ASIAN ACADEMY *of* MANAGEMENT JOURNAL *of* ACCOUNTING *and* FINANCE

*AAMJAF, Vol. 8, No. 2, 21–41, 2012*

# INTEGRATION OF ASEAN-5 STOCK MARKETS: A REVISIT

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## ABSTRACT

*This study re-examines the integration among five selected ASEAN emerging stock markets (Malaysia, Thailand, Indonesia, the Philippines and Singapore) based on Autoregressive Distributed Lag (ARDL) bound testing approach proposed by Pesaran, Shin and Smith (2001). This study finds that the stock markets in the ASEAN region are integrated during the pre-, post-1997 and post U.S. subprime financial crisis. In line with many studies on international interdependences of stock markets, our study finds that the ASEAN stock markets are moving towards more integration among themselves, especially following the global financial crisis. This implies that the long-run diversification benefits that can be earned by investors across the ASEAN markets tend to diminish. In addition, there is a need for policy coordination among ASEAN region to mitigate the impact of financial fluctuations, as the stock markets are interdependent.*

**Keywords:** financial integration, ASEAN-5, ARDL, diversification benefit

**JEL Classification**: C32, F15, F13

## INTRODUCTION

The market integration has been defined by many studies either based on asset pricing or statistical perspectives (Yusof & Majid, 2006). In terms of asset pricing, Jorion and Schwartz (1986) defined integration as a situation where investors earn the same risk-adjusted expected return on similar financial instrument in different national markets. With integration, the world market index should be mean-variance efficient and, as a result, the only priced risk should be the systematic risk relative to

the world market. A complete integration of capital market should imply the absence of arbitrage opportunities (Akdogan, 1992). Using adjusted pricing errors for 49 international stock markets, Hooy and Lim (2009) also found a positive association between market integration and informational efficiency.

Statistically, the markets are integrated if the markets share a long-run equilibrium relation between two variables (Bachman, Choi, Jeon, & Kopecky, 1996; Yusof & Majid, 2006). Thus, the stock prices in national markets have a tendency to move together in the long-run, which could be caused by arbitrage activity (Narayan, Smyth, & Nandha, 2004) and other common factors such as technological change, financial deregulation and international capital goods trade (Bachman et al., 1996). In this study, we adopt the statistical aspect in representing the stock market integration. If the Association of Southeast Asian Nations (ASEAN) stock markets are integrated thus this could considerably reduce benefits from international portfolio diversification. In addition, the degree of stock market integration also has major implications on financial stability of a country (Ibrahim, 2005).

Earlier studies provide evidence of lower correlations among national stock markets (Grubel, 1968; Levy & Sarnat, 1970; Solnik, 1974). On the other hand, more recent studies note increasing interactions among them. For example, Goldstein and Michael (1993) found that the international linkages have been rising over the past decade. The emerging markets are also found to be more closely integrated with markets in the rest of the world, even though their integration progress has been far less than rest of the world. Moreover, the co-movements among stock prices are manifested strongly during the periods of major financial disturbances such as the October 1987 market crash, the 1997/1998 Asian financial crisis and the latest U.S. subprime crisis.

Despite there have been numerous studies examining market integration among developed and emerging markets, but there have been relatively few studies explore the issue of stock market integration in the ASEAN region in the last few decades. For instance, Roll (1995) confirmed that even though Indonesia has had an active equity market for a number of years, no empirical studies on this market have emerged in Western scholarly journals. However, in current years, the vast-growing economies activities and the growing investment opportunities in some Asian emerging markets have attracted investors' and researchers' attention. In the context of ASEAN markets, among the studies have been done are Palac-McMiken (1997), Roca, Selvanathan and Shepherd (1998), Azman-Saini, Azali, Habibullah and Matthews (2002), Yang, Kolari and Min (2003), Chen, Leng and Lian (2003), Click

and Plummer (2005), Ibrahim (2005), Yusof and Majid (2006), Janor, Ali and Shaharudin (2007), Majid, Meera and Omar (2008), Karim and Majid (2009), Oh, Lau, Chin Hong and Abu Mansor (2010), Yeoh, Hooy and Arsad (2010) , and Karim, Kassim and Arip (2010).

Palac-McMiken (1997) examined the long-run relations of five ASEAN stock markets of Malaysia, Indonesia, the Philippines, Singapore and Thailand. Using monthly data from January 1987 to October 1995 and cointegration approach, he found that with the exception of Indonesia all the origin members of ASEAN markets are correlated with each other. In addition, using weekly data from 1988 to 1995, Roca et al. (1998) investigated the long-run co-movements of the five ASEAN markets. The results from multivariate cointegration test of Johansen (1988) and Johansen and Juselius (1990) show that no evidence of integration among them. However, with the exception of Indonesia, these markets have significant short-run linkages.

Another study, Azman-Saini et al. (2002) empirically examined the financial integration among the ASEAN-5 equity markets. Employing the Toda and Yamamoto's (1995) approach of Granger non-causality test and weekly data from January 1988 to August 1999, he found the dominance of Singapore market in the region. In addition, with the exception of Malaysia, the Indonesian market is affected by other ASEAN markets but does not significantly influence the other markets. Using daily data over the period of January 1992 to August 2002, Chen et al. (2003) found that the ASEAN-5 stock markets are integrated before and after the crisis but not during the crisis. The results are consistent with Click and Plummer (2005) who also found that the markets were integrated. Ibrahim (2005) investigated integration among the ASEAN markets from the perspective of the Indonesian market using co integration techniques and vector auto regression (VAR) for the periods of January 1988 to December 2003. However, he found evidence for lack of integration among the ASEAN markets. In recent studies, Yang et al. (2003), Majid et al. (2008) and Oh et al. (2010) reveal that the ASEAN stock markets are going towards a greater integration among themselves particularly in the post-1997 financial crisis. Another studies, Yusof and Majid (2006) and Karim and Majid (2009) found that Japan is more important than the U.S. over the ASEAN markets. In contrast, in a more recent study, Karim et al. (2010) document evidence that the Islamic stock markets in the region provide opportunity for the potential benefits from international portfolio diversification, even after the subprime crisis.

In terms of integration, we note that the results reported in the previous studies were mixed. Thus, this topic is still open for further examination. Unlike previous studies, we re-visit the issue of stock market integration among ASEAN-5 (Malaysia, Indonesia, the Philippines, Singapore and Thailand) utilizing recent and larger monthly data and Autoregressive Distributed Lags (ARDL) bounds test procedure as developed by Pesaran et al. (2001). In addition, we also examine the impact of current global U.S. sub prime crisis on the stock market integration in this region. Using both ARDL and the latest global financial crisis, to the best of our knowledge goes clearly beyond the existing literature on the subject matter in ASEAN-5.

Thus, this study attempts to partially fill the gap in the literature and to provide recent empirical evidence on the stock market integration among the ASEAN-5 stock markets of Malaysia, Indonesia, the Philippines, Singapore and Thailand. The findings of this study may have implications for international portfolio diversification, capital budgeting decisions and on financial stability of a country. The objective of this study is therefore to re-examine the stock market integration among the ASEAN-5 stock markets, adopting ARDL approach and recent sample of data.

## EMPIRICAL FRAMEWORK

### Autoregressive Distributed Lag (ARDL) Model

The study employs the autoregressive distributed lags (ARDL) bounds test proposed by Pesaran et al. (2001) to explore the integration relationship among the ASEAN-5 countries, Malaysia, Indonesia, the Philippines, Singapore and Thailand. The bounds testing procedure does not require the pre-testing of the variables included in the model for unit roots unlike other techniques such as the Johansen and Juselius (1990) approach.

Current studies have shown that the ARDL approach is preferable to other conventional approaches such as Engle and Granger (1987), Gregory and Hansen (1996), Johansen (1988) and Johansen and Juselius (1990). In addition, as opposed to other multivariate techniques such as Johansen and Juselius (1990), it allows the relationship to be estimated by ordinary least squares (OLS) once the lag order of the model is identified (Fosu & Magnus, 2006) and the procedure is simple. Finally, another reason for using the ARDL approach is that it provides robust results for a

smaller sample size in analysis. From the Monte Carlo experiments, Omtzigt and Fachin (2006) argued that there is no evidence to support the bound testing over Johansen co integration test for small sample size. However, Pesaran and Shin (1995), Narayan and Narayan (2005) and Narayan and Smyth (2006) show that with the ARDL framework, the ordinary least squares estimators of the short-run parameters are super-consistent in small sample sizes. Since we divide the data into pre and post-1997 crisis and post sub prime crisis, the sample size of our study is considered small thus ARDL model is suitable.

The ARDL procedure involves two stages. In the first stage, we establish a long-run relationship exists among the variables. The second stage involves estimating the long-run and short-run coefficients of equations conditional on whether the variables are integrated. Details of the mathematical derivation of the long-run and short-run parameters can be found in Pesaran et al. (2001). The long-run multivariate ARDL model employed in this study can be written as follows:

**Malaysia:**

$$MAL_t = \alpha_0 + \beta_1 INA_t + \beta_2 SING_t + \beta_3 PHI_t + \beta_4 THAI_t + \varepsilon_t \quad (1)$$

**Singapore:**

$$SING_t = \alpha_0 + \beta_1 INA_t + \beta_2 MAL_t + \beta_3 PHI_t + \beta_4 THAI_t + \varepsilon_t \quad (2)$$

**Thailand:**

$$THAI_t = \alpha_0 + \beta_1 INA_t + \beta_2 SING_t + \beta_3 MAL_t + \beta_4 THAI_t + \varepsilon_t \quad (3)$$

**the Philippines:**

$$PHI_t = \alpha_0 + \beta_1 INA_t + \beta_2 SING_t + \beta_3 MAL_t + \beta_4 THAI_t + \varepsilon_t \quad (4)$$

**Indonesia:**

$$INA_t = \alpha_0 + \beta_1 SING_t + \beta_2 MAL_t + \beta_3 PHI_t + \beta_4 THAI_t + \varepsilon_t \quad (5)$$

Here *MAL, SING, THAI, PHI* and *INA* are the natural logs of the stock prices in Malaysia, Singapore, Thailand, the Philippines and Indonesia respectively, while the $\varepsilon_t$ term is serially independent random error with mean zero and finite covariance matrix. To implement the bound test consider a vector of variables: $A_t$ where $A_t = (y_t, x_t)'$, $y_t$ is the dependent variable and $x_t$ is a vector of regressors. The data generating process of $A_t$ is a $p$-order vector autoregression. For integration analysis, $\Delta y_t$ is modelled as a conditional Error-Correction Model as follows:

$$\Delta y_t = \alpha_0 + \pi_{yy} y_{t-1} + \pi_{yx.x} x_{t-1} + \sum_{i=1}^{p} \theta_i \Delta y_{t-i} + \sum_{j=0}^{p} \varphi_j \Delta y_{t-i} + \mu_t \quad (6)$$

Here, $\pi_{yy}$ and $\pi_{yx.x}$ are long-run multipliers, is the drift. Lagged values of $\Delta y_t$ and current and lagged values of $\Delta x_t$ are used to model the short-run dynamic structure. The presence of integration is traced by restricting all estimated coefficients of lagged level variables equal to zero. That is, the null hypothesis $H_0$: = $\pi_{yy} = \pi_{yx.x} = 0$ against the alternative, hypothesis $H_a$: $\pi_{yy} \neq \pi_{yx.x} \neq 0$. These hypotheses can be examined using the critical values bounds as tabulated in Pesaran et al. (2001). The relevant critical value bounds are based on case III in Pesaran et al. (2001) study with unrestricted intercepts and no trend and number of regressors, *k* are 4. Critical value bounds exist for all classifications of the regressors into purely *I*(1), purely *I*(0) or mutually integrated. If the computed *F*-statistic is less than lower bound critical value, then we do not reject the null hypothesis of no integration. However, if the computed *F*-statistics is greater than upper bound critical value, then we reject the null hypothesis and conclude that there exists steady state equilibrium between the variables under study. However, if the computed value falls within lower and upper bound critical values, then the result is inconclusive.

The above model is based on the assumption that the error term is serially uncorrelated. Thus, it is important that the lag order *p* of the underlying model is chosen appropriately (Pesaran et al., 2001). The order of the distributed lag on the dependent variable and the regressors is selected using either Akaike Information Criterion (AIC) of the Schwartz Bayesian Criterion (SBC). However, based on Monte Carlo evidence, Pesaran and Shin (1995) find that SBC is preferable to AIC, as it is a parsimonious model that selects the smallest possible lag length, while AIC selects the maximum relevant lag length. Therefore, this study will use SBC as a lag selection criterion.

**Data Preliminaries**

The data utilised in this study are monthly stock indices spanning from January 1988 to December 2010. The study employs monthly data instead of higher frequency data to avoid the problem of non-synchronous trading. The daily and weekly data contain too much noise and are subject to the problem of non-synchronous infrequent trading (Ibrahim, 2005). Thus, this might lead to erroneous conclusion in the lead-lags relationship among the variables. The following indices are used to represent the markets: the Kuala Lumpur Composite Index for Malaysia; the Jakarta Stock

Exchange Composite Index for Indonesia; the Bangkok Stock Exchange Trade Index for Thailand; the Philippines Stock Exchange Index for the Philippines; and the Singapore Straight Time Index for Singapore. All indices are based on local currency and are collected from the Bloomberg Database. All series are transformed into natural logarithm.

To avoid the disturbances of the "financial crisis" in July 1997 on stock market integration analysis, we divide the data into pre- and post-crisis periods. The pre-crisis period covers the period from January 1988 to June 1997. The post-crisis period covers the period from July 1998 to June 2007. According to Dungey, Fry, Hermosillo, Martin and Tang (2008), the U.S. sub prime crisis started in July 26, 2007. In order to get richer findings on the impact of recent global financial crisis on the stock market integration in ASEAN-5, we also include the post sub prime crisis that covers from January 2008 to December 2010.

Table 1 provides summary statistics of the market returns (i.e., stock indices in first difference) for the ASEAN markets. It is interesting to note that for all sample periods, all stock markets recorded positive average monthly returns. During the twenty-three year period, the Indonesian stock market earned the highest average monthly returns of 1.95%, followed by the Philippines (1.03%), Malaysia (1.01%), Singapore (0.74%) and Thailand (0.91%). Additionally, the finding that the Indonesian market had the highest returns in the region conforms to the theory of finance, which says that the riskier (more volatile) the market, the higher would be the returns. This evidence is supported by the standard deviation, where the Indonesian stock market recorded the highest. The findings from the preliminary analysis for the Indonesian stock market are in line with the studies of Palac-McMiken (1997) and Majid et al. (2008). All monthly market returns, have excess kurtosis (greater than 3), which means that they have a thicker tail and a higher peak than a normal distribution. Consistent with previous studies, the Jarque-Bera test also indicates the rejection of normality on these five markets' monthly return dataset.

Table 1
*Summary statistics of the market returns*

| | | INA | MAL | PHI | SING | THAI |
|---|---|---|---|---|---|---|
| Pre-Crisis (1997) | Mean | 0.0191 | 0.0118 | 0.0109 | 0.0069 | 0.0044 |
| | Maximum | 0.6777 | 0.2468 | 0.3293 | 0.1460 | 0.2666 |
| | Minimum | -0.1978 | -0.1668 | -0.3168 | -0.1961 | -0.2962 |
| | Std. Dev. | 0.1026 | 0.0649 | 0.0939 | 0.05234 | 0.0904 |
| | Skewness | 2.5895 | -0.1555 | -0.1577 | -0.5346 | -0.1921 |
| | Kurtosis | 17.71359 | 4.3842 | 4.5716 | 4.9560 | 4.1584 |
| | Jarque-Bera | 1145.593*** | 9.4767*** | 12.0973*** | 23.3964*** | 7.0135** |
| Post-Crisis (1997) | Mean | 0.0139 | 0.0113 | 0.0077 | 0.0113 | 0.0100 |
| | Maximum | 0.2501 | 0.2944 | 0.3316 | 0.2484 | 0.2663 |
| | Minimum | -0.3412 | -0.2846 | -0.2989 | -0.2172 | -0.2436 |
| | Std. Dev. | 0.0850 | 0.0730 | 0.0782 | 0.0679 | 0.0859 |
| | Skewness | -0.5770 | 0.1769 | 0.0642 | -0.2269 | 0.0155 |
| | Kurtosis | 5.4093 | 6.7760 | 6.6195 | 6.2283 | 4.4632 |
| | Jarque-Bera | 31.8169*** | 64.1284*** | 58.4814*** | 47.3842*** | 9.5500*** |
| Post-Crisis (Subprime) | Mean | 0.0098 | 0.0029 | 0.0072 | 0.0020 | 0.0083 |
| | Maximum | 0.1834 | 0.1270 | 0.1394 | 0.1930 | 0.1476 |
| | Minimum | -0.3771 | -0.1651 | -0.2753 | -0.2736 | -0.4480 |
| | Std. Dev. | 0.0985 | 0.0518 | 0.0769 | 0.0801 | 0.1020 |
| | Skewness | -1.6914 | -0.8111 | -1.3570 | -0.8730 | -2.6331 |
| | Kurtosis | 8.1489 | 5.2742 | 6.7688 | 6.1272 | 12.5843 |
| | Jarque-Bera | 55.3517*** | 11.3807*** | 31.4571*** | 18.7082*** | 174.4059*** |

*Note*: *** and ** denote significant at 1% and 5% respectively.

To highlight the short-run relations between the movements of the stock markets in the ASEAN region, the standard correlation coefficients are reported in Table 2. This was used to measure the extent of the association between the stock markets. For all periods, all 20 correlation pairs are found to be significantly correlated, at least at the 10% level of significance. Among ASEAN, Malaysia recorded the highest correlation in stock return with Singapore, while Malaysia is shown to have the lowest correlated returns with Indonesia during the 1997 pre-crisis period. During the 1997 post-crisis period, Singapore is found to have the most correlated market returns with Thailand, whereas Malaysia and the Philippines are found to have the lowest correlated market returns in the region. Interestingly, during

the post sub prime crisis, Singapore is found to have the highest correlation with Indonesia while the lowest is Thailand-the Philippines pair. In addition, compared to the pre-crisis period, we find a marked increase in short-run interactions among pairs of market returns during the both post-crisis periods. For the 1997 post-crisis period, the increase in the market correlation is recorded for 7 pairs out of 10 possible pairs of equity returns while for the post sub prime crisis recorded for 9 pairs out of 10. This is indicated by the bold figures in Table 2. The significant increase in the correlation coefficients in the ASEAN markets indicates that there are short-term co-movements among the markets, suggesting that the benefits of any short-term diversification, or speculative activities, are limited within the region.

Table 2
*Correlation of market returns*

| | Pre-Crisis (1997) | Post-Crisis (1997) | Post-Crisis (Sub prime) |
|---|---|---|---|
| MAL-INA | 0.2654 | *0.4924* | *0.8373* |
| MAL-THAI | 0.6219 | 0.5183 | *0.7130* |
| MAL-SING | 0.7842 | 0.5678 | 0.8153 |
| MAL-PHIL | 0.5892 | 0.4364 | *0.7247* |
| INA-THAI | 0.3039 | *0.5097* | *0.8166* |
| INA-SING | 0.2949 | *0.6005* | *0.8685* |
| INA-PHIL | 0.3253 | *0.6025* | *0.7603* |
| THAI-SING | 0.6072 | *0.7068* | *0.7808* |
| THAI-PHIL | 0.4990 | *0.6823* | 0.6322 |
| PHIL-SING | 0.6449 | *0.6890* | *0.7171* |

## EMPIRICAL RESULTS

Before estimating the short- and long-run relationships among the variables, we have to decide on the lag-length on the first difference variables. Pesaran and Shin (1995) noted that ARDL model requires a priori knowledge of the orders of the extended ARDL that is sufficient to simultaneously correct for residual serial correlation and the problem of endogenous regressors. In this study, the order of the distributed lag on the dependent variable and the regressors is selected using SBC. Based on SBC, the optimal lag-length is found to be one.

The results of the bounds tests for integration are reported in Table 3. Narayan et al. (2004) noted that another advantage of the ARDL approach is that we can tell which series is the dependent variable from the F-test when integration exists. For the 1997 pre-crisis period, the F-test shows that the null hypothesis of no integration among the variable in Equation (2) cannot be accepted because $F_{SING}$ (.) exceeds the upper bound critical value at 10% level. Therefore, there is a long-run relationship between the variables when stock prices in Singapore are treated as the dependent variable. However, for Equations (1), (4) and (5) the F-statistic is less than the lower bound critical value and the null hypothesis of no integration is accepted. Interestingly, in the Equation (3) the result is inconclusive.

Table 3
*F-statistics for testing the existence of a long-run relationship among variables*

| Period | Equation | The computed F-statistics | Outcome |
|---|---|---|---|
| Pre-Crisis (1997) | F (MAL / SING, THAI, PHI, INA) | 1.6528 | No integration |
| | F (SING / MAL, THAI, PHI, INA) | 3.8600* | Integration |
| | F (THAI / MAL, SING, PHI, INA) | 1.9512 | No integration |
| | F (PHI / MAL, SING, THAI, INA) | 2.8026 | In conclusive |
| | F (INA / MAL, SING, THAI, PHI) | 2.2066 | No integration |
| Post-Crisis (1997) | F (MAL / SING, THAI, PHI, INA) | 6.0667** | Integration |
| | F (SING / MAL, THAI, PHI, INA) | 3.5031 | In conclusive |
| | F (THAI / MAL, SING, PHI, INA) | 1.8308 | No integration |
| | F (PHI / MAL, SING, THAI, INA) | 2.9310 | In conclusive |
| | F (INA / MAL, SING, THAI, PHI) | 3.5700* | Integration |
| Post-Crisis (Subprime) | F (MAL / SING, THAI, PHI, INA) | 4.3227** | Integration |
| | F (SING / MAL, THAI, PHI, INA) | 2.3400 | No integration |
| | F (THAI / MAL, SING, PHI, INA) | 3.2878 | In conclusive |
| | F (PHI / MAL, SING, THAI, INA) | 4.7242** | Integration |
| | F (INA / MAL, SING, THAI, PHI) | 2.3537 | No integration |

*Note:* The relevant critical value bounds are obtained from Pesaran et al. (2001), where the critical values in the case of 4 regressors are 2.86–4.01 at the 95% significance level and 2.45–3.52 at the 90% significance level. * denotes that F-statistics fall above the 90% upper bound and ** denotes above the 95% upper bound.

For the 1997 post-crisis period, the F-test shows that the null hypothesis of no integration among the variables in Equations (1) and (5) cannot be accepted because $F_{MAL}$(.) and $F_{INA}$ (.) exceed the upper bound critical value at 1% and 10% level respectively. Thus, there are long-run relationships between the variables when stock prices in Malaysia and Indonesia are treated as the dependent variables. While

there is no evidence of integration in Equation (3), we find the results are inconclusive for the Equations (2) and (4).

For the post subprime crisis period, the F-test shows that the null hypothesis of no integration among the variables in Equations (1) and (4) cannot be accepted because $F_{MAL}(.)$ and $F_{PHI}(.)$ exceed the upper bound critical value at 5% level. Thus, there are long-run relationships between the variables when stock prices in Malaysia and the Philippines are treated as the dependent variables. There is no evidence of integration in Equations (2) and (5), however we find the result is inconclusive for the Equation (3).

Following the establishment of the existence of integration, we retain the lagged level of variables and estimate the long-run and short-run together with the relevant diagnostic tests for the short-run model when stock prices in Singapore are the dependent variable (1997 pre-crisis) and when stock prices in Malaysia and Indonesia are the dependent variable (1997 post-crisis) and also when stock prices in Malaysia and the Philippines are treated as dependent variables (post sub prime crisis). Tables 4, 5 and 6 report the long-run coefficients and error correction model (ECM) of the selected ARDL models for pre-and post-crisis periods respectively. The coefficients of the ECM are negative and highly significant at 1%. These confirm the existence of a stable long-run relationship and indicate to a long-run relationship between variables. The coefficients of the ECM are -0.2454 (1997 pre-crisis), -0.1893 and 0.3827 (1997 post-crisis) and -0.6507 and -0.6863 (post subprime crisis) respectively, imply that a deviation from the long-run equilibrium following a short-run disturbances is corrected by about 24.54% (1997 pre-crisis), 18.93%–38.27% (1997 post-crisis) and 65.07%–68.63% after one month. The ECM corresponds to the speed of adjustment to restore equilibrium in the dynamic model following disturbances. We note that the speed of adjustment has increased significantly over 23 years thus this implies that the ASEAN stock markets become more integrated.

Therefore, we found evidence of integration among the ASEAN-5 stock markets for all periods. The markets are found to be more integrated recently particularly after the sub prime crisis. The results are in line with Chen et al. (2003) and Majid et al. (2008). In their study on ASEAN-5 (Malaysia, Indonesia, Singapore, the Philippines and Thailand), they found that these markets were integrated before and after the crisis. This might be due to a remarkable rise in the proportion of bilateral trade among the countries in the region from the pre- to post-crisis periods. This finding seems to be consistent with the view that the stronger the bilateral trade

ties among the countries, the higher the degree of co-movements (Masih & Masih, 1999; Bracker, Dockling, & Koch, 1999; Pretorius, 2002; Kearney & Lucey, 2004). Hilliard (1979) also found that most intra-continental price indices move simultaneously, even in the context of hourly fluctuations.

Table 4
*Estimated long- and short-run coefficients (pre-1997 crisis)*
*Dependent variable: SING*

| **Long-run coefficients** | |
|---|---|
| **SING (ARDL 1,0,1,0,0)** | |
| Regressors | Coefficients |
| MAL | 0.3061** (2.2486) |
| THAI | 0.1801*** (3.3818) |
| PHI | 0.1497* (1.9585) |
| INA | 0.0021 (0.0445) |
| Constant | 3.0779*** (14.9322) |
| **Short-run coefficients** | |
| Regressors | Coefficients |
| ΔMAL | 0.4504*** (4.4674) |
| ΔTHAI | 0.0442** (2.6363) |
| ΔPHI | 0.1711*** (4.4674) |
| ΔINA | 0.0052 (0.0447) |
| Constant | 0.7555*** (3.8609) |
| ECT(-1) | -0.2454*** (-3.7850) |
| **Diagnostic tests** | |
| $R^2$ | 0.7108 |
| Adj-$R^2$ | 0.6915 |
| $\chi^2_{Auto}$ | 3.9140 [0.1413] |
| $\chi^2_{Norm}$ | 2.1768 [0.3368] |
| $\chi^2_{RESET}$ | 1.4967 [0.4731] |

*Note: Auto* is the Breusch-Godfrey LM test for autocorrelation; *Norm* is the Jarque-Bera normality test; *RESET* is the Ramsey test for functional form. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively. Figures in parentheses and square brackets represent *t*-statistics and *p*-value respectively.

Table 5
*Estimated long- and short-run coefficients (post-1997 crisis)*
*Dependent variable: MAL and INA*

| **Long-run coefficients** | | |
|---|---|---|
| | **MAL (ARDL 1,1,0,1,0)** | **INA (ARDL 1,0,1,0,1)** |
| Regressors | Coefficients | Coefficients |
| MAL | NA | 0.4994 (1.2304) |
| SING | 0.8851*** (6.6022) | 0.4411 (1.0081) |
| THAI | 0.2116* (1.9524) | 0.8511*** (6.1611) |
| PHI | -0.2072** (-2.0836) | 0.2844 (1.3548) |
| INA | -0.0166 (-0.1501) | NA |
| Constant | 0.3290 (0.4142) | -7.4717*** (-8.2205) |
| **Short-run coefficients** | | |
| Regressors | Coefficients | Coefficients |
| ΔMAL | NA | 0.0965 (1.2418) |
| ΔSING | 0.3113*** (3.8775) | 0.3349** (2.5755) |
| ΔTHAI | 0.1918* (2.4362) | 0.1645*** (4.4248) |
| ΔPHI | -0.0729 (1.6828) | 0.3197*** (3.1366) |
| ΔINA | 0.1722* (1.9253) | NA |
| Constant | 0.1157 (0.4041) | -1.4439*** (-5.6363) |
| ECT(-1) | -0.3517*** (-4.9350) | -0.1933*** (-5.5605) |
| **Diagnostic tests** | | |
| $R^2$ | 0.4937 | 0.5926 |
| Adj-$R^2$ | 0.4579 | 0.5637 |
| $\chi^2_{Auto}$ | 13.8839 [0.3081] | 12.7112 [0.3901] |
| $\chi^2_{Norm}$ | 5.7270* [0.0571] | 0.0399 [0.9801] |
| $\chi^2_{RESET}$ | 1.4735 [02251] | 12.4628 [0.000] |

*Note: Auto* is the Breusch-Godfrey LM test for autocorrelation; *Norm* is the Jarque-Bera normality test; *RESET* is the Ramsey test for functional form. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively. Figures in parentheses and square brackets represent *t*-statistics and *p*-value respectively.

Table 6
*Estimated long- and short-run coefficients (post-subprime crisis)*
*Dependent variable: MAL and PHI*

| | **Long-run coefficients** | |
|---|---|---|
| | **MAL (ARDL 1,0,1,0,0)** | **PHI (ARDL 1,0,0,0,0)** |
| Regressors | Coefficients | Coefficients |
| MAL | NA | 0.4632 (1.0470) |
| SING | -0.0014 (-0.0117) | -0.3524$^{*}$ (-2.1009) |
| THAI | 0.1309 (1.2229) | 0.8511$^{***}$ (6.1611) |
| PHI | 0.1354 (1.0222) | NA |
| INA | 0.3361$^{***}$ (2.2951) | 0.7940$^{***}$ (3.4995) |
| Constant | 2.5583 (4.7144) | 1.7144 (1.2994) |
| | **Short-run coefficients** | |
| Regressors | Coefficients | Coefficients |
| ΔMAL | NA | 0.3179 (1.0215) |
| ΔSING | 0.1906$^{*}$ (1.9745) | -0.2419$^{*}$ (-2.0973) |
| ΔTHAI | 0.0852 (1.1532) | -0.0448 (-0.3299) |
| ΔPHI | 0.0881 (0.9678) | NA |
| ΔINA | 0.2187$^{**}$ (2.4896) | 0.5449$^{***}$ (3.7991) |
| Constant | 1.6647 (4.0632) | 1.1766 (1.3030) |
| ECT(-1) | -0.6507$^{***}$ (-4.3367) | -0.6863$^{***}$ (-8.0490) |
| | **Diagnostic tests** | |
| $R^2$ | 0.8443 | 0.7547 |
| Adj-$R^2$ | 0.8109 | 0.7124 |
| $\chi^2_{Auto}$ | 11.1290 [0.5180] | 14.7798 [0.2540] |
| $\chi^2_{Norm}$ | 0.5990 [0.7410] | 1.2445 [0.5370] |
| $\chi^2_{RESET}$ | 0.7457 [0.3880] | 2.1060 [0.147] |

*Note: Auto* is the Breusch-Godfrey LM test for autocorrelation; *Norm* is the Jarque-Bera normality test; *RESET* is the Ramsey test for functional form. $^{***}$, $^{**}$ and $^{*}$ indicate significance at the 1%, 5% and 10% levels, respectively. Figures in parentheses and square brackets represent *t*-statistics and *p*-value respectively.

In addition, Ng (2002) noted that this might be due to geographic proximity and close relationship between the markets. Apart from that, Janakiramanan and Lamba (1998) provided empirical evidence that the geographically and economically close countries should exhibit higher levels of market integration. In addition, we should note that Association of Southeast Asian Nations (ASEAN) aims to remove

trade barriers among its member countries. Taylor and Tonks (1989) noted that a stronger financial integration would be expected among countries that reduce trade barriers and develop stronger economic ties.

Interestingly, compared to the pre-crisis period, we conclude that the market become more integrated after the financial crisis i.e. Asian financial crisis and the U.S. subprime crisis. The results are consistent with Francis et al. (2002), Yang et al. (2003), Hwahsin and Glascock (2006) and Majid and Kassim (2009). Francis, Kim and Yoon (2002) and Yang et al. (2003) noted that the short- and long-run relationship among equity markets were strengthened during the financial crisis 1997 and become more integrated after the crisis. The performances of our estimated of the error correction representation for ARDL seem to be acceptable. The diagnostic tests perform well, supporting the overall validity of the short-run model.

## CONCLUSION AND POLICY IMPLICATIONS

This study re-examines the integration among five selected ASEAN emerging stock markets (i.e., Malaysia, Thailand, Indonesia, the Philippines and Singapore) based on ARDL bound testing approach proposed by Pesaran et al. (2001). In line with many studies on international interdependences of stock markets, our study found that the ASEAN stock markets are moving towards more integration among themselves, especially following the global financial crisis. Pretorius (2002) notes that the crisis put pressure on emerging markets and has contributed to virulent contagion and volatility in international markets. In addition, Kearney and Lucey (2004) note that the world's economic and financial systems are becoming increasingly integrated because of the rapid expansion of international trade in commodities, services and financial assets.

The stock markets in the ASEAN region are found to be integrated during the pre, post-1997 and post subprime financial crisis. However, the degrees of short- and long-run integration have significantly increased; particularly during the post-subprime financial crisis period. This implies that investors who diversified their investments across the ASEAN markets could only gain limited benefits during the period. Our findings are similar to the findings by Chen et al. (2003) and Majid et al. (2008). In their study on ASEAN-5 (Malaysia, Indonesia, Singapore, the Philippines and Thailand), they found that these markets were integrated before and after the crisis. This result indicated that during the pre- and post-crisis periods, the ASEAN stock markets were driven by a common international factor and country-specific

factors have become less important than the international factors, leading to the long-run co-movements among the stock markets.

Accordingly, the implication of our findings on integrated ASEAN markets is that, investors who allocated their investment across the stock markets of ASEAN could not totally enjoy long-run diversification benefits. Our findings are consistent with those of Ibrahim (2005), Azman-Saini et al. (2002), and Daly (2003) and Majid et al. (2008). It is important to note that the existence of integration among the ASEAN markets does not rule out the possibility of arbitrage profits through diversifying portfolios across these countries in the short-term, which may last for quite a while (Dwyer & Wallace, 1992; Yang & Siregar, 2001). Thus, because of varying degrees of business and financial risks of different securities and various security cash flows covarying less than perfectly across the ASEAN stock markets (and even within the same country), the diversification benefits in the ASEAN markets in the long-term may be reduced but are not likely to be fully eliminated in practice.

As far as Efficient Market Hypothesis (EMH) is concerned, our finding that the five markets are integrated suggests that each stock price series contains information on the common stochastic trends, thus the predictability of one country's stock prices can be enhanced considerably through utilising information on the other countries' stock prices. However, Granger (1986) argues that integration between two prices reflects an inefficient market. Masih and Masih (2002) suggest that predictability from integration implies nothing necessarily about inefficiency. A market is inefficient only if by using the predictability, investors can earn risk-adjusted excess return, but if returns are generated it is unclear whether they are just compensation for risks incurred or are truly excess and risk-adjusted.

Similarly, the extent of integration among the ASEAN market will have important bearings on the formulation of the financial policies of multinational corporations. Majid et al. (2008) argued that the effectiveness of the macro-economies policies of each ASEAN stock markets dealing with its stock market imbalances depends on the extent of financial integration of each market with the rest. For example, the 1997 East Asian crisis that started in Thailand affected both the currency and stock markets. Later, many firms in the ASEAN countries found themselves in financial distress. The recent global US sub prime crisis has been labelled as the worst financial crisis since the Great Depression (Jaffee, 2008). The crisis has not only been affecting the financial markets and the economy of the U.S., but it has also been spreading over the other countries' financial markets worldwide

(Majid & Kassim, 2009). In addition, Mundell (2000) notes that exchange rate volatility is a major threat to global prosperity that causes unnecessary volatility in capital markets. Therefore, having knowledge of the co-movement among the stock markets and exchange rate risk between countries can assist managers to mitigate international risks and transaction and translation of risks.

In future, to add the existing literature on market integration in the ASEAN region, further empirical studies can explore factors leading for market integration such as contagion effect, economic integration and stock market characteristics. International investors have to comprehend the driving forces behind the market integration in order to grasp the potential risks and returns of diversification.

## ACKNOWLEDGEMENT

We would like to thank the anonymous referees for the constructive comments and suggestions which have significantly improved the paper. All remaining errors and omissions are the authors' responsibility. Financial support from Universiti Malaysia Sarawak (UNIMAS) and the Ministry of Higher Education Malaysia through Fundamental Research Grant Scheme [Grant No: FRGS/05(29)/783/2010(64)] is gratefully acknowledged.

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