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Testing the Conditional Correlations and Volatility Spillovers between US and ASEAN Islamic Stock Markets: A Multivariate GARCH Analysis

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Abstract: This study examines the conditional correlations and volatility spillovers between the US and ASEAN Islamic stock markets. The empirical design uses MSCI (Morgan Stanley Capital International) Islamic indexes as it adopted stringent restrictions to include companies in the sharia list. By using three multivariate GARCH models (BEKK, diagonal VECH, and CCC model), we find evidence of returns and volatility spillovers from the US to the ASEAN Islamic stock markets. However, as the estimated time-varying conditional correlations and volatilities indicate there is still room for diversification benefits, particularly in the single markets. The Islamic MSCI of Thailand, Indonesia, and Singapore are less correlated to the US MSCI Islamic index. The implication is that foreign investors may benefit from the reduction of risk by adding Islamic stocks in those countries.

Keywords: *Islamic Stock Markets, Conditional Correlations, Volatility Spillovers, Multivariate GARCH, BEKK, and ASEAN.*

JEL Classification: *G1, G11, C58, F15, and F21.*

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Introduction

The trends in Islamic equity funds over the decade show a positive pattern. The Islamic stock market via Islamic equity funds has come to the fore to foster growth in the Islamic finance industry. The international Islamic equity funds recorded 1,065 funds with US$56 billion of total Islamic assets in the year 2013 which most of them are concentrated in the Gulf-Cooperation Council (GCC) and Southeast Asian markets/ASEAN (Thomson Reuters Report, 2013). Attracting institutional and individual investors from cross-border countries has come to pivotal issues for Islamic stock markets. In doing so, the Islamic stock products should meet the risk appetite and the investment criteria of investors, such as the conditional correlations of and diversification benefits of the Islamic stock markets.

The potential benefits of cross-countries diversification are characterized by the low correlation among the stock's returns (Levy & Sarnat, 1970). But yet, the current studies reveal that there is an increasing pattern of international linkages of the stocks in the global market over the past decade (Goldstein & Michael, 1993). Masih and Masih (1997) argue that when the stocks in international markets are less than perfectly correlated with the local market, there is room to take benefits from portfolio diversification. Therefore, it advocates the investors to diversify their stocks in cross-countries universe. In reverse, when the stock markets are highly correlated, it means that there are no

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room to take benefits from portfolio diversification since the returns of the stocks are highly correlated to each other.

The salient sharia injunctions that are strictly observed in Islamic investment practices include the prohibition of all prohibited activities involving the practices of *riba* (interest), *gharar* (excessive uncertainty), and *maysir* (gambling) which are deemed unethical or not permissible according to the sharia teachings. The Islamic stocks, moreover, must be structured according to the sharia with follow specific underlying contracts. In doing so, the Islamic stocks must fulfill certain criteria, such as ethical and ratio screenings, the threshold of the interest-based income, and excessive leverage. Due to these unique features, therefore, Islamic stocks should enjoy a better position of diversification benefits (Saiti et al., 2014). Moreover, the Islamic index is believed to be more resilient as compared to the conventional counterpart (Sukamana & Kolid, 2012). The current studies have emphasized the integration and portfolio diversification of Islamic stocks in international markets. However, the results of empirical studies on Islamic stock markets are still inconclusive. The issue of the correlation and diversification of Islamic stocks are remains contentious to be investigated. The assessment of the time-varying correlations and volatilities of Islamic stock markets over time is pivotal to the investors as they need to contemplate strategies to capitalize on market expansion and find lucrative opportunities to develop the Islamic fund's universe.

The objective of this paper is to examine the conditional correlations and volatility spillovers between the US and ASEAN Islamic MSCI indexes. The sample of five ASEAN countries (Indonesia, Malaysia, Singapore, Thailand, and Philippines) using Islamic MSCI indexes. The feature of this index adopted more stringent restrictions to include companies in the sharia-compliant investment universe. The restriction, therefore, is imposed on interest-based income and excessive leverage investments. In that sense, perhaps the screens process of the MSCI Islamic index can meet the salient sharia injunctions in Islamic investment practices. The study explores the extent to which the Islamic stocks correlate in short-run and long-run horizons, and investigates the degree to which the volatility spillovers are significant and transmitted across the pairs of Islamic stocks. Being so, the study of volatility spillovers attracts high attention from academia as it is imperative from the perspective of diversification benefits and hedging strategies.

The empirical study is constructed using three multivariate GARCH models, namely BEKK-MGARCH, diagonal VECH, and CCC model. The multivariate GARCH model is widely believed to be very useful in studying volatility spillovers in equity markets (see Hamao et al., 1990; Lin et al., 1994; and Karolyi & Stulz, 1996). In this study, the BEKK model is used as the benchmark. Our findings suggest that the volatility spillovers are persistent from the US to the ASEAN Islamic stock markets. Nevertheless, the conditional correlations in pair countries, such as Thailand, Indonesia, and Singapore, are less correlated to the US Islamic index. Therefore, there is a benefit from portfolio diversification in order to minimize the risk to invest in these markets.

After this brief introduction, the paper discusses relevant literature related to Islamic investment and volatility spillovers. Section 3 elaborates on the methodology used for the analysis and is followed by Section 4 which reports the findings. Finally, Section 5 concludes the paper and highlights the implications of the findings.

Literature Review

Islamic Investment

The feature of Islamic investment, which is also in harmony with all of the sub-sector of Islamic finance, lies in the ethical principles embodied in the *maqasid shari'ah*, where its ultimate objective is generally aimed at realizing overall human well-being and social justice. In order to be considered permissible stocks for investment, the operation of companies listed in the stock exchange must not contravene sharia principles. Among the salient sharia injunctions strictly observed including the prohibition of all activities and transactions involving the elements of *riba'* (interest), *gharar* (excessive uncertainty), *maysir* (gambling), and all other types of activities and transactions which are considered unethical or unlawful as prescribed by the sharia (Usmani, 1998). In that sense, such prohibitions necessarily remove companies with main activities deemed as non-sharia sectors like

conventional banking and insurance, gambling, alcohol, non-*halal* meat, tobacco, entertainment and other business activities considered unlawful from the sharia-approved investable universe.

For companies with mixed activities, the screening methodology investigates the main activities of the business and potential sources of non-*halal* income from its operation. If the main business activity of the company is permissible and the percentage of income from non-permissible sources is below the threshold, thus, the shares of the company are considered as sharia-compliant for investment. The five percent tolerance threshold for impure sources of income is the international norm adopted by global indices such as Dow Jones Islamic Market Index (DJIMI) and FTSE Global Islamic Index (Derigs & Marzban, 2008; Rahman, et al., 2010). Notwithstanding, a process of cleansing or purification to remove the portion of the impure income need to be done, usually through transmitting of this portion from the dividends of the companies to charitable organizations (Yaquby, 2000; Usmani, 1998). Table 1 exhibits the screening norms of Islamic investment.

Table 1. Screening Norms of Islamic Investment

Screens	*Shari'ah* Issues	Industry Norms
Sector: Main business activities	Business activities and transactions involving *riba', gharar, maysir,* excessive speculation, and other activities or transactions repugnant to the *shari'ah* are strictly prohibited.	All securities with unlawful core business activities are excluded from the list of permissible securities; conventional financial services and products, insurance, gambling, liquor, production/distribution of non-*halal* meat, hotels, entertainment services unacceptable in *Shari'ah*, tobacco, and some include weapon and genetic biotechnology.
Sector: Mixed business activities	Lawful core business activities but mixed with some impermissible activities; - Discussions have been contentious among the *shari'ah* scholars on the issue. - Many have accepted its permissibility (with relevant parameters) based on legal juristic opinion and the present circumstances of the market and the industry.	A tolerable threshold of mixed-income from impermissible activities was adopted to limit exposure to such elements; e.g. total impure income must not exceed 5% of the total revenue.
Financial: Interest ratio	Receiving interest income is unlawful, even if such income is not generated from its main business activity.	Interest income must be very negligible; - Both the combined unlawful income from mixed activities and interest income must not exceed 5% of total revenue. - Alternatively, a ratio of liquid assets (e.g. cash receivables and short-term investment) that can generate interest income over total assets/market capitalization is also used, e.g. must not exceed 33%.
Financial: Liquidity ratio	Concerns with the presence of substantial elements of liquid assets, e.g. account receivables, cash or cash equivalent, and short-term investment of the company; - The prohibition of the sale of debt to a third party. - Money can only be exchanged at par value. - Real assets must constitute a substantial component of the total assets.	The accepted level of liquid assets to total assets/market capitalization of a company varies between institutions and index providers; ranges from 33% to 80%.
Financial: Debt ratio	Payment of interest is also unlawful; financing business activities using interest-based transactions is problematic; any involvement in such financing activities must be kept minimal.	The sum of the total debt of a company must not represent more than 33% of the total asset/market capitalization.

Source: Adopted from Usmani (1998), Yaquby (2000), and Derigs and Marzban (2008).

At a first glance, the current Islamic stock products serve the same features as conventional stock products. Nevertheless, Islamic stocks should comply with the sharia principles and must be structured according to sharia, whereby the features of products must be structured with the underlying concepts or contracts. To be compliance, therefore, the issuance of these Islamic sock products should fulfill the Islamic contract on *musharakah*. This means, the stockholders are eligible for any capital gain or profit, which lies in the form of dividends. It is acceptable, as being shareholder to benefit from the capital gain (as well as a loss) of the company. As the distribution of dividends should be done in the concept of *musharakah*, therefore, there is no issue of *riba* for dividend payment (Securities Commission, 2009). However, investors should not invest in stocks where business activities are forbidden according to sharia rules.

Nowadays, Islamic stocks are flourished across the markets. The market for Islamic equity funds has evolved substantially over the past decade. The Islamic funds topped 1,000 funds with US$56 billion of total Islamic asses in the year 2013, which most of them are concentrated in the Gulf-Cooperation Council (GCC) and Malaysia (Thomson Reuters, 2013). Being so, the different jurisdictions of the Islamic equity benchmark have been launched as a consequence of the rapid growth of Islamic equity markets. The most prominent ones include Dow Jones Islamic Market Index, FTSE Global Islamic Index Series, and MSCI (Morgan Stanley Capital International) Islamic index. As the study is designed to focus on the MSCI Islamic index, therefore, we will deal with MSCI index screenings.

To be considered as sharia-compliant investment, the MSCI uses two criteria: business activity and financial ratios. According to business activity screening, the companies are excluded from the Islamic securities index if they are directly active in prohibited activities: alcohol, tobacco, pork-related products, conventional financial services, defense/weapons, gambling/casino, hotels, cinema, and adult entertainment (MSCI Report, 2014). Upon completion of the first screen related to the business activity, the second filter uses financial ratios. The companies will be excluded from the sharia list if they are deriving excessive interest income or they have excessive leverage portion. In this regard, the MSCI employs three financial ratio's screening, namely total debt to total assets, interest income to total assets, and accounts receivables and cash to total assets. Across these three ratios, the companies should not exceed 33.33% threshold. If so, the companies will be deleted from the sharia list. Ultimately, the companies are deemed as a non-sharia compliant investments.

Empirical Studies on Volatility Spillovers

The study of conditional correlations and volatilities is embedded in the universe of modern portfolio theories, for instance, the capital asset pricing model (CAPM) and the modern portfolio theory (MPT). The theories rule that investors should well-diversified their portfolios to reduce the level of risks. The MPT, similarly, encouraged the investors should diversify their investment across cross-countries, as far as the returns to stocks in other countries are less than perfectly correlated with the domestic market. Likewise, the correlation also can explain the observed risk patterns among the stock markets. To deal with this fact, the literature on volatility spillovers have been flourished in recent decades for both developed and emerging markets.

In earlier studies, Hamao et al. (1990) show volatility spillovers are persistent from the US to Japan market. Similarly, Lin et al. (1994), by using the GARCH model, find that there is a cointegration between the US and Japanese markets. The return of the domestic market is substantially affected by the foreign market. Karolyi and Stulz (1996) find that the persistence of co-movement of the US and Japanese markets, and the coefficient correlations are significantly influenced by the large shocks to broad-based market. Meric and Meric (1997) investigate the impact of the 1987 market crash on the global equity markets and find that there is an increasing pattern of co-movements of equity markets after the 1987 crash, being so the diversification benefits decreased significantly.

Furthermore, numerous studies have flourished in the academia investigating the volatility spillovers from developed to emerging markets, for instance, Ng (2000), Miyakoshi (2003), Wang and Firth (2004), Dungey et al. (2007), and Beirne et al. (2009). Ng (2000) examines the volatility spillovers between the US and Japanese markets. He stated that the market volatility is driven by

regional and international factors (i.e cultural and religious). Miyakoshi (2003), in much the same way as Ng (2000), examines the volatility spillovers from Japanese and US market to Asian markets and shows that the volatility spillovers is persistence from the Japan and US to Asian markets. Wang and Firth (2004) study the volatility spillovers across Asian emerging markets and US market, find that there is bi-directional volatility transmission from the developed to the emerging markets. Dungey et al. (2007) find the result of volatility spillovers that is transmitted from the developed into emerging markets. Similarly, Beirne et al. (2009) show that emerging countries are affected by the volatility transmitted from the mature market. In a commodity market, Sadorsky (2012) measures the volatility spillovers between oil prices and the clean energy and technology stock prices in the US market. By using dynamic conditional correlation, he finds that the clean energy stocks are highly correlated with the oil prices rather than the technology stocks.

To date, the empirical research to examine the volatility spillovers of Islamic equity markets has increased. Among them including the study of Rahman and Sidek (2011), Majdoub and Mansour (2014), Saiti et al. (2014), and Bahlous and Yusof (2014). Rahman and Sidek (2011) investigated the effect of the US subprime crises on the ASEAN-5 stock markets. It is evidence of the cointegration of stock markets between the US and ASEAN-5 countries, in that there is no room for diversification benefits in ASEAN-5 countries during the financial meltdown. Majdoub and Mansor (2014) examine the volatility spillovers of Islamic equity between the US and emerging markets. They find that there are no volatility spillovers from the US into emerging markets. Even so, the correlation between the two is weakly correlated. More recently, Saiti et al. (2014) examine the conditional correlations from Islamic investment in different regions during the financial crises. From their study, as far as US-based investors are concerned, the Islamic MSCI indexes of Malaysia, Hong Kong, Japan, and GCC countries appear to have a low conditional correlation with the US market. Bahlous and Yusof (2014) examine the diversification benefits of Islamic funds in the Asia Pacific and the Middle East and Northern Africa (MENA) region. The study finds that there is a negative correlation across Islamic funds in those regions, being so the diversification benefit is persistence.

Research Methodology

Data

In this study, we use daily data from September 2007 until November 2014 of five ASEAN Islamic indexes, namely Indonesia, Malaysia, Singapore, Thailand, and Philippines, hand in hand with the US Islamic index. The study covered 15,798 observations. All data were retrieved from the Bloomberg database. The analysis of this study is constructed based on the Morgan Stanley Capital International (MSCI) Islamic index. The MSCI index is expressed in US dollars in that we can get a homogenous series of dataset. The index series, following sharia investment principles, has been declared permissible by the MSCI sharia advisors committee. In order to be compatible with sharia principles, the screening criteria adopted by MSCI includes the business activity and financial ratios. The MSCI Islamic indexes, in short, are designed to measure the performance of all segments across markets that are in harmony with Islamic principles. Table 2 shows the Islamic MSCI indexes used in this study.

Table 2. Stock Markets and Indexes

Stock Market	Benchmark
Indonesia	Indonesia MSCI Islamic Index
Malaysia	Malaysia MSCI Islamic Index
Singapore	Singapore MSCI Islamic Index
Thailand	Thailand MSCI Islamic Index
Philippines	Philippines MSCI Islamic Index
USA	USA MSCI Islamic Index

Model Specification

The BEKK Model

The multivariate GARCH models are widely used to capture the dynamic relationship between the indexes and to see how the covariances move over time (for example Sadorsky, 2012; Cha & Jithendranathan, 2009; Brooks et al., 2002). Some different applications of multivariate GARCH models have been introduced in the literature, including the BEKK model. To capture the conditional mean estimation and the values of the conditional variances and covariances over time, hence, we propose the BEKK model. The BEKK model, which is developed by Engle and Kroner (1995), provides conditional covariance matrices that are always positively definite. The BEKK (1,1) model is represented in the equation below.

$$GARCH = M + A1 * RESID(-1) * RESID(-1)' * A1 + B1 * GARCH(-1) * B1 \quad (1)$$

where A and B are 2 x 2 matrices of parameters and M is an upper triangular matrix of constant. The parameters in A and B measure the effect of previous shocks and previous volatility on its conditional volatility, respectively. The parameters of the BEKK model can be generated from the maximum likelihood estimation under the assumption of conditional normality (Brooks, 2008). The maximizing likelihood function is given by:

$$L(\theta) = -\frac{TN}{2}\log 2\pi - \frac{1}{2}\sum_{i=1}^{T}(\log|H_t| + \varepsilon_t H_t^{-1}\varepsilon_t) \quad (2)$$

where T is the number of observations, θ is the unknown parameters to be estimated, and N is the number of series in the system. The maximum-likelihood estimation of θ is asymptotically normal assuming a normal condition of errors.

The Diagonal VECH Model

Bollerslevet al. (1988) introduce a VECH-GARCH model where the conditional variance-covariance presents the pas information of $t - 1$. In that model, the conditional variances-covariances depend on the lagged values of the aggregate conditional variances. The VECH model is given by the equation below.

$$VECH(Ht) = C + A\,VECH(\varepsilon_{t-1}\varepsilon'_{t-1}) + B\,VECH\,(H_{t-1}) \quad (3)$$

However, for the unrestricted VECH model, the estimation result becomes more tedious when the number of assets in the model increases. In that case, Bollerslev et al (1988) assumed that the A and B matrices were diagonal. The diagonal VECH model is characterized by the equation below.

$$h_{i,j,t} = \omega_{ij} + \alpha_{ij}\mu_{i,t-1}\mu_{j,t-1} + \beta_{ij}h_{ij,t-1} \;\; for\; i,j = 1,2 \quad (4)$$

Where the $\omega_{ij}\,\alpha_{ij}\,\beta_{ij}$ are parameters. The diagonal VECH multivariate GARCH model can be expressed as an infinite-order multivariate ARCH model, where the covariance is expressed geometrically.

The Constant Conditional Correlation (CCC) Model

Bollerslev (1990) proposes a set of multivariate GARCH modeling, including the constant conditional correlation (CCC-MGRCH). The CCC model assumes that the conditional variances across the returns are independent and do not accommodate asymmetric behavior. The CCC model is represented in the equation below.

$$h_{it} = \omega_i + \sum_{j=1}^{q}\alpha_{ij}\varepsilon_{i,t-j}^2 + \sum_{j=1}^{q}\beta_{ij}\varepsilon_{i,t-j}^2, i = 1,\dots,k \quad (5)$$

where α_{ij} is the ARCH effects or short-run persistence of shocks to return j, and β_{ij} is the GARCH effects or long-run persistence of shocks to return i.

Findings and Discussion

Descriptive Statistics

We embark on the analysis by providing the descriptive statistics of the samples. Table 3 presents the descriptive statistics of the ASEAN and US Islamic daily index returns, respectively. The table shows the results of the mean, standard deviation, minimum, maximum, and median. Across all markets, the assessment of the sample data for Islamic MSCI index returns indicates that the mean and the median for each index are varies. In most cases, the average returns of Islamic MSCI indexes (Malaysia, Singapore, Thailand, and Philippines) are positive, except for Indonesia and USA markets are negative. According to the table, the Philippines has the highest spread swinging between -1.39 and 1.47. Indonesia is ranked second position with the spread ranging between -1.30 and 1.26. Being so, the Philippines market is more volatile as compared to other markets, indicating it has the highest yield spread.

Furthermore, according to the standard deviation, the yield volatility of the Philippines market is the highest. Its standard deviation of 0.5233 is consistent with the highest yield of 0.0001786 than other markets. The Indonesian market, followed in second place, has a standard deviation of 0.3826 which is still highly volatile in the ASEAN market. The high market volatility, to a certain extent, drives the short-term capital inflow to the country (Majdoub & Mansour, 2014).

Table 3. Descriptive Statistics for Islamic MSCI Indexes Returns

Stock Market	Mean	Std.Dev	Min	Max	Median
Indonesia	-0.0000674	0.3826602	-1.300174	1.269826	-0.0053099
Malaysia	0.0001006	0.2782053	-0.9073337	0.799264	-0.0041159
Singapore	0.0000561	0.2525058	-0.8832011	0.771592	0.003283
Thailand	0.0001571	0.3159042	-0.9725659	1.017507	0.0014463
Philippines	0.0001786	0.523362	-1.396179	1.479416	0.0007653
USA	-0.00014979	0.3032245	-0.9251827	0.9243282	-0.002849

Table 4 gives the correlation matrix across the ASEAN and US markets. From the table, as far as the Islamic stock indices are concerned, the US market has a high correlation with Malaysia (0.49), followed by Indonesia (0.45), Philippines (0.44), Singapore (0.42), and Thailand (0.38), respectively. The correlations between the US and ASEAN Islamic indexes, at a glance, are positively correlated and more or less has a similar degree to each other. The Islamic indexes between the US and ASEAN markets are moving in tandem, as the value of the US Islamic stock market increases, so do the ASEAN Islamic stock indexes.

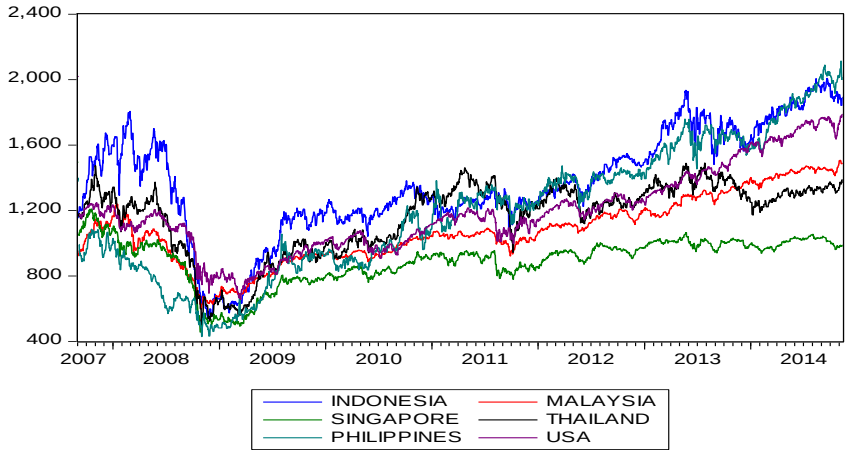
Table 4. Correlation Matrix of Islamic MSCI Indexes Return

	Indonesia	Malaysia	Philippines	Singapore	Thailand	USA
Indonesia	1	0.47489	0.424013	0.462473	0.436941	0.452006
Malaysia	0.47489	1	0.472626	0.433211	0.417669	0.492392
Philippines	0.424013	0.472626	1	0.381463	0.400341	0.449273
Singapore	0.462473	0.433211	0.381463	1	0.470602	0.421865
Thailand	0.436941	0.417669	0.400341	0.470602	1	0.387943
USA	0.452006	0.492392	0.449273	0.421865	0.387943	1

Figure 1 depicts the daily series of Islamic price indexes, in Panel A, and the daily index returns, in Panel B, between the US and ASEAN Islamic indexes over the sample period spanning from 2007 to 2014. From panel A, albeit the indexes move in tandem over time, it appears that the Islamic indexes series cross each other. In fact, the Indonesia Islamic index crosses simultaneously the Thailand and

Philippines indexes. Likewise, the Malaysia Islamic index crosses the Singapore, Philippines, and Thailand series. The crosses between the indexes indicate that there is still a negative correlation among the markets, as the indexes move in opposite directions. Panel B presents the pattern of the Islamic index returns in log differences between the US and ASEAN markets. At a first glance, it seems that the Islamic indexes have similar patterns of time-varying returns.

Panel A



Panel B

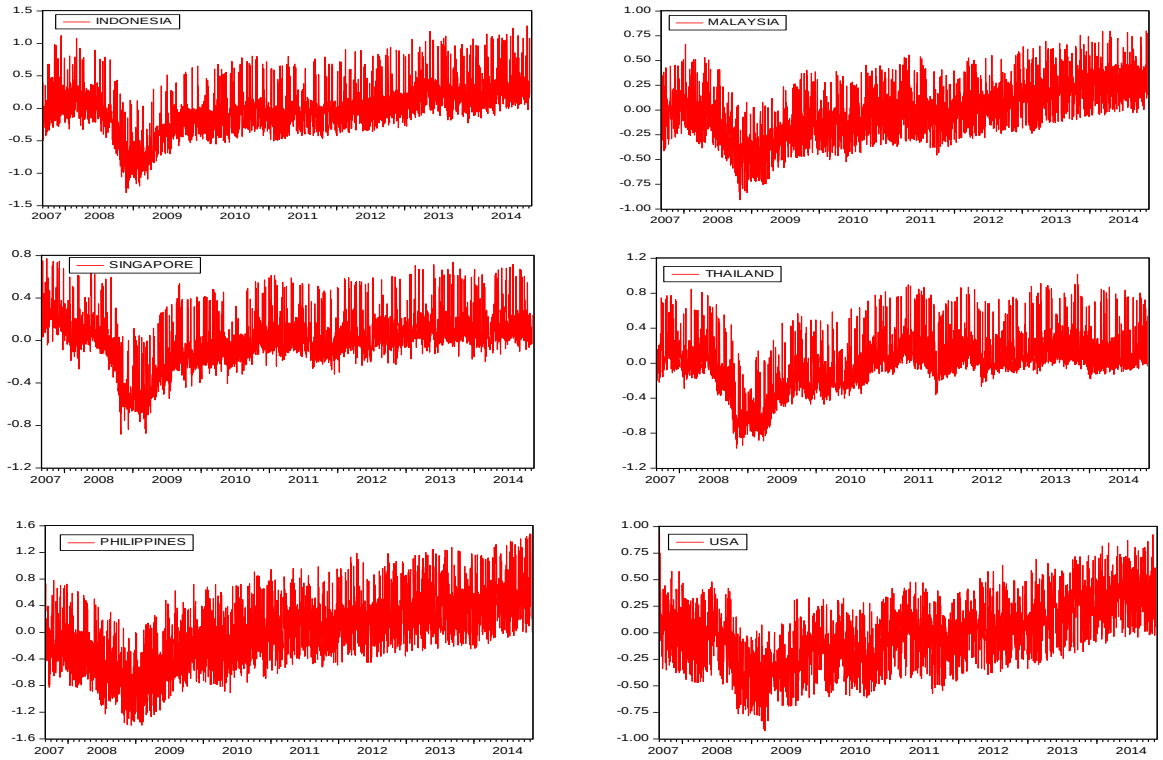


Figure 1. Daily Series of US and ASEAN Islamic MSCI Indexes – Prices and Returns

Figure 2 shows the country pairs daily moving correlations of returns. This figure is corroborated the result of the correlation matrix of Islamic MSCI Indexes returns as indicated in Table 4. The Malaysia-USA holds the highest correlation with almost equal to 0.5 as the both indexes are highly tied up over period. Others markets, likewise, also swings in tandem with the US market, for instance the pair of Indonesia-USA and Singapore-USA with correlation of 0.45 and 0.42, respectively.

However, to certain extent, the pair of Thailand-USA exhibits the lowest correlation among ASEAN countries with correlation of 0.38.

Even so, this simple descriptive result cannot provide us the degree of volatilities and correlations between Islamic indexes returns change over time including their directions and size, particularly during financial turmoil. Beirne et al. (2009) find that the conditional correlations between emerging and developed markets tend to increase in crises period. However, the unique features of Islamic indices, perhaps, can play a role in lowering the correlation coefficients, specifically during turmoil period. Being so, to understand the conditional correlations across the US and ASEAN Islamic stock indexes and the benefits of these, thus, we performed the multivariate GARCH approaches.

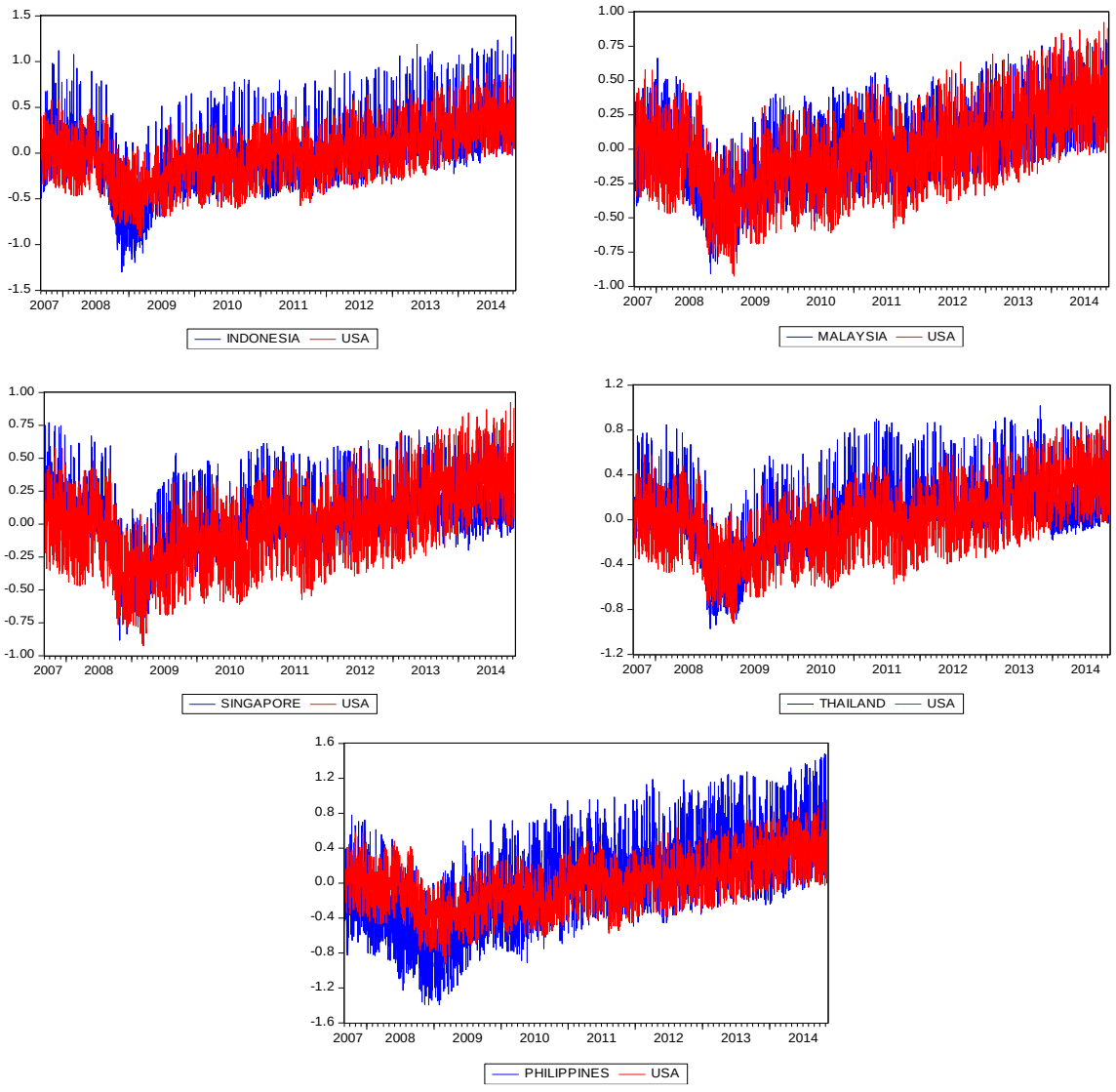


Figure 2. Country Pairs Daily Moving Correlation Coefficients

Volatility Spillovers

In this part, we test the time-varying conditional variance-covariances using the different sets of multivariate GARCH (1,1) models, including BEKK, Diagonal, and CCC models. The BEKK model is used as the benchmark and compared to the diagonal and constant conditional correlation model (CCC). The most beneficial of the BEKK model is that it can portray the causality relation for both variance and covariance. The presence of a causality relation between variance and covariance, in turn, indicates that the 2 x 2 matrices of A and B parameters are statistically significant. In our

analysis, we denote the countries of USA, Indonesia, Malaysia, Singapore, Thailand, and Philippines, by 1, 2, 3, 4, 5, and 6, respectively. Table 5 shows the estimation result of multivariate GARCH models.

The results of the BEKK model show that, in most cases, the pairs are statistically significant. The element of matrix A represents the short-term persistence (ARCH effects) in explaining conditional volatility. Across the coefficient of $A_{i,j}$, the values are low but statistically significant. For instance, the coefficient of A(1,2) is 0.0169 and is statistically significant at 1% alpha level. Similarly, the low value of the $A_{i,j}$ term is consistent across the ASEAN market. Thus, it is evidence of short-term persistent volatility spillovers between the US and ASEAN Islamic indexes.

Similarly, the estimated coefficients which measure long-term persistence (GARCH effects), the $B_{i,j}$ coefficient, are statistically significant and remarkably similar across the markets. The $B_{i,j}$, to a certain extent, is important in explaining the conditional variance of the stock markets. For instance, the coefficient of B(1,2) is equal to 0.97 and is statistically significant at 1% alpha. It shows that the past conditional volatility of the US market spillovers to the Indonesian market. In fact, there is a long-run persistence of volatility spillovers between the US and ASEAN Islamic stock markets. Across the markets, the estimated coefficients of B are remarkably high, such as in Malaysia, Singapore, Thailand, and the Philippines, with a coefficient of 0.97. Even so, for each ASEAN market, the estimated $A_{i,j}$ values are lower than the $B_{i,j}$ values, suggesting that the long-run volatility persistence (GARCH effects) is substantially larger than the short-run volatility persistence (ARCH effects). The results are consistent across the markets. Our results are different with previous studies, for example, Majdoub and Mansour (2014) show that the past conditional volatility does not spillovers from the US to the Malaysian market. Our findings also do not support Saiti et al. (2014) that shows the Malaysia Islamic MSCI index has the lowest volatility with the US market.

Looking across the full suite of multivariate GARCH models, the results are consistent across different models. For instance, the diagonal shows evidence of short-run persistence volatility spillovers from the US to ASEAN markets and is statistically significant. The estimated coefficient of M(1,2) is positive and statistically significant. Even so, the diagonal model also presents the existence of long-run volatility spillovers from the US to ASEAN markets. Similarly, for the CCC model, the coefficient of A(1,2), A(1,3), A(1,4), A(1.5), and A(1,6) are positive and statistically significant at 1% alpha. It is evidence of short-run volatility spillovers. Likewise, there is a long-run volatility spillover from the US to ASEAN markets as indicated by the positive values of B(1,2).

As expected, the results of the diagonal and the CCC models corroborate the multivariate GARCH BEKK (1,1) model. The conditional correlations between US and ASEAN counties are somewhat high, indicating that the US market has the ability to transmit the shocks and volatility spillovers to ASEAN Islamic markets. Apparently, as far as ASEAN Islamic stock indexes are concerned, they do not provide much diversification benefits to US-based investors. Click and Plummer (2005) examine the Asian crisis 1997 and the stock market integration in the ASEAN-5 countries. It is evidence of the cointegration among ASEAN-5 counties. In summary, across all M-GARCH models, it shows evidence of volatility spillovers from the US to ASEAN Islamic stock indexes.

The Estimated Conditional Correlations and Volatilities for US and ASEAN Islamic Stock Indexes

Figure 3 shows time-varying conditional correlations and volatilities for both US and ASEAN Islamic stock indexes. Panel A in Figure 3 presents the conditional correlations between US and ASEAN countries. Panel B in Figure 3 reports the conditional volatilities across the markets, from September 2007 until November 2014.

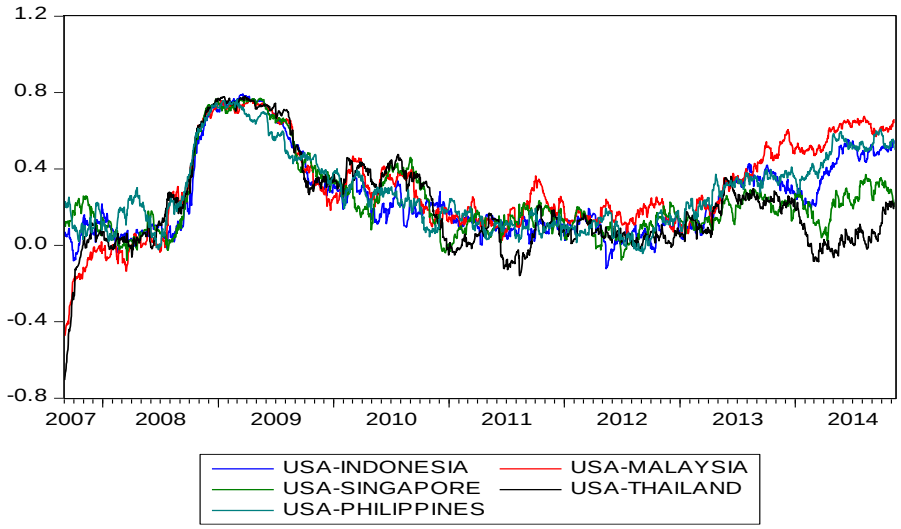
Panel A in Figure 3 shows the conditional correlations between US and ASEAN markets. At a glance, it seems that there is a high correlation between the US and ASEAN markets. The high correlation between the US and ASEAN Islamic stock indexes, to a certain extent, may create a dilemma for investors. In detail, we notice that the US Islamic index has a relatively high correlation with the Malaysia and Philippines Islamic indexes. This evidence also confirms our previous results which were exhibited earlier. Nevertheless, there is still room for diversification benefits, especially in a single market.

Table 5. Estimation Result of Multivariate GARCH Models

BEKK								Diagonal				CCC			
Variable	Coefficient	T-statistic	Prob.	Variable	Coefficient	T-statistic	Prob.	Variable	Coefficient	T-statistic	Prob.	Variable	Coefficient	T-statistic	Prob.
Mean								*Mean*				*Mean*			
Mean(1)	0.0200	2.7972	0.0052					Mean(1)	0.0195	2.7458	0.0060	Mean(1)	0.0002	0.0386	0.9692
Mean(2)	0.0460	5.0089	0.0000					Mean(2)	0.0449	5.0376	0.0000	Mean(2)	0.0228	2.8017	0.0051
Mean(3)	0.0316	4.8199	0.0000					Mean(3)	0.0317	4.9050	0.0000	Mean(3)	0.0096	1.6806	0.0928
Mean(4)	0.0554	8.5854	0.0000					Mean(4)	0.0558	8.7288	0.0000	Mean(4)	0.0287	5.2041	0.0000
Mean(5)	0.0892	10.4397	0.0000					Mean(5)	0.0888	10.5479	0.0000	Mean(5)	0.0392	5.1984	0.0000
Mean(6)	0.0692	5.5074	0.0000					Mean(6)	0.0695	5.5829	0.0000	Mean(6)	0.0269	2.3898	0.0169
Variance				*Variance*				*Variance*				*Variance*			
M(1,1)	0.0006	3.1816	0.0015	A1(3,4)	0.0173	8.7478	0.0000	M(1,1)	0.0005	3.7651	0.0002	M(1)	0.0015	2.0029	0.0452
M(1,2)	0.0001	1.7456	0.0809	A1(3,5)	0.0181	8.8638	0.0000	M(1,2)	0.0001	2.2364	0.0253	A1(1)	0.0116	2.1519	0.0314
M(1,3)	0.0001	2.5885	0.0096	A1(3,6)	0.0151	6.8772	0.0000	M(1,3)	0.0001	2.9006	0.0037	B1(1)	0.9707	70.0550	0.0000
M(1,4)	0.0001	2.0153	0.0439	A1(4,4)	0.0177	7.2461	0.0000	M(1,4)	0.0001	2.0637	0.0390	M(2)	0.0035	2.5249	0.0116
M(1,5)	0.0001	2.0415	0.0412	A1(4,5)	0.0188	9.7487	0.0000	M(1,5)	0.0001	2.4845	0.0130	A1(2)	0.0163	3.0814	0.0021
M(1,6)	0.0002	2.2886	0.0221	A1(4,6)	0.0158	7.7118	0.0000	M(1,6)	0.0002	2.5586	0.0105	B1(2)	0.9553	60.7774	0.0000
M(2,2)	0.0016	4.5339	0.0000	A1(5,5)	0.0178	7.2213	0.0000	M(2,2)	0.0013	5.4111	0.0000	M(3)	0.0020	1.6826	0.0925
M(2,3)	0.0001	2.4627	0.0138	A1(5,6)	0.0170	7.3660	0.0000	M(2,3)	0.0001	2.8317	0.0046	A1(3)	0.0127	1.8980	0.0577
M(2,4)	0.0001	2.0064	0.0448	A1(6,6)	0.0206	5.0902	0.0000	M(2,4)	0.0001	2.3673	0.0179	B1(3)	0.9583	40.9729	0.0000
M(2,5)	0.0001	1.6974	0.0896	B1(1,1)	0.9751	180.1587	0.0000	M(2,5)	0.0001	2.0259	0.0428	M(4)	0.0009	3.6371	0.0003
M(2,6)	0.0001	1.5786	0.1144	B1(1,2)	0.9731	286.5774	0.0000	M(2,6)	0.0002	1.9318	0.0534	A1(4)	0.0146	4.2735	0.0000
M(3,3)	0.0005	3.4070	0.0007	B1(1,3)	0.9762	286.5517	0.0000	M(3,3)	0.0005	4.2057	0.0000	B1(4)	0.9665	123.4102	0.0000
M(3,4)	0.0001	1.8458	0.0649	B1(1,4)	0.9735	287.5708	0.0000	M(3,4)	0.0001	2.1106	0.0348	M(5)	0.0019	3.4877	0.0005
M(3,5)	0.0001	1.6750	0.0939	B1(1,5)	0.9709	280.0950	0.0000	M(3,5)	0.0001	1.7293	0.0838	A1(5)	0.0159	4.1863	0.0000
M(3,6)	0.0001	2.1853	0.0289	B1(1,6)	0.9767	272.5180	0.0000	M(3,6)	0.0002	2.7061	0.0068	B1(5)	0.9608	99.8925	0.0000
M(4,4)	0.0005	4.4402	0.0000	B1(2,2)	0.9649	170.1067	0.0000	M(4,4)	0.0005	5.4512	0.0000	M(6)	0.0112	2.4353	0.0149
M(4,5)	0.0001	2.2769	0.0228	B1(2,3)	0.9732	300.2389	0.0000	M(4,5)	0.0001	2.3063	0.0211	A1(6)	0.0249	2.6668	0.0077
M(4,6)	0.0001	2.2973	0.0216	B1(2,4)	0.9675	286.0616	0.0000	M(4,6)	0.0001	2.3506	0.0187	B1(6)	0.9300	35.5743	0.0000
M(5,5)	0.0009	4.9437	0.0000	B1(2,5)	0.9681	297.5427	0.0000	M(5,5)	0.0010	7.3518	0.0000	R(1,2)	0.3750	19.5803	0.0000
M(5,6)	0.0001	1.9233	0.0544	B1(2,6)	0.9734	318.3390	0.0000	M(5,6)	0.0002	2.2475	0.0246	R(1,3)	0.4316	25.0392	0.0000
M(6,6)	0.0031	4.9875	0.0000	B1(3,3)	0.9751	183.0717	0.0000	M(6,6)	0.0025	6.2400	0.0000	R(1,4)	0.3489	18.2673	0.0000
A1(1,1)	0.0162	4.8140	0.0000	B1(3,4)	0.9716	285.8918	0.0000	A1(1,1)	0.1272	13.4414	0.0000	R(1,5)	0.3112	16.3720	0.0000
A1(1,2)	0.0169	7.6681	0.0000	B1(3,5)	0.9697	283.3616	0.0000	A1(2,2)	0.1383	15.2974	0.0000	R(1,6)	0.3941	21.6665	0.0000
A1(1,3)	0.0153	7.1819	0.0000	B1(3,6)	0.9752	284.4762	0.0000	A1(3,3)	0.1276	14.6313	0.0000	R(2,3)	0.3921	21.1227	0.0000
A1(1,4)	0.0164	7.9235	0.0000	B1(4,4)	0.9706	225.6211	0.0000	A1(4,4)	0.1374	16.2849	0.0000	R(2,4)	0.3280	17.4511	0.0000
A1(1,5)	0.0182	7.9507	0.0000	B1(4,5)	0.9679	282.6731	0.0000	A1(5,5)	0.1382	17.9240	0.0000	R(2,5)	0.3082	16.2072	0.0000
A1(1,6)	0.0144	6.4071	0.0000	B1(4,6)	0.9728	287.9170	0.0000	A1(6,6)	0.1300	15.4077	0.0000	R(2,6)	0.3422	17.7816	0.0000
A1(2,2)	0.0197	6.3935	0.0000	B1(5,5)	0.9698	222.7338	0.0000	B1(1,1)	0.9878	497.8684	0.0000	R(3,4)	0.3368	18.3801	0.0000
A1(2,3)	0.0162	8.2114	0.0000	B1(5,6)	0.9710	257.8361	0.0000	B1(2,2)	0.9838	463.1753	0.0000	R(3,5)	0.3257	17.1758	0.0000
A1(2,4)	0.0194	9.5199	0.0000	B1(6,6)	0.9641	161.2221	0.0000	B1(3,3)	0.9868	500.7840	0.0000	R(3,6)	0.4054	22.0445	0.0000
A1(2,5)	0.0188	9.9775	0.0000					B1(4,4)	0.9840	488.7127	0.0000	R(4,5)	0.3250	17.5025	0.0000
A1(2,6)	0.0156	8.0841	0.0000					B1(5,5)	0.9836	586.7349	0.0000	R(4,6)	0.2924	14.8149	0.0000
A1(3,3)	0.0149	4.8596	0.0000					B1(6,6)	0.9852	558.6142	0.0000	R(5,6)	0.3110	16.1704	0.0000

Across the markets, Thailand, Singapore, and Indonesia are recorded as having a low correlation with the US market. From the year 2010 onwards, Thailand has the lowest correlation with the US market as compared to others markets, followed by Singapore and Indonesia. Even so, Indonesia is still recorded to have the lowest correlation with the US in the year 2012. Similarly, the low correlation also appears in the Singapore market. Being so, as far as the US based-investor is concerned, the Islamic MSCI indexes of Thailand, Singapore, and Indonesia provide better diversification benefits as compared to Malaysia and Philippines.

Panel A. Conditional Correlations



Panel B. Conditional Volatilities

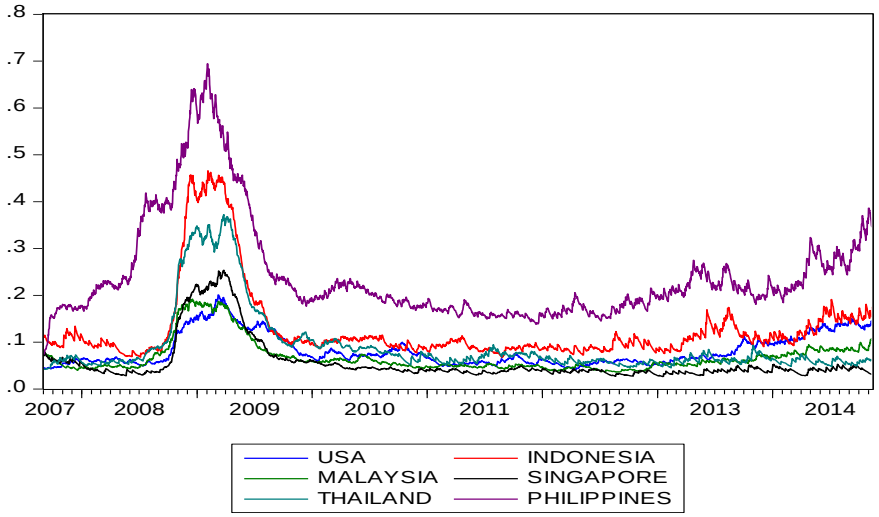


Figure 3. Conditional Correlations and Volatilities of US and ASEAN Islamic MSCI Indexes

From Panel B in Figure 3, the conditional volatilities of the Islamic MSCI indexes return move more closely together over the period. The pattern is in harmony with the previous findings, the Philippines and Malaysia Islamic MSCI indexes appear to have the highest volatility level, while Singapore Islamic MSCI index seems to have the lowest volatility. Specifically, during the financial turmoil of 2008-2009, the Philippines markets recorded the peak level of conditional volatility, followed by Malaysian market. The high volatility during the crises is also consistent with others ASEAN and US markets, respectively. The relatively high volatility in the year 2008-2009, perhaps due to the collapse of Lehman Brothers and subprime-mortgage crises. Our findings are different with

the study of Saiti et al. (2014) which shows the Malaysia Islamic MSCI index has the lowest volatility.

Conclusion

As the amount of Islamic stocks via Islamic equity funds has grown in the decade, it is imperative to have a clear picture of the volatility spillovers of the Islamic stock markets, particularly between the US and ASEAN Islamic markets. This study uses multivariate GARCH models, such as the BEKK model, diagonal VECH, and CCC model, to examine the conditional correlations and volatility spillovers between the US and the ASEAN Islamic MSCI indexes. By selecting the BEKK-GARCH model as the benchmark, the empirical results show that the volatility spillovers are persistent between the US and ASEAN Islamic MSCI indexes.

Nevertheless, albeit there is a transmission of shocks from the US to the ASEAN markets, there is still room for diversification benefits to international investors, particularly in the single markets. The Islamic MSCI of Thailand, Indonesia, and Singapore are less correlated to the US MSCI Islamic index. The implication is that foreign investors may benefit from the reduction of risk in their portfolios by adding Islamic stocks in those countries. However, we also notice that the US Islamic index has a relatively high correlation with the Malaysia and Philippines Islamic indexes. Our results, to a certain extent, are pivotal to the investors as they need to contemplate strategies to capitalize on market expansion and find lucrative opportunities to develop the Islamic funds' universe, as far as Islamic stock markets are concerned.

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