ASEAN5 Equity Market Linkages

by

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Abstract:

ASEAN5 equity markets have experienced the 'Asian Miracle', survived the 1997 crisis, and are now re-building their strength in the region. This paper examines the short-run and long-run linkages that exist between the ASEAN5 equity markets over the period from 1990 to 2006. Analysis of correlation coefficients between the ASEAN5 equity markets suggests an increase in correlation following the 1997 crisis. Further, cointegration is evident over both the full period and in the pre and post 1997 crisis periods. Finally, the influence of the US, Japan and Australia equity markets is also examined with evidence of a strong exogenous US equity market effect over the 16-year period of the study.

JEL codes: G15, F36

KEYWORDS: *ASEAN5; COINTEGRATION TEST; VECM*

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1. Introduction

The integration of the Association of Southeast Asian Nations' (ASEAN) financial markets is an important goal towards realising an ASEAN Economic Community. Stability in each country's financial system is generally recognised as a precondition for maintaining the momentum towards achieving ASEAN economic integration and so policy initiatives to further integrate member equity markets seem appropriate for meeting this goal. However, the Asian 1997 crisis marked a setback in the moves towards integration. Consequently, increasing the level of capital market efficiency in ASEAN financial markets has become even more important since the crisis. If the stock markets are interdependent, then there is a need for policy coordination among ASEAN member countries to mitigate the impact of financial fluctuations. Indeed, Sharma and Wongbangpo (2002), argue that efforts towards greater policy coordination and the removal of trade and investment barriers are essential if ASEAN is to exploit the advantages of greater economic and financial interdependence.

The issue of equity market linkages and interdependence among the ASEAN equity markets is the focus of this paper.[1] These markets are bound by, and share the aspirations of, ASEAN. These equity markets are geographically close and have undergone substantial financial liberalisation (e.g. the opening up of the financial markets to foreign investors) since the late 1980s and early 1990s. It is expected that these markets should have become more closely linked over time (Bekaert & Harvey, 2000; Phylaktis & Ravazzolo, 2002). Our study extends the work of Roca et al. (1998), Azman-Saini et al. (2002), Ng (2002), Daly (2003) and

[1] Following Ng (2002), we define the term 'linkages of stock markets' as co-movements in national stock market returns.

Click and Plummer (2005).[2] This study also expands upon the work of Chen et al. (2002), although focusing on ASEAN5 instead of Latin American equity markets.

The current analysis extends the existing empirical literature in three ways. First, a more recent period is used in comparison with previous studies. We tests for patterns in linkages that exist between stock markets of the ASEAN5 from January 1990 to March 2006, using correlation analysis, cointegration tests and error correction models. Click and Plummer (2005) employ the period of July 1998 to December 2002 to study the ASEAN5 equity market linkages. Second, we examine the impact of the 1997 Asian crisis by determining whether there are differences in the number of cointegrating vectors and common trends that exist in the pre-crisis and post crisis periods. More importantly, our study allows for a reasonable length for the crisis period – i.e. one year – to capture the possible change in the level of cointegrating relationships among the equity markets.[3] Third, our study extends cointegration analysis beyond the ASEAN5 markets, with the inclusion of three developed equity markets (the USA, Japan and Australia). As such, we also investigate the impact of developed markets on ASEAN5 equity market returns. The rationale for including these major regional markets as well as the US market lies with conventional finance theory, the Capital Asset Pricing Model (CAPM). The CAPM proposes that securities returns are linearly related to the returns earned on the market portfolio of risky assets. Accordingly, securities in the market are priced so that their expected return compensates investors for their risk relative to the market and the US in particular should provide a useful proxy for the market portfolio of risky assets (see

[2] The cited studies also use the Johansen cointegration tests where Roca et al. (1998) use data that span from 1988 to 1995, while Azman-Saini et al. (2002) use data from 1988 to 1999.
[3] For example, Daly (2003) employs only a one-month (October 1997) crisis period; Chen et al. (2002) denote November 1997 to August 1998 (10 months) as the crisis period, while Jang and Sul (2002) use June 1997 to January 1998 (eight months) as the crisis period.

Solnik, 1974). In addition, the inclusion of the Australian equity market marks one contribution of this study to the literature, given the limited studies dealing with the impact of Australia on Asian equity markets and the links that exist between Australia and the ASEAN5.

Three questions that are pertinent to our study include: Q1: Are the equity markets of the ASEAN5 cointegrated during the pre-crisis and post-crisis periods? If they are, then how do these relationships change after the crisis? Q2: Do global equity market returns, proxied by the US and Japan, have a significant impact on the equity returns of the ASEAN5 markets? Q3: What are the patterns in causality among the equity markets in this study, and do the patterns change after the 1997 crisis?

Our results indicate the existence of only one cointegrating relationship in both the pre-crisis and post-crisis period. As such, the ASEAN5 equity markets share only one long-term relationship in both the pre-crisis and post-crisis period, suggesting that these markets share four common stochastic trends regardless of the crisis. Similar results are obtained when using more complex models.[4] The equity markets of the ASEAN5 are therefore cointegrated but they are not driven by a single stochastic trend.

The remaining of this paper is organized as follows: Section 2 surveys the existing literature on equity market integration in the ASEAN region and beyond. Section 3 describes the data employed in analysis. Section 4 presents the methodology used in analysis while section 5 contains results and discussion of preliminary and main findings of this paper. Finally, section 6 offers some conclusion of the study.

[4] For example, when the ASEAN5 are combined with the USA, Japan and Australia in one VAR model and when the ASEAN5 are combined with the Japanese and Australian equity markets in the VAR model while the US market returns are included as an exogenous variable.

2. Literature Review

Recent studies have shown growing interest in the interdependence and linkages that exist between emerging equity markets in general and the ASEAN market in particular. There are a limited number of studies that deal specifically with the ASEAN5 country equity markets. Yet, the results are not unanimous as the studies are based on a range of approaches and methodologies, data frequencies, and time frames.

There are a few studies that find no cointegration relationships among the ASEAN5 equity markets. For example, Roca et al. (1998) find that the ASEAN5 equity markets are not significantly cointegrated in the long-term but correlations occur in the short term. Further, they show that Malaysia and Indonesia are the most and the least influential markets respectively. Ng (2002) also finds no evidence of a long-run relationship among the ASEAN5 markets using monthly data from 1988 to 1997. Two sub-periods are employed, with the market correlations increasing in the second sub-period, except for Singapore and Malaysia.[5] Ibrahim (2005) corroborates these studies and also finds no cointegration between ASEAN5 markets and the US and Japan in the long-run. In the short-run, though, he finds evidence that the ASEAN markets are closely linked with each other and with the US and Japan. Also, the US market appears to be more dominant than the Japanese market in this region.

Yet, there are studies that support the existence of cointegration among the ASEAN5 markets. Sharma and Wongbangpo (2002) document cointegrating relationships among the ASEAN4 (they exclude the Philippines from cointegration test) from 1986 to 1996 using monthly data. They also identify Malaysia and Singapore equity markets as trend dominated markets while Thailand and Indonesia are cycle-dominated markets. Employing the sample period from 1998 to 2002, Click and Plummer (2005) also document cointegrating

[5] The sub-periods are 1988 – 1992 and 1993 – 1997.

relationships among ASEAN5 markets regardless of data frequency or the index denomination used in analysis.[6] This premise is further supported by Azman-Saini et al. (2002) in their study of weekly data from 1988 to 1999. In addition, they identify the exogeneity of Singapore, the influence of Malaysia and the weakness of Indonesia equity markets.[7] Accordingly, Abd. Majid et al. (2008) find cointegration relationships exist among the ASEAN5 and also with Japan and the US stock markets over the period of 1988 to 2006. Market integration is also found to be greater in the post-crisis period. This is consistent with Ibrahim (2005), in terms of the dominant influence of the US in comparison to Japanese market. Daly (2003), however, finds mixed results based on different market order in his study of ASEAN5, Australia, Germany and the US equity markets from 1990 to 2001.[8] Bivariate cointegration tests suggest no significant increase in the integration between the ASEAN5 markets. Using similar methodology, Palac-McMiken (1997) concludes that all the ASEAN5 markets are linked together (with the exception of Indonesia). It is further noted that that Thailand equity market plays the connecting role that linked these ASEAN5 markets together.

In summary, the existence of long-run links between the ASEAN5 equity markets is still debatable. Therefore, analysis carried out in this paper provides further insight into this relationship, in particular amidst the upheaval of the 1997 crisis.

3. Methodology

While descriptive statistics such as the mean, median, standard deviation, minimum, maximum, skewness, kurtosis, and Pearson correlations are used in describing the data, the Augmented Dickey Fuller (1979) test, the Phillips-Perron test, and the KPSS test are used to

[6] Daily and weekly data in local currencies, US dollars, and Japanese yen is used in this study.
[7] This conclusion is based on the results from Granger non-causality (Toda-Yamamoto test), standard Granger causality, variance decomposition and impulse response analysis.
[8] The pre-crisis period is from April 1, 1990 to September 1, 1997) and post-crisis period is from November 1, 1997 to October 5, 2001.

test for the existence of a unit root in the series. The Johansen test (Johansen, 1988, 1991, 1992, 1994 and Johansen and Juselius, 1990) is used in testing for cointegration in the ASEAN5 equity markets. The Johansen tests are based on the model:

$$\Delta X_t = \theta_1 + \theta_2 T + \sum_{k=1}^{k} \theta_{3k} \Delta X_{t-k} + \theta_4 X_{t-1} + \varepsilon_t \quad (1)$$

where X_t is a (*p x 1*) vector as at time t, Δ is the change operator from time *t-1* to *t*, θ_i is a parameter vector, and *T* is a time trend. The Johansen tests focus on the parameter matrix θ_4 and the number of linearly independent vectors in this matrix. This is generally written in the form:

$$\theta_4 = \alpha' \beta$$

The coefficient α is an (*p x j*) matrix of error correction term parameters and β is a (*j x p*) matrix of cointegrating vectors, with *j* being the number of cointegrating vectors and *p-j* being the number of common stochastic trends. There are five countries in the ASEAN5 analysis, therefore *p* is set to 5 (*p*= 5). Further, the θ_3 term provides estimates of the temporal causality that exists between the time series variables. These are similar to traditional Granger causality estimates, although they are adjusted for the impact of longer-term effects as captured by the error correction term. The *t*-statistic is referred to in the discussion of temporal causality results when there is only one lag in the estimation. If there is more than one lag, Chi-square statistics are used instead. The temporal causality parameter, θ_3, is represented by:

$$\sum_{k=1}^{K} \theta_{3k} \Delta X_{t-k}$$

$$\text{for lag} = k, \begin{bmatrix} \theta_{3k}(1,1) & \theta_{3k}(1,2) & \dots & \theta_{3k}(1,\rho) \\ \theta_{3k}(2,1) & \theta_{3k}(2,2) & \dots & \theta_{3k}(2,\rho) \\ \dots & \dots & \dots & \dots \\ \theta_{3k}(\rho,1) & \theta_{3k}(1,1) & \dots & \theta_{3k}(\rho,\rho) \end{bmatrix} \quad (2)$$

A better understanding of the shared variation in links that exist between the ASEAN5 will provide further insight into the likelihood of integration of the ASEAN nations. Based on Click and Plummer (2005), Hafer and Kutan (1994) and Kasa (1992), complete convergence is assumed when there are *p*-1 cointegrating vectors among *p* series. This implies a single shared common stochastic trend such that the series are perfectly correlated over long horizons. Further, a finding of less than *p*-1 but at least one cointegrating vector implies some partial convergence of the series. If there were no cointegrating vectors, there is no shared common trend and thus no long-run convergence in the series. Further, the results for trace statistic and maximum eigenvalue statistic are presented but the cointegrating relationship is assumed based on the results from trace statistics when none is observed from maximum eigenvalue statistics (see Dunis & Shannon, 2005; Johansen & Juselius, 1990; Lutkepohl, Saikkonen & Trenkler, 2001) .

The Schwarz information criterion (SC) is used to identify the number of lags for cointegration tests and vector error correction model estimation (see Herzer & Nowak-Lehmann, 2006; Irandoust & Ericsson, 2004) in the full period, pre-crisis and post-crisis period. The number of lags used in this study is one for all three periods.

4. Data

in this study, we employ weekly index data as in Al-Kazali et al. (2006) and Azman-Saini et al. (2002). It has been argued that daily return data are preferable to lower frequency data such

as weekly or monthly returns because longer horizon returns can obscure transient responses to innovations which may last just a few days. However, daily data contains considerable noise and could be affected by market features such as day-of-the-week effects.

We choose to use total return (price plus gross dividends) rather than price indices because it more accurately captures the return to equity market investments. The stock market indices are collected for each of the ASEAN5 countries, the USA, Japan and Australia. Continuously compounding returns are then calculated. Data for this study are obtained from Datastream and include both International Finance Corporation (IFC) for Malaysia, Thailand, Indonesia and the Philippines and MSCI data for Singapore, the USA, Japan and Australia. The IFC indices are particularly appropriate because they are consistently computed across the different countries and this aids comparability.

We use investable indices where available because they represent a portfolio of domestic equities that are available to foreign investors, while the IFC Global Index represents the overall market portfolio for each country (Bekaert, Harvey & Lundblad, 2003). All the indices are expressed on a US dollar basis lest the effect of currency fluctuations confound the equity market return effects (Yang, Tapon & Sun, 2006).

The study period employed for this study is from January 1990 to March 2006 and in accordance with the literature the sample is divided into pre- and post-1997 crisis periods. Observations from July 1997 to June 1998 are excluded from sub-periods analysis to avoid the impact of the crisis. This approach is also used in Ibrahim (2005) and Chen et al. (2002) in their study of the ASEAN5 and Latin American markets respectively. The pre-crisis period

used for this study is from January 1990 to June 1997 and the post-crisis period is from July 1998 to March 2006. [9]

5. Results and Discussion

5.1 Statistical characteristics of the series

Table 1 provides summary statistics of weekly continuously compounded returns for the ASEAN5, the US, Japan and Australia. The average returns for the ASEAN5 in the pre-crisis period are range from 0 percent to 0.4 percent and between -0.3 percent to 0.5 percent in the post-crisis period. There is little change in the average returns for Malaysia and Singapore, though some returns decrease over the period for Thailand and the Philippines, with an increase evident for the Indonesian equity market over the period.

The standard deviation of returns for the ASEAN5 in the post-crisis period (2.9 percent to 6.2 percent) is higher than in the pre-crisis period (1.9 percent to 4.1 percent). It appears that markets in Thailand, Indonesia and the Philippines exhibit higher volatility compared to the markets in Malaysia and Singapore. This is consistent with the fact that these latter markets are more developed than the others. Yet, higher volatility seems to be the norm for almost all of the markets in the post-crisis period, most notably for Indonesia. This is consistent with Ibrahim (2005). The Singapore market, as one of the 'Asian Tigers', exhibits the most stable return characteristic among the ASEAN5 markets.

During the pre-crisis period, the US exhibits the greatest returns of the three developed markets (0.4 percent), followed by Australia and Japan. After the crisis, Australian returns

[9] Click and Plummer (2005), Choudhry et al. (2007) and Lim (in press) also choose July 1998 as the start of the post-crisis period for their study, as the devaluation of the Thai baht in July 1997 is widely regarded as the triggering event for the crisis. However, Daly (2003) chooses a post-crisis period starting from November 1, 1997 and his pre-crisis period ends September 1, 1997. Thus the crisis period in this study runs for only two months.

remain little changed but Japanese returns increase while US returns decrease. The standard deviation of the US returns also increases over the period and is the largest of the three developed markets. The drop in average returns and the increase in volatility observed for the US post-crisis period are probably due to the negative impact of IT crisis in 2000. Still, emerging stock returns and volatility are comparatively higher than that of mature stock markets.[10]

[INSERT TABLE 1 ABOUT HERE]

5.1.1 Correlations

Table 2 presents the pairwise correlation coefficients among the ASEAN5 equity markets. In general, intra-regional correlations tend to be higher than inter-regional correlations, consistent with Eun and Shim (1989) and Pretorius (2002). During the pre-crisis period, we find that the highest pairwise return correlation is recorded between Malaysia and Singapore. Yet, after the crisis, this correlation drops from 59.2 percent to 26.8 percent which is more than half from the pre-crisis levels. A drop in return correlation is also recorded by Daly (2003) and Abd. Majid et al (2008), although the recorded drop in the latter study is smaller (69 percent to 49.8 percent) than recorded in this study.

The post-crisis correlation coefficient value is similar to that found in Click and Plummer (2005), which is 25 percent. This might be attributable in part to the reintroduction of currency and capital controls instituted by the Malaysian government in September 1998 to curb the capital flight associated with the Asian crisis (Click and Plummer, 2005 and Ibrahim,

[10] In general, the characteristics of emerging market returns could be summarized as having higher average returns, low correlations with developed markets returns, could be predicted based on past returns, and returns tend to be much more dispersed (more volatile) than for the developed market returns [Bekeart & Harvey (1997,1995)].

2005). This may have led to decreases in Malaysian correlations with other ASEAN5 markets in the post-crisis period.

Overall, we find that the correlation coefficients for all the markets except for Malaysia increase after the crisis.[11] Similarly, other than for Thailand, all the ASEAN5 return correlations increase with the developed markets returns after the crisis. This result is consistent with Daly (2003) in relation to the ASEAN5 with the Australian and US returns, suggesting that the ASEAN5 equity markets have become more integrated with each other, as well as with global markets, following the crisis.

The pairwise correlations results for the ASEAN5 suggest that there are some similarities between the markets' fundamentals (Chiang, Jeon & Li, 2007). In general, the more integration that exists between a pair of economies, the more strongly the stock market movements in one country would be correlated with those in the other country (Eun and Shim, 1989).[12] While various economic variables such as inflation, interest rates and trade have been studied in regard to this issue, trade is regarded as the most important factor underlying stock market correlations (Bekaert & Harvey, 1997; Chen & Zhang, 1997; Soydemir, 2000).[13]

[INSERT TABLE 2 ABOUT HERE]

5.1.2 Unit Root Tests

It is important to test for stationarity of the series before proceeding with cointegration tests.[14] In this study, three unit root tests are employed: Augmented Dickey-Fuller (ADF), Phillips-

[11] Daly (2003) finds that correlation coefficients for Singapore with other markets also decrease after the crisis. This might be due to a different post-crisis period employed in his study.
[12] In Eun & Shim (1989) this point is supported by the unusually high correlation of the US and Canadian national stock markets.
[13] See Pretorius (2002) for a brief survey of stock market independence.
[14] The results for autocorrelations of the series are available upon request.

Perron (PP) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS). The null hypothesis for ADF and PP is that the series is non-stationary if $\rho = 0$ and the process is stationary if $\rho < 0$. Rejection of the unit root hypothesis is necessary to support stationarity of the series. The null hypothesis for the KPSS test is that the series is stationary, such that failure to reject the null hypothesis is consistent with a series that is stationary and rejection of the null hypothesis supports the existence of a unit root in the process. Results of the unit root tests show that returns for the ASEAN5 are stationary for all the three tests. [15]

5.2 ASEAN5 Cointegration tests

The Johansen cointegration test is used in this study to identify the number of cointegrating vectors among the ASEAN5 equity markets. This procedure has the advantage of taking into account the error structure of the underlying process, that also incorporates different short- and long-run dynamics of a system (Chen et al., 2002).

We present the empirical results for the Johansen test Table 3, Panel A (ASEAN5), Panel B (ASEAN5 and the US, Japan and Australia) and Panel C (ASEAN5 with Japan and Australia in the VAR and with the US returns included as an exogenous variable).[16] The results for the ASEAN5 reported in Panel A show that only one cointegrating vector exists for the full, pre-crisis (for trace statistics) and post-crisis periods, consistent with the existence of one long-run relationship in the system. This also suggests that there are four common stochastic trends prevail among the ASEAN5 stock markets, regardless of sample period chosen. In particular, the pre-crisis period finding of one cointegrating vector is consistent

[15] To conserve space, results are available upon request.
[16] The US is tested as an exogenous variable in Panel C given the lack of significance coefficient for the US found in the VECMs results presented in Table 5-8, for all periods.

with Daly (2003) even though he uses daily data in his analysis. The pre-crisis period employed in his study is quite similar to our study which is from April 1, 1990 to September 1, 1997.

In addition, Sharma and Wongbangpo (2002) also find one cointegrating vector from their study; however, the Philippines is excluded from the analysis and their pre-crisis period is from January 1986 to December 1996.

It is noted that Roca et al. (1998), Ibrahim (2005) and Ng (2002) find no cointegrating relationship among the ASEAN5 equity markets prior to the crisis. Despite using weekly data, Roca et al. focus on the period from 1988 to 1995 and choose nine lags for their VAR model. Ibrahim (2005) uses monthly data that is taken from www.econstats.com with the pre-crisis period spanning from January 1988 to June 1997. Ng (2002) also uses monthly data with two pre-crisis sub-periods, 1988-1992 and 1993-1997, which raises a concern given that the second sub-period analysis includes the 1997 crisis period. Thus, the differences between the results of the three studies are probably due to the differences in model specification.

Our post-crisis period results show the existence of one cointegrating vector among the ASEAN5 equity markets. These results are consistent with those of Click and Plummer (2005), Azman-Saini *et al.* (2005), and Daly (2003). Ibrahim (2003), however, finds no evidence of a cointegrating relationship for this period, using a post-crisis period of July 1997 to December 2003.

[INSERT TABLE 3 ABOUT HERE]

Further, we find that the choice of developed market returns included in the analysis has little impact on the equity market linkages existing within the ASEAN5 where the number of cointegrating vectors remains unchanged (one cointegrating vector found in Panels A, B, and C). As such, the results are consistent with previous studies that indicate the inclusion of developed stock markets, such as the US and Japan, does not change the number of cointegrating relationships evident in a particular regional equity market group (see Choudhry, Lu & Peng, 2007; Ibrahim, 2005). In general, the consistency of the pre-crisis and post-crisis period results lends support to Phylaktis and Ravazzolo (2002), who suggest that the Asian countries were already financially and economically cointegrated prior to the crisis, thus the level of integration remains after the crisis.

The cointegration results reported in our study imply that the equity markets of the ASEAN5 are partially cointegrated, or, as suggested by Click and Plummer (2005), these equity markets are integrated in an economic sense. The existing linkages indicate that the stock price movements in one equity market may predict the stock price movements in other markets (Sharma and Wongbangpo, 2002). The co-movements of asset prices also suggest the presence of underlying exogenous influences (Chen, Roll & Ross, 1986) that is probably enhanced by the globalisation of national equity markets, in particular through efficient information sharing and free accessibility to markets by foreign investors (Chen et al., 2002).

5.3 The vector error correction model (VECM)

The vector error correction model results provide further insight into the linkages that exist between the ASEAN5 equity markets. When the variables are cointegrated, short-term deviations from the long-run equilibrium will feed back into changes in the dependent variable, in order to ensure a return towards the long-run equilibrium (Chen et al., 2002). The

speed of adjustment term captures this effect (θ_3 term in equation 2). The significant *t*-tests for the speed of adjustment coefficients indicate the existence of long-run causal effects.

5.3.1 Speed of adjustment effects for ASEAN5

Table 4 exhibits the results for the ASEAN5 speed of adjustment coefficients. For the full period (Panel A), all of the speeds of adjustment coefficients are statistically significant. However, in the pre-crisis period (Panel B), significant coefficients are found only for Singapore, Thailand and the Philippines. The coefficient for the Philippines remains significant in the post-crisis period (Panel C), along with the Indonesian market. Speed of adjustment parameters indicate that Malaysia is exogenous in both pre-crisis and post-crisis periods, while Singapore and Thailand are exogenous in the post-crisis period. In this period, Indonesia and the Philippines appear to bear the adjustment towards equilibrium.

[INSERT TABLE 4 ABOUT HERE]

5.3.2 Temporal Causality for ASEAN5

The short-run causal relationship is represented by temporal causality estimates. The temporal causality refers to the impact of lagged returns on present returns and the results for the ASEAN5 are presented in Table 5. Panel A reports the results for the full period where Singapore appears to be independent of the other four markets, while the remaining four markets are affected by at least one other market. This period exhibits a number of bi-directional causal linkages. This result may be driven by the crisis period, as interaction generally strengthens during major crisis periods (see Arshanapalli & Doukas, 1993; Masih & Rumi, 1997; Pretorius, 2002). As such, it is important to determine whether these links are also evident in both the pre-crisis and post-crisis periods.

[INSERT TABLE 5 ABOUT HERE]

The ASEAN5 equity markets do not exhibit strong causal relationships in the pre-crisis period (Panel B) when most of the significant relationships are unidirectional, except for Malaysia and Indonesia. Singapore, the most developed market among the ASEAN5, does not explain the movements in any other markets, though there is some evidence that the Philippines returns explain Singapore equity returns. This is consistent with Azman-Saini *et al.* (2002) and Roca *et al.* (1998) and the latter attribute this scenario to significant investments made by Singapore in the Philippines. Thailand and Malaysia equity returns lead Indonesian returns but Indonesia returns explain only the Malaysian returns. The Philippines market return is not explained by other markets, though it does explain the returns for Thailand, Indonesia and Singapore. In the post-crisis period (Panel C), causal relationships are mostly unidirectional, though a bi-directional link does exist between Singapore and the Philippines. Furthermore, Indonesia equity return is almost unrelated with the other ASEAN5 equity market returns.

Taken together, the temporal causality results for all periods indicate that the individual ASEAN5 equity markets are most probably affected more by international sources of random shocks rather than from shocks arising from within ASEAN5 itself. This is consistent with the arguments proposed by Phylaktis and Ravazzolo (2002) who claim that economic integration leads to financial integration. As the ASEAN5 countries trade more with economies outside the ASEAN5, their equity markets may become more responsive to shocks originating from their non-ASEAN5 trading partners than from within the ASEAN5. For the ASEAN5 countries, their principal trading partners include the US, Japan and China.[17] As a

[17] https://www.cia.gov/library/publications/the-world-factbook/index.html

result, shocks that come from these countries may carry greater weight in explaining the movements in ASEAN5 equity markets.

5.3.3 Speed of adjustment effects for ASEAN5, US, Japan and Australia

The results are presented in Table 6. The full period results shown in Panel A indicate that all the markets except Singapore and the US exhibit statistically significant speed of adjustment. The speed of adjustment results in the pre-crisis period (Panel B) show that coefficients for Indonesia, the Philippines and Australia are statistically significant. The post-crisis period results presented in Panel C documents statistically significant speed of adjustment coefficients for Malaysia, Indonesia, the Philippines and Japan.

[INSERT TABLE 6 ABOUT HERE]

5.3.4 Speed of adjustment effects for ASEAN5 + Japan and Australia + US returns (as an exogenous variable).

The results are presented in Table 7 where the full period results shown in Panel A indicate that all the markets except Singapore exhibit statistically significant speed of adjustment. Some variation exists for the pre-crisis period (Panel B) and post-crisis period (Panel C). However, in all of the three periods, Singapore is exogenous.

[INSERT TABLE 7 ABOUT HERE]

5.4 Temporal causality

Table 8 presents the temporal causality for the ASEAN5, US, Japan and Australia. The full period results (Panel A) show that the US equity market is found to explain the movement in the developed markets of Japan, Australia and Singapore for the full period but does not explain movements in other ASEAN5 markets. The Japanese equity market does not explain

innovations in other equity markets although it is affected by innovations from the Singaporean, Indonesian and US equity markets. The Australian returns lead the Singaporean, Thai and Indonesian returns, though among the ASEAN5 this equity market is affected only by Indonesian market movements. Among the ASEAN5 equity markets, it appears that Singapore is most responsive to movements in the US equity market, which probably indicates that a strong link exists between the equity markets of Singapore and the US that could be explained by their close economic ties via trade relations and the presence of the US MNCs in Singapore.[18]

It appears that the results for the pre-crisis period (Panel B) and post-crisis period (Panel C) show some variation on the influence of these three developed markets on the equity markets of the ASEAN5. The US equity markets seems to have stronger influence on the ASEAN5 markets in the pre-crisis period but in the post-crisis period only Singapore is driven by returns on the US. It is interesting to note that the Japanese and Australian equity markets have limited impacts on the ASEAN5 returns in these two sub-periods.

[INSERT TABLE 8 ABOUT HERE]

Table 9 provides the temporal causality results for the ASEAN5, Japan and Australia with the US returns estimated as an exogenous variable. In general, it demonstrates that the Japanese and Australian equity markets show small variation from the results reported previously in Table 5-10. The influence of these two markets on the ASEAN5 equity markets is limited and this is particularly true of the Japanese market for all three periods. It is noted that the US equity market influence is more prominent on the ASEAN5 equity markets in all three periods, with the influence becoming stronger in the post-crisis period, consistent with

[18] Refer to Leung (2007) for an informative discussion on Singapore and its MNCs.

Abd. Majid *et al.* (2008). As the US equity market is generally viewed as a proxy for the world market, it is reasonable to suggest that the ASEAN5 equity markets conform to the international CAPM, in the sense that these equity market returns are correlated with world market returns.

[INSERT TABLE 9 ABOUT HERE]

6. Conclusion

ASEAN5 stock markets have experienced the 'Asian Miracle' phase, survived the 1997 crisis, and are now re-building their position and strength in the region. The equity markets of the ASEAN5 represent different levels of market development; thus, it is important to examine the short-run and long-run linkages within these equity markets, as well as their relations with the developed markets of the US, Japan and Australia.

Our results from Pearson correlation coefficients suggest that ASEAN5 market correlation increased after the 1997 crisis, except for Malaysia. Capital controls may explain the reduction observed for the Malaysian equity market relative to other ASEAN5 equity markets (Click & Plummer, 2005). Further, our results from cointegration analysis show that these five equity markets share a long-term equilibrium relationship with each other. This relationship remains with the inclusion of the US, Japanese and Australian equity markets in the analysis. While the Japanese and Australian equity market returns provide limited influence on the ASEAN5 equity markets, a more prominent effect is recorded for the US equity market, in particular when the US returns are tested as an exogenous variable to the system.

While there are some exceptions reported in the literature, evidence presented in this study indicates that a substantial amount of interdependence and co-movement exists among the ASEAN5 national markets. As such, the results from our study lend support to previous studies such as those by Click and Plummer (2005), Daly (2003), Sharma and Wongbangpo (2002) and Azman-Saini *et al.* (2002).

Information on the degree of equity market linkages within the ASEAN5 equity markets is one of the important factors considered in an investment portfolio made by investors (Roca *et al.*, 1998). It has been argued that the existence of cointegration in ASEAN5 markets may limit the potential for risk diversification. Nevertheless, it is important to remember that the ASEAN5 markets are partially cointegrated, which means that the diversification benefits are probably reduced but not eliminated.

Bibliography

Abd. Majid, MS, Meera, AK & Omar, MA. 2008, 'Interdependence of ASEAN-5 Stock Markets from the US and Japan', *Global Economic Review*, vol. 37, no. 2, pp. 201-25.

Arshanapalli, B & Doukas, J. 1993, 'International Stock Market Linkages: Evidence from the Pre- and Post-October 1987 Period', *Journal of Banking and Finance*, vol. 17, no. 1, pp. 193-208.

Azman-Saini, WNW, Azali, M, Habibullah, MS & Matthews, KG. 2002, 'Financial Integration and the ASEAN-5 Equity Markets', *Applied Economics*, vol. 34, no. 18, pp. 2283-8.

Bekaert, G, Harvey, C & Lundblad, C. 2003, 'Equity Market Liberalization in Emerging Markets', *Journal of Financial Research*, vol. 26, no. 3, pp. 275-99.

Bekaert, G & Harvey, CR. 1997, 'Emerging Equity Market Volatility', *Journal of Financial Economics*, vol. 43, no. 1, pp. 29-77.

Bekaert, G & Harvey, CR. 2000, 'Foreign Speculators and Emerging Equity Markets', *Journal of Finance*, vol. 55, pp. 564-614.

Chen, G, Firth, M & Rui, OM. 2002, 'Stock Market Linkages: Evidence from Latin America', *Journal of Banking & Finance*, vol. 26, no. 6, pp. 1113-41.

Chen, N, Roll, R & Ross, S. 1986, 'Economic Forces and the Stock Market', *Journal of Business*, vol. 59, no. 3, pp. 383-403.

Chen, N & Zhang, F. 1997, 'Correlations, Trades and Stock Returns of the Pacific-Basin Markets', *Pacific-Basin Finance Journal*, vol. 15, no. 5, pp. 559-77.

Chiang, TC, Jeon, BN & Li, H. 2007, 'Dynamic Correlation Analysis of Financial Contagion: Evidence from Asian Markets', *Journal of International Money and Finance*, vol. 26, no. 7, pp. 1206-28.

Choudhry, T, Lu, L & Peng, K. 2007, 'Common Stochastic Trends among Far East Stock Prices: Effects of the Asian Financial Crisis', *International Review of Finance and Economics*, vol. 16, no. 3, pp. 242-61.

Click, RW & Plummer, MG. 2005, 'Stock Market Integration in ASEAN after the Asian Financial Crisis', *Journal of Asian Economics*, vol. 16, no. 1, pp. 5-28.

Daly, KJ. 2003, 'Southeast Asian Stock Market Linkages: Evidence from Pre- and Post-October 1997', *ASEAN Economic Bulletin*, vol. 20, no. 1, pp. 73-85.

Dunis, CL & Shannon, G. 2005, 'Emerging Markets of South-east and Central Asia: Do They Still Offer a Diversification Benifit?' *Journal Asset Management*, vol. 6, no. 3, pp. 168-90.

Eun, C & Shim, S. 1989, 'International Transmission of Stock Market Movements', *Journal of Financial and Quantitative Analysis*, vol. 24, no. 2, p. 241.

Hafer, RW & Kutan, AM. 1994, 'A Long-Run View of German Dominance and the Degree of Policy Convergence in the EMS', *Economic Inquiry*, vol. 32, no. 4, pp. 684-95.

Herzer, D & Nowak-Lehmann, F. 2006, 'Is there a Long-run Relationship between Exports and Imports in Chile', *Applied Economics Letters*, vol. 13, no. 15, pp. 684-95.

Ibrahim, MH. 2005, 'International Linkages of Stock Prices: The Case of Indonesia ', *Management Research News*, vol. 28, no. 4, pp. 93-115.

Irandoust, M & Ericsson, J. 2004, 'Are Imports and Exports Cointegrated? An International Comparison', *Metroeconomica*, vol. 55, no. 1, pp. 49-64.

Jang, H & Sul, W. 2002, 'The Asian Financial Crisis and the Co-movement of Asian Stock Market', *Journal of Asian Economics*, vol. 13, no. 1, pp. 94-104.

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*, vol. 52, no. 2, pp. 169-210.

Kasa, K. 1992, 'Common Stochastic Trends in International Stock Markets ', *Journal of Monetary Economics*, vol. 29, no. 1, pp. 95-125.

Leung, H. 2007, 'Two New Lessons from the Asian Miracles', *Journal of the Asia Pacific Economy*, vol. 12, no. 1, pp. 1-16.

Lutkepohl, H, Saikkonen, P & Trenkler, C. 2001, 'Maximum Eigenvalue Versus Trace Tests for the Cointegrating Rank of a VAR Process', *Econometrics Journal*, vol. 4, no. 2, pp. 287-310.

Masih, AMM & Rumi, M. 1997, 'Dynamic Linkages and the Propagation Mechanism Driving Major International Stock Markets: An Analysis of the Pre- and Post-Crash Era ', *Quarterly Review of Economics and Finance*, vol. 37, no. 4, pp. 859-85.

Ng, HN. 2002, 'Stock Market Linkages in South-East Asia', *Asian Economic Journal*, vol. 16, no. 4, pp. 353-977.

Palac-McMiken, ED. 1997, 'An Examination of ASEAN Stock Markets', *ASEAN Economic Bulletin*, vol. 13, no. 3, pp. 299-311.

Phylaktis, K & Ravazzolo, F. 2002, 'Measuring Financial and Economic Integration with Equity Prices in Emerging Markets', *Journal of Money and Finance*, vol. 21, no. 6, pp. 879-903.

Pretorius, E. 2002, 'Economic Determinants of Emerging Stock Market Interdependence', *Emerging Markets review*, vol. 3, no. 1, pp. 84-105.

Roca, ED, Selvanathan, EA & Shepherd, WF. 1998, 'Are the ASEAN Equity Markets Interdependent?' *ASEAN Economic Bulletin*, vol. 15, no. 2, pp. 109-20.

Sharma, SC & Wongbangpo, P. 2002, 'Long-term Trends and Cycles in ASEAN Stock Markets', *Review of Financial Economics*, vol. 11, no. 4, pp. 299-315.

Soydemir, G. 2000, 'International Transmission Mechanism of Stock Market Movements: Evidence from Emerging Equity Markets', *Journal of Forecasting*, vol. 19, no. 3, pp. 149-76.

Yang, L, Tapon, F & Sun, Y. 2006, 'International Correlations across Stock Markets and Industries: Trends and Patterns 1988-2002', *Applied Financial Economics*, vol. 16, no. 16, pp. 1171-83.

Table 1 Descriptive Statistics of Market Returns

a. Full period								
	Mean	Median	Maximum	Minimum	Std. Dev	Skewness	Kurtosis	Obs
Malaysia	0.0008	0.0014	0.3615	-0.2907	0.0413	0.3401	19.6701	809
Singapore	0.0016	0.0016	0.1570	-0.2269	0.0287	-0.5568	10.1776	809
Thailand	-0.0003	0.0000	0.2147	-0.2532	0.0504	-0.0356	5.6243	809
Indonesia	-0.0001	0.0008	0.4927	-0.6290	0.0673	-1.0246	21.9465	809
Philippines	0.0006	0.0009	0.1712	-0.2999	0.0425	-0.6037	8.0799	809
US	0.0022	0.0032	0.0753	-0.1229	0.0209	-0.4737	6.3074	809
Japan	0.0006	-0.0002	0.1169	-0.1051	0.0311	0.3394	4.1298	809
Australia	0.0023	0.0028	0.0876	-0.1051	0.0225	-0.2488	3.8979	809
b. Pre-crisis period								
	Mean	Median	Maximum	Minimum	Std. Dev	Skewness	Kurtosis	Obs
Malaysia	0.0029	0.0027	0.0810	-0.0938	0.0272	-0.1283	3.7773	353
Singapore	0.0024	0.0016	0.0805	-0.0570	0.0194	0.0412	3.8068	353
Thailand	-0.0002	0.0022	0.1054	-0.1442	0.0406	-0.2574	3.7803	353
Indonesia	0.0012	0.0008	0.1262	-0.1876	0.0335	-0.3482	7.2169	353
Philippines	0.0037	0.0046	0.1490	-0.1873	0.0395	-0.3928	5.3582	353
US	0.0036	0.0043	0.0609	-0.0374	0.0152	0.2717	3.6770	353
Japan	0.0008	-0.0007	0.1169	-0.0885	0.0298	0.4704	5.0243	353
Australia	0.0028	0.0020	0.0546	-0.0556	0.0203	-0.1167	3.1378	353
c. Post-crisis period								
	Mean	Median	Maximum	Minimum	Std. Dev	Skewness	Kurtosis	Obs
Malaysia	0.0026	0.0014	0.3136	-0.1381	0.0356	1.5294	18.4666	405
Singapore	0.0025	0.0024	0.1090	-0.1107	0.0290	0.0240	4.3013	405
Thailand	-0.0034	-0.0042	0.1645	-0.1982	0.0477	-0.0680	4.9228	405
Indonesia	0.0046	0.0015	0.3590	-0.2201	0.0618	0.6445	7.1817	405
Philippines	0.0002	-0.0007	0.1712	-0.1562	0.0374	0.2190	5.4084	405
US	0.0006	0.0020	0.0753	-0.1229	0.0249	-0.4917	5.5940	405
Japan	0.0016	0.0013	0.1140	-0.1051	0.0313	0.1986	3.5836	405
Australia	0.0028	0.0047	0.0876	-0.1051	0.0239	-0.2905	4.1022	405

Note: Obs indicates the number of observations.

Table 2 Correlation matrix of equity market returns.

Full period	Malaysia	Singapore	Thailand	Indonesia	Philippines	US	Japan
Singapore	0.518						
Thailand	-0.006	-0.014					
Indonesia	0.446	0.473	0.069				
Philippines	0.426	0.448	-0.081	0.476			
US	0.176	0.346	-0.072	0.150	0.213		
Japan	0.226	0.371	-0.029	0.169	0.166	0.228	
Australia	0.237	0.419	-0.086	0.237	0.280	0.383	0.333
Pre-crisis period	Malaysia	Singapore	Thailand	Indonesia	Philippines	US	Japan
Singapore	0.592						
Thailand	-0.020	-0.082					
Indonesia	0.391	0.288	0.022				
Philippines	0.382	0.340	-0.139	0.425			
US	0.098	0.217	-0.084	0.027	0.088		
Japan	0.178	0.303	0.007	-0.012	0.020	0.209	
Australia	0.153	0.253	0.008	0.080	0.116	0.270	0.186
Post-crisis period	Malaysia	Singapore	Thailand	Indonesia	Philippines	US	Japan
Singapore	0.268						
Thailand	-0.003	-0.047					
Indonesia	0.202	0.394	0.080				
Philippines	0.244	0.377	-0.091	0.393			
US	0.19	0.411	-0.126	0.135	0.245		
Japan	0.263	0.408	-0.033	0.277	0.242	0.269	
Australia	0.27	0.496	-0.123	0.287	0.372	0.456	0.418

Table 3 Johansen's Cointegration test results

		Full period			*Pre-crisis period*			*Post-crisis period*		
H_0	H_A	Eigenvalues	λ_{max}	λ_{trace}	Eigenvalues	λ_{max}	λ_{trace}	Eigenvalues	λ_{max}	λ_{trace}
Panel A										
ASEAN5										
r = 0	r > 0	0.0529	43.8735*	84.0648*	0.0768	28.1300	72.7529*	0.1010	43.1103*	90.5819*
r ≤ 1	r > 1	0.0282	23.1289	40.1913	0.0629	22.8708	44.6229	0.0605	25.2680	47.4716
r ≤ 2	r > 2	0.0127	10.3676	17.0624	0.0444	15.9776	21.7521	0.0298	12.2646	22.2036
r ≤ 3	r > 3	0.0080	6.5101	6.6948	0.0148	5.2569	5.7744	0.0146	5.9604	9.9391
r ≤ 4	r = 4	0.0002	0.1847	0.1847	0.0015	0.5175	0.5175	0.0098	3.9786	3.9786
Panel B										
ASEAN5 + US, Japan and Australia										
r = 0	r > 0	0.0688	57.5747*	177.9139*	0.1230	46.2046	162.3611*	0.1495	65.5682*	180.3566*
r ≤ 1	r > 1	0.0412	33.9967	120.3392	0.1135	42.4204	116.1564	0.0900	38.1737	114.7885
r ≤ 2	r > 2	0.0403	33.2670	86.3425	0.0625	22.7015	73.7360	0.0613	25.6327	76.6148
r ≤ 3	r > 3	0.0298	24.4527	53.0755	0.0601	21.8178	51.0345	0.0445	18.4296	50.9821
r ≤ 4	r > 4	0.0147	11.9281	28.6228	0.0330	11.8061	29.2168	0.0346	14.2640	32.5525
r ≤ 5	r > 5	0.0100	8.1487	16.6947	0.0250	8.9132	17.4106	0.0291	11.9425	18.2885
r ≤ 6	r > 6	0.0097	7.8544	8.5460	0.0188	6.6920	8.4974	0.0114	4.6442	6.3460
r = 7	r = 7	0.0009	0.6916	0.6916	0.0051	1.8054	1.8054	0.0042	1.7018	1.7018
Panel C										
ASEAN5 + Japan and Australia + US returns										
r = 0	r > 0	0.0618	51.5370*	139.3886*	0.1174	43.9409	131.2871*	0.1490	65.3387*	152.3168*
r ≤ 1	r > 1	0.0411	33.8824	87.8516	0.0861	31.6893	87.3462	0.0773	32.5859	86.9781
r ≤ 2	r > 2	0.0308	25.2936	53.9692	0.0609	22.1066	55.6569	0.0602	25.1370	54.3923
r ≤ 3	r > 3	0.0166	13.5332	28.6756	0.0523	18.8964	33.5503	0.0331	13.6234	29.2552
r ≤ 4	r > 4	0.0096	7.8103	15.1424	0.0246	8.7703	14.6539	0.0233	9.5405	15.6319
r ≤ 5	r > 5	0.0088	7.1036	7.3321	0.0137	4.8454	5.8836	0.0105	4.2670	6.0914
r = 6	r = 6	0.0003	0.2285	0.2285	0.0029	1.0383	1.0383	0.0045	1.8244	1.8244

Note: The critical values are taken from MacKinnon-Haug-Michelis (1999). r represents the number of cointegrating vectors. H_0 and H_A refer to the null and alternative hypotheses respectively. * denotes rejection of the hypothesis at the 5% level..

Table 4 Speed of adjustment parameters for ASEAN5 VECM

Panel A. Full period					
Cointegrating vector	Malaysia	Singapore	Thailand	Indonesia	Philippines
CIV 1	-0.0091*	-0.0036*	-0.0096*	-0.0190*	-0.0100*
	(-4.4417)	(-2.4974)	(-3.8080)	(-5.7463)	(-4.7336)
Panel B. Pre-crisis period					
Cointegrating vector	Malaysia	Singapore	Thailand	Indonesia	Philippines
CIV 1	0.0111	0.0250*	0.0287**	0.0191	0.0660*
	(1.0829)	(3.4109)	(1.8691)	(1.5234)	(4.4621)
Panel C. Post-crisis period					
Cointegrating vector	Malaysia	Singapore	Thailand	Indonesia	Philippines
CIV 1	-0.0009	0.0008	-0.0012	-0.0239*	-0.0086*
	(-0.3198)	(0.3616)	(-0.3408)	(-5.2693)	(-3.1111)

Note: CIV indicates the number of cointegrating vectors. * indicates 5% level of significance; $^{+}$ indicates 10% significance level.

Table 5 Temporal causality results for ASEAN5

Panel A. Full period					
Explanatory Markets	*Market Explained*				
	Malaysia	Singapore	Thailand	Indonesia	Philippines
Malaysia	-0.0286	0.0083	-0.0106	-0.1569*	-0.0030
	(-0.6649)	(0.2759)	(-0.2024)	(-2.2655)	(-0.0689)
Singapore	-0.0517	-0.0679	0.0110	-0.0581	0.0936
	(-0.7721)	(-1.4460)	(0.1344)	(-0.5399)	(1.3645)
Thailand	0.1004*	0.0295	0.0121	0.1510*	0.0929*
	(2.6714)	(1.1187)	(0.2634)	(2.4971)	(2.4160)
Indonesia	0.0190	-0.0017	-0.1078*	-0.1135*	-0.0387
	(0.7173)	(-0.0889)	(-3.3349)	(-2.6632)	(-1.4268)
Philippines	-0.0265	0.0465	0.1490*	0.0101	-0.0323
	(-0.6420)	(1.6052)	(2.9554)	(0.1517)	(-0.7635)
R-squared	0.0421	0.0184	0.0405	0.0672	0.0514
F-statistic	5.8620*	2.4989	5.6380*	9.6211*	7.2360*
Panel B. Pre-crisis period					
Explanatory Markets	*Market Explained*				
	Malaysia	Singapore	Thailand	Indonesia	Philippines
Malaysia	0.1284^{+}	0.0352	-0.1317	-0.0143^{+}	0.0927
	(1.8446)	(0.7082)	(-1.2666)	(-0.1687)	(0.9260)
Singapore	0.0237	-0.0177	0.1036	0.0876	-0.0015
	(0.2483)	(-0.2601)	(0.7276)	(0.7550)	(-0.0109)
Thailand	0.0629	0.0049	0.0692	0.1600*	0.0492
	(1.5437)	(0.1680)	(1.1367)	(3.2233)	(0.8393)
Indonesia	-0.1116*	-0.0373	-0.0983	-0.0209	-0.0391
	(-2.2748)	(-1.0641)	(-1.3420)	(-0.3495)	(-0.5544)
Philippines	0.0666	0.0493^{+}	0.1709*	0.0988*	0.0080
	(1.5911)	(1.6506)	(2.7321)	(1.9365)	(0.1322)
R-squared	0.0594	0.0510	0.0456	0.0841	0.0778
F-statistic	3.6327*	3.0895*	2.7460	5.2809*	4.8493*
Panel C. Post-crisis period					
Explanatory Markets	*Market Explained*				
	Malaysia	Singapore	Thailand	Indonesia	Philippines
Malaysia	0.0046	0.0596	-0.0204	-0.0506	-0.0608
	(0.0878)	(1.4027)	(-0.2928)	(-0.5735)	(-1.1366)
Singapore	0.2240*	0.0088	0.1311	0.0627	0.1399^{+}
	(2.9457)	(0.1414)	(1.2831)	(0.4854)	(1.7860)
Thailand	-0.0367	-0.0014	-0.0693	-0.0272	0.0720
	(-0.7242)	(-0.0338)	(-1.0191)	(-0.3168)	(1.3806)
Indonesia	0.0538	-0.0051	-0.1033*	0.0286	0.0142
	(1.5846)	(-0.1833)	(-2.2661)	(0.4965)	(0.4062)
Philippines	-0.0405	0.1107*	0.1814*	0.0471	0.0288
	(-0.7244)	(2.4205)	(2.4166)	(0.4961)	(0.5011)
R-squared	0.0389	0.0298	0.0291	0.0781	0.0772
F-statistic	2.6869	2.0401	1.9880	5.6169*	5.5523*

Note: CIV denotes the number of cointegrating vectors. * indicates 5% level of significance; $^{+}$ indicates 10% significance level.

Table 6 Speed of adjustment parameters for ASEAN5 + USA + Japan + Australia

Panel A. Full period								
	Malaysia	Singapore	Thailand	Indonesia	Philippines	US	Japan	Australia
CIV 1	-0.0251*	-0.0032	-0.0222*	-0.0358*	-0.0248*	0.0047	-0.0117*	-0.0072*
	(-4.4747)	(-0.8155)	(-3.2504)	(-3.9365)	(-4.3046)	(1.6222)	(-2.7838)	(-2.3471)
Panel B. Pre-crisis period								
	Malaysia	Singapore	Thailand	Indonesia	Philippines	US	Japan	Australia
CIV 1	0.0025	0.0014	0.0156	0.0217*	0.0515*	0.0050	0.0004	0.0238*
	(0.3372)	(0.2511)	(1.3894)	(2.4242)	(4.7926)	(1.1633)	(0.0534)	(4.3198)
Panel C. Post-crisis period								
	Malaysia	Singapore	Thailand	Indonesia	Philippines	US	Japan	Australia
CIV 1	-0.0285*	0.0105	-0.0142	-0.0932*	-0.0378*	0.0029	-0.0263*	-0.0057
	(-2.8284)	(1.2621)	(-1.0406)	(-5.3656)	(-3.5945)	(0.3993)	(-2.9942)	(-0.8299)

Note: CIV denotes the number of cointegrating vectors. * indicates 5% level of significance; $^{+}$ indicates 10% level of significance. Values in parentheses indicate t-statistics.

Table 7 Speed of adjustment parameters for ASEAN5 + Japan and Australia + US returns (as an exogenous variable)

Panel A. Full period							
	Malaysia	Singapore	Thailand	Indonesia	Philippines	Japan	Australia
CIV 1	-0.02691*	-0.0052	-0.0235*	-0.0402*	-0.0271*	-0.0120*	-0.0071*
	(-4.8567)	(-1.3952)	(-3.4939)	(-4.4601)	(-4.8126)	(-2.8886)	(-2.4833)
Panel B. Pre-crisis period							
	Malaysia	Singapore	Thailand	Indonesia	Philippines	Japan	Australia
CIV 1	0.0022	-0.0010	0.0077^{+}	0.0082*	0.0152*	-0.0013	0.0086*
	(0.8091)	(-0.5013)	(1.9159)	(2.5250)	(3.8902)	(-0.4628)	(4.4373)
Panel C. Post-crisis period							
	Malaysia	Singapore	Thailand	Indonesia	Philippines	Japan	Australia
CIV 1	-0.0265*	0.0104	-0.0138	-0.0916*	-0.0362*	-0.0243*	-0.0054
	(-2.7848)	(1.4135)	(-1.0804)	(-5.5112)	(-3.6801)	(-2.9163)	(-0.9005)

Note: CIV denotes the number of cointegrating vectors. * indicates 5% level of significance; $^{+}$ indicates 10% level of significance. Values in parentheses indicate t-statistics.

Table 8 Temporal causality for ASEAN5, US, Japan and Australia

Panel A. Full period								
Explanatory	*Market Explained (t)*							
Markets (t-1)	Malaysia	Singapore	Thailand	Indonesia	Philippines	US	Japan	Australia
Malaysia	-0.0176	0.0133	-0.0006	-0.1436*	0.0062	0.0063	0.0282	-0.0304
	(-0.4096)	(0.4432)	(-0.0108)	(-2.0562)	(0.1410)	(0.2865)	(0.8754)	(-1.2923)
Singapore	-0.0956	-0.1332*	-0.0881	-0.1993^{+}	0.0506	-0.0075	-0.1143*	-0.0367
	(-1.3277)	(-2.6462)	(-1.0017)	(-1.7065)	(0.6839)	(-0.2015)	(-2.1225)	(-0.9312)
Thailand	0.1021*	0.0309	0.0095	0.1548	0.1001*	0.0135	-0.0095	0.0219
	(2.7050)	(1.1687)	(0.2053)	(2.5269)	(2.5801)	(0.6957)	(-0.3378)	(1.0613)
Indonesia	0.0182	-0.0013	-0.1077*	-0.1177*	-0.0399	-0.0034	-0.0351^{+}	-0.0246^{+}
	(0.6866)	(-0.0711)	(-3.3287)	(-2.7403)	(-1.4664)	(-0.2460)	(-1.7717)	(-1.6962)
Philippines	-0.0330	0.0386	0.1394*	0.0107	-0.0341	-0.0008	-0.0232	0.0156
	(-0.7952)	(1.3304)	(2.7483)	(0.1594)	(-0.7987)	(-0.0366)	(-0.7475)	(0.6878)
US	0.1058	0.1366*	0.1396	-0.0126	0.0959	-0.1270*	0.2310*	0.2033*
	(1.3864)	(2.5591)	(1.4977)	(-0.1016)	(1.2227)	(-3.2329)	(4.0478)	(4.8699)
Japan	-0.0537	0.0014	0.0186	0.1293	-0.0129	0.0072	-0.0601	0.0039
	(-1.0564)	(0.0392)	(0.3002)	(1.5682)	(-0.2462)	(0.2749)	(-1.5814)	(0.1407)
Australia	0.0725	0.1083*	0.1605^{+}	0.2598*	0.0149	0.0477	0.0603	-0.0629
	(0.9666)	(2.0638)	(1.7513)	(2.1339)	(0.1932)	(1.2349)	(1.0748)	(-1.5335)
R-squared	0.0467	0.0294	0.0434	0.0560	0.0482	0.0166	0.0456	0.0424
F-statistic	4.3409*	2.6854	4.0256*	5.2593*	4.4916*	1.4972	4.2386*	3.9218*
Panel B. Pre-crisis period								
	Market Explained (t)							
Explanatory								
Markets (t-1)	Malaysia	Singapore	Thailand	Indonesia	Philippines	US	Japan	Australia
Malaysia	0.1422*	0.0516	-0.1190	-0.0078	0.1056	0.0082	0.0233	-0.0606
	(2.0566)	(1.0270)	(-1.1413)	(-0.0946)	(1.0589)	(0.2082)	(0.3035)	(-1.1864)
Singapore	0.0144	-0.0133	0.1060	-0.0469	-0.0414	-0.0199	0.0569	-0.1393^{+}
	(0.1421)	(-0.1802)	(0.6945)	(-0.3863)	(-0.2837)	(-0.3441)	(0.5065)	(-1.8629)
Thailand	0.0673^{+}	0.0143	0.0828	0.1687*	0.0755	-0.0397^{+}	-0.0741^{+}	-0.0056
	(1.6640)	(0.4877)	(1.3580)	(3.4796)	(1.2951)	(-1.7135)	(-1.6523)	(-0.1889)
Indonesia	-0.1150*	-0.0468	-0.1100	-0.0206	-0.0690	0.0350	-0.1036*	-0.0336
	(-2.3668)	(-1.3249)	(-1.5006)	(-0.3540)	(-0.9844)	(1.2564)	(-1.9229)	(-0.9354)
Philippines	0.0565	0.0378	0.1644*	0.0927^{+}	0.0051	-0.0088	0.0046	0.0203
	(1.3531)	(1.2472)	(2.6132)	(1.8533)	(0.0844)	(-0.3672)	(0.1002)	(0.6582)
US	0.2944*	0.1651*	0.2534^{+}	0.3890*	0.2511^{+}	-0.0648	0.0935	0.2880*
	(2.9709)	(2.2913)	(1.6959)	(3.2748)	(1.7572)	(-1.1423)	(0.8512)	(3.9346)
Japan	-0.0555	-0.0137	-0.0290	0.0076	-0.0216	-0.0333	0.0068	0.0437
	(-1.0685)	(-0.3618)	(-0.3710)	(0.1219)	(-0.2886)	(-1.1207)	(0.1181)	(1.1394)
Australia	-0.0207	0.0430	-0.1112	0.1317	-0.0760	-0.0239	0.0343	-0.0922^{+}
	(-0.2792)	(0.7984)	(-0.9954)	(1.4842)	(-0.7116)	(-0.5633)	(0.4178)	(-1.6851)
R-squared	0.0820	0.0388	0.0507	0.1342	0.0958	0.0342	0.0268	0.1067
F-statistic	3.3925*	1.5358	2.0292	5.8907*	4.0283*	1.3469	1.0446	4.5383*

Note: * indicates 5% level of significance; $^{+}$ indicates 10% level of significance. Values in parentheses indicate t-statistics.

Table 8 Temporal causality for ASEAN5, US, Japan and Australia (continued)

Panel C. Post-crisis period

Explanatory Markets (t-1)	*Market Explained (t)*							
	Malaysia	Singapore	Thailand	Indonesia	Philippines	US	Japan	Australia
Malaysia	0.0315	0.0465	-0.0395	-0.0799	-0.0632	0.0125	0.0129	-0.0608^{+}
	(0.6083)	(1.0881)	(-0.5622)	(-0.8937)	(-1.1685)	(0.3351)	(0.2840)	(-1.7284)
Singapore	0.2219*	-0.0432	0.0007	-0.0963	0.0877	-0.0548	-0.1550*	-0.0429
	(2.6835)	(-0.6334)	(0.0064)	(-0.6750)	(1.0155)	(-0.9232)	(-2.1464)	(-0.7648)
Thailand	-0.0467	0.0024	-0.0892	-0.0412	0.0710	0.0410	0.0234	0.0409
	(-0.9291)	(0.0581)	(-1.3097)	(-0.4754)	(1.3528)	(1.1346)	(0.5337)	(1.1983)
Indonesia	0.0673*	-0.0021	-0.0983*	-0.0053	0.0066	-0.0115	-0.0303	-0.0245
	(2.0270)	(-0.0760)	(-2.1873)	(-0.0932)	(0.1908)	(-0.4813)	(-1.0440)	(-1.0862)
Philippines	-0.0643	0.1018*	0.1372^{+}	0.0302	0.0233	0.0166	-0.0766	0.0503
	(-1.1506)	(2.2084)	(1.8142)	(0.3135)	(0.4004)	(0.4139)	(-1.5700)	(1.3268)
US	0.0492	0.1560*	0.1778	0.0395	0.0827	-0.1179*	0.2754*	0.2009*
	(0.6126)	(2.3561)	(1.6362)	(0.2856)	(0.9878)	(-2.0471)	(3.9308)	(3.6900)
Japan	-0.1445*	0.0004	0.0010	0.1688	0.0387	0.0514	-0.1055^{+}	-0.0042
	(-2.2521)	(0.0075)	(0.0112)	(1.5251)	(0.5777)	(1.1167)	(-1.8830)	(-0.0967)
Australia	0.0084	0.0390	0.2236^{+}	0.1388	-0.0414	0.0504	0.0542	-0.0907
	(0.0899)	(0.5066)	(1.7685)	(0.8623)	(-0.4249)	(0.7525)	(0.6643)	(-1.4326)
R-squared	0.0743	0.0519	0.0506	0.0841	0.0873	0.0216	0.0835	0.0544
F-statistic	3.5243*	2.4024	2.3398	4.0311*	4.1980*	0.9672	3.9960*	2.5270

Note: * indicates 5% level of significance; $^{+}$ indicates 10% level of significance. Values in parentheses indicate t-statistics.

Table 9 Temporal causality for ASEAN5 + Japan and Australia + US returns (as an exogenous variable)

Panel A. Full period

Explanatory Markets (t-1)	*Market Explained (t)*						
	Malaysia	Singapore	Thailand	Indonesia	Philippines	Japan	Australia
Malaysia	-0.0205	0.0092	-0.0047	-0.1465*	0.0028	0.0245	-0.0346
	(-0.4841)	(0.3247)	(-0.0921)	(-2.1262)	(0.0650)	(0.7732)	(-1.5741)
Singapore	-0.0643	-0.0960*	-0.0465	-0.1837	0.0828	-0.0634	0.0118
	(-0.9242)	(-2.0604)	(-0.5500)	(-1.6223)	(1.1688)	(-1.2192)	(0.3263)
Thailand	0.0939*	0.0207	-0.0004	0.1446*	0.0905*	-0.0183	0.0132
	(2.5297)	(0.8341)	(-0.0089)	(2.3925)	(2.3944)	(-0.6597)	(0.6835)
Indonesia	0.0177	-0.0022	-0.1085*	-0.1160*	-0.0400	-0.0375^{+}	-0.0266*
	(0.6820)	(-0.1235)	(-3.4305)	(-2.7396)	(-1.5115)	(-1.9271)	(-1.9691)
Philippines	-0.0301	0.0452^{+}	0.1449*	0.0084	-0.0311	-0.0143	0.0246
	(-0.7394)	(1.6571)	(2.9229)	(0.1268)	(-0.7501)	(-0.4708)	(1.1629)
Japan	-0.0528	0.0054	0.0203	0.1248	-0.0125	-0.0533	0.0095
	(-1.0591)	(0.1605)	(0.3343)	(1.5387)	(-0.2467)	(-1.4315)	(0.3649)
Australia	0.0926	0.1361*	0.1870*	0.2472*	0.0311	0.1135*	-0.0180
	(1.3006)	(2.8545)	(2.1585)	(2.1318)	(0.4289)	(2.1331)	(-0.4868)
US returns	0.3528*	0.4698*	0.4965*	0.4876*	0.4445*	0.3349*	0.4166*
	(5.2574)	(10.454)	(6.0819)	(4.4622)	(6.5017)	(6.6747)	(11.9328)
R-squared	0.0787	0.1399	0.0838	0.0817	0.0970	0.0785	0.1632
F-statistic	7.5773*	14.4273*	8.1146*	7.8927*	9.5191*	7.5509*	17.2936*

Panel B. Pre-crisis period

Explanatory Markets (t-1)	*Market Explained (t)*						
	Malaysia	Singapore	Thailand	Indonesia	Philippines	Japan	Australia
Malaysia	0.1315^{+}	0.0461	-0.1282	-0.0158	0.1087	0.0179	-0.0683
	(1.8954)	(0.9377)	(-1.2345)	(-0.1886)	(1.0812)	(0.2393)	(-1.3681)
Singapore	0.0407	0.0218	0.1229	-0.0002	0.0274	0.0852	-0.0983
	(0.4037)	(0.3052)	(0.8146)	(-0.0018)	(0.1876)	(0.7834)	(-1.3547)
Thailand	0.0738^{+}	0.0239	0.0924	0.1728*	0.0873	-0.0596	0.0086
	(1.8088)	(0.8269)	(1.5128)	(3.5091)	(1.4773)	(-1.3541)	(0.2913)
Indonesia	-0.1285*	-0.0599^{+}	-0.1267^{+}	-0.0368	-0.0926	-0.1192*	-0.0565
	(-2.6270)	(-1.72870)	(-1.7298)	(-0.6226)	(-1.3061)	(-2.2574)	(-1.6048)
Philippines	0.0655	0.0434	0.1708*	0.0980^{+}	0.0000	0.0103	0.0257
	(1.5673)	(1.4661)	(2.7312)	(1.9418)	(-0.0004)	(0.2284)	(0.8532)
Japan	-0.0221	0.0060	0.0023	0.0369	-0.0154	0.0264	0.0746*
	(-0.4278)	(0.1637)	(0.0295)	(0.5924)	(-0.2066)	(0.4747)	(2.0082)
Australia	0.0331	0.0793	-0.0562	0.2088*	0.0007	0.0622	-0.0227
	(0.4564)	(1.5407)	(-0.5170)	(2.3812)	(0.0069)	(0.7939)	(-0.4343)
US returns	0.2147*	0.3006*	0.2320	0.1341	0.2525^{+}	0.4095*	0.3612*
	(2.2703)	(4.4841)	(1.6389)	(1.1745)	(1.8428)	(4.0109)	(5.3041)
R-squared	0.0742	0.0784	0.0558	0.1135	0.0791	0.0687	0.1435
F-statistic	3.0449*	3.2335*	2.2462	4.8659*	3.2649*	2.8050*	6.3654*

Note: * indicates 5% level of significance; $^{+}$ indicates 10% level of significance. Values in parentheses indicate t-statistics.

Table 9 Temporal causality for ASEAN5 + Japan and Australia + US returns (continued)

Panel C. Post-crisis period							
Explanatory	*Market Explained*						
Markets	Malaysia	Singapore	Thailand	Indonesia	Philippines	Japan	Australia
Malaysia	0.0292	0.0435	-0.0418	-0.0807	-0.0654	0.0137	-0.0623*
	(0.5760)	(1.1085)	(-0.6155)	(-0.9121)	(-1.2471)	(0.3089)	(-1.9632)
Singapore	0.2610*	0.0318	0.0834	-0.0560	0.1400^{+}	-0.0610	0.0399
	(3.3000)	(0.5193)	(0.7878)	(-0.4061)	(1.7128)	(-0.8821)	(0.8065)
Thailand	-0.0601	-0.0214	-0.1153^{+}	-0.0591	0.0529	0.0018	0.0168
	(-1.2183)	(-0.5623)	(-1.7474)	(-0.6874)	(1.0386)	(0.0413)	(0.5437)
Indonesia	0.0686*	-0.0040	-0.0998*	-0.0004	0.0079	-0.0358	-0.0274
	(2.1155)	(-0.1611)	(-2.2987)	(-0.0079)	(0.2363)	(-1.2629)	(-1.3520)
Philippines	-0.0643	0.1043*	0.1396^{+}	0.0258	0.0231	-0.0678	0.0544
	(-1.1781)	(2.4691)	(1.9095)	(0.2711)	(0.4092)	(-1.4203)	(1.5931)
Japan	-0.1597*	-0.0182	-0.0190	0.1503	0.0210	-0.1163	-0.0204
	(-2.5433)	(-0.3749)	(-0.2258)	(1.3724)	(0.3229)	(-2.1194)	(-0.5185)
Australia	0.0204	0.0847	0.2767*	0.1497	-0.0185	0.1411^{+}	-0.0294
	(0.2332)	(1.2506)	(2.3604)	(0.9807)	(-0.2042)	(1.8436)	(-0.5363)
US returns	0.2955*	0.4742*	0.4976*	0.3328*	0.3690*	0.3464*	0.4408*
	(4.3317)	(8.9888)	(5.4474)	(2.7977)	(5.2342)	(5.8105)	(10.326)
R-squared	0.1137	0.2024	0.1108	0.1032	0.1433	0.1205	0.2295
F-statistic	5.6310*	11.1363*	5.4687*	5.0526*	7.3384*	6.0147*	13.0743*

Note: * indicates 5% level of significance; $^{+}$ indicates 10% level of significance. Values in parentheses indicate t-statistics.