Journal of Economics and Sustainable Development www.iiste.org
ISSN 2222-1700 (Paper) ISSN 2222-2855 (Online)
Vol.5, No.8, 2014

Virtual Spider Threads Interconnecting Globally: From 'Soft Power' to MENA Stock Market Volatility

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Abstract
This study investigates the dynamic of the volatilities and the conditional correlations between the 4 world-stock market of London, France, Frankfort, US and 8 Middle East and North African (MENA) stock markets from Amman, Bahrain, Egypt, Morocco, Muscat, UAE, Saudi Arabia, and Tunis. Using the GARCH, TGARCH models that account for asynchronous data, conditional heteroscedastic, asymmetric volatility responses, and the joint dynamics of each country's index with the world-market returns. Our results show that shocks originating in world-market conflicts and the associated uncertainty have increased the volatility of MENA equity markets. Secondly, regardless of its impact on volatility spillover transmission, there is little evidence to suggest that MENA markets have become more integrated with world-markets after financial crisis. Finally, these results are robust to model specification and consistent with the notion that uncertainty contributes to financial volatility spillover. It is worth mentioning that the findings from this paper will have a significant implication for investors, managers, market regulators, decision-makers, and scholars interested in the equity markets of MENA region in particular, and other developing nations in general.

Keywords: GARCH, TGARCH, Conditional correlations, Stock market volatility spillover, World equity market, MENA equity markets.

1. Introduction

Volatility is a measure of the relative degree of change, which has been one of the most active and successful areas of research in time series "econometrics and economic forecasting" in recent decades. In finance volatility is often defined as average magnitude of fluctuations observed in asset price movements over a period of time. An estimate of the volatility of these assets is a crucial input for determining these capital requirements. Therefore, financial market volatility plays an important role in financial economics and is at the heart of several subjects including asset allocation, market timing, risk management and the pricing of assets and derivatives. In spite of the ample theoretical and empirical evidence in the financial crisis started to show its effects in the middle of 2007 and into 2009 has proven that the impact of financial market volatility is not only limited to the financial industry. It shows that volatility may be costly for the financial market and economy as a whole. For instance, extreme stock market volatility may negatively influence aggregate investments behavior; in particular as companies often require equity as a source of external financing.

In this respect, one of the most popular publications regarding the literature on modeling volatility dynamics dates back to Engle (1982), Engle & Kraft (1983), Bollerslev (1986), Engle & Mezrich (1995), who develop the (G)ARCH-type volatility model. This model takes into account two significant aspects of asset return volatilities: they are time-varying and persistent. This so-called phenomenon of "volatility clustering" - periods of high volatility and low volatility tend to alternate - was originally put forward by Mandelbrot (1963). Mandelbrot (1963) already noticed that periods of high (low) volatility tend to be followed by periods of high (low) volatility. This time-varying volatility clustering and the predictability of volatility processes results in important implications for financial risk measurement and risk management. As pointed out by Andersen *et al*. (2006), this feature is observed across assets, asset classes, time periods, and countries. As a result of this inadequate measurement, the GARCH model is still popular after 20 years since it provides a simple intuitive way to incorporate this volatility clustering. Hence, this model when applied to daily returns, it relates today's conditional volatility linearly to the squared return of yesterday. In response to these concerns, a large shock in yesterday's return boosts the volatility today and vice versa. As a result the GARCH model (and many extensions which are proposed in the literature) is easy to estimate and can be seen as the benchmark volatility model in the field of financial econometrics. An examination of the volatility spillover process is also a key variable in the understanding of information transmission between international equity markets method. More recently, Le & Kakinaka (2010), Ke *et al.* (2010), who have found significant volatility spillover effects from a number of selected developed countries to developing countries equity markets[2]. According to previous studies,

[2] For a detailed summary of this literature, see surveys by Hodges (1992), Damodaran & Subrahmanyam (1992), Mayhew (1999), Maghyereh & Al-zoubi (2004), Engle & Rangel (2008), Andersen *et al*. (2010), Ke *et al*. (2010), Le & Kakinaka (2010), Moon & Yu (2010), Brownlees & Engle (2011), Maghyereh & Awartani (2012), and among many others.

applicable time series volatility measures are namely, standard deviation of asset returns or conditional variance (variance dependent on time) or auto regressive conditional heteroscedastic (ARCH) type and stochastic volatility models, refer to Nelson & Foster (1995). There is sample evidence in finance literature to suggest that integrated markets should have assets of identical risk command the same expected return irrespective of their location (Bekaert & Harvey 2003). Newness of an idea or practice should also be considered in terms of its adoption by the process of integration is how regional markets react to shocks originating in world-markets, for instance, whether domestic equity markets react differently to positive as opposed to negative shocks originating in foreign equity market.

2. Study Purpose and Scope

The main purpose of this study is to identify, consider, evaluate, and comment on existing research model on the dynamics of volatility spillover transmission from mature equity returns of developed capital markets of (London, France, Frankfort, US) to MENA equity markets, such as those of (Amman, Bahrain, Egypt, Morocco, Muscat, UAE, Saudi Arabia, and Tunis). The focus on MENA equity markets is of interest for several key reasons: firstly, the parameter estimation of multivariate volatility models is now at the forefront of the foreign investment agenda; secondly, the MENA markets has been willing to develop stock market performance after uncertainty contributes to financial volatility, and its recent policies at engaging both employees and managers alike in striving for reform ownership change and foreign policy investment; thirdly, the equity returns of developed capital markets experience could provide new insights in the MENA equity markets in developing economy. There is currently no clear conclusion can be reached at this early stage, however not all, of the results reported in some areas the existing literature are robust across countries. Therefore, this study will provide a contribution to the subject of MENA equity markets by providing an analysis of data that will evaluate the success to improve on the methodology used in prior studies. In particular, following Bessembinder & Seguin (1992, 1993), Antoniou *et al*. (2005) to a GARCH-based framework. Using a framework that allows for generalized autoregressive conditional heteroscedastic (GARCH) and TGARCH (threshold GARCH) technique of returns with long time series is required to obtain reliable GARCH parameter estimates such that allow for including possible exogenous variables. For the model estimated over the entire sample periods on monthly data (between February 2, 2000 and February 2, 2014), this might not be a problem[3]. This is vital given the difficulty of obtaining reliable GARCH estimates in small samples.

The main findings of our investigation can be summarized as follows. First, our results indicate that shocks originating in world-market conflicts and the associated uncertainty have increased the volatility of MENA equity markets. Second, regardless of its impact on volatility spillover transmission, there is little evidence to suggest that MENA markets have become more integrated with world-markets after financial crisis. Third, these results are robust to model specification and consistent with the notion that uncertainty contributes to financial volatility spillover. Overall, the results are a significant to understanding the role of uncertainty about the stability of the stock market and are of great importance to investors, managers and decision-makers, stockholder, and researchers interested in the stock markets in the equity markets of MENA region. Furthermore, this paper therefore has implications for policy makers and international investors.

2. Literature Review and The modeling framework

Our paper contributes to the existing literature in several ways. To the best of our knowledge, it is the most comprehensive examination to date on the impact of futures equity markets and integration of between an MENA economy and the world-market returns. For instance, investigative the existing literature, as summarized by Mayhew (1999), who introduced that the introduction of stock equity index futures is equally likely to be associated with increasing or decreasing volatility. The vast collection of literature on financial market volatility dynamics was kick-started by Engle (1982), Engle & Kraft (1983), Bollerslev (1986), Engle & Mezrich (1995)who introduced the (Generalised) Autoregressive Conditional Heteroscedastic "(G) ARCH" models. Consistent with economic theory daily asset return predictions exhibit negligible or very little explanatory power. For this reason it is common practice to assume daily stock returns are unpredictable. The volatility of daily returns, therefore, is conditionally dependent and due to its relatively high persistence it is quite predictable, especially when compared to the predictability of daily stock returns. The concept of ARCH process introduced by Engle (1982) explicitly recognises the difference between the unconditional and the conditional variance allowing the latter to change over time as a function of past errors. The statistical property of this new parametric class of models has been studied further in early papers by Weiss (1982), Milhoj (1984). In empirical applications of the ARCH model a relatively long lag in the conditional variance equation is often called for, and to avoid problems with negative variance parameter estimates a fixed lag structure is typically imposed (e.g., Engle 1982, 1983;

[3] Engle & Mezrich (1995) suggested using at least eight years of daily data for proper GARCH estimation.

Engle & Kraft 1983; Bollerslev 1986; Engle & Mezrich 1995). In this light it seems of immediate practical interest to extend the ARCH class of models to allow for both a longer memory and a more flexible lag structure. The GARCH, have been proposed to capture the empirical properties of financial time series like changing volatility and volatility clustering. The simplest *GARCH*(*p*, *q*) model is defined as:

$$\varepsilon_t \left[\psi_{t-1} \approx N(0, h_t)\right), \quad (1)$$

$$h_t = \alpha_0 + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-1}^2 + \sum_{i=1}^{p} \beta_i h_{t-i} = \alpha_0 + A(L)\varepsilon_t^2 + B(L)h_t, \quad (2)$$

$$[(p \geq 0, \quad q > 0) \quad (\alpha_0 \geq 0, \quad \text{i=1,...,}q)],$$

$$\beta_i \geq 0, \quad i = 1, ..., p.$$

where ε_t denote a real-valued discrete-time stochastic process, and ψ_t the information set (σ-field) of all information through time *t*. h_t the conditional volatility depends on the GARCH specification. For $p = 0$ the process reduces to the *ARCH*(*q*) process; and for $p = q = \varepsilon_t$ is simply white noise, whereas the *GARCH*(*p*, *q*) regression model is obtained by letting the ε_t be innovations in a linear regression:

$$\varepsilon_t = y_t - x_t^{'} b, \quad (3)$$

where y_t is the dependent variable, x_t a vector of explanatory variables, and *b* a vector of unknown parameters. If all the roots of $1 - B(z) = 0$ lie outside the unit circle, (Eq.2) can be rewritten as a distributed lag of past ε_t^2:

$$h_t = \alpha_0 (1 - B(1))^{-1} + A(L)(1 - B(L))^{-1} \varepsilon_t^2 = \alpha_0 \left(1 - \sum_{i=1}^{p} B_i\right)^{-1} + \sum_{i=1}^{\infty} \delta_i \varepsilon_{t-1}^2 \quad (4)$$

with (Eq.1) together can be seen as an infinite-dimensional *ARCH*(∞) process. The δ_i are found from the power series expansion of:

$$D(L) = A(L)(1 - B(L))^{-1},$$

$$\delta_i = \alpha_i + \sum_{j=1}^{n} B_j \delta_{i-j}, \quad i = 1, ..., q, \quad (5)$$

$$= \sum_{j=1}^{n} B_j \delta_{i-j}, \quad i = q + 1, ...,$$

where $n = \min\{p, i - 1\}$. It follows, that if $B(1) < 1$, δ_i will be decreasing for *i* greater than $m = \max\{p, q\}$. Thus if $D(1) < 1$, the *GARCH*(*p*, *q*) process can be approximated to any degree of accuracy by a stationary *ARCH*(*q*) for a sufficiently large value of *q*. However, from the theory on finite-dimensional *ARCH*(*q*) processes it is to be expected that $D(1) < 1$, or equivalently $A(1) + B(1) < 1$. The *GARCH(p, q)* process as defined in (Eq.1) and (Eq.2) is wide-sense stationary with $E(\varepsilon_t) = 0$, $\text{var}(\varepsilon_t) = \alpha_0 (1 - A(1) - B(1))^{-1}$ *and* $\text{cov}(\varepsilon_t, \varepsilon_s) = 0$ for $t \neq s$ *if* and only *if* $A(1) + B(1) < 1$. An equivalent representation of the *GARCH*(*p*, *q*) process is given by:

$$\varepsilon_t^2 = \alpha_0 + \sum_{i-1}^{q} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{p} \beta_j \varepsilon_{t-j}^2 - \sum_{j-1}^{p} \beta_j v_{t-j} + v_t \quad (6)$$

$$\text{and} \quad v_t = \varepsilon_t^2 - h_t = (\eta_t^2 - 1)h_t, \quad \text{where} \quad \eta_t \overset{j.i.d.}{\approx} N(0,1) \quad (7)$$

where v_t is serially uncorrelated with mean zero. Therefore, a parameterisation along the lines of (Eq.6) might be more meaningful from a theoretical time series' point of view; (Eq.1) and (Eq.2) are easier to work with in practice. This framework is parsimonious, which allowed us to capture many of the salient features of the data, and to partially account for movements in the world market in a model with relatively few parameters. Later, we would estimate a multivariate GARCH model that would allow us a richer model of the joint dynamics of MENA country-specific and world-market returns.

3. Research Framework, and Methodology

For the design of this study it is decided to adopt a following-step empirical methodology within the impact of futures introduction on volatility and integration of between a MENA country's and the world-market returns using a modification of the GARCH framework approach include: Amman, Bahrain, Egypt, Morocco, Muscat, UAE, Saudi Arabia, and Tunis how many country and time from to world-market_include: London, France, Frankfort, US. In the following *GARCH*(1,1) model to test for the impact of futures trading, we incorporated a multiplicative dummy variable in the conditional variance equation. Next, using a technique similar to the one employed by Bessembinder & Seguin (1992, 1993), Antoniou *et al*. (2005) to most appropriate GARCH-based framework model for each return series. We then checked our analysis is to remove the influence of worldwide movements and potential autocorrelation using various alternative specifications. Then, we examine how the impact of MENA markets' volatility using the carefully selected GARCH models that account for non-synchronous trading, conditional heteroscedasticity, and asymmetric volatility responses. Finally, to capture the spillover effect TGARCH model is used to further investigate from world-market return series to returns of corresponding MENA market returns series. This richer frameworks not only allows us to test whether the conditional covariance between a country's and the world's market return changed with futures event; however, it also allows us to more carefully control for the movements in world-wide markets. Despite the obvious success of ARCH and GARCH parameterisation, these models do not capture the asymmetric news effect or the leverage effect discovered by Black (1976), Nelson (1991), Engle & Ng (1993), Golsten *et al*. (1993). Statistically, the asymmetric effect reflects the pragmatic fact that downward movements in market returns are followed by higher volatilities than upward movements of the same magnitude. The simplest basic *GARCH*(1, 1) model given by (Eq.1) specification can be expressed as following:

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1}, \qquad \alpha_0 > 0, \quad \alpha_1 \geq 0, \quad \beta_1 \geq 0 \qquad (8)$$

where h_t is the conditional volatility at time *t*, ε_{t-1} is the innovation at time *t*-1. Eq.8 gives the basic volatility model, which captures heteroscedasticity property in returns series of MENA market of interest. News about volatility from the previous period, measured as the lag of the squared residual from the mean equation is the ARCH term (measured by α_1) and the last period's forecast variance is the GARCH term (measured by β_1). $\alpha_1 + \beta_1 < 1$ suffices for wide-sense stationary. $\alpha_0 > 0, \quad \alpha_1 \geq 0, \quad \beta_1 \geq 0$ and ε_{t-1}^2 is the lagged squared shock of MENA market of interest and provides the news about volatility from the previous period. For instance, Black (1976) observes the tendency of stock market volatility to fall when there are "good news" and to rise when there are "bad news". Engle & Ng (1993) propose tests to examine this different impact of positive and negative returns on volatility (Sign Bias, Negative Size Bias and Positive size Bias tests). By means of the regressions following:

$$h_t = \alpha_0 + \beta_1 h_{t-1} + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 \varepsilon_{t-1}^2 d_{t-1} \qquad (9)$$

where α_2 is the coefficient that takes leverage effect into consideration, and d_t is the dummy variable that takes the value of 1 when the $\varepsilon_{t-1} < 0$ and 0 otherwise. The leverage effect is captured by the use of d_t = 1 if $\varepsilon_{t-1} < 0$ "bad new", while $\varepsilon_{t-1} > 0$ have "good news". If α_2 is positive, it implies that a negative shock or bad news will increase volatility by more than it would increase with a positive shock or positive news. Similarly if it is negative, the volatility will increase more with a positive shock, than it would with a negative shock. To integrate spillover effect from global market return, its extracted residuals are included as regressors in the volatility equation. The specification for *GARCH*(1, 1) spillover equation can be expressed as following:

$$h_{t(Spillover)} = \alpha_0 + \beta_1 h_{t-1} + \alpha_1 \varepsilon_{t-1}^2 + \psi_1 \xi_{t-1}^2 \qquad (10)$$

It is measured as the lag of the squared residual from the mean equation, and $\psi_1 \xi_{t-1}^2$ is the lagged squared shock extracted from the reference global market returns series of interest. The coefficient ψ represents volatility spillover coefficient measuring the extent and behavior of volatility spillover effect. Although, to capture the spillover effect from reference world-market return series to returns of corresponding MENA market series of interest using a TGARCH model. The conditional volatility equation takes the following form:

$$h_t = \alpha_0 + \beta_1 h_{t-1} + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 \varepsilon_{t-1}^2 d_{t-1} + \psi_1 \xi_{t-1}^2 + \psi_2 \xi_{t-1}^2 d_{t-1} \qquad (11)$$

where ξ_{t-1}^2 is the lagged squared residual from reference world-market returns series and ψ_2 captures the leverage effect on the volatility of the MENA market series return of interest. If it is positive, then we can assume that a large positive shock in world-market returns series will result in larger observed volatility in returns of the MENA market series of interest then when compared to negative shocks in the corresponding world-market returns. The 'best-performing' model is identified per series using several information criteria, including the log-likelihood functions (Log L), Akaike Information Criterion (AIC) and Heteroscedastic Mean Squared Error (HMSE). Furthermore, applied model and empirical results are clarified in the following sections.

4. Data and Descriptive Statistics

In this paper we examine the relative performance of selected symmetric GARCH models, such as, the *GARCH*(1,1) model with normal and TGARCH (threshold GARCH) technique of returns with long time series is required to obtain reliable GARCH parameter estimates. With this approach, we will be able to focus more on the estimation of meaningful, interpretable parameters with minimal computational difficulties than for several other models. The financial time series we use consist of continuously compounded returns of equity stock market for eight MENA stock markets to proxy for the regional, global and world influences. These are the markets of eight MENA benchmark countries include; Amman (ASE), Bahrain (BSE), Egypt (EGX 30), Morocco (MASI), Muscat (MSM), FTSE NASDAQ Dubai UAE 20 Index (UAE), Saudi Arabia (TASI), and Tunis (TSE)[4]. As the European stock markets we consider the three most important stock markets in the developed benchmark courtiers "the FTSE100 from London, France from CAC 40 and DAX30 from Frankfort. Additionally we consider the more popular US stock exchange from S&P 500 Index since the US advanced MENA economies play an important role in the world economy. These countries were chosen to ensure that our sample represents a spectrum of MENA and developed equity markets from entire sample periods on monthly data between February 2, 2000 and February 2, 2014[5], at total of 168 monthly observations. The dataset is obtained from Datastream which contains several sources for MENA market data, MSCI Barra, IFC, FTSE and national indices. To eliminate local currency effect, all performance of stock market indices are expressed in US dollar terms.

Table 1 provides the descriptive statistics of data. Based on the *means skewness* and *kurtosis*[6], the outputs of tests, indicated that the mean monthly returns, over the entire sample period, ranges from 0.22% in UAE to 2.25% in MSM. Over the entire period, all the positive average returns in a number of markets may be attributed to the overall growth in these markets during the sample period. The negative skewness apparent in all the markets implies that the distribution of the series has a fatter left tail, while the kurtosis higher than 3 "which the kurtosis of the normal distribution" indicates that we have higher mass of extreme returns than the one predicted by the normal distribution. Further, the market indexes returns show higher values of standard deviation, which indicates higher fluctuations of the series. Other funds from the Augmented Dickey Fuller (ADF) test statistics shows that in all the cases the series of indexes returns is stationary "the critical vale of the test at 5% level of significance is -2.862". The results thus indicate time-varying returns in these stock markets. Observation of these statistics characteristics further motivates of a process at time-series use of the methodology for analysis.

[4] For Libya is not included, a significant problem for a serious and statistically significant analysis is the short histories of their market economies and active trading in financial markets.
[5] It should be noted that the MENA stock markets do not share the same week-end, and their week-ends are different from week-ends in Western markets. Therefore, we cannot pool variables across countries on a daily basis.
[6] Skewness values within the range of -1 to +1 and Kurtosis values within -3 to +3 indicate an acceptable rate for normality whereas values decreasing outside the range of skewness and kurtosis indicate a substantial exit from a normal distribution (Hair *et al*. 1998, 2003).

Table. 1 Descriptive Statistics of the Data

	Mean	Min	Max	St.de	Skewness	Kurtosis	Aug Dickey Fuller test (p-value)
ASE	-0.0105	-0.2297	0.1496	0.0644	-0.6925	5.0513	-37.652 (0.000)
BSE	-0.0179	-0.2625	0.1556	0.0785	-0.5283	4.8705	-46.743 (0.000)
EGX	0.0071	-0.3422	0.2554	0.1049	-0.4731	3.7452	-46.923 (0.000)
MASI	-0.0147	-0.1305	0.2423	0.0682	0.0526	3.8267	-47.443 (0.000)
MSM	-0.0016	-0.2808	0.1223	0.0685	-1.2403	5.4920	-49.420 (0.000)
UAE	0.0225	0.3266	0.2395	0.1124	-0.0605	3.6779	-45.221 (0.000)
TASI	0.0108	-0.2330	0.4659	0.1210	1.2529	6.9106	-36.882 (0.000)
TSE	0.0076	-0.1687	0.2397	0.0705	0.3323	5.0886	-38.984 (0.000)
MENA[a]	-0.0070	-0.3035	0.2694	0.1365	-1.3557	4.3206	-50.520 (0.000)
World-market[b]	0.0095	-0.2179	0.5233	0.0985	-1.6156	5.7352	-51.752 (0.000)

Notes: (a) MENA group of countries: Amman (ASE), Bahrain (BSE), Egypt (EGX 30), Morocco (MASI), Muscat (MSM), FTSE NASDAQ Dubai UAE 20 Index (UAE), Saudi Arabia (TASI), and Tunis (TSE). (b) World-market group of countries: FTSE100 from London, France from CAC 40 and DAX30 from Frankfort, US stock exchange from S&P 500 Index.

Source: Data and Summary Statistical Analysis 2014.

Another important issue that needs paying attention to when using multiple regressions is multicollinearity, which refers to the correlation among the independent variables. This exists when there is a strong correlation between two or more predictors in a regression model. One simple way of identifying multicollinearity is to scan a correlation matrix of all the independent variables in order to find out if there is any very high correlation among them (e.g. > .90) (Hair *et al*. 1998; Field 2006). The output of the analysis of correlations among the stock markets of interest, as presented in Table 2, indicated a significant the coefficient of correlations between stock markets. The correlations are statistically positive and significant at (5%, 1%) level of significance. The monthly return correlations are relatively moderate to low between MENA equity market and world-market due to the possibility of spurious correlation. Accordingly, we would expect these markets to be more integrated with the regional and world-market than the others. On the whole the results show that these markets are still much segmented.

Table. 2 Correlation Matrixes of Independent Variables

	ASE	BSE	EGX	MASI	MSM	UAE	TASI	TSE	MENA	World market
ASE	1.000									
BSE	0.3605***	1.000								
EGX	0.5215***	0.5437***	1.000							
MASI	0.2398***	0.4518***	0.4755***	1.000						
MSM	0.4215***	0.5398***	0.5592***	0.1738*	1.000					
UAE	0.5879***	0.5683***	0.5409***	0.2495**	0.6598***	1.000				
TASI	0.2801**	0.2550**	0.4336***	0.3828**	0.3628**	0.2724**	1.000			
TSE	0.2873**	0.3611***	0.3783***	0.3765**	0.3790***	0.2993***	0.3589**	1.000		
MENA	0.5812***	0.4340***	0.5750***	0.3092**	0.3276***	0.4987***	0.3187***	0.4987**	1.000	
World market	0.3775**	0.4058**	0.5984***	0.3954**	0.5020***	0.5547***	0.4863***	0.3871**	0.5292**	1.000

Notes: The t-statistics are shown in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, 1% level, respectively.

Source: Data and Summary Statistical Analysis 2014.

5. Empirical Results

Following Engle & Sheppard (2001), the step we removed the mean and any deterministic features of the series applying the statistical analysis of time series an Autoregressive-Moving-Average (ARMA) framework filter indicated by the lowest values of Schwarz Information Criterion. For each country, the lowest value of this criterion we obtain for ASE - *ARMA*(2,2), BSE - *ARMA*(2,2), EGX - *ARMA*(2,1), MASI - *ARMA*(2,2), MSM - *ARMA*(2,2), UAE - *ARMA*(2,1), TASI - *ARMA*(2,2), TSE - *ARMA*(2,2), *ARMA*(2,1) and *ARMA*(1,1) for MENA and World-market respectively. Applying these ARMA models filters we obtain purely stochastic series with zero mean used to estimate conditional variance and covariance models. Table 3 additionally indicates the results of this test for the lags 1-5. As can be noted from Table 3, these results can be interpreted as each lag we reject the hypothesis regression model revealed the constant nature of the correlation matrix. In these contacts, all the *p*-values are significantly zero. Accordingly, these results support the idea of using the Dynamic Correlation GARCH model and its asymmetric version.

Table. 3 Engle and Sheppard Test for Constant Correlation with Corresponding *p*-values

lag	1	2	3	4	5
ARMA test	53.4031	60.0231	71.2930	78.5321	89.0218
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)

Source: Data and Summary Statistical Analysis 2014.

To investigate the impact of MENA markets on the level of volatility spillover, a multiplicative dummy is incorporated in the best volatility model in a similar fashion as in (Eq.10). As presented in Table 4, the specifications of selected GARCH processes and estimated parameters by introducing the residuals from world-market returns in the variance equation of MENA market return series. Consider first the results for the spillover effect of market returns of world-market on MENA equity markets indices given in Table 4. It can be seen from the basic GARCH model we observe that both GARCH terms variance process *β,* and the ARCH parameters *α* are significant for all series. Further, *α*+*β* tend to be close to 1, suggesting that the conditional volatility shocks in these series are a highly persistent process. The significance of ψ means that conditional variance is an asymmetric function of the past squared residuals. If the coefficient ψ 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 results support the findings of the stock market volatility is highly persistent and asymmetric (Engle & Ng 1993; Bauwens *et al*. 2006).

It can be observed from Table 4 that α_1 and *β* coefficients are significant for EGX, UAE, TASI, TSE and MENA market returns indicating an evidence of ARCH and GARCH structure in returns of these returns series. Also, a negative α_1 is observed for UAE, TASI and TSE. The negative sign indicates that volatility increases when past innovations are negative. All other α_1 coefficients, which are significant in the series, are observed positive. The spillover coefficient ψ is positive and significant for BSE, EGX, MASI and TSE equity market returns indicating that there is evidence of volatility spillover from market returns of world-market to these markets. Further, the positive sign indicates that the return shocks originating in world-market equity market increase the volatility among the returns of these markets BSE, EGX, MASI and TSE. The relationship is significant and negative for case of MSM indicating that volatility in world-market increases, volatility in MSM market decreases.

Table. 4 Results of the Test for Spillover Effects from World-market Returns to MENA Market Returns

	C	α_0	β	α_1	ψ
ASE	-0.0195	0.0078	0.0918	0.2016	0.0744
BSE	-0.0192**	0.0083*	0.4210	0.1065	0.4823**
EGX	0.0145	0.0218**	-0.0286**	0.1091	0.6984**
MASI	0.0189**	0.0030*	-0.1278	0.0692	0.7260*
MSM	0.0025	0.0014*	0.4130	-0.1059	-0.4903*
UAE	-0.0233**	0.0045	0.8805**	-0.1382**	0.8904
TASI	0.0010	-0.0009	0.0280**	-0.1241**	0.03592
TSE	0.0069	0.0008***	0.9790***	-0.1359**	0.0787**
MENA	0.0077	0.0062**	-0.1780**	0.5804**	0.2926

Notes: The t-statistics are shown in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, 1% level, respectively.

$$h_{t(Spillover)} = \alpha_0 + \beta_1 h_{t-1} + \alpha_1 \varepsilon_{t-1}^2 + \psi_1 \xi_{t-1}^2$$

Source: Data and Summary Statistical Analysis 2014.

The output of TGARCH estimates test analysis, in terms of conditional volatility to capture the spillover effect from world-market return series to returns of corresponding MENA market, did not just however provides information on whether the effect of shock from originating from MENA market's own return is asymmetric (reported by α_2), but it provides information on whether the effects of shocks from world-markets are

asymmetric (reported by ψ_2). In relation to this model, the coefficient ψ_1 presents information regarding the spillover effect from world-market returns, while ψ_2 captures the asymmetric effect. For this model, a significant α_2 indicates that the effects from returns of MENA market of interest's own shock are asymmetric. Table 5 provides a summary of statistics for the TGARCH results with world-market as the global equity market over the sample period used for estimation during 2000-2014. It can be noted that, where positive and negative shocks can have different effects. Coefficient α_2 are positive and significant for ASE, TASI, TSE and the MENA indicating the volatility tends to increase more asymmetrically, in response to its own negative shock. Consequently, ψ_1 for case of UAE, TSE and MENA is found to be negative and significant, which indicates that these were believed to in fact be among the causes of the unrest and the stock exchanges have already been weakened by the effect of the global financial crisis of 2007-2009 and with the start of Arab Spring, the market indices all over the region have fallen. The results support the findings of Harvey & Ferson (1993, 1994) supply evidence that emerging markets have higher volatility than their industrial or developed counterparts. Low correlation between developed and emerging markets reduces volatilities in portfolios from these markets (Hassan *et al*. 2006). Clearly, both regional and world stock market variations jointly explain a very small part of the local market volatility. In order to estimate the impact of ψ_2 for case of MSM, UAE and TSE is found to be positive and significant, which indicates that when there is bad news (negative shock) in world equity market, the volatility of returns in MSM, UAE and the TSE market returns is more than what it would have with a positive shock (good news) of same magnitude.
To conclude, the findings of conditional volatility models indicate that the conditional covariance between MENA countries and world-market returns (a measure of financial integration) is time-varying and may be simultaneously affected by the financial crisis. 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. As suggested by Johnson & Soenen (2009), this greater extent of developed countries' stock market integration, apart from economic integration as proved by regression results, may also be attributed to the presence of a more favorable economic and political climate towards business in these countries compared to the emerging ones.

Table. 5 Results of the TGARCH Test for Volatility Effects from World-market Returns to MENA Market Returns

	C	α_0	β	α_1	α_2	ψ_1	ψ_2
ASE	-0.0068	0.0028*	1.1025	-1.0968	0.6578***	0.0055**	0.0503
BSE	-0.0099	0.0019*	-0.1392**	0.8230*	-0.4065**	0.0008**	-0.1221
EGX	0.0127	0.0065*	0.0954	0.1859	0.2049	-0.0033	0.9805
MASI	0.0341*	0.0062	-0.0544	-0.1228	0.1068	-0.0009	0.6009
MSM	0.0064	0.0029**	-0.0573	-0.2115	0.2992	-0.0026	0.3104**
UAE	-0.0301**	0.0092**	-0.0803	0.2577	0.1649	-0.0089**	1.2290*
TASI	0.0118	0.0021	-0.1294**	0.2542	0.2394*	-0.0033	0.1928
TSE	0.0088	0.0043**	-0.1624***	-0.0962	0.7944***	-0.0028**	0.2069**
MENA	-0.0029	0.0055**	-0.1204	0.7339	0.4447*	-0.0019**	0.1059

Notes: The t-statistics are shown in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, 1% level, respectively.

$$h_t = \alpha_0 + \beta_1 h_{t-1} + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 \varepsilon_{t-1}^2 d_{t-1} + \psi_1 \xi_{t-1}^2 + \psi_2 \xi_{t-1}^2 d_{t-1}$$

Source: Data and Summary Statistical Analysis 2014.

In respect of the empirical work, Wooldridge (1990, 1991) proposes the regression based diagnostics that can be applied to test for many possible misspecifications. Empirically, therefore, using the Wooldridge framework we can check if both asymmetric effects not only the sign of shocks influence the conditional volatility[7]. However, the size of the shock has different impact, are correctly captured by the models whether a variable is useful in predicting a generalized residuals (defined as $u_t = \varepsilon_{it}^2 - h_{it}$). The resulting statistic tests if a set of moment conditions x_{gt-1} can predict the generalized residuals series. The test statistics is given by

$$C = \left(\frac{1}{T} \sum_{t=1}^{T} u_{ij,t} \lambda_{g,t-1} \right)^2 \left(\frac{1}{T} \sum_{t=1}^{T} u_{ij,t}^2 \lambda_{g,t-1}^2 \right)^2 \quad (12)$$

[7]The sign effect, which means that shocks of different sign have different impact on conditional volatility and size effect.

where $\lambda_{g,t-1}$ is the residual from a regression the moment conditions on the scores of the likelihood. Under regularity conditions C is x^2 distributed with one degree of freedom. The innovations in (Eq.12) are estimated from the following robust conditional moment tests of Wooldridge process:

$$x_{1t-1} = I[z_{t-1} < 0] \qquad x_{2t-1} = I[z_{t-1} > 0]$$
$$x_{3t-1} = z_{t-1}^2 I[z_{t-1} < 0] \qquad x_{4t-1} = z_{t-1}^2 I[z_{t-1} > 0] \qquad (13)$$

In this setting the first two moments (x_{1t-1}, x_{2t-1}) account for the sign effect and the other two (x_{3t-1}, x_{4t-1}) for size effect. To be consistent with previous tests we take into account four lags and therefore the test statistics is x^2. The null hypothesis is that there is no serial correlation of any order. The test statistics is x^2 distributed with a critical value 9.48 at the 5% level of significance. In general, this serial correlation test is statically more powerful than the Durbin-Watson test which is only valid for non-stochastic regressors. The misspecification test for each of the moments findings, as depicted in Table 6, illustrate that the results of the test prove that both the sign and size effects are accounted for by our models. All the estimated models pass the tests for misspecification at 5% level of significance. This finding indicated the models for conditional volatility correctly capture the volatility clustering and symmetry in the data.

Table. 6 Results of the Test for Non Misspecification with Different Moment Conditions

	ASE	BSE	EGX	MASI	MSM	UAE	TASI	TSE	MENA	World market
$x_{1t-1} - 1$	0.33 (0.5029)	0.12 (0.7118)	0.05 (0.8803)	0.08 (0.7517)	0.02 (0.8992)	0.35 (0.4729)	0.09 (0.7412)	0.05 (0.8803)	0.07 (0.7546)	0.18 (0.8705)
$x_{2t-1} - 1$	0.11 (0.7229)	0.59 (0.4861)	0.09 (0.7412)	0.14 (0.7092)	0.29 (0.5042)	0.24 (0.6021)	0.08 (0.7517)	0.31 (0.4822)	0.10 (0.7241)	0.37 (0.3992)
$x_{3t-1} - 1$	0.24 (0.6021)	0.09 (0.7412)	0.12 (0.7118)	0.18 (0.8705)	0.49 (0.4143)	0.09 (0.7412)	0.50 (0.4108)	0.49 (0.4143)	0.37 (0.3992)	0.52 (0.4211)
$x_{4t-1} - 1$	0.87 (0.3044)	0.72 (0.3382)	0.35 (0.4729)	0.02 (0.8992)	0.66 (0.3890)	0.70 (0.3582)	0.16 (0.8892)	0.88 (0.2944)	0.59 (0.4861)	0.89 (0.2971)

Notes: The t-statistics are shown in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, 1% level, respectively.

Source: Data and Summary Statistical Analysis 2014.

On the whole, our results suggest that there is a great deal of potential for cross country diversification in these markets, as a large part of the total domestic variance appears country- specific. Our results also show that the political and financial reforms along with golbalisation attempts in MENA countries have not yet achieved the desired financial integration with the global financial markets. MENA stock markets are likely to be influenced by world-markets, which still segmented. It is therefore we find that the low levels of correlation among MENA markets themselves and also with the regional and global market reported in previous studies still persist. Although, significant costs and constraints (political and financial liberalisation) still persists in these markets, significant reforms are still being pursued to enhance transparency in market transactions and liquidity. It is important for investors and fund managers in MENA to take advantage of these benefits and invest beyond their domestic markets.

6. Concluding and Future Work

In this paper, we have examined the effect of a GARCH model to determine whether volatility spills over from major world-markets to the equity markets of MENA region. Thus, it is useful to consider the status and features of emerging markets in the MENA region where most are relatively well in the areas of regulation and supervision as well as in financial openness (Naceur *et al*. 2008). Specifically, most of these markets have similarities based on the region in which they are located. This has a significant implication; it provides a significant and positive spillover from world-market to these markets BSE, EGX, MASI and TSE. The positive relationship indicates that when volatility in world-market increases, volatility in these markets also increases. The relationship is significant and negative for case of MSM indicating that volatility in world-market increases, volatility in MSM market decreases. In respect of the empirical results of volatility transmission or the leverage effect we use TGARCH model. Findings from this model, indicates that the markets of MSM, UAE and TSE are found to be positive and significant. It would appear that when there is bad news (negative shock) in world equity market, the volatility of returns in MSM, UAE and the TSE market returns is more than what it would have with a positive shock (good news) of same magnitude. Finally, we extended our analysis to a multivariate framework that allows for the possibility of volatility spillover and time-varying conditional covariance between country-specific and world-market returns. In this framework, we found that time-varying integration from these markets experience, the level of integration has diminished over time. The emphasis is that these markets have become even more segmented in recent times.

Overall, the empirical results supported the hypotheses in these findings and, hence, confirmed that the significance of stock market performance in the development process of the MENA equity markets has been affected. These findings might appropriately be generalised to other developing or emerging economies that have similar economic and financial structure. Thus, when applied to the important role to developing countries that have similar economic structure to the MENA economy, it could be beneficial for their financial market to liberalise and mobilise a higher amount of national savings. It is worth mentioning that the findings from this paper will have a significant implication for investors, managers, policy-makers, and scholars interested in the equity markets of MENA countries. Whilst this study has significantly contributed research to the understanding of the growing empirical literature in developing countries, much still needs to be done. With this in view, possible guidance and a number of ideas are offered for future extensions to this study, which could be undertaken following the results and theoretical framework stated in this research. Future research could expand the analysis of this research to study other countries, extend the multivariate GARCH and TGARCH 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. Additionally, liberalisation and the consequent development of a country's financial sector tends to greatly facilitate economic growth would also be an interesting area for future research, as shown in papers such as those of King & Levine (1993), Jayaratne & Strahan (1996), Levine (2000). Furthermore, different financial returns may follow different distributions. Further research is also needed to improve the empirical tests for contagion. Heteroschedasticity in the correlations could be removed by other methods such as switching-regime model or a copula model.

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