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Asymmetric Return and Volatility Transmission in Conventional and Islamic Equities

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Abstract: This paper analyses the interdependence between Islamic and conventional equities by taking into consideration the asymmetric effect of return and volatility transmission. We empirically investigate the decoupling hypothesis of Islamic and conventional equities and the potential contagion effect. We analyse the intra-market and inter-market spillover among Islamic and conventional equities across three major markets: the USA, the United Kingdom and Japan. Our sample period ranges from 1996 to 2015. In addition, we segregate our sample period into three sub-periods covering prior to the 2007 financial crisis, the crisis period and the post-crisis period. We find weak support for the decoupling hypothesis during the post-crisis period.

Keywords: Islamic stock market; conventional stock markets; asymmetric return and volatility spillovers; EGARCH

JEL Classification: G01; G10; G15

1. Introduction

The resilience of Islamic financial assets during the global financial crisis of 2007 has attracted the attention of academics, investors and policy makers around the world. According to the Islamic financial services industry stability report (IFSB 2015), Islamic financial assets exhibited an impressive compound annual growth of 17% during the period 2009–2013. This phenomenal growth in the Islamic finance assets has inspired researchers to investigate the risk return characteristics of Islamic finance assets. In addition, the performance of Islamic financial assets vis-à-vis conventional financial assets has also attracted a lot of attention and a number of studies have documented the comparative analysis of Islamic and conventional financial assets. The main difference between Islamic and conventional financial assets is that Islamic financial assets must comply with certain restrictions derived from the teachings of the Islamic faith. However, from an investor's perspective it is important to analyse the transmission of these restrictions on the risk return characteristics of Islamic financial assets. It is also important to analyse how the risk return characteristics of Islamic financial assets differ from the risk of other available (conventional) financial assets.

The bulk of the existing literature is focused on the comparative performance of Islamic and conventional financial assets [1–8] The issue of potential risk transmission between Islamic and conventional financial assets is relatively less explored. This paper contributes toward this strand of literature by analysing the risk transmission mechanism between Islamic and conventional equities. In view of the fundamental differences between Islamic and conventional financial assets, one might argue against the potential transmission of risk or volatility across Islamic and conventional equities [9].

Majdoub and Mansour [10] document the weak volatility transmission] between the USA and five emerging Islamic market equity indices. There results were based on BEKK-MGARCH, CCC and DCC models. However, Hammoudeh et al. [6] report a significant dependence structure between Islamic and conventional equity indices. The results are drawn from copula-based GARCH models. Similarly, Nazlioglu et al. [11] document evidence of volatility transfer between the Islamic and conventional indexes using the causality-in-variance approach. Rejeb [12] uses a GARCH model and the quantile regression technique to highlight the existence of strong interdependencies between the conventional stock market and Islamic ones, especially from the conventional developed markets to the emerging Islamic and Arab markets and the Islamic developed markets. Thus, the relatively sparse empirical literature on the issue of volatility transmission between Islamic and conventional equities is showing mixed results.

Koutmos and Booth [13] point out the importance of the quantity (captured by the size of an innovation) and the quality (captured by the sign of an innovation) of news in analysing the transmission mechanism across equity markets. The asymmetric effect of past volatility on current volatility in equity markets is widely documented. In particular, Saadaoui and Boujelbene [14] investigate the transmission of volatility between the Dow Jones stock index and the Dow Jones emerging Islamic stock index using vicariate BEKK-GARCH and DCC-GARCH model and find no evidence of a shock spillover effect between them. Assessing the co-movements among Islamic equity markets versus their conventional counterparts across different regions (Asia–Pacific, USA, Eurozone and United Kingdom), Dewandaru et al. [5] find incomplete market integration, with Islamic markets demonstrating a higher fundamental integration. Using Engle and Granger's cointegration technique, El Khamlichi et al. [15] explore the ethical equities potential for diversification in comparison to their conventional counterparts and find an absence of cointegration among two index families (Dow Jones and Standard & Poor's), therefore indicating diversification opportunities for these indices. Moreover, their work highlights similar tendencies and levels of (in) efficiencies in both Islamic and conventional indices.

The purpose of this study is to examine the asymmetric volatility transmission between Islamic and conventional markets. Thus, we test the validity of the decoupling hypothesis of Islamic equities from their conventional counterparts by taking into consideration the asymmetric effects of volatility transmission. In addition, we analyse the standalone regional volatility spillover for both conventional and Islamic equities. One of the drawbacks of the financialization and integration of equity markets is increased interdependence among international markets. This increased dependence has led to a reduction in diversification benefits and an increase in the contagion risk during bad times. Highlighting the financialization of commodity markets, Saadaoui and Boujelbene [14] find that the subprime crisis contributed to developing a relationship between conventional and emerging Islamic Dow Jones Indexes, and higher correlations between them were witnessed during the financial crisis. The regional spillover dynamics of Islamic and conventional equities helps us to see the degree of integration between the Islamic and conventional markets. In order to capture the asymmetric effect of volatility transmission, we employ a multivariate VAR-EGARCH model. To the best of our knowledge, this is the first paper to analyse the volatility transmission between Islamic and conventional markets by employing this methodology in a multivariate framework. The multivariate VAR-EGARCH model enables us to test the possibility of asymmetric volatility transmission across these equity markets.

The results from this paper have a number of implications. From the perspective of investors, it will be useful to analyse the volatility spillover for portfolio diversification and hedging purposes. In particular, it has investment and portfolio implications for institutional investors such as pension funds and insurance companies looking for alternative investment avenues. For investors, the absence of cointegration between conventional and Islamic stock indices signals opportunities for long-term portfolio diversification. Research has shown the presence of mutual risk transmission between the Islamic and conventional stock markets, which indicates the presence of contagion, unaffected by the financial crisis [11], thereby having important implications for institutional investors. The contagion effect makes returns on investment less certain and questions the return potential of Islamic equities in the diversified portfolio. As far as gains from portfolio diversification are concerned, cointegrated assets exhibit limited gains through portfolio diversification [15]. Interestingly, research has shown that the Islamic equity market responds to shocks from the risk factors and not from the oil price and the U.S. economic policy uncertainty index [11] pre- and post-2008 crisis. Therefore, the extent to which Islamic assets can be regarded as a safe investment option during times of financial crisis can be questioned and can hold important implications for investors who aim to benefit through portfolio diversification. It is important to note that Islamic investors must be cautious of structural shocks (such as those ingrained in trade linkages), as these may adversely affect returns [5]. Notably, investors can receive higher short-term diversification benefits from investing in a mix of EU and U.K. as well as developed and emerging markets [5].

For institutional investors, the lower exposure of Asian Islamic markets to financial leverage can provide a suitable investment hedge. From a strategic investment perspective, investors can maintain a balanced investment portfolio with a strategic asset allocation to Islamic equity as it can ensure a sustainable stream of returns along with a controlled degree of risk across markets [5]. For policy makers, the empirical evidence on volatility spillovers can be a useful ingredient in formulating policies for market stability. It will also help us analyse whether the decoupling hypotheses between Islamic and conventional finance holds.

We employ aggregate Islamic and conventional equity indices for the USA, United Kingdom and Japan. We analyse the volatility transmission across the aggregate Islamic and conventional indices. Our sample period spans from 1996 to 2015. In addition we segregate our sample period into three sub-periods capturing pre-crisis (1996–2007), crisis (2007–2011) and post-crisis (2011–2015). The sub-sample analysis allows us to capture the return and volatility transmission before, during and after the global financial crisis of 2007. Our results show weak support for the decoupling hypothesis for the post-crisis time period. Similarly, we find a lower level of integration for Islamic and conventional equities in the post-crisis period. The rejection of the decoupling hypothesis of Islamic and conventional equities has important implications for investors looking for alternative investment avenues. Similarly, the lower level of integration implies potential diversification and risk reduction opportunities for investors.

The remainder of the paper is organized as follows: Section 2 describes the methodology employed in this study. Sections 3 and 4 describe the data and empirical results, respectively, followed by the conclusions in Section 4.

2. Methodology

In this section, we describe the methodology employed in this study. We start with the Bivariate VAR model, which will help us to test the intramarket spillover between Islamic and conventional equities and thus test the decoupling hypothesis of Islamic and conventional equities. Thereafter, we present the methodology for multivariate VAR-EGARCH to test the intermarket spillovers of Islamic and conventional equities.

2.1. Bivariate VAR-EGARCH Model

In order to capture the return and volatility spillover between Islamic and conventional equities, we employ a Bivariate VAR-EGARCH model. This technique helps us to analyse the persistence of shocks to conditional variance. In addition, it requires no parameter restriction to ensure the non-negativity of the conditional variance (see [16]). The asset return dynamics can be captured by a first-order vector autoregressive (VAR) model as follows:

$$\begin{pmatrix} R_{C,t} \\ R_{I,t} \end{pmatrix} = \begin{pmatrix} \beta_{C,o} \\ \beta_{I,o} \end{pmatrix} + \begin{pmatrix} \beta_{C,1} & \beta_{C,2} \\ \beta_{I,1} & \beta_{I,2} \end{pmatrix} \begin{pmatrix} R_{C,t-1} \\ R_{I,t-1} \end{pmatrix} + \begin{pmatrix} \varepsilon_{C,t} \\ \varepsilon_{I,t} \end{pmatrix} \quad (1)$$

$$\varepsilon_t|\psi_{t-1} = \begin{pmatrix} \varepsilon_{c,t} \\ \varepsilon_{I,t} \end{pmatrix} \sim N(0,\ \Sigma_t) \tag{2}$$

and

$$\Sigma_t = \begin{pmatrix} h_{cC,t} & h_{CI,t} \\ h_{IC,t} & h_{II,t} \end{pmatrix}, \tag{3}$$

where $R_{c,t}$ and $R_{I,t}$ represent the returns of conventional and Islamic equity indices, respectively; ε_t denotes the error term conditional on the past information set ψ_{t-1}; $h_{CC,t}$, $h_{II,t}$ are the variance of conventional and Islamic indices, respectively; and $h_{CI,t}$ represents the covariance between these two indices. The impact of conventional equities on the Islamic equities returns and vice versa is measured by $\beta_{C,I}$ and $\beta_{I,C}$, respectively.

As mentioned above, we employ a bivariate version of the EGARCH model proposed by Nelson. The bivariate EGARCH model is written as follows:

$$logh_{C,t} = \ \gamma_C + \gamma_{CC} log\ \sigma^2_{C,t-1} + \ \gamma_{CI} log\ \sigma^2_{I,t-1} + \ g_C(Z_{C,t-1}) \tag{4}$$

$$logh_{I,t} = \ \gamma_I + \gamma_{IC} log\ \sigma^2_{C,t-1} + \ \gamma_{II} log\ \sigma^2_{I,t-1} + \ g_I(Z_{I,t-1}), \tag{5}$$

where the subscripts I and C stand for Islamic and conventional, respectively.

The sign and size effect of the lagged innovation are determined by the following functions:

$$g_C(Z_{C,t-1}) = (|Z_{C,t-1}| - E|Z_{C,t-1}|) \ + \ \tau_C Z_{C,t-1} \tag{6}$$

$$g_I(Z_{I,t-1}) = (|Z_{I,t-1}| - E|Z_{I,t-1}|) \ + \ \tau_I Z_{I,t-1} \tag{7}$$

and

$$\sigma_{C,I,t} = \ \rho_{C,I}\sigma_{C,t}\sigma_{I,t}. \tag{8}$$

The standardized innovation in the above equation is $Z_t = \ \varepsilon_t/\ \sigma_t$. The correlation in Equation (8) is assumed to be time-invariant, an assumption that reduces the number of parameters to be predicted. The parameters γ_{CI} and γ_{IC} measure the impact of conventional and Islamic markets on Islamic and conventional stock returns, respectively. The size effect is measured by the first two terms and the third term captures the sign effect in Equations (6) and (7) for conventional and Islamic stocks, respectively. Furthermore, the asymmetry impact on the volatility is measured by the parameters τ_C and τ_I for both markets. Asymmetry is present in the returns if τ_C and $\tau_I < 0$ and is statistically significant. The extent to which negative innovations increase volatility more than positive innovation is defined as $|-1+\ \tau|/(1\ +\ \tau)$. The parameter vector $\theta\ (\beta,\ \lambda,\ \gamma,\ \tau)$ is estimated by maximum likelihood. The log likelihood function for the bivariate EGARCH model is written as

$$L(\theta) = \ -T\ log\ (2\pi) - 0.5\Sigma_{t=1}^{T}\ log\ (|H_t(\theta)\,) - 0.5\Sigma_{t=1}^{T}\varepsilon_t(\theta)\prime H_t^{-1}(\theta)\varepsilon_t\ (\theta), \tag{9}$$

where T is the number of observations, ε_t is the 1×2 vector of innovation at time t, Σ_t is the time varying 2×2 variance-covariance matrix and θ is the vector of parameters to be estimated.

2.2. Multivariate VAR-EGARCH Model

In order to analyse the regional spillover dynamics of Islamic and conventional equities, we employ a multivariate VAR-EGARCH extension of Nelson's [17] E-GARCH. The multivariate EGARCH imposes no parameter and sign restrictions, permits volatility asymmetry and is more robust to deviation to standard error. In addition, the multivariate VAR-EGARCH model is also free from a priori restrictions on the structure of relationship among the variables under consideration [18]. Following Koutmos [19], we use the following specification of the multivariate EGARCH model:

$$R_{i,t} \ = \ \beta_{i,0} \ + \ \sum_{j=1}^{3}\beta_{i,j}R_{j,t-1} + \varepsilon_{i,t}, \text{for } i,j = 1,2,3; \tag{10}$$

$$\sigma^2_{i,t} = \exp\{\alpha_{i,0} + \sum_{j=1}^{3}\alpha_{i,j}f_j(z_{j,\,t-1}) + \gamma_i \ln(\sigma^2_{i,t-1})\}, \text{for } i,j = 1,2,3; \quad (11)$$

$$f_j(z_{j,t-1}) = (|Z_{j,t-1}| - E|Z_{j,t-1}|) + \tau_j Z_{j,t-1}, \text{for } i,j = 1,2,3; \quad (12)$$

$$\sigma_{i,j,t} = \rho_{i,j}\sigma_{i,t}\sigma_{j,t}, \text{for } i,j = 1,2,3; \text{ and } i \neq j, \quad (13)$$

where $R_{i,t}$ represents return at time t for the markets *i* where, *i* = 1, 2, 3, (1 = USA, 2 = UK and 3 = Japan). The system of the above equation and all system parameters are conditioned upon the information set denoted by Ω_{t-1}, which carries all information till time $t-1$. $\sigma_{i,t}$ is the conditional variances. In Equation (13) $\sigma_{i,j,t}$ is the conditional covariance between markets *i* and *j* and $\varepsilon_{i,t}$ is the innovation at time t and $z_{i,t}$ is the standard innovation (i.e., $z_{i,t} = \varepsilon_{i,t}/\sigma_{i,t}$). Equation (10) describes the return in each market as the function of its own previous returns and also of cross-market returns. If $\beta_{i,j}$ is significant then market *i* leads market *j*. Equation (11) is conditional variance, which is a function of conditional variance at previous lags and is used to accommodate the asymmetric relation between stock returns and volatility changes. The function $f_j(z_{j,\,t-1})$ is made to account for both the magnitude and sign of z_j. The component of $f_j(z_{j,t-1})$, i.e., $(|Z_{j,t-1}| - E|Z_{j,t-1}|)$ represents magnitude effect and $Z_{j,t-1}$ sign effect, so that if $Z_{j,t-1} < 0$ the slope of the function will be equal to $-1 + \tau_j$ whereas for $Z_{j,t-1} > 0$ the slope becomes $1 + \tau_j$; for a shock to be positive, the value of $Z_{j,t-1}$ must be greater than its own expectation and vice versa. The coefficient of $f_j(z_{j,\,t-1})$, that is, $\alpha_{i,j}$, measures cross-market spillover, which may be either symmetric or asymmetric depending upon τ_j, which is the coefficient of $Z_{j,t-1}$. The persistence of the conditional variance is measured by γ_i and for unconditional variance to be finite $\gamma < 1$ must hold. Equation (12) hence allows for standardized own and cross-market innovation to influence the conditional variance in each market asymmetrically. To, estimate these parameters we assume that they are normally distributed, taking the log of the probability density function of the parameters of system the likelihood for multivariate VAR-EGARCH model can be written as

$$L(\Theta) = -0.5(NT)\ln(2\pi) - \frac{1}{2}\sum_{t=1}^{T}\ln(|S_t|) + \varepsilon_t S_t^{-1}\varepsilon_t \quad (14)$$

where *N* is the number of equations (in this case we have three); *T* is the total number of observations Θ is the 33×1 parameter vector to be estimated; $\varepsilon_1 = |\varepsilon_{1,t}, \varepsilon_{2,t}, \varepsilon_{3,t,}|$ is the 1×3 vector of innovation at time *t*; S_t is the 3×3 time varying conditional variance-covariance matrix with diagonal elements given by Equation (2) for *i* = 1, 2, 3; and cross-diagonal elements are given by Equation (4) for *i*, *j* = 1, 2, 3 and $i \neq j$.

3. Data

In this section, we report the details of the data series employed and the estimation results for return and volatility spillover among Islamic and conventional equity indices. Table 1 shows the sample statistics along with the mnemonic codes for each data series. We obtained all the data series from Thompson Reuters DataStream. The full sample period encompasses daily observations from January 1996 to December 2015. We divide the total sample period into three sub-sample periods encompassing the pre-crisis period (January 1996–June 2007), crisis period (July 2007–June 2011) and post-crisis period (July 2011–December 2015).

Following the extant literature, we use the Dow Jones total return Islamic indices for the USA, United Kingdom and Japan. Dow Jones Islamic indices include companies that fulfil certain Sharia requirements such as acceptable products, business activities, debt levels, and interest income and expenses. Equities are included following a screening methodology that is based upon input from an independent Sharia supervisory board. These indices exclude companies involved in industries such as alcohol, pork-related products, conventional financial services, entertainment, tobacco, weapons and defence. In addition, the financial screening ensures exclusion of companies for which any of the following three parameters are above 33%:

- The total debt divided by trailing 24-month average market capitalization,

- The sum of a company's cash and interest-bearing securities divided by trailing 24-month average market capitalization,
- The accounts receivables divided by trailing 24-month average market capitalization.

We employ Dow Jones global total return indices for the USA, United Kingdom and Japan as our conventional equity indices. The sample means for all equities are positive, with the highest mean for U.K. Islamic.

Table 1 presents descriptive statistics for the three markets for both Islamic and conventional equities. All the returns show negative skewed and high kurtosis, establishing higher leptokurtic behaviour. Significant statistics for the Jarque–Bera test reject the normality assumption for all the return series, which motivates us to use non-linear models. Further autocorrelation of simple and squared returns confirms the presence of linear and non-linear dependences. The ARCH test also displays significant results, which further confirms the presence of heteroskedasticity. Finally, we also conduct Engle and Ng's test for asymmetric response of variance to past shocks. We find significant coefficients for the sign-based test, which reveals that positive and negative shocks have different effects on the residuals. From these results we confirm the presence of an asymmetric effect and thus the appropriateness of the multivariate VAR-EGARCH model for studying the relationship between Islamic and conventional equities.

Table 1. Sample statistics.

Statistics	Islamic			Conventional		
	Japan	USA	UK	Japan	USA	UK
Mean	0.007	0.014	0.010	0.002	0.010	0.010
Median	0.006	0.016	0.022	0.004	0.032	0.017
Std. Dev.	0.620	0.543	0.562	0.608	0.424	0.592
Skewness	−0.053	−0.133	−0.158	−0.017	−0.402	−0.102
Kurtosis	6.703	9.642	11.510	7.244	10.246	9.518
Jarque-Bera	2982 ***	9606 ***	15768 ***	3916 ***	11554 ***	9245 ***
AC(10) Residual	0.0100	0.0240	0.0170	0.0100	0.0170	0.0250
AC(10) Squared Residual	0.1180	0.1830	0.2020	0.1580	0.1430	0.1910
Arch	0.1701 ***	0.2131 ***	0.1902 ***	0.1635 ***	0.2210 ***	0.1931 ***
Size bias	−0.0031	−0.0933 *	−0.1202 *	−0.0125	−0.0342	−0.0981 *
Negative sign bias	−0.3527 ***	−0.7095 ***	−0.6834 ***	−0.3736 ***	−0.5264 ***	−0.7262 ***
Positive sign bias	0.2875 ***	0.1603 ***	0.2543 ***	0.2835 ***	0.2382 ***	0.2897 ***

The residual diagnostics based on simple and squared residuals at the 10th lag are also reported in the table. The significance level is *, **, *** at 10, 5 and 1 %, respectively.

4. Results and Discussion

In this section, we report the empirical results and analysis of our study. We start this section with the empirical results for the intra-market spillover among Islamic and conventional equities, followed by the results for inter-market spillovers.

4.1. Intra-Market Spillover among Islamic and Conventional Equities

We employ the bivariate VAR-EGARCH model to analyse the intra-market return and volatility spillover among Islamic and conventional equities. The first, second and third panels of Table 2 reports the estimation results of the bivariate VAR-EGARCH model for Japan, the USA and the United Kingdom, respectively, using Equations (1), (4) and (5). The coefficients $\beta_{1,2}$ and $\beta_{2,1}$ show the return spillover from Islamic to conventional and conventional to Islamic equity indices, respectively. The volatility spillover between Islamic and conventional equity indices and vice versa is measured through γ_{12} and γ_{21}, respectively. τ_C and τ_I are the coefficients of asymmetry for the conventional and Islamic equity indices, respectively.

Table 2. Estimation from the bivariate VAR-EGARCH (full sample).

Japan				United States				United Kingdom			
$\beta_{1,0}$	−0.0125 **	$\beta_{1,0}$	−0.0077	$\beta_{1,0}$	0.0045	$\beta_{1,0}$	0.0061	$\beta_{1,0}$	0.0109 *	$\beta_{1,0}$	0.0101
$\beta_{1,1}$	0.3426 ***	$\beta_{2,1}$	**−0.4983** ***	$\beta_{1,1}$	0.0168	$\beta_{2,1}$	**0.0519** **	$\beta_{1,1}$	−0.0546	$\beta_{2,1}$	**0.1367** ***
$\beta_{1,2}$	**0.2752** ***	$\beta_{2,2}$	0.4157 ***	$\beta_{1,2}$	**0.1456** ***	$\beta_{2,2}$	−0.0808 **	$\beta_{1,2}$	**0.0453**	$\beta_{2,2}$	0.1075 **
γ_{10}	−0.0213 ***	γ_{20}	−0.0187 ***	γ_{10}	−0.0401 ***	γ_{20}	−0.0317 ***	γ_{10}	−0.0234 ***	γ_{20}	−0.0196 ***
γ_{11}	0.9768 ***	γ_{21}	**−0.0469** ***	γ_{11}	0.9791 ***	γ_{21}	**0.0182** **	γ_{11}	0.9829 ***	γ_{21}	**0.0051** *
γ_{12}	**0.1249** ***	γ_{22}	0.9784 ***	γ_{12}	**0.0186** ***	γ_{22}	0.9763 ***	γ_{12}	**0.0426** ***	γ_{22}	0.9839 ***
τ_C	−0.1305 ***	τ_I	−0.1023 ***	τ_C	−0.5661 ***	τ_I	−0.6544 ***	τ_C	−0.5986 ***	τ_I	−0.4983
Correlation Coefficients											
$\rho_{1,2}$	0.6560 ***	$\rho_{2,1}$	0.6560 ***	$\rho_{1,2}$	0.8651 ***	$\rho_{2,1}$	0.8651 ***	$\rho_{1,2}$	0.8589 ***	$\rho_{2,1}$	0.8589 ***
Residual Diagnostics											
AC(10) Residual	0.01628	0.02231		AC(12) Residual	0.00093	0.01600		AC(10) Residual	−0.01268	−0.01423	
AC(10) Squared Residual	0.00526	0.00174		AC(12) Squared Residual	0.03174	0.02518		AC(10) Squared Residual	0.01978	0.01112	

Note: This table reports the results from the bivariate VAR-EGARCH equation, as explained in the methodology section. The parameters $\beta_{1,2}$ and $\beta_{2,1}$ display the return spillover from Islamic to conventional and conventional to Islamic equity markets, respectively, whereas γ_{12} and γ_{21} are the volatility spillover from Islamic to conventional and conventional to Islamic equity markets. The asymmetry parameter for τ and γ is volatility persistence. The cross-correlation of the returns is denoted by ρ. The residual diagnostics based on simple and squared residuals at the 10th lag are also reported in the table. The significance level is *, **, *** at 10, 5 and 1%, respectively.

The coefficient for return spillover is statistically significant for all countries except the coefficient for return spillover between Islamic and conventional equities for the United Kingdom. The coefficients of second moment (volatility spillover) are statistically significant for all three countries. This implies that the conditional variance of conventional and Islamic equities is influenced by their past innovation. Similarly, the coefficient of asymmetry is statistically significant for all countries, which confirms that negative shocks have more impact on volatility as compared to positive shocks of the same magnitude. These results show that the risk and return of both Islamic and conventional equities are interlinked.

The results discussed above are based on a relatively long time period, characterized by different intervals of the economic business cycle. Therefore, we segregate our sample period into three intervals: pre-crisis, crisis and post-crisis. The pre-crisis period ranges from 1995 to June 2007, the crisis period ranges from July 2007 to June 2011 and the post-crisis period ranges from July 2011 to 2015. Tables A1–A3 report the results of the bivariate VAR-EGARCH model for pre-crisis, crisis and post-crisis periods. Here again, we are interested in the coefficients of return and volatility spillover along with the coefficient of asymmetry. The results for the pre-crisis period are similar to the full sample period. However, the results for the crisis and post-crisis periods are slightly different. During the crisis period, one of the volatility spillover coefficients is statistically insignificant for each country. Similarly, one return spillover coefficient is statistically insignificant for both Japan and the United Kingdom. During the post-crisis period, at least one return spillover coefficient is statistically insignificant for each country, whereas one of the volatility spillover coefficients is statistically insignificant for Japan and the USA.

The sub-sample analysis gives us some interesting insights into the decoupling hypothesis. Our results show that the 2007 financial crisis resulted in a reduction in the interdependence between Islamic and conventional equities. Thus, we find weak support for the decoupling hypothesis during and after the crisis period.

4.2. Inter-Market Spillover Effects

In this section we analyse the inter-market return and volatility spillover for conventional equity indices across the USA, United Kingdom and Japan. We analyse the inter-market spillover effects of Islamic and conventional indices across these markets on a standalone basis, i.e., we analyse the spillover effects of Islamic and conventional equities separately. This analysis will help us to see the level of integration across markets for both these indices. A lower level of integration may translate into higher diversification opportunities and lower contagion effects. We employ the multivariate MVR-EGARCH model given by Equations (10) and (11) for the USA, United Kingdom and Japan. Similar to the analysis in the previous section, we estimate our results for both the full sample period and three sub-sample periods.

We start our analysis by reporting the results for the full sample period. Table 3 shows the estimated MVR-EGARCH results for Islamic equities, whereas Table 4 gives the results for convention equities. The AR coefficients ($\beta_{1,1}$, $\beta_{2,2}$, $\beta_{3,3}$) are negative and significant for all three equity market indices, indicating a negative serial correlation in returns. Focusing on the first moment interdependencies, there is significant spillover from the United Kingdom to Japan and the USA to the United Kingdom but not from Japan to the USA and United Kingdom. However, there are significant spillovers from both the USA and the United Kingdom to the Japanese equity market ($\beta_{3,1}$ and $\beta_{3,2}$). Moving to the volatility spillovers (second moment interdependencies), the results are stronger. The conditional variance for every country is influenced by innovations from the other two countries. There are significant volatility spillovers from the United Kingdom and Japan to the USA (α_{12} and α_{13}), from the USA and Japan to the United Kingdom (α_{21} and α_{23}) and also from the USA and United Kingdom to Japan (α_{31} and α_{32}). Furthermore, the volatility transmission is asymmetrical for all three equity indices.

Table 3. Estimation from the multivariate MVR-EGARCH model (Islamic equities).

United States		United Kingdom		Japan	
$\beta_{1,o}$	0.0089	$\beta_{2,o}$	0.0054	$\beta_{3,o}$	−0.0018
$\beta_{1,1}$	−0.0361 *	$\beta_{2,1}$	**0.3416 *** **	$\beta_{3,1}$	**0.4092 *** **
$\beta_{1,2}$	**0.0227 ***	$\beta_{2,2}$	−0.1339 ***	$\beta_{3,2}$	**0.1307 *** **
$\beta_{1,3}$	**−0.0014**	$\beta_{2,3}$	**−0.0091**	$\beta_{3,3}$	−0.0967 ***
α_{10}	−0.0296 ***	α_{20}	−0.0222 ***	α_{30}	−0.0319 ***
α_{11}	0.0986 ***	α_{21}	**0.0413 *** **	α_{31}	**0.0432 *** **
α_{12}	**0.0385 *** **	α_{22}	0.0901 ***	α_{32}	**0.0387 *** **
α_{13}	**0.0549 *** **	α_{23}	**0.0226 ** **	α_{33}	0.1606 ***
τ_1	−0.0482 ***	τ_2	−0.4833 ***	τ_3	−0.1802 ***
γ_1	0.9776 ***	γ_2	0.9821 ***	γ_3	0.9716 ***
Correlation Coefficients					
$\rho_{1,2}$	0.0547 ***	$\rho_{2,3}$	0.1318 ***	$\rho_{1,3}$	0.4568 ***
Residual Diagnostics					
AC(10) Residual	0.0166	AC(10) Residual	0.0154	AC(10) Residual	0.0125
AC(10) Squared Residual	0.0043	AC(10) Squared Residual	0.0084	AC(10) Squared Residual	0.0093

Note: This table reports the results from the multivariate VAR-EGARCH equation as explained in the methodology section (Equations (10)–(13)). The parameters $\beta_{1,2}$ and $\beta_{1,3}$ display the return spillover from the United Kingdom and Japan to the USA's Islamic equity returns. $\beta_{2,1}$ and $\beta_{2,3}$ display the return spillover from the USA and Japan to the United Kingdom and $\beta_{3,1}$ and $\beta_{3,2}$ display the return spillover from the USA and the United Kingdom to Japan, whereas α_{12} and α_{13} are the volatility spillover from the United Kingdom and Japan to the USA's Islamic equity returns. $\alpha_{2,1}$ and $\alpha_{2,3}$ display the volatility spillover from the USA and Japan to the United Kingdom and $\alpha_{3,1}$ and $\alpha_{3,2}$ the volatility spillover from the USA and the United Kingdom to Japan. The asymmetry parameter for τ and γ is volatility persistence. The cross-correlation of the returns is denoted by ρ. The residual diagnostics based on simple and squared residuals at the 10th lag are also reported in the table. The significance level is *, **, *** at 10, 5 and 1%, respectively.

Table 4. Estimation from the multivariate MVR-EGARCH model (conventional equities).

United States		United Kingdom		Japan	
$\beta_{1,o}$	0.0064	$\beta_{2,o}$	0.0062	$\beta_{3,o}$	−0.0085
$\beta_{1,1}$	0.3144 ***	$\beta_{2,1}$	**0.5879 *** **	$\beta_{3,1}$	**0.6815 *** **
$\beta_{1,2}$	**−0.0972 *** **	$\beta_{2,2}$	−0.3106 ***	$\beta_{3,2}$	**−0.0345 ***
$\beta_{1,3}$	**−0.0638 *** **	$\beta_{2,3}$	**−0.0907 *** **	$\beta_{3,3}$	−0.1899 ***
α_{10}	−0.0484 ***	α_{20}	−0.0404 ***	α_{30}	−0.0387 ***
α_{11}	0.0845 ***	α_{21}	**0.0608 *** **	α_{31}	**0.0523 *** **
α_{12}	**0.0357 *** **	α_{22}	0.0746 ***	α_{32}	**0.0138**
α_{13}	**0.0282 ** **	α_{23}	**0.0166 ** **	α_{33}	0.1487 ***
τ_1	−0.1429 ***	τ_2	−0.4175 ***	τ_3	−0.2374 ***
γ_1	0.9756 ***	γ_2	0.9728 ***	γ_3	0.9675 ***
Correlation Coefficients					
$\rho_{1,2}$	0.7295 ***	$\rho_{2,3}$	0.3199 ***	$\rho_{1,3}$	0.1584 ***
Residual Diagnostics					
AC(10) Residual	0.01552	AC(10) Residual	0.01046	AC(10) Residual	0.01775
AC(10) Squared Residual	0.00926	AC(10) Squared Residual	0.00864	AC(10) Squared Residual	0.00173

Note: This table reports the results from the multivariate VAR-EGARCH equation as explained in the methodology section (Equations (10)–(13)). The parameters $\beta_{1,2}$ and $\beta_{1,3}$ display the return spillover from the United Kingdom and Japan to the USA's conventional equity returns. $\beta_{2,1}$ and $\beta_{2,3}$ display the return spillover from the USA and Japan to the United Kingdom and $\beta_{3,1}$ and $\beta_{3,2}$ display the return spillover from the USA and the United Kingdom to Japan, where as α_{12} and α_{13} are the volatility spillover from the United Kingdom and Japan to the USA's conventional equity returns. $\alpha_{2,1}$ and $\alpha_{2,3}$ display the volatility spillover from the USA and Japan to the United Kingdom and $\alpha_{3,1}$ and $\alpha_{3,2}$ the volatility spillover from the USA and the United Kingdom to Japan. The asymmetry parameter for τ and γ is volatility persistence. The cross-correlation of the returns is denoted by ρ. The residual diagnostics based on simple and squared residuals at the 10th lag are also reported in the table. The significance level is *, **, *** at 10, 5 and 1%, respectively.

Table 4 presents the results for multivariate MVR-EGARCH for the USA, United Kingdom and Japan with the full sample for conventional equity indices. The AR coefficients ($\beta_{1,1}$, $\beta_{2,2}$, $\beta_{3,3}$) are negative and significant for the United Kingdom and Japan, indicating a negative serial correlation in returns, whereas it is positive for the USA only. Focusing on the first moment interdependencies, there is a significantly negative spillover from the United Kingdom and Japan to the USA, and from the USA to the United Kingdom is significantly positive. However, there is a negative significant return spillover found Japan to the United Kingdom. Similar results found for Japan as return spillover are negative from the United Kingdom to Japan and positive from the USA. Moving towards second moment interdependencies, the results are stronger. The conditional variance for almost every country is influenced by innovations from the other two countries. There are significant volatility spillovers from the United Kingdom and Japan to the USA (α_{12} and α_{13}), from the USA and Japan to the United Kingdom (α_{21} and α_{23}) and also from the USA to Japan (α_{31}), but not from the United Kingdom to Japan (α_{32}).

The coefficient of asymmetry τ_1 is negative and significant in all three cases for both Islamic and conventional equities. This confirms that the size of the innovations is important in determining the volatility spillovers. The volatility persistence measure γ is significant and close to unity for all three countries for both equities, which suggests that current innovations are important for forecasting future conditional variance. The results of a residual-based diagnostic test for residual and squared residuals up to lag 10 are reported in Tables 3 and 4. The results confirm no evidence of serial correlation, as the coefficients are small and non-significant.

Next we extend our analysis and segregate our full sample period into three sub-periods encompassing the pre-crisis, crisis and post-crisis periods. In the Appendix A, Tables A4 and A5 show the results for the pre-crisis period for Islamic and conventional equities, respectively. During the pre-crisis period, the equities exhibit insignificant return spillover from the United Kingdom and Japan to the USA. Similarly, the volatility spillover from the United Kingdom to Japan is insignificant. All other spillover parameters are statistically significant. The pre-crisis results for conventional equities show significant return spillovers for all countries. The volatility spillovers parameters are also significant for all except the spillover parameters from the USA and the United Kingdom to Japan. Tables A6 and A7 in the Appendix A show the estimation results during the crisis period for Islamic and conventional equities, respectively. The general pattern is similar to the results for the pre-crisis period. The volatility spillover parameters for Islamic equities are more significant than those for the conventional equities. Tables A8 and A9 in the Appendix A show the estimation results for the post-crisis period for Islamic and conventional equities. During the post-crisis period, Islamic and conventional equities exhibit the lowest return and volatility spillover effect. Most of the spillover parameters are statistically insignificant.

5. Conclusions

In the last few years Islamic equities have attracted a lot of attention from both academics and practitioners. Islamic equities provide faith-based (Muslim) investors with an investment option in accordance with the principles of Islam. However, they can also be a desirable investment avenue for conventional investors' portfolio provided that their risk return profile is better than their conventional counterpart.

The purpose of this study is twofold. First, we test the decoupling hypothesis between Islamic and conventional equities. If the decoupling hypothesis holds, this means Islamic equities can be an interesting component of an investor's portfolio. We test the decoupling hypothesis by testing the return and volatility spillover between Islamic and conventional equities in the USA, the United Kingdom and Japan during the period 1995–2015. In addition, we subdivide our full sample period into three sub-sample periods covering the pre-crisis, crisis and post-crisis periods. In addition to the decoupling hypothesis, we also see whether the level of integration between Islamic and conventional equities is similar. We test the intra-market spillover effects between conventional and Islamic equities on a standalone basis, i.e., we test the intra-market spillover for Islamic and conventional equities, separately. We employ the multivariate VAR-EGARCH model, enabling us to analyse the asymmetrical return and volatility transmission across various markets and asset classes.

Our results show support for the decoupling hypothesis in the post-crisis period. However, the intra-market spillover exhibits similar results for both Islamic and conventional equities. Our results have important implications for individual as well as institutional investors seeking alternative investment and diversification avenues. In particular, the results have portfolio and risk management implications for institutional investors such as pension funds and insurance companies. The support for the decoupling hypothesis shows that Islamic equities can be a desirable component for investors seeking to diversify.

Author Contributions: Both authors contributed equally.

Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A

Table A1. Estimation from the bivariate VAR-EGARCH (pre-crisis).

Japan				United States				United Kingdom			
$\beta_{1,o}$	−0.0217 **	$\beta_{1,o}$	−0.0162 *	$\beta_{1,o}$	0.0042	$\beta_{1,o}$	0.0004	$\beta_{1,o}$	0.0227 **	$\beta_{1,o}$	0.0231 **
$\beta_{1,1}$	−0.2734 ***	$\beta_{2,1}$	**−0.4768** ***	$\beta_{1,1}$	0.0255	$\beta_{2,1}$	**0.0368**	$\beta_{1,1}$	−0.1405 **	$\beta_{2,1}$	**−0.2576** ***
$\beta_{1,2}$	**0.2695** ***	$\beta_{2,2}$	0.4580 ***	$\beta_{1,2}$	**0.1454** ***	$\beta_{2,2}$	−0.0371	$\beta_{1,2}$	**0.1097** **	$\beta_{2,2}$	0.1930 ***
γ_{10}	−0.0209 ***	γ_{20}	**−0.0173** ***	γ_{10}	−0.0672	γ_{20}	−0.0409	γ_{10}	−0.0305 ***	γ_{20}	−0.0220 ***
γ_{11}	0.9759 ***	γ_{21}	−0.0773 ***	γ_{11}	0.9690 ***	γ_{21}	**0.0487** ***	γ_{11}	0.9818 ***	γ_{21}	**0.0097**
γ_{12}	**0.1321** ***	γ_{22}	0.9776 ***	γ_{12}	**−0.0124**	γ_{22}	0.9693 ***	γ_{12}	**0.0474** **	γ_{22}	0.9847 ***
τ_C	−0.0846 ***	τ_I	−0.0217 *	τ_C	−0.6667 ***	τ_I	−0.5451 ***	τ_C	−0.4798 ***	τ_I	−0.3222 ***
Correlation Coefficients											
$\rho_{1,2}$	0.9458 ***	$\rho_{2,1}$	0.9458 ***	$\rho_{1,2}$	0.8487 ***	$\rho_{2,1}$	0.8487 ***	$\rho_{1,2}$	0.9492 ***	$\rho_{2,1}$	0.9492 ***
Residual Diagnostics											
AC(10) Residual		0.01854	0.02119	AC(12) Residual		0.01971	0.01099	AC(10) Residual	0.01128	0.01450	
AC(10) Squared Residual		0.00570	0.00722	AC(12) Squared Residual		0.00130	0.00358	AC(10) Squared Residual	0.00803	0.00464	

Note: This table reports the results from the bivariate VAR-EGARCH equation, as explained in the methodology section. The parameters $\beta_{1,2}$ and $\beta_{2,1}$ display the return spillover from Islamic to conventional and conventional to Islamic equity markets, respectively, whereas γ_{12} and γ_{21} are the volatility spillover from Islamic to conventional and conventional to Islamic equity markets. The asymmetry parameter for τ and γ is volatility persistence. The cross-correlation of the returns is denoted by ρ. The residual diagnostics based on simple and squared residuals at the 10th lag are also reported in the table. The significance level is *, **, *** at 10, 5 and 1%, respectively.

Table A2. Estimation from the bivariate VAR-EGARCH (crisis).

Japan				United States				United Kingdom			
$\beta_{1,o}$	0.0003	$\beta_{1,o}$	0.0007	$\beta_{1,o}$	−0.0056	$\beta_{1,o}$	−0.0006	$\beta_{1,o}$	0.0027	$\beta_{1,o}$	0.0091
$\beta_{1,1}$	−0.1681 *	$\beta_{2,1}$	**0.1897** **	$\beta_{1,1}$	0.0883	$\beta_{2,1}$	**0.2021** **	$\beta_{1,1}$	0.2360 *	$\beta_{2,1}$	**0.1553**
$\beta_{1,2}$	**0.0481**	$\beta_{2,2}$	0.0520	$\beta_{1,2}$	**0.1318** **	$\beta_{2,2}$	−0.0973	$\beta_{1,2}$	**−0.2532** **	$\beta_{2,2}$	−0.1886
γ_{10}	−0.0562 ***	γ_{20}	−0.0529 ***	γ_{10}	−0.1403 ***	γ_{20}	−0.1542 ***	γ_{10}	−0.0133 ***	γ_{20}	−0.0136 ***
γ_{11}	0.9473 ***	γ_{21}	**0.1025** **	γ_{11}	0.9479 ***	γ_{21}	**0.0873** **	γ_{11}	0.9874 ***	γ_{21}	**0.0048**
γ_{12}	**0.0176**	γ_{22}	0.9536 ***	γ_{12}	**0.0119**	γ_{22}	0.9295 ***	γ_{12}	**0.0867** **	γ_{22}	0.9878 ***
τ_C	−0.2857 ***	τ_I	−0.2746 **	τ_C	−0.3791 ***	τ_I	−0.0340 ***	τ_C	−0.0529 ***	τ_I	0.9673 ***
Correlation Coefficients											
$\rho_{1,2}$	0.6719 ***	$\rho_{2,1}$	0.6719 ***	$\rho_{1,2}$	0.8940 ***	$\rho_{2,1}$	0.8940 ***	$\rho_{1,2}$	0.9673 ***	$\rho_{2,1}$	0.8695 ***
Residual Diagnostics											
AC(10) Residual		0.00477	0.01771	AC(12) Residual	0.04776		0.00726	AC(10) Residual	0.01732		0.05216
AC(10) Squared Residual		0.03718	0.03288	AC(12) Squared Residual	0.00251		0.00221	AC(10) Squared Residual	0.00250		0.00950

Note: This table reports the results from the bivariate VAR-EGARCH equation, as explained in the methodology section. The parameters $\beta_{1,2}$ and $\beta_{2,1}$ display the return spillover from Islamic to conventional and conventional to Islamic equity markets, respectively, whereas γ_{12} and γ_{21} are the volatility spillover from Islamic to conventional and conventional to Islamic equity markets. The asymmetry parameter for τ and γ is volatility persistence. The cross-correlation of the returns is denoted by ρ. The residual diagnostics based on simple and squared residuals at the 10th lag are also reported in the table. The significance level is *, **, *** at 10, 5 and 1%, respectively.

Table A3. Estimation from the bivariate VAR-EGARCH (post-crisis).

Japan				United States				United Kingdom			
$\beta_{1,o}$	0.0002	$\beta_{1,o}$	0.0007	$\beta_{1,o}$	−0.0292	$\beta_{1,o}$	−0.0260	$\beta_{1,o}$	−0.0182	$\beta_{1,o}$	−0.0183
$\beta_{1,1}$	−0.1681 *	$\beta_{2,1}$	**0.1897 ** **	$\beta_{1,1}$	−0.0629	$\beta_{2,1}$	**−0.0213**	$\beta_{1,1}$	−0.1608	$\beta_{2,1}$	**−0.1267**
$\beta_{1,2}$	**0.0481**	$\beta_{2,2}$	0.0521	$\beta_{1,2}$	**0.1926 ** **	$\beta_{2,2}$	−0.1586 **	$\beta_{1,2}$	**0.2522**	$\beta_{2,2}$	0.2161
γ_{10}	−0.0562 ***	γ_{20}	−0.0529 ***	γ_{10}	−0.0273 ***	γ_{20}	−0.0226 **	γ_{10}	−0.0474 **	γ_{20}	−0.0345 **
γ_{11}	0.9473 ***	γ_{21}	**0.1025 ** **	γ_{11}	0.9749 ***	γ_{21}	**0.1241 ** **	γ_{11}	0.9744 ***	γ_{21}	**0.0117**
γ_{12}	**0.01769**	γ_{22}	0.9536 ***	γ_{12}	**0.1461 ** **	γ_{22}	0.9740 ***	γ_{12}	**0.0005 ** **	γ_{22}	0.9805 ***
τ_C	−0.2857 ***	τ_I	−0.2746 **	τ_C	−0.7042 ***	τ_I	−0.6611 **	τ_C	−0.7101	τ_I	−0.9452
Correlation Coefficients											
$\rho_{1,2}$	0.7709 ***	$\rho_{2,1}$	0.7709 ***	$\rho_{1,2}$	0.8980 ***	$\rho_{2,1}$	0.8980 ***	$\rho_{1,2}$	0.8744 ***	$\rho_{2,1}$	0.8744 ***
Residual Diagnostics											
AC(10) Residual	0.00477		0.01771	AC(12) Residual	0.00406		0.00173	AC(10) Residual	0.08458		0.09864
AC(10) Squared Residual	0.00079		0.00097	AC(12) Squared Residual	0.00840		0.00399	AC(10) Squared Residual	0.00783		0.00254

Note: This table reports the results from the bivariate VAR-EGARCH equation, as explained in the methodology section. The parameters $\beta_{1,2}$ and $\beta_{2,1}$ display the return spillover from Islamic to conventional and conventional to Islamic equity markets, respectively, whereas γ_{12} and γ_{21} are the volatility spillover from Islamic to conventional and conventional to Islamic equity markets. The asymmetry parameter for τ and γ is volatility persistence. The cross-correlation of the returns is denoted by ρ. The residual diagnostics based on simple and squared residuals at the 10th lag are also reported in the table. The significance level is *, **, *** at 10, 5 and 1%, respectively.

Table A4. Estimation from the multivariate MVR-EGARCH model (Islamic equities—pre-crisis).

United States		United Kingdom		Japan	
$\beta_{1,o}$	0.0103	$\beta_{2,o}$	0.0153 **	$\beta_{3,o}$	−0.0039
$\beta_{1,1}$	−0.0077	$\beta_{2,1}$	**0.3144** ***	$\beta_{3,1}$	**0.3951** ***
$\beta_{1,2}$	**0.0232**	$\beta_{2,2}$	−0.1020 **	$\beta_{3,2}$	**0.1284** ***
$\beta_{1,3}$	**−0.0129**	$\beta_{2,3}$	**−0.0353** **	$\beta_{3,3}$	−0.0188
α_{10}	−0.0280 ***	α_{20}	−0.0277 ***	α_{30}	−0.0238 ***
α_{11}	0.0812 ***	α_{21}	**0.0315** ***	α_{31}	**0.0278** **
α_{12}	**0.0631** ***	α_{22}	0.0934 ***	α_{32}	**0.0615** ***
α_{13}	**0.0443** **	α_{23}	**0.0155**	α_{33}	0.1469 ***
τ_1	−0.0340 ***	τ_2	−0.3050 **	τ_3	−0.1127 *
γ_1	0.9788 ***	γ_2	0.9817 ***	γ_3	0.9764 ***
Correlation Coefficients					
$\rho_{1,2}$	0.0683 ***	$\rho_{2,3}$	0.1567 ***	$\rho_{1,3}$	0.3352 ***
Residual Diagnostics					
AC(10) Residual	0.01663	AC(10) Residual	0.01055	AC(10) Residual	0.01739
AC(10) Squared Residual	0.00790	AC(10) Squared Residual	0.00353	AC(10) Squared Residual	0.00378

Note: This table reports the results from the multivariate VAR-EGARCH equation, as explained in the methodology section (Equations (10)–(13)). The parameters $\beta_{1,2}$ and $\beta_{1,3}$ display the return spillover from the United Kingdom and Japan to the USA's Islamic equity returns. $\beta_{2,1}$ and $\beta_{2,3}$ display the return spillover from the USA and Japan to the United Kingdom and $\beta_{3,1}$ and $\beta_{3,2}$ display the return spillover from the USA and the United Kingdom to Japan. α_{12} and α_{13} are the volatility spillover from the United Kingdom and Japan to the USA's Islamic equity returns. $\alpha_{2,1}$ and $\alpha_{2,3}$ display the volatility spillover from the USA and Japan to the United Kingdom and $\alpha_{3,1}$ and $\alpha_{3,2}$ the volatility spillover from the USA and the United Kingdom to Japan. The asymmetry parameter for τ and γ is volatility persistence. The cross-correlation of the returns is denoted by ρ. The residual diagnostics based on simple and squared residuals at the 10th lag are also reported in the table. The significance level is *, **, *** at 10, 5 and 1%, respectively.

Table A5. Estimation from the multivariate MVR-EGARCH model (conventional equities—pre-crisis).

United States		United Kingdom		Japan	
$\beta_{1,o}$	0.0101 *	$\beta_{2,o}$	0.0141 *	$\beta_{3,o}$	−0.0098
$\beta_{1,1}$	0.3394 ***	$\beta_{2,1}$	**0.5718** ***	$\beta_{3,1}$	**0.6517** ***
$\beta_{1,2}$	**−0.0832** ***	$\beta_{2,2}$	−0.2604 ***	$\beta_{3,2}$	**−0.0402**
$\beta_{1,3}$	**−0.0762** ***	$\beta_{2,3}$	**−0.1167** ***	$\beta_{3,3}$	−0.1128 ***
α_{10}	−0.0512 ***	α_{20}	−0.0553 ***	α_{30}	−0.0240 ***
α_{11}	0.0636 ***	α_{21}	**0.0464** ***	α_{31}	**0.0357** ***
α_{12}	**0.0790** ***	α_{22}	0.1105 ***	α_{32}	**0.0524** ***
α_{13}	**0.0121**	α_{23}	**−0.0056**	α_{33}	0.1108 ***
τ_1	−0.4675 ***	τ_2	−0.1168	τ_3	−0.1832 **
γ_1	0.9768 ***	γ_2	0.9697 ***	γ_3	0.9779 ***
Correlation Coefficients					
$\rho_{1,2}$	0.6284 **	$\rho_{2,3}$	0.3870 ***	$\rho_{1,3}$	0.1874 ***
Residual Diagnostics					
AC(10) Residual	0.01087	AC(10) Residual	0.02988	AC(10) Residual	0.02535
AC(10) Squared Residual	0.00696	AC(10) Squared Residual	0.00885	AC(10) Squared Residual	0.00421

Note: This table reports the results from the multivariate VAR-EGARCH equation, as explained in the methodology section (Equations (10)–(13)). The parameters $\beta_{1,2}$ and $\beta_{1,3}$ display the return spillover from the United Kingdom and Japan to the USA's conventional equity returns. $\beta_{2,1}$ and $\beta_{2,3}$ display the return spillover from the USA and Japan to the United Kingdom and $\beta_{3,1}$ and $\beta_{3,2}$ display the return spillover from the USA and the United Kingdom to Japan. α_{12} and α_{13} are the volatility spillover from the United Kingdom and Japan to the USA's conventional equity returns. $\alpha_{2,1}$ and $\alpha_{2,3}$ display the volatility spillover from the USA and Japan to the United Kingdom and $\alpha_{3,1}$ and $\alpha_{3,2}$ the volatility spillover from the USA and the United Kingdom to Japan. The asymmetry parameter for τ and γ is volatility persistence. The cross-correlation of the returns is denoted by ρ. The residual diagnostics based on simple and squared residuals at the 10th lag are also reported in the table. The significance level is *, **, *** at 10, 5 and 1%, respectively.

Table A6. Estimation from the multivariate MVR-EGARCH model (Islamic equities—crisis).

United States		United Kingdom		Japan	
$\beta_{1,o}$	0.0134	$\beta_{2,o}$	−0.0044	$\beta_{3,o}$	−0.0103
$\beta_{1,1}$	−0.0606 *	$\beta_{2,1}$	**0.5033 *****	$\beta_{3,1}$	**0.4296 *****
$\beta_{1,2}$	**0.0091**	$\beta_{2,2}$	−0.2592	$\beta_{3,2}$	**0.1248 *****
$\beta_{1,3}$	**0.0082**	$\beta_{2,3}$	**0.0535 ****	$\beta_{3,3}$	−0.1781 ***
α_{10}	−0.0288 ***	α_{20}	−0.0153 ***	α_{30}	−0.0629 ***
α_{11}	0.0581 **	α_{21}	**0.0290 ****	α_{31}	**0.0260 ****
α_{12}	**0.0407 ****	α_{22}	0.0740 ***	α_{32}	**0.0206**
α_{13}	**0.0296 ****	α_{23}	**0.0254 ***	α_{33}	0.1786 ***
τ_1	−0.2173 ***	τ_2	−0.4677 ***	τ_3	−0.4659 ***
γ_1	0.9799 ***	γ_2	0.9831 ***	γ_3	0.9542 ***
Correlation Coefficients					
$\rho_{1,2}$	0.0494 **	$\rho_{2,3}$	0.1199 ***	$\rho_{1,3}$	0.6357 ***
Residual Diagnostics					
AC(10) Residual	0.01948	AC(10) Residual	0.02327	AC(10) Residual	0.01360
AC(10) Squared Residual	0.00698	AC(10) Squared Residual	0.00593	AC(10) Squared Residual	0.00898

Note: This table reports the results from the multivariate VAR-EGARCH equation, as explained in the methodology section (Equations (10)–(13)). The parameters $\beta_{1,2}$ and $\beta_{1,3}$ display the return spillover from the United Kingdom and Japan to the USA's Islamic equity returns. $\beta_{2,1}$ and $\beta_{2,3}$ display the return spillover from the USA and Japan to the United Kingdom and $\beta_{3,1}$ and $\beta_{3,2}$ display the return spillover from the USA and the United Kingdom to Japan. α_{12} and α_{13} are the volatility spillover from the United Kingdom and Japan to the USA's Islamic equity returns. $\alpha_{2,1}$ and $\alpha_{2,3}$ display the volatility spillover from the USA and Japan to the United Kingdom and $\alpha_{3,1}$ and $\alpha_{3,2}$ the volatility spillover from the USA and the United Kingdom to Japan. The asymmetry parameter for τ and γ is volatility persistence. The cross-correlation of the returns is denoted by ρ. The residual diagnostics based on simple and squared residuals at the 10th lag are also reported in the table. The significance level is *, **, *** at 10, 5 and 1%, respectively.

Table A7. Estimation from the multivariate MVR-EGARCH model (conventional equities—crisis).

United States		United Kingdom		Japan	
$\beta_{1,o}$	0.0059	$\beta_{2,o}$	−0.0004	$\beta_{3,o}$	−0.0112
$\beta_{1,1}$	0.3678 ***	$\beta_{2,1}$	**0.8221 *****	$\beta_{3,1}$	**0.6923 *****
$\beta_{1,2}$	**−0.1676 *****	$\beta_{2,2}$	−0.5247 ***	$\beta_{3,2}$	**−0.0398**
$\beta_{1,3}$	**−0.0558 *****	$\beta_{2,3}$	**−0.0682 ****	$\beta_{3,3}$	−0.2819 ***
α_{10}	−0.0224 ***	α_{20}	−0.0120 ***	α_{30}	−0.0860 ***
α_{11}	0.0852 ***	α_{21}	**0.0580 *****	α_{31}	**0.0471 ****
α_{12}	**0.0051**	α_{22}	0.0244 ***	α_{32}	**0.0007**
α_{13}	**0.0138**	α_{23}	**0.0166**	α_{33}	0.1969 ***
τ_1	−0.1841 ***	τ_2	−0.2023 **	τ_3	−0.4570 ***
γ_1	0.9857 ***	γ_2	0.9875 ***	γ_3	0.9352 ***
Correlation Coefficients					
$\rho_{1,2}$	0.8588 ***	$\rho_{2,3}$	0.2504 ***	$\rho_{1,3}$	0.1331 ***
Residual Diagnostics					
AC(10) Residual	0.01305	AC(10) Residual	0.01883	AC(10) Residual	0.01063
AC(10) Squared Residual	0.00590	AC(10) Squared Residual	0.00850	AC(10) Squared Residual	0.00407

Note: This table reports the results from the multivariate VAR-EGARCH equation, as explained in the methodology section (Equations (10)–(13)). The parameters $\beta_{1,2}$ and $\beta_{1,3}$ display the return spillover from the United Kingdom and Japan to the USA's conventional equity returns. $\beta_{2,1}$ and $\beta_{2,3}$ display the return spillover from the USA and Japan to the United Kingdom and $\beta_{3,1}$ and $\beta_{3,2}$ display the return spillover from the USA and the United Kingdom to Japan. α_{12} and α_{13} are the volatility spillover from the United Kingdom and Japan to the USA's conventional equity returns. $\alpha_{2,1}$ and $\alpha_{2,3}$ display the volatility spillover from the USA and Japan to the United Kingdom and $\alpha_{3,1}$ and $\alpha_{3,2}$ the volatility spillover from the USA and the United Kingdom to Japan. The asymmetry parameter for τ and γ is volatility persistence. The cross-correlation of the returns is denoted by ρ. The residual diagnostics based on simple and squared residuals at the 10th lag are also reported in the table. The significance level is *, **, *** at 10, 5 and 1%, respectively.

Table A8. Estimation from the multivariate MVR-EGARCH model (Islamic equities—post-crisis).

United States		United Kingdom		Japan	
$\beta_{1,o}$	−0.0110	$\beta_{2,o}$	−0.0307 **	$\beta_{3,o}$	0.0242
$\beta_{1,1}$	−0.0239	$\beta_{2,1}$	**0.2790** ***	$\beta_{3,1}$	**0.3962** ***
$\beta_{1,2}$	**0.0943** *	$\beta_{2,2}$	0.0325	$\beta_{3,2}$	**0.1008** *
$\beta_{1,3}$	**0.0374**	$\beta_{2,3}$	**0.0092**	$\beta_{3,3}$	−0.2105 **
α_{10}	−0.1844	α_{20}	−0.1529	α_{30}	−0.0538 *
α_{11}	0.0082	α_{21}	0.0039	α_{31}	0.0024
α_{12}	0.0121	α_{22}	0.0215	α_{32}	0.0080
α_{13}	0.1671 **	α_{23}	0.0659	α_{33}	0.0801 **
τ_1	−0.2581	τ_2	−0.4031	τ_3	−0.2497
γ_1	0.9121 ***	γ_2	0.9182 ***	γ_3	0.9673 ***
Correlation Coefficients					
$\rho_{1,2}$	−0.0129	$\rho_{2,3}$	0.0907 *	$\rho_{1,3}$	0.5256 ***
Residual Diagnostics					
AC(10) Residual	0.03585	AC(10) Residual	0.03963	AC(10) Residual	0.02418
AC(10) Squared Residual	0.00605	AC(10) Squared Residual	0.00042	AC(10) Squared Residual	0.00374

Note: This table reports the results from the multivariate VAR-EGARCH equation, as explained in the methodology section (Equations (10)–(13)). The parameters $\beta_{1,2}$ and $\beta_{1,3}$ display the return spillover from the United Kingdom and Japan to the USA's Islamic equity returns. $\beta_{2,1}$ and $\beta_{2,3}$ display the return spillover from the USA and Japan to the United Kingdom and $\beta_{3,1}$ and $\beta_{3,2}$ display the return spillover from the USA and the United Kingdom to Japan. α_{12} and α_{13} are the volatility spillover from the United Kingdom and Japan to the USA's Islamic equity returns. $\alpha_{2,1}$ and $\alpha_{2,3}$ display the volatility spillover from the USA and Japan to the United Kingdom and $\alpha_{3,1}$ and $\alpha_{3,2}$ the volatility spillover from the USA and the United Kingdom to Japan. The asymmetry parameter for τ and γ is volatility persistence. The cross-correlation of the returns is denoted by ρ. The residual diagnostics based on simple and squared residuals at the 10th lag are also reported in the table. The significance level is *, **, *** at 10, 5 and 1%, respectively.

Table A9. Estimation from the multivariate MVR-EGARCH model (conventional equities—post-crisis).

United States		United Kingdom		Japan	
$\beta_{1,o}$	0.0001	$\beta_{2,o}$	−0.0106	$\beta_{3,o}$	0.0051
$\beta_{1,1}$	0.2802 ***	$\beta_{2,1}$	**0.6161** ***	$\beta_{3,1}$	**0.6846** ***
$\beta_{1,2}$	**−0.0926** ***	$\beta_{2,2}$	−0.3553 ***	$\beta_{3,2}$	**−0.0433**
$\beta_{1,3}$	**−0.0303** ***	$\beta_{2,3}$	**−0.0247**	$\beta_{3,3}$	−0.2857 ***
α_{10}	−0.0712 ***	α_{20}	−0.0520	α_{30}	−0.1316 **
α_{11}	0.1030 ***	α_{21}	**0.0748** ***	α_{31}	**0.0605** ***
α_{12}	**−0.0141**	α_{22}	0.0094	α_{32}	**−0.029**
α_{13}	**−0.0048**	α_{23}	**−0.0163**	α_{33}	0.1538 ***
τ_1	−0.7891 ***	τ_2	−0.3245 *	τ_3	−0.4148 **
γ_1	0.9676 ***	γ_2	0.9679 ***	γ_3	0.9236 ***
Correlation Coefficients					
$\rho_{1,2}$	0.8404 ***	$\rho_{2,3}$	0.1763 ***	$\rho_{1,3}$	0.2879 ***
Residual Diagnostics					
AC(10) Residual	0.01134	AC(10) Residual	0.03414	AC(10) Residual	0.01297
AC(10) Squared Residual	0.00926	AC(10) Squared Residual	0.03226	AC(10) Squared Residual	0.00569

Note: This table reports the results from the multivariate VAR-EGARCH equation, as explained in the methodology section (Equations (10)–(13)). The parameters $\beta_{1,2}$ and $\beta_{1,3}$ display the return spillover from the United Kingdom and Japan to the USA's conventional equity returns. $\beta_{2,1}$ and $\beta_{2,3}$ display the return spillover from the USA and Japan to the United Kingdom and $\beta_{3,1}$ and $\beta_{3,2}$ display the return spillover from the USA and the United Kingdom to Japan. α_{12} and α_{13} are the volatility spillover from the United Kingdom and Japan to the USA's conventional equity returns. $\alpha_{2,1}$ and $\alpha_{2,3}$ display the volatility spillover from the USA and Japan to the United Kingdom and $\alpha_{3,1}$ and $\alpha_{3,2}$ the volatility spillover from the USA and the United Kingdom to Japan. The asymmetry parameter for τ and γ is volatility persistence. The cross-correlation of the returns is denoted by ρ. The residual diagnostics based on simple and squared residuals at the 10th lag are also reported in the table. The significance level is *, **, *** at 10, 5 and 1%, respectively.

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