Stock Market Integration and the Impact of the Subprime Financial Crisis: A Malaysian Perspective

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ABSTRACT

Using weekly data over the period 2002-2011, we examine market integration among 22 international markets from the viewpoint of Malaysian investors. We also analyse the impact of the subprime financial crisis of 2007-2008 on the linkages of these markets. In general, our results indicate a lack of cointegration in all market groups. We find that the subprime crisis has resulted in a temporary cointegration in the groups during the peak of the crisis, but cointegration is weak or absent in the pre- and post-crisis periods. We also find that cointegration is strongest in the Malaysian and European market groups and surprisingly weak in the group involving Malaysia and its neighbouring emerging markets. The results of the causality and variance decomposition analyses strongly indicate that Malaysia is largely unrelated with other markets. Overall, our evidence points towards the possibility for diversification benefits to local investors.

Keywords: Stock Market Integration, Subprime Crisis, Cointegration, Structural Breaks, Granger Causality, Variance Decomposition
JEL: F30, F36, G15

1. Introduction

With the rapid development in information and communication technology, it is reasonable to assume that financial markets around the world are becoming more integrated compared to the situation a decade ago. Indeed, evidence seems to suggest stronger integration among

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large and developed markets (Kasa, 1992; Friedman & Shachmurove, 1997; Fu & Pagani, 2012). However, studies also indicate that market integration is not uniform across markets, even in the same geographical regions, and neither is it stable over time. While many studies have been done on the interrelationships among large and developed markets (Chan, Gup, & Pan, 1997; Bessler & Yang, 2003; Kim, Moshirian, & Wu, 2005), recent studies focus on the relationships between developed and emerging markets (DeFusco, Geppert, & Tsetsekos, 1996; Voronkova, 2004; Syriopoulos, 2007; Ozdemir, Olgun, & Saracoglu, 2009).

The liberalisation of equity markets in many Asian emerging markets during the 1980s has resulted in a rising of interest among international investors to invest in these markets. Their interest in the Asian emerging markets is justified based on the growth potential of these markets and portfolio diversification of risks. In relation to this development, many studies were undertaken to analyse the relationship between the developed and the Asian emerging markets in order to analyse the potential diversification benefits. However, the findings are generally inconsistent; some studies show the existence of cointegration while others do not. Given this situation, the challenge to international portfolio managers is to identify markets that are unrelated or at least related to their home markets and to other markets already in their portfolios in order to maximise the diversification benefits.

This study is prompted by the need to have more research evidence concerning the integration of Asian markets with other markets of the world, and also by the lack of agreement in the results of the previous studies on market integration. The objective of this study is to examine stock market integration between Malaysia and 21 selected markets from different regions – Asian-Pacific, European and American, which are heavily invested by Malaysian mutual funds. We specifically investigate the following specific issues from the perspective of Malaysian investors: first, to examine whether the Malaysian stock market has long-run linkages with the markets in the three regions mentioned above. This is done through cointegration analysis, with and without structural breaks. Secondly, to examine short-run linkages between Malaysian market and international markets through causality and variance decomposition analyses. Thirdly, to examine whether and to what extent the 2007-2008 sub-prime financial crisis affected the long-run and short-run linkages between the financial markets. This is done by dividing the data into three subperiods: before, during and after the crisis, and examining the linkages within the subperiods.

This study contributes to the existing literature in several ways. First, our data is comprehensive in its coverage. It covers all the important regions of the world, including the Asian-Pacific, European and American markets. Our findings provide useful information for Malaysian investors in formulating their international diversification strategies. Malaysia is chosen as the focal point to represent an Asian-Pacific emerging market; this is a departure from most of the previous studies that tend to focus on developed markets. Secondly, the study provides an addition to the much needed evidence on market integration involving the Asian-Pacific region. Thirdly, this study examines the impact of the subprime financial crisis on the integration of international markets. It would be interesting to analyse the impact of the crisis that starts in the developed markets, on the Asian-Pacific emerging markets.

The paper is organised as follows. Section 2 discusses the literature on regional and global stock market cointegration. In Section 3, we describe the data and methodology used in this study, and Section 4 presents our findings. Finally, Section 5 provides a summary and conclusion of the study.

2. Literature Review

Earlier studies on Asian market integration seem to indicate the non-existence of cointegration. Cheung and Ho (1991) examine the co-movements between the developed markets and the Asian-Pacific markets and they find that there are no stable relationships over time. Similarly, Chan, Gup, and Pan (1992) use unit root and cointegration to examine the relationship among the stock markets of the US, Japan, Hong Kong, South Korea, Singapore and Taiwan, using daily and weekly data and find no evidence of cointegration. In a later study, DeFusco et al. (1996) use cointegration tests to examine the long-run diversification potential of 13 emerging capital markets and the US market using weekly data in the period of early 1990s. They report no evidence of cointegration with the US and these emerging markets. These studies therefore suggest that international diversification across these markets is justified and desirable. However, Cheung and Mak (1992) find different evidence. Using weekly data from eight Asian-Pacific markets and two developed markets (US and Japan), they find that the US market leads most of the Asian-Pacific markets in the years 1978-1988, with the exception of Korea, Taiwan and Thailand. This means that US investors may not be getting much diversification benefits by investing in the Asian-Pacific markets. Masih and Masih (1999)

provide further evidence on the role of the US market in leading the emerging Asian markets, in the short-term as well as in the long-term.

The Asian financial crisis of 1997-1998 created a sudden interest among researchers to study the nature of market integration involving Asian markets. The main question of interest concerns the impact of the crisis on market integration. It is generally believed that global events, such as financial crises, would have the systemic effect of moving markets together that will show up in the form of increased cointegration in statistical analysis. Studies on the impact of the Asian crisis on market integration include Sheng and Tu (2000), Ng (2002), Jang and Sul (2002), Manning (2002), Yang, Kolari, and Min (2003), Click and Plummer (2005), Dunis and Shannon (2005), Goh, Wong, and Kok (2005), Chi, Li, and Young (2006) and Ibrahim (2006). Most of these studies, with the exception of Goh et al. (2005) and Ibrahim (2006), generally find evidence of strengthened market integration among the Asian markets and among US and Asian markets during and after crisis. The studies also indicate that the US market is becoming more influential in leading the Asian markets. Later studies by Ozdemir et al. (2009) and Chen, Gerlach, Cheng, and Yang (2009) also find support for the increased integration. Ozdemir et al. (2009) show there are significant linkages between the US and 15 emerging equity markets in the period from 1985-2006. Chen et al. (2009) examine the integration of ASEAN-5 (Indonesia, Malaysia, the Philippines, Singapore, and Thailand) stock markets over the period from 1994 to 2005 and find evidence of cointegration. They also find that Singapore and Thailand are the main long-term drivers, while Malaysia and Indonesia are more short-term drivers of the ASEAN-5 markets.

Studies that find lack of integration in the Asian markets after the Asian financial crisis includes Goh et al. (2005), Ibrahim (2006), and Huyghebaert and Wang (2010). Goh et al. (2005) find that the linkage among the five ASEAN stock markets during the crisis is limited to the short-run relationships, in which the co-movement was stronger during the crisis, reflecting the contagion effect of the financial turmoil. They find that the long-run equilibrium relationship shared among ASEAN markets before the crisis no longer holds after the crisis. Additional evidence concerning the lack of integration is provided by Ibrahim (2006) who utilises cointegration and vector auto-regression to assess the integration of the Malaysian markets both prior to the Asian financial crisis and after the imposition of capital controls in Malaysia. Ibrahim reaches a similar conclusion to the findings of Goh et al. that suggest the absence of long-run cointegration. Both studies attribute the lack of cointegeration to the capital controls imposed by the Malaysian

Government as part of its crisis management strategy. Huyghebaert and Wang (2010) find that the relationships among the East Asian stock markets in the period 1992-2003 are time-varying; the authors find that integration was strengthened during the crisis period; however, this is just a temporary phenomenon possibly due to the crisis contagion effect. Lee, Shie, and Chang (2012) analyse market cointegration between Taiwan and other international markets and find that the cointegration relationship only exist during the Asian financial crisis between Taiwan and Hong Kong; they find no integration between Taiwan and other countries. In summary, most of the previous studies on Asian markets indicate that during the Asian financial crisis, market integration became stronger. However, once the financial crisis was over, the results became inconsistent.

Evidence among developed markets is also mixed. We mention a few studies to provide a general idea of the findings. Bessler and Yang (2003) investigate the dynamic structure of nine major developed stock markets around the world over the years 1997-1999. The authors find that the US is the only market that has a consistent impact on price movements in other major stock markets in the long-run. Voronkova (2004) examines the long-run relationship between the three emerging central European markets (the Czech Republic, Hungary and Poland), three developed European stock markets (Great Britain, France and Germany), and the US using weekly data over the period 1993-2002. Voronkova finds evidence of linkages between the emerging central European markets within the region and globally that is stronger than has previously been reported. However, Phengis and Apilado (2004), using monthly data over the period 1979-2002, find that the US does not influence European markets (France, Germany, Italy, the Netherlands and Spain). Laopodis (2005) examines 11 European and the US stock markets and concludes that European markets and the US market have not been cointegrated since the mid-1990s.

The introduction of the single European currency in 1999 has significant impact on European stock markets. Yang, Min, and Li (2003) and Westermann (2004) find that the introduction of the Euro as a single currency significantly strengthened stock market integration among its member markets. Kim et al. (2005) find that the creation of a European currency union has played a significant role in enforcing stock market integration, not only among the union members, but also the US and Japan. Bartram, Taylor, and Wang (2007) provide evidence that the increase in market integration after the introduction of the common

currency only applies for large capitalisation and liquid European markets.

Recent studies on market integration try to capture the impact of the sub-prime crisis of 2007-2008. Cheung, Fung, and Tsai (2010) examine the impact of the crisis on the interrelationship among global stock markets. They find a significant spillover effect from the US market to other global stock markets (the UK, Hong Kong, Japan, Australia, and China). The results indicate that the linkages among these markets, both the short-term causal relationships and long-term cointegration, strengthen during the crisis. The authors suggest that portfolio managers need to consider the increasing international linkages when constructing their portfolio. Gupta and Guidi (2011) examine the integration of the Indian stock market and three developed Asian markets (Hong Kong, Japan and Singapore) and the US market, using daily data over the period 1999 to 2009. Their results show no long-run relationships between India and any of the Asian developed markets. To allow for the impact of the crisis, the authors use the Gregory-Hansen test with structural breaks, but find no evidence of cointegration among these markets.

3. Data and Methodology

3.1 Data

Our sample includes stock indices for 22 international markets over a 10-year period of January 2002 to December 2011. These markets represent the top 21 international markets most heavily invested by Malaysian mutual funds in the year 2010. This information is extracted from the master prospectuses of mutual fund companies that contain all funds under their management. These markets are divided into various geographical regions or blocks for further analysis. The blocks are strategically formed to represent areas of interest from the perspective of Malaysian portfolio managers. In this study, we focus on the following blocks: Asian-Pacific, European and American.

We select the main equity index in each market to be included in our study. The list of markets and their respective equity index used are presented in the Appendix A. Stock index data are obtained from the Bloomberg database. Following the works of DeFusco et al. (1996), Click and Plummer (2005) and Cheung et al. (2010), we use weekly returns in our analysis. Weekly returns are calculated using the log formula on the Friday to Friday index values. Compared to daily data, weekly data has the advantage of minimising the problems associated

with overlapping time period and non-synchronicity of returns due to geographical location of the markets. Theoretically, for cointegration analysis, the data should preferably be in a longer interval and over a long period of time (Hooker, 1993; Lahiri & Mamingi, 1995). However, we need to strike a compromise between the need for a long study period and longer return intervals. For the study duration, we do not go too far back beyond 2002 because it may carry a confounding effect from the Asian 1997-98 crisis. As for the choice of weekly interval, it is a compromise between monthly data (less noisy but fewer observations) and daily data (noisy but large data). Our choice of the period length and data frequency is also guided by previous studies. For example, Cheung and Mak (1992), Chung and Liu (1994), DeFusco et al. (1996), Click and Plummer (2005), and Gerlach, Wilson, and Zurbruegg (2006) use weekly data over a 10-year period or less. Further, Hakkio and Rush (1991), Click and Plummer (2005) and Gerlach et al. (2006) conclude that data frequency does not have a significant impact on cointegration analysis.

Since we are interested in providing integration analysis from the Malaysian perspective, we use the Malaysian Ringgit (RM) index returns available in the Bloomberg database. However, we would like to caution that the first four years of our data coincided with the fixed exchange rate regime between Malaysia Ringgit and US Dollar (USD), implemented by the Malaysian government in response to the Asian 1997-98 financial crisis. In our opinion this does not significantly affect our overall results because it involves only converting the US market returns and only during the first subperiod.

Table 1 presents descriptive statistics on our data for the whole period and for subperiods. The subperiods are designed to reflect pre-crisis (January 2002-June 2007), during crisis (July 2007-March 2009) and post-crisis (April 2009-December 2011). The dates are determined based on the earliest and the latest structural breaks indicated by Zivot-Andrews unit-root test (see Table 2). Table 1 shows that for the whole period data, we find that all the mean equity returns are positive, except for a few European markets (UK, France, Italy and Netherlands). It can also be seen that, on average, the Asian-Pacific emerging market (Group A2) returns are highest and volatilities are greatest compared to the Asian-Pacific developed (Group A1), European (Group B) and American (Group C) markets. The Malaysian stock market has a lower average return than its neighbours of Indonesia, the Philippines and Thailand. Similar observation may be made for the pre-crisis period. Market performance changed dramatically during the crisis period

(subperiod 2) when all markets experienced negative returns and increased volatilities. Although the subprime crisis originated in the developed markets, it was the Asian-Pacific emerging markets that suffered the lowest average returns and highest volatilities. In the post-crisis period almost all markets showed positive returns, with the Asian-Pacific emerging markets showing the largest average returns.

Table 1: Mean and Standard Deviation of Weekly Returns of the Markets Included in this Study

	Whole period Jan 2002-Dec 2011		Subperiod 1 Jan 2002-Jun 2007		Subperiod 2 July 2007-March 2009		Subperiod 3 April 2009-Dec 2011	
Country	Mean (%)	S.D (%)	Mean (%)	S.D (%)	Mean (%)	S.D (%)	Mean (%)	S.D (%)
Group A1: Asian-Pacific developed markets								
JP	0.004	0.491	0.029	0.485	-0.088	0.622	0.014	0.392
HK	0.007	0.334	0.021	0.255	-0.043	0.525	0.010	0.315
AU	0.001	0.308	0.018	0.194	-0.086	0.553	0.020	0.263
SG	0.015	0.338	0.033	0.273	-0.075	0.514	0.034	0.306
NZ	0.023	0.297	0.053	0.225	-0.089	0.466	0.034	0.267
Average	*0.010*	*0.354*	*0.031*	*0.286*	*-0.076*	*0.536*	*0.022*	*0.309*
Group A2: Asian-Pacific emerging markets								
CH	0.013	0.507	0.043	0.463	-0.045	0.739	0.012	0.393
KR	0.026	0.506	0.040	0.433	-0.322	0.793	0.239	0.264
ID	0.041	0.563	0.086	0.483	-0.082	0.817	0.029	0.502
TW	0.007	0.490	0.023	0.473	-0.077	0.635	0.028	0.407
MY	0.022	0.279	0.034	0.251	-0.061	0.398	0.052	0.225
TH	0.068	0.813	0.099	0.781	-0.102	0.932	0.140	0.620
IN	0.063	0.485	0.058	0.643	-0.164	0.593	0.254	0.379
PH	0.051	0.658	0.081	0.601	-0.118	0.931	0.098	0.499
Average	*0.036*	*0.538*	*0.058*	*0.516*	*-0.121*	*0.729*	*0.106*	*0.411*
Group B: European markets								
UK	-0.001	0.292	0.015	0.184	-0.080	0.526	0.018	0.248
ES	0.006	0.416	0.042	0.253	-0.075	0.602	-0.013	0.515
FR	-0.001	0.357	0.025	0.246	-0.079	0.547	-0.002	0.383
DE	0.006	0.368	0.025	0.305	-0.060	0.537	0.011	0.349
IT	-0.009	0.315	0.017	0.184	-0.081	0.479	-0.016	0.380
SZ	0.006	0.283	0.020	0.220	-0.054	0.463	0.017	0.235
NL	-0.006	0.487	0.019	0.378	-0.121	0.746	0.016	0.464
Average	*0.000*	*0.360*	*0.023*	*0.253*	*-0.078*	*0.557*	*0.004*	*0.368*
Group C: American markets								
US	0.001	0.228	0.006	0.180	-0.050	0.364	0.021	0.196
CA	0.014	0.317	0.030	0.182	-0.056	0.551	0.025	0.287
Average	*0.008*	*0.273*	*0.018*	*0.181*	*-0.053*	*0.458*	*0.023*	*0.242*

Notes: These are index returns on the 22 stock markets included in the study: Australia (AU), China-Shanghai (CH), Hong Kong (HK), India (ID), Indonesia (IN), Japan (JP), South Korea (KR), New Zealand (NZ), Malaysia (MY), Philippines (PH), Singapore (SG), Taiwan (TW), Thailand (TH), French (FN), Germany (DE), Italy (IT), Netherlands (NL), Spain (ES), Switzerland (SZ), United Kingdom (UK), Canada (CA), and United States (US). Weekly returns are calculated using Friday-to-Friday closing prices, which are then converted into the Malaysia Ringgit (RM) returns. S.D denotes standard deviation.

3.2 Methodology

This paper investigates stock market integration from the Malaysian perspective. Our analysis is carried out in three stages. The first stage is diagnosing the nature of the stock index returns in order to ensure that we are dealing with a stationary series. For this analysis, we use three stationary tests: Augmented Dickey-Fuller (1979), Phillip-Perron (1988) and Zivot and Andrews (1992). In stage 2, we perform cointegration analysis to analyse the long-run relationship between markets for the whole period and the subperiods. For this analysis, we use the cointegration procedure developed by Johansen (1988), Johansen and Juselius (1990), and Gregory and Hansen (1996). In the third stage we breakdown our analysis to provide further understanding concerning the nature of the market relationships. We use Granger causality tests and the variance decomposition method to assess the dynamic interactions between Malaysia and other markets. The specific methods used are briefly described below.

3.2.1 Unit Root Test

Augmented Dickey-Fuller (ADF), and Phillip-Perron (PP) unit root tests are used to examine the stationary properties of the series. In addition, we use the Zivot and Andrews (ZA) test that accommodates structural breaks in the time series. ZA suggest three univariate structural break models for a unit root test. The first model (equation 1) allows for a one-time shift in the intercept of the series. The second model (equation 2) allows for a break in the slope of the trend function. The third model (equation 3) includes combinations of the intercept and the slope. The ZA models are as follows:

Model 1 Level shift: $$\Delta y_t = c + \alpha y_{t-1} + \beta_t + \gamma DU_t + \sum_{j=1}^{k} d_j \Delta y_{t-j} + \varepsilon_\varepsilon \quad (1)$$

Model 2 Level shift with trend: $$\Delta y_t = c + \alpha y_{t-1} + \beta_t + \vartheta DT_t + \sum_{j=1}^{k} d_j \Delta y_{t-j} + \varepsilon_\varepsilon \quad (2)$$

Model 3 Regime shift: $$\Delta y_t = c + \alpha y_{t-1} + \beta_t + \vartheta DT_t + \gamma DU_t + \sum_{j=1}^{k} d_j \Delta y_{t-j} + \varepsilon_\varepsilon \quad (3)$$

The above equations are similar to the ADF unit root test but with the inclusion of dummy terms. DU_t is an indicator dummy variable for a mean shift occurring at each possible break-date, while DT_t is the corresponding trend shift dummy variable. Following most of the previous time series studies, we only use model 1 and model 3 for our analysis.

3.2.2 Cointegration Test

The long-run relationship among stock markets can be explored using the Johansen (1988), and Johansen and Juselius (1990) cointegration technique, which models time series as a reduced rank regression based on maximum likelihood estimation. The Johansen method, which takes its starting point in the vector autoregression (VAR) of order p is given by:

$$y_t = \mu + A_1 y_{t-1} + ... + A_p y_{t-p} + \varepsilon_t \quad (4)$$

Where y_t is an n x 1 vector of variables that are integrated of order one that is commonly denoted as $I(1)$, and ε_t is a zero mean white noise vector process. This VAR can be re-written as:

$$\Delta y_t = \mu + \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + \varepsilon_t \quad (5)$$

Where $\Pi = \alpha\beta'$ the matrix α contains short-run adjustment parameters to the long-run relationship reflect in the matrix β, and the rank Π determines the r number of cointegrating vectors.

While Gregory and Hansen (1996) show that in the case of instability in the cointegration vector parameter, standard tests may lose power and falsely signal the absence of equilibrium in the system, the Gregory-Hansen test for cointegration allows for an endogenously determined structural break of unknown timing. They suggest three alternative models allowing structural change in the cointegrating relationship. The first model is called Model C (level shift model), which allows for a change only in the intercept:

$$\text{Model C: } y_{1t} = \mu_1 + \mu_2 \varphi_{t\tau} + \alpha' y_{2t} + \varepsilon_t, \qquad t=1,\ldots,n \quad (6)$$

The second model is called Model C/T (level with a trend), which accommodates a trend in the data, while also restricting the changes to shifts in the level:

$$\text{Model C/T: } y_{1t} = \mu_1 + \mu_2 \varphi_{t\tau} + \beta t\ \alpha' y_{2t} + \varepsilon_t, \qquad t=1,\ldots,n \quad (7)$$

The last model is called Model C/S (Regime shift), which allows for changes in both the intercept and slope of the cointegration vector:

$$\text{Model C/S: } y_{1t} = \mu_1 + \mu_2 \varphi_{t\tau} + \alpha_1' y_{2t} + \alpha_2' y_{2t} \varphi_{t\tau} + \varepsilon_t,\ t=1,\ldots,n \quad (8)$$

All the models above permit a structural change through the dummy variable $\varphi_{t\tau}$, which is defined as:

$$\varphi_{t\tau} = \begin{cases} 0, & t \le [n\tau] \\ 1, & t > [n\tau] \end{cases} \quad (9)$$

Where t (0,1) is a relative timing of change point. Equations (6) to (8) are estimated sequentially with the changing break points. The non-stationarity of the obtained residuals is verified by the ADF and PP tests. Setting the test statistics (denoted as ADF*(Z_a*, Z_t*)) to the smallest values of the ADF (Z_a, Z_t) statistics in the sequence, we select the value that constitutes the strongest evidence against the null hypothesis of no cointegration.

3.2.3 Causality and Variance Decomposition Tests

To further study the financial integration and how the stock markets affect each other, the Granger causality test is applied in this study. We conduct the causality test based on Granger's approach (Granger, 1969) to examine the relationships between Malaysia and other stock markets. In order to test for Granger causality, we estimate the following equations:

$$Y_t = \alpha_0 + \sum_{i=1}^{k} \alpha_i Y_{t-i} + \sum_{i=1}^{k} \beta_i X_{t-i} + e_t \quad (10)$$

$$X_t = b_0 + \sum_{i=1}^{k} b_i X_{t-i} + \sum_{i=1}^{k} \delta_i Y_{t-i} + \nu_t \quad (11)$$

In these equations, X_t and Y_t are returns on two stock market indices. In equation (10), X_t is said to Granger-cause Y_t if $\Sigma_{i=1}^{k} \beta_i$ is significantly different from zero. Equation (11) is essentially the same as Equation (10) with X_t and Y_t reversing their positions. In this equation, Y_t is said to Granger-cause X_t if $\Sigma_{i=1}^{k} \delta_i$ is significantly different from zero.

In addition to the Granger causality analysis, we use variance decomposition of forecast error analysis to show the proportion of the movements in a market due to its own shocks versus shocks from other

markets. Variance decomposition serves to supplement the findings of Granger causality. In the presence of causality, we expect the shocks of the causing market to be transmitted to the caused market. If the variance of the forecast error of a market is explained mostly by its own shocks and less by shocks of other markets, the market is said to be more segmented than integrated.

4. Results

4.1 Unit Root Tests

This study uses the ADF test and PP test to examine whether the stock indices are stationary. In Table 2 column (1) the ADF test statistic result shows that the presence of a unit root in the market indices cannot be rejected for all markets. However, taking the first difference (Column 2), the null hypothesis of a unit root is strongly rejected at the 1 per cent significance level. Therefore, the indices are non-stationary in their level form, but are stationary in their first differenced forms. In short, these indices can generally be characterised as integrated of order 1, or an *I*(1) process. The PP test (not reported here) produces the same results as ADF test.

The shortcoming of the ADF and PP tests is that neither allow for a structural break in time series data, which may have a significant impact on the stationary result. Zivot and Andrews (ZA) (1992) develop unit root procedures that allow the existence of a structural break in the series, without predetermining the break point. Since the subprime crisis is embedded in our data, we use the ZA procedure to detect the possible existence of structural breaks. The results of the ZA unit root test are presented in columns 3 to 6 of Table 2. Two main observations arise. First, similar to the ADF and PP tests, the ZA test statistics indicate that all series are *I* (1). Secondly, the breakpoints, as identified by the ZA test, vary across markets, but most breaks occur during the crisis years of 2007-2009; the earliest occurrence was in July 2007 and the latest was in March 2009. For subsequent analysis, we use the breakpoints identified by the ZA test to divide our sample into three subperiods, which are as follows: subperiod 1 is the pre-crisis period (January/2002 – June/2007), subperiod 2 is during crisis (July/2007 – March/2009) and subperiod 3 (April/2009 – December/2011) is the post-crisis period.

Table 2: Results of Unit Root Test (Level and First Difference)

	Augmented Dickey-Fuller (ADF) unit root test		Zivot-Andrews test Level		Zivot-Andrews test Fist differences	
Country	Level	First difference	Model 1	Model 3	Model 1	Model 3
Group A1: Asian-Pacific developed markets						
JP	-1.901	-23.280***	-3.419	-3.792	-23.479*** [03/10/09]	-25.288*** [03/10/09]
HK	-1.533	-23.486***	-3.431	-3.901	-23.827*** [11/06/07]	-23.815*** [03/10/09]
AU	-1.350	-9.786***	-4.145	-3.800	-25.966*** [03/10/09]	-26.031*** [03/10/09]
SG	-1.309	-14.739***	-3.807	-3.765	-15.086*** [03/10/09]	-15.384*** [03/10/09]
NZ	-2.523	-14.969***	-3.782	-2.889	-15.968*** [03/10/09]	-16.001*** [03/10/09]
Group A2: Asian-Pacific emerging markets						
CH	-1.261	-11.634***	-3.607	-3.455	-12.460*** [10/16/07]	-12.460*** [10/16/07]
KR	-1.169	-25.045***	-3.832	-3.782	-25.253*** [07/24/07]	-24.913*** [03/17/09]
ID	-1.716	-10.058***	-2.871	-3.959	10.510*** [11/13/07]	-10.791*** [03/17/09]
TW	-1.995	-15.060***	-3.838	-3.949	-15.317*** [12/02/08]	-15.504*** [02/10/09]
MY	-0.881	-14.068***	-3.740	-3.850	-14.449*** [03/17/09]	-14.582*** [03/17/09]
TH	-1.700	-7.901***	-3.275	-3.862	-9.667*** [12/02/08]	-9.680*** [12/09/08]
IN	-0.805	-11.609***	-4.175	-4.369	-8.603*** [11/25/08]	-8.683*** [11/25/08]
PH	-0.668	-15.440***	-4.752	-4.649	-24.429*** [07/17/07]	-24.448*** [07/17/07]
Group B: European markets						
UK	-1.376	-29.944***	-4.284	-4.303	-26.299*** [03/10/09]	-26.350*** [03/10/09]
ES	-1.551	-24.916***	-2.444	-3.716	-25.216*** [03/10/09]	-25.340*** [03/10/09]
FR	-1.398	-24.338***	-3.264	-3.863	-24.535*** [03/10/09]	-24.647*** [03/10/09]
DE	-1.526	-14.953***	-3.864	-4.236	-15.119*** [08/01/08]	-15.202*** [08/01/08]
IT	-0.463	-23.533***	-2.844	-3.733	23.974*** [03/10/09]	-24.179*** [03/10/09]
SZ	-1.755	-11.430***	-3.382	-3.656	-11.842*** [03/10/09]	-11.943*** [03/10/09]
NL	-1.537	-22.210***	-4.543	-4.537	-22.381*** [03/10/09]	-22.452*** [03/10/09]
Group C: American markets						
US	-1.941	-14.735***	-4.303	-4.350	-15.113*** [03/10/09]	-15.123*** [03/10/09]
CA	-1.584	-24.590***	-4.402	-4.256	-24.925*** [03/10/09]	-25.053*** [03/10/09]

Notes: Models 1 and 3 denote the different model types in Zivot and Andrews (1992). Model 1 (level shift) allows for a one-time shift in the intercept, and Model 3 (regime shift) combines the one-time shift in the intercept and the slope of the trend function of the series. The numbers in brackets are the estimated structural break dates [mm/dd/year]. *, ** and *** indicate significance at the 10%, 5% and 1% levels respectively. For ZA test only dates for statistically significant breaks are reported.

4.2 Cointegration Tests

4.2.1 Johansen Test

To analyse the long-run interrelationships among stock markets, we first apply the Johansen and Juselius cointegration procedure that requires estimating a vector autoregressive of order p, VAR (p). We use the Akaike Information Criterion (AIC) to estimate the optimal lag p of the VAR. In our case, the AIC result indicates that only one lag is appropriate. We organise the markets into various groups based on geographical location. Group A consists of Asian-Pacific markets and this is further subdivided into developed markets (A1 - Japan, Hong Kong, Australia, Singapore and New Zealand) and emerging markets (A2 - China, Korea, India, Taiwan, Thailand, Indonesia and Philippines) using the MSCI classification. Group B consists of seven European markets (UK, Spain, French, Germany, Italy, Switzerland and the Netherlands) while Group C consists of the US and Canadian markets. Table 3 presents the trace test results of the Johansen multivariate test for cointergration. In most cases, we find that the trace statistics results are the same either with or without a linear trend. In addition, the results are qualitatively similar in the maximum Eigenvalue statistics.

For the whole period, only Group B shows cointegration with one integrating vector, with and without linear trend. Moving into the subperiods, we find similar behaviour in the pre-crisis period. However, we find a dramatic increase in cointegration among the groups during the crisis period in which there exists significant cointegration for Groups A1, A2 and B. There are at least two cointegrating vectors for Group A1, one vector for Group A2 and two vectors for Group B. This result is consistent with most of the previous studies (for example, Jang & Sul, 2002; Click & Plummer, 2005; and Chi et al., 2006) that find increased cointegration during crisis times because all markets are reacting to a common stimulus. After the crisis, results for subperiod 3 indicate less cointegration in the groups, except for Group B that shows increased cointegration. It seems that the European markets are having an extended impact of the crisis. Our results reinforce prior studies (for example, Westermann, 2004; and Kim et al., 2005) on the European market, which show strong cointegration since the formation of the European Union.

It may be worth pointing out that despite increased intra-regional trade between Malaysia and neighbouring emerging markets, the results indicate that there is no cointegration among them except during the

peak of the subprime crisis. Our result is consistent with Sheng and Tu (2000) and Ibrahim (2006) but not with Goh et al. (2005). It should be mentioned that all these studies focus on the Asian 1997-98 financial crisis whereas the current study focuses on the 2007-2008 global financial crisis. The common feature of these studies and our study is the objective of analysing the impact of financial crisis on market integration. In addition our data encompass all markets covered by each of these studies. However, their data frequency and study periods are different. Sheng and Tu (2000), using daily data for the period 1996-1998 find one cointegrating vector among nine Asian markets during the Asian financial crisis, but none in the period before crisis. Ibrahim (2006), using monthly data over the period 1988 to 2003 finds no cointegration among ASEAN markets before, as well as after the crisis. In contrast Goh et al. (2005), using daily data for the period 1992 to 2002, find cointegration evidence during the pre-crisis period, but none during the crisis period.

Table 3: Multivariate Johansen Cointegration Trace Tests Results

Hypothesised number of CE	Whole period Jan 2002- Dec 2011		Subperiod 1 Jan 2002-Jun 2007		Subperiod 2 Jul 2007-Mar 2009		Subperiod 3 Apr 2009-Dec 2011	
	Without linear trend	*With linear trend*	*Without linear trend*	*With linear trend*	*Without linear trend*	*With linear trend*	*Without linear trend*	*With linear trend*
Group A1								
None	96.351	75.143	95.342	106.851	127.929**	134.530**	85.598	113.667
At most 1					72.651**	92.571**		
At most 2					39.428	55.005		
Group A2								
None	157.067	122.331	143.107	181.820	196.333**	213.982**	148.056	173.333
At most 1					123.348	123.571		
Group B								
None	194.227**	165.223**	169.469**	194.476**	227.455**	259.145**	193.380**	227.931**
At most 1	132.501	105.801	125.460	144.267	143.625**	175.085**	137.864**	158.002**
At most 2					90.426	112.151	96.746**	118.384**
At most 3							69.051	87.193
Group C								
None	26.918	10.146	20.173	35.793	13.154	27.073	18.683	27.869

Notes: This table reports the results of Group A1: Malaysia and Asian-Pacific developed markets (JP, HK, AU, SG and NZ); Group A2: Malaysia and Asian-Pacific emerging markets (CH, KR, ID, TW, TH, IN and PH); Group B: Malaysia and European markets (UK, ES, FR, DE, IT, SZ and NL); and Group C: Malaysia and American markets (US and CA). Two likelihood ratio techniques including trace statistics and maximum eigenvalue statistic are used to determine the number of cointegrating vectors. In this table, we present the trace test results only. *, ** and *** indicate significance at the 10%, 5% and 1% levels respectively, as provided by Mackinnon (1994).

4.2.2 Gregory-Hansen Test

Gregory and Hansen's (1996) methodology focus on improving the power of conventional cointegration tests by allowing for a structural change within the data. The analysis is conducted using the whole period sample as well as for the subperiods. Table 4 presents the results of the Gregory-Hansen cointegration test for all the three models (C, C/S and C/T). The numbers in the brackets show the dates of the break points detected. We only report the break points for which the null hypothesis of no cointegration was rejected. Table 4 shows that for the

Table 4: Gregory-Hansen Cointegration Test Statistic (ADF)

Model	Whole period Jan 2002-Dec 2011	Subperiod 1 Jan 2002-Jun 2007	Subperiod 2 Jul 2007-Mar 2009	Subperiod 3 Apr 2009-Dec 2011
Group A1: Malaysia and Asian-Pacific developed markets (JP, HK, AU, SG and NZ)				
C – Level shift model	-5.643	-4.032	-5.523* [07/01/2008]	-5.082
C/T – Level with a trend model	-5.551	-4.133	-5.591* [07/01/2008]	-5.318
C/S – Regime shift model	-6.376	-5.427	-7.483** [07/15/2008]	-6.188
Group A2: Malaysia and Asian-Pacific emerging markets (CH, KR, ID, TW, TH, IN and PH)				
C – Level shift model	-6.072	-5.316	-5.718** [07/22/2008]	-5.320
C/T – Level with a trend model	-6.209	-5.248	-6.427** [07/22/2008]	-5.304
C/S – Regime shift model	-6.695	-6.247	-7.034** [02/26/2008]	-5.964
Group B: Malaysia and European markets (UK, ES, FR, DE, IT, SZ and NL)				
C – Level shift model	-7.198** [08/25/2009]	-5.694** [02/28/2006]	-6.189** [06/10/2008]	-6.593** [04/13/2010]
C/T – Level with a trend model	-7.112** [01/26/2010]	-5.931** [02/28/2006]	-6.043** [06/10/2008]	-6.457** [04/13/2010]
C/S – Regime shift model	-7.502** [01/20/2009]	-6.974** [05/30/2006]	-7.462** [02/26/2008]	-6.576** [7/27/2010]
Group C: Malaysia and American markets (US, and CA)				
C – Level shift model	-4.098	-3.248	-4.357	-4.673
C/T – Level with a trend model	-4.306	-3.957	-3.643	-4.524
C/S – Regime shift model	-4.363	-4.540	-4.382	-5.695

Notes: Model C: level shift (change in constant); Model C/T: level shift with trend (change in constant with a linear trend); Model C/S: regime shift (change in both constant and slope). Critical values are taken from Gregory and Hansen (1996). The dates in brackets refer to the structural break dates [mm/dd/yy]; only dates for statistically significant breaks are reported. *, ** and *** indicate significance at the 10%, 5% and 1% levels respectively.

whole period and for the pre-crisis period, only Group B markets are integrated. However, for subperiod 2, all groups except Group C are integrated, while in the post-crisis period only Group B is integrated. In fact, Group B shows integration for all subperiods, while Group C shows no integration for all subperiods. The Gregory-Hansen results presented in Table 4 is therefore consistent with the Johansen multivariate results that are presented in Table 3.

In summary, our cointegration tests indicate that the Asian-Pacific developed stock markets and the Asian-Pacific emerging markets are not integrated except during the peak of the crisis. The absence of cointegration in these markets indicates that the markets are independent or segmented and there are opportunities for portfolio diversification. Our results of no cointegration in the Asian-Pacific markets are somewhat inconsistent with the majority of the previous studies (for example, Yang et al., 2003; and Click & Plummer, 2005) that were conducted in the aftermath of the Asian financial crisis of 1997-98. Our results on the presence of cointegration in the European market are consistent with most of the previous findings (for example, Kim et al., 2005; and Bartram et al., 2007). Surprisingly, the group of the US, Canada and Malaysia does not indicate any cointegration among them.

4.3 Causality and Variance Decomposition Analyses

The cointegration results presented in the previous section look for long-term co-movements of markets. In order to provide further insight into the nature of the relationship between the cointegrated markets, in this section we present causality analysis between markets. Egert and Kocenda (2007) argue that even in situation where there is a lack of cointegration, it is important to investigate the presence of short-term linkages between markets. Thus, in this section, we present also the results of two tests of the short-term market relationships. These are the Granger causality test and the variance decomposition analysis.

4.3.1 Granger Causality Analysis

Granger causality is an analysis to understand the nature of linkages between two markets – whether one market is influencing or causing the other market, or whether the two markets are causing each other. Technically, we can analyse causality for many pairs of markets in our multiple-market group. However, since our interest is

from the Malaysian perspective, we only analyse results of the causality between Malaysia and other markets. The analysis is based on vector autoregressive (VAR) model in the case of no cointegration and on the vector error correction (VEC) model if there is cointegration. The number of optimal lag in Granger causality test is based on the Akaike Information Criterion (AIC). The results of the Granger's causality tests are presented in Table 5 based on F-statistic.

In Table 5, Column (1) shows results of other markets Granger-causing Malaysia and Column (2) shows results of Malaysia Granger-

Table 5: Granger Causality Test Results

	Whole period Jan 2002- Dec 2011		Subperiod 1 Jan 2002- Jun 2007		Subperiod 2 Jul 2007- Mar 2009		Subperiod 3 Apr 2009-Dec 2011	
Group A1: Malaysia and Asian-Pacific developed markets (JP, HK, AU, SG and NZ)								
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
JP	0.182	0.306	0.974	1.110	3.623**	0.138	3.651**	0.811
HK	1.350	0.010	1.631	1.146	5.461**	0.034	1.325	1.137
AU	0.051	0.253	1.640	0.810	1.660	1.878	0.786	0.037
SG	4.031**	0.018	2.554**	1.988*	2.878**	1.424	1.697	1.514
NZ	0.482	0.200	0.631	0.264	1.896	1.223	1.245	0.929
Group A2: Malaysia and Asian-Pacific emerging markets (CH, KR, ID, TW, TH, IN and PH)								
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
CH	0.322	0.221	1.542	1.889	1.877**	1.394	1.387	1.758
KR	0.664	2.350	0.705	1.731	0.981	0.504	0.225	1.262
ID	2.019	0.341	1.347	1.855	1.450	1.436	0.471	0.868
TW	0.234	0.431	0.393	0.370	0.639	1.477	0.772	0.947
TH	0.474	1.853	0.355	0.135	0.229	3.787**	1.271	2.068
IN	4.360**	4.073**	3.147**	0.871	0.975	6.043**	0.421	1.961
PH	6.390**	4.694**	3.176**	0.910	1.251	3.706**	1.028	0.895
Group B: Malaysia and European markets (UK, ES, FR, DE, IT, SZ and NL)								
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
UK	4.636**	0.378	2.841**	0.981	2.359**	1.241	0.538	0.425
ES	1.902	1.858	1.867	1.594	1.567	0.324	1.665	1.025
FR	1.263	0.709	3.854**	1.331	2.535*	0.401	0.582	0.804
DE	6.910**	0.161	4.232**	1.068	3.095**	0.729	1.539	0.878
IT	2.474	2.559	4.096**	0.989	2.405**	1.435	2.887**	0.363
SZ	1.254	0.181	1.547	0.640	0.627	0.576	0.376	0.088
NL	0.052	0.180	1.626	1.069	1.818	0.738	1.246	0.348
Group C: Malaysia and American markets (US, and CA)								
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
US	10.791**	0.384	5.772**	1.712	3.935**	1.165	0.944	0.323
CA	5.122**	0.220	2.920**	0.746	2.941**	1.742	0.815	0.501

Notes: The table shows the F-statistics for coefficients, presented in two columns. Column (1) refers to other markets (on the left) Granger-causing Malaysia; Column (2) refers to Malaysia Granger-causing other markets. *, ** and *** indicate significance at the 10%, 5% and 1% levels respectively.

causing other markets. The results indicate a lack of causality between Malaysia and other markets, and also there is a lack of observable impact of the crisis on the causality relationships. Among the Asian-Pacific developed markets (Group A1), only Singapore may be Granger-causing Malaysia, while Japan and Hong Kong also join in to lead Malaysia during the crisis period. Surprisingly, Japan being the de-facto leader of Asian-Pacific equity markets, does not show strong influence on the Malaysian market, except during crisis. This result is in contrast to Masih and Masih (2001). Among the Asian-Pacific emerging markets, Indonesia and the Philippines indicate a two-way causality with Malaysia over the whole period, but further breakdown shows that the two countries lead Malaysia during pre-crisis period while the opposite takes place during crisis period. The results for Group B indicate a one-way causality between UK, France, Germany and Italy in which these markets Granger-cause Malaysia, but Malaysia does not lead any of the European markets. Group C results clearly show that the US and Canada are Granger-causing Malaysia, while Malaysia does not Granger-cause these markets.

4.3.2 Variance Decomposition Analysis

The Granger causality tests only indicate the most significant direct causal relationship. To investigate further the extent to which Malaysia market could be explained by changes in other markets, variance decomposition (VDC) of forecast error is used. Variance decomposition shows the per centage of forecast error variance that is attributable to its own and other countries shocks.

Table 6 shows the results of variance decomposition analysis for a two-week forecast period. For Group A1, it can be seen that the Malaysian market explains almost 99 per cent of its own variance, except during the crisis period. Other Asian-Pacific developed markets are not found to be explaining fluctuations in the Malaysian market. During the crisis period, Japanese market seems to exert some influence on the Malaysian market. Group A2 shows more or less a similar story with Group A1 in the sense that about 98 per cent of the forecast error is explained by its own variance; other markets including its neighbours have little role in influencing Malaysia's market. But during the crisis period the immediate neighbouring markets (Thailand, Indonesia and Philippines) show some influence in the variance of the Malaysian market. In general, Malaysia looks somewhat detached from other Asian-Pacific markets.

More or less similar observations may be made with the European markets (Group B) in which the Malaysian variance is not much influenced by innovations from European markets. The results also show that the magnitude of responses to any random innovations during the crisis period is relatively larger compared to the pre- and post-crisis periods, in particular by the UK market. Group C results indicate that Malaysian variance is marginally explained by the US market and unrelated to the Canadian market. The US influence ranges between 2 to 3 per cent. In general it is fair to conclude that movements in the Malaysian stock market are unrelated to other markets across the world.

Table 6: Generalised Variance Decomposition of Forecast Error

	Whole period Jan 2002-Dec 2011	Subperiod 1 Jan 2002-Jun 2007	Subperiod 2 Jul 2007-Mar 2009	Subperiod 3 Apr 2009-Dec 2011
Group A1: Malaysia and Asian-Pacific developed markets (JP, HK, AU, SG and NZ)				
MY	98.869	98.864	95.460	98.212
JP	0.221	0.412	3.061	0.730
HK	0.060	0.014	0.610	0.088
AU	0.553	0.261	0.017	0.348
SG	0.296	0.409	0.491	0.456
NZ	0.001	0.040	0.361	0.166
Group A2: Malaysia and Asian-Pacific emerging markets (CH, KR, ID, TW, TH, IN and PH)				
MY	98.551	97.646	94.236	98.789
CH	0.053	0.332	0.165	0.320
KR	0.034	0.009	0.436	0.265
ID	0.362	0.741	0.671	0.005
TW	0.158	0.472	0.236	0.104
TH	0.290	0.563	1.840	0.454
IN	0.314	0.121	1.357	0.003
PH	0.238	0.116	1.059	0.060
Group B: Malaysia and European markets (UK, ES, FR, DE, IT, SZ and NL)				
MY	97.750	98.270	89.798	96.024
UK	1.203	0.769	3.390	0.193
ES	0.046	0.490	0.857	1.975
FR	0.351	0.090	1.605	0.563
DE	0.397	0.314	2.266	0.084
IT	0.052	0.002	0.878	0.087
SW	0.070	0.001	0.612	1.071
NL	0.131	0.064	0.594	0.003
Group C: Malaysia and American markets (US, and CA)				
MY	97.682	97.847	96.829	98.794
US	2.297	2.070	2.961	1.193
CA	0.021	0.083	0.210	0.013

Notes: Variance forecast are over a two-week horizon. Entries in the table are per centages of the forecast error variance of the Malaysian market explained by the shocks of own and of other markets. The per centages are standardised so that they sum up to 100%.

In summary, the variance decomposition results are consistent with those from the Granger causality tests. First, our findings for the Malaysian stock market indicate that it is a fairly isolated market, as it does not respond significantly to shocks in the other international markets, while influence in other markets are also limited. The variance decomposition analysis shows that the Malaysian market is not influenced by foreign shocks, with about 2 per cent of its forecast variance explained by the Asian-Pacific developed markets and by its neighbouring emerging markets (A2 - China, Korea, India, Taiwan, Thailand, Indonesia and Philippines), and less than 4 per cent of its variance explained by the European and by the American markets during the pre- and post-crisis periods. However, during the crisis period, the results show an increased influence of other markets on Malaysia. This finding is consistent with Goh et al. (2005) who find that the influence of foreign market shocks on the Malaysian market was highest during the crisis period.

5. Conclusion

This paper examines the market integration involving Malaysia and other global stock markets over the period 2002-2011 using weekly returns that are computed on Friday-to-Friday closing prices. All international returns are converted into Malaysia currency returns. Using the Johansen cointegration analysis, our results indicate little evidence of cointegrating relationships between Malaysia and the Asian-Pacific developed or Asian-Pacific emerging markets except during the peak of the subprime crisis. However, Malaysia and the European markets show significant cointegration and the cointegrating relationships seem to become stronger during and after the crisis periods. We find no cointegration in the Malaysian, US and Canadian markets. To account for potential instability in the market relationship over the period, the Gregory-Hansen cointegration test is applied; the evidence found is similar with the Johansen cointegration results.

The Granger causality test indicates that the Malaysian market has a weak interdependence with other Asian-Pacific emerging or developed markets. Statistically significant relationships show that Singapore, Indonesian and the Philippines are causing Malaysia, but Malaysia seems to have little influence on other markets except on its neighbouring markets (Thailand, Indonesia and Philippines) during the crisis period. A number of European markets show a one-way

causality with Malaysia but Malaysia does not cause any European markets. The US and Canada, however, indicate their dominant role in causing the Malaysian market. The variance decomposition of forecast variance analyses show that, at the two-week horizon, the Malaysia stock market is largely unresponsive to foreign innovations. Shocks from other markets have marginal influence in explaining fluctuations in the Malaysia market, except during the peak of the subprime crisis. These results are consistent with the results of the causality analysis.

Given the continuous advancement in communication technology and increased international trades between countries, our results on the absence of cointegration in the market groups, except the European group, and the lack of linkages and influence between Malaysia and other markets, may be considered as somewhat unexpected. Variance decomposition analysis clearly suggests that the Malaysian market is relatively isolated. The main implication of these results is that ample opportunities of gaining diversification benefits for Malaysian portfolio investors exist by going international.

References

Bartram, S.M., Taylor, S.J., & Wang, Y.H. (2007). The Euro and European financial market dependence. *Journal of Banking and Finance*, *31*(5), 1461-1481.

Bessler, D.A., & Yang, J. (2003).The structure of interdependence in international stock markets. *Journal of International Money and Finance*, *22*(2), 261-287.

Chan, K.C., Gup, B.E., & Pan, M.S. (1992). An empirical analysis of stock prices in major Asian markets and the United States. *The Financial Review*, *27*(2): 289-308.

Chan, K.C., Gup, B.E., & Pan, M.S. (1997). International stock market efficiency and integration: A study of eighteen nations. *Journal of Business Finance and Accounting*, *24*(6), 803-813.

Chen, C.W.S., Gerlach, R., Cheng, N.Y.P., & Yang, Y.L. (2009). The impact of structural breaks on the integration of the ASEAN-5 stock markets. *Mathematics and Computers in Simulation*, *79*(8), 2654-2664.

Cheung, Y.L., & Ho. Y.K. (1991). The inter-temporal stability of the relationships between Far East equity and the developed equity markets. *Journal of Business Finance and Accounting*, *18*(2), 235-254.

Cheung, Y.L., & Mak, S. (1992).The international transmission of stock market fluctuations between the developed markets and the Asian-Pacific markets. *Applied Financial Economics*, *2*(1), 43-47.

Cheung, W., Fung, S., & Tsai, S.C. (2010). Global capital market interdependence and spillover effect of credit risk: Evidence from the 2007-2009 global financial crisis. *Applied Financial Economics, 20*(1-2), 85-103.

Chi, J., Li, K., & Young, M. (2006). Financial integration in East Asian equity markets. *Pacific Economic Review*, *11*(4), 513-526.

Chung, P.J., & Liu, D.J. (1994). Common stochastic trends in Pacific Rim stock markets. *Quarterly Review of Economics and Finance*, *34*(3), 241-259.

Click, R.W., & Plummer, M.G. (2005). Stock market integration in ASEAN after the Asian financial crisis. *Journal of Asian Economics*, *16*(1), 5-28.

DeFusco, R.A., Geppert, J.M., & Tsetsekos, G.P. (1996). Long-run diversification potential in emerging stock markets. *The Financial Review*, *31*(2), 343-363.

Dickey, D.A., & Fuller, W.A. (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association*, *74*(366), 427-431.

Dunis, C.L., & Shannon, G. (2005). Emerging markets of South-East Asia and Central Asia: Do they still offer a diversification benefit? *Journal of Asset Management*, *6*(3), 168-190.

Egert, B., & Kocenda, E. (2007). Interdependence between Eastern and Western European stock markets: Evidence from intraday data. *Economic Systems*, *31*(2), 184-204.

Friedman, J., & Shachmurove, Y. (1997). Co-movements of major European community stock markets: A vector autoregression analysis. *Global Finance Journal*, *8*(2), 257-277.

Fu, R., & Pagani, M. (2012). On the cointegration of international stock indices. *Journal Economics and Finance*, *36*(2), 463-480.

Gerlach, R., Wilson, P., & Zurbruegg, R. (2006). Structural breaks and diversification: The impact of the Asian financial crisis on the integration of Asia-Pacific real estate markets. *Journal of International Money and Finance*, *25*, 974-999.

Goh, K.L., Wong, Y.C., & Kok, K.L. (2005). Financial crisis and intertemporal linkages across the ASEAN-5 stock markets. *Review of Quantitative Finance and Accounting*, *24*, 359-377.

Granger, C.W.J. (1969). Investigating causal relations by econometric models and cross-spectral methods. *Econometrica*, *37*(3), 424-438.

Gregory, A.W., & Hansen, B.E. (1996). Residual-based tests for cointegration in models with regime shift. *Journal of Econometrics*, *70*(1), 99-125.

Gupta, R., & Guidi, F. (2011). Cointegration relationship and time varying co-movements among Indian and Asian developed stock markets. *International Review of Financial Analysis*, *21*, 10-22.

Hakkio, C.S., & Rush, M. (1991). Cointegration: How short is the long-run? *Journal of International Money and Finance*, *10*, 571-581.

Hooker, M.A. (1993). Testing for cointegration: Power versus frequency of observation. *Economic Letter*, *41*, 359-362.

Huyghebaert, N., & Wang, L.H. (2010). The co-movement of stock markets in East Asia: Did the 1997-1998 Asian financial crisis really strengthen stock market integration? *China Economic Review*, *21*(1), 98-112.

Ibrahim, M.H. (2006). Integration or segmentation of the Malaysian equity market: An analysis of pre- and post-capital controls. *Journal of the Asia Pacific Economy*, *11*(4), 424-443.

Jang, H., & Sul, W. (2002). The Asian financial crisis and the co-movement of Asian stock markets. *Journal of Asian Economics*, *13*(1), 94-104.

Johansen, S. (1988). Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control*, *12*(2), 231-254.

Johansen, S., & Juselius, K. (1990). Maximum likelihood estimation and inference on cointegration: With applications to the demand for money. *Oxford Bulletin of Economics and Statistics*, *52*(2), 169-210.

Kasa, K. (1992). Common stochastic trend in international stock markets. *Journal of Monetary Economics*, *29*(1), 95-124.

Kim, S.J., Moshirian, F., & Wu, E. (2005). Dynamic stock market integration driven by the European Monetary Union: An empirical analysis. *Journal of Banking and Finance*, *29*(10), 2475-2502.

Lahiri, K., & Mamingi, N. (1995). Testing of cointegration: Power versus frequency of observation – Another view. *Economic Letter*, *49*, 121-124.

Laopodis, N.T. (2005). Portfolio diversification benefits within Europe: Implications for the US investor. *International Review of Financial Analysis*, *14*(4), 455-476.

Lee, C.N., Shie, F.S., & Chang, C.Y. (2012). How close a relationship does a capital market have with other such markets? The case of Taiwan from the Asian financial crisis. *Pacific Basin Finance Journal*, *20*(3), 349-362.

MacKinnon, J.G. (1994). Approximate asymptotic distribution functions for unit-root and cointegration tests. *Journal of Business and Economic Statistics*, *12*(2), 167-176.

Manning, N. (2002). Common trends and convergence? South East Asian equity markets 1988-1999. *Journal of International Money and Finance*, *21*(2), 183-202.

Masih, A.M.M., & Masih, R. (1999). Are Asian stock market fluctuations due mainly to intra-regional contagion effects? Evidence based on Asian emerging stock markets. *Pacific-Basin Finance Journal*, *7*, 251-282.

Masih, A.M.M., & Masih, R. (2001). Long and short term dynamic causal transmission amongst international stock markets. *Journal of International Money and Finance*, *20*(4), 563-587.

Ng, H.T. (2002). Stock market linkages in South East Asia. *Asian Economic Journal*, *16*(4), 335-346.

Ozdemir, Z.Z., Olgun, H., & Saracoglu, B. (2009). Dynamic linkages between the center and periphery in international stock markets. *Research in International Business and Finance*, *23*(1), 46-53.

Phengis, C.W., & Apilado, V.P. (2004). Economic interdependence and common stochastic trends: A comparative analysis between EMU and non-EMU stock markets. *International Reviews of Financial Analysis*, *13*(3), 245-263.

Phillips, P.C.B., & Perron, P. (1988). Testing for unit roots in time series regression. *Biometrika*, *75*(2), 335-346.

Sheng, H., & Tu, A. (2000). A study of cointegration and variance decomposition among national equity indices before and during the period of the Asian financial crisis. *Journal of Multinational Financial Management*, *10*(3-4), 345-365.

Syriopoulos, T. (2007). Dynamic linkages between emerging European and developed stock markets: Has the EMU any impact? *International Review of Financial Analysis*, *16*(1), 41-60.

Voronkova, S. (2004). Equity markets integration in Central European emerging markets: A cointegration analysis with shifting regimes. *International Review of Financial Analysis*, *3*(5), 633-648.

Westermann, F. (2004). Does the Euro affect the dynamics interactions of stock markets in Europe? Evidence from France, Germany and Italy. *European Journal of Finance*, *10*(2), 139-148.

Yang, J., Kolari, J.W., & Min, I. (2003). Stock market integration and financial crises: The case of Asia. *Applied Financial Economics*, *13*(7), 477-86.

Yang, J., Min, I., & Li, Q. (2003). Europe an stock market integration: Does EMU matter? *Journal of Business Finance and Accounting, 30*(9-10), 1253-1276.

Zivot, E., & Andrews, D.W.K. (1992). Further evidence on the great crash, the oil price shock, and the unit root hypothesis. *Journal of Business and Economic Statistic*, *10*(3), 251-270.

Appendix A: Market Indices used in this study.

Countries	*Region*	*Developed/ Emerging Markets*	*Stock Exchange*	*Stock indices*
Australia	Asian-Pacific	Developed	Australia Stock Exchange (ASX)	All Ordinaries Index
Canada	American	Developed	Toronto Stock Exchange (TSE)	S&P/TSX Composite Index
China	Asian-Pacific	Emerging	Shanghai Stock Exchange (SSE)	SSE Composite Index
French	European	Developed	Paris Bourse	CAC-40 Index
Germany	European	Developed	Frankfurt Stock Exchange	DAX Index
Hong Kong	Asian-Pacific	Developed	Stock Exchange of Hong Kong (SEHK)	Hang Seng Index
India	Asian-Pacific	Emerging	Bombay Stock Exchange (BSE)	BSE-200 Index
Indonesia	Asian-Pacific	Emerging	Jakarta Stock Exchange (JSX)	JSX Composite Index
Italy	European	Developed	Milan Stock Exchange	FTSE Italia All share
Japan	Asian-Pacific	Developed	Tokyo Stock Exchange	Nikkei-225 Index
Malaysia	Asian-Pacific	Emerging	Kuala Lumpur Stock Exchange (KLSE)	Kuala Lumpur Composite Index
Netherlands	European	Developed	Amsterdam Stock Exchange (AEX)	AEX Index
New Zealand	Asian-Pacific	Developed	New Zealand Stock Exchange (NZSE)	NZSE-50 Capital Index
Philippines	Asian-Pacific	Emerging	Philippines Stock Exchange (PSE)	PSE Composite Index
Singapore	Asian-Pacific	Developed	Stock Exchange of Singapore (SES)	Strait Times Index
Spain	European	Developed	Madrid Stock Exchange	MADX Index
South Korea	Asian-Pacific	Developed	Korea Stock Exchange (KSE)	KSE Composite Stock Price Index (KOSPI)
Switzerland	European	Developed	Zurich Stock Exchange	Swiss Market Index (SMI)
Taiwan	Asian-Pacific	Emerging	Taiwan Stock Exchange	Taiwan Stock Exchange Composite Index
Thailand	Asian-Pacific	Emerging	Stock Exchange of Thailand (SET)	SET Index
United Kingdom	European	Developed	London Stock Exchange (LSE)	FTSE-100 Index
United States	American	Developed	New York Stock Exchange (NYSE)	Dow Jones Industrial Average (DJIA)