Relationship between regional Shariah stock markets: The cointegration and causality

Yildirim, Ramazan and Masih, Mansur

INCEIF, Malaysia

15 December 2013

Relationship between regional Shariah stock markets: The cointegration and causality

Ramazan Yildirim[1*]; A. Mansur M. Masih[2]

[1] Research Student, INCEIF, Lorong Universiti A, 59100, Kuala Lumpur Malaysia
[2] Professor, INCEIF, Lorong Universiti A, 59100, Kuala Lumpur Malaysia
[*]Corresponding Author: ramjumyas@gmail.com

ABSTRACT

This paper investigates the relative importance of the global and regional markets affecting Asian financial market, the cross-market transmission mechanism between the stock markets, and the Asian market responses to the global financial crises in 2008. It's objective is to answer whether there is a cointegration among the selected 5 regional stock markets – Asia, USA, Europe, BRIC and Arabian; especially their Shariah Indices. In case a cointegration exist, which of the 5 financial markets are the most leader (exogenous) or most follower (endogenous) and whether specifically the Asian market is influenced by this cointegration. Lastly this paper will try to emphasize the implications to the Asian Islamic investors. (e.g. Portfolio Management, Strategic Investment Management). This paper applies the eight steps of time series techniques based on the 5 years daily data, from 04/2008 to 09/2013. Time series econometrics has been selected, since is better than regression approach, because it tested long term theoretical relationship between the variables rather than making any early assumption of such relationship. Empirical results show a long-term equilibrium relationship (co-integration) between the selected 5 Shariah indices. It shows also that the US-, European and the BRIC Sharia Indices are the leading markets compared to the Asian and Arabian Shariah Indices. The causality test show, that especially the Asian Sharia Index is strongly impacted by the other indices and less impacted by the Arabian Shariah Index.

Keywords: Spillover, Asian financial market, Shariah Indices, Financial crisis

1 Introduction: The Issue Motivating This Article

The economic integration of international stock markets has become especially relevant over the last two decades. The substantial development of technology and the increased flow of capital between countries are the main factors for this globalization process. Thus, understanding the linkages between different financial markets is of great importance for portfolio managers and financial institutions. Volatility, as measured by the standard deviation or variance of returns, is often used as a crude measure of the total risk of financial assets (Brooks, 2002), so when referring to international equity markets integration, researchers not only investigate the return causality linkages, but they also measure volatility spillover effects. Information about volatility spillover effects is very useful for the application of value at risk and hedging strategies.

Recently, with the role of the emerging markets becoming more important, economists not only focus on developed countries, e.g. United States, the United Kingdom and Japan, but they also pay great attention to the emerging markets. For example, in the equity markets, the extent of the linkages of the emerging stock market exchanges with developed stock market exchanges has important implications for both the developing and the developed countries' investors. If the emerging market stock exchange is only weakly integrated with the developed market, this means that external shocks will have less influence on the emerging markets, and then the developed market investors can benefit through including the emerging market stocks in their portfolio as this diversification should reduce risk. On the contrary, if the emerging stock markets are fully integrated with the developed stock markets, the volatility in the emerging markets will decrease as it will be mainly determined by the developed markets' volatilities, and the domestic emerging investors will benefit from a low cost of capital (Li, 2007).

This topic is worth studying because it will focus only on the Sharia Indices of the selected regional financial markets. In order to see the contagion/spillover effect especially after the Asian crises in 2008 in the selected regional financial markets, we have tested the long run theoretical relationship by using time series econometrics. Time series econometrics is better than regression because it tested long term theoretical relationship between the variables rather than making any early assumption of such relationship. It also identifies the exogenous and endogenous variables which will be beneficial for financial decision makers and especially for the Islamic investors. Chapter 2 states the research objectives and the

discussion of the existing literature leading to the major objective of the study are highlighted in Chapter 3. It is followed by the theoretical framework and the very recent methodology used in chapter 4 and 5, respectively. Data, empirical results and discussions are dealt with in chapter 6. Finally, this paper ends with the conclusions and the implications of the study in chapter 7.

2 Literature Review

Acknowledging the rapid growth of Islamic financial industries during the last three decades, researchers have started shifting their focus to the integration of both Islamic and conventional stock markets. However, in comparison with the studies on the conventional stock markets, efforts devoted to the Islamic stock markets are still trivial. Hence, it is the opinion of the author that there is no prior research conducted on the unity of global Islamic indices.

In Lucia and Bernadette's (2010) analysis, in regards to the contagion effects in a worldwide framework, shows the evidence that the current global financial crisis has been affecting differently the world economic regions. In general terms, there is no evidence that supports the existence of world market or across regional market contagion effects. Further, they claim that instead of contagion, markets suffered mostly from spillover effects, originating from the US economy and that were transmitted and propagated by some key countries in to the different regions (Singapore in Asia, UK in Europe). According to Rizvi and Arshad (2013) the ripples of the financial crisis are still being felt over different parts of the world causing much distress to the real economy. The capital market, in particular, took a massive hit during the crisis declined to all-time lows. However, in the pace of globalization, a financial shock to the US capital market can cause a spillover effect to other markets, Islamic capital market included.

When discussing volatility of Islamic indices, Charles, Darne and Pop (2010) discovered that during the crisis, both Islamic and conventional indexes were affected to the same degree by variance changes. However, when they tested the indices over other periods, it was found that the variance was not the same, where Islamic indices showed a slightly higher volatility as compared to their financial counterpart. In contrast, Al-Zoubi and Maghyereh (2007) found Islamic indices to be less risky than the benchmark, attributing it to the profit and loss sharing principle in Islamic finance.

While studying the correlation between indices, Rizvi and Arshad (2012) suggest a low moving correlation between the conventional and Islamic indices substantiating that Islamic index may provide a better alternative for hedging against crisis.

Several researches (Kumar and Mukhopadhyay (2002), Wong, Agarwal and Du (2005) support the notion that there is a correlation between the various markets globally. They further emphasis that dramatic movements in one equity market can have a powerful impact on different market. The same applies for Islamic indices, where any volatility in major global markets is very likely to influence Islamic indices Majid, Meera and Omar (2007), Rahman and Sidek (2011), Siskawati (2010). However, Karim, Kassim and Arip (2010), and Yusof and Majid (2007) contradict this, as they failed to find any empirical existence of co-integration among the Islamic indices.

With the abovementioned studies, this paper attempts to contribute to the literature on the Islamic stock market by undertaking a unique study of how the regional Islamic stock markets are co-integrated to each other by employment of the time-series technique.

3 The Objective of the Study

This issue is worth studying because it will test whether the US financial crises in 2008 has a contagion and/or spillover effect to the other major Shariah financial markets. In addition, it is interesting to explore which of the indices are exogenous respectively endogenous variables and to what extend an index-shock in e.g. USA effect the other indices and the time needed to settle back to the equilibrium.

4 Theoretical Framework

The contagion theory identifies at least two possible mechanisms by which shocks in one market may spill over into other markets. First, Kaminsky, Reinhart, and Vegh (2003), and others describe mechanisms in which negative shocks in one market represent the arrival of economic news that directly affects the collateral values or cash flows associated with securities in other markets. In this mechanism, contagion can be viewed as the transmission of information from more-liquid markets or markets with more rapid price discovery to other markets. Second, Allen and Gale (2000) and others show how investors who suffer losses in one market may find their ability to obtain funding impaired, potentially leading to a downward spiral in overall market liquidity and other asset prices via a “flight to quality.” In this mechanism, contagion occurs through a liquidity shock across all markets. Since the

Shariah indices and the theory behind it are quite new on the market compared to the conventional stock indices, limited access to respective information is available in the literature. Also little research has been conducted on the global level in comparison of the contagion/spillover effect from one market into the other.

5 The Methodology Used

Masih and Algahtani and Masih, Al-Sahlawi and De Mello (2010) mentioned about the dilemma of testing non-stationary variables. On the one hand, testing the 'level' form of non-stationary variables will invalidate conventional stationary tests (i.e. R2, t). On the other hand, if the variables were differenced to make it stationary, we will lose long-term information contained in the trend element. Fortunately, the development of time series techniques manages to overcome the above shortcoming inherent in traditional regression.

Basically, there are eight required steps to perform time series econometrics as detailed in Masih, Al-Elg and Madani (2009) and Masih (2012). The first step is to test the stationarity of the data. It is worth to note here that most of the economic and finance variables are non-stationary. Non-stationary series has an infinite variance (it grows over time), shocks are permanent (on the series) and its autocorrelations tend to be unity (Masih, 2012).

The second step is to determine the optimum order (or lags) of the vector autoregressive model. The order given will be used in the third step subject to certain conditions. The third step is testing cointegration. Cointegration implies that the relationship among the variables is not spurious i.e. there is a theoretical relationship among the variables and that they are in equilibrium in the long run (Masih, 2012). However, cointegration is not able to test causality.

The fourth step is Long Run Structural Modeling (LRSM). This test confirms whether a variable is statistically significant and tests the long run coefficients of the variables against theoretically expected values. Vector Error Correction Model (VECM) is the fifth step, and it is used to test Granger causality. The VECM shows the leading and following variables but it is unable to show relative exogeneity and endogeneity.

The sixth step (Variance Decompositions or VDCs) ranked the variables by determining the proportion of the variance explained by its own past shocks whereby the variable that is explained mostly by its own shocks (and not by others) is deemed to be the most exogenous

of all (Masih, 2012).

Step seven, the Impulse Response Function (IRF) and step eight, Persistence Profiles (PP) is in graph form. According to Masih et. al. (2009), IRF exposes relative exogeneity and endogeneity (similar to VDC) while PP estimates the speed with which the variables get back to equilibrium when there is a system-wide shock (unlike the IRF which traces out the effects of a variable-specific shock on the long-run relationship).

6 Data, Empirical Results and Discussion

Number of variables:	**5**	Sample period:	**07-04-2008 – 06-09-2013**	Source of data:	**DataStream**
Number of observations:	**1415**	Data frequency:	**Daily**	Software used:	**Microfit 4.1**

- S&P ASIA PAC X JAPAN BMI Shariah Index (ASIA): The stocks for this index are drawn from the Asian country indices in the S&P Global BMI index, excluding Australia, Japan and New Zealand
- S&P 500 Shariah Index (USAM): Widely regarded as the best single gauge of the U.S. equities market, this world-renowned index includes 500 leading companies in leading industries of the U.S. economy
- S&P EUROPE 350 Shariah Index (EURO): The S&P Europe 350 combines the benefits of representation with replication for the Europe region, spanning 17 exchanges
- S&P BRIC Shariah Index (BRIC): The S&P BRIC Shariah index is designed to provide exposure to the leading companies from the emerging markets of Brazil, Russia, India, and China, while at the same time complying with Shariah law
- S&P PAN ARAB Shariah Index (ARAB): The S&P Pan Arab Shariah Index includes stocks from listed companies in the countries of Bahrain, Egypt, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Tunisia and the United Arab Emirates

#	Code	Description	Log Level Form	Log 1st Diff. Form
1	ASIA	S&P ASIA PAC X JAPAN BMI Shariah Index	LASIA	DASIA
2	USAM	S&P 500 Shariah Index (USAM)	LUSAM	DUSAM
3	EURO	S&P EUROPE 350 Shariah Index	LEURO	LEURO
4	BRIC	S&P BRIC Shariah Index	LBRIC	DBRIC
5	ARAB	S&P PAN ARAB Shariah Index	LARAB	DARAB

Table 1: List of variables under research

All the data are converted into logarithms form (LASIA, LUSAM, LEURO, LBRIC and LARAB). This conversion is necessary to achieve stationarity in variance (Masih, 2009).

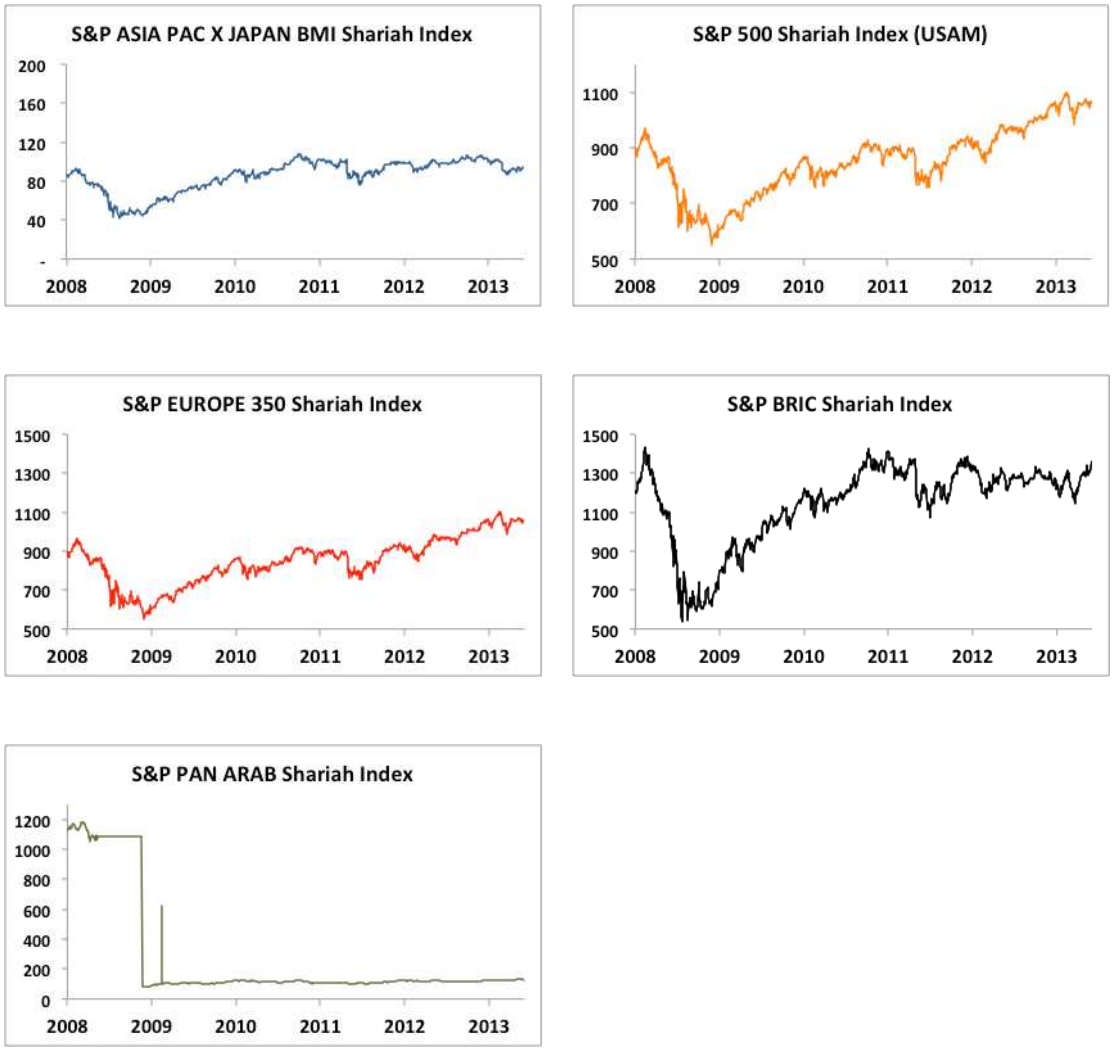


Figure 1: Graphs based on the raw data

Preliminary observation of graphs from Figure 1 suggests that the variables are of random walk in nature, which will be tested for in the coming section.

6.1 Step 1 – Unit Root Test

In this step, the objective is to check whether the variables chosen were stationary or not. The checking can be done by using the Augmented Dickey-Fuller Unit Root Tests (ADF) and also the Phillips-Perron Test (PP). PP test is an alternative test for a unit root (Masih, 2012).

Augmented Dickey-Fuller (ADF) Test

In order to confirm stationarity, the variables are tested at the 'level' form (Table 2) and 'differenced' form (Table 3). In testing the 'level' form, the lower table (3rd table which includes an intercept and a linear trend) of the ADF results should be used. The test statistic figures are obtained based on the highest value of Akaike Information Criterion (AIC) and Schwarz Bayesian Criterion (SBC) which sometimes give an equivalent test statistic results. Ignoring the minus sign, the test statistics for all variables are smaller than their 95 percent critical value which means that the null hypothesis cannot be rejected. In other words, all the variables are non-stationary in its 'level' form.

For 'differenced' form variables, the upper table (2nd table which includes an intercept but not a trend) should be used instead. Again, the test statistic figures are obtained based on the highest value of AIC and SBC. Here, the test statistics for all variables are higher than their 95 percent critical value which means that the null hypothesis can be rejected (i.e. variables are stationary). Since the variables are non-stationary in 'level' form but stationary in 'differenced' form, these variables are known as I(1) from this ADF test.

Below is the summary of ADF results of the variables in its 'level' form and 'differenced' form (see appendix 1A-1J for full results).

	Variable	ADF	Value	T-Stat	Critical Value	Result
LOG LEVEL FORM	LASIA	ADF(3)=AIC	3759.1	-2.2220	-3.4155	Non-Stationary
		ADF(1)=SBC	3745.1	-2.3188	-3.4155	Non-Stationary
	LUSAM	ADF(2)=AIC	4125.7	-2.8214	-3.4155	Non-Stationary
		ADF(2)=SBC	4112.6	-2.8214	-3.4155	Non-Stationary
	LEURO	ADF(5)=AIC	4137.7	-2.7195	-3.4155	Non-Stationary
		ADF(5)=SBC	4116.7	-2.7195	-3.4155	Non-Stationary
	LBRIC	ADF(2)=AIC	3580.5	-2.5710	-3.4155	Non-Stationary
		ADF(2)=SBC	3567.3	-2.5710	-3.4155	Non-Stationary
	LARAB	ADF(2)=AIC	1343.1	-2.1651	-3.4155	Non-Stationary
		ADF(1)=SBC	1331.0	-2.2776	-3.4155	Non-Stationary

Table 2: Results of the ADF Test (level form)

	Variable	ADF	Value	T-Stat	Critical Value	Result
FIRST DIFFERENCED FORM	DASIA	ADF(2)=AIC	3755.4	-22.8709	-2.8640	Stationary
		ADF(2)=SBC	3744.9	-22.8709	-2.8640	Stationary
	DUSAM	ADF(1)=AIC	4120.0	-30.7534	-2.8640	Stationary
		ADF(1)=SBC	4112.1	-30.7534	-2.8640	Stationary
	DEURO	ADF(4)=AIC	4131.9	-18.5451	-2.8640	Stationary
		ADF(4)=SBC	4116.1	-18.5451	-2.8640	Stationary
	DBRIC	ADF(5)=AIC	3582.9	-18.0797	-2.8640	Stationary
		ADF(1)=SBC	3568.3	-27.4918	-2.8640	Stationary
	DARAB	ADF(1)=AIC	1340.7	-31.4847	-2.8640	Stationary
		ADF(1)=SBC	1332.8	-31.4847	-2.8640	Stationary

Table 3: Results of the ADF Test (differenced form)

Phillips-Perron (PP) Test

Then, we used PP to confirm stationarity. As in ADF test, the variables were tested in the 'level' form (Table 4) and 'differenced' form (Table 5). The results are concluded based on the p-value. P-value informs the error we are making when rejecting the null (i.e. variable is non-stationary). If the p-value is high (the value is above 0.05), the null hypothesis cannot be rejected. On the other hand, if the p-value is low (the value is below 0.05), the null hypothesis can be rejected.

As expected, the PP test confirmed that the 'level' form (differenced once) variables are non-stationary and the 'differenced' form (differenced twice) variables are stationary analogy to the ADF test.

The summary of the PP test results is shown below (see also appendix 1K-1T for details).

Variable	T-Statistic (p-value)	Results
DASIA	0.322	Non-Stationary
DUSAM	0.334	Non-Stationary
DEURO	0.192	Non-Stationary
DBRIC	0.240	Non-Stationary
DARAB	0.152	Non-Stationary

Table 4: PP results for 'level' form (differenced once)

Variable	T-Statistic (p-value)	Result
DASIA	0.000	Stationary
DUSAM	0.000	Stationary
DEURO	0.000	Stationary
DBRIC	0.000	Stationary
DARAB	0.000	Stationary

Table 5: PP results for 'differenced' form (differenced twice)

6.2 Step 2 - Vector Autoregressive (VAR) model

Before proceeding to the cointegration test, it is compulsory to determine the optimum order (or lags) of the vector autoregressive model. Referring to Table 6 (see appendix 2A for details), it is found that there is a contradicting optimum order given by the highest value of AIC and SBC. As expected, SBC gives lower order as compared to AIC. This difference is due to the AIC tries to solve for autocorrelation while SBC tries to avoid over-parameterization. In other words, the different lag values may be attributable to the different nature or concern of the test. However, since the p-value for all lag order shows 0.000 it is recommended to take lag order 2 as estimated value for further processing with the cointegration.

Order	AIC	SBC	T-Statistic (p-value)	Critical Value
18	18458.8		[.336]	5%
2		18262.2	[.000]	5%

Table 6: Lag order identification

In addition, we have examined the issue of serial correlation (Table 7 and see appendix 2B-2F for details) and confirmed that some of the variables are, in fact, serially correlated. In essence, since DEURO has serial correlation or autocorrelation issue, we should use the highest order of VAR, which are 18 in this case. I have chosen the highest SBC (rather than the highest AIC) to avoid the over-parameterization problem. As a result, the order of lag used is 2 given by SBC.

Variable	Chi-Sq (p-value)	Implication (at 10%)
DASIA	[.464]	There is no serial correlation
DUSAM	[.264]	There is no serial correlation
DEURO	[.000]	There is serial correlation
DBRIC	[.149]	There is no serial correlation
DARAB	[.235]	There is no serial correlation

Table 7: Autocorrelation Diagnostic Test (Serial Correlation) results

6.3 Step 3 - Cointegration Test

Johansen method

We have performed two tests to identify cointegration between the variables; namely Johansen method and Engle-Granger method. The Johansen method uses maximum likelihood (i.e. eigenvalue and trace) and may identify more than one cointegrating vectors while the Engle-Granger method can only identify one cointegrating vector.

According to the Johansen method (Table 8), we have found that there is at least one cointegrating vectors between the variables which confirm cointegration. This test considers the available number of cointegrating vectors or r. In the case when the null hypothesis is r = 0, there is no cointegration when we fail to reject the null. On the other hand, there is cointegration if the null is rejected (see appendix 3A for details).

Cointegration LR Test based on Maximal Eigenvalue of the Stochastic Matrix				
Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	36.9670	37.8600	35.0400
r <= 1	r = 2	22.8450	31.7900	29.1300

Cointegration LR Test based on Trace of the Stochastic Matrix				
Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	104.4136	87.1700	82.8800
r <= 1	r = 2	67.4467	63.0000	59.1600

Table 8: Maximal Eigenvalue and Trace test results

Engle-Granger method

Alternatively, we have used the Engle-Granger method (Table 9 and see appendix 3B for details. Here, it is found that the variables are stationary, which means that there is cointegration between the variables. This result does confirm the earlier Johansen method test of cointegration. Nevertheless, we rely on Johansen method which is a better test and confirmed that there is at least one cointegration.

Variable	T-Stats	Test Statistic		Critical Value	Result
		AIC	SBC		
DF	-7.3579	3896.9	3894.3	-4.1076	Non-Stationary
ADF(1)	-5.1447	3961.4	3956.2	-4.1076	Non-Stationary
ADF(2)	**-4.1282**	3983.3	**3975.5**	-4.1076	**Stationary**
ADF(3)	-3.7703	3985.6	3975.1	-4.1076	Non-Stationary
ADF(4)	-3.6965	3984.7	3971.6	-4.1076	Non-Stationary

Table 9: Engle-Granger results

An evidence of cointegration implies that the relationship among the selected Shariah indices are not spurious, i.e. there is a theoretical relationship among the variables and that they are in equilibrium in the long run (Masih et. al., 2009). The long run theoretical relationship between the selected Shariah indices is consistent with theories, as mentioned in chapter 3.

However, cointegration cannot tell us the direction of Granger-causality as to which variable

is exogenous and which variable is endogenous, for which in chapter 6.5 Step 05 the Vector Error Correction Modeling technique (VECM) will be applied.

6.4 Step 4 - Long Run Structural Modeling (LRSM)

Earlier, we have mentioned that we want to identify the direction of causality between Asian Shariah Index and USA-, European-, BRIC- and ARAB Shariah indices. In other words, our focus variable in this paper is ASIA Shariah Index. Thus, we first normalized LASIA (i.e. normalizing restriction of unity) at the 'Exactly Identifying' stage (Panel A of Table 10). Next, we imposed restriction of zero on one of the LUSAM and LEURO variable at the 'Over Identifying' stage (Panel B of Table10).

When we normalized LASIA, we found that all the coefficients of the cointegrating vector are significant except for LUSAM and LEURO (refer Panel A of Table 10 and see appendix 4A for the result). However, when we imposed restriction of zero on LUSAM and LEURO (refer Panel B of Table 9 and see appendix 4B for the result), we found that the over-identifying restriction is rejected. We are rejecting the NULL at 10% significant level. That means, both variable (LUSAM and LEURO) are jointly significant. The test before (A1=1) showed that both of the variables are insignificant.

Variable	Panel A	Panel B

LASIA	1.0000	1.0000
	(NONE)	(NONE)
LUSAM	-.19985	-.0000
	(.35943)	(NONE)
LEURO	-.59648	-.0000
	(.39041)	(NONE)
LBRIC	-.58648*	-0.92691*
	(.16560)	(0.063099)
LARAB	.093007*	0.030069*
	(.035536)	(0.017203)
Trend	0.0001625	-0.00004783
	(0.000126)	(0.00002991)
CHSQ(2)	NONE	5.6502[.059]

Table 10: Exact- and Over Identifying results

*Indicates significance

6.5 Step 5 - Vector Error Correction Model (VECM)

The previous four steps tested theories and confirm that there is cointegration between the variables but it did not show which the leader and the follower variables. Step 5 onwards allows us to answer this shortcoming. The statistical results generated from these steps will be welcomed by the investors. Stock market broker want to know which variable is the leader to focus their policies on those variables to make the biggest impact. Thus, we have performed VECM and the results are summarized in Table 11 (see appendix 5A-5E for the details).

The statistical results showed that USA, EUROPE and BRIC shariah indices are exogenous while Asian and Arabian shariah indices are endogenous. Masih et. al. (2009) explained about the significance of the error correction term in the equation. One of the functions of error correction term is to show long-term relationship of the variable.

Investors should be aware of those results because sound investment decisions and risk management require understanding of long-term relationships between economic variables to achieve the ultimate objective.

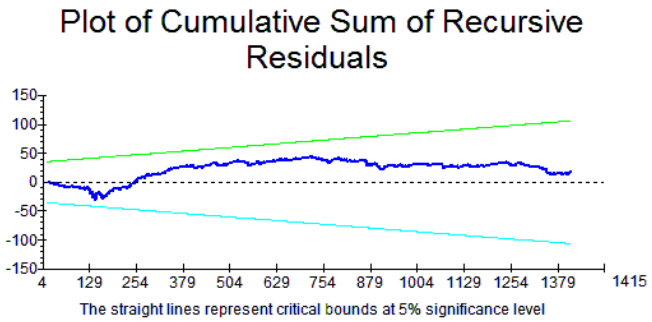
We have used the CUSUM and CUSUM SQUARE (see figure 2) to check the stability of the coefficients. The CUSUM and CUSUMSQ tests employ the cumulative sum of recursive residuals based on the first set of observations and is updated recursively and plotted against the break points.

If the plots of the CUSUM and CUSUMSQ statistics are found to be within the critical bounds of 5 percent level, the H_0 that all coefficients in the model are stable cannot be rejected. On the other hand, if the lines are found to be crossed, the H_0 of coefficient constancy can therefore be rejected at 5 percent significance level. Here, it is found that the parameters are structurally unstable which indicates structural breaks. Structural breaks may be corrected by using dummy variables. Unfortunately, we are unable to correct all these problems due to time constraint.

This is explained by the 2008 US originated subprime financial crises.

ecml(-1)	Coefficient	Std. Error	T-Ratio [Prob.]	S.L.	Result
DLASIA	-.038172	.0083967	-4.5461[.000]	5%	Endogenous
DLUSAM	.0011234	.0076557	.14674[.883]	5%	Exogenous
DLEURO	.0010058	.0072422	.13888[.890]	5%	Exogenous
DLBRIC	-.0099849	.011213	-.89044[.373]	5%	Exogenous
DLARAB	-.14634	.054798	-2.6705[.008]	5%	Endogenous

Table 11: ECM(-I) results



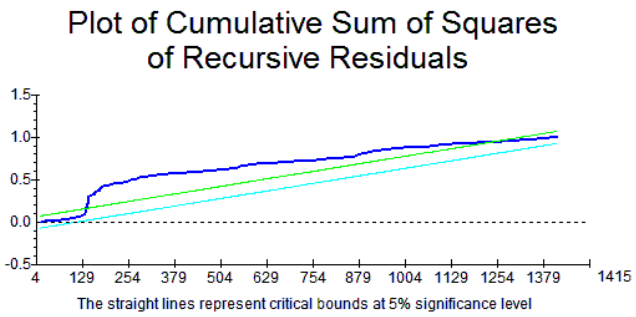


Figure 2: DASIA – CUSUM & CUSUM SQARE

6.6 Step 6 - Variance Decompositions (VDCs)

Although the error-correction model has identified the exogeneity or endogeneity of a variable, the generalized variance decomposition technique will assist in determining the relative degree of exogeneity or endogeneity of the variables. The VDCs and IRF serve as tools for evaluating the dynamic interactions and strength of causal relations among variables in the system. The VDC indicates the percentages of a variable's forecast error variance attributable to its own innovations and innovations in other variables over a series of time horizons, i.e. the variable that is explained mostly by its own shocks is deemed to be the most exogenous.

There are two ways to identify the relative exogeneity: generalized approach and orthogonalized approach. The generalized approach is preferred compared to the orthogonalized approach, because the orthogonalized approach is sensitive to the order of the variables in a VAR system which determines the outcome of the results, whereas the generalized approach is invariant to the ordering of variables in the VAR and produce one unique result.

It is surprising to see, that the results in Table 12 show S&P PAN ARAB Shariah Index (ARAB) being the first leader followed by S&P 500 Shariah Index (USAM) and S&P EUROPE 350 Shariah Index (EURO) and S&P BRIC Shariah Index (BRIC) the second, third and fourth leader respectively, while S&P ASIA PAC X JAPAN BMI Shariah Index is the first follower and the most endogenous. This ranking is not consistent and contradicting to the results from the previous step VECM, where the Arabian Shariah Index was identified as endogenous/follower.

Nevertheless, this can be explained by that the VDC looks at the short-term performance and not to the long-term performance or reactions. In the long run equilibrium, Arabian market must perform as follower (as resulted in VECM test). But in the shot-run, this market, since it has its own unique characteristics, may not be affected by this cointegration, rather its runs by its own dynamics. Due to the isolation (in terms of financial markets) of those particular Arabian countries, contributions don't necessarily have to be originated from outside regions. In other words, in case of a specific problem happens in those Arabian countries (i.e. shock is originated by their own reasons) other regional markets will not correct it. But if some major happenings are originated from outside of the Arabian markets (i.e. other financial markets), this market will be corrected by the other markets.

Our focus on this paper relies on stock markets, not in the real economies. Therefore, this normally may happen. Even though e.g. GCC countries play important role in the world's economy (biggest oil exporter), we cannot talk about the same effect in the financial stock markets.

ORTHOGONALIZED APPROACH							GENERALIZED APPROACH						
Horizon	Variable	LASIA	LUSAM	LEURO	LBRIC	LARAB	Horizon	Variable	LASIA	LUSAM	LEURO	LBRIC	LARAB
30 days	LASIA	66.85%	22.08%	4.93%	3.98%	2.17%	30 days	LASIA	25.40%	21.48%	21.72%	30.87%	0.53%
	LUSAM	16.29%	83.56%	0.01%	0.14%	0.01%		LUSAM	8.16%	50.00%	20.92%	20.65%	0.27%
	LEURO	23.67%	42.00%	34.04%	0.28%	0.00%		LEURO	9.95%	26.11%	39.87%	24.01%	0.06%
	LBRIC	38.57%	25.35%	4.39%	31.50%	0.20%		LBRIC	16.45%	21.44%	19.90%	42.18%	0.02%
	LARAB	0.16%	5.37%	0.58%	0.60%	93.29%		LARAB	0.16%	3.85%	2.34%	1.59%	92.07%
	Exogeneity	66.85%	83.56%	34.04%	31.50%	93.29%		Exogeneity	25.40%	50.00%	39.87%	42.18%	92.07%
	Ranking	3	2	4	5	1		Ranking	5	2	4	3	1
60 days	LASIA	57.24%	25.82%	6.53%	6.21%	4.20%	60 days	LASIA	21.88%	22.27%	22.89%	31.79%	1.17%
	LUSAM	16.37%	83.46%	0.01%	0.15%	0.01%		LUSAM	8.20%	50.01%	20.90%	20.61%	0.28%
	LEURO	23.94%	42.05%	33.74%	0.26%	0.01%		LEURO	10.04%	26.14%	39.76%	23.99%	0.07%
	LBRIC	36.79%	26.05%	4.68%	32.14%	0.34%		LBRIC	15.81%	21.64%	20.18%	42.31%	0.06%
	LARAB	0.52%	9.23%	1.54%	1.90%	86.80%		LARAB	0.50%	6.13%	4.42%	3.26%	85.69%
	Exogeneity	57.24%	83.46%	33.74%	32.14%	86.80%		Exogeneity	21.88%	50.01%	39.76%	42.31%	85.69%
	Ranking	3	2	4	5	1		Ranking	5	2	4	3	1
90 days	LASIA	52.31%	27.58%	7.35%	7.40%	5.36%	90 days	LASIA	20.16%	22.62%	23.45%	32.21%	1.56%
	LUSAM	16.42%	83.40%	0.01%	0.16%	0.01%		LUSAM	8.23%	50.01%	20.89%	20.59%	0.29%
	LEURO	24.08%	42.04%	33.63%	0.24%	0.01%		LEURO	10.08%	26.15%	39.72%	23.97%	0.08%
	LBRIC	35.86%	26.40%	4.83%	32.48%	0.43%		LBRIC	15.48%	21.74%	20.32%	42.38%	0.08%
	LARAB	0.79%	11.70%	2.25%	2.91%	82.36%		LARAB	0.76%	7.56%	5.80%	4.39%	81.50%
	Exogeneity	52.31%	83.40%	33.63%	32.48%	82.36%		Exogeneity	20.16%	50.01%	39.72%	42.38%	81.50%
	Ranking	3	1	4	5	2		Ranking	5	2	4	3	1

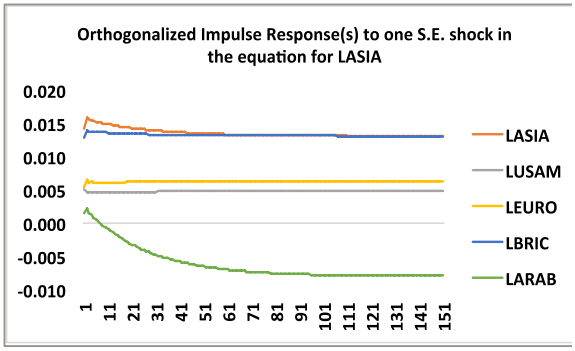
Table 12: Generalized and Orthogonalized Approaches

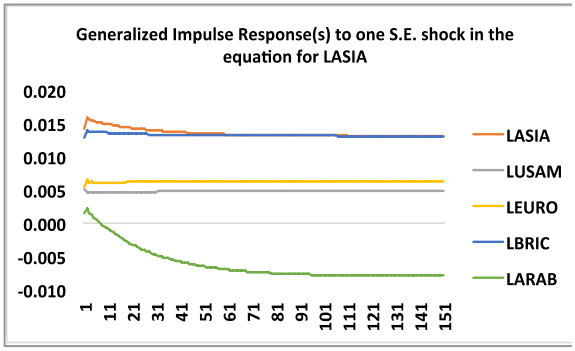
It is important for decision makers to identify the relative exogeneity of variables. Affecting

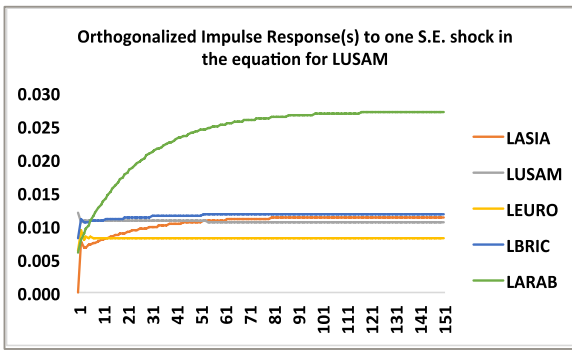
on the most exogenous variable will have greater impact on other variables. Thus, knowing relative endogeneity/exogeneity helps investors to choose among variables those which will have due impact on others. For the investors, investment decisions will be more rational, so as movements of variables of interest could be relatively easier to predict based on co-moving variables.

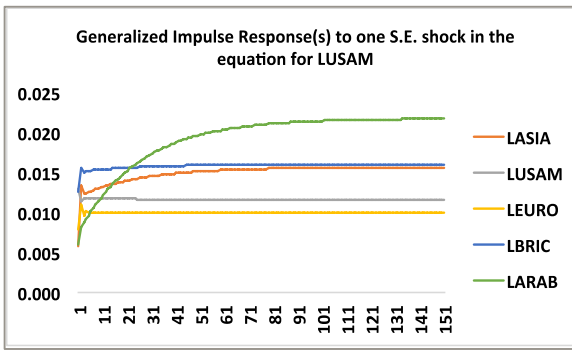
6.7 Step 7 - Impulse Response Functions (IRFs)

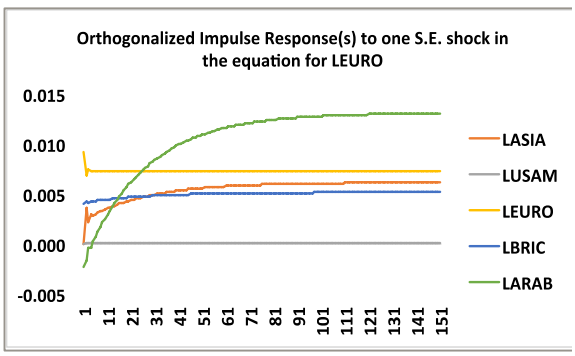
IRFs essentially map out the dynamic response path of a variable owing to a one-period standard deviation shock to another variable. An impulse response function is helpful in tracing the time path of the various shocks on the variables contained in the VAR system. It is normalized such that zero represents the steady-state value of the response variable.

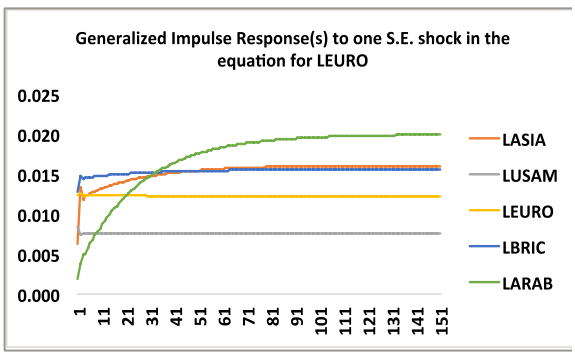












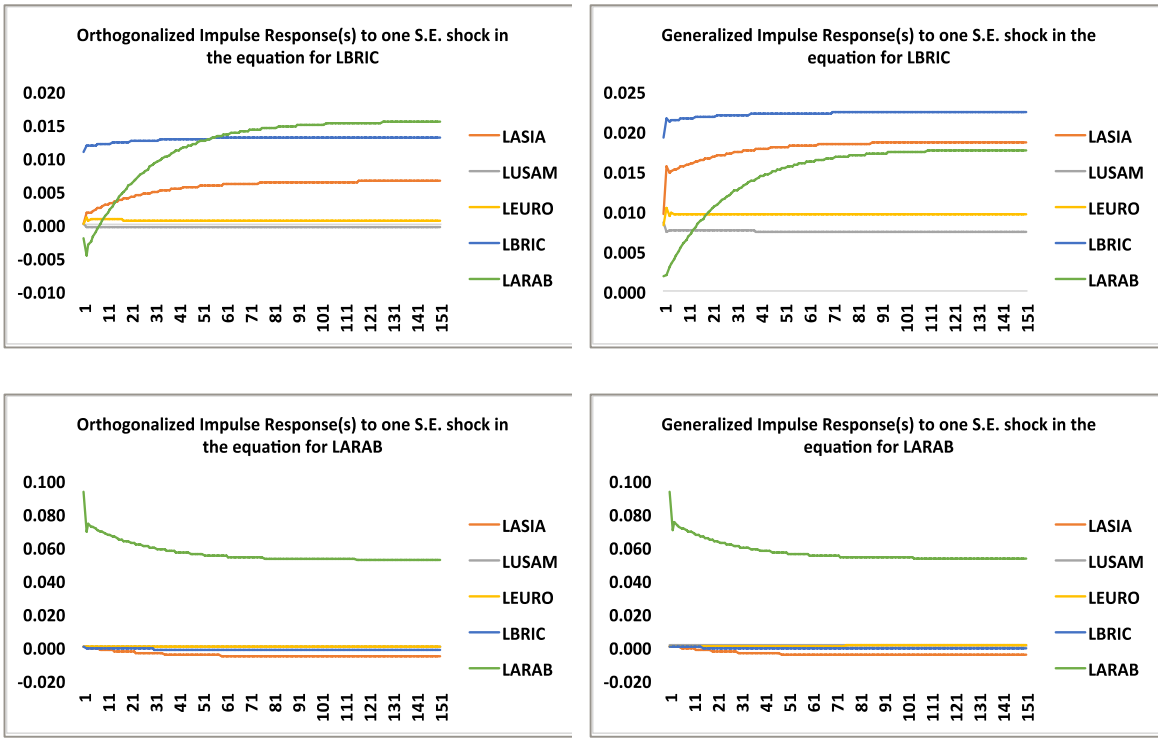


Figure 3: Orthogonalized and Generalized Impulse Response to one S.E. shock for each variable

We have performed both orthogonalized and generalized IRFs on all variable and from the graphs in Figure 3 we can infer that changes in the Asian Shariah Index influence on Arabian Shariah Index and that disturbance lasts for about 90 days, while the other Sharia indices stabilize within 20 to 30 days.

A shock on the US Shariah Index has big impact on the Arabian and Asian Shariah Indices and that disturbance last for about 140 days and 80 days respectively, followed by the BRIC Sharia Index which stabilizes in about 40 days. In contrast, there is a little impact of the US Shariah Index shock on the European Shariah Index (less than 5 days).

A shock on the European Shariah Index shows the same impact on all other Shariah Indices as the previous shock to the US Shariah Index, with the only difference that the BRIC Shariah Index stabilizes in about 2 months.

A shock on the BRIC Shariah Index influences the Arabian and the Asian Shariah Indices strongly and that disruption last for about 110 days and 85 days respectively. The impact on the remaining Shariah Indices namely US and European is little, whereby the European recovers after couple days and the US still needs about 40 days to find back its equilibrium.

A shock on the Arabian Shariah Index has almost no strong impact to the other Sharia Indices

and the graphs show that the Asian Sharia Index needs about 50 days to be back to its equilibrium and the remaining Shariah Indices recover within days.

6.8 Step 8 – Persistence Profiles (PP)

The PP deals with effects of system-wide shock in the long run rather than of variable-specific shock as it is done in IRF.

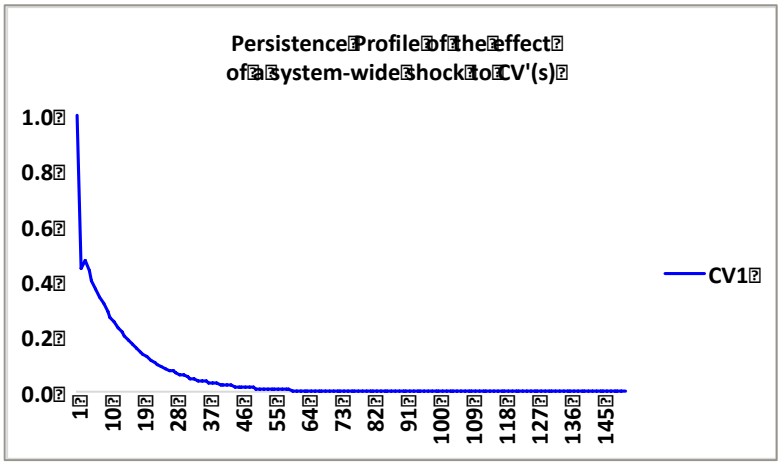


Figure 4: Persistence Profile of the effect of a system-wide shock to CV

The results in Figure 4 indicate that if the long-term convergence between the variables is disturbed by any shocks, it will take about 80 days to restore the equilibrium.

7 Conclusion

This paper conducted an investigation about the co-movements of selected five Shariah Indices around the world. These indices are: S&P ASIA PAC X JAPAN BMI Shariah Index, S&P 500 Shariah Index, S&P EUROPE 350 Shariah Index, S&P BRIC Shariah Index and S&P PAN ARAB Shariah Index. Using daily data for 5 years, it examined the existence of cointegration, Granger causality, VECM, VDCs, IRF and PP. It has found that all mentioned Shariah Indices are affected by each other. Especially the Asian Shariah Index is strongly impacted by any shock respectively change on the other Shariah Indices.

This confirms the research results made by Kumar and Mukhopadhyay (2002) and Wong, Agarwal and DU (2005) that there is a correlation between various markets globally. They further emphasized, that dramatic movements in one equity market can have a powerful impact on different markets incl. Islamic stock market, where any volatility in major global markets is very likely to influence Islamic indices. However, our results do not confirm the

results of Karim, Kassim and Arip (2010), and Yusof and Majid (2007) who claim that there is no empirical existence of co-integration among the Shariah Indices.

Asian investors and Shariah stock broker should be aware of those results because sound investment decisions and risk management require understanding of long-term relationships between those selected indices to achieve the ultimate objective.

REFERENCES

Allen, F and Gale, D (2000): "Financial contagion", *Journal of Political Economy*, pp. 1–33

Charles, Amélie, Pop, Adrian and Darné, Olivier (2011): "Is the Islamic Finance Model More Resilient than the Conventional Finance Model? Evidence from Sudden Changes in the Volatility of Dow Jones Indexes", *International Conference of the French Finance Association (AFFI)*

Kaminsky, G, Reinhardt, C and Vegh, C (2003): "The unholy trinity of financial contagion" *Journal of Economic Perspectives*, pp. 51–74

Kumar, K and Mukhopadhyay C (2002): "Equity Market Interlinkages: Transmission of Volatility – A Case of US and India", *NSE Working Paper No.16*

Lucia M. and Bernadette A.-O. (2010): "The Global Financial Crisis: World Market or Regional Contagion Effects?" *Conference Paper*, Dublin Institute of Technology

Masih, M., Al-Sahlawi, M. A. and De Mello, L. (2010): "What drives carbon-dioxide emissions: Income of electricity generation? Evidence from Saudi Arabia", *The Journal of Energy and Development,* Vol. 33, No. 2, 201–213

Masih, M. (2012): The steps required for the application of Microfit to real world data, *Lecture Note*

Masih, M., Al-Elg, A. and Madani, H. (2009): "Causality between financial development and economic growth: an application of vector error correction and variance decomposition methods to Saudi Arabia", *Applied Economics,* 41, 1691–1699

Rizvi, S. Arshad, S. (2012): "Are Islamic Equity Indices a Safer Haven in Times of Crisis? An Empirical Proof Via Investigation of Global Indices Using Multivariate GARCH DCC." *International Islamic Capital Market Conference, Indonesia*

Rizvi, S. Arshad, S. (2013): "The Impact of Global Financial Shocks to Islamic Indicies: Speculative Influence or Fundamental Changes?", Journal of *Islamic Finance International Islamic*

Rahman, Aisyah Abdu, and Noor Zahirah Mohd Sidek (2011): "Spill-over Effect of US Sub-prime Crisis on ASEAN-5 Stock Markets." *Business and Social Science Research Conference.* Dubai, UAE: World Business Institute Australia, 334

Wong W K, A Agarwal and J Du (2005): "Financial Integration for India Stock Market, a Fractional Cointegration Approach", National University of Singapore *Working Paper No. WP0501*

Yusof, Rosylin Mohd., and M. Shabri Abd.Majid (2007): "Stock Market Volatility Transmission in Malaysia: Islamic Versus Conventional Stock Market." *Journal of King Abdulaziz University:* Islamic Economics