)	(2.030)
Arab	0.1397	0.2247 ***	-0.0627	0.0254	0.0098	-0.0125	0.0154	0.0017	-0.0486	-0.0510	-0.2483
	(1.150)	(3.290)	(-1.500)	(0.717)	(0.274)	(-0.353)	(0.436)	(0.010)	(-0.283)	(-0.297)	(-1.440)
Developed	0.0174	0.6672 ***	-0.3529 ***	-0.0811 **	-0.0778 **	-0.0443	-0.0143	-0.0393	0.0773	-0.0197	-0.1015
	(0.151)	(5.760)	(-4.810)	(-2.260)	(-2.220)	(-1.260)	(-0.409)	(-0.240)	(0.472)	(-0.121)	(-0.620)

Note:
This table reports the results from the first-stage pre-whitening regression of each country-specific returns on lagged world-market index, lagged own returns, and day-of-the-week dummies

$$R_t = \omega_0 + \alpha_0 R_{Wt-1} + \sum_{j=1}^{5} \alpha_j R_{t-j} + \sum_{\iota=MON}^{THUR} \beta_\iota DAY_\iota + u_t \qquad (1)$$

where R_t is the daily return on the country's stock index and R_{wt} is the daily return on the world market index on day t, R_{t-j} is the lagged daily return on the country's stock index, and DAY_ι are day-of-the-week dummies for Monday through Thursday. The model is estimated for each country-specific returns for both conventional stock index (Panel A) and Islamic stock index (Panel B). The t-statistics are shown in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, 1% level, respectively.

Table 1: Results from the preliminary regression (Cont'd)

	Constant	α_0	α_1	α_2	α_3	α_4	α_5	β_{Mon}	β_{Tue}	β_{Wed}	β_{Thur}
Panel B : Islamic											
Bahrain	-0.3414 ***	0.0385	0.1342 ***	0.0456	0.0200	-0.0153	-0.0106	0.2611 **	0.2916 **	0.3855 ***	0.3381 ***
	(-3.890)	(0.925)	(3.770)	(1.270)	(0.557)	(-0.427)	(-0.300)	(2.110)	(2.350)	(3.100)	(2.730)
Kuwait	-0.3456 ***	0.1132 **	-0.0125	-0.0427	-0.0063	0.0252	0.0226	0.4964 ***	0.3341 **	0.3104 **	0.3530 **
	(-3.440)	(2.360)	(-0.349)	(-1.200)	(-0.179)	(0.716)	(0.646)	(3.480)	(2.350)	(2.180)	(2.480)
Oman	0.1239 **	0.1753 ***	-0.0639 *	0.0760 **	-0.0001	0.0445	0.0189	-0.1052	-0.2525 ***	-0.1397	-0.1241
	(2.020)	(5.990)	(-1.830)	(2.180)	(-0.004)	(1.280)	(0.545)	(-1.210)	(-2.910)	(-1.610)	(-1.430)
Egypt	0.0181	0.2632 ***	0.0806 **	0.0053	-0.0328	-0.0065	-0.0432	-0.0121	-0.1410	0.1196	-0.0345
	(0.138)	(4.170)	(2.270)	(0.150)	(-0.929)	(-0.183)	(-1.210)	(-0.065)	(-0.759)	(0.644)	(-0.186)
Jordan	0.0990	0.1791 ***	0.0244	-0.0155	0.0144	-0.0195	0.0128	-0.2482 *	-0.1197	-0.2131	-0.0969
	(0.956)	(3.600)	(0.690)	(-0.438)	(0.407)	(-0.558)	(0.369)	(-1.690)	(-0.817)	(-1.450)	(-0.661)
Lebanon	-0.3010 **	0.1077 *	0.1211 ***	-0.1090 ***	0.0027	0.0393	-0.0934 ***	0.2918 *	0.4081 **	0.2151	0.3872 **
	(-2.550)	(1.910)	(3.420)	(-3.070)	(0.077)	(1.110)	(-2.650)	(1.750)	(2.440)	(1.290)	(2.320)
Arab	0.1056	0.2210 ***	-0.0106	-0.0335	0.0063	-0.0063	0.0079	-0.0046	-0.0407	-0.0089	-0.0565
	(0.809)	(3.230)	(-0.275)	(-0.940)	(0.176)	(-0.177)	(0.222)	(-0.025)	(-0.221)	(-0.048)	(-0.306)
Developed	0.0436	0.6717 ***	-0.3921 ***	-0.0878 **	-0.0481	-0.0379	-0.0064	-0.0195	0.0349	-0.0448	-0.1329
	(0.398)	(6.260)	(-5.510)	(-2.450)	(-1.370)	(-1.090)	(-0.182)	(-0.126)	(0.225)	(-0.289)	(-0.856)

Note:
This table reports the results from the first-stage pre-whitening regression of each country-specific returns on lagged world-market index, lagged own returns, and day-of-the-week dummies

$$R_t = \omega_0 + \alpha_0 R_{Wt-1} + \sum_{j=1}^{5} \alpha_j R_{t-j} + \sum_{\iota=MON}^{THUR} \beta_\iota DAY_\iota + u_t \qquad (1)$$

where R_t is the daily return on the country's stock index and R_{wt} is the daily return on the world market index on day t, R_{t-j} is the lagged daily return on the country's stock index, and DAY_ι are day-of-the-week dummies for Monday through Thursday. The model is estimated for each country-specific returns for both conventional stock index (Panel A) and Islamic stock index (Panel B). The t-statistics are shown in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, 1% level, respectively.

Table 2: Summary statistics of filtered returns

	Mean	Max	Min	Std. Dev.	Skew	Kurt	LB(6)	ARCH(6)		JOINT	
Panel A : Conventional											
Bahrain	0.0000	5.8094	-5.5995	0.9639	-0.5743	6.3936	0.838	58.918	***	12.984	***
								<0.000>		<0.004>	
Kuwait	0.0000	5.6830	-9.5986	1.1841	-1.0611	8.5607	0.651	42.087	***	4.612	
								<0.000>		<0.202>	
Oman	0.0000	5.2687	-10.1085	0.8601	-1.2355	29.6312	3.299	38.728	***	24.761	***
								<0.000>		<0.000>	
Egypt	0.0000	10.4019	-10.2490	1.6910	-0.3556	6.7436	1.682	16.343	**	14.012	***
								<0.012>		<0.003>	
Jordan	0.0000	3.7009	-3.6378	0.9112	0.0633	3.1337	4.591	32.517	***	7.542	*
								<0.000>		<0.056>	
Lebanon	0.0000	9.1487	-5.4483	1.0133	0.9062	12.1709	3.033	52.919	***	23.575	***
								<0.000>		<0.000>	
Arab	0.0000	6.8615	-7.1051	1.5232	-0.1598	1.5319	5.238	53.560	***	38.155	***
								<0.000>		<0.000>	
Developed	0.0000	8.2091	-6.7720	1.4519	-0.0751	2.6220	0.444	59.742	***	10.022	**
								<0.000>		<0.018>	
Panel B : Islamic											
Bahrain	0.0000	7.5131	-6.4238	1.0938	-0.3338	7.0730	1.623	25.429	***	4.732	
								<0.000>		<0.193>	
Kuwait	0.0000	4.6804	-10.4191	1.2504	-1.1606	9.8499	4.908	13.422	**	2.615	
								<0.037>		<0.455>	
Oman	0.0000	7.3998	-5.8411	0.7671	1.6445	21.4398	1.365	25.825	***	24.077	***
								<0.000>		<0.000>	
Egypt	0.0000	11.0935	-10.4128	1.6474	-0.0745	9.5837	2.523	25.671	***	6.534	*
								<0.000>		<0.088>	
Jordan	0.0000	7.7303	-7.6392	1.2978	0.0895	4.9185	4.680	11.251	*	0.517	
								<0.081>		<0.915>	
Lebanon	0.0000	11.5008	-7.9327	1.4760	0.5530	8.7959	3.799	70.714	***	41.155	***
								<0.000>		<0.000>	
Arab	0.0000	6.8747	-7.5304	1.6374	0.0465	2.1170	7.534	34.462	***	21.296	***
								<0.000>		<0.000>	
Developed	0.0000	6.4576	-6.4315	1.3770	-0.1447	1.8112	0.920	65.829	***	5.270	
								<0.000>		<0.153>	

Note:

This table presents the summary statistics of filtered returns generated from the first-stage pre-whitening equation (1) for both conventional stock indices (Panel A) and Islamic stock indices (Panel B). LB(6) is the Ljung-Box Q test of serial correlation for the return; the test statistics are distributed as χ^2 with 6 degree of freedom. ARCH(6) is the Lagrange Multiplier LM test for ARCH effects and distributed as a χ^2 with 6 degree of freedom. The test results for JOINT are Engle and Ng's (1993) test for the potential asymmetries in conditional volatility. The test statistic is a F-statistic for the null hypothesis of $b_1=b_2=b_3=0$ of the following regression:

$$Z_t^2 = a + b_1 S_t^- + b_2 S_t^- \varepsilon_{t-1} + b_3 S_t^+ \varepsilon_{t-1} + v_t$$

where Z_t^2 is the square standardized residuals, $(\varepsilon_{t-1}/\sigma_t)^2$, S_t^- is a dummy variable that takes a value of unity if $\varepsilon_{t-1} < 0$ and zero otherwise; and S_t^+ is a dummy variable that takes a value of unity if $\varepsilon_{t-1} > 0$ and zero otherwise.

Table 3: Results of specification tests for various GARCH models

	GARCH			EGARCH			GJR-GARCH			Selected Model
	Log L	HMSE	AIC	Log L	HMSE	AIC	Log L	HMSE	AIC	
Panel A : Conventional										
Bahrain	-1054.23	8.6146	2.6456	-1097.87	8.6959	2.7572	**-1048.49**	**8.1675**	**2.6337**	GJR-GARCH
Kuwait	**-1202.29**	9.1734	**3.0157**	-1253.70	8.8590	3.1467	-1202.96	**8.8346**	3.0199	GARCH
Oman	-919.58	11.5805	2.3089	-989.26	23.9242	2.4856	**-768.58**	**5.3519**	**1.9364**	GJR-GARCH
Egypt	-1537.62	8.3922	3.8541	-1529.89	8.3262	3.8372	**-1529.50**	**7.9459**	**3.8362**	GJR-GARCH
Jordan	-1050.92	5.1197	2.6373	-1048.35	**4.7334**	2.6334	**-1038.28**	5.0835	**2.6082**	GJR-GARCH
Lebanon	-1064.92	16.8389	2.6723	-1063.76	16.1358	2.6719	**-1063.39**	**15.8506**	**2.6710**	GJR-GARCH
Arab	-1447.39	**2.7926**	3.6285	-1445.98	2.9107	3.6274	**-1442.64**	2.8165	**3.6191**	GJR-GARCH
Developed	-1373.76	2.7891	3.4444	**-1346.51**	**2.4340**	**3.3788**	-1353.00	2.4541	3.3950	EGARCH
Panel B : Islamic										
Bahrain	-1157.68	8.8032	2.9042	-1199.71	8.8023	3.0118	**-1148.98**	**8.1817**	**2.8850**	GJR-GARCH
Kuwait	-1249.30	6.8078	3.1333	-1301.83	8.8048	3.2671	**-1246.13**	**6.5163**	**3.1278**	GJR-GARCH
Oman	-852.68	17.7630	2.1417	-901.58	23.0914	2.2664	**-847.63**	**17.5183**	**2.1316**	GJR-GARCH
Egypt	-1514.53	10.5615	3.7963	-1517.12	**9.6716**	3.8053	**-1502.18**	10.0620	**3.7680**	GJR-GARCH
Jordan	**-1185.10**	**5.0487**	**2.9778**	-1318.45	7.8491	3.3061	-1317.95	7.9533	3.3074	GARCH
Lebanon	-1350.30	12.9233	3.3858	-1350.95	**12.2404**	3.3899	**-1349.25**	12.3340	**3.3856**	GJR-GARCH
Arab	-1505.53	**3.5318**	3.7738	**-1498.90**	3.6339	**3.7597**	-1500.18	3.5904	3.7629	EGARCH
Developed	-1346.19	2.6508	3.3755	**-1318.78**	**2.2637**	**3.3095**	-1325.45	2.3072	3.3261	EGARCH

Note:
This table summarizes the results from an extensive GARCH model specification test. The standard GARCH model is compared with the asymmetric GJR-GARCH and the EGARCH:

$$h_t = \omega + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1} \qquad \text{[GARCH]}$$

$$\log(h_t) = \omega + \alpha\frac{|\varepsilon_{t-1}|}{\sqrt{h_{t-1}}} + \gamma\frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}} + \beta\log(h_{t-1}) \qquad \text{[EGARCH]}$$

$$h_t = \omega + \alpha\varepsilon_{t-1}^2 + \gamma I\left[\varepsilon_{t-1} < 0\right]\varepsilon_{t-1}^2 + \beta h_{t-1} \qquad \text{[GJR-GARCH]}$$

The 'best-performing' model is chosen on the basis of several information criteria, including the log-likelihood functions (Log L), Akaike Information Criterion (AIC) and Heteroscedastic Mean Squared Error (HMSE). The best model according to each criterion is highlighted in bold while the selected specifications used in our analysis are reported in the final column.

Table 4: Effects of Arab Spring on the MENA stock market volatility

	Selected Model	ω	α	β	γ	λ_d
Panel A : Conventional						
Bahrain	GJR-GARCH	0.0748 ***	0.0471 ***	0.8176 ***	0.1256 ***	0.0155
		(5.844)	(2.831)	(38.647)	(5.701)	(1.446)
Kuwait	GARCH	0.0619 ***	0.0561 ***	0.9153 ***		0.0657 ***
		(4.178)	(6.325)	(64.071)		(4.374)
Oman	GJR-GARCH	0.0379 ***	-0.0177 ***	0.8399 ***	0.2651 ***	-0.0094
		(6.770)	(-3.084)	(45.677)	(11.212)	(-1.134)
Egypt	GJR-GARCH	0.6123 ***	-0.0032	0.6753 ***	0.1397 ***	-0.0767 ***
		(5.130)	(-0.234)	(12.751)	(4.891)	(-4.071)
Jordan	GJR-GARCH	0.0682 ***	-0.0190 **	0.8849 ***	0.0972 ***	-0.0048
		(3.998)	(-2.536)	(36.124)	(5.225)	(-0.656)
Lebanon	GJR-GARCH	0.0627 ***	0.1533 ***	0.8062 ***	-0.0313	0.0337 ***
		(6.806)	(8.193)	(60.497)	(-1.017)	(2.620)
Arab	GJR-GARCH	0.4546 ***	0.0478 **	0.6833 ***	0.1428 ***	0.0104
		(3.819)	(2.150)	(10.522)	(3.386)	(0.400)
Developed	EGARCH	0.0161 *	0.0857 ***	0.9687 ***	1.8478 ***	-0.0026
		(1.955)	(3.247)	(131.326)	(2.936)	(-0.419)
Panel B : Islamic						
Bahrain	GJR-GARCH	0.0834 ***	0.0432 ***	0.8260 ***	0.1535 ***	0.0221 **
		(6.147)	(2.766)	(40.933)	(6.269)	(2.319)
Kuwait	GJR-GARCH	0.0941 ***	0.0267 *	0.8874 ***	0.0978 ***	0.0894 ***
		(4.607)	(1.798)	(42.860)	(4.209)	(5.099)
Oman	GJR-GARCH	0.0363 ***	0.0514 ***	0.8360 ***	0.1488 ***	0.0117
		(4.893)	(3.606)	(31.938)	(5.199)	(1.089)
Egypt	GJR-GARCH	0.3560 ***	-0.0042	0.7861 ***	0.1375 ***	0.0332 ***
		(5.371)	(-0.565)	(25.908)	(6.120)	(3.152)
Jordan	GARCH	0.0286 ***	0.1119 ***	0.9326 ***		0.0365 ***
		(3.877)	(4.572)	(55.577)		(3.153)
Lebanon	GJR-GARCH	0.2270 ***	0.2307 ***	0.7135 ***	-0.0373	0.0877 ***
		(6.535)	(7.281)	(31.604)	(-0.861)	(3.300)
Arab	EGARCH	0.1206 ***	0.1876 ***	0.8638 ***	0.5942 ***	-0.0243
		(3.440)	(5.009)	(23.307)	(4.085)	(-1.427)
Developed	EGARCH	0.0096	0.0484 **	0.9777 ***	2.8293 **	-0.0023
		(1.534)	(2.230)	(157.301)	(2.164)	(-0.494)

Note:
This table reports the parameter estimates for each of the selected ‘best-performing’ GARCH model with a multiplicative dummy; for instance in the case of GJR-GARCH:

$$h_t = (1+\lambda_d D_t)(\omega + \alpha\varepsilon_{t-1}^2 + \gamma I[\varepsilon < 0]\varepsilon_{t-1}^2 + \beta h_{t-1}) \qquad (2)$$

where D_t is a dummy variable takes on a value of unity after the start of Arab Spring and zero otherwise. A significant and positive estimate for λ_d would indicate an increase in MENA stock market volatility during the period of political uncertainty. The heteroscedasticity-consistent t-statistics are shown in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, 1% level, respectively.

Table 5: Joint dynamics of MENA country and world returns

	c_{11}	c_{21}	α_{11}	α_{12}	α_{21}	g_{11}	g_{22}	d_{11}	d_{12}
Panel A : Conventional									
Bahrain	0.2584 ***	-0.0867 *	0.2585 **	-0.0895 ***	0.0362	0.9015 ***	0.9473 ***	0.0122	0.0327
	(4.493)	(-1.727)	(2.391)	(-2.850)	(0.401)	(32.849)	(89.915)	(0.318)	(1.343)
Kuwait	0.1779 ***	0.0347	0.1437	-0.0267	0.0252	0.9403 ***	0.9472 ***	0.1711 ***	-0.0136
	(4.410)	(1.150)	(1.344)	(-0.675)	(0.887)	(42.286)	(81.171)	(2.943)	(-0.428)
Oman	0.2048 ***	-0.0246	0.0024	-0.0463	0.1051 ***	0.9077 ***	0.9495 ***	-0.0380	0.0438
	(5.708)	(-0.841)	(0.056)	(-1.490)	(3.104)	(65.258)	(76.507)	(-1.096)	(1.336)
Egypt	0.5863 **	-0.0600	0.1666	0.0111	-0.2012 *	0.9156 ***	0.9481 ***	-0.1516	0.0612 **
	(2.246)	(-0.640)	(1.493)	(0.515)	(-1.866)	(14.715)	(70.894)	(-1.620)	(2.191)
Jordan	0.2013 ***	-0.0988 *	0.0324	0.0701	0.0490	0.9568 ***	0.9502 ***	-0.0170	0.0263
	(4.330)	(-1.704)	(1.120)	(1.564)	(0.640)	(53.497)	(74.749)	(-0.626)	(1.243)
Lebanon	0.2253 ***	-0.0441 *	0.3973 ***	-0.0469 **	-0.0313	0.8873 ***	0.9464 ***	0.0249 *	0.0144
	(4.025)	(-1.794)	(5.977)	(-2.097)	(-0.754)	(22.119)	(93.585)	(1.649)	(0.612)
Arab	0.8025 ***	0.1272 ***	0.0843	0.0445	0.2243	0.7391 ***	0.9810 ***	0.0147	0.0546 **
	(4.816)	(3.526)	(0.394)	(0.847)	(0.786)	(06.935)	(58.797)	(0.283)	(2.262)
Developed	0.3143 ***	0.1209 ***	0.0772	0.0451	-0.3796 **	0.7792 ***	1.0827 ***	-0.0889	-0.0153
	(4.432)	(3.104)	(0.526)	(0.536)	(-1.965)	(12.177)	(17.193)	(-1.283)	(-0.425)

Note:

This table reports the parameter estimates for the BEKK model with dummy variables for political revolution in each MENA country's conditional variance equation and conditional covariance equation:

$$\mathrm{H}_t = C'C + \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}' \begin{bmatrix} \varepsilon_{1,t-1}^2 & \varepsilon_{1,t-1}\varepsilon_{2,t-1} \\ \varepsilon_{2,t-1}\varepsilon_{1,t-1} & \varepsilon_{2,t-1}^2 \end{bmatrix} \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} + \begin{bmatrix} g_{11} & g_{12} \\ g_{12} & g_{22} \end{bmatrix}' \mathrm{H}_{t-1} \begin{bmatrix} g_{11} & g_{12} \\ g_{12} & g_{22} \end{bmatrix} + \begin{bmatrix} d_{11} & d_{12} \\ d_{12} & 0 \end{bmatrix} D_t \qquad (3)$$

For brevity, coefficients specific to the world-market conditional variance equation are not reported. The heteroscedasticity-consistent t-statistics are shown in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, 1% level, respectively.

Table 5: Joint dynamics of MENA country and world returns (Cont'd)

	c_{11}	c_{21}	α_{11}	α_{12}	α_{21}	g_{11}	g_{22}	d_{11}	d_{12}
Panel B : Islamic									
Bahrain	0.2316 ***	-0.0218	-0.2455 ***	-0.0099	0.0018	0.9158 ***	0.9533 ***	0.0566 **	0.0059
	(4.169)	(-0.774)	(-2.884)	(-0.194)	(0.029)	(37.949)	(109.539)	(1.975)	(0.195)
Kuwait	0.2258 ***	0.0299	0.1738 *	-0.0366	0.0127	0.9268 ***	0.9494 ***	0.1756 ***	0.0082
	(6.006)	(1.087)	(1.903)	(-1.255)	(0.426)	(59.397)	(99.308)	(4.354)	(0.293)
Oman	0.1277 *	-0.1254 ***	0.1314 **	-0.0519	-0.1384 **	0.9270 ***	0.9468 ***	0.0092	0.0562
	(1.905)	(-3.125)	(2.016)	(-1.265)	(-2.274)	(42.081)	(75.682)	(0.242)	(1.475)
Egypt	0.6364 ***	-0.0095	0.0667	-0.0032	0.1261	0.9002 ***	0.9533 ***	-0.1453 *	0.0468 **
	(4.352)	(-0.246)	(0.631)	(-0.291)	(0.626)	(22.969)	(78.413)	(-1.656)	(2.104)
Jordan	0.3011 ***	0.0229	0.1893 ***	-0.0105	0.0514	0.9510 ***	0.9514 ***	-0.0664	0.0097
	(3.064)	(0.304)	(3.576)	(-0.337)	(0.512)	(46.896)	(95.943)	(-1.051)	(0.308)
Lebanon	0.4799 ***	-0.0536 **	0.5029 ***	-0.0047	-0.0578	0.7792 ***	0.9467 ***	0.1481 *	0.0022
	(4.434)	(-2.179)	(5.588)	(-0.251)	(-0.578)	(09.261)	(93.809)	(1.724)	(0.088)
Arab	0.7571 ***	0.0439	0.1253	0.0209	-0.0254	0.8009 ***	0.9725 ***	-0.0416	0.0666 *
	(5.939)	(1.281)	(1.112)	(0.582)	(-0.240)	(16.602)	(91.300)	(-0.593)	(1.806)
Developed	0.3044 ***	0.1283 **	-0.0295	-0.0494	-0.1327	0.7219 ***	1.1161 ***	0.1000 **	0.0624 *
	(5.237)	(2.427)	(-0.287)	(-0.702)	(-0.995)	(16.859)	(35.947)	(2.294)	(1.682)

Note:

This table reports the parameter estimates for the BEKK model with dummy variables for political revolution in each MENA country's conditional variance equation and conditional covariance equation:

$$H_t = C'C + \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}' \begin{bmatrix} \varepsilon_{1,t-1}^2 & \varepsilon_{1,t-1}\varepsilon_{2,t-1} \\ \varepsilon_{2,t-1}\varepsilon_{1,t-1} & \varepsilon_{2,t-1}^2 \end{bmatrix} \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} + \begin{bmatrix} g_{11} & g_{12} \\ g_{12} & g_{22} \end{bmatrix}' H_{t-1} \begin{bmatrix} g_{11} & g_{12} \\ g_{12} & g_{22} \end{bmatrix} + \begin{bmatrix} d_{11} & d_{12} \\ d_{12} & 0 \end{bmatrix} D_t \quad (3)$$

For brevity, coefficients specific to the world-market conditional variance equation are not reported. The heteroscedasticity-consistent t-statistics are shown in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, 1% level, respectively.