

# Integration of Asian Stock Markets

Noor A. Auzairy, Rubi Ahmad, Catherine S.F. Ho, and Ros Z. Z. Sopian

**Abstract**—This paper is to explore the relationship and the level of stock market integration of the Asian countries, primarily concentrating on Malaysia, Thailand, Indonesia, and South Korea, with the world from January 1997 to December 2009. The degree of short-run and long-run stock market integration of those Asian countries are analyzed in order to determine the significance of series of regional and world financial crises, liberalization policies and other financial reforms in influencing the level of stock market integration. To test for cointegration, this paper applies coefficient correlation, univariate regression analyses, cointegration tests, and vector autoregressive models (VAR) by using the four Asian stock markets main indices and the MSCI World index. The empirical findings from this work reveal that there is no long-run stock market integration for the four countries and the world market. However, there is short run integration.

**Keywords**—Asia, integration, relationship, stock market.

## I. INTRODUCTION

THE Asian financial crisis of 1997-1998 proved to be devastating to the foreign exchange and financial markets of the Asian region, which had a lasting impact on their respective economic systems. The crisis created awareness for the Asian nations that the region needs to maintain financial stability and possess strong and stable equity markets. In order to promote financial stability, strengthen and stabilize equity market, and create economic and political balance with EU and NAFTA, Asian countries need to strengthen their monetary and financial cooperation. The strengthening of financial cooperation would act as a counterweight to the recent increase in the integration of global financial markets. If Malaysia and its neighboring countries, or more specifically, ASEAN (The Association of Southeast Asian Nations), manage to combine their effort in strengthening their respective financial markets to drive their respective economies, it would be much easier for these countries to cooperate financially, and integrate effectively. The integration shows how the countries in the region assimilate in order to stabilize and strengthen the regional markets. Once the markets have been integrated, the creation of a common regional market should not be a problem. Indeed, attempts are

already underway for an Asian and ASEAN common market.

This paper, therefore, investigates whether there is an increase in the level of stock market integration after the countries experiencing devastating impact of 1997 financial crisis and having series of financial reforms. The short-run and long-run integration levels of the Asian stock markets: mainly, Malaysia, Indonesia, Thailand and South Korea are analyzed. Those four Asian countries had been directly affected by the Asian financial crisis in 1997, have gone through numbers of financial reforms and as the representatives of other Asian emerging economies. This paper analyzes the relationship and the integration level of the stock markets in the region with the rest of the world from Jan 1997 to December 2009.

The findings of this paper would acknowledge how related and integrated the countries in the region are and how they are connected to the rest of the world. This would also assist international portfolio investors in making right decision in their assets allocation. By analyzing the four Asian countries representing the developed and emerging economies, the findings would be able to assist the Asian authorities of different economies, as well as the authorities of other developing economies, in making decisions on their financial reforms and how to go further in having stronger financial cooperation, and thus, having stronger capital markets in the region.

The paper is divided into five sections. This section details the background of the research, problem statement, objectives, and contribution. The next section is on the literature review. Section three explains the research methodology. The findings on stock market integration are in section four before a section on conclusion and recommendation.

## II. LITERATURE REVIEW

Many studies have focused on the integration or segmentation of financial or stock markets during pre and post first liberalization and financial crisis, mainly for developing or emerging countries. This thesis differs from earlier studies since it focuses on the level of integration of the four Asian countries and the world stock markets from 1997 to 2009, the period in which a number of financial reforms and liberalization policies have been implemented. The stock markets have also undergone the 1997-1998 Asian financial crisis and world recession in the early and end of 2000s.

The findings of previous literature on the impact of stock market liberalization on stock market integration of emerging countries, reveal that there is little to no evidence of market segmentation, but an increasing level of market integration after the first stock market liberalization [1]-[6]. The countries were found segmented before liberalization [2]. Hoque [7],

N. A. Auzairy is with the National University of Malaysia, Bangi, Malaysia. She is now with the School of Management, Faculty of Economics and Management. She is also a PhD student of University Malaya, Malaysia. (e-mail: azryani.auzairy@yahoo.com).

R. Ahmad is with University of Malaya, Malaysia. She is now the head of Finance and Banking Department, Faculty Business and Accounting.

C. S. F. Ho is the head for Management School of Finance, Insurance, Economics and Islamic Banking, Faculty of Business Management, University Institute of Technology Mara, Shah Alam, Selangor, Malaysia.

R. Z. Z. Sopian is with the National University of Malaysia, Bangi, Malaysia. She is now with the School of Management, Faculty of Economics and Management.jp).

Taskin and Muradoglu [8] also proved that the stock market liberalization manages to integrate its market with the rest of the world. There is also claim that the removal of capital flow restrictions, and the introduction of different types of index funds managed to increase the integration of stock markets [8]. Chuah [10] states that country risk, trade openness and stock market development are important determinants in explaining the different level of integration of emerging markets.

Currency crisis is found to have significant influence on the progress of financial and economic integration in Asia both in the short run and long run [11]-[13]. The benefits of an international portfolio diversification seemed reduced, but not eliminated. Guo [4], Ibrahim [14] and Ibrahim [15], however, claim that there is no significant improvement in stock market integration after the Asian financial crisis. Currency crises, indeed, are found to have caused temporarily increase in the level of segmentation [16], [17]. There are also claims that there are diversification benefits at the initial stage of the 2007 crisis, but no diversification benefits during the prolonged downturn [18], [19].

### III. METHODOLOGY

The data used for the integration analyses were the countries' weekly stock market main indices in terms of log, and the first difference of countries' main indices, which were also the countries' weekly stock market returns. The weekly stock market indices collected are the Kuala Lumpur Composite Index, Stock Exchange of Thailand Composite Index, Jakarta Stock Exchange Composite Index, Korea Composite Stock Price Index and Morgan Stanley Capital International World Index. The indices used were in natural logarithm to allow for better comparison among the countries.

The relation and integration analyses of the four Asian countries and the world stock markets were divided into two groups. The first group analyzes the integration level of full sample period from 1997 to 2009. This thirteen year integration analyses cover the period before, during and after the Asian financial crisis and the period of the U.S. subprime mortgage crisis. The second group analyzes further the integration level in shorter time frame, which is in five-year period, starting year 2000, in which the Asian economy has been recovered from the Asian financial crisis. The earlier five-year analysis was from 2000 to 2004, while the later five-year analysis was from 2005 to 2009. The earlier five-year analyses include the 2001 recession, while the later five-year analyses includes the 2008-2009 U.S. subprime mortgage crisis. The two groups of analyses would be able to indicate if there was any improvement in the integration from time to time.

The relation and integration analyses carried out in this thesis were the coefficient of correlation, ordinary least square (OLS) regression estimations controlling for world effect, Johansen cointegration test, and vector autoregressive model (VAR) of variance decomposition and impulse response. The

time series applied in the analyses had been tested for stationarity, autocorrelation, multicollinearity and heteroskedasticity. The findings of those integration analyses are illustrated in detail in the following sections.

### IV. FINDINGS

#### A. Coefficient Correlation

The coefficient correlations were carried out to measure the extent of linear relationship between the two countries' stock market indices. The associations within the five stock markets of South Korea, Malaysia, Thailand, Indonesia and the world seemed lower in the earlier five-year period of 2000-2004, and higher in the later five-year period of 2005-2009 (refer to Appendix A). The thirteen-year correlations, generally, were the average. These results revealed that those markets are closely linked to each other more recently compared to the earlier periods, except for the association between Thailand's and Indonesia's stock markets, and the association between Thailand's and South Korea's. The closer link might be due to the implementation of liberalization policies and other financial reforms, advances in information and communication technology.

The correlations between the two Asian countries' stock market indices were greater than the correlations between the world's and any of the Asian countries' stock market indices. These findings were proven in the correlation analyses within the thirteen-year period of 1997-2009, and the earlier five-year period of 2000-2004. Only in the later five-year period of 2005-2009, the correlations between the world's and any of the Asian countries' stock markets seemed to be stronger, especially between the world's and Thailand's stock markets.

#### B. Ordinary Least Square Regression

Ordinary least square (OLS) regression estimation, an indicator of short-run correlation, were conducted to measure the relationships of the four Asian countries' with the MSCI world's stock market. The Model of  $R_{it} = \alpha_i + \beta R_{Wot} + \varepsilon_{it}$ , where  $R_{it}$  is the market returns of main index of country  $i$  at time  $t$ ;  $R_{Wot}$  is the MSCI world market returns at time  $t$ ;  $\varepsilon_{it}$  is independently distributed random error term with zero mean and constant variance, was applied in three periods: the full-year period of 1997-2009, the earlier five-year period of 2000 to 2004, and the later five-year period of 2005 to 2009.

Appendix B.1 shows that the world stock market returns were significantly and positively related to each of the four Asian stock market returns. Studies done on emerging markets [21] and Asian emerging markets [1] also convey that there is a positive relationship between country's stock market returns and world stock market returns. South Korea's had the greatest relationship with the world stock market returns, while Indonesia's had the lowest. The  $R^2$ s, with a range of 5 percent to 24 percent, implied that the regression model still does not fit well with the data. There should be other factors that contribute to the performances of those four Asian countries' stock markets. The world's stock returns, being the independent variable in the model, however, was able to

explain the variation in  $y$  due to the probabilities of F-statistics.

Appendix B.2 indicates that in the earlier five-year period of 2000-2004, only three Asian countries were significantly related to the changes in the world stock market. Those three countries were South Korea, Malaysia and Thailand. Only Indonesia's stock market returns were not significantly affected by the changes in the world stock market returns. Among the three countries with significant world market coefficients, South Korea earned the highest impact from the world stock market. The other countries experienced lesser impact of the world stock market in this period than the impact during the thirteen full-year period.

There were superior relationships between the stock market returns of Asian country and the world in the later five-year period than those in the earlier five-year period, except for the relationship between South Korea and the world markets. Among the three periods, South Korea obtained the lowest coefficient of the world market. In comparison to the other three countries, South Korea was still the country with the highest world market's influence. Appendix B.3 portrays all significant world market coefficients at one and five percent levels for all the four Asian countries. Therefore, there was evidence to support that the four Asian countries and the world stock markets were related, but at different degrees. Indeed, the  $R^2$ s were also higher, which indicates that the variables in the equation fit better, but are not that highly correlated.

#### C. Long-Run Cointegration

Long-run integration among the four Asian countries and the world stock markets is analyzed by applying Johansen cointegration test.

Based on Appendix C.1, the trace test results suggest that there was an absence of cointegration among the five stock markets, since none of its probabilities obtained less than 0.05 significant levels. Max-eigenvalue test results, however, exhibit one cointegrating equation among the region at 5 percent significant level. Due to weak power of the cointegration tests, it is concluded that the null hypothesis stating that there were no cointegrating vectors, could not be rejected. Thus, in the full-year period of 1997 to 2009, the five stock markets had no long-term tendency to converge with each other.

For the earlier five-year period of 2000-2004, the results in Appendix C.2, portray no cointegration equation at the 0.05 significant level for both trace and max-eigenvalue tests. Therefore, the Asian countries' stock markets were neither tied to each other, nor to the world market. In the long run, their stock markets start to drift away from other market trends.

It was found that there was also no cointegrating equation among the five stock markets in the later five-year period (refer to Appendix C.3). The results suggest that the four Asian countries and the world stock markets do not share a long run equilibrium.

Due to weak power of cointegration tests, there was lack of evidence to reject the null hypothesis of no long-run co-movement. Therefore, the four Asian stock markets and the world stock market did not share a long-run equilibrium. Those stock markets could drift away arbitrarily from each other. This finding was inconsistent with the findings of others, which generally found that the emerging markets were just increasingly integrated, especially after relaxing foreign investment restrictions [1], [3], [4], introduction of different types of index funds [9], trade openness and stock market development [10], [20]. Ibrahim [14] and Ibrahim [15], however, supported the claim that there was no significant integration in the long run.

#### D. Vector Autoregression (VAR)

This paper continued to examine the short-run dynamic interactions among the five stock markets of South Korea, Malaysia, Thailand, Indonesia and the world after discovering that there was no long-run co-movement among those stock markets by applying vector autoregressive (VAR) models. The VAR was performed based on the descending order, from the most to the least developing countries [2]. The orders were as follows: South Korea, Malaysia, Thailand and Indonesia, which was based on the GDP per capital for each country (World Bank data website).

To further examine the influences of the world, other Asian countries and its own domestic disturbances on a country's stock market returns, the variance decompositions and impulse responses based on a VAR specification were carried out on those five countries stock market returns.

For short-run dynamic interactions between Asian and the world stock markets, both variance decompositions and impulse response results in Appendices D, documented that the interaction between those Asian and the world stock markets had been increasing. These findings of significant and positive relationships between the Asian and the world markets were also supported by other studies [1], [21]. South Korea's interaction with the world market had been the highest among the four Asian stock markets. Its interaction with the world had been consistent in years 2000 onwards but had shown some improvement as compared to its world interaction in late 1990s. Generally, the innovations in the world stock market explained greater sizeable fractions of the Asian stock markets forecast error variances in the later years. However, the world innovations were the third contributor to the fluctuations in the four Asian markets after domestic disturbances and innovation in Indonesia. World innovations remained as the second contributor to the fluctuations in Indonesia market with the maximum percentage of 13 percent in the later five-year period.

In terms of short-run integration between the Asian countries, the results of the four analyses portrayed greater positive correlation between the two countries in Asia in the later five-year period. Indonesia's market managed to account for 27 to 31 percents of fluctuations in the other three Asian markets and became the second contributor. In early 2000s,

innovation in Indonesia only accounted for 1 to 8 percents of the other four stock market movements. Indeed, Indonesia's market even contributed one third of the world market fluctuations. Fluctuations in Indonesia, on the other hand, had been substantially dominated by its own domestic sources and world shocks.

The domestic variations turned up to be the first significant contributors to variations in the four Asian and world markets. Even so, the fraction that was accounted for by the domestic variations reduced substantially in the later five-year period by 10 to 42 percents. The influence of domestic shocks in accounting for domestic aggregate fluctuations had reduced to less than 50 percent to the three Asian markets, not including Indonesia. Indonesia's domestic shocks accounted up to 80 percents still, which implied that a strong or stable economic environment in Indonesia was crucial for better performance of its stock market.

As a whole, in the short-run, the four Asian countries are highly integrated to their own domestic shocks and are increasingly influenced by the world market. Thus, policy makers should focus in stabilizing and enhancing the economic conditions of their own country policy. At the same time, some international financial diversification strategies are also needed in order to encounter international disturbances. In addition, due to an increasing importance of Indonesia's market in the region, any matters arise in that country, should be looked into, possibly is to align with its policies. The implementation of liberalization policies and other financial reforms are considered successful in integrating regional stock markets and with the world market but only in the short-run, not in the long-run.

## V. CONCLUSION

The weak results of the Johansen cointegration tests reveal that there is no long-run integration among the four Asian countries and the world stock markets. Those Asian countries stock prices are neither tied to regional markets, nor to the world market. These results imply that the liberalization policies and other financial reforms are not sufficiently significant in deepening the integration levels of the stock markets in the region and the world. The 1997 Asian financial crisis may contribute to an increasing level of segmentation in the region. After going through a hard time to survive in the major crisis, those Asian countries emerged to be stronger with improved local and regional mechanisms, which made them not totally dependent on U.S and world markets. Hence, the 2009 U.S. subprime mortgage crisis could not affect those Asian countries as bad as it affect the European countries.

The results on short-run dynamic interaction as shown in variance decomposition and impulse response, indicate that the domestic variations are the most significant contributors to variations in the four Asian and world markets. Even so, the fraction that is accounted for by the domestic variations is substantially reduced in the last five-year period of 2005-2009. Thus, the domestic matters, economically, politically

and socially, still become the major factor determining the performance of the stock markets. Proper control and management of the local markets would make it easier to control and manage the regional and world market.

Indonesia's shocks then became the second contributor to variations in the other Asian and world markets. These results prove that there is a short-run integration between the Asian countries' stock markets, mainly Indonesia's. Indonesia has been increasingly attractive to many foreign investors after China. Thus, anything matters on Indonesian stock market, should be looked into by the other Asian markets.

The short-run dynamic integration between the four Asian countries and the world stock market is also improving recently. The world market becomes the third contributor to the stock market fluctuations in South Korea, Malaysia and Thailand, after Indonesia. In Indonesia, world market play significant role in affecting its stock market after its own domestic shocks. The results from coefficient correlation and OLS regression are consistent with the findings in VAR analyses that the four Asian countries are becoming closely related or integrated with the world market. Being positively related, the growth in the world market would initiate the growth in the region, however, any crisis which affect the world market, such as the U.S. subprime mortgage crisis, would badly affect the region too. Therefore, it is important to identify the factors contributing to the link with the world market and how to go about extricating the link at the time of world crisis.

An increased segmentation or reduced long-run integration of the four Asian stock markets reveals that there could be also another factor(s) that contribute to the insulation of the stock markets in the region. The experienced of the financial crisis encountered by the four countries, may have awakened them and make them become more cautious, stringent and independent, which contribute to the insulation of the markets. Such condition helps the countries and the region from being badly affected by the U.S. subprime mortgage crisis. The results of the findings also imply that the international portfolio diversification benefits are still relevant in these four Asian markets in the long-run.

The international portfolio diversification benefits in these four Asian markets, however, may be limited in the short-run since there are substantial short-run dynamic interactions among the four Asian and the world markets. In the recent five-year period, Indonesia and world markets have big influenced on stock market fluctuations of Malaysia, South Korea and Thailand. Therefore, Indonesia market has lesser potential for short-run diversification as compared to the other three Asian countries'. It is suggested to explore further the factors that contribute to greater interaction with Indonesia market and factors that contribute to lesser interaction with Malaysia, South Korea and Thailand markets.

Other financial measures should be in place if the objectives of having regional and world integrations are to achieve in order to enhance financial cooperation and financial stability. Thus, further studies on the determinants of

stock market integration are recommended. Due to the negative impact of the U.S. subprime mortgage crisis on the European economy and its financial markets, other countries try to be isolated from the U.S. and the world markets. Indeed, France and Germany had also been demanding for a tough new regulation of global finance at G20 in April, 2009, instead of demanding for the deregulation of global finance in order to avoid a repeat of the financial crisis. As a result, there is a question whether should the countries integrate to each other or should they not. Therefore, getting to know the factor(s) that play significant role in integrating and segmenting markets would be a great advantage, which should be explored further.

## APPENDIX

## APPENDIX A I

COEFFICIENT CORRELATION OF THE FOUR ASIAN COUNTRIES AND THE  
WORLD STOCK MARKET MAIN INDICES  
(1997 - 2009)

|       | World                    | Korea                    | Msia                     | Thai                     |
|-------|--------------------------|--------------------------|--------------------------|--------------------------|
| Korea | ***0.559<br><i>0.000</i> |                          |                          |                          |
| Msia  | ***0.470<br><i>0.000</i> | ***0.870<br><i>0.000</i> |                          |                          |
| Thai  | ***0.395<br><i>0.000</i> | ***0.775<br><i>0.000</i> | ***0.813<br><i>0.000</i> |                          |
| Indo  | ***0.531<br><i>0.000</i> | ***0.925<br><i>0.000</i> | ***0.852<br><i>0.000</i> | ***0.812<br><i>0.000</i> |

Note: Probabilities of t-statistics are in italic.

\*, \*\*, and \*\*\* denote rejection of the hypothesis at 10%, 5%, and 1% levels, respectively

## APPENDIX A II

COEFFICIENT CORRELATION OF THE FOUR ASIAN COUNTRIES AND THE  
WORLD STOCK MARKET MAIN INDICES  
(2000 - 2004)

|       | World                    | Korea                    | Msia                     | Thai                     |
|-------|--------------------------|--------------------------|--------------------------|--------------------------|
| Korea | ***0.205<br><i>0.001</i> |                          |                          |                          |
| Msia  | ***0.545<br><i>0.000</i> | ***0.777<br><i>0.000</i> |                          |                          |
| Thai  | -0.076<br><i>0.219</i>   | ***0.701<br><i>0.000</i> | ***0.597<br><i>0.000</i> |                          |
| Indo  | ***0.242<br><i>0.000</i> | ***0.753<br><i>0.000</i> | ***0.776<br><i>0.000</i> | ***0.903<br><i>0.000</i> |

Note: Probabilities of t-statistics are in italic.

\*, \*\*, and \*\*\* denote rejection of the hypothesis at 10%, 5%, and 1% levels, respectively.

## APPENDIX A III

COEFFICIENT CORRELATION OF THE FOUR ASIAN COUNTRIES AND THE  
WORLD STOCK MARKET MAIN INDICES  
(2005 - 2009)

|       | World                    | Korea                    | Msia                     | Thai                     |
|-------|--------------------------|--------------------------|--------------------------|--------------------------|
| Korea | ***0.619<br><i>0.000</i> |                          |                          |                          |
| Msia  | ***0.633<br><i>0.000</i> | ***0.880<br><i>0.000</i> |                          |                          |
| Thai  | ***0.870<br><i>0.000</i> | ***0.552<br><i>0.000</i> | ***0.565<br><i>0.000</i> |                          |
| Indo  | ***0.431<br><i>0.000</i> | ***0.901<br><i>0.000</i> | ***0.917<br><i>0.000</i> | ***0.390<br><i>0.000</i> |

Note: Probabilities of t-statistics are in italic.

\*, \*\*, and \*\*\* denote rejection of the hypothesis at 10%, 5%, and 1% levels, respectively.

## APPENDIX B I

COUNTRIES' AND WORLD MARKET RETURNS IN OLS REGRESSION MODEL  
(1997 - 2009)

|                    | Korea                    | Msia                     | Thai                     | Indo                     |
|--------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| C                  | 0.095<br><i>0.542</i>    | -0.018<br><i>0.887</i>   | -0.046<br><i>0.754</i>   | 0.181<br><i>0.271</i>    |
| World              | ***0.889<br><i>0.000</i> | ***0.405<br><i>0.000</i> | ***0.665<br><i>0.000</i> | ***0.401<br><i>0.000</i> |
| R <sup>2</sup>     | 0.240                    | 0.094                    | 0.165                    | 0.055                    |
| Adj R <sup>2</sup> | 0.239                    | 0.093                    | 0.163                    | 0.054                    |
| Prob(Fst)          | 0.000                    | 0.000                    | 0.000                    | 0.000                    |

Note: Regression model as  $R_{it} = \alpha_i + \beta R_{Wot} + \varepsilon_{it}$ , where  $R_{it}$  is the market returns of main index of country  $i$  at time  $t$ ;  $R_{Wot}$  is the MSCI world market returns at time  $t$ ;  $\varepsilon_{it}$  is independently distributed random error term with zero mean and constant variance;  $\alpha_i$  and  $\beta$  are the parameters to be estimated. Data is stationary Probabilities of t-statistics are in italic.

\*, \*\*, and \*\*\* indicate significant difference at 10, 5 and 1 percent levels, respectively.

## APPENDIX B II

COUNTRIES' AND WORLD MARKET RETURNS IN  
OLS REGRESSION MODEL (2000 - 2004)

|                    | Korea                    | Msia                     | Thai                     | Indo                  |
|--------------------|--------------------------|--------------------------|--------------------------|-----------------------|
| C                  | 0.028<br><i>0.907</i>    | 0.073<br><i>0.624</i>    | 0.171<br><i>0.406</i>    | 0.178<br><i>0.375</i> |
| World              | ***0.956<br><i>0.000</i> | ***0.237<br><i>0.000</i> | ***0.423<br><i>0.000</i> | 0.147<br><i>0.154</i> |
| R <sup>2</sup>     | 0.235                    | 0.048                    | 0.077                    | 0.011                 |
| Adj R <sup>2</sup> | 0.232                    | 0.044                    | 0.073                    | 0.007                 |
| Prob(Fst)          | 0.000                    | 0.000                    | 0.000                    | 0.095                 |

Note: Regression model as  $R_{it} = \alpha_i + \beta R_{Wot} + \varepsilon_{it}$ , where  $R_{it}$  is the market returns of main index of country  $i$  at time  $t$ ;  $R_{Wot}$  is the MSCI world market returns at time  $t$ ;  $\varepsilon_{it}$  is independently distributed random error term with zero mean and constant variance;  $\alpha_i$  and  $\beta$  are the parameters to be estimated. Data is stationary Probabilities of t-statistics are in italic.

\*, \*\*, and \*\*\* indicate significant difference at 10, 5 and 1 percent levels, respectively.

## APPENDIX B III

COUNTRIES' AND WORLD MARKET RETURNS IN OLS REGRESSION  
MODEL (2005 - 2009)

|                    | Korea                    | Msia                     | Thai                     | Indo                    |
|--------------------|--------------------------|--------------------------|--------------------------|-------------------------|
| C                  | 0.246<br><i>0.140</i>    | 0.126<br><i>0.281</i>    | 0.031<br><i>0.853</i>    | 0.355<br><i>0.135</i>   |
| World              | ***0.814<br><i>0.000</i> | ***0.344<br><i>0.000</i> | ***0.678<br><i>0.000</i> | **0.275<br><i>0.026</i> |
| R <sup>2</sup>     | 0.458                    | 0.234                    | 0.366                    | 0.045                   |
| Adj R <sup>2</sup> | 0.455                    | 0.231                    | 0.364                    | 0.042                   |
| Prob(F-st)         | 0.000                    | 0.000                    | 0.000                    | 0.001                   |

Note: Regression model as  $R_{it} = \alpha_i + \beta R_{Wot} + \varepsilon_{it}$ , where  $R_{it}$  is the market returns of main index of country  $i$  at time  $t$ ;  $R_{Wot}$  is the MSCI world market returns at time  $t$ ;  $\varepsilon_{it}$  is independently distributed random error term with zero mean and constant variance;  $\alpha_i$  and  $\beta$  are the parameters to be estimated. Data is stationary Probabilities of t-statistics are in italic.

\*, \*\*, and \*\*\* indicate significant difference at 10, 5 and 1 percent levels, respectively.

## APPENDIX C I

JOHANSEN COINTEGRATION TESTS – MALAYSIA, THAILAND, INDONESIA,  
SOUTH KOREA AND WORLD STOCK MARKETS (1997 – 2009)

| Hypothesized<br>No. of CE(s) | Trace<br>Statistic | Prob. <sup>+</sup> | Max-Eigen<br>Statistic | Prob. <sup>+</sup> |
|------------------------------|--------------------|--------------------|------------------------|--------------------|
| None                         | 68.320             | 0.065              | *38.620                | 0.013              |
| At most 1                    | 29.701             | 0.734              | 16.346                 | 0.636              |
| At most 2                    | 13.355             | 0.875              | 7.547                  | 0.929              |
| At most 3                    | 5.808              | 0.718              | 5.783                  | 0.641              |
| At most 4                    | 0.025              | 0.874              | 0.025                  | 0.874              |

Trace test indicates no cointegration at the 0.05 level

Max-eigenvalue test indicates 1 cointegrating equation(s) at the 0.05 level

\* and \*\* denotes rejection of the hypothesis at the 0.10 and 0.05 levels, respectively

## APPENDIX C II

JOHANSEN COINTEGRATION TESTS – MALAYSIA, THAILAND, INDONESIA,  
SOUTH KOREA AND WORLD STOCK MARKETS (2000 – 2004)

| Hypothesized<br>No. of CE(s) | Trace<br>Statistic | Prob.** | Max-Eigen<br>Statistic | Prob.** |
|------------------------------|--------------------|---------|------------------------|---------|
| None                         | 53.782             | 0.471   | 27.289                 | 0.248   |
| At most 1                    | 26.493             | 0.873   | 12.331                 | 0.919   |
| At most 2                    | 14.162             | 0.831   | 7.659                  | 0.923   |
| At most 3                    | 6.503              | 0.636   | 4.797                  | 0.767   |
| At most 4                    | 1.706              | 0.192   | 1.706                  | 0.192   |

Trace test indicates no cointegration at the 0.05 level

Max-eigenvalue test indicates no cointegration at the 0.05 level

## APPENDIX C III

JOHANSEN COINTEGRATION TESTS – MALAYSIA, THAILAND, INDONESIA,  
SOUTH KOREA AND WORLD STOCK MARKETS (2005 – 2009)

| Hypothesized<br>No. of CE(s) | Trace<br>Statistic | Prob.** | Max-Eigen<br>Statistic | Prob.** |
|------------------------------|--------------------|---------|------------------------|---------|
| None                         | 64.092             | 0.132   | 32.597                 | 0.071   |
| At most 1                    | 31.496             | 0.640   | 14.002                 | 0.823   |
| At most 2                    | 17.493             | 0.604   | 11.986                 | 0.549   |
| At most 3                    | 5.507              | 0.753   | 3.691                  | 0.890   |
| At most 4                    | 1.8162             | 0.178   | 1.816                  | 0.178   |

Trace test indicates no cointegration at the 0.05 level

Max-eigenvalue test indicates no cointegration at the 0.05 level

## APPENDIX D I

VARIANCE DECOMPOSITION OF MSCI WORLD, SOUTH KOREA,  
MALAYSIA, THAILAND AND INDONESIA STOCK MARKET RETURNS (1997 –  
2009)

| Variance Decomposition of World: |       |        |        |        |        |        |
|----------------------------------|-------|--------|--------|--------|--------|--------|
| Period                           | S.E.  | World  | Korea  | Msia   | Thai   | Indo   |
| 5                                | 2.595 | 88.176 | 1.529  | 0.395  | 0.337  | 9.563  |
| 10                               | 2.599 | 88.071 | 1.553  | 0.427  | 0.376  | 9.574  |
| 15                               | 2.599 | 88.068 | 1.555  | 0.427  | 0.376  | 9.573  |
| 20                               | 2.599 | 88.068 | 1.555  | 0.427  | 0.376  | 9.573  |
| Variance Decomposition of Korea: |       |        |        |        |        |        |
| 5                                | 4.697 | 20.806 | 73.486 | 0.452  | 0.918  | 4.339  |
| 10                               | 4.709 | 20.850 | 73.196 | 0.479  | 0.975  | 4.501  |
| 15                               | 4.709 | 20.852 | 73.190 | 0.480  | 0.977  | 4.501  |
| 20                               | 4.710 | 20.852 | 73.190 | 0.481  | 0.977  | 4.501  |
| Variance Decomposition of Msia:  |       |        |        |        |        |        |
| 5                                | 3.417 | 8.269  | 6.119  | 78.277 | 0.842  | 6.492  |
| 10                               | 3.434 | 8.640  | 6.293  | 77.671 | 0.850  | 6.546  |
| 15                               | 3.434 | 8.644  | 6.307  | 77.653 | 0.850  | 6.546  |
| 20                               | 3.434 | 8.644  | 6.308  | 77.652 | 0.850  | 6.546  |
| Variance Decomposition of Thai:  |       |        |        |        |        |        |
| 5                                | 4.232 | 15.861 | 9.838  | 5.311  | 64.783 | 4.208  |
| 10                               | 4.247 | 16.006 | 9.981  | 5.365  | 64.431 | 4.218  |
| 15                               | 4.247 | 16.010 | 9.984  | 5.367  | 64.422 | 4.218  |
| 20                               | 4.247 | 16.010 | 9.984  | 5.367  | 64.421 | 4.218  |
| Variance Decomposition of Indo:  |       |        |        |        |        |        |
| 5                                | 4.431 | 9.591  | 2.319  | 6.205  | 3.417  | 78.468 |
| 10                               | 4.446 | 9.664  | 2.512  | 6.196  | 3.407  | 78.222 |
| 15                               | 4.446 | 9.666  | 2.523  | 6.197  | 3.406  | 78.208 |
| 20                               | 4.446 | 9.666  | 2.523  | 6.197  | 3.406  | 78.207 |

Note: Cholesky Ordering: World, South Korea, Malaysia, Thailand, and Indonesia

## APPENDIX D II

VARIANCE DECOMPOSITION OF THE WORLD, SOUTH KOREA, MALAYSIA,  
THAILAND AND INDONESIA STOCK MARKET RETURNS  
(2000 - 2004)

| Variance Decomposition of World: |       |        |        |        |        |        |
|----------------------------------|-------|--------|--------|--------|--------|--------|
| P                                | S.E.  | World  | Korea  | Msia   | Thai   | Indo   |
| 5                                | 2.299 | 96.151 | 1.484  | 0.046  | 1.141  | 1.179  |
| 10                               | 2.299 | 96.151 | 1.484  | 0.046  | 1.141  | 1.179  |
| 15                               | 2.299 | 96.151 | 1.484  | 0.046  | 1.141  | 1.179  |
| 20                               | 2.299 | 96.151 | 1.484  | 0.046  | 1.141  | 1.179  |
| Variance Decomposition of Korea: |       |        |        |        |        |        |
| 5                                | 4.530 | 23.097 | 73.896 | 0.290  | 0.698  | 2.019  |
| 10                               | 4.530 | 23.097 | 73.896 | 0.290  | 0.698  | 2.019  |
| 15                               | 4.530 | 23.097 | 73.896 | 0.290  | 0.698  | 2.019  |
| 20                               | 4.530 | 23.097 | 73.896 | 0.290  | 0.698  | 2.019  |
| Variance Decomposition of Msia:  |       |        |        |        |        |        |
| 5                                | 2.356 | 5.215  | 2.458  | 84.220 | 0.321  | 7.786  |
| 10                               | 2.356 | 5.215  | 2.458  | 84.220 | 0.322  | 7.786  |
| 15                               | 2.356 | 5.215  | 2.458  | 84.220 | 0.322  | 7.786  |
| 20                               | 2.356 | 5.215  | 2.458  | 84.220 | 0.322  | 7.786  |
| Variance Decomposition of Thai:  |       |        |        |        |        |        |
| 5                                | 3.484 | 10.123 | 13.979 | 4.584  | 66.629 | 4.684  |
| 10                               | 3.484 | 10.123 | 13.979 | 4.584  | 66.629 | 4.684  |
| 15                               | 3.484 | 10.123 | 13.979 | 4.584  | 66.629 | 4.684  |
| 20                               | 3.484 | 10.123 | 13.979 | 4.584  | 66.629 | 4.684  |
| Variance Decomposition of Indo:  |       |        |        |        |        |        |
| 5                                | 3.290 | 6.133  | 1.444  | 0.319  | 3.103  | 89.002 |
| 10                               | 3.290 | 6.133  | 1.444  | 0.319  | 3.103  | 89.001 |
| 15                               | 3.290 | 6.133  | 1.444  | 0.319  | 3.103  | 89.001 |
| 20                               | 3.290 | 6.133  | 1.444  | 0.319  | 3.103  | 89.001 |

Note: Cholesky Ordering: World, South Korea, Malaysia, Thailand, and Indonesia

## APPENDIX D III

## VARIANCE DECOMPOSITION OF THE WORLD, SOUTH KOREA, MALAYSIA, THAILAND AND INDONESIA STOCK MARKET RETURNS (2005 - 2009)

| Variance Decomposition of World: |       |        |        |        |        |        |
|----------------------------------|-------|--------|--------|--------|--------|--------|
| P                                | S.E.  | World  | Korea  | Msia   | Thai   | Indo   |
| 5                                | 3.128 | 62.942 | 0.752  | 1.198  | 1.910  | 33.198 |
| 10                               | 3.143 | 62.764 | 0.914  | 1.206  | 2.033  | 33.084 |
| 15                               | 3.143 | 62.763 | 0.914  | 1.206  | 2.033  | 33.084 |
| 20                               | 3.143 | 62.763 | 0.914  | 1.206  | 2.033  | 33.084 |
| Variance Decomposition of Korea: |       |        |        |        |        |        |
| 5                                | 3.758 | 23.162 | 44.619 | 1.829  | 3.665  | 26.725 |
| 10                               | 3.774 | 23.206 | 44.267 | 1.904  | 3.891  | 26.732 |
| 15                               | 3.774 | 23.205 | 44.264 | 1.905  | 3.894  | 26.732 |
| 20                               | 3.774 | 23.205 | 44.264 | 1.905  | 3.894  | 26.732 |
| Variance Decomposition of Msia:  |       |        |        |        |        |        |
| 5                                | 2.229 | 16.914 | 2.062  | 49.626 | 0.555  | 30.843 |
| 10                               | 2.235 | 16.944 | 2.081  | 49.414 | 0.750  | 30.812 |
| 15                               | 2.235 | 16.944 | 2.081  | 49.412 | 0.750  | 30.813 |
| 20                               | 2.235 | 16.944 | 2.081  | 49.412 | 0.750  | 30.813 |
| Variance Decomposition of Thai:  |       |        |        |        |        |        |
| 5                                | 3.495 | 18.273 | 1.590  | 2.020  | 49.998 | 28.118 |
| 10                               | 3.516 | 18.545 | 1.629  | 2.063  | 49.679 | 28.085 |
| 15                               | 3.516 | 18.544 | 1.629  | 2.063  | 49.678 | 28.085 |
| 20                               | 3.516 | 18.544 | 1.629  | 2.063  | 49.678 | 28.085 |
| Variance Decomposition of Indo:  |       |        |        |        |        |        |
| 5                                | 4.045 | 13.043 | 2.639  | 1.904  | 1.491  | 80.923 |
| 10                               | 4.063 | 13.331 | 2.631  | 1.929  | 1.696  | 80.413 |
| 15                               | 4.063 | 13.332 | 2.632  | 1.929  | 1.698  | 80.410 |
| 20                               | 4.063 | 13.332 | 2.632  | 1.929  | 1.698  | 80.410 |

Note: Cholesky Ordering: World, South Korea, Malaysia, Thailand, and Indonesia

## REFERENCES

- [1] C.-S. Tai, "Market integration and contagion: Evidence from Asian emerging stock and foreign exchange markets," *Emerging Markets Review*, vol. 8, pp. 264-283, 2007.
- [2] A. Z. Baharumshah, T. Sarmidi and Hui T. B., "Dynamic linkages of Asian stock markets: An analysis of pre-liberalization and post-liberalization eras," *Journal of the Asia Pacific Economy*, vol. 8, pp. 180-209, 2003.
- [3] M.-C. Lin, "Capital market integration and market liberalization in Asian emerging markets," *International Journal of Management*, vol. 22, no. 2, pp. 249-265, 2005.
- [4] F. Guo, *Essays on East Asian capital markets: Integration and implications for economic activity*. Unpublished Ph.D, City University of New York, New York, U.S.A., 2005.
- [5] B. Gerard, K. Thanyalakpark and J. Batten, "Are the East Asian markets integrated? Evidence from the ICAPM," *Journal of Economics and Business*, vol. 55, pp. 585-607, 2003.
- [6] R. Levine and S. Zervos, "Capital control liberalization and stock market development," *World Development*, vol. 26, pp. 1169-1183, 1998.
- [7] H. A. A. Hoque, "Co-movement of Bangladesh stock market with other markets: Cointegration and error correction approach," *Journal of Managerial Finance*, vol. 33, no. 10, pp. 810-820, 2007.
- [8] F. Taskin and G. Muradoglu, "Financial liberalization: from segmented to integrated economies," *Journal of Economics and Business*, vol. 55, pp. 529-555, 2003.
- [9] V. Errunza, and E. Losq, "International asset pricing under mild segmentation: theory and test," *Journal of Finance*, vol. 40, pp. 105-124, 1985.
- [10] H. L. Chuah, *The integration of international equity markets*. Duke University, 2005.
- [11] R. Click, and M. Plummer, "Stock market integration in ASEAN after the Asian financial crisis," *Journal of Asian Economics*, vol.16, pp. 5-28, 2005.
- [12] J. Yang, J. W. Kolari and I. Min, "Stock market Integration and financial crisis: the case of Asia," *Applied Financial Economics*, vol. 13, pp. 477-486, 2003.
- [13] Z. A. Mahani, "ASEAN integration: at risk of going in different directions," *World Economy*, vol. 25, no. 9, pp. 1263-1277, 2002.
- [14] M. H. Ibrahim, "Integration or segmentation of Malaysian equity market: An analysis of pre- and post-capital controls," Unpublished *Econ WPA. International Islamic University Malaysia*, 2004.
- [15] S. Ibrahim, "East Asian financial integration: A cointegration test allowing for structural break and the role of regional institutions," *International Journal of Economics and Management*, vol. 3, no. 1, pp. 184-203, 2009.
- [16] D. M. Hunter, "The evolution of stock market integration in the post-liberalization period: A look at Latin America," *Journal of International Money and Finance*, vol. 25, pp. 795-826, 2006.
- [17] Z. Wang, J. Yang and D. A. Bessler, "Financial crisis and African stock market integration," *Applied Economics Letters*, Taylor and Francis Journals, vol. 10, no. 9, pp. 527-533, 2003.
- [18] S. H. Kassim, M. S. Abd. Majid and Z. Hamid, "The 2007 global financial crisis and the Malaysian stock market: A sectoral analysis," *Afro-Asian Journal of Finance and Accounting*, vol. 2, no. 3, pp. 185-209, 2011.
- [19] J. Nikkinen, V. Piljak and J. Äijö, "Baltic stock markets and the financial crisis of 2008-2009," *Research in International Business and Finance*, vol. 26, no. 3, pp. 398-409, 2012.
- [20] P. Wang and T. Moore, *Stock market integration for the transition economies: time-varying conditional correlation approach*. Unpublished Manchester School, 2008.
- [21] C. M. Bilson, T. J. Brailsford, and V. J. Hooper, "Selecting macroeconomic variables as explanatory factors of emerging stock market returns," *Pacific-Basin Finance Journal*, vol. 9, pp. 401-426, 2001.