This paper examines the time-varying financial integration in the Middle East and North Africa (MENA) countries: Bahrain, Egypt, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Tunisia and the United Arab Emirates (UAE) in pre and post-crisis sub-periods. The paper apply Bekaert and Harvey (1995) International Capital Asset Pricing Model (ICAPM) with regime switching mechanism, including both, constant and time-varying transition probabilities. The results indicates that stock markets of Egypt, Jordan Morocco and UAE appear to be integrated to world stock market; while the stock market of Bahrain, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia and Tunisia appear to be segmented from world stock market. In general, the stock markets in MENA region exhibit a variation in their degree of integration with world stock market except for Lebanon and Qatar.

**Key words:** Time varying financial integration, International capital asset pricing model, DCC-GARCH

**Introduction**

The developments and upgrades of emerging stock markets have led to emergence of new investment opportunities. The research in international finance has become more concerned with potential diversification benefits in emerging markets. The emerging stock markets of MENA region are considered as promising investment opportunity. In the past two decades, MENA countries have gone through a period of important steps to improve economic and financial integration such as substantial improvement in business environment and regulatory framework, accompanied with increased economic harmonization and financial
liberalization (ESCWA, 2008). These developments have led to noticeable improvements in their economic and financial performances\(^1\).

The paper displayed various cointegration and causality tests to study the alterations in stock markets integration and causal relationships among MENA stock markets, and among MENA and developed stock markets in pre and post global financial crisis.

Research in this paper studies time-variation in integration of MENA stock markets with world capital market in pre and crisis and post-crisis. There is no study that explores the dynamics of the time varying integration of MENA markets with world capital market in post-crisis sub-period. In this paper, we develop an integration index based on regime switch approach that measures time-varying integration of eleven stock markets in MENA region, that are stock markets in : Bahrain, Egypt, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Tunisia and UAE, with world market in pre and crisis and post-crisis sub-periods. This paper employs weekly observations of MENA markets for two sub-periods, the pre-crisis sub-period that ranges from January 2000 to December 2006, and crisis and post-crisis sub-period that ranges between January 2007 and May 2013\(^2\).

The aim of this paper is to measure the magnitude of change, if any, in degree of integration of stock markets in MENA region in the global context in crisis and post-crisis as compared to pre-crisis sub-periods, that to the best of our knowledge, this is the first attempt to develop an integration index for stock markets in MENA region after the GFC.

This paper is divided as follows. Section 2 describes the literature review. Section 3 discusses data and descriptive statistics, and tests for the presence of non-linear behaviour of MENA stock market indices. Section 4 describes methodology and empirical results of the time varying integration of MENA markets. Section 5 presents the Lagrange Multiplier test for robustness of our results and final conclusions and comments are mentioned in section 6.

**Literature Review**

There is a consensus among researchers that the portfolio diversification benefit is achieved when non-correlated securities are added into a portfolio of financial assets Markowitz (1952). Sharpe (1964), Lintner (1965) and Mosin (1966) develop the capital asset pricing model (CAPM). According to this model, different stock markets are integrated if assets with the same level of systematic risk exhibit same returns, irrespective of markets in which they are traded. The application of CAPM in domestic constant assumes that stock markets are perfectly segmented, that the risk refers to exposure to local market factor rather than common world factor. In other words, the reward to risk on a given asset in

\(^1\) MENA region has experienced high average growth of GDP during the period 2003-2008. Moreover, in 2008, the total FDI inflows to the region reached 14.4% of total inflows to developing counties, as compared to 2.2% in 2000. The stock market capitalization of MENA region accounts for slightly less than 60% of MSCI Frontier Markets Index (Shamma and Khatoun, 2013).

\(^2\) The crisis and post-crisis sub-period starts from January 2007 as it covers the time when the US subprime default occurred, and it was directly related to US and international banks’ liquidity which triggered the GFC.
country A is determined by the degree of asset’s covariance with the return on country A’s market portfolio, wherein the covariance of local market with world factor is negligible and has no ability to explain expected return (Bekaert and Harvey, 1995).

CAPM has been subject to several developments with the aim of capturing the effects of various international risk and premium factors. Solnik (1974) attempts to determine the international market structure of asset prices, using data set of 8 major European and US markets over the period from 1966 to 1971. He finds that the local securities are priced based on international systematic risk, as well as, domestic factors. Black (1974) develops an International Capital Assets Pricing Model (ICAPM) that considers the exisce of investment barriers among countries by incorporating the tax factor to the original CAPM. The model states that the optimal investment portfolio choice depends on the magnitude of taxation, and domestic investors may concentrate mainly on domestic assets when they construct their investment portfolios, with a minor consideration of the other foreign assets as they exhibit tax charges. Similarly, Stulz (1981a) employs proportional tax to account for barriers to international investment. He concludes that all domestic investors of one country hold the same portfolio of risky asset, and the world market portfolio becomes inefficient for investors who face barriers to international investment.

There is a wide literature that employs the international asset pricing model (ICAPM). Stulz (1981b), Adler and Dumas (1983), Dumas (1994), and Dumas and Solnik (1995) find that in an international context, when the purchasing power parity (PPP) does not hold, returns on foreign investments possess an exposure to exchange rate risk and, the performance of foreign investment depends on performance of domestic currency relative to foreign currency. Dumas and Solnik (1993) affirm that the ICAPM is more capable (than CAPM without exchange rate risk) of explaining worldwide rates of return. Similarly, Dahlquist and Sallstom (2002) and Zhang (2006) affirm that foreign exchange risk exposure contributes considerably to international asset returns, and the ICAPM with foreign exchange risk can explain variations in average rate of returns. Wu (2008) evaluates the ability of different sets of asset pricing models in forecasting expected returns. Using three major currencies to test the existence of exchange risk premium, he concludes that the ICAPM with exchange risk surpasses other international asset pricing models in forecasting the variations in expected returns.

Over the last three decades, some studies have utilized different versions of international asset pricing model to test stock market integration. Wheatley (1988) employs consumption based asset pricing model. He tests the financial markets integration of US and other seventeen countries using monthly data from 1960 to 1985. He assumes that there is an asset pricing line for each country, which represents the relationship between the expected return on the domestic assets and the growth of the individual’s consumption. His study affirms financial integration between markets under examination. Jorion and Schwartz (1986) examine the financial integration between Canadian equity market and United States, using monthly rates of return from January 1963 to December 1982. They do not find evidence of financial integration between stock markets in Canadian and U.S stock markets. Buckberg (1995) applies ICAPM to investigate the impact of increased international capital flows
from developed to emerging markets during the period 1977 to 1991, and he concludes that emerging markets are more integrated with the world especially during the period from 1984 to 1991. Hooy and Lim (2013) employ ICAFM in an attempt to specify the relationship between market integration and information efficiency. They take into account both direct and indirect forms of investment barriers, using data from 49 countries. They find positive relationship between stock market integration and informational efficiency.

Asset pricing models in the international context generally assume markets to be perfectly integrated, where there are no investment barriers between capital markets. In such case, markets expected return depends on covariance with world market portfolio. The CAPM in domestic context assumes that markets to be perfectly segmented wherein, the return on local security is a linear function of return on domestic portfolio.

Errunza and losq (1985) develop the mild segmentation model wherein market does not conform to either complete segmentation or full integration. They affirm that mild segmentation could arise from inability of group of investors to trade in a particular class of assets. Errunza et al (1992) investigate mild segmentation of eight emerging markets over the period from 1975 to 1987. Their results provide strong evidence in favour of mild segmentation. The mild segmentation model introduced by Errunza and Losq (1985) does not consider the changing degree of market integration through time; instead, the degree of market segmentation/integration is fixed over time.

Bekaert and Harvey (1995) develop an asset pricing model that measures the time-varying integration of stock markets. They attach constant and time-varying transition probabilities that follow Markov switching process and allow the degree of market integration to vary over time between two polar cases of full integration/complete segmentation. The model is conditional i.e. the transition probabilities which control the switch of one market from integration to segmentation regimes (regime one to regime two), or vice versa, are conditional upon predetermined set of local and global variables. They develop an integration index for twelve emerging markets over the period 1975-1992. The integration index depicts the change in degree of financial integration of sample markets through time. They find that most of emerging markets under consideration exhibit time-varying degree of integration with the world, whereas, few markets exhibit little variation in the integration measure through time.

Cumby and Khanthavit (1998) use regime switch approach to study integration of three stock markets of; Korea, Taiwan and Thailand. They find that the markets are subject to regime switch from segmented state between 1970s and mid-1980s, to integrated state thereafter.

Adler and Qi (2003) estimate time-varying integration between Mexican and North American stock markets over the period from 1991 to 2002. They extend the model of Bekaert and Harvey (1995) to comprise three factors, Mexican stock market and North American equity market in addition to peso/dollar exchange rate risk. They find that the stock market in Mexico exhibits a time-varying integration with the US market. They conclude that the integration measure decreases in the wake of peso crisis, and begins to rise since the early 2000s. Hardouvelis et al (2006) measure the time-varying integration
between 12 EU equity markets and EMU stock market index over 1990s. In their paper, switching probabilities are conditional upon set of country-specific variables that account for gradual convergence of local EU markets toward integration with EMU index. They find increased integration among Eurozone markets during the second half of 1990s influenced by prospects of EMU formation and application of single common currency.

Carriére et al (2007) study financial integration of eight emerging markets. They determine ex-post financial integration factors. Their results indicate that local factor is important for pricing of emerging market assets, and they affirm the important role of liberalization policies and financial market development in emerging stock markets integration. Chambet and Gibson (2008) extend the sample markets to include 25 emerging equity markets. They find that some markets are still segmented. Guesmi and Nguyen (2014) measure time varying regional integration of Southeast Europe in the context of partially integrated ICAPM. They utilize the Dynamic Conditional Correlation GARCH model (DCC-GARCH) of Engle (2002). They show that the markets have experienced a time varying degree of integration between 1996 and 2007.

Cheng et al (2010) investigate stock markets behaviour in MENA region. They utilize Markov-switch ICAPM to model time varying degree of integration between 1997 and 2008. They conclude that MENA markets exhibit a time-varying integration with world capital market. However, most of MENA markets are segmented from international capital markets except for stock markets in Bahrain, Israel and Turkey with high degree of persistence of observed integration state of Israel and Turkey, while Egypt, Jordan, Oman and Saudi Arabia show high persistence of segmentation state. Arouri and Nguyen (2010) measure time varying integration of GCC stock markets over the period 2005-2008. They apply DCC-GARCH model to infer cross-market linkages within GCC region and between GCC stock markets and world market. They find that the degree of integration among GCC stock markets varies over time, with higher levels of integration during economic downturns and political tensions. On the other hand, the integration among GCC markets and the world is small and insignificant; consequently, the portfolio diversification opportunities for global and regional investors still exist. Guesmi and Nguyen (2011) measure time-varying integration of MENA region with world capital market over the period from 1996 to 2008. They employ the multivariate DCC-GARCH model to measure time variation of the variance-covariance matrix and conditional correlation. They find that the Middle East region is ranked third in level of integration with world after Latin America and South-Eastern Europe, yet before Emerging Asia. Guesmi et al (2014) study financial integration among group of MENA countries. They find that most of MENA markets have experienced a variation in integration levels between 2000 and 2007 due to the increase in foreign flows to MENA markets.

In this paper, we develop an integration index based on regime switch approach that measures capital market integration of MENA region with world market in pre and post GFC. To the best of our knowledge, there is no existing study which has explored the time-varying integration of MENA markets with world capital market in crisis and post-crisis period.
Model of Time-Varying Integration of Stock Markets

Bekaert and Harvey (1995) employ ICAPM with conditional regime-switching model which combines two polar cases of full integration and complete segmentation. That under the full integration condition, and according to Sharpe (1964) and Lintner (1965), the return on asset in market is as follow:

\[
E_{t-1}r_{i,t}^x = \lambda_{t-1} \text{cov}_{t-1} r_{i,t}^x, r_{w,t}
\]  

where \(E_{t-1}r_{i,t}^x\) is the conditionally expected return on security. This equation states that if market \(i\) exhibits full integration with world market index, then the expected return on asset in country \(i\) for time \(t\) is a function of its covariance (\(\text{cov}\)) with return on a value-weighted world portfolio (\(r_w\)) times the conditionally expected world price of covariance risk (\(\lambda_{t-1}\)), for time \(t\). This implies that asset \(x\) is priced with respect to its covariance with return on value-weighted world market portfolio.

When local market is completely segmented of world market index, then the return on asset \(x\) is as follow:

\[
E_{t-1}r_{i,t}^x = \lambda_{i,t-1} \text{var}_{t-1} r_{i,t}
\]  

This model suggests that the expected return on security in a completely segmented market \(i\) is determined by variance of return in market times the local price of risk. The local price of risk depends on the weighted relative risk aversion of investor in country. Bekaert and Harvey (1995) combine two polar cases of full integration and complete segmentation.

\[
E_{t-1}r_{i,t}^x = \phi_{i,t-1} \lambda_{t-1} \text{cov}_{t-1} r_{i,t}^x, r_{w,t} + (1 - \phi_{i,t-1}) \lambda_{i,t-1} \text{var}_{t-1} r_{i,t}
\]

where, \(r_{i,t}\) is return on single asset in country \(i\) at time \(t\), \(r_{w,t}\) represents the return on value-weighted world portfolio at time \(t\), \(\lambda_{t-1}\) and \(\lambda_{i,t-1}\) are conditionally expected world price of covariance risk for time \(t\) and local price of risk for time \(t\), respectively. The parameter \(\lambda_{i,t-1}\) is the regime probability that represents conditional probability of variable \(i\) of being integrated (or segmented). It falls in the interval \([0, 1]\). It takes the value of 1 if market is exhibits full integration, whereas it takes zero value when the market is completely segmented. Thus, based on the value of the regime probability, equation (3) will yield two different polar cases. If \(\lambda_{i,t-1} = 1\) then, the expected return on a single asset in country for time \(t\) is given by equation (4.1). However, when \(\lambda_{i,t-1} = 0\) return on a single asset in country for time \(t\) is given by equation (4.2).

Gray (1995) introduces the following representation for the regime probability (\(\lambda_{t-1}\)):

\[
\phi_{t-1} = (1 - Q) + (P + Q - 1) \left\{ \frac{f_{1,t-1} \phi_{t-1}}{f_{1,t-1} \phi_{t-1} + f_{2,t-1} (1 - \phi_{t-1})} \right\}
\]

where \(f_{j,t}\) is the likelihood at time \(t\) conditional on being in regime \(j\) and time \(t - 1\). \(P\) and \(Q\) represent transition probabilities of the transition matrix \(T\). According to Goldfeld and Quandt (1973), the transition matrix takes the following form:

\[
T = \begin{bmatrix}
IP(S_t = 0|S_{t-1} = 0) & IP(S_t = 1|S_{t-1} = 0) \\
IP(S_t = 0|S_{t-1} = 1) & IP(S_t = 1|S_{t-1} = 1)
\end{bmatrix}
\]
$S$ denotes unobserved state variable (that controls the pre-specified regime probability $\phi_{i,t-1}$), $p_{ij}(i, j = 0, 1)$ denote the transition probabilities of $S_t = j$ given that $S_{t-1} = i$ is a transition matrix which encompasses two parameters; $p_{00}$ and $p_{11}$, they represent two transition probabilities ($P$ and $Q$) denoted in equation (4.6). The transition matrix $P$ and $Q$ governs the behaviour of unobserved state variable $S$, hence the regime probability $\phi_{i,t-1}$, based on the regime switching model. Bekaert and Harvey (1995) adopt two different regime switching models; the first is the standard Hamilton (1989, 1990) model of constant transition probabilities.

$$P = \text{prob}[(S_t = 1 | S_{t-1} = 1)]$$
$$Q = \text{prob}[(S_t = 2 | S_{t-1} = 2)]$$

(6)

According to this model, the transition probabilities $P$ and $Q$ are constant. The transition probability $P$ indicates probability of being in regime 1 (market integration) in time $t$ given the occurrence of regime 1 in time $t-1$. This implies that the state variable is constant $S_t = S_{t-1} = 1$ and depends on its immediate past value $S_{t-1} = 1$. The transition probability $Q$ indicates probability of being in regime 2 (market segmentation) in time $t$ given the occurrence of regime 2 in time $t-1$. This implies that the state variable is constant $S_t = S_{t-1} = 2$ and depends on its immediate past value $S_{t-1} = 2$. According to standard Hamilton (1989, 1990) model, the switching probabilities are time invariant but the regime probability $\phi_{i,t-1}$ and the degree of market integration vary through time as new information change the inference on relative likelihood of two regimes (Bekaert and Harvey, 1995).

The second regime switching model adopted by Bekaert and Harvey (1995) is model of time varying transition probabilities developed by Diebold et al (1994), Ghysels (1993) and Gray (1995). They extend Hamilton model to allow for time varying transition probabilities ($P'$ and $Q'$), as function of predetermined variables:

$$P_i = \frac{\exp(\beta_i Z_{t-1}^*)}{1 + \exp(\beta_i Z_{t-1}^*)}$$
$$Q_i = \frac{\exp(\beta_i Z_{t-1}^*)}{1 + \exp(\beta_i Z_{t-1}^*)}$$

(7)

where $\beta_i = 1, 2$ are vector of parameters. $Z_{t-1}^*$ is subset of $Z_{t-1}$, a set of information variables specific to country $i$. Since the information variables pertinent to local market change through time, they should influence the transition probabilities. Consequently, the degree of market integration is expected to change though time.

Research in this paper employs model proposed by Bekaert and Harvey (1995) with conditional regime switching mechanism as per equation (3), where $i$ represents stock markets in eleven MENA countries: Bahrain, Egypt, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia and UAE. This paper utilizes two regime switching models. The first is the standard Hamilton (1989, 1990) model with constant transition probabilities.
\( P \) and \( Q \), and the second regime switching model is the one with time-varying transition probabilities introduced by Diebold et al (1994), Ghysels (1993) and Gray (1995). The set of information variables is represented by \( Z_{t-1}^* \) (as per equation (7)), and it encompasses the stock market capitalization as a percentage of GDP and changes in exchange rate of each MENA country\(^3\). Since these two variable changes through time, the application of this model will display the change (if any) in degree of financial integration of MENA region over time and hence, the time-varying integration of MENA markets will be depicted.

This paper also applies the likelihood ratio test. The likelihood ratio test is performed by estimating two regime switching models; the first one is regime switching model with constant transition probabilities, and the other one is the regime switching model with time varying transition probabilities. We test the fit of one model to the fit of the other by comparing the log likelihoods of the two models (Brooks, 2002). The resulting test statistics is distributed chi-square with degrees of freedom which equals the number of parameters that are constrained.

**Data and Descriptive Statistics**

Research in this paper employs weekly stock market returns\(^4\) of eleven MENA countries (Bahrain, Egypt, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Tunisia and UAE)\(^5\), and weekly returns of the MSCI value-weighted world market index. This data is divided up into two sub-periods; pre-crisis sub-period (January 2000 to December 2006) and crisis and post-crisis sub-period (January 2007 to October 2014). This paper also uses the stock market capitalization as a percentage of GDP, and change in exchange rates of each country since these variables are expected to influence over the stock market integration process. The variation in ratio of market capitalization to GDP through time may indicate for change in degree of financial integration among local and global indices (Bekaert and Harvey, 1995). The changes in exchange rates represent currency risk faced by international investors.

Table 1 illustrates descriptive statistics and of weekly stock returns for MENA markets and world. In general, the average returns of MENA markets are higher than the world. The stock market in Saudi Arabia has the highest average return followed by stock markets in Qatar and Egypt. The stock market in UAE is the only that has negative return. Table 1 shows that MENA indices are more volatile than the world stock index, except for stock market indices in Bahrain and Tunisia. The highest standard deviation is for stock market in UAE (5.06\%) followed by stock market in Egypt (4.27\%). The coefficients of skewness are negative for MENA markets, except Tunisia and Lebanon. The kurtosis coefficients of

---

\(^3\) The main reason of considering only local variables in the set of information variables \( \{Z_{t-1}^*\} \) is that the global variables are only allowed to influence transition probabilities through their correlation with local variables (indirectly).

\(^4\) Weekly data has significant advantage over the daily and monthly data, since it avoids the autocorrelation and noise related to daily observations (Wang et al, 2003), and it enables more proper testing for short lived interactions than monthly observations.

\(^5\) MSCI indices data is for Bahrain, Egypt, Jordan, Morocco and UAE. S&P indices data is for Kuwait, Lebanon, Oman, Qatar, Saudi Arabia and Tunisia. Data is from Datastream.
all MENA markets are greater than 3, especially for market indices of Lebanon, Oman and Saudi Arabia whose exhibit significant excess kurtosis coefficients (27.01, 14.96 and 13.60, respectively). Jarque-Bera test statistics strongly reject the null hypothesis of normality at 1% level of significance. This indicates that MENA stock market returns exhibit non-normal error terms and demonstrate a departure from normality.

Table 1 illustrates results of the test statistics of Box-Pierce (1970), Ljung-Box (1978)\(^6\) and ARCH. These tests are conducted to examine the presence of nonlinearity in MENA stock market returns\(^7\). Table 4.1 also illustrates the Box-Pierce test for non-linearity of order 12 (\(Q(12)\)). The null hypothesis of linearity (no autocorrelation) of order 12 is rejected at 1% level of significance for Jordan, Kuwait, Oman and world indices, and at 5% level for Egypt, Qatar and Saudi Arabia, and at 10% level in case of UAE. Yet, the null hypothesis of linearity is accepted for stock markets in Lebanon, Morocco and Tunisia. Nevertheless, this test has been subject to criticism as it may lead to spurious conclusion in case of small sample properties (Brook, 2002). \(Q^*(12)\) is Ljung-Box (1987) test for non-linearity of order 12. The test statistics reject the null hypothesis of linearity of order 12 at 1% level of significance for all return indices (except for Tunisia, where the rejection is at 5% level of significance). Table 1 illustrates results of autoregressive conditional heteroskedasticity Lagrange Multiplier (ARCH LM) test for nonlinearity\(^8\). The test statistics indicate that the null hypothesis of no ARCH effect is rejected at 1% level of significance of lag 13 for all series. There is strong evidence of the presence of ARCH effects in the residuals, and this exhibits a clear evidence of nonlinearity of MENA stock market returns. Table 2 reports correlation matrix of MENA stock market returns. The results show that the cross-market correlations are low among MENA markets. The highest correlations are observed for the pairs of Bahrain and Kuwait (4.90%), and Oman and Qatar(4.30%).

Qatar exhibits the highest correlation with the world stock market (38.6%) followed by Egypt (37.6%). The correlation between MENA and world stock markets is generally low.

Table 3 illustrates Brock, Dechert and Scheinkman (1987) (BDS)\(^9\) test statistics of MENA and world stock market returns for the whole period, for -values from 2 to 10, and equal to 0.5, 1 and 1.5. The BDS results in table 3 show that MENA stock market returns exhibit nonlinear behaviour. The null hypothesis of i.i.d is strongly rejected at 1% level of significance for majority of markets\(^10\). Table 3 presents some evidences in favour of linearity emerges for Lebanon and Tunisia, where the test cannot reject the null hypothesis

---

\(^6\) Refer to Appendix (B) for detailed explanation of Box-Pierce (1970) and Ljung-Box (1987) tests.

\(^7\) According to Campbell et al (1997), the nonlinear time series can be defined as one where current value of the series is nonlinearly related to current and previous value of error term. The time series models can be characterized as nonlinear in mean, nonlinear in variance, or nonlinear in mean and variance.

\(^8\) This test is developed by Engle (1982) to test for the presence of ARCH effect in a time series. The time series is said to have ARCH effect (conditional heteroskedasticity) when large values of its variance can be predicted using past squared residuals.

\(^9\) Refer to Appendix (B) for detailed explanation of the BDS test.

\(^10\) In general, the rejection of linear behaviour of MENA return is not sensitive to the choice of and , and the majority of BDS statistics lie in the positive tail of standard normal distribution. The small values of BDS statistics reported in table 3 can be accounted for by sample size that the values of BDS test statistics would be increased for sample size of 1000, and can be more enlarged if when the size reaches 2500 observations (Hsieh, 1989).
Table 1: Descriptive Statistics for Whole Period

<table>
<thead>
<tr>
<th></th>
<th>Bahrain</th>
<th>Egypt</th>
<th>Jordan</th>
<th>Kuwait</th>
<th>Lebanon</th>
<th>Morocco</th>
<th>Oman</th>
<th>Qatar</th>
<th>Saudi Arabia</th>
<th>Tunisia</th>
<th>UAE</th>
<th>World</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>0.038</td>
<td>0.156</td>
<td>0.026</td>
<td>0.019</td>
<td>0.077</td>
<td>0.042</td>
<td>0.150</td>
<td>0.169</td>
<td>0.186</td>
<td>0.052</td>
<td>-0.048</td>
<td>0.019</td>
</tr>
<tr>
<td>S.D</td>
<td>2.059</td>
<td>4.274</td>
<td>2.676</td>
<td>2.971</td>
<td>3.887</td>
<td>2.636</td>
<td>2.503</td>
<td>3.850</td>
<td>3.421</td>
<td>1.981</td>
<td>5.062</td>
<td>2.453</td>
</tr>
<tr>
<td>Skewness</td>
<td>-0.858</td>
<td>-0.671</td>
<td>-0.095</td>
<td>-1.219</td>
<td>1.868</td>
<td>-0.379</td>
<td>-1.382</td>
<td>-0.676</td>
<td>-1.699</td>
<td>0.080</td>
<td>-0.923</td>
<td>-0.792</td>
</tr>
<tr>
<td>J-B</td>
<td>1657***</td>
<td>373.3***</td>
<td>649.4***</td>
<td>2126***</td>
<td>0.0***</td>
<td>212.8***</td>
<td>4760***</td>
<td>944.7***</td>
<td>3991***</td>
<td>3134***</td>
<td>382.8***</td>
<td>684.7***</td>
</tr>
<tr>
<td>Q (12)</td>
<td>82.34***</td>
<td>24.45**</td>
<td>32.45***</td>
<td>55.66***</td>
<td>9.81</td>
<td>14.77</td>
<td>84.50***</td>
<td>21.51**</td>
<td>24.98**</td>
<td>15.93</td>
<td>19.39*</td>
<td>32.21***</td>
</tr>
<tr>
<td>Q* (12)</td>
<td>121.49***</td>
<td>124.29***</td>
<td>185.79***</td>
<td>309.23***</td>
<td>85.63***</td>
<td>127.82***</td>
<td>366.79***</td>
<td>155.89***</td>
<td>207.66***</td>
<td>21.90**</td>
<td>175.19***</td>
<td>222.48***</td>
</tr>
<tr>
<td>ARCH (13)</td>
<td>75.19***</td>
<td>87.53***</td>
<td>91.77***</td>
<td>179.69***</td>
<td>80.61***</td>
<td>71.50***</td>
<td>183.47***</td>
<td>84.54***</td>
<td>109.87***</td>
<td>51.57***</td>
<td>78.48***</td>
<td>118.11***</td>
</tr>
</tbody>
</table>

Note: S.D represents the standard deviation of stock market return for MENA and world. The J-B represents the results of Jarque-Bera test statistics. Q (12) and Q* (12) present the results of Box-Pierce (1970) and Ljung-Box (1978) test statistics, respectively. ***, **, * indicate; rejection of the null hypotheses under 1%, 5% and 10% levels of confidence respectively.

Table 2: Correlation Matrix for Whole Period

<table>
<thead>
<tr>
<th></th>
<th>Bahrain</th>
<th>Egypt</th>
<th>Jordan</th>
<th>Kuwait</th>
<th>Lebanon</th>
<th>Morocco</th>
<th>Oman</th>
<th>Qatar</th>
<th>Saudi Arabia</th>
<th>Tunisia</th>
<th>UAE</th>
<th>World</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bahrain</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Egypt</td>
<td>0.246</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jordan</td>
<td>0.251</td>
<td>0.253</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kuwait</td>
<td>0.490</td>
<td>0.248</td>
<td>0.281</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lebanon</td>
<td>0.081</td>
<td>0.096</td>
<td>0.091</td>
<td>0.099</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morocco</td>
<td>0.121</td>
<td>0.190</td>
<td>0.085</td>
<td>0.103</td>
<td>0.094</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oman</td>
<td>0.367</td>
<td>0.293</td>
<td>0.284</td>
<td>0.406</td>
<td>0.028</td>
<td>0.088</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Qatar</td>
<td>0.398</td>
<td>0.325</td>
<td>0.335</td>
<td>0.378</td>
<td>0.093</td>
<td>0.074</td>
<td>0.430</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>0.339</td>
<td>0.330</td>
<td>0.292</td>
<td>0.301</td>
<td>0.052</td>
<td>0.105</td>
<td>0.372</td>
<td>0.388</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tunisia</td>
<td>0.103</td>
<td>0.114</td>
<td>0.109</td>
<td>0.090</td>
<td>0.121</td>
<td>0.167</td>
<td>0.094</td>
<td>0.047</td>
<td>0.138</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UAE</td>
<td>0.079</td>
<td>0.149</td>
<td>0.068</td>
<td>0.145</td>
<td>0.199</td>
<td>0.046</td>
<td>0.105</td>
<td>0.188</td>
<td>0.114</td>
<td>0.121</td>
<td></td>
<td></td>
</tr>
<tr>
<td>World</td>
<td>0.209</td>
<td>0.376</td>
<td>0.205</td>
<td>0.254</td>
<td>0.094</td>
<td>0.183</td>
<td>0.272</td>
<td>0.386</td>
<td>0.271</td>
<td>0.150</td>
<td>0.189</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Bahrain</td>
<td>Egypt</td>
<td>Jordan</td>
<td>Kuwait</td>
<td>Lebanon</td>
<td>Morocco</td>
<td>Oman</td>
<td>Qatar</td>
<td>Saudi Arabia</td>
<td>Tunisia</td>
<td>UAE</td>
<td>World</td>
</tr>
<tr>
<td>-------</td>
<td>---------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>--------------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>2</td>
<td>0.5</td>
<td>0.013***</td>
<td>0.008***</td>
<td>0.008***</td>
<td>0.021***</td>
<td>0.001</td>
<td>0.008***</td>
<td>0.013***</td>
<td>0.026***</td>
<td>0.024***</td>
<td>0.014***</td>
<td>0.014***</td>
</tr>
<tr>
<td>3</td>
<td>0.5</td>
<td>0.013***</td>
<td>0.006***</td>
<td>0.007***</td>
<td>0.024***</td>
<td>0.014*</td>
<td>0.005***</td>
<td>0.013***</td>
<td>0.029***</td>
<td>0.026***</td>
<td>0.015***</td>
<td>0.015***</td>
</tr>
<tr>
<td>4</td>
<td>0.5</td>
<td>0.009***</td>
<td>0.004***</td>
<td>0.004***</td>
<td>0.018***</td>
<td>0.033***</td>
<td>0.003***</td>
<td>0.009***</td>
<td>0.027***</td>
<td>0.021***</td>
<td>0.003</td>
<td>0.011***</td>
</tr>
<tr>
<td>5</td>
<td>0.5</td>
<td>0.005***</td>
<td>0.002***</td>
<td>0.002***</td>
<td>0.011***</td>
<td>0.025***</td>
<td>0.002***</td>
<td>0.006***</td>
<td>0.020***</td>
<td>0.014***</td>
<td>0.004</td>
<td>0.007***</td>
</tr>
<tr>
<td>6</td>
<td>0.5</td>
<td>0.003***</td>
<td>0.001***</td>
<td>0.001***</td>
<td>0.007***</td>
<td>0.011*</td>
<td>0.001***</td>
<td>0.003***</td>
<td>0.014***</td>
<td>0.009***</td>
<td>0.006***</td>
<td>0.004***</td>
</tr>
<tr>
<td>7</td>
<td>0.5</td>
<td>0.001***</td>
<td>0.000***</td>
<td>0.000***</td>
<td>0.004***</td>
<td>0.004*</td>
<td>0.002***</td>
<td>0.009***</td>
<td>0.006***</td>
<td>0.005***</td>
<td>0.002</td>
<td>0.002***</td>
</tr>
<tr>
<td>8</td>
<td>0.5</td>
<td>0.000***</td>
<td>0.000***</td>
<td>0.000***</td>
<td>0.002***</td>
<td>0.000*</td>
<td>0.001***</td>
<td>0.006***</td>
<td>0.004***</td>
<td>0.003***</td>
<td>0.001</td>
<td>0.001***</td>
</tr>
<tr>
<td>9</td>
<td>0.5</td>
<td>0.000***</td>
<td>0.000***</td>
<td>0.000***</td>
<td>0.001***</td>
<td>0.000*</td>
<td>0.000***</td>
<td>0.004***</td>
<td>0.002***</td>
<td>0.001***</td>
<td>0.001</td>
<td>0.000***</td>
</tr>
<tr>
<td>10</td>
<td>0.5</td>
<td>0.000***</td>
<td>0.000***</td>
<td>0.000***</td>
<td>0.000***</td>
<td>0.000*</td>
<td>0.000***</td>
<td>0.003***</td>
<td>0.001***</td>
<td>0.000***</td>
<td>0.000</td>
<td>0.000***</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>0.022***</td>
<td>0.019***</td>
<td>0.019***</td>
<td>0.035***</td>
<td>0.003</td>
<td>0.017***</td>
<td>0.024***</td>
<td>0.039***</td>
<td>0.041***</td>
<td>-0.005</td>
<td>0.027***</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>0.038***</td>
<td>0.025***</td>
<td>0.028***</td>
<td>0.062***</td>
<td>0.003</td>
<td>0.022***</td>
<td>0.042***</td>
<td>0.070***</td>
<td>0.071***</td>
<td>-0.009</td>
<td>0.049***</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>0.047***</td>
<td>0.030***</td>
<td>0.032***</td>
<td>0.073***</td>
<td>0.018*</td>
<td>0.025***</td>
<td>0.050***</td>
<td>0.096***</td>
<td>0.093***</td>
<td>-0.017*</td>
<td>0.061***</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>0.048***</td>
<td>0.031***</td>
<td>0.030***</td>
<td>0.073***</td>
<td>0.009</td>
<td>0.024***</td>
<td>0.052***</td>
<td>0.108***</td>
<td>0.103***</td>
<td>-0.006</td>
<td>0.065***</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>0.045***</td>
<td>0.028***</td>
<td>0.026***</td>
<td>0.068***</td>
<td>0.010</td>
<td>0.021***</td>
<td>0.050***</td>
<td>0.111***</td>
<td>0.104***</td>
<td>0.003</td>
<td>0.064***</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>0.040***</td>
<td>0.022***</td>
<td>0.022***</td>
<td>0.062***</td>
<td>0.020</td>
<td>0.017***</td>
<td>0.046***</td>
<td>0.107***</td>
<td>0.099***</td>
<td>0.005</td>
<td>0.058***</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>0.033***</td>
<td>0.017***</td>
<td>0.017***</td>
<td>0.055***</td>
<td>0.065*</td>
<td>0.013***</td>
<td>0.040***</td>
<td>0.100***</td>
<td>0.090***</td>
<td>0.004</td>
<td>0.050***</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>0.026***</td>
<td>0.013***</td>
<td>0.013***</td>
<td>0.048***</td>
<td>0.027**</td>
<td>0.010***</td>
<td>0.033***</td>
<td>0.091***</td>
<td>0.082***</td>
<td>0.002</td>
<td>0.042***</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>0.020***</td>
<td>0.010***</td>
<td>0.010***</td>
<td>0.042***</td>
<td>0.030***</td>
<td>0.008***</td>
<td>0.027***</td>
<td>0.081***</td>
<td>0.073***</td>
<td>0.004</td>
<td>0.035***</td>
</tr>
<tr>
<td>2</td>
<td>1.5</td>
<td>0.017***</td>
<td>0.018***</td>
<td>0.021***</td>
<td>0.033***</td>
<td>0.000</td>
<td>0.014***</td>
<td>0.022***</td>
<td>0.028***</td>
<td>0.034***</td>
<td>-0.007*</td>
<td>0.020***</td>
</tr>
<tr>
<td>3</td>
<td>1.5</td>
<td>0.037***</td>
<td>0.031***</td>
<td>0.040***</td>
<td>0.070***</td>
<td>0.000</td>
<td>0.026***</td>
<td>0.043***</td>
<td>0.062***</td>
<td>0.067***</td>
<td>-0.014*</td>
<td>0.050***</td>
</tr>
<tr>
<td>4</td>
<td>1.5</td>
<td>0.056***</td>
<td>0.047***</td>
<td>0.056***</td>
<td>0.098***</td>
<td>0.009</td>
<td>0.036***</td>
<td>0.064***</td>
<td>0.097***</td>
<td>0.104***</td>
<td>-0.024**</td>
<td>0.079***</td>
</tr>
<tr>
<td>5</td>
<td>1.5</td>
<td>0.071***</td>
<td>0.059***</td>
<td>0.065***</td>
<td>0.117***</td>
<td>0.003</td>
<td>0.043***</td>
<td>0.082***</td>
<td>0.126***</td>
<td>0.135***</td>
<td>-0.016</td>
<td>0.106***</td>
</tr>
<tr>
<td>6</td>
<td>1.5</td>
<td>0.080***</td>
<td>0.067***</td>
<td>0.070***</td>
<td>0.131***</td>
<td>0.024*</td>
<td>0.047***</td>
<td>0.094***</td>
<td>0.147***</td>
<td>0.157***</td>
<td>-0.006</td>
<td>0.126***</td>
</tr>
<tr>
<td>7</td>
<td>1.5</td>
<td>0.084***</td>
<td>0.068***</td>
<td>0.071***</td>
<td>0.139***</td>
<td>0.038**</td>
<td>0.047***</td>
<td>0.104***</td>
<td>0.161***</td>
<td>0.174***</td>
<td>-0.000</td>
<td>0.138***</td>
</tr>
<tr>
<td>8</td>
<td>1.5</td>
<td>0.085***</td>
<td>0.065***</td>
<td>0.071***</td>
<td>0.142***</td>
<td>0.046***</td>
<td>0.045***</td>
<td>0.109***</td>
<td>0.167***</td>
<td>0.184***</td>
<td>0.000</td>
<td>0.143***</td>
</tr>
<tr>
<td>9</td>
<td>1.5</td>
<td>0.083***</td>
<td>0.063***</td>
<td>0.069***</td>
<td>0.142***</td>
<td>0.052***</td>
<td>0.042***</td>
<td>0.110***</td>
<td>0.168***</td>
<td>0.190***</td>
<td>0.002</td>
<td>0.144***</td>
</tr>
<tr>
<td>10</td>
<td>1.5</td>
<td>0.079***</td>
<td>0.060***</td>
<td>0.066***</td>
<td>0.140***</td>
<td>0.060***</td>
<td>0.039***</td>
<td>0.110***</td>
<td>0.168***</td>
<td>0.191***</td>
<td>0.007</td>
<td>0.141***</td>
</tr>
</tbody>
</table>

Note: ***, **, * indicate rejection of the null hypotheses under 1%, 5% and 10% levels of confidence, respectively.
of linearity. The linear behaviour of Lebanon and Tunisia is noticed under different embedding dimensions and various epsilon values, however, more acceptance of null hypothesis is noticed when $\varepsilon = 1.5$. Overall, the results of Box-Pierce (1970), Ljung-Box (1978), ARCH(LM) and BDS tests presented in tables 1 and 3 indicate that MENA stock market exhibit nonlinear (non-i.i.d) behaviour\textsuperscript{11}.

**Empirical Results**

The results of time-varying integration of MENA markets are presented in table 4. Column (2) illustrates the probability of being in the integrated state (P) given that the previous state was integration. Column (3) reports the probability of being in segmented state (Q) given that the previous state was segmentation. P and Q are transition probabilities associated with pre-crisis sub-period. Column (4) presents results of the likelihood ratio test of null hypothesis that the transition probabilities are constant. The rejection of the null indicates that the transition probabilities are not constant but time-varying. The last two columns (5) and (6) illustrate the results of regime switching model with time-varying transition probabilities that are logistic function of $Z_{i-1}$ (stock market capitalization as percentage of GDP and changes in exchange rates). Columns (5) and (6) illustrate time varying integration index of MENA markets in global level in pre and crisis and post-crisis sub-periods, respectively.

### Table 4: Time-Varying Integration of MENA Stock Markets

<table>
<thead>
<tr>
<th>Market</th>
<th>Transition Probabilities</th>
<th>(p-value)</th>
<th>Degree of Integration Pre-Crisis</th>
<th>Degree of Integration Crisis and Post-Crisis</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
<tr>
<td>Bahrain</td>
<td>0.157909.9451</td>
<td>6.75**</td>
<td>0.12</td>
<td>0.73</td>
</tr>
<tr>
<td>Egypt</td>
<td>0.5212</td>
<td>0.1716</td>
<td>11.87***</td>
<td>0.44</td>
</tr>
<tr>
<td>Jordan</td>
<td>0.7851</td>
<td>0.2135</td>
<td>7.99**</td>
<td>0.74</td>
</tr>
<tr>
<td>Kuwait</td>
<td>0.5389</td>
<td>0.8622</td>
<td>5.23*</td>
<td>0.26</td>
</tr>
<tr>
<td>Lebanon</td>
<td>0.0000</td>
<td>0.9804</td>
<td>0.33</td>
<td>0.32</td>
</tr>
<tr>
<td>Morocco</td>
<td>0.5305</td>
<td>0.4694</td>
<td>7.34**</td>
<td>0.85</td>
</tr>
<tr>
<td>Oman</td>
<td>0.6054</td>
<td>0.9534</td>
<td>4.97*</td>
<td>0.52</td>
</tr>
<tr>
<td>Qatar</td>
<td>0.0000</td>
<td>0.9232</td>
<td>2.35</td>
<td>0.47</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>0.4185</td>
<td>0.9839</td>
<td>5.32*</td>
<td>0.37</td>
</tr>
<tr>
<td>Tunisia</td>
<td>0.0720</td>
<td>0.9627</td>
<td>2.86**</td>
<td>0.05</td>
</tr>
<tr>
<td>UAE</td>
<td>0.8484</td>
<td>0.6177</td>
<td>3.08**</td>
<td>0.74</td>
</tr>
</tbody>
</table>

Notes: This table illustrates results of time varying integration of MENA markets. P and Q represent transition probabilities associated with pre-crisis era. represents the likelihood ratio testing results. ***, **, * indicate; rejection of the null hypotheses under 1%, 5% and 10% levels of confidence respectively. Source: Authors’ own calculations.

\textsuperscript{11} Can be due to nonlinear stochastic process or chaos, linear stochastic process, non-stationarity or nonlinear deterministic system.
Bahrain

Table 4 illustrates that in pre-crisis sub-period, Bahrain appears to be segmented from world stock market. The constant transition probabilities in pre-crisis, $Q$ (0.9451) parameter is very high as compared to $P$(0.1579). The likelihood ratio test (LR) results in column (4) indicate that null hypothesis of constant transition probabilities is rejected at 5%. This implies that integration index is time-varying. Figure 1 illustrates that the integration index is steady at a low level during the pre-crisis era. Figure 2 illustrates that integration index of Bahrain at global level increased sharply in crisis and post-crisis sub-period. Column (6) of table 4.4 illustrates that average integration index is 0.73. In October 2007, the market capitalization increased by 22% compared to October 2006, and during the first half of 2008 the capitalization raised up to 151% of GDP (Central Bank of Bahrain, June 2008). In the wake of GFC, GDP growth declined from 8% in 2007 to 6% in 2008 (IMF, 2009a). 

![Figure 1: Time-Varying Integration of Stock Market in Bahrain (Pre-Crisis).](image1)

![Figure 2: Time-Varying Integration of Stock Market in Bahrain (Crisis and Post-Crisis).](image2)
The stock market index has deteriorated by 43.6% between May 2008 and May 2009 (Central Bank of Bahrain, June 2009).

The recovery of Bahrain from GFC was not swift as compared to other GCC countries. The market index declined by another 10.6% and the market capitalization decreased by 4.4% over the period from May 2009 to May 2010 (Central Bank of Bahrain, June 2010). The economic and financial indicators of Bahrain showed some improvements after 2010. In 2013, the GDP growth increased by 5.3% as compared to 2012, (IMF, 2014). The market index rebounded by 15.2% in 2013, as compared to 2012 (Central Bank of Bahrain, February 2014).

**Egypt**

The long history of equity trading in Alexandria and Cairo stock exchanges (established in 1883 and 1903, respectively) may indicate a high degree of integration of the Egyptian stock market. Table 4 illustrates that $P$ and $Q$ parameters of constant transition probabilities are 0.52 and 0.1716, respectively. This indicates that Egyptian stock market is integrated to (rather than segmented from) world stock market. The likelihood ratio test results show that transition probabilities are time-varying. Columns (5) and (6) in table 4 indicate that the average values of integration index of Egypt are 0.44 percent in pre-crisis and 0.80 percent in crisis and post crisis. Figure 3 shows that the integration index fluctuates drastically between 2001 and 2003. This may be due to political instability in Egypt at end of 1990s (Marashdeh, 2006).

![Figure 3: Time-Varying Integration of Stock Market in Egypt (Pre-Crisis).](image)

Figure 4 indicates that during 2007 and 2008, in the wake of GFC, the integration index fluctuates and this may be due to sharp decrease in Egyptian stock market index. The pull out of foreign portfolios and investors led to a decline of 50% of market index in November 2008.

---

12 In 1997, 62 people (almost tourists) were killed in Luxor city due to terrorist violence.
2008 as compared to previous level (IMF, 2009b). In general, the integration index of Egyptian stock market has average value of 0.80 in crisis and post-crisis sub-period. There is a slight decrease at end of which may be attributed to social and political unrest resulted due to Arab Spring. The stock market capitalization decreased from US$ 82.49 billion in 2010 to US$ 48.62 billion in 2011 and the turnover ratio declined by roughly 10% in 2011 as compared to 2010.

**Figure 4:** Time-Varying Integration of Stock Market in Egypt (Crisis and Post-Crisis).

**Jordan**

The results for Jordan suggest that the market is more integrated than segmented. The estimated $P$ parameter in pre-crisis is 0.7851, whereas the $Q$ parameter is 0.2135. There has been a significant increase in market capitalization from US$ 10.96 billion in 2003 to US$ 18.38 billion in 2004 and portfolio equity flows (from Jordanian Dinar 33.4 million in 2002 to Jordanian Dinar 145.2 in 2003. Column (4) of table 4 indicates that Jordanian stock market exhibits a time-varying degree of integration since the likelihood ratio results rejects the model with constant transition probabilities at 5%. Columns (4) and (6) indicate that the integration parameter shows a decrease from 0.74 in pre-crisis to 0.34 in crisis and post-crisis. This decrease may be explained by the political unrest in neighbouring countries (Syria, Iraq, Egypt and Lebanon) that led to deceleration in key performance indicators of ASE during post-crisis period wherein, the market capitalization and value traded have reached low levels compared to previous years as compared to pre-crisis. Figure 6 shows integration index of Jordanian stock market, the index is highly fluctuating (between 0.2 and 0.9) during GFC. The performance of Jordanian stock market has been weakened due to GFC, yet not as severe as other MENA markets, however, the ASE declined by 16.23% by end of 2008 (Doha Securities Market, 2008).

---

13. The Arab Spring that took place in Egypt at beginning of 2011 was political transition accompanied with social and political unrest.
Kuwait

Results in table 4 indicate that Kuwaiti stock market is segmented in pre-crisis\textsuperscript{14} since the $Q$ (0.8622) is higher than $P$(0.5389). This can be attributed to political instability in Iraq (neighbouring country of Kuwait), and instability of oil market in 2004. The likelihood ratio test results in column (4) of table 4 indicate that the stock market in Kuwait exhibits a time-varying integration. Table 4 indicates that Kuwaiti stock market becomes less integrated in crisis and post-crisis sub-period as compared to pre-crisis sub-period. The integration index decreases from 0.26 in pre-crisis to 0.13 in post-crisis. This can be attributed to weak

\textsuperscript{14} In case of Kuwait, the pre-crisis sub-period includes only weekly observations for the years 2005 and 2006 due to non-availability of data.
stock market performance during and after the GFC\textsuperscript{15}, and to political instability in MENA region.

\textbf{Figure 7}: Time-Varying Integration of Stock Market in Kuwait (Pre-Crisis).

\textbf{Figure 8}: Time-Varying Integration of Stock Market in Kuwait (Crisis and Post-Crisis).

\textbf{Lebanon}

Table 4 illustrates that the stock market in Lebanon is highly segmented. The evidence of segmentation in Lebanon is consistent with the investment environment as well as lack of liquidity. The value traded ranges between US$ 100 million in 2000 to US$ 200 million in 2004 and the number of listed companies ranges between 11 in 2000 to 13 in

\textsuperscript{15} Kuwait Stock Exchange index has decreased drastically by 1373.6 points in September 2008 as compared to 2007, followed by another 2589.7 points decrease in October 2008. The KSE recovery has been dampened as five investment companies defaulted on their debt (Doha Securities Market, 2008).
Moreover, the investment environment in Lebanon has been weakened by political unrest that has been amplified during pre-crisis sub-period. At the beginning of 2005, the assassination of the Lebanese Prime Minister led to significant financial turmoil and in the two months following the assassination, US$ 2 billion deposits was withdrawn and $ 5.5 billion was transferred into dollar deposits (IMF, 2006a). Additionally, the Israel-Lebanon war in July 2006 has deteriorated the investment environment since Lebanon has incurred huge capital outflows. Consequently, economic growth has slowed down considerably from 7.48% in 2004 to 1% and 0.6% in 2005 and 2006, respectively. The likelihood ratio test statistics in column (4) fails to reject the null hypothesis of constant transition probabilities in pre-crisis. The GFC in 2008 followed by repercussions of political unrest in neighbour countries (Syria) have put more pressure on Lebanese economy. The stock market in Lebanon is largely segmented from world market.

Figure 9: Time-Varying Integration of Stock Market in Lebanon (Pre-Crisis).

Figure 10: Time-Varying Integration of Stock Market in Lebanon (Crisis and Post-Crisis).
Morocco

For Morocco, results in table 4 indicate that the markets seems to be more integrated to the world than segmented. Columns (2) and (3) of table 4 indicate that transmission probabilities P and Q are respectively, 0.53 and 0.46. This might be attributed to the financial reform and liberalization process during 1990s accompanied by privatization of transportation, energy and telecommunication sectors, have improved the investment environment in Morocco. Moreover, Morocco has a deep and liquid stock market with long history of equity trading, and it has no restrictions on foreign ownership of companies’ capital. Column (4) shows the likelihood ratio test results which indicate that the market exhibits a time-varying integration.

Figure 11 illustrates integration index of Morocco in pre-crisis sub-period. The index reached high levels between 2000 and 2003. In the wake of GFC, and by the end of 2008,
the Casablanca Stock Exchange index has decreased by 13.84% compared to 2007 level. Figure 12 illustrates that the integration parameter fluctuates between 0.4 and 1.00 in crisis-period.

**Oman**

For Oman, columns (2) and (3) of table 4 illustrate that the pre-crisis constant integration parameter is 0.6054 whereas, \( Q \) is 0.9534. Column (4) in table 4 indicates that market exhibits a time-varying integration. Moreover, the time-varying integration index in pre-crisis is 0.52. This can be mainly attributed to acceleration in structural reforms since 1990s. These reforms were geared toward enhancing the economic diversification, privatization programs and encouraging FDI inflows (IMF, 2005). The debt was lowered from 32.3 percent of GDP.

![Figure 13: Time-Varying Integration of Stock Market in Oman (Pre-Crisis).](image)

![Figure 14: Time-Varying Integration of Stock Market in Oman (Crisis and Post-Crisis).](image)
in 1998 to 16 percent of GDP in 2002 (IMF, 2003a). FDI inflows increased sharply to US$ 1.53 billion in 2005 and US$ 1.59 billion in 2006, compared to US$ 0.052 billion in 2001 and US$ 0.109 billion in 2002. Foreign participation in Omani stock market has increased substantially in 2006 as compared to previous years (IMF, 2007). Column (6) illustrates that the integration index in post-crisis sub-period decreased to 0.35. In 2008, the Muscat Securities Market index fell by 39.78% of its 2007 value (Doha Securities Market, 2008). There was significant spike in average inflation rates from 0.81% in 2006 to 5.36% in 2012.

**Qatar**

For Qatar, column (2) of table 4 illustrates constant transition probabilities which indicate that the Qatari stock market is highly segmented in pre-crisis sub-period, where the integration parameter is zero. The likelihood ratio test results in column (4) of table 4 indicate that the null hypothesis of constant probability cannot be rejected hence the integration of stock market of Qatar to world is time invariant.

![Figure 15: Time-Varying Integration of Stock Market in Qatar (Pre-Crisis).](image)

![Figure 16: Time-Varying Integration of Stock Market in Qatar (Crisis and Post-Crisis).](image)
The crisis and post-crisis sub-period is characterized by high volatility of integration index as per figure 16. By the end of 2008, the DSE index has declined by 28.12% compared to 2007 as a result of GFC (Doha Securities Market, 2008). Furthermore, during 2011 and 2012 the financial sector in Qatar has been affected by Euro debt crisis since there was about 20% drop in lending from European banks (IMF, 2012a).

**Saudi Arabia**

For Saudi Arabia, the constant transition probabilities parameters in pre-crisis $Q(0.9839)$ indicate that the market is appear to be segmented. The segmentation of Saudi Arabian stock market in pre-crisis may be explained by tight restrictions on foreign participation in stock market activities. The likelihood ratio test results in Column (4) indicate that the Saudi stock exchange exhibits a time varying degree of integration since the null hypothesis of constant transition probabilities is rejected at 10% significance level.

Table 4 illustrates that the average integration index of stock market in Saudi Arabia in pre-crisis is 0.37. The integration index rises in 2004 after enormous fluctuation in 2003 and peaks in 2005. This may be attributed to significant improvement in stock market performance. In 2005, the market capitalization increased by more than 400% as compared to 2003, and by 100% as compared to 2004. The main factors behind the improvement in stock market performance are: (a) excess in liquidity as a result of spike in oil prices in 2004 and 2005 (b) rapid growth of credit to private sector and (c) overvaluation of share prices (IMF, 2006b). However, in 2006 the market experienced a sharp decline due to stock market crash (bubble) in GCC region. Figure 17 illustrates that there is high fluctuations in integration index in 2006.

Columns (5) and (6) of table 4 suggest that the time-varying degree of Saudi Arabian stock market integration increases from 0.37 in pre-crisis to 0.79 in crisis and post-crisis sub-period. In 2007 the market was opened to GCC investors and in 2008 the non-GCC (international) investors were allowed to participate indirectly in stock market transactions. Figure 18 illustrates the integration index in crisis and post-crisis. The index fluctuates tremendously during the GFC period. The impact of GFC on Saudi Arabian stock market index was enormous. The index tumbled by 46% in last quarter of 2008, and the market capitalization declined by 50% in 2008 as compared to 2007. Furthermore, the ratio of stock market capitalization to GDP has decreased by 150% in 2008 as compare to 2007.

---

16 Prior to 2008, the non-GCC nationals were prohibited to participate in Saudi Arabian stock market.
17 In 2006, the total traded value in the stock market in Saudi Arabia peaked at US$ 1403.02 billion representing the investors’ pull out during the crash time.
18 Refer to table 2.5: Stock Market Indicators of Saudi Arabia. Source: Datastream.
Figure 17: Time-Varying Integration of Stock Market in Saudi Arabia (Pre-Crisis).

Figure 18: Time-Varying Integration of Stock Market in Saudi Arabia (Crisis and Post-Crisis).

**Tunisia**

For Tunisia, column (3) of table 4 illustrates that the parameter of constant transition probabilities in pre-crisis is 0.9627, this implies that Tunisian stock market is segmented. In spite of the improved performance since 2003; the market remains thin and illiquid as compared to other MENA markets. Column (4) of table 4 illustrates that the market displays time-varying degree of integration. The average integration index in pre-crisis is 0.05 and rises to 0.2 in crisis and post-crisis sub-period. In 2009 and 2010, the Tunisian stock market performance improved as a result of surge in domestic demand on financial market’s products following reduction in interest rate (IMF, 2012b).
The impact of GFC on Tunisian stock exchange was small and manageable, and this could be explained by low level of integration with international stock markets (Rachdi, 2013).

Figure 19: Time-Varying Integration of Stock Market in Tunisia (Pre-Crisis).

For UAE, column (2) of table 4 illustrates that constant transition probability parameter P has value of 0.8484. This implies that in pre-crisis the stock market in UAE appear to be integrated with world stock market\(^{19}\). The UAE government has embarked on comprehensive economic reform program at the beginning of last decade, and this has included the establishment of Dubai Financial Market and Abu Dhabi Stock Exchange in 2000 (IMF, 2003b). Foreign investors can own up to 49% of companies listed in ESM\(^{20}\).

\(^{19}\) In case of UAE, the pre-crisis sub-period includes only observations of 2005 and 2006 due to unavailability of data.

\(^{20}\) www.dfm.com.ae
Column (4) illustrates that the null hypothesis of constant transition probabilities in pre-crisis is rejected at 5%. Figure 21 illustrates that the average time-varying integration index in pre-crisis is 0.74, and it displays a significant fluctuations in 2006. This may be due to GCC’s stock market crash in 2006. The main reasons for crash were the overvaluations of share prices that pushed stock market indicators beyond their historical levels, and the significant boom in real estate sector that caused a great shift in liquidity from stock market to real estate sector. The average degree of integration of stock market in UAE to the world increases to 0.84 in crisis and post-crisis. In 2014, MSCI upgraded classification of UAE stock market index to emerging market index.

Figure 22 illustrates that the integration index exhibits an increase in its level during 2008. There is unprecedented fluctuation of integration index in 2009 which might be attributed to UAE’s Sovereign Debt Crisis which was triggered by debt default of state-owned Dubai World due to high leverage of state-owned companies.

Figure 21: Time-Varying Integration of Stock Market in UAE (Pre-Crisis).

Figure 22: Time-Varying Integration of Stock Market in UAE (Crisis and Post-Crisis).
Robustness Check

In previous section, results of time-varying integration models illustrated in table 4 indicate that, in general, the MENA stock indices exhibit increase in their integration index in crisis and post-crisis sub-period (except for stock markets in Jordan, Kuwait, Morocco and Oman). At this stage, it is desirable to test whether the data has been adequately represented by aforementioned integration model with time-varying transition probabilities. We apply the Lagrange Multiplier (LM) test for serial correlation developed by Breusch (1978) and Godfrey (1978). The null hypothesis is that there is no serial correlation.

Table 5 illustrates the LM test results for pre and crisis and post-crisis integration models. The values of LM statistics are illustrated for each country. Results for pre-crisis model as presented in second column indicate that the null hypothesis of no serial correlation is accepted for all countries except for Saudi Arabia. The null hypothesis of no serial correlation is rejected at 10% hence; this provides evidence against the integration model of stock market of Saudi Arabia in pre-crisis. In the case of post-crisis, table 5 presents evidences against the validity of time-varying integration model for stock markets in Kuwait and Lebanon. That null hypothesis is rejected for markets in Kuwait and Lebanon at 1% and 5%, respectively. Overall, the LM test results suggest that there are no evidences against models specifications for our sample markets. The rejection of the null hypotheses in cases of stock markets in Saudi Arabia (in pre-crisis), Kuwait and Lebanon (in crisis and post-crisis), does not imply that the models do not yield invalid results. However, we should be more careful in interpreting the integration index for stock markets of Saudi Arabia in pre-crisis and Kuwait and Lebanon in crisis and post-crisis. Overall, the robustness of the time-varying integration indices resulted from time varying integration models estimated with time-varying transition probabilities is generally confirmed.

Table 5: Lagrange Multiplier Test for Pre and Crisis and Post-Crisis Sub-Periods.

<table>
<thead>
<tr>
<th>Stock Market (1)</th>
<th>Pre-Crisis LM (2)</th>
<th>Crisis and Post-Crisis LM (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bahrain</td>
<td>0.38</td>
<td>0.30</td>
</tr>
<tr>
<td>Egypt</td>
<td>0.94</td>
<td>2.51</td>
</tr>
<tr>
<td>Jordan</td>
<td>0.33</td>
<td>0.71</td>
</tr>
<tr>
<td>Kuwait</td>
<td>0.67</td>
<td>15.40***</td>
</tr>
<tr>
<td>Lebanon</td>
<td>0.54</td>
<td>5.99**</td>
</tr>
<tr>
<td>Morocco</td>
<td>3.29</td>
<td>0.27</td>
</tr>
<tr>
<td>Oman</td>
<td>0.37</td>
<td>2.09</td>
</tr>
<tr>
<td>Qatar</td>
<td>0.25</td>
<td>0.44</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>4.83*</td>
<td>1.43</td>
</tr>
<tr>
<td>Tunisia</td>
<td>0.43</td>
<td>2.91</td>
</tr>
<tr>
<td>UAE</td>
<td>0.90</td>
<td>0.97</td>
</tr>
</tbody>
</table>

The LM test enables the examination of relationship between model errors and several of its lagged values at the same time (Brooks, 2002).
Note: the LM test is standard Lagrange Multiplier test for serial correlation of regime switching models (in pre and crisis and post-crisis sub-periods) with time-varying transition probabilities. ***, **, * indicate; rejection of the null hypotheses of no serial correlation under 1%, 5% and 10% levels of confidence, respectively.

Conclusion

Research in this paper develops time-varying integration index for eleven MENA stock markets: Bahrain, Egypt, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Tunisia and UAE in pre and crisis and post-crisis sub-periods. Research in this paper utilizes Bekaert and Harvey (1995) methodology of International Capital Asset Pricing Model (ICAPM) with regime switching mechanism, including both, constant and time-varying transition probabilities. The results of the regime switching model with constant transition probabilities in pre-crisis era suggest that the stock markets of Egypt, Jordan, Morocco and UAE appear to be integrated to world stock market. The stock market of Bahrain, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia and Tunisia appear to be segmented from world market.

In general, the stock markets in MENA region exhibit a variation in their degree of integration with world stock market except for Lebanon and Qatar. The integration indices of MENA stock markets in pre and post-crisis are developed by the regime switching model with time varying transition probabilities. The integration index illustrates that the stock markets of Bahrain, Egypt, Saudi Arabia, Tunisia, and UAE and to lesser extent Lebanon and Qatar, become more integrated to the world after the GFC, as they exhibit higher values of integration indices in crisis and post-crisis than pre-crisis sub-period. On the other hand, the stock markets of Jordan, Kuwait, Morocco and Oman become less integrated to the world in crisis and post-crisis as compared to pre-crisis sub-period.

The results in this paper have important implications for economic policies as well as the assets allocation in regionally and internationally oriented portfolio management. We believe that portfolio diversification within stock markets in MENA region is still beneficial since these markets exhibit dissimilar degree of linkages with the world capital market. Henceforth, the investment in MENA stock markets can provides returns uncorrelated with global markets. Moreover, the variation in the value of integration index of MENA markets in pre and crisis and post-crisis sub-periods indicates for the changing dynamic of financial integration of MENA markets. This indicates that the opportunities for regional and global investors to improve their portfolio risk-return performance may change over time as these markets embrace more foreign investments.

References


IMF 2003b, ‘United Arab Emirates: Financial system stability assessment, including reports on observance of standards and codes on the following topics: Monetary and fiscal policy transparency, banking supervision and payment systems’, IMF Working Papers 03/20, International Monetary Fund.


Marashdeh, HA 2006, ‘Financial Integration of the MENA emerging stock markets’, University of Wollongong, Australia.


