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Volatility Spillover Effect from Conventional Stock Markets to Islamic Stock Markets

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Abstract

The aim of this study is testing whether there is volatility spillover effect from international markets to OIC member countries' Islamic markets. For this purpose, we use USA, EU and ASIA conventional indices for international markets' indicator. We test the existence of information transmission between markets via causality in mean test and causality in variance test for volatility spillover effect. Empirical results show that there is intensive information transmission between markets but limited spillover effect.

Keywords: Organisation of Islamic Cooperation, Volatility Spillover Effect, Causality in Variance Test

Introduction

In recent years, financial markets have witnessed liberalized capital movements, financial reforms, advances in computer technologies and information processes. These developments are experienced both in developed and developing countries. While these developments are reducing the isolation of national markets, they increase the immediate reaction capacity of markets to news and shocks from other markets. Therefore the linkages between capital markets are increased and strengthened (Singh et al., 2010: 55). As a result of the increase in financial liberalization, a financial crisis that emerges in one country may affect more than one country and pull these countries into trouble. It has been more realized that markets are tightly connected to each other especially due to the financial crises. In the findings of many studies it is observed that the integration between the markets have been increased as a result of the crises (Lee and Kim, 1993, Blackman et al., 1994, Cha and Oh, 2000, Hoque, 2007). Information transmission between markets may occur not only in terms of returns but also through volatility (Worthington and Higgs, 2004). It is claimed that any shock in a market affects not only the average in other markets, but also the variance of the return. Since volatility plays a role both in measuring the risk and in estimating the portfolio diversification risk, it is important to understand the volatility spillover in the market. Volatility is used as a measure of standard deviation or variance of returns and generally refers to the total risk of financial assets. In volatility following models are used; historical volatility model, implied

volatility model, exponentially weighted moving average (EWMA) model, autoregressive variance model (ARMA), autoregressive conditional heteroscedasticity (ARCH) model, generalized ARCH (GARCH) model and stochastic volatility models (Brooks, 2002). Investigating the volatility spillover effect and the interaction between financial markets has a critical importance in terms of understanding the pricing of securities, asset allocation decisions and global hedging strategies (Ng, 2000: 207). Hence, the integration between the markets attracts investors, researchers and politicians.

Generally in literature, volatility spillover effect from developed markets such as the US, EU and Japanese towards the less developed or developing markets is studied (Bekaert and Harvey, 1997; Liu and Pan, 1997; Ng, 2000; Beirne et al., 2013). Although in early studies on the subject, low correlations between markets were observed (Levy and Sarnate, 1970; Lessard, 1973), consecutive studies showed an increase in integration of markets (Lee and Kim, 1993; Arshanapalli and Doukas, 1993).

With the increase of integration between markets; the financial crisis, emerged in different countries at different periods in the global markets, not only affected a single country but through spillover and contagion effects has reached levels that could affect more than one country. In this context, as investors, who try to avoid risk, search for an alternative financial system, the Islamic financial market has become the focus of attention of these investors. The demand of investors for Islamic financial systems has also increased due to social and religious reasons. Thinking that the Islamic financial market might have different features compared to conventional markets, researchers also are making many empirical studies on the issue.

After the 2008-2009 global financial crises, Islamic financial system showed significant progress and has become one of the fastest growing sectors of the global financial system (Toraman et al., 2015). The total assets of the Islamic finance industry increased from USD 1.8 trillion in 2013 to USD 2.1 trillion in 2014 and it is estimated that by 2020 this number will reach to USD 6.5 trillion (Hammoudeh et al., 2014: 190). Although Islamic finance activities have actually been practiced in different forms since the emergence of Islam, it is stated that in modern financial markets the existence of Islamic finance is mentioned since the early 1980s (Iqbal and Mirakhor, 2013). Since it is thought that Islamic financial system is more resistant to financial crises than other financial systems it is seen as an alternative financial system.

Various economic and political power changes are witnessed in the world as globalization and regionalization gain importance. Countries form different establishments to defend themselves economically and politically where different criteria are taken into account in the formation of these unities. In their studies, Ahmed and Ugurel (1998) and Raimi and Mobolaji (2008) noted that economic co-operation and Islam are important factors in the formation of unions. The agreements between unions and organizations such as the United Nations, the European Union, the North American Free Trade Agreement (NAFTA), Asia-Pacific Economic Cooperation (APEC), the Association of Southeast Asian Nations (ASEAN) and the Organization for Islamic Cooperation (OIC), play important roles in the world economy as well as economic development and international trade (Mohmand and Wang, 2014: 116).

OIC is the second largest international organization in the world after the United Nations, with 57 members spread over 4 continents and a population of about 1.6 billion. The organization aims to preserve the interests of the Muslim world, to ensure its security and to be the voice of the Muslim world, with the thought of providing international peace and harmony among the people of different nations. At the same time, the OIC aims preserving Islamic social and economic values; providing solidarity among members; increasing social, economic, cultural,

scientific and political cooperation; preserving international peace and security and to advance in science and technology (http://www.oic-oci.org). The vast majority of OIC countries do not generally fall within the definition of developed countries (Hamid, 2006; Buchanan, 2008). In addition, trade volume among OIC countries remains at a lower level compared to other similar unities (Buchanan, 2008; Rachdi, 2008). Based on this information, this study aims to examine the interaction between the markets of developed countries and the Islamic financial markets which are accepted as alternative financial markets. In this context, volatility spillover effect from the EU, US and Asian markets towards the markets of the OIC countries is tested.

Literature

It is possible to conclude some common results when the researches that explore the interaction between the markets are reviewed. Liu and Pan (1997: 48) summarize these common results as follows: (i) volatility of stock returns are time-varying, (ii) mean and volatility spillover from the US stock market to other national stock markets is observed, (iii) information transmission seems to have changed after the 1987 Stock Market Crisis.

In the studies that examine the integration between the stock exchanges, in general attempts were made to identify the existence of an interaction from developed markets towards developing or less-developed markets. While the US, EU and Japanese markets were used as developed markets, for developing or less-developed markets many different countries' markets were used. Studies related to Islamic financial markets are also included in the literature. However, to the best of our knowledge, there are not many studies in the literature that examine the volatility spillover effect from developed markets to OIC countries' markets. Studies on OIC member countries include, political issues (Akbarzadeh and Connor, 2005), economic relations (Bendjilali, 1997, Dabour, 2004, Ghani, 2007, Hassan et al., 2010, Abidin et al., 2013), conventional banking and Islamic banking comparisons (Mobarek and Kalonov, 2014; Sun et al., 2014). As a study investigating volatility spillover effect in OIC countries, it is believed that this study will contribute to the literature.

Although there are not many studies in the literature covering OIC countries, it is possible to come across studies that involve Islamic financial markets. In their study on the relationship between conventional and Islamic indices in developing countries, Saadaoui and Boujelbene (2015), found significant relationships between conventional and Islamic indices, especially during the 2007-2008 global crises. In their study it is also observed that the crisis affected financial assets in both markets. Exploring the existence of volatility spillover from the US, European and conventional Asian stock markets to the Dow Jones Islamic market, Nazlıoğlu et al., (2015), concluded that there is volatility/risk transfer between the Islamic equity market and the three major global equity markets. Abu Bakar and Masih (2014), who examined the cross volatility and co-movement between Islamic finance indices and conventional markets, included the Dow Jones Islamic index and the US, UK, European, Japanese, Chinese and Malaysian international securities markets as samples. The findings of the study show that comparing to Asian markets there is a stronger link between the Western markets and the Islamic index. It is also observed that volatility and co-movement between indices are higher and unstable during crisis periods. Majdoub and Mansour (2014) aimed to test the presence of conditional correlations between the US market and the five emerging Islamic markets (Turkey, Indonesia, Pakistan, Qatar, and Malaysia). Analyzes showed that there is a low correlation between the US market and the Islamic markets. The authors have not encounter a positive proof of a spillover effect from the US market towards the Islamic market.

Besides the studies examining the volatility spillover effect between the conventional and Islamic markets, there are also studies in the literature that examine this effect only among the Islamic markets. In their study on transmission of information (at return and volatility) across the Indonesian and Malaysian Islamic indices, Rahim et al. (2009) identified significant return and volatility transmission from the Malaysian stock market to the Indonesian stock market.

Methodology

The increased relationship of integration between the markets has made it possible not only the interaction between returns but also an interaction in volatility. In this context, the existence of mean and variance causality relationship between markets is researched. Granger causality can be defined as the situation in which the independent variable (X) provides useful information in predicting the future values of the dependent variable (Y). In the traditional sense, the first moment of the series mentioned in the definition is the conditional averages of the series. Cheung and Ng (1996) have developed a methodology that allows Granger causality to be applied over conditional variance, which is the second moment of the series. This development is important in terms of enabling the analysis of the volatility spillover effect across financial instruments and financial markets in general (Korkmaz et al., 2012). Cheung and Ng (1996) formulated variance causality between two stationary series as follows;

$$E\left\{\left(X_{t+1}-\mu_{x,t+1}\right)^2|I_t\right\}\neq E\left\{\left(X_{t+1}-\mu_{x,t+1}\right)^2|J_t\right\} \quad (1)$$

In case of the inequality in formula (1), X is said to cause in variance of Y. I_t, $I_t=\left\{X_{t-j};j\geq 0\right\}$, and J_t, $J_t=\left\{X_{t-j},Y_{t-j};j\geq 0\right\}$ represents two types of information sets (Korkmaz et al., 2012).

The variance causality test is performed in two stages. First, a univariate autoregressive conditional variance (Univarite GARCH) model is established for two variables, such as X and Y, in which the causality relation is examined;

$$\begin{aligned} X_t&=\mu_{xt}+\sum_{i=1}^{k}b_iX_{t-i}+\varepsilon_t & Y_t&=\mu_{yt}+\sum_{i=1}^{k}b_iY_{t-i}+\zeta_t, \\ h_t&=\omega+\alpha_i\varepsilon_{t-1}^2+\beta_ih_{t-1} & h_t&=\omega_y+\alpha_i\varepsilon_{t-1}^2+\beta_ih_{t-1} \end{aligned} \quad (2)$$

From the GARCH model that is formed, standard errors are obtained;

$$U_t=\left\{\left(X_t-\mu_{x,t}\right)^2/h_{x,t}\right\}=\varepsilon_t^2 \qquad V_t=\left\{\left(Y_t-\mu_{y,t}\right)^2/h_{y,t}\right\}=\zeta_t^2 \quad (3)$$

After this stage S test statistics are obtained;

$$S=T\sum_{j=1}^{M-1}\hat{\rho}_{uv}^2(j) \quad (4)$$

$\hat{\rho}_{uv}^2(j)$, represents cross-correlations ($\hat{\rho}_{uv}^2(j)=\left\{\hat{C}_{uu}(0)\hat{C}_{vv}(0)\right\}^{-1/2}\hat{C}_{uv}(j)$). However, when the S statistic is calculated, equal weight is given to each delay, and the increase in the number of delays has decreased the effectiveness of the test statistics (Gębka and Serwa,

2007; Korkmaz et al., 2012). In order to overcome this problem Hong (2001) developed two test methods named Q_1 and Q_2. To determine causality in the mean Q_1 is calculated as;

$$Q_1 = \frac{T\sum_{l=1}^{T-1} k^2\left(\frac{j}{M}\right)\hat{\rho}_{uv}^2(j) - C_{1T}(k)}{\sqrt{2D_{1T}(k)}} \quad (5)$$

$\hat{\rho}_{uv}^2(j) = \left\{\hat{C}_{uu}(0)\hat{C}_{vv}(0)\right\}^{-1/2}\hat{C}_{uv}(j)$, $\hat{C}_{uu}(0) = T^{-1}\sum_{t=1}^{T}\hat{u}_t$, $\hat{C}_{vv}(0) = T^{-1}\sum_{t=1}^{T}\hat{v}_t$ defined as such. In equations u and v represent the standardized errors obtained from the GARCH models. For variance causality, Q_2 test statistics is calculated in a similar way, except for using u^2 and v^2, the squares of standardized errors. The weighting is obtained as;

$$k(j/M) = \begin{cases} 1-|j/(M+1)| & eğer\ k/(M+1) \le 1 \\ 0 & dd. \end{cases} \quad (6)$$

In the study, to incorporate possible asymmetry in financial markets, exponential GARCH (EGARCH) model developed by Nelson (1991) is used. In the EGARCH models, firstly the mean equation is estimated and appropriate AR and MA processes are determined and added to the mean equation. The structural breaks that may occur in the variance of the series are identified by the statistics of Kappa-2 test developed by Sansó et al. (2004). The statistics of Kappa-2 test is the most appropriate test that can be used when the series are not normally distributed and the autoregressive conditional heteroscedasticity (ARCH) effect is seen (Korkmaz et al., 2012). Kappa-2 is calculated as follows;

$$\kappa 2 = \sup_k \left| T^{-1/2} G_k \right| \quad (7)$$

$G_k = \hat{\omega}_4^{-1/2}\left(C_k - \frac{k}{t}C_T\right)$ and $\hat{\omega}_4 = \frac{1}{T}\sum_{t=1}^{T}\left(r_t^2 - \hat{\sigma}^2\right)^2 + \frac{2}{T}\sum_{t=1}^{m}\omega(l,m)\sum_{t=l+1}^{T}\left(r_t^2 - \hat{\sigma}^2\right)\left(r_{t-1}^2 - \hat{\sigma}^2\right)$ defined as such. The structural breaks detected by the Kappa-2 test were added to the variance equation of the EGARCH model by creating dummy variables and the statistically insignificant dummy variables were not included in the model.

Data and Findings

In Table 1 market price indices are given. In choosing OIC member countries, firstly countries with the most developed market capitalization are identified and among them the ones which data can be accessed are selected. The data set is based on daily closing prices of markets listed in Table 1 between 02/01/2012 and 31/12/2015. Time-path diagrams of price indices are shown in Figure 1. The data of price index is obtained from MSCI-Barra web address. The logarithmic return series are calculated by the $r_t = 100x\ln(P_t/P_{t-1})$ formula and in the analysis the return series are taken into account.

Table 1
Selected OIC Member Countries and Developed Markets

USA	USA Standard (Large+Mid Cap)
EU	EUROPE Standard (Large+Mid Cap)
ASIA	ASIA APEX 50 Standard (Large+Mid Cap)
IND	INDONESIA ISLAMIC Standard (Large+Mid Cap)
MLY	MALAYSIA ISLAMIC Standard (Large+Mid Cap)
QTR	QATAR ISLAMIC Standard (Large+Mid Cap)
TUR	TURKEY ISLAMIC Standard (Large+Mid Cap)
UAE	UNITED ARAB EMIRATES ISLAMIC Standard (Large+Mid Cap)
JOR	JORDAN ISLAMIC Standard (Large+Mid Cap)
KWT	KUWAIT ISLAMIC Standard (Large+Mid Cap)
PKT	PAKISTAN ISLAMIC Standard (Large+Mid Cap)
BHR	BAHRAIN ISLAMIC Standard (Large+Mid Cap)
OMAN	OMAN ISLAMIC Standard (Large+Mid Cap)

When we look at the graphs of developed markets in Figure 1, it can be seen that the USA has a growth trend, the EU has a growth trend until the middle of 2014 after the debt crisis and the ASIA has a high volatility. After the mid-2014, the start of a downtrend in the markets of Indonesia, Malaysia, Qatar, Bahrain, Pakistan, Kuwait and the EU is observed.

Descriptive statistics of the return series are given in Table 2. While the UAE and Turkey have the highest returns, Jordan and Bahrain have the lowest return among the OIC countries. The normality test results show that the frequencies of all indices are not normally distributed. Furthermore, in all indices the autoregressive conditional heteroscedasticity (ARCH) effect is observed, and the series provide stationary condition. The abnormal distribution of the series and the presence of the ARCH effect indicate that the appropriate model is the GARCH model.

Correlations between the series are shown in Table 3. Results show that there is a low correlation between markets of developed countries and OIC countries. The country with the highest correlation with the US and EU is Turkey (0.237 and 0.443). Countries with the highest correlation with ASIA are Malaysia (0.494) and Indonesia (0.471). The correlation coefficients between the OIC countries themselves are also low. Jordan's correlation with markets of any developed country is not statistically significant. The correlation is strong among the countries which are geographically close to each other. The UAE and Qatar (0.507), Indonesia and Malaysia (0.475) can be given as examples.

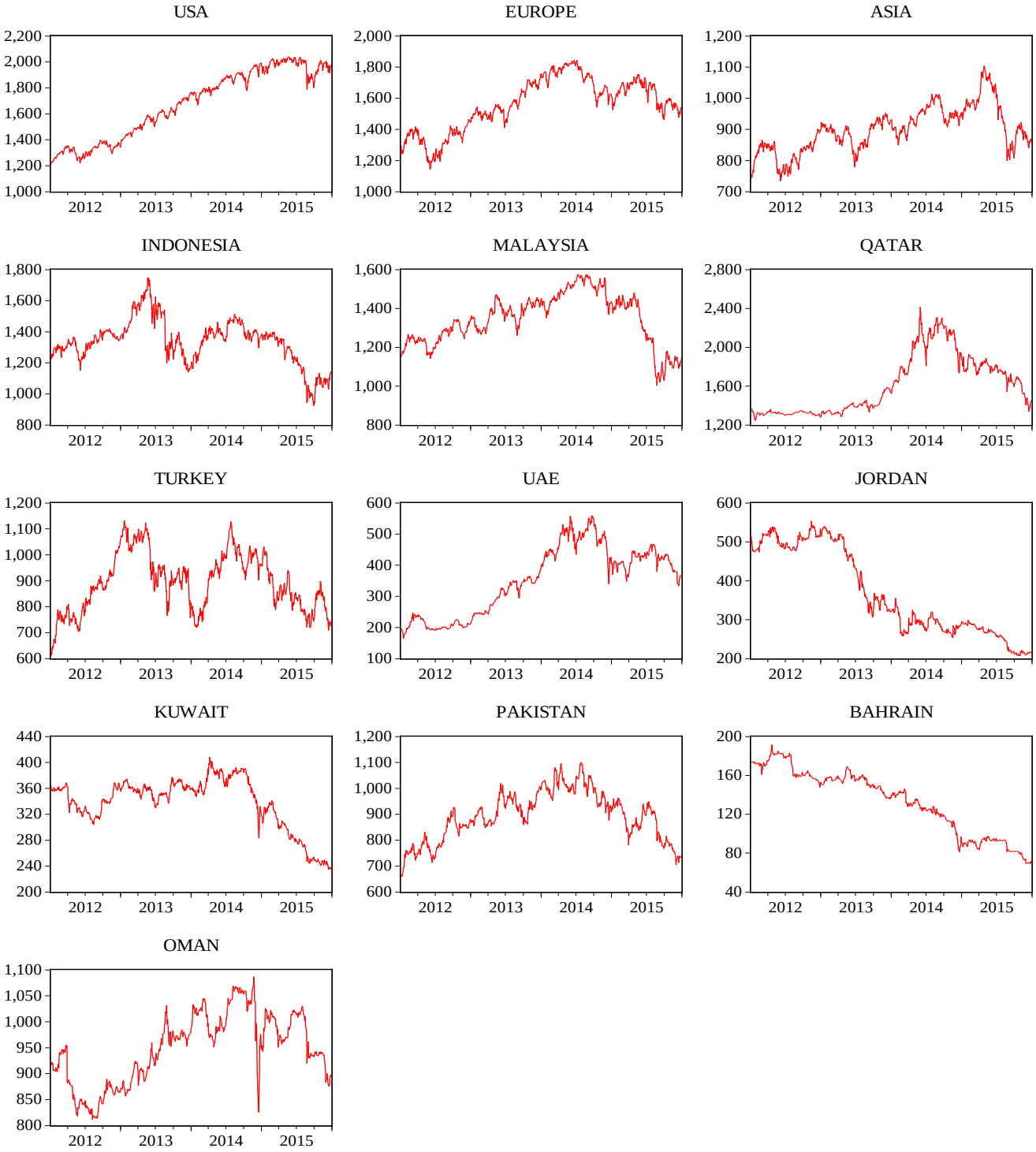

Figure 1. Graphics of Price Indices

Table 2

Descriptive Statistics

	USA	EU	ASIA	IND	MLY	QTR	TUR

Mean	0.0466	0.0175	0.0145	-0.0064	0.0000	0.0074	0.0140
Std. Dev.	0.7919	1.0259	0.9499	1.5277	0.8749	1.2399	1.7283
Maximum	3.7692	4.6426	3.9883	7.4094	4.9522	11.6060	7.2979
Minimum	-4.0444	-4.7279	-5.1160	-8.4544	-4.4391	-8.3466	-9.5767
Skewness	-0.2746	-0.1277	-0.1364	-0.2249	0.1588	0.4418	-0.4151
Kurtosis	2.0406	1.8501	2.0980	3.3093	3.6095	15.7050	2.8105
Jarque-Bera	194.07 [0.0000]	151.58 [0.0000]	194.52 [0.0000]	484.73 [0.0000]	570.59 [0.0000]	10753 [0.0000]	373.22 [0.0000]
ARCH(5)	27.882 [0.0000]	4.4519 [0.0005]	7.4074 [0.0000]	19.687 [0.0000]	8.2806 [0.0000]	5.1685 [0.0001	9.6904 [0.0000]
Q(20)	16.9978 [0.6531]	19.4958 [0.4898]	30.0445 [0.0691]	39.7320 [0.0054]	40.9848 [0.0037]	40.0271 [0.0049]	14.7301 [0.7916]
Qs(20)	264.895 [0.0000]	82.4959 [0.0000]	139.351 [0.0000]	372.755 [0.0000]	138.215 [0.0000]	219.378 [0.0000]	164.723 [0.0000]
ADF	-31.4801***	-33.3139***	-30.5499***	-21.1752***	-19.4520***	-31.9821***	-32.1451***
PP	-32.1679***	-33.3723***	-30.5436***	-30.7094***	-28.5608***	-31.9949***	-32.1493***
KPSS	-32.1679***	0.0345***	0.0368***	0.0379***	0.0383***	0.1343***	0.0396***

Table 2
Descriptive Statistics (continuous)

	UAE	JOR	KWT	PKT	BHR	OMAN
Mean	0.0611	-0.0836	-0.0423	0.0114	-0.0853	-0.0034
Std. Dev.	1.8412	1.5761	1.0525	1.1210	1.1832	0.8219
Maximum	11.3190	9.5936	10.2670	3.8605	7.8355	8.1704
Minimum	-11.1830	-15.4750	-5.9192	-7.0686	-8.6870	-7.6996
Skewness	-0.1215	-0.4539	0.5802	-0.3481	-0.8396	-1.5520
Kurtosis	7.5164	14.1530	11.3540	3.3783	12.2150	32.0430
Jarque-Bera	2457.8 [0.0000]	8741.3 [0.0000]	5660.7 [0.0000]	517.05 [0.0000]	6607.1 [0.0000]	45040 [0.0000]
ARCH(5)	29.461 [0.0000]	2.6433 [0.0220]	25.275 [0.0000]	2.8903 [0.0134]	17.166 [0.0000]	19.506 [0.0000]

	39.1701	38.9321	22.5241	35.1292	25.2291	54.1152
Q(20)	[0.0063]	[0.0067]	[0.3127]	[0.0194]	[0.1928]	[0.0001]
	243.584	48.5229	167.225	22.6872	171.693	285.890
Qs(20)	[0.0000]	[0.0003]	[0.0000]	[0.3044]	[0.0000]	[0.0000]
	-	-	-	-	-	-
ADF	31.8143***	32.9455***	34.2861***	28.7756***	32.5740***	20.2903***
	-	-	-	-	-	-
PP	31.8360***	33.1844***	34.3103***	28.7066***	32.5721***	31.1204***
KPSS	0.0680***	0.0680***	0.0781***	0.0177***	0.0229***	0.0604***

Notes: The figures in square brackets show the probability (p-values) of rejecting the null hypothesis. ARCH (5) indicates LM conditional variance test. Q(20) and Q_S(20) indicate Ljung–Box serial correlation test for return and squared return series respectively. *** indicate that the series in question is stationary at the 1% significance level.

Table 3
Correlation Coefficients

	USA	EU	ASIA	UAE	BHR	IND
USA	1.000					
EU	0.572***	1.000				
ASIA	0.248***	0.407***	1.000			
UAE	0.133***	0.206***	0.271***	1.000		
BHR	0.048	0.085***	0.087***	0.229***	1.000	
IND	0.186***	0.252***	0.471***	0.241***	0.087***	1.000
KWT	0.069**	0.103***	0.139***	0.313***	0.193***	0.116***
MLY	0.159***	0.277***	0.494***	0.263***	0.087***	0.475***
OMAN	0.106***	0.093***	0.145***	0.325***	0.223***	0.111***
PKT	0.023	0.065**	0.157***	0.164***	0.042	0.141***
QTR	0.129***	0.133***	0.215***	0.507***	0.236***	0.206***
TUR	0.237***	0.443***	0.296***	0.125***	0.042	0.288***
JOR	0.036	0.032	0.031	0.073**	0.087***	0.005

Note: ** and *** indicates statistically significance at the 5% and 1% level respectively.

Table 3
Correlation Coefficients (continuous)

	KWT	MLY	OMAN	PKT	QTR	TUR
MLY	0.138***	1				
OMAN	0.236***	0.187***	1			
PKT	0.131***	0.161***	0.139***	1		
QTR	0.264***	0.195***	0.297***	0.149***	1	
TUR	0.113***	0.297***	0.071**	0.067**	0.085***	1
JOR	-0.012	0.019	0.026	0.028	0.085***	0.032

Note: ** and *** indicates statistically significance at the 5% and 1% level respectively.

Rolling window correlation coefficients are calculated to examine the dynamic correlation between markets of developed countries and Islamic markets of the OIC countries. In doing so the aim is to reveal the time-varying behavior between the series. In revealing time-varying

behavior the window size to be determined is important. Therefore we use 80 day rolling-window. The descriptive statistics for the rolling window correlation coefficients are given in Table 4, which shows a low correlation between the USA, the EU and the OIC member countries. It also show that ASIA has low correlation with other countries except Indonesia and Malaysia. When the standard deviations of the Rolling Correlation Coefficients are examined, it is seen that the highest volatility for the USA and the EU is with Indonesia and for ASIA with Pakistan.

Table 4
Descriptive statistics for rolling correlation coefficients

	Mean	Median	Maximum	Minimum	Std. Dev.
USA and IND	0.141	0.124	0.537	-0.178	0.171
USA and MLY	0.127	0.123	0.417	-0.159	0.107
USA and QTR	0.108	0.110	0.396	-0.303	0.137
USA and TUR	0.231	0.243	0.536	-0.090	0.120
USA and UAE	0.118	0.093	0.409	-0.142	0.114
USA and JOR	0.052	0.044	0.500	-0.159	0.102
USA and KWT	0.073	0.082	0.285	-0.252	0.085
USA and PKT	-0.015	-0.075	0.421	-0.282	0.168
USA and BHR	0.038	0.007	0.398	-0.208	0.134
USA and OMAN	0.058	0.024	0.476	-0.176	0.140

Table 4
Descriptive statistics for rolling correlation coefficients (continuous)

	Mean	Median	Maximum	Minimum	Std. Dev.
EU and IND	0.219	0.237	0.623	-0.288	0.205
EU and MLY	0.25	0.274	0.492	-0.075	0.125
EU and QTR	0.139	0.13	0.414	-0.103	0.116
EU and TUR	0.426	0.427	0.731	0.152	0.151
EU and UAE	0.214	0.209	0.51	-0.162	0.137
EU and JOR	0.034	0.044	0.323	-0.194	0.108
EU and KWT	0.098	0.084	0.322	-0.095	0.097
EU and PKT	0.05	0.032	0.492	-0.218	0.14
EU and BHR	0.074	0.082	0.346	-0.222	0.124
EU and OMAN	0.057	0.06	0.38	-0.205	0.15
ASIA and IND	0.429	0.432	0.674	0.055	0.153
ASIA and MLY	0.462	0.506	0.763	0.039	0.163
ASIA and QTR	0.2	0.159	0.67	-0.09	0.17
ASIA and TUR	0.264	0.26	0.541	-0.1	0.138
ASIA and UAE	0.273	0.25	0.605	-0.029	0.147
ASIA and JOR	0.031	0.009	0.316	-0.187	0.119
ASIA and KWT	0.124	0.113	0.383	-0.132	0.122
ASIA and PKT	0.113	0.08	0.665	-0.243	0.193
ASIA and BHR	0.061	0.024	0.448	-0.279	0.163
ASIA and OMAN	0.096	0.053	0.531	-0.242	0.177

To see the time-varying dynamics, the rolling correlation coefficients are given in graphical form. The relation of the OIC member countries with the USA is shown in Figure-2, with the EU in Figure-3, and with the ASIA in Figure-4. The time-varying behavior can be seen in all

correlations. It is also observed that correlations show considerable volatility and rarely fall below zero. The market with the highest correlation with the developed markets is the Indonesian Islamic market.

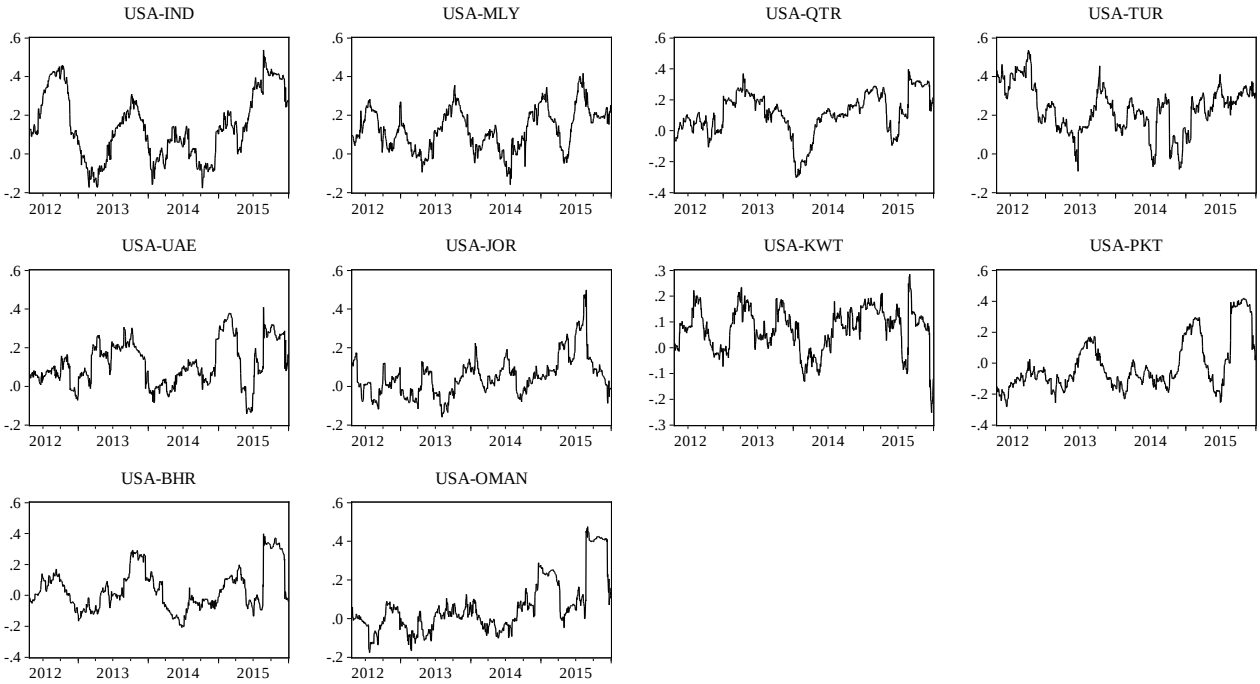

Figure 2. Rolling correlation coefficient among USA and OIC Member Countries

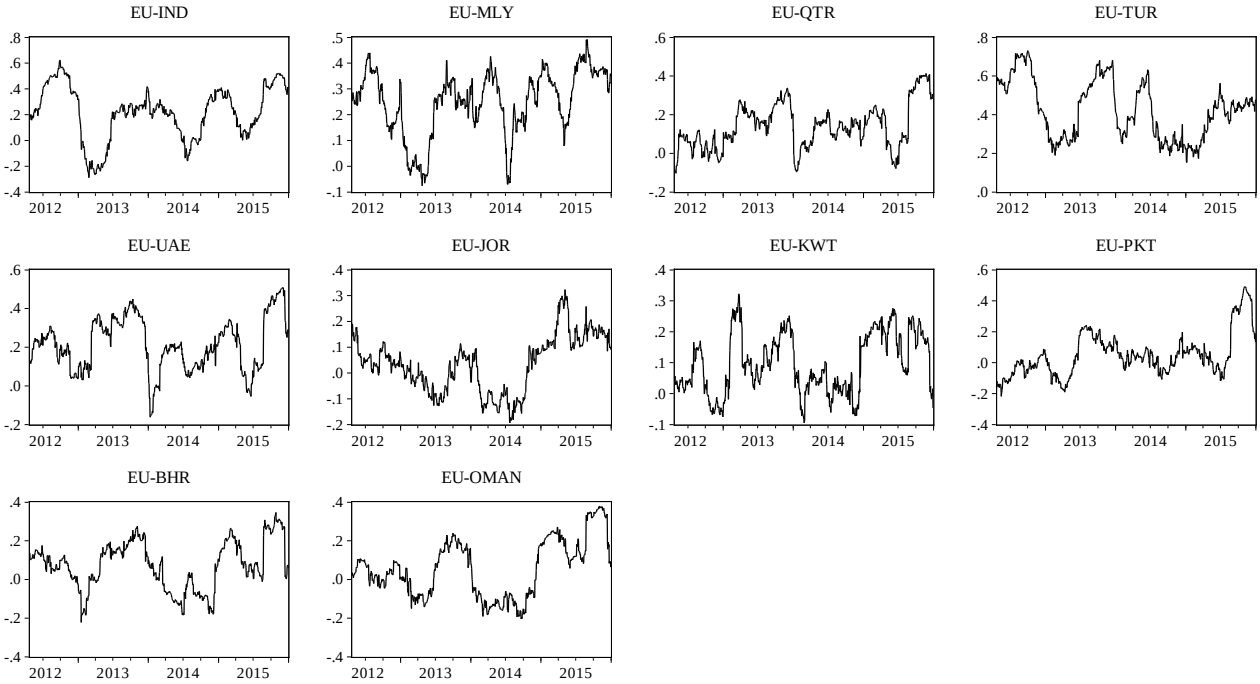

Figure 3. Rolling correlation coefficient among EU and OIC Member Countries

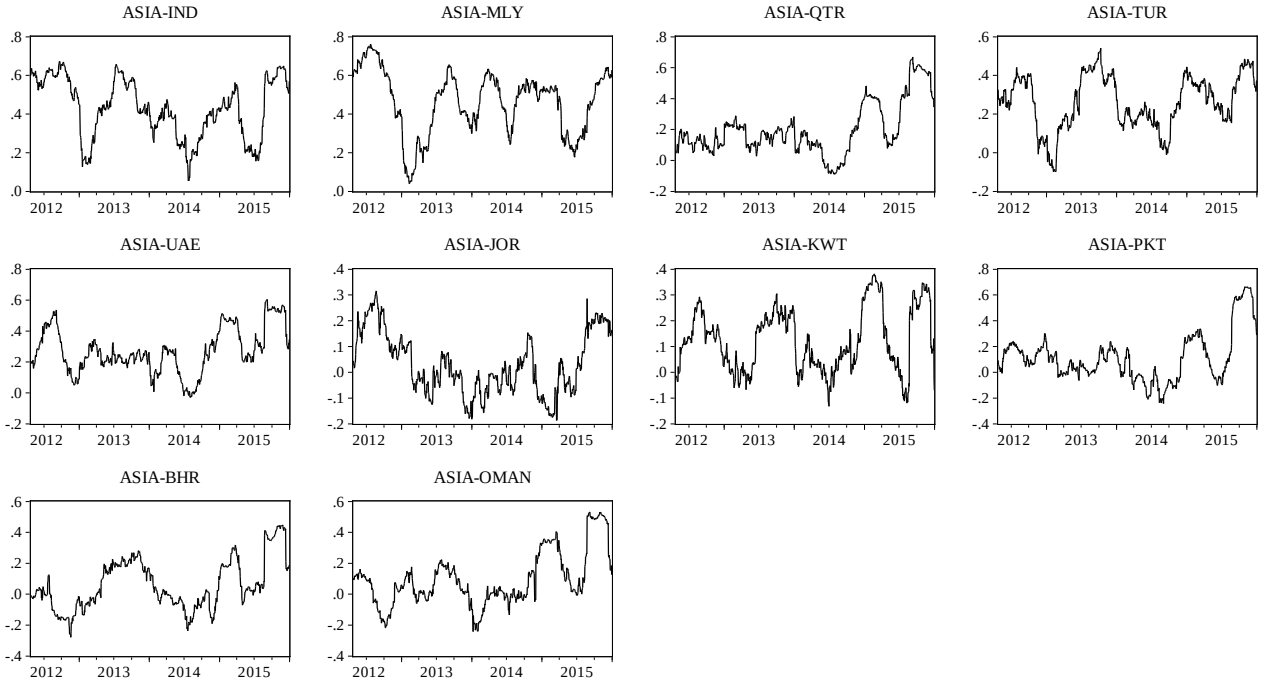

Figure 4. Rolling correlation coefficient among ASIA and OIC Member Countries

In order to apply the variance causality test, firstly volatilities of the series are modeled and standardized errors are obtained from the model. For the mean equations of the series optimum AR and MA processes are calculated firstly. For the variance equation, the existence of the asymmetric relation is determined by the EGARCH model and for the markets without asymmetric effect, the GARCH model is used in the volatility model. The results of EGARCH and GARCH models for the series are shown in Table 5. As the errors are not normally distributed in all models the GED distribution is used. Table 5 shows that the GED parameter is statistically significant in all of the models.

Table 5
GARCH and EGARCH Model Results

	USA	EU	ASIA	IND	MLY	QTR	TUR	UAE	JOR	KWT	PKT	BHR	OMAN
Mean Equation													
μ	0.0525***	0.0230	0.0017**	0.0320	-0.0058	0.0002***	0.0507	-0.0003***	0.0001***	0.0000	-0.0003	0.0009***	0.0003***
ρ_1	0.0032	0.0122	-0.7373**	-0.0270	-	-0.0036**	-	-0.0048***	0.0069***	-0.0042	-0.1390	0.0021	-0.0002
ρ_2	0.6606*	-0.1467**	-0.2391**	0.1087	-	-0.0044	-	0.0025	-0.0004	0.0034	-0.0181	0.0061	0.0012
ρ_3	0.1949	-0.39***	-0.7526**	0.5337***	-	-0.0007	-	0.0001	0.0002	-0.0065	-0.1293*	0.0015	-0.0010
ρ_4	-	0.0167	-0.9386**	0.0014	-	-0.0105	-	0.0029	0.0003	-0.0007	-0.0512	-0.0005	-0.0021

ρ_5	-	-0.2071***	0.0443**	0.0250	-	-0.0017***	-	-	-	0.0000	-0.7604***	0.0009	-0.0004
ρ_6	-	-0.8060***	-	0.0178	-	-	-	-	-	-	-0.3261***	-0.0001	0.0002
δ_1	-0.0327	-0.0357	0.7977**	0.0199	0.1146***	0.0038**	-	0.0049***	-0.0069***	0.0042	0.2167	-0.0004	0.0004
δ_2	-0.6817**	0.1525**	0.3011**	-0.1389	0.0686**	0.0036	-	-0.0026	0.0004	-0.0034	0.0572	-0.0060	-0.0012
δ_3	-0.2068	0.3607***	0.7918**	-0.5968***	-	0.0009	-	-0.0001	-0.0002	0.0065	0.1273*	-0.0017	0.0000
δ_4	-	-0.0227	0.9901**	-	-	0.0106	-	-0.0029	-0.0003	0.0007	0.0602	0.0001	0.0020
δ_5	-	0.2331***	-	-	-	-	-	0.0003***	-	-	0.7779***	-0.0043	0.0004
δ_6	-	0.8312***	-	-	-	-	-	0.0001*	-	-	0.4112**	0.0004	0.0003
Variance Equation													
ω	-0.1493***	0.0589	-0.0167	-0.1349***	-0.2149***	0.9958	-0.0476*	9.3437	3.6971	-0.0516*	0.8277***	1.0245	0.6441
a	0.0698	0.0254	0.0293	0.2321***	0.1242*	0.6605	0.1201***	0.4845	0.5284	0.1243**	0.2997***	0.7201	0.0260
γ	-0.3378***	-0.2206***	-0.0803***	-0.0672**	-0.1194***	-	-0.0826***	-	-	-0.1028**	-	-	-
β	0.8766***	0.8702***	0.9644***	0.9501***	0.7409***	0.9115***	0.9537***	0.9893***	0.9893	0.9603***	0.0801	0.9825***	0.9591***
d	-	-0.1397***	-0.0204*	-	0.1702**	-	-	-	-	-	-	-	-
d_2	-	-0.1062***	-	-	-0.3725**	-	-	-	-	-	-	-	-
v	1.4525***	1.3681***	1.4879***	1.0468***	1.2229***	0.1933***	1.3197***	0.1277***	0.1398***	0.5267***	0.9923***	0.1339***	0.1713***
Log-L	-1093.4830	-1367.7800	-1322.2030	-1747.7840	-1224.781	-917.4585	-1971.7310	-1381.227	-1354.0220	-1300.0110	-1482.6210	-421.0270	-416.2513

Note: v is GED parameter, γ is asymmetric effect coefficient and d is dummy variable corresponding to structual break. *, ** and *** indicates statistically significance at the 10%, 5% and 1% level respectively.

As can be seen in Table 5, the parameter γ representing asymmetric information in OIC member countries and developed markets is significant except for Qatar, the UAE, Jordan, Pakistan, Bahrain and Oman. The parameter β showing the permanence of volatility in the

models appears to be low in USA, EU and Malaysia. In remaining markets, the volatility seems to permanent and the highest parameter is in the UAE and Bahrain markets. Structural breaks that occurred in the variance of the series are added to the variance models and those that are not statistically significant are excluded from the model. Accordingly, 2 breaks for the EU and Malaysia and 1 break for ASIA are statistically significant and added to the models.
The causality in the mean test is performed with standardized errors obtained from the EGARCH and GARCH models and the variance causality test is performed with the squares of the standardized errors. The results are shown in Table 6 and Table 7.

Table 6
Causality in Mean

	M=1	M=2	M=3	M=4	M=5
USA ⇄IND	62.742***	60.707***	56.856***	53.190***	50.016***
USA ⇄MLY	56.908***	55.062***	51.561***	48.272***	45.418***
USA ⇄QTR	18.772***	18.585***	17.621***	16.529***	15.524***
USA ⇄TUR	10.833***	10.519***	9.796***	9.252***	8.860***
USA ⇄UAE	15.999***	16.206***	15.709***	14.966***	14.181***
USA ⇄JOR	-0.242	-0.402	-0.568	-0.707	-0.827
USA ⇄KWT	-0.257***	0.480***	1.084***	1.451*	1.655**
USA ⇄PKT	10.814***	10.932***	10.563***	10.071***	9.568***
USA ⇄BHR	3.525***	3.405***	3.111***	2.836***	2.600***
USA ⇄OMAN	9.507***	9.199***	8.533***	7.852***	7.237***
EU ⇄IND	29.161***	28.173***	26.291***	24.487***	22.918***
EU ⇄MLY	30.483***	29.601***	27.696***	25.877***	24.306***
EU ⇄QTR	17.243***	16.570***	15.342***	14.199***	13.222***
EU ⇄TUR	0.665	0.661	0.575	0.469	0.360
EU ⇄UAE	7.007***	7.136***	7.019***	6.880***	6.747***
EU ⇄JOR	-0.429	-0.560	-0.665	-0.751	-0.836
EU ⇄KWT	-0.141***	0.732***	1.254***	1.423*	1.445*
EU ⇄PKT	7.435***	7.153***	6.593***	6.031***	5.569***
EU ⇄BHR	3.525***	3.277***	2.958***	2.809***	2.742***
EU ⇄OMAN	2.452***	2.801***	2.933***	2.887***	2.761***
ASIA ⇄IND	-0.120	-0.213	-0.325	-0.292	-0.175
ASIA ⇄MLY	-0.680	-0.717	-0.728	-0.725	-0.726
ASIA ⇄QTR	3.068***	2.840***	2.516***	2.241***	2.031***
ASIA ⇄TUR	-0.707	-0.857	-0.989	-1.077	-1.144
ASIA ⇄UAE	0.862	0.668	0.551	0.470	0.372
ASIA ⇄JOR	0.234	0.057	-0.058	-0.057	-0.022
ASIA ⇄KWT	1.274	1.130	1.130	1.156	1.119
ASIA ⇄PKT	3.293***	3.510***	3.471***	3.285***	3.122***
ASIA ⇄BHR	2.327***	2.095**	1.808**	1.552*	1.398*
ASIA ⇄OMAN	-0.525	-0.636	-0.728	-0.817	-0.905

Note: *, ** and *** indicates statistically significance at the 10%, 5% and 1% level respectively. M represents the maximum lag.
Table 6 indicates that there is causality in the mean from the USA market to the Islamic markets in OIC member countries except Jordan. Similar findings are observed for the EU with exception of Jordan and Turkey. Causality in the mean is also observed from the ASIA market towards Qatar, Pakistan and Bahrain markets. While Jordan Islamic markets are the most segmented (least integrated) markets, Qatar, Pakistan and Bahrain Islamic markets are the

most integrated (least segmented) markets. It seems that the return spillover effect from the conventional markets in the USA and the EU towards the OIC Islamic markets is strong. Findings also show that return spillover effect is lower in the ASIA conventional market than that of the USA and the EU.

Table 7
Causality in Variance

	M=1	M=2	M=3	M=4	M=5
USA ⇄IND	**20.587*** **	**19.868*** **	**18.473*** **	**17.119*** **	**15.923*** **
USA ⇄MLY	**10.304*** **	**10.338*** **	**9.919*** **	**9.400*** **	**8.892*** **
USA ⇄QTR	-0.642	-0.522	-0.485	-0.530	-0.606
USA ⇄TUR	**2.738*** **	**2.560*** **	**2.267** **	**1.973** **	**1.717** **
USA ⇄UAE	-0.296	-0.458	-0.609	-0.742	-0.858
USA ⇄JOR	-0.343	-0.433	-0.506	-0.547	-0.578
USA ⇄KWT	0.498	0.338	0.180	0.047	-0.075
USA ⇄PKT	0.136	0.010	-0.152	-0.005	0.359
USA ⇄BHR	-0.446	-0.212	-0.077	-0.032	0.013
USA ⇄OMAN	-0.056	0.675	1.120	1.268	1.274
EU ⇄IND	**4.222*** **	**3.948*** **	**3.520*** **	**3.116*** **	**2.760*** **
EU ⇄MLY	**0.304*** **	**1.399***	**2.047** **	**2.256** **	**2.269** **
EU ⇄QTR	-0.601	-0.754	-0.819	-0.860	-0.918
EU ⇄TUR	-0.509	-0.638	-0.772	-0.896	-1.007
EU ⇄UAE	-0.650	-0.795	-0.909	-1.008	-1.103
EU ⇄JOR	-0.293	-0.455	-0.559	-0.641	-0.731
EU ⇄KWT	-0.596	-0.749	-0.895	-1.006	-1.096
EU ⇄PKT	0.910	0.772	0.579	0.386	0.208
EU ⇄BHR	-0.673	-0.823	-0.963	-1.054	-1.103
EU ⇄OMAN	-0.694	-0.828	-0.918	-0.991	-1.071
ASIA ⇄IND	**2.995*** **	**2.738*** **	**2.380*** **	**2.099** **	**1.915** **
ASIA ⇄MLY	-0.664	-0.815	-0.784	-0.706	-0.670
ASIA ⇄QTR	-0.268	-0.392	-0.522	-0.647	-0.755
ASIA ⇄TUR	-0.347	-0.377	-0.440	-0.500	-0.523
ASIA ⇄UAE	0.782	0.620	0.415	0.222	0.048
ASIA ⇄JOR	-0.690	-0.807	-0.917	-1.023	-1.126
ASIA ⇄KWT	-0.635	-0.779	-0.895	-0.994	-1.087
ASIA ⇄PKT	-0.703	-0.806	-0.765	-0.661	-0.588
ASIA ⇄BHR	-0.343	-0.394	-0.469	-0.508	-0.500
ASIA ⇄OMAN	0.729	0.597	0.452	0.333	0.293

Note: *, ** and *** indicates statistically significance at the 10%, 5% and 1% level respectively. M represents the maximum lag.

According to causality in variance results, there are volatility spillover effects from each of three developed markets to Indonesian Islamic markets. While Malaysia has a volatility spillover effect from the USA and the EU, Turkey has volatility spillover effect only from the USA market. It can be said that volatility spillover effect is generally low from conventional markets of developed countries to OIC Islamic markets.

Conclusion

The aim of this study is to test whether there is volatility spillover effect from international markets towards the Islamic financial markets of the member countries of the Organization of Islamic Cooperation. In this context, for international markets conventional indices of the US, the EU and ASIA are used. The information transmission between the markets is analyzed by the causality in the mean test and the volatility spillover is analyzed by the causality in variance test. Besides, the dynamic structure of the correlation between the developed markets and the OIC Islamic markets is examined by rolling correlation.

The existence of asymmetric effect is found in many markets in the formed volatility models. Accordingly, the impact of negative information in the market will be greater than the impact of positive information. The results of causality in the mean test show that the most dominant conventional market over the markets of OIC countries is the USA followed by the EU and ASIA. On the other hand findings of the causality in variance test, indicate a limited volatility spillover effect from the conventional markets to the OIC Islamic markets. When the rolling correlation coefficients are examined, it is observed that the correlation between developed markets and OIC Islamic markets has a time-varying behavior. Indonesia has the highest time-varying correlation with developed markets. The findings indicate that Islamic stock markets are compatible with decoupled hypothesis. Islamic stock markets can provide investors with portfolio diversification benefits. The findings of this study is expected to contribute to international investors in forming portfolios.

References

Abidin, I. S. Zainal; Abu Bakar, Nor'Aznin and Sahlan, Rizauddin (2013). The Determinants of Exports between Malaysia and the OIC Member Countries: A Gravity Model Approach. Procedia economic and Finance, 5, 12-19.

Abu Bakar, N. and Masih A. M. (2014). The Dynamic Linkages between Islamic Index and the Major Stock Markets: New Evidence from Wavelet time-scale decomposition Analysis. MPRA Paper No. 56977.

Ahmed, Z. and Ugurel, I. (1998). The Islamic Capital Market: Is it Economically and Politically Justifiable?. Humanomics, 14(4), 79-117.

Akbarzadeh, Shahram and Connor, Kylie (2005). The Organization of The Islamic Conference: Sharing an Illusion. Middle East Policy, 12(2), 79-92.

Arshanapalli, B. and Doukas, J. (1993). International stock market linkages: Evidence from the pre and post-October 1987 period. Journal of Banking & Finance, 17(1), 193-208.

Beirne, John; Caporale, Guglielmo Maria; Schulze-Ghattas, Marianne and Spagnolo, Nicola (2013). Volatility Spillovers and Contagion from Mature to Emerging Stock Markets. Review of International Economics, 21(5), 1060–1075.

Bekaert, Geert and Harvey Campbell R. (1997). Emerging equity market volatility. Journal of Financial Economics, 43, 29-77.

Bendjilali, B. (1997). An Intra-Trade Econometric Model for OIC Member Countries: A Cross Country Analysis. IRTI Research Papers, 55.

Blackman, S.C. Holden, K. and Thomas, W.A. (1994). Long-term relationships between international share prices. Applied Financial Economics, 4, 297-304.

Brooks, Chris (2002). Introductory Econometrics for Finance. Cambridge Universities.

Buchanan, I.C. (2008). Bridging the Income Gap Between Nations by Unlocking the Potential of the State Owned Sector. Paper Presented at the World Islamic Economic Forum, Kuala Lumpur.

Cha, B. and Oh, S. (2000). The relationship between developed equity markets and the Pacific Basin's emerging equity markets. International Review of Economics & Finance, 9(4), 299-322.

Cheung, Yin-Wong and Ng, Lilian K. (1996). A causality-in-variance test and its application to financial market prices. Journal of Econometrics, 72(1-2), 33-48.

Dabour, N.M. (2004). Implications of Establishing an Islamic Common Market: Gradual Integration and Possible Consequences. Journal of Economics Cooperation, 25(1), 71-98.

Gębka, Bartosz and Serwa, Dobromił (2007). Intra-and inter-regional spillovers between emerging capital markets around the world. Research in International Business and Finance, 21(2), 203-221.

Ghani, G. M. (2007). Does OIC Membership Reduce Trade?. Journal of Economic Cooperation, 28(4), 39-62.

Hamid, H. (2006). A Shapshot of Current Economics State of Being for Muslim Countries. Paper Presented at the World Islamic Economic Forum, Kuala Lumpur.

Hammoudeh, Shawkat; Mensi, Walid; Reboredo, J.Carlos and Nguyen, D.Khuong (2014). Dynamic dependence of the global Islamic equity index with global conventional equity market indices and risk factors. Pacific-Basin Finance Journal, 30, 189–206.

Hassan, M.K., B.A. Sanchez, and M.E. Hussain. (2010). Economic Performance of the OIC Countries and the Prospect of an Islamic Common Market. Journal of Economic Cooperation and Development, 31(2), 65–121.

Hong, Y. (2001). A test for volatility spillover with application to exchange rates. Journal of Econometrics, 103(1), 183–224.

Hoque, H. (2007). Co-movement of Bangladesh stock market with other markets: Cointegration and error correction approach. Managerial Finance, 33(10), 810-820.

Iqbal, Zamir and Mirakhor, Abbas (2013), "Economic Development and Islamic Finance", Directions in Development, Washington, DC: World Bank.

Korkmaz, Turhan; Çevik, Emrah İ. and Atukeren, Erdal (2012). Return and Volatility Spillover among CIVETS Stock Markets. Emerging Markets Eview, 13, 230-252.

Lee, S.B. and Kim, K.J. (1993). Does the October 1987 crash strengthen the co-movements among national stock markets?. Review of Financial Economics, 3, 89-102.

Lessard, D. R. (1973). International portfolio diversification: a multivariate analysis for a group of Latin American countries. The Journal of Finance, 28(3), 619-633.

Levy, H. and Sarnat, M. (1970). International diversification of investment portfolios. The American Economic Review, 668-675.

Liu, Y. Angela and Pan, Ming–Shiun (1997). Mean and Volatility Spillover Effects in the U.S. and Pacific–Basin Stock Markets. Multinational Finance Journal, 1(1), 47-62.

Majdoub, J. and Mansour, W. (2014). Islamic equity market integration and volatility spillover between emerging and US stock markets. The North American Journal of Economics and Finance, 29, 452470.

Mobarek, Asma and Kalonov, Alovaddin (2014). "Comparative Performance Analysis between Conventional and Islamic Banks: Empirical Evidence from OIC Countries. Applied Economics, 46(3), 253-270.

Mohmand, Y. Tariq and Wang, Aihu (2014). Is the Organization of Islamic Cooperation Promotin Trade Among Members?. Pakistan Journal of Statistics, 30(21), 113-128.

Nazlıoğlu, Saban; Hammoudeh, Shawkat and Gupta, Rangan (2015). Volatility Transmission between Islamic and Conventional Equity Markets: Evidence from Causality-in-Variance Test. Applied Economics, 47(46), 4996-5011.

Nelson, D. B. (1991). Conditional heteroscedasticity in asset returns: A new approach. Econometrica: Journal of the Econometric Society, 347–370.

Ng, Angela (2000). Volatility spillover effects from Japan and the US to the Pacific–Basin. Journal of International Money and Finance, 19, 207-233.

Rachdi, A. (2008). Trade Complementarities and Prospects of Trade among the Member States of the Organisation of the Islamic Conference (OIC). Paper Presented at the World Islamic Economic Forum, Kuala Lumpur.

Rahim, Fahmi Abdul; Ahmad, Noryati and Ahmad, Ismail (2009). Information transmission between Islamic stock indices in South East Asia. International Journal of Islamic and Middle Eastern Finance and Management, 2(1), 7-19.

Raimi, L. and Mobolaji, H. I. (2008). Imperative of Economic Integration among Muslim Countries: Lessons from European Globalisation. Humanomics, 24(2), 130-144.

Saadaoui, Amir and Boujelbene, Younes (2015). Volatility Transmission between Dow Jones Stock Index and Emerging Islamic Stock Index: Case of Subprime Financial Crises. Emerging Markets Journal, 5(1), 40-49.

Sansó Andreu; Aragó Vicent and Carrıon S. Josep Lluis, (2004). Testing for Changes in the Unconditional Variance of Financial Time Series, Revista de Economía Financiera, 1-24.

Singh, Priyanka; Kumar, Brajesh and Pandey Ajay (2010). Price and volatility spillovers across North American, European and Asian stock markets. International Review of Financial Analysis, 19, 55-64.

Sun P.Hun; Hassan, M.Kabir; Hassan, Taufiq and Ramadili, S.Mohamed (2014). The Assets and Liabilities Gap Management of Conventional and Islamic Banks in the Organization of Islamic Cooperation (OIC) Countries. Applied Financial Economics, 24(5), 333-346.

Toraman, Cengiz, Ata, H. Ali and Buğan, M.Fatih (2015). A Study on Customer Perception towards the Islamic Banking Operations. Gaziantep University Journal of Social Sciences, 14(4), 761-779.

Worthington, Andrew and Higgs, Helen (2004). Random walks and market efficiency in European equity markets. Global Journal of Finance and Economics, 1(1), 59-78. http://www.oic-oci.org/oicv3/home/?lan=en