The Impact of Subprime Crisis on Asia-Pacific Islamic Stock Markets[1]

Zhang Hengchao[2] and Zarinah Hamid[3]

The objective of this study is to examine the impact of Subprime Crisis on the long-term and short-term dynamic relationships between selected Asia-Pacific Islamic Stock Markets and leading conventional stock markets. The co-movement among the United States, Japan, China, Malaysia, Indonesia stock markets, both Islamic and Conventional, is examined from February 1, 2006 to December 31, 2010. This study applies rigorous empirical testing, including Vector Autoregression (VAR) method to examine the long-run and short-run dynamics, and Vector Error Correction Model (VECM) to explore the dynamic co-movement. To extend the previous study, firstly, China's Islamic Stock Market is included in the test; secondly, the performance of the conventional stock markets from these five countries is also taken into account. The study reveals that at the pre-crisis period, investors find that there are diversification benefits of diversifying their portfolio in the Asia-Pacific Islamic Stock Markets and conventional Stock Markets. However, during the crisis period these stock market share a long-run equilibrium relationship, which implies that they are integrated and hence provide diversification benefits for the investor.

Keywords: Subprime Crisis, Asia-Pacific Islamic Stock Markets, Long-term Relationship, Short-term Relationship, VAR, VECM.

1. Introduction

During the last three decades, the world economies have been increasingly globalized. As the world becomes flatter, economies tend to intensively liberalize their markets to compete for the foreign investment. Since economic liberalization involves in removal of capital barriers to investment, the liberalization process effectively enables one country's capital market to be more accessible to the foreign investors. Thus, economies around the world become integrated with one another.

As world economies become increasingly integrated, enormous researches have been devoted to examine whether the financial crisis in one country will be spilled over to other countries. For example, King and Wadhwani (1990) studied about the volatility transmission of the 1987 US stock market crash on the global market; Masih and Masih (1999) and Yang, Kolari, and Min (2003) examined the intra-regional contagious effect of Asian Financial Crisis, and etc. The emergence of the US Subprime Mortgage 2007 has again spurred the study of the contagious effect of financial crisis to the new height. As being labeled to be the worst financial crisis ever since the Great Depression, the US Subprime Crisis has not only affected the US economy, it has spread to other countries as well, both developed and developing nations. In addition, as stated by Ibrahim (2005), studies on the impact of

[1] This paper originates from a research project (EDW-All-063-0854) funded by the Research Management Office, International Islamic University Malaysia. The authors would like to thank the Office for funding this research.

[2] Faculty of Economics and Management Sciences, International Islamic University, 50728 Kuala Lumpur, Malaysia. Corresponding author's contact information: Email: zhanghengchao_919@hotmail.com Telephone: +60-132001340.

[3] Associate Professor, Faculty of Economics and Management Sciences, International Islamic University, 50728 Kuala Lumpur, Malaysia

financial crisis on the financial markets integration may help investors to grasp the potential benefits of international portfolio diversification.

Although there are voluminous studies on stock market integration, most of them have been focusing on the stock market integration among developed countries (see, for example, Grubel (1968); Levy and Sarnat (1970); Lessard (1973); Solnik (1974); Odier and Solnik (1993); Eun and Resnick (1994); Goldstein and Michael (1993); Blackman and Holden (1994); and Hanna et al. (1999)). Recently, research focus has shifted to the stock markets of the developing countries (see, for example, Hung and Cheung (1995); Ratanapakorn and Sharma (2002); and Abd. Majid et al. (2008). Furthermore, despite the rapid development of Islamic financial industry, especially the Islamic stock markets, little attention have been given to the impact of the financial crisis on the integration between conventional stock markets and the Islamic counterparts. In this regard, this study hopes to shed light on the stock markets integration between Islamic stock markets and conventional stock markets, with the special focus on the Asia-Pacific Islamic stock markets.

The aim of this study is two-fold: first is to examine the impact of US Subprime Crisis on the integration between selected Asia-Pacific Islamic stock markets and conventional counterparts; and second is to identify which stock market, either conventional or Islamic, primarily drives the volatility of the Asia-Pacific Islamic Stock markets.

The rest of this study is organized as follows: the subsequent section provides literature review pertaining to past researches. Section 3 describes the methodology and variables used in this study. Section 4 illustrates the results of various empirical tests. Finally, major findings of this study are summarized, and some possible areas of that warrant further research are provided in the conclusion section.

2. Literature review

Acknowledging the rapid growth of the Asian economies and Islamic financial industries during the last three decades, researchers have started shifting their focus to the integration of Asian stock markets, both Islamic and conventional. However, in comparison with the studies on the conventional stock markets, efforts devoted to the Islamic stock markets are still trivial.

In Janakiramanan and Lamba (1998), the authors applied Vector Autoregression Model (VAR) to examine the integration of stock markets in the Pacific-Basin region. They concluded that US stock market had significant influence on the Australasian stock markets, during 1988-1996. Besides, the authors have positively attributed the level of integration between countries to four major factor namely: geographical location, economic tie, numbers of cross-border listings, and precedence of market close.

In a similar study, Masih and Masih (1999) investigated the long-run and short-run dynamic linkages among emerging Asian stock markets and other leading stock markets internationally. Echoing with Janakiramanan and Lamba (1998), this paper stated that the US and UK had significant influence, both long-run and short-run, over other stock markets world widely. In addition, the authors also found that there were significant long-run and short term relationship between OECD stock markets and Asian stock markets. On the other hand, the Hong Kong stock market had the leading role among Southeast Asia stock markets at the regional level. The paper added that the volatility of Asian stock markets could be mostly attributed to the fluctuations in the regional markets, rather than the advanced markets.

Another early study on the long-run and short-run dynamic relationship among Asia emerging stock markets and the advanced stock markets (i.e. US and Japan) can be traced back to Yang, Kolari, and Min (2003). In this study, the authors gave special focus to the

effect of Asia financial crisis on the stock market integration. By evaluating the stock market in the separated time intervals (i.e. pre-crisis, crisis, and post crisis), the paper concluded that the long-run co-integration and short-run causal linkages among these markets had been intensified during the crisis. In addition, the level of integration among these stock markets was higher for the after crisis period than the pre-crisis period.

Furthermore, Majid, Meera and Omar (2007) zoomed in to investigate the integration among selected ASEAN markets and their interdependencies from US and Japan. By applying the Generalized Method of Moments (GMM) on the daily stock indices, ranging from January 1, 1988 to December 31, 2006, the study revealed that in general, ASEAN stock markets were increasingly interrelated among themselves as well as with the US and Japan. Thus, the benefits of diversifying the investments into ASEAN stock markets tend to disappear. In addition, in a recent article, Rahman and Sidek (2011) estimated the impact of the US subprime mortgage crisis on the stock market return of the ASEAN-5. By applying the panel data techniques, the results derived from the estimation indicated that the US and ASEAN-5 stock markets are co-integrated. In accordance with Majid, Meera and Omar (2007), the authors of this paper also discouraged investors to diversify their portfolio into ASEAN-5 market during financial crisis.

With regards to the integration of Islamic stock markets in the Asia region, Yusof and Majid (2007), Karim, Kassim, and Arip (2010), and Siskawati (2011) could be considered as the pioneer on this field of study. In the early study, Yusof and Majid (2007) employed the Generalized Autoregressive Conditional Hereoskedasticity (GARCH) together with Vector Autoregressive Analysis to estimate the responses of both conventional and Islamic stock markets in Malaysia to the conditional volatility of monetary policy variables. Confirming with the Islamic principles, the study found that, from January 1992 to December 2000, interest rate was significant for Malaysia's conventional stock market, while insignificant for the Islamic counterpart.

In the most recent research, Karim, Kassim, and Arip (2010) examined the effects of the US Subprime Crisis on the integration of selected Islamic stock markets (i.e. Malaysia, Indonesia, US, UK, and Japan). Employed with Johansen-Juselius (JJ) co-integration approach, the study failed to prove the existence of co-integration among these Islamic stock markets for both pre-crisis period (February 15, 2006- July 25, 2007) and during crisis period (July 26, 2007-December 31, 2008). However, contradictory results were found by Siskawati (2011), where the author concluded the existence of co-integration among Jakarta Islamic Index, Kuala Lumpur Shariah Index, and Dow Jones Islamic Market Index.

3. Data preliminaries and empirical approach

Data preliminaries

The data for this study is retrieved from Bloomberg Database, covering the period from February 2006 to December 2010. The logarithmic values of daily closing market indices (i.e. logNikkei225, logUS Tot, logKLCI, logJakCI, logChina88, logIMUS, logIMJap, logIMKL, logIMJak, logIMChina) have been used as the proxy of selected stock markets, namely: Japan Nikkei, US Total Market, Kuala Lumpur Composite Index, Jakarta Composite Index, China Total Market, US Islamic Market, Japan Islamic Market, Kuala Lumpur Islamic Market, Jakarta Islamic Market, and China Islamic Market.

In order to comprehensively explore the impacts of the U.S subprime crisis on the integration of the selected stock markets, the time interval has been divided into two periods, namely: the pre-crisis period and during crisis period. Following Majid and Kassim (2009) and Karim, Kassim, and Arip (2010), our study sets July 25, 2007 as the starting point of the US Subprime Crisis and extend the during-crisis period from December 31, 2008 to

December 31, 2010. In the case of missing data, this study adopts a similar technique by Jeon and Von Furstenberg (1990) and Karim, Kassim, and Arip (2010) whereby the slot if missing data is filled by the adjacent day market indices.

Empirical approach

In order to avoid spurious results, Unit Root analysis has been firstly employed to ensure the stationarity of the time series data. Besides, Unit Root test enables us to identify whether the external financial shocks have permanent or temporary impact on the stock market. If time series data has unit root (non-stationary), the impact of the financial shock will never die out, and the market return will permanently deviate from the long-run equilibrium. However, if unit root does not exist, the effects of external shocks will only be temporary. Although in the short-run, there may be drift away from long term equilibrium, the deviation will be reverted back to the equilibrium level in the long-run. To examine the existence of unit root, Augmented Dickey Fuller (ADF) test is the common approach. However, since both Gujarati (2003) and Rahman and Sidek (2011) have criticized about the lower power of ADF test, Phillips-Perron (PP) test has been included to complement the ADF test.

In terms of the empirical methodology, this study initially adopts the Johansen-Juselius (JJ, henceforth) co-integration approach together with Vector Autoregressive (VAR, henceforth) framework to investigate the long-run relationship among selected stock market, for both pre-crisis and during crisis periods. Then, VECM model is applied to explore the short-term dynamic relationship among the selected stock markets. Since JJ's procedure has relative superior performance over other methods for testing the order of co-integration rank, JJ co-integration approach has been employed. In addition, since VAR model needs not to distinguish between exogenous and endogenous variables in the model, employing the model will be less complicated (Gujarati 2003).

Since the maximum likelihood of JJ co-integration test is based on the VAR model, VAR model is specified as follows:

$$\Delta X_t = \alpha + \sum_{k=1}^{p} \beta_k \Delta X_{t-k} + e_t \quad (1)$$

Where Δ denotes the first difference, $\Delta X_t$is an n×1 vector of variables, α is an n×1 vector of the constant terms, β is an n×n matrix of coefficients, e_t is an n×1 vector of white noise error terms, and p is the order of autoregression, respectively.

In order to determine the number of co-integration vectors (the rank of long-run information δ), Johansen (1988) and Johansen and Juselius (1990) developed two test statistics, which are the trace and the maximal eigenvalue statistics:

$$\lambda_{trace} = -T \sum_{i=r+1}^{k} \ln (1 - \lambda_i) \quad (2)$$

$$\lambda_{max} = -T \ln(\mathrm{i} - \lambda_{r+1}) \quad (3)$$

Where T is the number of effective observation and λ_r are estimated eigenvalues. The trace statistics tests the null hypothesis that there are at most *r* co-integration vectors. On the other hand, the maximal eigenvalue test is based on the hypothesis that the number of co-integration vectors is *r* against the alternative hypothesis that it is *r+1*.

Furthermore, in order to explore the short-term and long-term dynamic relationship among the selected stock markets, VECM model has been applied. Since, VECM is derived from the basis of VAR model, the functional form of VECM model can be specified as follow:

$$\Delta X_t = \alpha + \sum_{k=1}^{p} \beta_k \Delta X_{t-k} + \Pi X_{t-k} + e_t \quad (4)$$

Specifically, β is the coefficient of the short-term dynamics, while Π is the error term which is an n×1 vector. In addition, the error term represents the speed of short term adjustment to the long-run equilibrium (Karim, Kassim, and Arip, 2010).

4. Empirical results

Descriptive data

Table 1 and 2 of the following summarize the basic statistical characteristics of the daily stock market indices for the selected 10 stock markets (i.e. Nikkei 225, U.S total, KLCI, Jakarta Composite Index, China 88 index, U.S Islamic Market, Japan Islamic Market, Kulua Lumpur Islamic Index, Jakarta Islamic Index, China Islamic Index), in the pre-crisis and during-crisis period respectively. In terms of market volatility, the comparison of the standard deviation for these two periods indicates that, in general the stock markets tend to be more volatile during the U.S. subprime crisis. With the exception of China's conventional stock market, the standard deviation for these two periods is found to be more stable during the financial crisis. Most probably, this can be attributed to the restricted accessibility to China's domestic stock market whereby foreign investors can only trade limited volume of China's domestic stocks, the external financial shock may have trivial spillover effect on China's domestic market.

In addition, both the skewness and kurtosis values suggest that the stock markets indices are not normally distributed. In terms of the skewness, most of the stock markets are positively skewed before the U.S subprime crisis, with the exception of Japan's conventional and Islamic markets. This indicates that the distributions of the tested stock market indices (excluding Japan' conventional and Islamic markets) have asymmetric tails extending towards more positive values. On the other hand, during the crisis period, surveyed stock markets are generally negatively skewed, with the exception of Japan's and China's conventional markets. In other words, excluding Japan's Nikkei 225 and China's 88, all other selected stock indices have asymmetric distributions with tails extending towards more negative values.

As for the Kurtosis statistics, it characterizes the relative peakedness or flatness of a distribution compared to the normal distribution. For the pre-crisis time interval, most of the stock markets have negative kurtosis value, with the exception of Japan's Islamic Market. This indicates that the distribution of stock market indices is relatively flatter than the normal distributed data before the U.S subprime crisis. Similar results can be found during the crisis period where negative kurtosis presents in most of the stock markets, with the exception of China's Islamic market.

Table 1. Pre-Crisis

	LogNikkei225	LogUS Tot	LogKLCI	LogJakCI	LogChina 88	LogIMUS	LogIMJap	LogIMKL	LogIMJak	LogIMChina
Mean	4.2217	4.1393	3.0296	3.2077	2.2147	3.3206	3.1200	3.8523	2.4454	3.0875
Median	4.2240	4.1394	2.9949	3.1987	2.1082	3.3175	3.1221	3.8136	2.4362	3.0738
Mode	4.2344	4.1528	2.9909	3.1967	2.0408	3.3275	3.1106	3.8099	2.4263	3.0288
Std. Dev.	0.0248	0.0291	0.0659	0.0793	0.1853	0.0304	0.0171	0.0739	0.0707	0.0542
Skewness	-0.4216	0.2276	0.5081	0.2214	0.5200	0.4471	-0.5082	0.5851	0.2142	0.4794
Kurtosis	-0.5793	-1.2370	-1.3552	-1.0703	-1.3028	-0.7690	0.2421	-1.2191	-1.0379	-0.6718
Mini.	4.1529	4.0888	2.9477	3.0850	1.9971	3.2650	3.0630	3.7672	2.3332	2.9993
Max	4.2615	4.1946	3.1437	3.3804	2.5736	3.3895	3.1609	3.9894	2.5982	3.2225
Sum	1633.8167	1601.9131	1172.4723	1241.3657	857.1077	1285.0801	1207.4476	1490.8442	946.3858	1194.8779
Count	387	387	387	387	387	387	387	387	387	387

Table 2. During Crisis

	LogNikkei225	LogUS Tot	LogKLCI	LogJakCI	LogChina 88	LogIMUS	LogIMJap	LogIMKL	LogIMJak	LogIMChina
Mean	4.0393	4.0607	3.0808	3.3623	2.4366	3.3005	3.0122	3.9181	2.5784	3.1368
Median	4.0114	4.0646	3.1028	3.3873	2.4200	3.3107	3.0093	3.9354	2.6178	3.1631
Mode	4.1849	4.1705	2.9409	3.4246	2.4123	3.3732	3.1230	3.7742	2.6776	3.1836
Std. Dev.	0.0945	0.0807	0.0715	0.1241	0.1275	0.0648	0.0708	0.0719	0.1254	0.1035
Skewness	0.4551	-0.4409	-0.7596	-0.7062	0.4697	-0.6023	-0.1485	-0.8006	-1.0393	-0.9694
Kurtosis	-0.7491	-0.5766	-0.4734	-0.0591	-0.3808	-0.5976	-0.5591	-0.3345	-0.0026	0.0406
Mini.	3.8485	3.8325	2.9188	3.0459	2.1747	3.1177	2.8312	3.7482	2.2373	2.8461
Max.	4.2420	4.1972	3.1841	3.5782	2.7247	3.3993	3.1433	4.0456	2.7385	3.3154
Sum	3615.2100	3634.3484	2757.2862	3009.2156	2180.7726	2953.9896	2695.9498	3506.6806	2307.7061	2807.4718
Count	895	895	895	895	895	895	895	895	895	895

Tests of Unit Root results

As for the stationary nature of the stock market indices, Table 3 illustrates the unit root test results for both ADF and PP methods during the two sub-periods. For the pre-crisis period, both ADF and PP statistics indicate that at level, none of the stock market indices are stationary. For the same time interval, all of the stock market indices are stationary at first difference. This implies that the null hypothesis of the presence of unit root can be rejected at all levels of significance before the U.S. subprime crisis when market indices are at first difference. On the other hand, during the crisis period, the null hypothesis of unit root at level failed to be rejected. However, for the first difference, all market indices are stationary at all levels of significance. In sum, for both pre-crisis and during-crisis periods, all the logarithmic forms of stock market indices are stationary at first difference. Alternatively, all of these stock markets are said to be integrated at order one, or I (1).

Table 3. Unit Root Test

	Pre-Crisis				During Crisis			
	Level		First Difference		Level		First Difference	
	ADF	PP	ADF	PP	ADF	PP	ADF	PP
LogNikkei225	-2.6778	-2.6217	-21.1989***	-21.1907***	-1.8709	-1.7185	-23.2496***	-30.3904***
LogUS Tot	-2.7078	-2.6725	-19.3979***	-19.5817***	-0.9718	-1.0505	-24.4983***	-34.0878***
LogKLCI	-1.9773	-1.8616	-15.8799***	-15.7500***	-0.9987	-1.0308	-27.2453***	-27.3349***
LogJakCI	-2.0990	-2.1503	-18.7640***	-18.7468***	-1.0527	-0.9574	-26.1111***	-25.9249***
LogChina 88	-1.7181	-1.6887	-20.5764***	-20.5756***	-1.2548	-1.2639	-29.9025***	-29.9030***
LogIMUS	-2.5687	-2.5138	-19.3408***	-19.5657***	-0.9816	-1.1614	-25.5434***	-34.6517***
LogIMJap	-3.1014	-3.1629*	-18.0886***	-27.8651***	-1.0872	-1.4268	-26.2749***	-35.5509***
LogIMKL	-1.8485	-1.6018	-15.7771***	-15.8092***	-0.9527	-0.9785	-26.9012***	-26.9632***
LogIMJak	-2.5292	-2.6334	-18.7016***	-18.6844***	-1.0961	-1.0444	-26.9140***	-26.7867***
LogIMChina	-1.6959	-1.8196	-19.1841***	-19.1899***	-0.9645	-1.0393	-27.7818***	-27.7563***

Note: *, **, *** denote significance at the 10%, 5%, and 1% level, respectively.

Co-integration analysis

The results of the co-integration test are presented in Table 4. The co-integration tests have been employed for two models, for both pre-crisis and during-crisis periods. For the first model only Islamic stock markets are included (i.e. logIMUS, logIMJap, logIMChina, logIMKL, logIMJak). As for the second model, all the tested stock markets both conventional and Islamic are included (i.e. logUSTot, logNikkei225, logChina88, logKLCI, logJakCI, logIMUS, logIMJap, logIMChina, logIMKL, logIMJak). In addition, the lag length incorporated in two models is based on Akaike Information Criterion (AIC). More specifically, the chosen lag length should give relative lower AIC value (Gujarati 2003). Thus, for the first model, the chosen lag length is 2 and 4 for the pre-crisis and during-crisis period, respectively. As for the second model, the lag length incorporated for the pre-crisis period is 2, while 3 lags are included for the during crisis period.

As the test results revealed in Table 4, none of the Islamic Stock Markets are co-integrated with each other before the U.S subprime crisis. Focusing on during the crisis period, the Trace statistics indicate the existence of co-integration among these Islamic stock markets, at 5% level of significance. However, co-integrated relationship does not appear based on Max-Eigen statistics, at all levels of significance. Thus, the co-integration among the selected Islamic markets during the crisis period tends to be weak. In other words, the co-integration test results reveal that, generally, the long-run co-movement relationship is not present among the five Islamic stock markets for both the pre-crisis and during crisis periods.

Since these stocks do not share a long-run equilibrium relationship, which implies that they do not have a tendency to move together towards the same direction in the long-run, then these markets are not integrated and thus provide some diversification benefits for the investors. Our findings are in accordance with the previous finding by Karim, Kassim, and Arip (2010).

For the second model, both conventional and Islamic stock markets from the five countries (i.e. U.S., Japan, China, Malaysia, and Indonesia) have been included. As indicated by both Trace and Max-Eigen statistics, these ten stock markets are not co-integrated with each other during the pre-crisis period. In contrast, during the crisis period, they are co-integrated with each other 5% level of significance. This suggest that the stock markets are highly integrated during the crisis period which could suggest the aggregate behaviour of the investors who become vigilant in all stock markets following the news of the sub-prime crisis.

This result could indicate that during the crisis period, investors treat investment in these stock markets could yield similar outcome, thus the highly co-integrated nature of both Islamic and convention al stock markets. This result concurs well with the findings of Majid and Kassim (2009) which document greater degree of integration among the US, Japan, and the emerging stock markets namely Malaysia and Indonesia during the U.S. sub-prime crisis.

Table 4. Co-integration Tests

Model	Null Hypothesis	Before Crisis		During Crisis	
		Trace	Max-Eigen.	Trace	Max-Eigen.
logIMUS, logIMJap, logIMChina, logIMKL, logIMJak	$r \leq 0$	65.4016	26.8038	96.4898**	34.5116
	$r \leq 1$	38.5979	14.9648	61.9782	30.4097
	$r \leq 2$	23.6331	12.3890	31.5685	19.0051
	$r \leq 3$	11.2440	7.0897	12.5634	8.6663
logUSTot, logNikkei225, logChina88, logKLCI, logJakCI, logIMUS, logIMJap, logIMChina, logIMKL, logIMJak	$r \leq 0$	256.4516	53.8962	287.8541**	74.4392**
	$r \leq 1$	197.1707	52.5651	213.4149	57.5935
	$r \leq 2$	147.8576	37.1016	155.8214	37.6064
	$r \leq 3$	106.1693	34.4931	118.215	35.9761

Note: **, *** denote significance at 5% and 1% level, respectively.

Vector Error Correction Model

The short-term and long-term dynamic relationships among the selected stock markets are illustrated in table 5 to table 8. Table 5 and 6 present the dynamic relationship among Islamic stock markets in the U.S., Japan, China, Malaysia, and Indonesia, for the pre-crisis and during-crisis periods, respectively. In addition, the dynamic relationships among Islamic and conventional stock markets have been investigated and table 6 and 7 summarize the results for the pre-crisis and during-crisis periods, respectively.

As table 5 indicates, the performance of Japan's Islamic stock markets is significant and positive. It depends on the performance of the Islamic stock market in the U.S and Indonesia for the pre-crisis period. In addition, the other three Islamic stock markets, namely China Islamic Market, K.L Islamic market and Jakarta Islamic market are all significantly correlated with the U.S Islamic markets. In other words, before the subprime crisis, the U.S Islamic stock markets have significant influence on the volatility of the Islamic stock markets in Japan, China, Malaysia, and Indonesia. In addition, interestingly, the table also suggests a significant negative correlation between China and Indonesia's Islamic stock markets. With regard to the error correction term, it is found to be positive and significant in China and Indonesia's Islamic stock markets. Alternatively, it indicates that external shocks have the tendency to push the short-term deviation in both markets further away from their long-run equilibrium.

Table 5. Vector Error Correction Model (Islamic Markets@Pre-Crisis)					
Error Correction:	D(LOGIMUS)	D(LOGIMJAP)	D(LOGIMCHINA)	D(LOGIMKL)	D(LOGIMJAK)
ECT	-0.0170	-0.0072	0.0652***	0.0161	0.1369***
D(LOGIMUS(-1))	0.0425	0.7835***	0.6470***	0.4430***	0.8687***
D(LOGIMUS(-2))	-0.0335	0.0907	0.1062	0.0769	0.2392*
D(LOGIMJAP(-1))	0.0103	-0.1233**	-0.0471	-0.0672*	-0.0238
D(LOGIMJAP(-2))	-0.0088	-0.0079	-0.0720	0.0050	0.0491
D(LOGIMCHINA(-1))	-0.0839	-0.0544	-0.2491***	-0.0770	-0.2425**
D(LOGIMCHINA(-2))	0.0951	0.0823	0.1383**	0.0259	0.0720
D(LOGIMKL(-1))	0.0467	-0.0126	0.0760	0.1593***	-0.1082
D(LOGIMKL(-2))	-0.0592	0.0982	0.0695	-0.0063	-0.0333
D(LOGIMJAK(-1))	-0.0409	0.1066**	0.1291***	0.0554	0.1055*
D(LOGIMJAK(-2))	0.0148	-0.0721	-0.0427	0.0200	-0.0150
C	0.0002	-0.0002	0.0003	0.0003**	0.0005**
Note: *, **, *** denote significance at 10%, 5%, and 1% level, respectively					

Focusing on during the crisis period, the VECM analysis results reveal that both U.S and Japan's Islamic stock markets have significant influence on the other Islamic stock markets. Interestingly, the U.S. Islamic market have positive impact on the performance of the other Islamic markets, while Japan's Islamic market influences the other Islamic markets negatively. Besides, it has also found that the Malaysia's Islamic market has significantly negative effect on all the other Islamic markets during the same period. In addition, the existence of a significant negative error term implies that all the Islamic markets' short-term drift will be reverted to the long-run equilibrium level during the crisis, with the exception of Japan's Islamic market. In other words, the negative impact of the U.S subprime crisis is only temporary for these markets of which it can be quickly diluted.

When both conventional and Islamic markets are included in the VECM analysis, it will give a more comprehensive insight on the dynamic relationship among these markets. As table 7 reveals, the conventional stock markets tend to have insignificant influence on the five stock markets before the crisis. However, the influence of the Kuala Lumpur Composite Index has found to be significant on both U.S and China's Islamic markets. Specifically, the performance of KLCI tends to negatively related with the return of U.S Islamic stock market, but positively contribute to the fluctuation of China's Islamic stock market. In addition, the significant error correction term can only be found in the U.S and Indonesia's Islamic markets, with negative and positive signs, respectively. In other words, before the crisis, the volatility of the other stock markets have temporary impacts on the performance of U.S Islamic market, but negative impacts on Indonesia's Islamic market.

As for the during-crisis period, the U.S conventional market tends to significantly positively affect Islamic markets in Japan and China. However, Japan's Nikkei has a significant adverse impact on Malaysia and Indonesia's Islamic markets. Furthermore, Kuala Lumpur Composite Index has significant negative influence on the performance of China's and Indonesia's Islamic markets during the crisis. As for the error correction term, it is found to be significant in Japan, China and Malaysia's Islamic markets with positive sign. Alternatively, the positive error terms suggest that in the short run, the U.S. subprime crisis will push the return in these three Islamic markets further away from their long-run equilibrium.

Table 6. Vector Error Correction Model (Islamic Markets@During-Crisis)					
Error Correction:	D(LOGIMUS)	D(LOGIMJAP)	D(LOGIMCHINA)	D(LOGIMKL)	D(LOGIMJAK)
ECT	-0.0786***	-0.0004	-0.0300*	-0.0247***	-0.0496***
D(LOGIMUS(-1))	-0.1362***	0.5977***	0.5627***	0.2199***	0.4661***
D(LOGIMUS(-2))	-0.0858*	0.3129***	0.2640***	0.1004***	0.2872***
D(LOGIMUS(-3))	0.1149***	0.1984***	0.1744***	0.0453	0.1005*
D(LOGIMUS(-4))	-0.0364	0.0368	-0.0179	0.0088	-0.0911*
D(LOGIMJAP(-1))	-0.1233***	-0.3821***	-0.2497***	-0.1134***	-0.1697***
D(LOGIMJAP(-2))	-0.1021**	-0.2648***	-0.1170**	-0.0024	-0.0318
D(LOGIMJAP(-3))	0.0255	-0.1054***	-0.0537	-0.0344	-0.0038
D(LOGIMJAP(-4))	-0.0954**	-0.0009	-0.0794**	-0.0029	0.0542
D(LOGIMCHINA(-1))	0.0814	-0.0645	-0.1435***	0.0088	-0.1087*
D(LOGIMCHINA(-2))	0.0539	0.0440	0.0375	0.0282	0.0787
D(LOGIMCHINA(-3))	0.0009	-0.0345	-0.0112	-0.0098	0.1794***
D(LOGIMCHINA(-4))	0.0939*	-0.0031	0.0505	0.0269	0.0098
D(LOGIMKL(-1))	-0.1160	0.0170	0.0257	-0.0694**	0.0655
D(LOGIMKL(-2))	-0.2649***	-0.1615***	-0.2365***	-0.1164***	-0.1743**
D(LOGIMKL(-3))	-0.0209	0.0984*	0.0934	0.1237***	0.0250
D(LOGIMKL(-4))	0.0061	-0.0103	-0.0574	0.0212	0.0818
D(LOGIMJAK(-1))	0.0292	0.1001***	0.0915**	0.1001***	0.0412
D(LOGIMJAK(-2))	0.0433	0.0409	0.0425	0.0495**	0.0158
D(LOGIMJAK(-3))	-0.0378	0.0238	-0.0512	-0.0263	-0.1013**
D(LOGIMJAK(-4))	-0.0260	0.0262	-0.0106	-0.0151	-0.0564
C	0.0000	-0.0002	0.0000	0.0000	0.0002

5. Conclusion

This study aims at empirically examining the impact of the U.S. sub-prime crisis on the integration of the Asia Islamic stock markets and selected conventional counterparts, namely the US, Japan, China, Malaysia and Indonesia stock markets. In the era of globalization, as Asia countries increasingly liberalize their financial markets to attract more foreign investments, the vulnerability of their stock markets to the external financial shocks has also increased. Due to the far-reaching influence of the U.S. sub-prime crisis on the global economy, the study aims to investigate whether investors can diversify their portfolios into Asia Islamic stock markets in the event of financial crisis. As it is revealed by the study, Asia Islamic stock markets have been significantly integrated with the conventional stock markets in US, Japan, China, Malaysia and Indonesia, during the subprime crisis. In other words, the volatility of the financial shock in these five conventional stock markets will be spilled over to the Asia Islamic markets. Thus, the potential benefits of diversifying the portfolio into Asian Islamic stock markets tend to diminish.

In addition, as the Vector Error Correction Model analysis reveals, among the five Islamic stock markets, the U.S Islamic stock market tend to have significant influence on the other Islamic markets before the U.S subprime crisis. As for the crisis period, the U.S. Islamic market has significant positive impact on the other Islamic markets, while both Japan and Malaysia's Islamic markets have significant negative impact on the other Islamic markets. Furthermore, when conventional stock markets are taken into account, the influence of the Kuala Lumpur Composite Index is found to be significant on both U.S and China's Islamic markets before the crisis. While, for the crisis period, the U.S conventional market tends to significantly positively affect Islamic markets in Japan and China. However, Japan's Nikkei has a significant adverse impact on Malaysia and Indonesia's Islamic markets. Furthermore, Kuala Lumpur Composite Index has significant negative influence on the performance China and Indonesia's Islamic markets during the crisis. To sum up, for the pre-crisis period, the selected Asia-Pacific Islamic stock markets are mainly influenced by the performance of U.S Islamic stock market and KLCI. On the other hand, both Islamic and

conventional markets in U.S, Japan, and Malaysia have significant impact on the performance of the Asia-Pacific Islamic stock markets during the crisis period. When the U.S. is in crisis, investors shift their funds to the developing or the emerging countries' market to avoid the impact of the crisis on their investments. However, as information became clearer and it is evident that the crisis will be longer, investors opt for other type of investments that the equity markets, resulting in all market to perform in a similar manner. The results of this study have opened a wide variety of possible areas that warrant further research. Among the possible areas include investigating if there is diversification benefit to be gained by buying different sectoral stocks during specified periods, investigating multiple sources of risks (such as foreign exchange risks) and by assessing the effects of regulatory changes of the stock markets.

Reference

Ahmed, Walid M. A. "Dynamic Relationships of International Stock Markets: An Emerging Market Perspective." *Middle Eastern Finance and Economics*, no. 11 (2011).

Gujarati, Damodar N. *Basic Econometrics.* 4. McGraw-Hill Companies, 2003.

Janakiramanan, Sundaram, and Asjeet S. Lamba. "An Empirical Examination of Linkages Between Pacific-Basin Stock Markets." *Journal of International Financial Markets,Institutions and Money* 8 (1998): 155–173.

Johansen, S., and K. Juselius. "Maximum Likelihood Estimation and Inference on Cointegration with Applications to the Demand for Money." *Oxford Bulletin of Economics* 52 (1990): 169-210.

Karim, Bakri Abdul, Nor Akila Mohd Kassim, and Mohammad Affendy Arip. "The Subprime Crisis and Islamic Stock Markets Integration." *International Journal of Islamic and Middle Eastern Finance and Managment* 3, no. 4 (2010): 363-371.

Karim, Bakri Abdul, Nor Akila Mohd. Kassim, and Mohammad Affendy Arip. "The Subprime Crisis and Islamic Stock Markets Integration." *International Journal of Islamic and Middle Eastern Finance and Managment* 3, no. 4 (2010): 363-371.

King, M. A., and S. Wadhwani. "Transmission of Volatility between Stock Markets." *Review of Financial Studies* 3 (1990): 5-33.

Majid, M. Shabri Abd., Ahamed Kameel Meera, and Mohd Azmi Omar. "Interdependence of ASEAN-5 Stock Markets from the US and Japan." *20th Australasian Finance & Banking Conference* , 2007.

Majid, M. Shabri Abd., and Rosylin Mohd. Yusof. "Long-run Relationship between Islamic Stock Returns and Macroeconomic Variables: an application of the autoregressive distributed lag model." *Humanomics* 25, no. 2 (2009): 127-141.

Majid, M. Shabri Abd., and Salina Hj Kassim. "Impact of the 2007 US Financial Crisis on the Emerging Equity Markets." *International Journal of Emerging Markets* 4, no. 4 (2009): 341-357.

Masih, A.M.M., and R. Masih. "Are Asian Stock Market Fluctuations due Mainly to Intra-regional Contangion Effects? Evidence Based on Asian Emerging Stock Markets." *Pacific-Basin Finance Journal* 7 (1999): 251-282.

Rahman, Aisyah Abdu, and Noor Zahirah Mohd Sidek. "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, 2011. 334.

Rahman, Aisyah Abdul, Noor Zahirah Mohd Sidek, and Fauziah Hanim Tafri. "Macroeconomic Determinants of Malaysian Stock Market." *African Journal of Business Management* 3, no. 3 (2009): 095-106.

Royfaizal, R. C, C. Lee, and Azali Mohamed. "Asean-5+3 And Us Stock Markets Interdependence Before, During And After Asian Financial Crisis." *MPRA Paper 10263* (University Library of Munich, Germany), 2007.

Siskawati, Eka. "Islamic Capital Market Interconnection : Evidence from Jakarta Islamic Index to The Regional Islamic Market and Global Islamic Market." *Proceeding of the International Conference on Social Science, Economics and Art.* Putrajaya, Malaysia: International Conference on Social Science, 2011. 153-156.

Yang, J., J.W. Kolari, and I. Min. "Stock market integration and financial crises:the case of Asia." *Applied Financial Economics* 13, no. 7 (2003): 477-486.

Yusof, Rosylin Mohd., and M. Shabri Abd. Majid. "Stock Market Volatility Transmission in Malaysia: Islamic Versus Conventional Stock Market." *Journal of King Abdulaziz University: Islamic Economics* 20, no. 2 (2007): 17-35.

Table 7. Vector Error Correction Model (All Markets@Pre-Crisis)										
Error Correction:	D(LOGUS_TOT)	D(LOGNIKKEI225)	D(LOGCHINA_88)	D(LOGKLCI)	D(LOGJAKCI)	D(LOGIMUS)	D(LOGIMJAP)	D(LOGIMCHINA)	D(LOGIMKL)	D(LOGIMJAK)
ECT	-0.1186***	-0.0858**	-0.0408	-0.0286	0.1291***	-0.1127***	-0.020789	-0.010512	-0.016948	0.1351***
D(LOGUS_TOT(-1))	-0.2294	-0.3513	-0.6548	0.3592*	0.2367	-0.1989	-0.2599	-0.1024	0.2582	0.2918
D(LOGUS_TOT(-2))	0.3213	-0.0464	-1.0503*	0.2282	0.1046	0.3302	0.1015	-0.0931	0.1583	0.0068
D(LOGNIKKEI225(-1))	-0.0174	-0.1618	-0.0814	0.0160	-0.0224	-0.0262	-0.0438	-0.1188	0.0193	-0.0571
D(LOGNIKKEI225(-2))	-0.0323	-0.0931	0.1761	-0.0184	-0.2157**	-0.0143	-0.0640	-0.0162	0.0084	-0.2775**
D(LOGCHINA_88(-1))	-0.0193	-0.0667**	-0.0245	-0.0107	-0.0085	-0.0175	-0.0188	-0.0261	-0.0072	-0.0013
D(LOGCHINA_88(-2))	-0.0087	0.0103	-0.0760	0.0136	0.0029	-0.0057	0.0119	0.0253	0.0243	-0.0022
D(LOGKLCI(-1))	-0.0403	0.1162	0.5379	-0.0247	0.1696	-0.0302	0.1330	0.5707***	0.0086	0.1774
D(LOGKLCI(-2))	-0.5152***	0.1713	-0.9857**	-0.1510	0.2392	-0.5474***	0.0736	-0.0160	-0.0359	0.0649
D(LOGJAKCI(-1))	-0.0701	0.0131	0.1361	-0.0393	0.0338	-0.0127	-0.0067	0.0901	-0.0778	0.0782
D(LOGJAKCI(-2))	-0.0062	-0.0324	-0.4029	-0.0222	-0.0167	0.0583	-0.0594	-0.0912	-0.0763	0.0837
D(LOGIMUS(-1))	0.2991	1.1180***	0.6863	0.1334	0.5884*	0.2637	1.0374***	0.8245***	0.2277	0.6654*
D(LOGIMUS(-2))	-0.3104	0.1339	0.8333	-0.1515	0.2151	-0.3435	-0.0093	0.1901	-0.0793	0.2791
D(LOGIMJAP(-1))	0.0381	-0.0177	0.2426	-0.0624	0.0014	0.0474	-0.0887	0.0516	-0.0732	0.0274
D(LOGIMJAP(-2))	0.0424	0.1044	-0.1358	0.0158	0.2018	0.0247	0.0433	-0.0397	0.0146	0.2596
D(LOGIMCHINA(-1))	0.0043	-0.0560	-0.3241	-0.0325	-0.2479**	-0.0100	-0.0391	-0.1891**	-0.0432	-0.2701**
D(LOGIMCHINA(-2))	0.1189**	0.0737	0.0835	0.0504	0.1366	0.1290**	0.1003	0.1579**	0.0335	0.1173
D(LOGIMKL(-1))	0.0458	-0.0365	-0.4058	0.1668	-0.2693	0.0579	-0.1177	-0.4682**	0.1262	-0.2815
D(LOGIMKL(-2))	0.4103**	-0.0442	0.8947**	0.1124	-0.2712	0.4317**	0.0217	0.0484	0.0146	-0.0977
D(LOGIMJAK(-1))	-0.0194	0.0910	0.0691	0.0660	0.0587	-0.0593	0.1074	0.0384	0.1108	0.0327
D(LOGIMJAK(-2))	0.0063	-0.0697	0.3249	0.0220	-0.0108	-0.0550	-0.0261	0.0235	0.0777	-0.0908
C	0.0002	-0.0001	0.0016***	0.0002	0.0006**	0.0002	-0.0002	0.0003	0.0003**	0.0005**

Note: *, **, *** denote significance at 10%, 5%, 1%, respectively.

Table 8. Vector Error Correction Model (All Markets@During-Crisis)

Error Correction:	D(LOGUS_TOT)	D(LOGNIKKEI225)	D(LOGCHINA_88)	D(LOGKLCI)	D(LOGJAKCI)	D(LOGIMUS)	D(LOGIMJAP)	D(LOGIMCHINA)	D(LOGIMKL)	D(LOGIMJAK)
ECT	0.0142	0.0776**	-0.1573***	0.0893***	0.0072	0.0211	0.0712**	0.0652**	0.0706***	0.0039
D(LOGUS_TOT(-1))	0.1556	0.3111**	0.6538***	0.1284	0.3417**	0.2106	0.1010	0.4248***	0.0354	0.2308
D(LOGUS_TOT(-2))	0.2831	0.2370	0.2886	0.0725	0.2733	0.2524	0.0896	0.2037	0.0246	0.2771
D(LOGUS_TOT(-3))	-0.3091*	0.2477*	0.3788*	0.0692	0.2129	-0.2896*	0.2761**	0.1765	0.0997	0.2837
D(LOGNIKKEI225(-1))	0.0186	0.0211	-0.0777	-0.0651*	-0.1402**	0.0043	0.1782***	-0.0045	-0.0906**	-0.1908**
D(LOGNIKKEI225(-2))	-0.2820***	-0.0423	0.0354	-0.0011	-0.0635	-0.2252***	0.0261	-0.0909	0.0072	-0.0574
D(LOGNIKKEI225(-3))	0.0464	-0.0168	-0.1002	0.0393	0.0285	0.0493	-0.0242	0.0286	0.0373	0.0495
D(LOGCHINA_88(-1))	-0.0266	-0.0798***	0.0079	-0.0129	-0.0246	-0.0218	-0.0455*	-0.0766***	-0.0169	-0.0104
D(LOGCHINA_88(-2))	-0.0187	0.0189	-0.0135	0.0144	0.0184	-0.0186	0.0040	-0.0044	0.0115	0.0283
D(LOGCHINA_88(-3))	0.0288	0.0016	0.0748*	0.0122	0.0004	0.0334	-0.0290	0.0483*	0.0061	0.0095
D(LOGKLCI(-1))	-0.4261*	-0.0240	0.0253	-0.2056*	-0.4945**	-0.3528*	0.1512	-0.5147**	-0.1396	-0.6248**
D(LOGKLCI(-2))	-0.2240	0.1313	-0.1194	-0.0760	-0.1272	-0.2540	0.0655	-0.2431	-0.0597	-0.1475
D(LOGKLCI(-3))	-0.1550	0.1330	-0.4560	0.0671	0.0185	-0.1811	0.1790	-0.1178	0.0268	-0.0904
D(LOGJAKCI(-1))	0.2399*	0.1653	0.1020	0.1199*	0.1678	0.2563**	0.0968	0.1809	0.1104	0.1031
D(LOGJAKCI(-2))	0.3346**	-0.0128	-0.0099	-0.1046*	-0.1262	0.3467***	0.0488	0.0406	-0.0851	-0.0776
D(LOGJAKCI(-3))	-0.2447*	0.0699	-0.2068	-0.0125	-0.3499***	-0.2628**	0.0527	-0.1524	-0.0166	-0.3493**
D(LOGIMUS(-1))	-0.3534*	0.3683**	-0.3720	0.0555	0.0659	-0.4077**	0.4260***	0.0607	0.1544	0.2282
D(LOGIMUS(-2))	-0.3970**	0.0560	-0.1092	0.0021	-0.0245	-0.3695**	0.1453	0.0263	0.0611	0.0477
D(LOGIMUS(-3))	0.4518**	-0.0756	-0.3766	-0.0423	-0.1061	0.4288**	-0.1377	-0.0096	-0.0721	-0.1536
D(LOGIMJAP(-1))	-0.0546	-0.4217***	-0.1536*	-0.0232	-0.0153	-0.0488	-0.5049***	-0.1932***	-0.0181	0.0023
D(LOGIMJAP(-2))	0.1805**	-0.2396***	-0.0415	-0.0048	0.0243	0.1402**	-0.2672***	-0.0117	-0.0052	-0.0101
D(LOGIMJAP(-3))	0.0055	-0.0878	0.1507	-0.0542	-0.0661	0.0052	-0.0601	-0.0620	-0.0615	-0.0988
D(LOGIMCHINA(-1))	0.1142*	-0.0079	-0.0393	0.0118	-0.0472	0.1034*	-0.0717	-0.0798	0.0355	-0.0577
D(LOGIMCHINA(-2))	0.1227*	0.0396	0.0658	0.0273	0.0675	0.1032*	0.0235	0.0594	0.0246	0.0647
D(LOGIMCHINA(-3))	-0.0038	-0.0191	-0.0157	-0.0297	0.1701***	-0.0046	-0.0164	-0.0366	-0.0239	0.1793***
D(LOGIMKL(-1))	0.2066	-0.0130	-0.0477	0.1487	0.4899**	0.1759	-0.1020	0.4958**	0.0892	0.6447***
D(LOGIMKL(-2))	-0.0502	-0.2714	0.0014	0.0001	-0.0404	-0.0041	-0.1813	0.0162	-0.0315	-0.0169
D(LOGIMKL(-3))	0.1565	0.0338	0.4911*	0.0931	0.0155	0.1944	-0.0193	0.2377	0.1334	0.1337
D(LOGIMJAK(-1))	-0.1609	-0.0581	0.0287	-0.0029	-0.0808	-0.1862*	0.0058	-0.0799	0.0089	-0.0482
D(LOGIMJAK(-2))	-0.2188**	0.0828	-0.0588	0.1245**	0.1330	-0.2356**	-0.0018	-0.0029	0.1102*	0.0735
D(LOGIMJAK(-3))	0.1439	-0.0688	0.1551	-0.0229	0.1913*	0.1482	-0.0390	0.0511	-0.0160	0.1775
C	-0.0001	-0.0003	-0.0001	0.0001	0.0003	0.0000	-0.0002	0.0001	0.0000	0.0002

Note: *, **, *** denote significance at 10%, 5%, 1%, respectively.