MODELLING VOLATILITY SPILLOVER BETWEEN CONVENTIONAL AND ISLAMIC STOCK INDEX IN THE UNITED KINGDOM

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Abstract

This paper analyzes the volatility spillover between Dow Jones UK conventional index (GBDOW) and Dow Jones UK Islamic index. Monthly observations spanning in a period from January 2010 until June 2017 are obtained from Investing.com database. Vector Auto-regression analysis (VAR) and Impulse response functions are used in order to estimate the impact. The results show that there is a significant impact of Dow Jones UK index volatility on Dow Jones UK Islamic index volatility.

Keywords: *Islamic stock market index, conventional stock market index, volatility, UK*

1. Introduction

One of the major innovations in the financial community is the rapid growth of Islamic financial services around the world. The demand of Islamic financial instruments is increasing significantly. Many individual and institutional investors, mainly from Islamic countries, seek to invest solely in stocks that are compliant with the Islamic laws (i.e., Sharia).

Al-Khazali, Lean, and Samet (2013) highlight that the investment in companies that are compliant with Islamic laws is consistent with socially responsible and ethical investment, in which investors select their stocks based on their religious beliefs.

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The dedication shown by the global index providers to offer Islamic indices has provided evidence that Islamic investors are showing a greater selectivity in their investment choices. Global index providers have shaped these new indices in slightly different ways in order to allow for different expectations of regulators of both Islamic and conventional markets. It is particularly fascinating to note that there has been a tremendous interest in Shari'ah compliant investments and indices, mainly due to their more equitable and profit-sharing nature, which draws a considerable research interest in recent years. The fastest growing part of the global financial industry is reportedly Islamic investments, which is alleged to yield good returns and is based on desirable ethical precepts requested by some investors in Islamic countries as mentioned by GIFF (2012) and Ho, et. al, (2013).

In recent decades, the world Islamic financial market has gathered a significant momentum in attracting international capital flows from both Muslim and non-Muslim investors, and the favored indices are the global Islamic indices such as FTSE, DJIM, and MSCI. Moreover, the development of Islamic capital markets in domestic and global markets continues to show positive trends. This is partly caused by development of Islamic country which continues to advance very rapidly with the accumulation of oil wealth. Money needs to be secured and accumulated as investors search for suitable Shari'ah compliant investment alternatives included in indices relative to others which may be non-compliant. With innovations from major global financial centers, the Islamic capital market has continued to show significant growth with products increasingly attractive to those who recognize them as viable alternatives. This has further encouraged market intermediaries to continue introducing new products and services, while enhancing existing ones to better serve the needs of investors and users.

Islamic stock indices, such as the DJIM and the FTSE Global Islamic Index included only companies which deal in businesses strictly in accordance with the Islamic Shari'ah rules. In addition, according to Dharani and Natarajan (2011), Islamic Index comprises Shari'ah compliant stocks which provide essential advantages of being socially responsible and ethically sound. Hassan and Girard (2011) referred to the McKinsey Management Consulting Firm report and concluded that Islamic finance is a new force in the financial market place as this niche market is attracting potential investors.

Therefore, the research that investigates Islamic indices' behavior is of a great significance nowadays, due to its higher importance and popularity, as well as the need for a deeper

investigation of this financial sector, since the literature covering these issues is still developing. This type of research could be beneficial for the academic society as well as for the investors.

This study examines the volatility of Islamic stock market index, more precisely Islamic stock market index in the UK. Study investigates one of the potential factors that affects Dow Jones UK Islamic index volatility. This factor being mentioned is the volatility rate of the conventional counterpart Dow Jones UK Index.

Despite the fact that the academic research on the relationship between conventional stock market indices is widely analyzed, there is a certain gap in the literature pertaining to the relationship between conventional and Islamic stock market indices.

Based on some previous research that is investigating conventional as well as Islamic stock market indices, there are evidences that conventional and Islamic stock market indices are similarly influenced, and that conventional indices impact the movement of Islamic ones. However, some of the studies find that these indices are independently moving.

Among the most pertinent questions raised are the following:

1. To what extent is the explanatory power of conventional indices able to explain the Islamic stock market volatility?

2. What is the extent to which the volatility in the international conventional indices transmitted across national stock markets is affecting Islamic stock market indices?

Since the literature investigating the behavior of the Islamic stock market indices is still developing, it is important to investigate if there is an impact on the Islamic stock market index volatility in the UK, coming from the conventional counterpart index.

The results from this study suggest that volatility of conventional Dow Jones UK index (GBDOW) significantly impacts (at 5% significance level) volatility of the Islamic index in the UK, namely Dow Jones UK Islamic index.

2. Literature Review

Studies investigating relationship between Islamic stock market indices and conventional indices are still rare and developing. 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.

Among few studies, Nazlioglu et al. (2013) examine whether a volatility/risk transmission exists between the Dow Jones Islamic stock index and three conventional stock markets for the U.S., Europe, and Asia. They find the evidence of volatility transfer between the Islamic and conventional indices using the causality-in-variance approach. Ajmi et al. (2013) use heteroscedasticity-robust linear Granger causality and nonlinear Granger causality tests to examine the links between the Islamic and global conventional stock markets. The findings reveal evidence of a significant linear and nonlinear causality between the Islamic and conventional stock markets. In their study, Majdoub and Mansour (2014) show that the US and five Islamic emerging equity markets are weakly correlated over time. The results were based on BEKK-MGARCH, CCC and DCC models. Hammoudeh et al. (2014) reveal a significant upper and lower tail dependence between the DJIM and major conventional markets. In their study, they also find a negative extreme dependence between the DJIM and each of the U.S. VIX and EMU debt indices reflecting U.S. and European risks. The results are drawn from copula-based GARCH models. Bakri Abdul et al. (2014) examine the dynamic causality between Malaysian Islamic stock market and conventional stock market. The results show that there is a significant short-run bidirectional causality between the two markets.

Furthermore, results of the study by Kim and Sohn (2016) show a unidirectional volatility spillover from the U.S. conventional stock market to the Islamic stock indices of Islamic countries, but not vice versa. The Islamic stock index (S&P 500 Sharia—SHX) of firms listed in the United States is also influenced by the U.S. conventional stock index (Dow Jones Industrial Average—DJIA). However, the empirical results also show there is no volatility spillover from the U.S. conventional stock index (DJIA) to the Dow Jones Islamic Market (DJIM) index of globally diversified Islamic stocks established on Sharia principles. This also holds for the Pakistan stock exchange index.

Thus, the relatively sparse empirical literature on the issue of volatility transmission between Islamic and conventional equities is showing mixed results. (Zaghum Umar and Tahir Suleman, 2017)

3. Data and Methodology

Monthly observations of Dow Jones UK Islamic Index and Dow Jones UK index (GBDOW) in the period from January 2010 until June 2017 are obtained from the International Monetary Fund database. Vector Auto-regression analysis and Impulse response functions are used in order to estimate the impact.

The arithmetic return of the indices is estimated by subtracting the index value at time *t - 1* from the index value at time *t* and dividing it by the index value at time *t* as shown in Eq. (1), where R_t is the return at time *t*, P_t is the index at time *t*, and P_{t-1} is the index at time *t - 1*.

$$\text{Equation 1.} \quad R_t = \frac{(P_t - P_{t-1})}{P_{t-1}}$$

The next step is the estimation of the volatility of the indices. Volatility is measured as square of the deviations from the mean. We consider that $\Delta \boldsymbol{y_t}$ indicates the series with deviations from means.

As it can be seen in the Equation 2., the volatility of the indices is estimated as:

$$\text{Equation 2.} \quad \Delta \boldsymbol{y_t^2} = (\Delta \boldsymbol{y_t} - \Delta \bar{\boldsymbol{y}})^{\boldsymbol{2}}$$

$$\text{where } \Delta \bar{y} = \Sigma \Delta y_t / T.$$

4. Empirical Analysis and Results

In this section, unit root test for the return time series, and the results of the VAR analysis and Impulse response functions are presented.

4.1. **ADF Unit Root Test**

From the ADF unit root test results given in Table 1., Table 2., Table 3. and Table 4. we can notice that the variables used in the study are stationary at the levels.

Table 1. ADF unit root test results (Dow Jones UK Islamic Index Return)

Null Hypothesis: Dow Jones UK Islamic index has a unit root			
Exogenous: Constant			
Lag Length: 0 (Automatic - based on SIC, maxlag=12)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.49240	**0.0000**
Test critical values:	1% level	-3.485115	
	5% level	-2.885450	
	10% level	-2.579598	
*MacKinnon (1996) one-sided p-values.			

Table 2. ADF unit root test results (Dow Jones UK Index Return)

Null Hypothesis: Dow Jones UK index has a unit root			
Exogenous: Constant			
Lag Length: 1 (Automatic - based on SIC, maxlag=12)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-11.06468	**0.0000**
Test critical values:	1% level	-3.483312	
	5% level	-2.884665	
	10% level	-2.579180	
*MacKinnon (1996) one-sided p-values.			

Table 3. ADF unit root test results (Volatility of Dow Jones UK Islamic Index Return)

Null Hypothesis: VOLISL has a unit root			
Exogenous: Constant			
Lag Length: 29 (Automatic - based on SIC, maxlag=12)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.609640	**0.0000**
Test critical values:	1% level	-3.485115	
	5% level	-2.885450	
	10% level	-2.579598	
*MacKinnon (1996) one-sided p-values.			

Table 4. ADF unit root test results (Volatility of Dow Jones UK Index Return)

Null Hypothesis: VOLCON has a unit root			
Exogenous: Constant			
Lag Length: 27 (Automatic - based on SIC, maxlag=12)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.446086	**0.0000**
Test critical values:	1% level	-3.483312	
	5% level	-2.884665	
	10% level	-2.579180	
*MacKinnon (1996) one-sided p-values.			

4.2.**Vector Autoregressive Analysis (VAR)**

VAR analysis enables us to estimate the predictive power of the variables. By using VAR framework, we carry out the analysis to assess the predictive power of the conventional index in the UK in explaining the Islamic index behavior. Vector Autoregressive Analysis (VAR) requires that the data is stationary in order to avoid spurious regression. Therefore, we

conducted the ADF unit root tests on the specified variance series. The number of lags for the Var model is selected based on Akaike information criterion (see Appendix A). The Var model satisfies the stability condition which was checked through AR roots Table (see Appendix B). The realiabilty of the Var model was checked through VAR Residual Serial Correlation LM Test (see Appendix C). After fitting these assumptions, Vector autoregressive analysis is performed.

Table 5. Vector autoregressive analysis (VAR)

Vector Autoregression Estimates			Sample (adjusted): 5 122	
Included observations: 118 after adjustments			t-statistics in [ ]	
	ISL_MONT	**CONV_MONT**	**VISL**	**VCON**
ISL_MONT(-1)	[-0.09827]	[-1.32477]	**[-4.23081]**	[0.68400]
ISL_MONT(-2)	[1.03848]	[-1.46981]	[-0.97139]	[0.51191]
ISL_MONT(-3)	[1.32844]	[0.35689]	[-0.26337]	[-1.14590]
ISL_MONT(-4)	[-0.10224]	**[13.8176]**	[-0.01486]	**[-2.11670]**
CONV_MONT(-1)	[-0.46231]	[-1.17970]	[1.25883]	[-0.13623]
CONV_MONT(-2)	[-0.09202]	[-0.70129]	[-0.79709]	[-0.35623]
CONV_MONT(-3)	[0.27955]	[0.54020]	[0.27951]	[0.54669]
CONV_MONT(-4)	[0.55325]	**[1.96599]**	[-1.42317]	[1.18736]
VISL(-1)	[-1.19096]	**[-2.55082]**	[1.32306]	**[2.25684]**
VISL(-2)	[1.50483]	[-0.01572]	[-0.35430]	[-1.16295]
VISL(-3)	[0.17263]	[1.06491]	[-0.49607]	[1.03242]
VISL(-4)	[0.19236]	[-1.84485]	[0.25339]	**[11.2353]**
VCON(-1)	[-1.01296]	[0.01657]	[-0.30949]	[-0.10278]
VCON(-2)	[0.61412]	[0.29523]	[-0.54409]	[0.43241]
VCON(-3)	[1.66513]	[0.75737]	[0.83149]	[1.30888]
VCON(-4)	[0.54664]	[-0.02106]	**[2.17022]**	[1.34613]
C	[-0.85081]	[1.24935]	[2.68462]	[-0.31070]
R-squared	0.101273	0.726149	0.273420	0.668035
Adj. R-squared	-0.041100	0.682766	0.158319	0.615446
Sum sq. resids	0.322601	0.054282	0.002048	0.000277
S.E. equation	0.056516	0.023183	0.004503	0.001656
F-statistic	0.711320	16.73832	2.375466	12.70304
Log likelihood	180.7846	285.9362	479.3095	597.3516
Akaike AIC	-2.776.010	-4.558.240	-7.835.754	-9.836.468
Schwarz SC	-2.376.843	-4.159.074	-7.436.587	-9.437.302
Mean dependent	0.000421	0.002187	0.003043	0.001680
S.D. dependent	0.055389	0.041160	0.004908	0.002670

The empirical results obtained through Vector Autoregressive method are summarized in the Table 5.

The results from the Table 3. indicate that the volatility of the conventional index return has a positive significant impact on the volatility of Islamic index return coming from the two previous period, precisely lag -4. This suggests that the higher volatility of the conventional index return in the previous period (-4) causes the higher volatility of the Islamic index return.

Also, the results indicate that the return of the Islamic index has a negative significant impact on the volatility of the Islamic index return. The significant impact comes from the previous period, lag (-1). This suggests that the higher return of the Islamic index in the previous periods (-1) causes the lower volatility of the Islamic index return.

Furthermore, the results from the Table 5. indicate that the conventional index return and the volatility of the conventional index return have no significant impact on the Islamic index return. The results suggest that Islamic index return is independent from the movement of the Conventional index return and volatility.

The results also indicate that the volatility of Islamic index return has no significant impact on the Islamic index return.

By summarizing the results from the Table 5, it can be concluded that Islamic index return, conventional index return, and conventional index return volatility have a significant impact on the Islamic index return volatility. It is also observed that the volatility of Islamic index return has a significant impact on the Islamic index return.

4.3.**Impulse Response Functions (IRFs) Results**

Impulse response functions (IRFs) are used to study the dynamic effects of a particular variable's shock on the other variables that are included in the same model. Besides, we can examine the dynamic behavior of the time series over a ten-year forecast horizon. Furthermore, through the IRF we can learn whether the response of one variable to changes in the other variables is positive or negative and whether it is significant or not. If the point estimate of the IRF is above the zero line, it means that the response is positive. On the other hand, if the point estimate of the IRF is below the zero line, the response is negative. Besides, if the point estimate of the IRF passes through the zero line, the response is insignificant. There are many options for transforming the impulses. We will use the Cholesky decomposition adjusted response functions.

In order to test how the Islamic index responds to the short-run temporary shocks, this study employs the impulse response function. The impulse response function is derived from the

estimation of the VAR model and are presented in Figures 1 to 6 (Response to Cholesky One S.D. Innovations ± 2 S.E.).

The visual examination of the Figures 1 to 6

Figure 1.

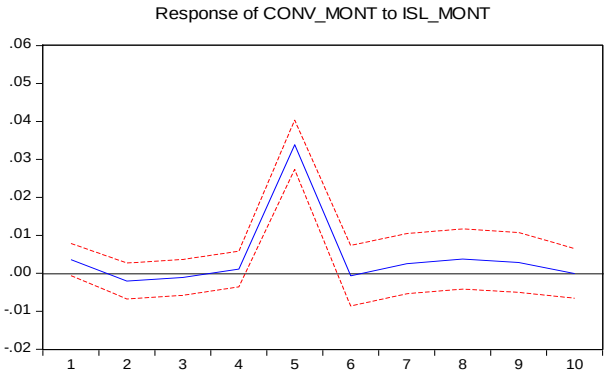

Figure 2.

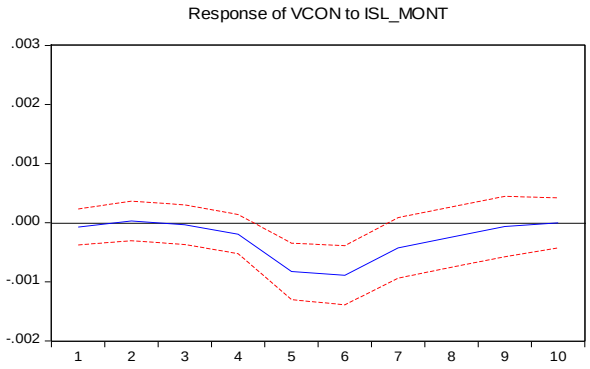

Figure 3.

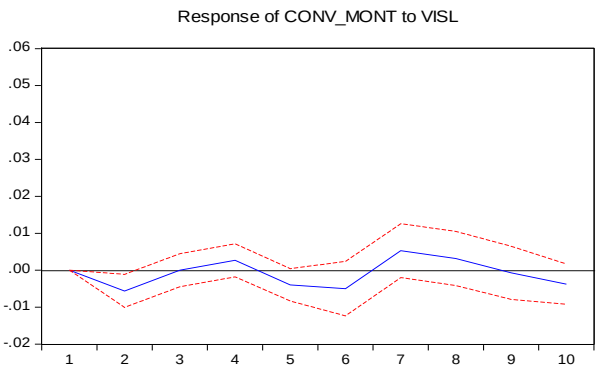

Figure 4.

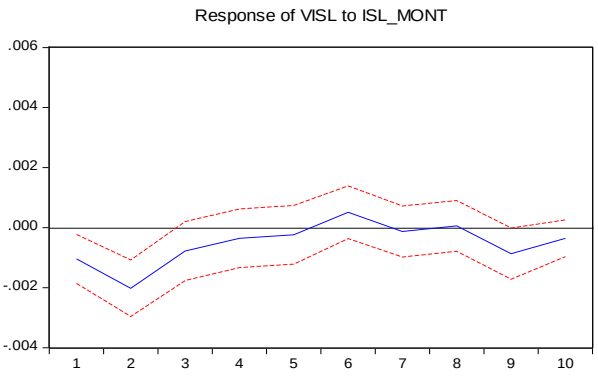

Figure 5.

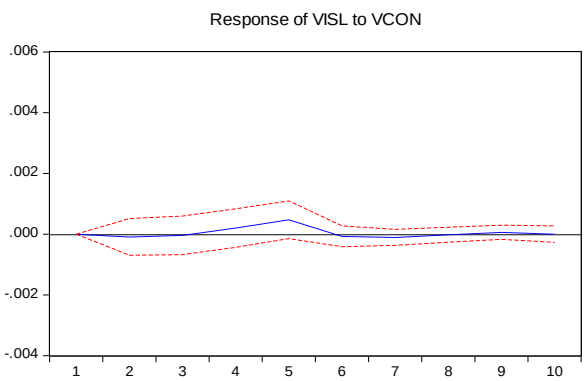

Figure 6.

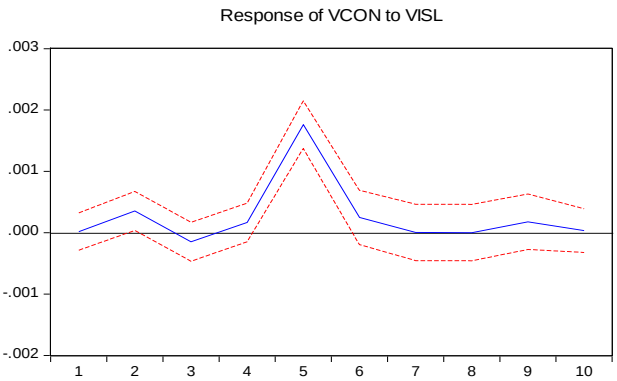

Figure 1 shows that Dow Jones UK index return responds positively to a shock in Dow Jones UK Islamic index return after the fourth period, and the impact of the shock comes to its peak in the fifth period. After the fifth period, the impact starts to fade away and becomes zero at the end of sixth period. This means that there is a positive effect of a shock of Dow Jones UK Islamic index return on Dow Jones UK index return. This result indicates that Conventional index in UK is not immune to the shocks in the Islamic index, and that the higher return of the Islamic index causes an increase in the return of the Conventional index.

In addition, as it can be seen in the Figure 2 the volatility of Dow Jones UK index is effected by the shock in Dow Jones UK Islamic index return. It responds negatively to a shock starting in third period, and the impact of the shock comes to its peak in the sixth period. After the sixth period, the impact starts to fade away and becomes zero after the eighth period. This result indicates that volatility of the Conventional index in the UK is not immune to the shocks in the Islamic index return. Furthermore, the result in Figure 3 shows that Dow Jones UK index return responds slightly negatively to a shock in Dow Jones UK Islamic index volatility. Slightly negative effect is present in the first, second and third period.

Figure 4 shows that Dow Jones UK Islamic index volatility responds negatively to a shock in Dow Jones UK Islamic index return from the first to fifth period. After the sixth period, the impact starts to fade away. The result suggests that Islamic index volatility is not immune to the Islamic index return changes, and that the higher the return is, less volatile is the Islamic index.

From the results showed in Figures 5 and 6 it can be concluded that there is bidirectional impact between volatilities of Dow Jones UK index return and Dow Jones UK Islamic index return. More preciselly, Figure 5 shows that volatility of Dow Jones UK Islamic index return responds slightly positively to a shock in volatility of Dow Jones UK index return. Slightly positive response starts from the fourth period and fades away in the fifth period. The result suggests that Islamic index volatility is not immune to the Conventional index volatility shocks, meaning that higher volatility of the Conventional index is, causes more volatile Islamic index in that periods. On the other side, as it can be seen from Figure 6, volatility of Dow Jones UK index return responds positively to a shock in volatility of Dow Jones UK Islamic index return. Positive response starts from the fourth period, comes to its peak in the fifth period and fades away in the sixth period. The result suggests that Conventional index volatility is not immune

to the Islamic index volatility shocks, meaning that, higher volatility of the Islamic index causes more volatile Conventional index in that periods.

Conclusion

The task of this research was to study the Islamic stock index return volatility response to the changes of the conventional stock index volatility. More precisely, it aimed to investigate the impact of the volatility of Dow Jones United Kingdom index return on the volatility of Dow Jones United Kingdom Islamic Index. In order to examine the impact, conducted are the Vector autoregressive analysis (VAR) and the generalized impulse-response functions. Furthermore, through VAR analysis and impulse-response functions the impact of Islamic index in UK on Conventional index in UK could also be examined.

The VAR analysis result indicated a significant impact of the volatility of conventional index return in the UK on the volatility of Islamic index return. However, the analysis showed that there is no significant impact of conventional index return and conventional index return volatility on the Islamic index return.

Furthermore, the analysis showed that there is also significant impact of the volatility of Islamic index return on the volatility of Conventional index return, meaning that there is bi-directional impact. Also, the analysis showed that there is significant impact of the return and volatility of Islamic index in UK on the volatility and return of Conventional index respectively.

In order to examine the responsiveness of the transmission mechanisms of the two indices short-run temporary shocks, we derived the generalized volatility impulse response functions. The results indicated that there was a volatility transmission from the conventional index in the UK to the Islamic index in the UK, as well as in the opposite direction.

While there were arguments that Islamic equity markets were not supposed to be impacted by the volatility transmission coming from conventional equity markets because they were fundamentally different, our findings contrasted with these arguments (Dridi and Hassan, 2010; Chapra, 2008; Dewi and Ferdian, 2010). The findings also provided more information on how the Islamic market responded to the shocks from the Conventional market.

Based on the results of the study several comments could be given, speaking from the Islamic index perspective. Islamic equity markets might not be such a safe way of investing, compared to the conventional counterpart. The results casts doubts on the diversification gains from including the Islamic stocks with the conventional ones in a portfolio. Therefore, the Islamic

equity investments in the UK could not generally constitute a very viable alternative for risk-averse investors who wished to hedge their investments against the turmoil of the conventional stock market in the UK. Furthermore, there was a doubt regarding the extent to which Sharia principles make Islamic stock indices different compared to the conventional ones.

Hammoudeh et al. (2014) suggested that both the Islamic and conventional stock markets were driven by common economic and financial factors in most cases, and that it seemed that the gap between the Islamic and conventional stock markets decreased significantly as a result of globalization. Therefore, the Islamic stock markets were also exposed to major economic and financial shocks affecting the world finance system. In line with this result was the research done by Walkshäusl and Lobe (2012) who compared the performance of the Islamic indices and conventional benchmarks in 35 developed and emerging markets. In their study they failed to show compelling evidence of a differential performance between those markets.

Also, it is important to mention that in terms of return and volatility, the impact also comes from the Islamic index to the Conventional one.

The findings of this study are important for policy makers and investors. The evidence of financial interdependence indicates that the financial shocks in conventional index will spill over to the Islamic counterpart, as well as in the opposite direction from Islamic index to the Conventional index. Knowledge of an integration of the indices is important for domestic and international investors for the sake of portfolio diversifications. It can be concluded that in the UK, the investments in the Islamic stock market index may not be a solution against heightening uncertainty in the conventional stock market. The integration of Islamic and conventional indices in the UK provides knowledge that the investors may be not able to benefit from diversification, if they have both indices in their portfolios.

The explanation for this could be found in the following arguments. In a market economy, the value of a firm can be influenced both directly and indirectly. Also, Islamic scholars have made some concessions on the permissible degree of financial leverage and the level of interest income in relation to DJIMI constituent firms. Thus, Dow Jones Islamic equity returns could be expected to be sensitive to conventional stock index changes.

The task of future research should be to study the stock market responses, more precisely Islamic stock market index return and volatility responses, to the conventional index behavior in different countries. In this way, an important contribution to Islamic finance academics as well as to the investors would be made, since this type of studies are still developing.

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Appendix A

Table A1. VAR Lag Order Selection Criteria

Endogenous variables: ISL_MONT CONV_MONT VISL VCON						
Exogenous variables: C						
Sample: 1 126						
Included observations: 114						
Lag	**LogL**	**sequential modified LR test statistic (each test at 5% level) LR**	**Final prediction error (FPE)**	**Akakike information criterion (AIC)**	**Schwarz information criterion (SC)**	**Hannan-Quinn information criterion (HQ)**
0	1335.169	NA	8.47e-16	-2.335.385	-2.325.784	-2.331.488
1	1354.203	36.39706	8.03e-16	-2.340.706	-2.292.703	-2.321.224
2	1358.597	8.095614	9.85e-16	-2.320.346	-2.233.940	-2.285.279
3	1374.874	28.84078	9.83e-16	-2.320.831	-2.196.022	-2.270.178
4	1499.408	211.9261*	1.47e-16*	**-25.11242***	-23.48030*	-24.45003*
5	1507.116	12.57744	1.72e-16	-2.496.696	-2.295.081	-2.414.872
6	1511.940	7.532075	2.11e-16	-2.477.088	-2.237.071	-2.379.679
7	1522.044	15.06731	2.38e-16	-2.466.744	-2.188.324	-2.353.749
8	1536.944	21.17368	2.48e-16	-2.464.815	-2.147.992	-2.336.234
*** indicates lag order selected by the criterion**						

Appendix B

Table B1. Roots of Characteristic Polynomial

Roots of Characteristic Polynomial	
Endogenous variables: ISL_MONT CONV_MONT VISL VCON	
Exogenous variables: C	
Lag specification: 1 4	
Root	**Modulus**
0.004907 - 0.842044i	0.842059
0.004907 + 0.842044i	0.842059
0.824705 - 0.113064i	0.832419
0.824705 + 0.113064i	0.832419
0.496016 - 0.617282i	0.791877
0.496016 + 0.617282i	0.791877
-0.140938 - 0.760773i	0.773717
-0.140938 + 0.760773i	0.773717
-0.519795 - 0.557494i	0.762225
-0.519795 + 0.557494i	0.762225
0.601978 - 0.403677i	0.724798
0.601978 + 0.403677i	0.724798
-0.706819 - 0.076240i	0.710919
-0.706819 + 0.076240i	0.710919
-0.538052 - 0.325212i	0.628700
-0.538052 + 0.325212i	0.628700

No root lies outside the unit circle. VAR satisfies the stability condition.

Appendix C

Table C1. VAR Residual Serial Correlation LM Tests

VAR Residual Serial Correlation LM Tests		
Null Hypothesis: no serial correlation at lag order h		
Sample: 1 126		
Included observations: 118		
Lags	**LM-Stat**	**Prob**
1	11.32251	0.7892
2	13.68080	0.6225
3	18.41847	0.3000
4	13.97956	0.6002
5	11.53027	0.7756
6	9.169782	0.9063
7	16.05281	0.4493
8	24.15221	0.0862
9	15.11043	0.5166
10	10.95473	0.8123
11	14.57311	0.5561
12	21.66491	0.1543
Probs from chi-square with 16 df.		