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Are Islamic Equities Immune to Global Financial Turmoil? An Investigation of the Time Varying Correlation and Volatility of Islamic Equity Returns

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Abstract: The significance of risk management strategies for Islamic portfolios has recently been a matter of great concern with the surge of investments in Islamic funds and assets in the global market after the 2008 subprime crisis in particular. An understanding of how volatilities of and correlations between asset returns change over time including their directions (positive or negative) and size (stronger or weaker) is of crucial importance for both the domestic and international investors with a view to diversifying their portfolios for hedging against unforeseen risks. In order to address the above issue, this study makes an attempt to investigate the time varying correlations and volatility of Islamic equity returns. Findings of our study indicate that both returns and volatility in Islamic equity markets are affected by the financial turmoil. Our findings also suggest that Islamic equity returns are relatively more sensitive to the regional rather than the global market conditions and also to the lower leverage ratio of firms as part of their stock screening methods. Finally, as regards the prediction of volatility, the evidence tends to indicate that the Islamic equity markets under review were relatively more stable in the longer term. Our findings appear to be plausible and intuitive and have strong policy implications.

Key words: Dynamic Conditional Correlation (DCC), Constant Conditional Correlation (CCC), Multivariate GARCH, Islamic Stock Indices, Financial Integration.

INTRODUCTION

Portfolio managers in the international market, in order to diversify risk, usually split their equity portfolios into a number of regions and select the stocks from each region with a view to outperforming the average market rate of return. This cross border diversification strategy has two intertwined features. One is the expected return of the portfolio and the other is the expected risk of the portfolio. These two issues have attracted the researchers and practitioners over the last decade. With reference to the risk feature of the portfolio, it has been known for some time that equity return correlations do not remain constant over time, tending to decline in bull markets and to rise in bear markets (De Santis and Gerard, 1997; Ang and Bekaert, 1999; Longin and Solnik, 2001). Correlations also tend to rise with the degree of international equity market integration (Erb *et al*., 1994; Longin and Solnik, 1995), which has gathered pace in Europe since the mid-1990s (Hardouvelis *et al*., 2000; Fratzschler, 2002). Moreover, volatility of returns may behave erratically for different assets during financial crises and contagion. Consequently, portfolio managers may find difficulty in selecting assets to ensure stable return with minimum risk. These issues have been highlighted by a number of recent studies, which include the study to address the impact of 2008 Global financial crisis on foreign exchange markets (Baba & Packer, 2009; Melvin & Taylor, 2009; Fratzscher, 2009) and on fixed income markets (Dwyer & Tkac, 2009; Hartmann, 2010). Some studies are particularly focused on the impact of 2008 crisis on the return correlation and volatility in equity markets (Billio & Caporin, 2010; Chudik & Fratzscher, 2011; Syllignakis & Kouretas, 2011; Kotkatvuori-Örnberg *et al*., 2013). Investors in the global market, amid the sharp drop in returns coupled with higher volatility in these traditional asset markets during 2008 global crisis, attempted to find shelter in the non-traditional asset markets such as commodities. A few recent studies highlighted the correlation and volatility dynamics in commodity markets (Baur and McDermott, 2010; Brooks and Prokopczuk, 2013; Creti et at., 2013; Mensi *et al*., 2013). All of these studies addressed the inconsistent behavior of investors' returns and volatility amid the financial crisis in different asset markets and thus how portfolio returns and risk were affected. Most of

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these studies claimed that both volatilities and correlations in these asset markets move together over time and consequently reduce the potential benefits of diversification.

None of the above studies, however, investigated the return and volatility movement in Islamic equity markets, which is claimed to be relatively safer market during financial turmoil. This claim is supported by risk sharing principle and low leverage ratio of Islamic equities. Practically and operationally, Islamic equities are a subset of the mainstream equities screened by the Shariah screening criteria, which makes the universe of Islamic equities smaller. Moreover, many profitable equities are not qualified to be included in Islamic funds due to non-compliance with Shariah screening criteria. The Dow Jones Shariah screening criteria claims to be the standard in the Islamic investment markets (Visser, 2009), which entails the following criteria firms must comply in order to be classified as permissible by Islam (Halal). These include (a) total debt divided by the trailing 12-month average market capitalization has to be less than 33%, (b) cash plus interest-bearing securities divided by the trailing 12-month average market capitalization has to be less than 33% and (c) accounts receivable divided by the 12-month average market capitalization has to be less than 33%. Hence, given the distinct characteristics of Islamic funds, there is a need to study the behavior of returns and volatility of Islamic funds during the financial crises. Investors would be interested to know whether Islamic equities and funds are really insulated from the global financial turmoil with a view to diversifying their portfolio to hedge against unforeseen risks.

Considering the research gap, the main objective of this study is to investigate time varying correlation and volatility of Shariah compliant equity returns during financial crisis using Islamic equity indices of Asia-Pacific, Japan, UK, USA, and Canada. Moreover, this study also attempts to investigate the behavior and pattern of forecast of conditional correlation and volatility of the concerned Islamic stock returns. The study applied dynamic conditional correlation (DCC) model proposed by Engle (2002) on 3913 daily observations of each index starting from March 5, 1996 to March 3, 2011. Dynamic conditional correlation (DCC) is useful in a number of ways. DCC allows for the analysis of time variation in both mean and variance equation. The DCC approach allows asymmetries, meaning that the weights are different for positive and negative changes to a series, which is an insightful advantage of this model. The main objective of the study is significant as it would be unrealistic to assume that co-movement and variability in Islamic equity returns do not change over time. It would be misleading to apply traditional measures of correlations and volatility to capture the wavering nature of co-movement and variability in equity returns. Prudent portfolio managers should take active decisions for ass*et al*location taking time varying correlation and volatility of equity returns into account. The result of this study would be valuable for both researchers and academicians. Moreover, this study would contribute significantly to the Islamic finance literature. Apart from academia and research, investors and portfolio managers would be benefitted from the result of this study in setting their Islamic portfolio strategies. Possibly, this would be a pioneering study in measuring the dynamic conditional correlations (DCC) and time varying volatilities of Islamic equities in a multivariate state employing MGARCH-DCC methods.

Findings of the study indicated that both returns and volatility in Islamic equity markets are affected by the financial turmoil. Overall, volatility level of Islamic equity markets seems to decline dramatically following the 2008 financial crisis for all concerned Islamic equity index returns, which may indicate relative consistent performance of Islamic equity markets. Interestingly, results of the study demonstrated that volatility of Islamic index returns is influenced relatively more by the regional market conditions as evidenced by the high correlation between the Asia-Pacific and Japanese Islamic indices returns. Similarly, high correlation can be observed between the Canadian and US Islamic indices returns. With respect to the return volatility, the Canadian Islamic stock index appears to be the most vulnerable. The US Islamic equity market, on the other hand, seems to be the least vulnerable market followed by the Asia-Pacific, UK and Japanese Islamic equity markets in terms of return volatility. Findings of the study also suggest that in terms of volatility prediction, the concerned Islamic equity markets are relatively more stable in the longer term.

Remainder of the paper is structured as follows: sections two and three report on literature review and data description and sources respectively. Theoretical framework and econometric modeling are presented in section four. Section five exhibits the estimation results of the study. This study concludes with concluding remarks and policy recommendations in section six.

Literature Review:

Portfolio return and risk management is one of the core issues in finance literature. Co-movement of asset returns, measured by correlation coefficient, in the portfolio is significant to determine the benefits of portfolio diversification. This correlation could be either constant or time varying. Generally, portfolio managers rely on lower or negative correlation between asset returns to reap the benefit of portfolio diversification. Relying on constant correlation could be misleading during uncertain and volatile economic behaviors such as financial crises. Portfolio managers, over a few decades, have been experiencing sharp decline in portfolios return due to a series of financial crises, which would be convincing enough to divert the attitude and preferences of portfolio managers and researches towards time varying correlation and risk of asset returns. Keeping this issue in mind,

this paper attempts to investigate time varying correlation and risk of Islamic equity returns over time and specifically, during financial turmoil. Substantial studies have been conducted on this issue.

With reference to risk feature of the portfolio, it has been known for some time that equity return correlations do not remain constant over time, tending to decline in bull markets and to rise in bear markets (De Santis and Gerard, 1997; Ang and Bekaert, 1999; Longin and Solnik, 2001). Correlations also tend to rise with the degree of international equity market integration (Erb *et al*., 1994; Longin and Solnik, 1995), which has gathered pace in Europe since the mid-1990s (Hardouvelis *et al*., 2000; Fratzschler, 2002).

Number of studies has been increasing on multivariate volatility modeling. Bauwens *et al*. (2006) provide a recent review. A general class of such models is the multivariate generalized autoregressive conditional heteroskedastic (MGARCH) specification (Engle and Kroner (1995).

Thomas *et al* (2007) employed dynamic conditional correlation (DCC) to investigate contagion effect in nine major Asian stock markets, which were the major victim of 1997 Asian financial crisis. The study used daily stock return data series of major Asian economies such as South Korea, Taiwan, Hong Kong, Philippines, Thailand, Malaysia, Indonesia, Singapore, Japan starting from January 01, 1990 to March 21, 2003. In addition, the study also considered stock return data of United States over the same period. The study found two phases of the crisis, the first showed a hike in correlation (contagion) followed by the second phase of continued high correlation (herding). The study also found the evidence of variance shifting among the equity markets during the crisis period strengthening the doubt on the benefit of international diversification. Findings of the study reported the major roles played by the international sovereign credit-rating agencies in shaping the structure of co-movement in Asian equity markets.

Dimitris *et al* (2011) investigated the issue of financial contagion focusing on BRIC (namely Brazil, Russia, India and china) and two developed (United States and United Kingdom) equity markets in a multivariate time-varying asymmetric framework during five recent financial crises. The study applied multivariate regime-switching Gaussian copula model and the asymmetric generalized dynamic conditional correlation (AG-DCC) approach to capture non-linear correlation dynamics of equity returns in the specified economies. Using stock return data starting from 1995 to 2006, the study found the evidence of contagion effect from the crisis country to all other countries during each of the financial crisis. The study found that BRIC equity markets are more affected by the financial crises and industry specific turmoil has a larger impact than country specific crises.

In order to examine quantified responses to international ass*et al*location decisions, Theodore and Efthimios (2009), applying Constant Conditional Correlation and the Asymmetric Dynamic Conditional Correlation models, investigated the presence of time-varying co-movements, volatility implications and dynamic correlations in major Balkan equity markets vis-à-vis leading equity markets in the world. The study found time dependent correlations in equity returns of Balkan stock markets as a peer group despite having modest correlation with the mature markets. The study also suggested active portfolio diversification to improve investors' risk-return trade-off.

Pesaran and Pesaran (2010), employing t-version of Dynamic Conditional Correlation (DCC) on weekly returns on futures markets, articulated that the t-DCC model passes the usual diagnostic tests based on probability integral transforms, but fails the value at risk (VaR) based diagnostics when applied to the post 2007 period that includes the recent financial crisis. Authors also stated that Modeling of conditional volatilities and correlations across asset returns is an integral part of portfolio decision making and risk management.

Kam *et al* (2011) applied Markov switching model on three different asset classes: financial assets (US stocks and Treasury bonds), commodities (oil and gold) and real estate assets (US Case–Shiller index) to investigate the relationships between their returns in different regimes. The study confirmed the existence of two distinct regimes: a "tranquil" regime (lower volatility and positive equity returns) with periods of economic expansion and a "crisis" regime (higher volatility and sharply negative returns) with periods of economic decline. Findings of the study also confirmed the evidence of a flight from quality (from gold to stocks) during the periods of tranquility and evidence of a flight to quality (from stocks to treasury bonds) during the crisis periods.

Emerson *et al* (2011), applying Dynamic Conditional Correlation models, investigated the issue of contagion in Asian and Latin American countries using the major stock indices over the period 1994 to 2003. The findings supported the presence of regional contagion in both Asia and Latin America and contagion diffused from the Asian crisis to Latin America, but not the other way around.

In order to examine the time-varying conditional correlations of seven emerging stock markets of Central and Eastern Europe (CEE), Manolis and Georgios (2011) applied Dynamic Conditional Correlation (MV-DCC) of multivariate GARCH family. Using weekly data for the period 1997 – 2009, the findings of the study advocated the evidence of a statistically significant increase in conditional correlations between the US and the German stock returns and the CEE stock returns during 2007 – 2009 financial crisis indicating that these emerging markets are exposed to external shocks with a substantial regime shift in conditional correlation. The study also demonstrated that domestic and foreign monetary variables and exchange rate movements have significant impact on the corresponding conditional correlations.

The issue of contagion between the Asian and the US stock markets has always been high in importance. In order to address the issue, Matthew *et al* (2010) applied Principal Component Analysis and Dynamic Conditional Correlation on stock returns of major eleven Asian stock markets and the US stock market. The study identified a mean shift in the estimated DCC in the period from late of 2007, which was termed as contagion from the US to the Asian markets. However, the study found no such evidence of having contagion between the US and individual markets in Asia during the Asian financial crisis.

Majority of the research claimed that substantial risk reduction of portfolios has been credited to the low constant correlation among international stock indices. Due to simplicity of constant correlations, Leyuan and Robert (2010) applied Dynamic Conditional Correlation (DCC) showing that diversification benefit based on DCC would be more realistic as it accounts for time dependent correlations. The study also found that there exists a trade-off between standard deviation of returns and the other risk factors.

George *et al* (2011) applied multivariate DCC-GARCH-GJR approach on data from three oil exporting (Canada, Mexico, Brazil) and three oil importing (USA, Germany, The Netherlands) countries to investigate the time-varying correlation between stock prices and oil prices. Findings of the study show that although time-varying correlation does not differ for oil importing and oil exporting countries, the correlation increases positively (negatively) in response to aggregate demand side (precautionary demand) oil price shocks, which are suspected to be caused by the financial crises and wars. Supply-side oil price shocks do not influence the relationship of the two markets. Finally, the study concluded that the oil market could not be a "safe haven" for offering protection against stock market losses during significant economic turmoil.

Naoui, Liouane and Brahim (2010) used DCC to examine the financial contagion phenomenon following the 2008 subprime crisis. They considered six developed countries, including the crisis-originating US market, and ten emerging countries. Data frequencies are on a daily basis reflecting the January 3rd 2006 to February 26th 2010 period. The obtained results seem to point to an amplification of dynamic conditional correlations during the crisis period which stretches from August 1st 2007 to February 26th 2010.

Lanza, A., Manera, M. and McAleer, M. (2006) have estimated the DCC of the daily returns of West Texas Intermediate (WTI) oil forward and futures prices from 3 January 1985 to 16 January 2004, using multivariate conditional volatility models. They found that the DCC can vary dramatically, being negative in four out of ten cases and being close to zero in another five cases. Only in the case of the dynamic volatilities of the three-month and six-month futures returns is the range of variation relatively narrow.

Kyongwook and Shawkat (2010) employed Dynamic Conditional Correlation (DCC) and Regime Switching techniques on prices of WTI crude oil, Brent oil, copper, gold and silver, and the S&P500 index to investigate the time varying correlation in different regimes. The dynamic conditional correlations (DCCs) indicate increasing correlations among all the commodities since the 2003 Iraq war but decreasing correlations with the S&P 500 index. The commodities also show different volatility persistence responses to financial and geopolitical crises, while the S&P 500 index responds to both financial and geopolitical crises.

In order to investigate the contagious nature of volatilities in major equity markets of Asia, Sheng (2005) applied dynamic conditional correlation (DCC) technique on daily stock return data of Taiwan, Singapore, Hong Kong, and South Korea from 1990 to 2003. Findings of the study supported the evidence of wide fluctuation in equity market correlations and volatility over time. The study, in addition, advocated the presence of contagion in stock market volatilities. The study also found that increased stock market correlations are concomitant with higher volatilities in stock market, which would diminish the benefits of international diversification.

The diagonal-VEC version of the MGARCH model is more parsimonious, but still contains too many parameters in most applications. To deal with the curse of dimensionality the dynamic conditional correlations (DCC) model is proposed by Engle (2002) which generalizes an earlier specification by Bollerslev (1990) by allowing for time variations in the correlation matrix. This is achieved parsimoniously by separating the specification of the conditional volatilities from that of the conditional correlations. The latter are then modeled in terms of a small number of unknown parameters, which avoid the curse of the dimensionality. With Gaussian standardized innovations Engle (2002) shows that the log-likelihood function of the DCC model can be maximized using a two-step procedure. In the first step, m univariate GARCH models are estimated separately. In the second step using standardized residuals, computed from the estimated volatilities from the first stage, the parameters of the conditional correlations are then estimated. The two-step procedure can then be iterated if desired for full maximum likelihood estimation.

Correlation dynamics of European equity markets was measured by Kearney and Poti (2005). They examined correlation dynamics using daily data from 1993 to 2002 on the five largest Euro-zone stock market indices. They applied both unconditional and conditional estimation methodologies, including estimation of the conditional correlations using the symmetric and asymmetric DCC-MVGARCH model, extended with the inclusion of a deterministic time trend. They found the presence of a structural break in market index correlations reported by previous researchers and, using an innovative likelihood-based search, they found that it occurred at the beginning the process of monetary integration in the Eurozone. They also found mixed evidence

of asymmetric correlation reactions to news of the type modeled by conventional asymmetric DCC-MVGARCH specifications.

Chang, McAleer and Tansuchat (2009) have estimated univariate and multivariate conditional volatility and conditional correlation models of spot, forward and futures returns from three major benchmarks of international crude oil markets, namely Brent, WTI and Dubai, to aid in risk diversification applying constant conditional correlation (CCC), VARMA GARCH (Ling and McAleer 2003), VARMA- AGARCH (McAleer *et al*, 2009) and dynamic conditional correlation (DCC). They found volatility spillovers and asymmetric effects for negative and positive shocks on conditional variance, which suggest that VARMA-GARCH is superior to the VARMA-AGARCH model. In addition, the DCC model gave statistically significant estimates for the returns in each market, which shows that constant conditional correlations do not hold in practice.

DCC has been estimated in MGARCH framework even in political science. Lebo and Box-Steffensmeier (2008) studied the evolution of relationships over time in a multivariate setting by relaxing model assumptions and offers researchers a chance to reinvigorate understandings that are tested using time series data. They demonstrated the method's potential in the first example by showing how the importance of subjective evaluations of the economy are not constant, but vary considerably over time as predictors of presidential approval. A second example using international dyadic time series data shows that the story of movement and co-movement is incomplete without an understanding of the dynamics of their variance as well as their means.

With a careful look at the above literature, it could be safely claimed that risk and return behavior of Islamic equities and mutual funds is still a virgin area, which finance researchers should study owing to massive growth of Islamic equities and mutual funds after 2008 global financial crisis. In order to fill in this knowledge gap, this study attempts to address the burning issue applying dynamic conditional correlation technique on Islamic equity returns.

Sources of Data and Variables:

This study uses Dow Jones Islamic indices returns of Asia Pacific, Japan, UK, Canada, and USA. The reason behind selecting the above indices is that Japan, UK, Canada, and USA fall in the developed country group, whereas in the Asia Pacific, most of the countries practicing Islamic finance fall in the developing country group. A comparative picture of dynamic volatility of Islamic equity returns in the developing and developed economies can be obtained from this study. The study covers 3913 daily observations starting from March 5, 1996 to March 3, 2011. The study also divides the entire data into two samples – first sample, for DCC estimation, covers ranges from March 5, 1996 to December 31, 2009 and the second sample, for DCC forecasting, ranges from January 1, 2010 to March 3, 2011. Logarithmic return, R_t is computed as follows:

$$R_t = 100 * LN\left({}^{P_t}/_{P_{t-1}}\right)$$

In addition, owing to the operating time differences among the stock markets, the study made required time adjustment following Universal Co-ordinated Time (UTC – 6.00 Hours) in order to maintain time homogeneity in data, which depicts the picture more accurately.

All data are collected from Datastream database. Data description and plot of the returns are presented in the following table 1 and figure 1 respectively:

Table 1: Description of returns.

Variable	Explanation
RAP	Return of DJ Asia Pacific Islamic Index
RJAP	Return of DJ Japan Islamic Index
RUK	Return of DJ United Kingdom Islamic Index
RUS	Return of DJ United States Islamic Index
RCAN	Return of DJ Canada Islamic Index

Plot of the return series evidences stationarity of the returns even though returns are volatile over the periods in general and financial crises periods in particular. This return volatility, naively, may suspect the effect of financial crises in Islamic equity markets.

Theoretical Framework and Econometric Modeling:

This study employs dynamic conditional correlation (DCC) method in order to estimate time dependent correlation and volatility of returns of Islamic indices. In addition to DCC, this study also tested mean reversion of volatility by giving linear restrictions. Moreover, forecasting correlation of the returns over a specific period is another focus of this study.

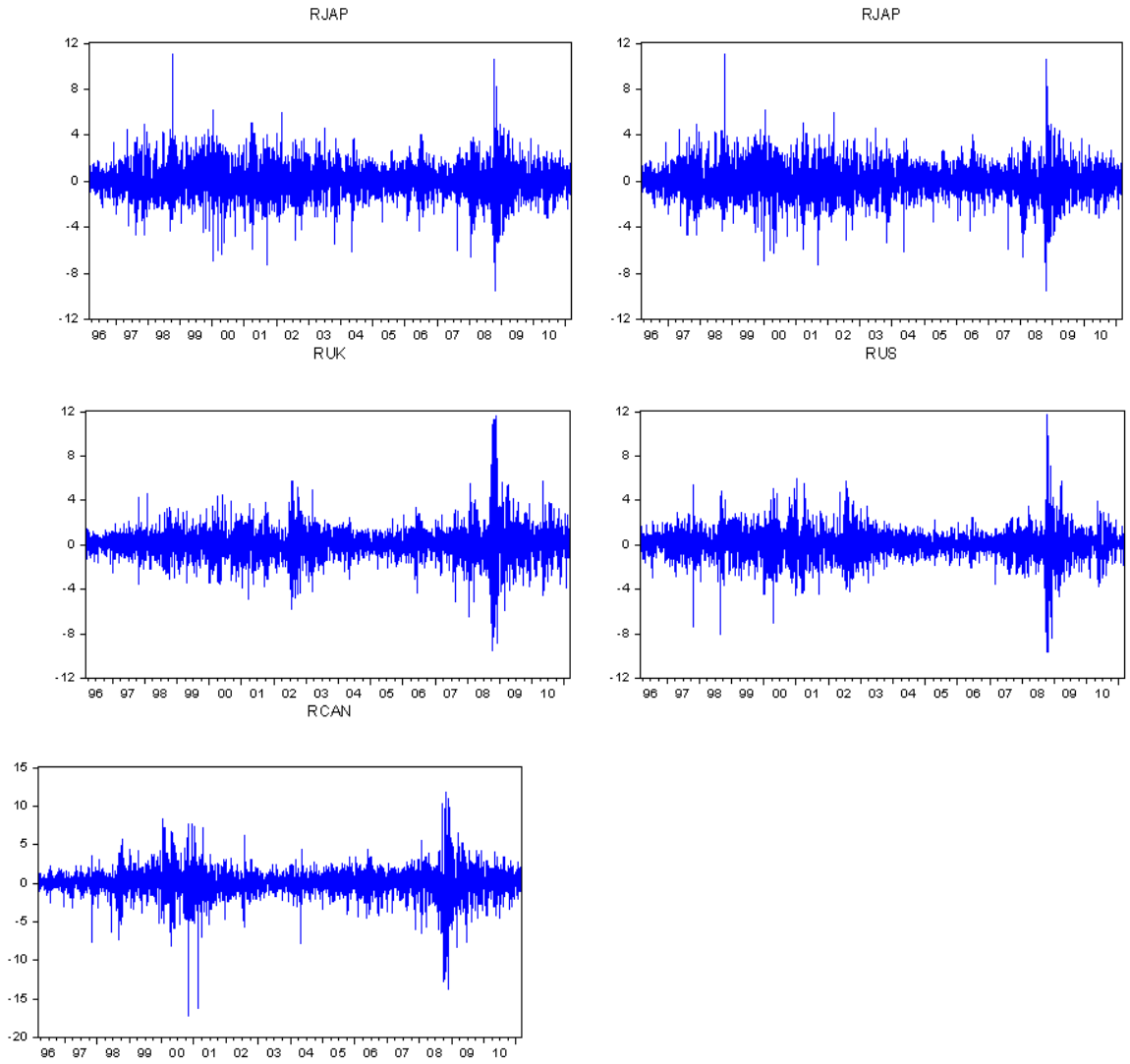


Fig. 1: Plot of the Returns.

With the DCC model, a member of the GARCH family, one can pinpoint precisely the timing and nature of plausible changes in the time series co-movement. For each time point, the DCC method gives a value that serves as the forecasted correlation between series for the next period. The estimation of DCC is broken into two stages, which simplifies the estimation of a time varying correlation matrix. In the first stage, univariate volatility parameters are estimated using GARCH models for each of the variables. In the second stage, the standardized residuals from the first stage are used as inputs to estimate a time varying correlation matrix. Following Engle (2001), H_t is a conditional covariance matrix and is:

$$H_t = D_t R_t D_t$$

Where, R_t = k × k time varying correlation matrix (R_t varies over time) and
D_t = k × k diagonal matrix of conditional, i.e. time varying, standardized residuals ε_t, that are obtained from the univariate GARCH models.
The log-likelihood of the above estimator can be written as:

$$L = -\frac{1}{2}\sum_{t=1}^{T}(Klog(2\pi) + 2log|H_t| + \acute{r}_t H_t^{-1} r_t)$$

$$= -\frac{1}{2}\sum_{t=1}^{T}(Klog(2\pi) + 2log|D_t R_t D_t| + \acute{r}_t D_t^{-1} R_t^{-1} D_t^{-1} r_t)$$

$$= -\frac{1}{2}\sum_{t=1}^{T}(Klog(2\pi) + 2log|D_t| + \log(|R_t| + \acute{\varepsilon_t}R_t^{-1}\varepsilon_t)$$

Where, $\varepsilon_t \sim N(0, R_t)$ are the residuals standardized on the basis of their conditional standard deviations. First, the conditional variances for any individual asset can be obtained from the univariate GARCH (p, q) model as follows:

$h_t = \omega_0 + \sum_{i=1}^{p}\delta_i h_{t-i} + \sum_{j=1}^{q}\gamma_j u_{t-j}^2$ for i = 1, 2, 3…….k

Then proposed dynamic correlation structure is:

$$Q_t = \left(1 - \sum_{m=1}^{M}\alpha_m - \sum_{n=1}^{N}\beta_n\right)\bar{Q} + \sum_{m=1}^{M}\alpha_m(\varepsilon_{t-m}\varepsilon_{t-m}) + \sum_{n=1}^{N}\beta_n Q_{t-n}$$

$$R_t = Q_t^{*-1}Q_t Q_t^{*-1}$$

Where, $\bar{Q}$ is the unconditional covariance of the standardized residuals resulting from the univariate GARCH equation and Q* is a diagonal matrix composed of the square root of the diagonal elements of Q_t, which is as follows:

$$Q_t^* = \begin{bmatrix} \sqrt{q_{11}} & 0 & \dots & 0 \\ 0 & \sqrt{q_{22}} & \dots & 0 \\ \vdots & \vdots & \vdots & 0 \\ 0 & 0 & \dots & \sqrt{q_{kk}} \end{bmatrix}$$

The typical element of R_t will be $\rho_{ijt} = \frac{q_{ijt}}{\sqrt{q_{ii}q_{jj}}}$ and the matrix R_t will be positive definite/constant. The K assets covariance H_t is thus a positive definite/constant and can be written as $H_t = D_t R_t D_t$.

The decomposition of H_t allows separate specification of the conditional volatilities and conditional cross asset returns correlations. For example, one can utilize the GARCH (1,1) model for the variance $\sigma_{i,t-1}^2$, namely

$V(r_{it}|\Omega_{t-1}) = \sigma_{i,t-1}^2 = \bar{\sigma}_i^2(1 - \lambda_{1i} - \lambda_{2i}) + \lambda_{1i}\sigma_{i,t-2}^2 + \lambda_{2i}r_{i,t-1}^2$

Where, $\bar{\sigma}_i^2$ is the unconditional variance of the ith asset return. λ_1 and λ_2 are asset specific volatility parameters (individual asset return volatilities). Under the restriction$\lambda_{1i} + \lambda_{2i} = 1$, the unconditional variance disappears in the above equation and we have the Integrated GARCH (IGARCH) model, which tells us that conditional variance is non-stationary, and then the shock to variance is permanent. A more general mean reverting specification is given by

$q_{ij,t-1} = \bar{\rho}_{ij}(1 - \phi_1 - \phi_2) + \phi_1 q_{ij,t-2} + \phi_2 \tilde{r}_{i,t-1}\tilde{r}_{j,t-1}$

where, $\bar{\rho}_{ij}$ is the unconditional correlation between r_{it} and r_{jt} and $\quad \phi_1 + \phi_2 < 1$.

One would expect $\phi_1 + \phi_2$ to be close to 1 in order to be non-mean reverting, which can be obtained when $\phi_1 + \phi_2 = 1$. Therefore, in order to test the existence of non-mean reversion, we need to put restriction of $\phi_1 + \phi_2 = 1$.

Estimation Results:

Descriptive statistics table shows that volatility of return (represented by standard deviation) is highest for the Japanese Islamic indices and lowest for the Asia Pacific Islamic indices followed by the highest and lowest average returns, which is in line with theory, higher the risk, higher is the return. This standard deviation shows absolute time independent volatility of the return.

Table 2: Descriptive Statistics.

Statistics	RAP	RJAP	RUK	RUS	RCAN
Mean	0.0192	1065.874	0.0199	0.0249	0.0393
Std. Deviation	1.3278	278.8590	1.4127	1.3294	1.8627
Skewness	-0.2289	1.1078	-0.0565	-0.0888	-0.8654
Kurtosis	7.6891	4.2332	9.8843	9.3682	13.1626
Jarque-Bera (JB)	3620.134 (0.0000)	1048.947 (0.0000)	7731.337 (0.0000)	6618.995 (0.0000)	17331.57 (0.0000)

N.B. Values in the parentheses are probability values of JB test

Skewness, the third moment of the any distribution, indicates asymmetry property of any distribution. Zero skewness leads to symmetry of a distribution. On the contrary, positive skewness refers to an asymmetric distribution with larger tail inclined to the right and negative skewness refers to an asymmetric distribution with larger tail inclined to the left. The result shows that distribution of all returns is negatively skewed except for the Japanese Islamic equity return, which indicates that equity return distributions are not symmetric leading to higher variability and risk.

On the other hand, kurtosis, the fourth moment of the distribution, measures fatness of any distribution relative to normal distribution. Measures of kurtosis describe how concentrated the data are around the mean of the distribution. The more peaked or flat is the distribution, the less normally distributed the data are and vice versa. Ideal value of kurtosis is 3 signifying the normality of the distribution, i.e. the distribution is neither peaked nor flat. Kurtosis value more than 3 indicates leptokurtic (peaked) distribution and the distribution is platykurtic (flat) with a kurtosis value of less than 3. Results show that kurtosis values of all returns series are more than 3 indicating fatness of the distribution (leptokurtic), which indicates that returns are not normally distributed and consequently return variability and risk are higher. Jarque-Bera test results of all return series are significant, which even further strengthens the non-normality, variability and risk of the returns' distributions.

Estimation of Dynamic Conditional Correlation (DCC):

DCC estimation results under t - distribution are presented in table 3 and 4. Volatility parameters are presented in table 3 and unconditional volatilities and unconditional correlations are presented in table 4.

Table 3: DCC Estimation results using t – Distribution.

Parameter	Estimate	T-Ratio	Probability
λ1_RAP	0.9454	176.09	.000
	(.0053)		
λ2_RAP	0.0441	11.24	.000
	(.0039)		
λ1_RJAP	0.9473	186.65	.000
	(.0051)		
λ2_RJAP	0.0422	11.44	.000
	(.0037)		
λ1_RUK	0.9483	160.36	.000
	(.0059)		
λ2_RUK	0.0443	9.36	.000
	(.0047)		
λ1_RUS	0.9475	155.12	.000
	(.0061)		
λ2_RUS	0.0474	9.09	.000
	(.0052)		
λ1_RCAN	0.9434	135.48	.000
	(.0069)		
λ2_RCAN	0.0472	8.56	.000
	(.0055)		
δ_1	0.9583	251.74	.000
	(.0038)		
δ_2	0.0236	13.97	.000
	(.0016)		
DF	11.80	17.23	.000
	(.6848)		
Max. Log-likelihood		23865.6	

Table 4: Unconditional Volatilities and Unconditional Correlations.

	RAP	RJAP	RUK	RCAN	RUS
RAP	1.3590	0.9266	0.3607	0.3955	0.4938
RJAP	0.9266	1.5470	0.2226	0.3231	0.4150
RUK	0.3607	0.2226	1.4210	0.1687	0.3312
RCAN	0.3955	0.3231	0.1687	1.9096	0.6327
RUS	0.4938	0.4150	0.3312	0.6327	1.3568

Table 3 presents the maximum likelihood estimates of λ_{i1} and λ_{i2} (Volatility Parameters of returns of Islamic indices) and δ_1 *and* δ_2 (Mean reverting parameters of the same indices).

It is observed that all volatility parameters are highly significant, which implies gradual volatility decay i.e. riskiness of the returns gradually decays (dies out) following a shock in the market. Even if we add λ1_RAP and λ2_RAP (0.9454 + 0.0441 = 0.9895 < 1), which is less than unity, implies that the volatility of th e Asia - Pacific Islamic index return is not following Integrated Generalized Auto Regressive Conditional Heteroskedasticity (IGARCH), i.e. the shock to volatility is not permanent. Similarly, for Japanese Islamic stock return, λ1_RJAP + λ2_RJAP = 0.9473 + 0.0422 = 0.9895 < 1, which implies that the volatility of the Japanese Islamic index return is not following IGARCH. Volatility parameters of UK, USA and Canadian Islamic index

returns are also not following IGARCH. This result has very important implications as the volatility is not going to be permanent following a shock in the economy. If volatility in the equity market is permanent and does not die out, investors and portfolio managers would have a high chance of losing their investment even though they may make higher profit in the short run. Apart from genuine investors and portfolio managers, speculators would welcome this situation for their own interest. Therefore, it is evidenced that the Islamic equities would be a safer investment instrument for both muslim and non-muslim investors and portfolio managers.

Table 4 reports the estimated unconditional volatilities and unconditional cross correlations between Islamic indices returns. The off diagonal elements represent unconditional correlation, which also can be termed as covariance and diagonal elements represent unconditional volatilities of the Islamic indices returns. Results show that the unconditional volatility is the highest for Canadian Islamic index (1.9096) and lowest for US Islamic index return (1.3568), which indicates higher stability and lower risk associated with United States Islamic equity market even amid 2002 stock market crash and 2008 financial global financial crisis. This lowest volatility in the US stock market may be attributed to lower leverage in Islamic stocks and relatively lower responsiveness to changes in mainstream equity markets. This result has significant impacts on ass*et al*location of Islamic portfolios.

With regard to the cross return correlation, we observe that correlation between returns from Japanese and Asia-Pacific Islamic stocks is the highest and positive, which is 0.9266. This high positive correlation shows the possible direction of movement and the degree of association (+92%) between the returns of Japanese and Asia-Pacific Islamic indices. It is also a concern for the investors as any movement in the return of either of the two causes the other to move in the same direction. Possibly, Japanese stock market is the most structured and developed market in Asia, which may lead other stock markets in Asia. Kuala Lumpur is termed as the leading Islamic capital market in the Asia-Pacific region. Therefore, high correlation between these two markets is not surprising. On the contrary, Asia Pacific Islamic equity market is least responsive to the United Kingdom Islamic equity market, which has been evidenced by the lowest correlation (+0.3607) between their returns. Results also show that between the United States and Canadian Islamic equity markets, Asia Pacific market is more sensitive to the happenings in the United States market as indicated by their positive correlation (+0.4938). Surprisingly, United States Islamic equity market possesses the highest correlation (+0.6327) with the Canadian Islamic equity market leaving behind Japanese, United Kingdom, and the Asia Pacific markets. It is also noticeable that Japanese Islamic index return, after the Asia Pacific index return, is highly responsive to the United States Islamic index return as evidenced by their positive correlation (+0.4150). These results indicate regional supremacy and relative higher co-movement between the major Islamic equity markets. As for the regional supremacy, in the Islamic equity markets, Japanese Islamic equity market exerts more influence on the Asia Pacific market as compared to other markets including the leading United States equity market. By the same token, United States equity market affects the Canadian market most as compared to other Islamic equity markets including the Japanese market, the leading market in Asia. Even though unlikely in the mainstream equity markets, the finding of regional leadership in the Islamic equity markets could be advocated by the findings of a recent study by Ip-Wing *et al* (2010), where the authors by applying Haldane and Hall (1991) approach articulated that individual equity market indices are becoming more responsive to regional than global influences. As for the higher co-movement between major Islamic equity markets, results reveal that Japanese and United States Islamic equity markets are highly correlated. These patterns of Islamic equity returns movement, to some extent, are mimicking the same of the mainstream equity markets in the world.

Looking at the mainstream equity markets, there is no suspicion to say that the United States equity market is the global leader to influence all other equity markets in the world. Similarly, Japanese equity market is termed as the Asian leader even though Malaysia is regarded as the leading Islamic equity market not only in Asia but also in the Asia Pacific. Market players, even in the smaller markets, are always concerned about the swings in the United States equity market being the leader. This issue, to a little extent, would be due to behavioral (psychological) factor of the investors and other major market players. Surprisingly, unlike the mainstream equity markets, Islamic equity markets appear to be more reactive to the regional leader, rather than to the global leader. This issue has been addressed by the higher correlation between Japanese and Asia Pacific, United States and Canadian Islamic indices returns. Following the mainstream equity market style, Japanese Islamic equity market is highly responsive to the United States Islamic equity market.

Both the findings of regional and global leadership in Islamic equity markets are crucial for the Islamic Portfolio managers in order for diversifying their investment and setting the portfolio strategies as real benefit of portfolio diversification depend on co-movement of the assets in the portfolio. Benefits of portfolio diversification can be obtained when the assets in the portfolio are negatively correlated or at least positively correlated with lower degree. The result shows that all correlation coefficients are positive, indicating movement of Islamic equity returns in the same direction with varying degrees. As a consequence, portfolios consisting of Islamic stocks from Japan and Asia-Pacific market would be less efficient in making profit as the correlation of returns is the highest. On the contrary, smart Islamic portfolio managers might get better benefit by forming portfolios of Islamic stocks from Canadian and the United Kingdom Islamic equity markets as evidenced by the

lowest correlation (+0.1617) between their returns. Above all, prudent portfolio managers should carefully look at the marginal contribution of any asset before taking it into the portfolio, which is again indicated by the correlation coefficient between individual asset's return and the return of the existing portfolio. The findings of all positive correlation between the major Islamic equity markets are indicative of investing in alternative assets which are not conflicting with Islamic stipulations and rules. This asset class may include real estate and major commodities such as gold, other minerals and food commodities. However, investment in major food commodities (staple and essential food) would be unethical should the price of those commodities be hiked on account of gradual switch of the investors from the financial markets to the commodities markets. This sort of commodities investment would be unethical according to the Islamic law as increased food price would be detrimental and conflicting to the public benefit by raising public sufferings, which is termed as maslahah in Islamic jurisprudence.

The following figures 2 and 3 portray conditional volatilities of the Islamic equity indices returns undertaken by this study. These volatilities are conditional upon the information available in the market up to t-1 period.

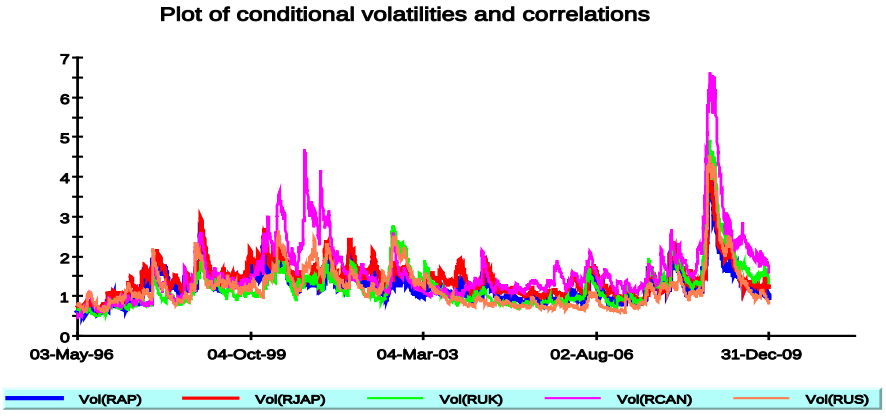


Fig. 2: Plot of the Conditional Volatilities of returns (All).

From the above figures, it would be easier to observe that the conditional volatilities of all Islamic indices returns move more or less simultaneously except around 2002 and 2008, when Canadian Islamic index returns are more volatile than other Islamic indices returns. This higher volatility of Canadian Islamic index returns is suspected to be caused by the 2002 stock market crash and 2008 global financial crisis. The above figures also suggest high convergence in volatility of Japanese and Asia-Pacific Islamic stock returns, which is almost similar to the convergence between Canadian and the US Islamic stock return volatility. This convergence of volatilities could reflect a closer financial integration between the markets. Closer financial integration usually is not beneficial for the investors and portfolio managers in the sense that there remains less opportunity of gain through portfolio diversification, which is already evidenced by the estimation results in tables 3 and 4.

Following figure 4 presents plot of conditional correlations between Islamic equity returns of Major markets.

From the above plots, we observe the swings of the conditional correlations between returns of Islamic indices, indicating variability in Islamic equity return over time. Figure also shows that conditional correlations of Japanese Islamic index return with other indices returns are volatile over the period except with the Asia-Pacific Islamic index return, which is almost stable over time, may be due to strong financial integration between these two markets. Similar pattern of movement is suspected in conditional correlations between the United States and Canadian Islamic equity indices, which could be attributed to the regional leadership of the United States Islamic equity market.

Forecasting Conditional Volatilities and Correlations:

Following figures 5 and 6 present forecast of conditional volatility and conditional correlations of the Islamic indices returns undertaken by this study.

The above figure shows that conditional volatility of and correlation between concerned Islamic indices returns are likely to increase immediately at the inception of the forecasting period, which starts at January 01, 2010, and gradually flatten out, indicating achievement of gradual stability in Islamic equity markets. This gradual stability could perhaps be explained by the huge volume of investment flows in Islamic equity markets after investors lost their confidence in the mainstream equities. These results bear significant implications in portfolio choice of the managers during post financial crisis periods.

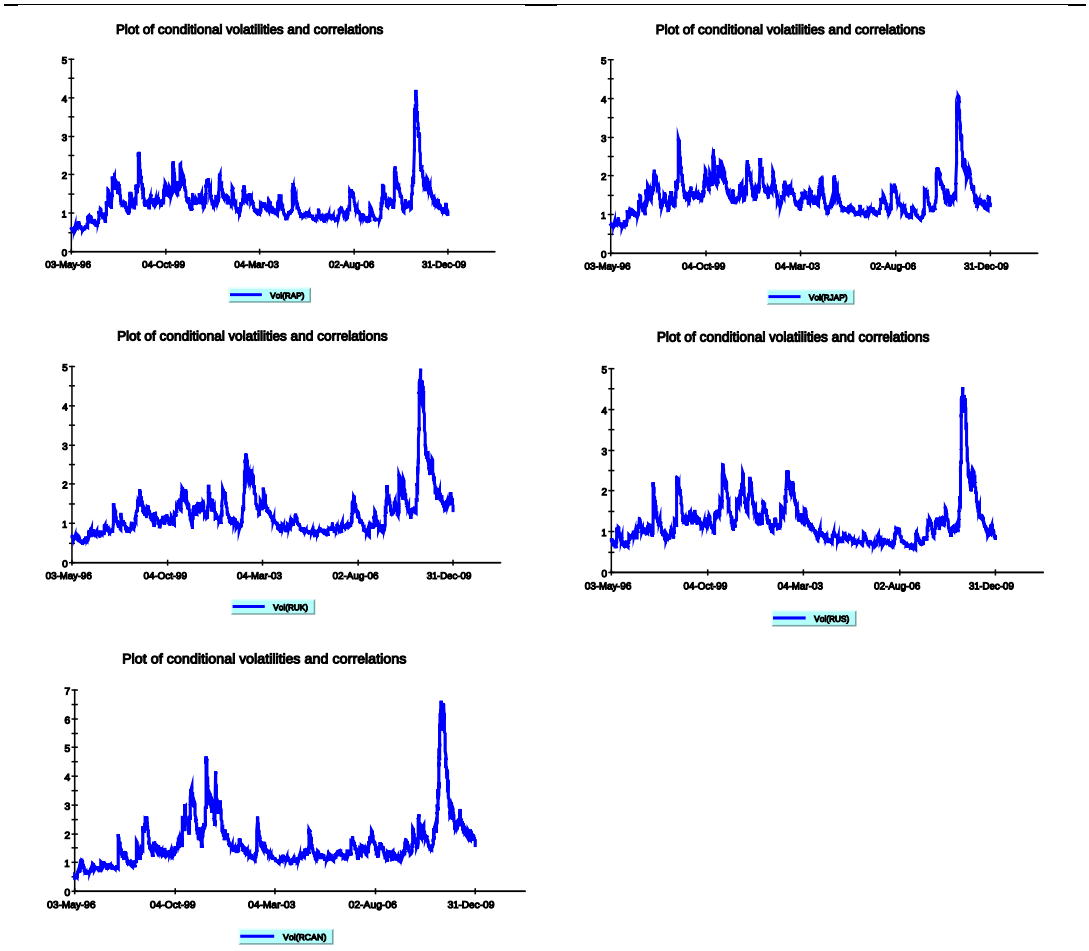


Fig. 3: Plot of the Conditional Volatilities of returns (By indices).

Testing for Linear Restrictions:

In order to test the mean reversion of volatility, linear restrictions are imposed on each Islamic index return. The focus is on the problem of testing the hypothesis that one of the indices returns has non-mean reverting volatility. That is λ_{i1} and λ_{i2} be the parameters for the conditional volatility equation of the *ith* asset we wish to test:

Null Hypothesis: H_0: $\lambda_{i1} + \lambda_{i2} = 1$

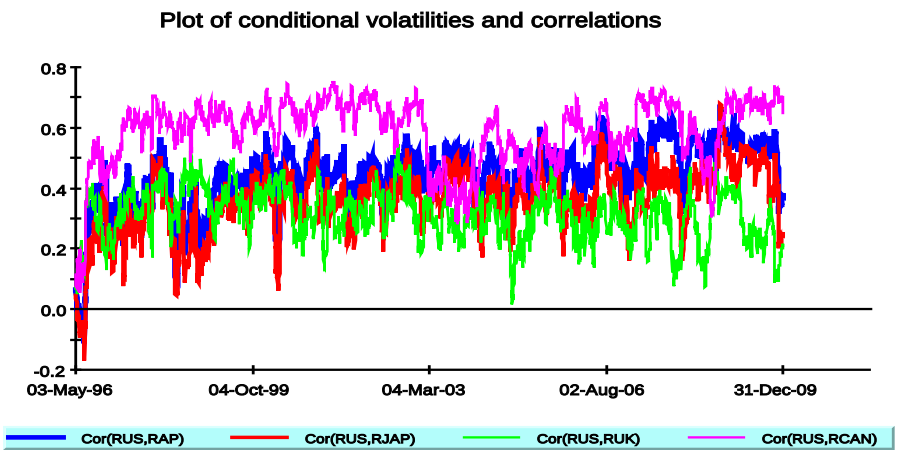
Under H_0, the process is non-mean reverting, and the unconditional variance for the asset does not exist.

Table 7: Summary of Testing for Linear Restrictions.

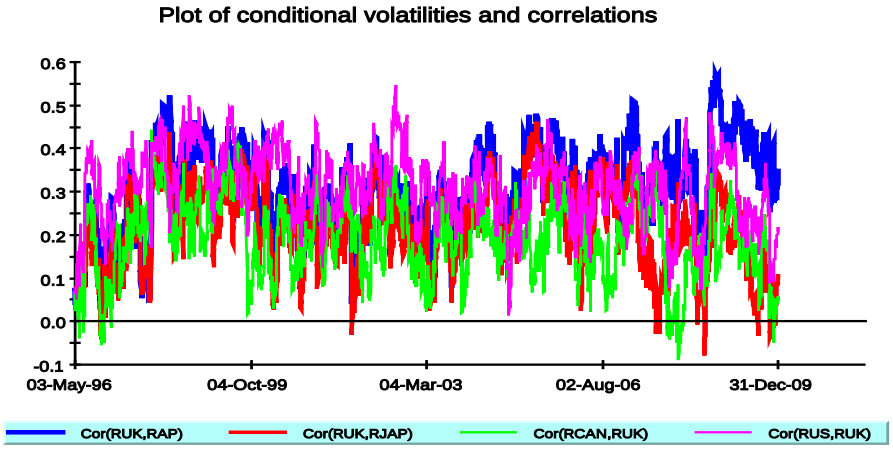
Asset	$1 - \lambda_1 - \lambda_2$	Std. Errors	t- ratio
RAP	.010429	.0020909	4.9877
RJAP	.010355	.0021042	4.9212
RUK	.0073035	.0021923	3.3314
RUS	.0049957	.0013875	3.6006
RCAN	.0092335	.0023211	3.9781

The above result in table 7 suggests very slow but statistically significant mean reverting volatility in all Islamic indices returns, which indicate that Islamic equity return volatility gradually moves back to equilibrium following a shock, which is again suggesting that none of the Islamic equity return is following IGARCH. Forecasting longer horizon volatility would be inaccurate and misleading when any time series follows IGARCH. With regard to the IGARCH effect, Starica (2003) argued that the GARCH (1, 1) model fails to provide sensible longer horizon volatility forecasts on sub-sample of returns on the S&P500 index in presence of IGARCH effect. The author also pointed out that the poor performance in forecast by the GARCH (1, 1) model is owing to the poor estimation of the unconditional volatility of the data caused by the IGARCH effect. Accordingly, findings of our study tend to indicate that prediction of riskiness in the concerned Islamic equity markets would not be inaccurate and misleading in the long term, even though it may be prevalent during the periods of economic turbulence. With the support of this finding and suggestion, it would not be unreasonable to

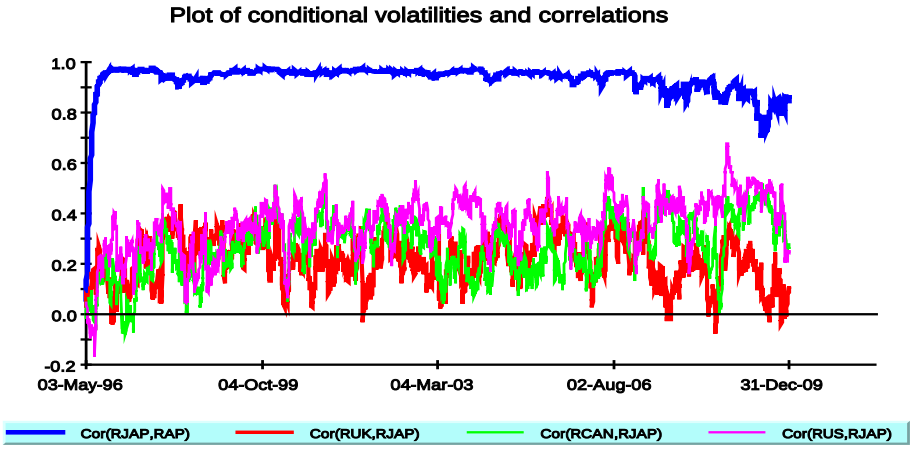
claim that equity investment in Islamic capital markets is relatively safer in general, specially, when investment horizon is relatively longer.



Conditional Correlation: US with Others



Conditional Correlation: UK with Others



Conditional Correlation: Japan with Others

Fig. 4: Plotting the Conditional Correlations.

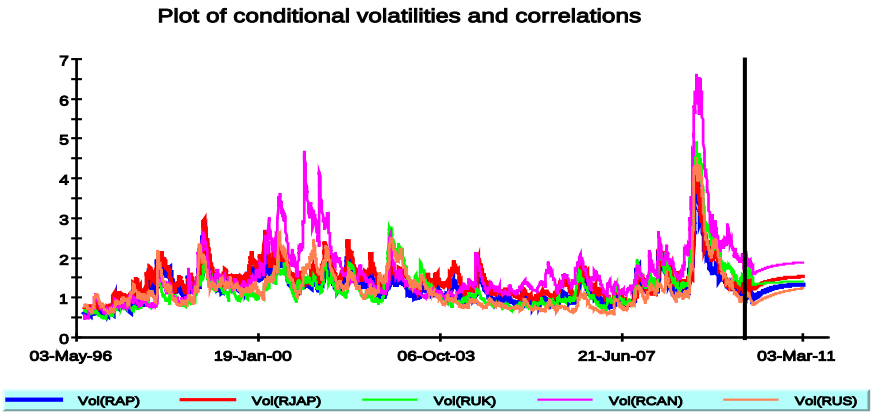
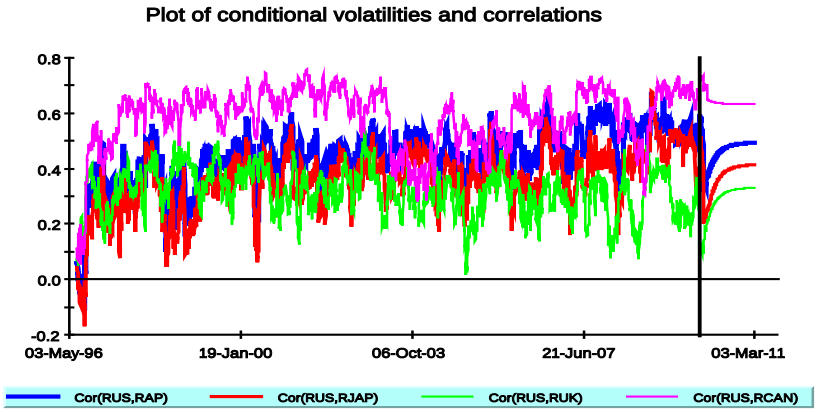
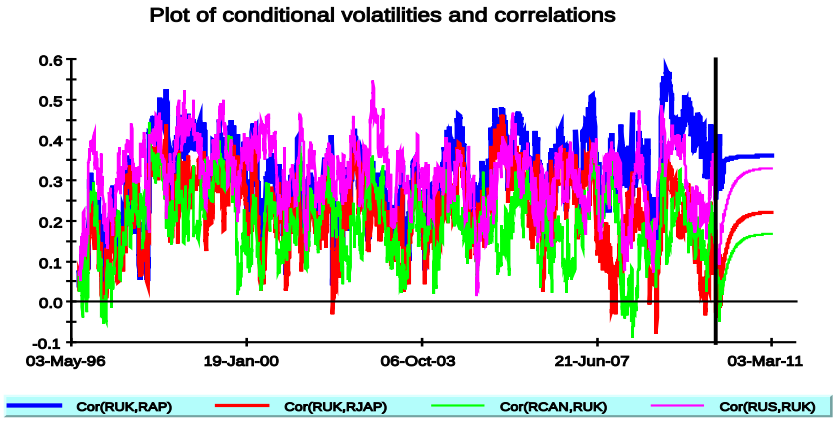


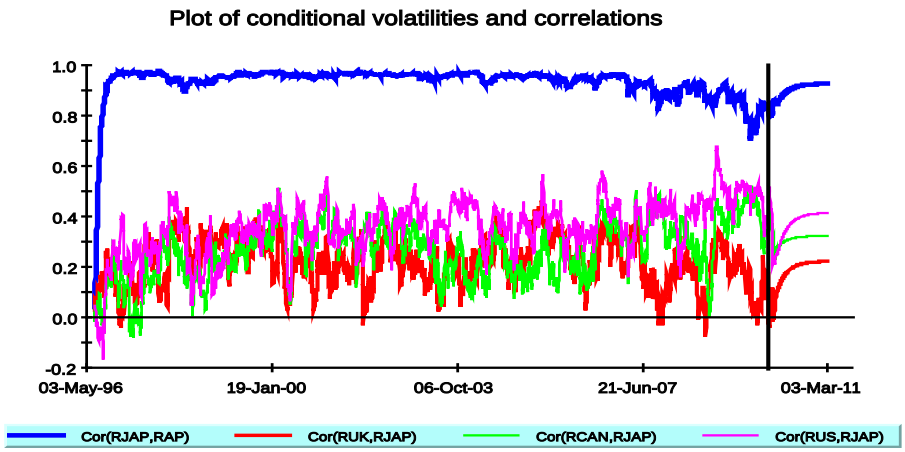
Fig. 5: Plot of the Forecast of Conditional Volatilities.



Forecast of Conditional Correlation: US with others



Forecast of Conditional Correlation: UK with others



Forecast of Conditional Correlation: Japan with others

Fig. 6: Plot of the Forecast of Conditional Correlation.

Concluding Remarks and Policy Implications:

This study investigated time varying correlation and volatility of Shariah compliant equity returns during financial crisis using Islamic equity indices of Asia-Pacific, Japan, UK, USA, and Canada. Moreover, this study also attempts to investigate the behavior and pattern of forecast of conditional correlation and volatility of the concerned Islamic stock returns. Findings of the study indicated that both returns and volatility in Islamic equity markets are affected by the financial turmoil, manifested by the downturn in 2002 and 2008 for all concerned Islamic indices. Overall, volatility level of Islamic equity markets seems to decline dramatically following the 2008 financial crisis for all concerned Islamic equity index returns, which is indicative of relative consistent performance of Islamic equity markets. Furthermore, results of the study demonstrated that volatility of Islamic index returns is influenced by the regional market conditions as evidenced by the high correlation between the Asia-Pacific and Japanese Islamic indices returns. Similarly, high correlation can be observed between the Canadian and US Islamic indices returns. These findings are in line with the findings of the study by Ip-Wing *et al* (2010), where the authors by applying Haldane and Hall (1991) approach articulated that individual equity market indices are becoming more responsive to the regional rather than the global influences. Market condition could be affected by macroeconomic factors as well as political and cultural factors, which influence investment behavior of investors and portfolio managers. Surprisingly, Asia-Pacific and the UK Islamic indices returns are found to be least correlated. With respect to return volatility, the Canadian Islamic stock index appears to be the most vulnerable. The US Islamic equity market, on the other hand, seems to be the least vulnerable market followed by the Asia-Pacific, UK and Japanese Islamic equity markets in terms of return volatility. Findings of the study also found that volatility prediction in the concerned Islamic equity markets was relatively more stable in the longer term.

The findings of this study have several implications for the policy makers of Islamic stock markets and investors as well. It would be better for the policy makers to look at macroeconomic, microeconomic, political, natural and cultural factors while changing or formulating new investment policies for the markets as the study found the equity markets' returns are highly correlated in a particular region, which indicates the existence of regional leaders such as, Japan in Asia and United States in the North America. Moreover, regional leaders tend to follow each other, especially, in the market turbulence periods. For example, bearish trend in Japanese stock markets on account of Tsunami and earthquake tends to spillover to other Asian stock markets in general and to the Asia Pacific stock markets in particular. This may happen due to information spillover and volatility spillover in the markets. Information spillover, to some extent, may be caused by the psychological issues of the market players due to bearish condition in the leading stock market. Volatility spillover, to a greater extent, may be caused by the cross listing of Japanese stocks in major Asian stock markets. Moreover, a number of Japanese firms have either subsidiaries or major manufacturing plants in the Asia Pacific countries, where, even they are listed in the stock markets. Almost the same process is followed by the North American and European markets. Why are these tales important for the Islamic equity markets? The main reason being the Islamic stocks are basically subset of the mainstream stocks in the main board. Accordingly, there remains a possibility of transmitting shocks from the mainstream equity market to the Islamic equity markets, may be to a lower extent.

Islamic Equity investment could be less risky during financial crises mainly because of strict stock screening methods in terms of firm's leverage ratio in particular. For example, Dow Jones maintains lower than 33% leverage ratio for the firms while certifying a stock as Shariah compliant. This limited leverage ratio

reduces the financial risk, which ultimately decreases total risk level of the firm. Investors and portfolio managers, in particular, may obtain higher benefits of portfolio diversification by investing in least correlated equities from Canadian and United Kingdom markets followed by United Kingdom and Japanese markets. Gradual mean reverting volatility process observed in the Islamic equity markets suggests that investors should react cautiously following any shock in the market as it is highly likely that Islamic equity markets come back to normal position after a certain period of time following any crisis. In spite of this fact, small investors groups with smaller volume of capital may get panicked as they are always in fear of losing their capital due to price drop in the market.

While this study looked at only Islamic equity indices, future research should try to look at the more comprehensive picture of return volatility by taking into account both Islamic and conventional equity indices together.

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