FINANCIAL INTEGRATION OF THE ASEAN-5 MARKETS: FINANCIAL CRISIS EFFECTS BASED ON BIVARIATE AND MULTIVARIATE COINTEGRATION APPROACH

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Abstract

In this study, regional and global financial market integration is examined for five major ASEAN countries: Malaysia, Singapore, Thailand, Philippines and Indonesia. One of the objectives is to examine the impact of structural break which may be generated by the Asian financial crisis. We test the long-run relationship between the markets by employing the bivariate and multivariate cointegration techniques in which the later approach considers the cointegration between more than one market at a time. While, the findings reveal that some of these markets are regionally and globally integrated, they are far from fully integrated, which reflects some diversification benefits in ASEAN markets. The results also show significant impact of structural break generated by Asian financial crisis and highlight the importance of applying multivariate cointegration in testing for integration on these markets. From the asset pricing perspective, the findings suggest the importance of including regional and global markets as risk factors for these markets.

Key words: ASEAN markets, financial integration, structural break.
JEL Classification: C22, F21, G15.

1. Introduction

The objective of this paper is to examine financial integration on ASEAN markets following the increasing liberalization measures undertaken by these countries, notably during the last two decades. These countries have been implementing financial reforms in their attempt to promote economic efficiency. For example Singapore was the first to begin liberalizing its financial systems by removing or relaxing interest rate regulations and abolishing exchange controls in the mid 1970s and followed by Malaysia with significant financial reforms in the late 1970s (Phylaktis, 1997). In addition, the emerging equity markets which include some of the ASEAN countries have attracted the attention of international fund managers as an opportunity for portfolio diversification (Jan, Chou and Hung, 2000) and have also intensified the curiosity of academics in exploring international market linkages because increasing degree of integration between emerging markets and developed countries may decrease their ability to enhance and diversify international portfolio (Yu & Hassan, 2006).

Why is the financial market integration so important? The economic implications of financial market integration have increased research interest on this subject matter. It may improve the global allocation of capital and help countries to better share risk by reducing consumption volatility (Kose, Prasad & Terrones, 2003) and the benefit to access to a larger pool of external finance and a larger investment opportunity set and increasing growth rate (Edison, Ricci & Slok, 2002). Despite these benefits, increasing market integration or reducing market segmentation diminishes the ability of governments to achieve independent economic policies (Swanson, 1987). Financial integration may also have impact upon risk return relationship between assets (Ragunathan, 1999), which is pertinent in the issue of portfolio selections and asset pricing. If markets are globally integrated, only global risk factors are priced for international assets (Zhang, 2006) and from the perspective of a portfolio investor, market integration suggests that separate markets move together and have high correlations, so there is less benefit from portfolio diversification across countries (Click & Plummer, 2005).

Studies on financial integration in developed markets (e.g., Davies, 2006; Choudhary, 1994; and Corhay, Tourani & Urbain, 1993) have provided mixed and conflicting evidence. While

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Choudhary found no evidence of long-run relationship among developed countries namely US, UK, Japan, Italy, France, Canada and Germany for the period of 1953-1989, Corhay et al. found evidences of strong integration among five major European markets (France, Germany, Italy, Netherlands and UK). Davies (2006) has found scant evidence in favour of market integration among seven major developed equity markets (US, UK, Japan, Germany, Switzerland, Australia and Canada) with a single regime treatment, however there is a significant evidence of long-run relationship when a two-regime Markov switching is applied. Studies for less developed market (e.g. Gerlach, Wilson & Zurbruegg, 2006; Click & Plummer, 2005; Daly, 2003; Durand, Kee & Watson, 2001; and Masih & Masih, 1999) have also yielded mixed conclusions. Studies by Durand et al. (2001) among others found that these markets are integrated with global markets, specifically with US ones. In contrast, Masih and Masih, (1999) found evidence that the stock market fluctuations in Southeast region are mostly influenced by the regional rather than the advanced or global markets. Comparisons as to the reasons of such different conclusions both on developed and less developed markets are difficult to carry out due to different markets indices used over various sample period and varying frequency of returns. Thus, determining the integration of national equity market from international financial markets is an empirical question and because of its economic implications, it is deserved to be explored further.

Our study contains several contributions. First, it considers whether stock markets of ASEAN economies are integrated with the global financial markets. We focus on five major ASEAN economies namely Malaysia, Singapore, Indonesia, Philippines and Thailand since they are among the largest equity markets in ASEAN region. We use US, Japan and World market as proxy for global market as most of previous studies have concentrated on the influence of two major world economies on ASEAN countries; the US and Japan (see among others Eun & Shim, 1989; Ghosh, Saidi & Johnson, 1999; Durand et al., 2001), however the findings vary with regard to which market is the significant driver of price changes in the region. For example, Eun and Shim found evidence that the US stock market is the most influential in the world and variations in the Japanese market fail to explain any substantial part of variations in other markets. In contrast Ghosh et al. found that some markets in Asian-Pacific are cointegrated with the US and some are cointegrated with Japan and others are not cointegrated with either. On the other hand, Durand et al. (2001) found that these markets are integrated with US stock market and the Japanese stock market had a significant effect in half of the markets included in the study.

Second, this study also investigates whether these countries are regionally integrated. Such study is parallel to several developments made by these countries as initiatives to coordinate the five national capital markets and to undertake economic and financial integrative measures such as the forming of the ASEAN Free Trade Area (AFTA) and the ASEAN Investment Area (AIA) and also the possibility of a currency union in the region (Click & Plummer, 2005). Several studies have examined integration across the ASEAN market and found evidence that these markets are regionally integrated. Chai and Rhee (2005) for example used cross-market correlations, focused mainly on the stock market to examine financial integration in East Asian countries namely Korea, China, Japan, Hong Kong, Taiwan, Indonesia, Malaysia, Philippines, Singapore, Thailand) with 14 European countries and found evidence that these markets are regionally integrated. Examining both integration regionally and globally in our study provides clearer picture on the integration in ASEAN equity market.

Third, we examine the impact of financial crisis on the integration. On this issue, Gerlach et al. (2006) have argued that the diversification benefits of integration are actually less than that suggested by an analysis incorrectly ignoring the crisis, since the existence of a structural break may disguise the true nature of any potential relationships between financial assets. Previous studies on the effect of financial crisis on financial integration have provided mixed results. While studies by Arshanapalli and Doukas (1993) and Gerlach (2006), among others, have found evidence of the effect of financial crisis on the relationship between stock markets, Daly (2003) has documented mixed evidence. Arshanapalli and Doukas (1993) examined the interactions among stock price indices across the major world exchanges during the pre and post October 1987 period and found evidence of stronger long run relationship between three European markets, namely France, Germany and the United Kingdom with the US stock market during post-1987 crash period than the pre-1987 period. Gerlach (2006) examined the impact of financial crisis upon the

integration and dynamic links between a number of Asia-Pacific real estate markets and found that the Asian crisis generated a structural break that caused a shift in the model parameter values around mid-1997. Despite such structural shift, the results showed that Asia-Pacific property markets are integrated. Daly (2003) studied the interdependence of the stock markets of Southeast Asian (Indonesia, Malaysia, Philippines, Singapore and Thailand) and the advanced stock markets of Australia, Germany and the United States (US) and found mixed results on the effect of financial crisis. While the correlation analysis indicates that the majority of stock markets in the study became more integrated after the October 1997 crash, the bivariate cointegration reveals one cointegrating vector over both the pre- and post-1997 crisis periods. However, the multivariate cointegration between the stock markets of Australia, Germany and the United States with the Southeast Asian market shows no evidence in support of cointegrating relationships, in either the pre- or post-crisis period. To consider both bivariate and multivariate approaches, finally, this paper examines the integration under both of them. Several studies have examined integration focusing on the cointegration of two I (1) series and do not examine if the market is cointegrated with more than one countries. Omitting such relationship might give rise to model misspecification and produce biased findings.

The paper is structured as follows. The first section contains introduction and literature review, followed by data and methodology in section 2. The results are reported in section 3 and lastly, the conclusions are given in section 4.

2. Data and Methodology

2.1. Data

Five major ASEAN stock indices used are Indonesia Jakarta Composite, Malaysia KLCI, Philippines Composite Index, Singapore Straits Times Index, Bangkok S.E.T, and the global indices are S&P 500 Composite for US, Nikkei 225 Stock Average for Japan, and Morgan Stanley Corporation (MSCI) World price index. All data are monthly closing prices for the period from April 1983 to December 2006 and from January 1986 to December 2006 only for Philippines, collected from the Datastream. To address the impact of financial crisis, the sample is further divided into the pre-crisis from April 1983 to June 1997 and post crisis from July 1998 to December 2006. Studies by Chai and Rhee (2005), Fujii (2002) and Phylaktis and Ravazzolo (2002) among others have used period before June 1997 as the pre-crisis period. For the post crisis, Click and Plummer (2005) and Tan and Tse (2002) have used mid-1998 (July 1998) as the beginning of the post-crisis period because the bulk of the Asian financial crisis had ended by then.

2.2. Methodology

Johansen (1988) cointegration test has been widely used in testing for financial integration. The test indicates the number of cointegrating vectors using the maximum likelihood approach. It provides two test statistics to test for the existence of r cointegrating vectors; the maximum eigenvalue test and trace test. A long run relationship between two stock market indices, j and i, can be represented by

$$Ln(P_t^j) = a_0 + a_1 Ln(P_t^i) + e_t, \quad (1)$$

where the stock market integration in the long run implies a linear relationship between the natural logarithms of the portfolio price indices, $Ln(P^j)$ and $Ln(P^i)$. This is a test of the cointegration of two variable series. If both of them are cointegrated, the error term *e* in the above equation is stationary, and there exists a long-run equilibrium relationship between the two series. The equation could also be applied to multivariate cointegration to test the cointegration of more than two variable series.

Before testing for cointegration, the series are required to be integrated of the same order. We tested for unit roots to verify the stationarity for all the series using the Augmented Dickey Fuller (ADF) test with the following regression:

$$\Delta r_t = \alpha + \gamma r_{t-1} + \sum_{i=1}^{k} \theta_i \Delta r_{t-i} + \varepsilon_t , \quad (2)$$

where, α and γ are parameters, r is the variable under consideration (i.e. stock price indices) and ε_t is assumed to be white noise. The results of the test can be very sensitive to the choice of the lag length k, therefore the Akaike Information Criteria (AIC) and Schwartz Information Criterion (SIC) are employed to determine the optimal lag-structure specification of equation (2).

3. Results and Discussions

3.1. Descriptive Statistics

Table 1 presents the descriptive statistics for monthly stock indices from the period of April 1983 to December, 2006. The highest mean price is in Japan (9.768) while Singapore has the lowest mean relative to other markets (5.264) and, as expected, has the lowest standard deviation (0.310). Philippines shows higher standard deviation and higher average price than other markets except for Japan. Indonesian market has average mean of 5.989 with the highest standard deviation of 0.750.

Table 1

Summary statistics of monthly stock price indices of five major ASEAN and global markets for full sample, April 1983 to December 2006

	Japan	Mal	Ind	Sing	Thai	US	World	Phil
Mean	9.768	6.477	5.989	5.264	6.322	6.462	6.686	7.249
Med	9.777	6.555	6.115	5.25	6.462	6.495	6.70	7.300
Max	10.56	7.151	7.499	6.004	7.428	7.325	7.504	8.138
Min	8.966	5.146	4.122	4.209	4.860	5.356	5.685	4.892
SDev.	0.347	0.438	0.750	0.310	0.571	0.602	0.394	0.609
Skew	-0.05	-0.99	-0.96	-0.50	-0.322	-0.17	-0.027	-1.276
Kurt	2.638	3.345	3.767	3.965	2.679	1.518	2.124	5.455
J-Bera	1.464	35.22	45.10	20.28	5.450	24.33	8.084	131.655
Prob	0.481	0.000	0.000	0.000	0.066	0.000	0.018	0.000

Notes: Phil = Philippines; Sing = Singapore; Mal = Malaysia; Ind = Indonesia; Thai = Thailand; US = United States; Med = median; Max = maximum; Min = minimum; SDev = standard deviation; Skew = skewness; Kurt = kurtosis; J-Bera = Jarque-Bera; Prob = probability.

3.2. Correlations

Correlations between ASEAN markets and global markets are presented in Table 2. While, all correlations among five major ASEAN countries are positive ranging from 0.485 (Singapore and Thailand) to 0.897 (Malaysia and Philippines), correlations among the global markets are higher, ranging from -0.489 (Japan and World) to 0.970 (US and World). Between ASEAN countries and the global market, correlations with Japan are generally the lowest ranging from 0.123 (Philippines and Japan) to 0.305 (Indonesia and Japan). In general, most correlations are less than one especially between ASEAN markets and Japan which indicates some diversification benefits for portfolio investors in the ASEAN region.

Table 2

Correlations between stock price indices of five major ASEAN and global markets for the period April 1983 to December 2006

	Japan	Mal	Ind	Sing	Thai	US	World	Phil
Japan	1	-0.261	-0.31	-0.252	0.240	-0.664	-0.489	-0.12
Mal	-0.261	1.000	0.846	0.830	0.713	0.613	0.618	0.897
Ind	-0.305	0.846	1.000	0.840	0.559	0.732	0.725	0.763
Sing	-0.252	0.830	0.840	1.000	0.485	0.733	0.772	0.777
Thai	0.240	0.713	0.559	0.485	1.000	-0.014	0.022	0.687
US	-0.664	0.613	0.732	0.733	-0.014	1.000	0.970	0.585
World	-0.489	0.618	0.725	0.772	0.022	0.970	1.000	0.638
Phil	-0.123	0.897	0.763	0.777	0.687	0.786	-0.623	1.000

Notes: Phil = Philippines; Sing = Singapore; Mal = Malaysia; Ind = Indonesia; Thai = Thailand; US = United States.

3.3. Unit Roots Test

The test results using both the AIC and SIC as shown in Table 3 fail to reject the null hypothesis of unit root in stock indices of all countries, however, the tests reject the null hypothesis of a unit root in log first difference of these series. Thus, each stock index series is integrated of order 1 or I(1). Due to limited space, only results for log first differences are reported in Table 3. Since, all the series integrated are of the same order and I(1) thus cointegration analysis is appropriate.

Table 3

Unit root tests of monthly ASEAN 5 stock price indices

	Full sample (April 1983 – December 2006)		Pre-crisis (April 1983 – Jun 1997)		Post-crisis (July 1998 – December 2006)	
LOG 1st difference	AIC	SIC	AIC	SIC	AIC	SIC
Mal	-6.208*	-15.055*	-7.341*	-12.494*	-3.329*	-8.729*
Sing	-7.778*	-15.678*	-7.079*	-10.713*	-5.672*	-9.264*
Thai	-9.154*	-15.483*	-9.968*	-9.968*	-10.351*	-10.351*
Ind	-14.185*	-14.185*	-10.56*	10.56*	-7.775*	-7.775*
Phil	-13.236*	-13.236*	-9.968*	-9.968*	-8.526*	-8.526*
US	-16.860*	-16.86*	-12.912*	-12.912*	-10.034*	-10.034*
World	-16.044*	-16.044*	-12.575*	-12.575*	-9.158*	-9.158*
Japan	-16.537*	-16.537*	-13.120*	-13.120*	-9.246*	-9.246*
Test CV						
1% level	-3.454	-3.453	-3.470	-3.469	-3.496	-3.496
5% level	-2.872	-2.872	-2.879	-2.879	-2.890	-2.890
10% level	-2.572	-2.572	-2.576	-2.576	-2.582	-2.582

Notes: * indicates significance at 1% level. Phil = Philippines; Sing = Singapore; Mal = Malaysia; Ind = Indonesia; Thai = Thailand; US = United States; AIC = Akaike Information Criteria; SBC = Schwartz Information Criteria.

3.4. Cointegration Test

Table 4 reports the bivariate cointegration test within ASEAN region and between these markets and global market for the whole sample, pre-crisis and post crisis (only significant relationships are reported). The results show that for the full sample, Malaysia is cointegrated with Thailand, and Philippines are cointegrated with all ASEAN countries with strong significant relationship between Philippines and Malaysia (1% significance level). However, such relationship differs during the pre- and post-crisis. During the pre-crisis, Philippines are cointegrated with all the countries except for Thailand, and Malaysia is cointegrated with Thailand. During the post-crisis, lesser cointegrating relationship is documented than the full sample and pre-crisis period whereby only Singapore has long-run relationship with Philippines and Thailand. While the results show evidence of regional integration across some of the countries, they are not consistent between the full sample and the two sub-periods which suggest the impact of structural break generated by financial crisis on the integration. Between ASEAN countries and global markets, the results of the bivariate test show that for the full sample, Philippines are cointegrated with Japan and US; Singapore and Malaysia are cointegrated only with the World market. There is no long-run relationship found for Thailand and Indonesia with any of the global market. The long-run relationships between Philippines and Japan under the full sample are consistent during both the pre- and post-crisis. During the pre-crisis Japan are cointegrated with all the countries except Malaysia; Singapore is cointegrated with Japan and World market.

Table 4

Bivariate cointegration test among ASEAN stock market indices and with global markets for full sample, pre- and post-crisis

Countries	Null	Full sample		Pre-crisis		Post-crisis	
		Trace	Max Eigen value	Trace	Max Eigen value	Trace	Max Eigen value
ST	r=0	5.591	4.339	12.495	10.167	13.177	7.372
	r≤ 1	1.252	1.252	2.329	2.329	5.805*	5.805*
SP	r=0	18.337*	15.835*	24.02**	16.500*	18.857*	18.048*
	r≤ 1	2.502	2.502	7.517**	7.517**	0.809	0.809
TM	r=0	16.975*	10.407	12.251	7.958	10.519	8.927
	r≤ 1	6.5686*	6.568*	4.294*	4.294*	1.592	1.592
TP	r=0	18.017*	15.683*	9.282	8.629	9.467	7.745
	r≤ 1	2.334	2.334	0.653	0.653	1.721	1.721
MP	r=0	23.17**	16.202*	16.535*	13.287	10.644	10.116
	r≤ 1	6.974**	6.974**	3.248	3.248	0.529	0.529
IP	r=0	15.794*	13.743	11.749	7.559	2.131	2.088
	r≤ 1	2.051	2.051	4.190*	4.190*	0.043	0.043
PJ	r=0	15.89*	14.030	16.95*	15.65*	18.38*	17.050*
	r≤ 1	1.856	1.856	1.296	1.296	1.329	1.329
PUS	r=0	19.27*	17.945*	14.024	12.749	6.190	4.930
	r≤ 1	1.329	1.329	1.275	1.275	1.260	1.260
SJ	r=0	7.509	6.983	13.130	8.703	12.991	12.420
	r≤ 1	0.527	0.527	4.426*	4.426*	0.571	0.571
SW	r=0	15.194	8.417	18.309*	15.648*	5.723	3.966
	r≤ 1	6.78**	6.776**	2.661	2.661	1.758	1.758

Table 4 (continued)

Countries	Null	Full sample		Pre-crisis		Post-crisis	
		Trace	Max Eigen value	Trace	Max Eigen value	Trace	Max Eigen value
TJ	r=0	8.042	5.106	13.593	7.318	16.38*	12.018
	r≤ 1	2.937	2.937	6.275*	6.275*	4.363*	4.363*
MW	r=0	10.375	5.482	9.451	6.818	7.911	6.603
	r≤ 1	4.893*	4.893*	2.633	2.633	1.307	1.307
IJ	r=0	10.204	9.612	14.354	10.212	5.793	4.631
	r≤ 1	0.591	0.591	4.141*	4.141*	1.162	1.162

Notes: * (**) indicates significance at 5% (1%) level. Critical values are based on Osterwald-Lenum (1992). Phil = Philippines; Sing = Singapore; Mal = Malaysia; Ind = Indonesia; Thai = Thailand; US = United States.

During the post-crisis only Japan is cointegrated with Philippines and Thailand. In general, the results show evidence of global integration for some of the ASEAN countries with World and Japan and not with US market for all the sample, thus supporting previous studies such as Tan and Tse (2002) who found evidence of increasing influence of Japan on ASEAN markets relative to US.

Table 5a

Multivariate cointegration test among ASEAN stock market indices for full sample, pre- and post crisis

		Full sample		Pre-crisis		Post crisis	
Countries	Null	Trace	Eigen value	Trace	Eigen value	Trace	Eigen value
ASEAN	r=0	58.212	23.77	62.622	27.264	91.12**	43.36**
	r≤ 1	34.444	18.49	35.357	21.525	47.759*	20.973
MTIS	r=0	36.167	14.37	40.816	19.167	41.031	23.280
	r≤ 1	21.799	13.37	21.648	11.537	17.751	9.227
	r≤ 2	8.435	8.245	10.112	5.589	8.524	7.628
	r≤3	0.190	0.190	4.523*	4.523*	0.896	0.896
MTSP	r=0	32.599	16.87	61.576**	29.610*	74.43**	48.36**
	r≤ 1	15.726	9.533	31.966*	23.204*	26.063	12.437
	r≤ 2	6.193	5.402	8.762	8.758	13.627	8.636
	r≤3	0.790	0.790	0.004	0.004	4.991*	4.991*
MISP	r=0	50.28*	23.29	66.875**	33.022**	75.07**	50.24**
	r≤ 1	26.989	16.92	33.853*	25.369*	24.828	16.388
MTI	r=0	21.503	11.69	18.967	8.947	28.357	18.689
	r≤ 1	9.815	8.530	10.020	5.446	9.668	7.417
	r≤ 2	1.285	1.285	4.574*	4.574*	2.251	2.251
MTS	r=0	26.996	16.54	34.203*	19.143	22.512	8.921
	r≤ 1	10.457	9.431	15.060	10.767	13.591	7.864

Table 5a (continued)

Countries	Null	Full sample		Pre-crisis		Post crisis	
		Trace	Eigen value	Trace	Eigen value	Trace	Eigen value
MTS	r≤ 2	1.026	1.026	4.294*	4.294*	5.728*	5.728*
MTP	r=0	25.766	16.37	27.375	18.199	26.860	12.627
	r≤ 1	9.397	7.154	9.176	8.961	14.233	9.240
	r≤ 2	2.243	2.243	0.215	0.215	4.992*	4.992*
MSP	r=0	27.534	17.79	39.388**	25.521**	50.45**	42.03**
	r≤ 1	9.739	7.276	13.866	11.776	8.415	7.769
	r≤ 2	2.463	2.463	2.090	2.090	0.646	0.646
MIP	r=0	33.76*	19.82	33.342*	24.121*	24.591	13.779
	r≤ 1	13.941	10.93	9.221	5.161	10.812	10.407
	r≤ 2	3.015	3.015	4.060*	4.060*	0.405	0.405
STI	r=0	23.844	17.47	21.581	14.086	31.002*	22.349*
	r≤ 1	6.372	5.960	7.495	4.641	8.653	8.104
	r≤ 2	0.411	0.411	2.854	2.854	0.549	0.549
STP	r=0	24.912	19.63	34.224*	24.433*	39.50**	23.149*
	r≤ 1	5.286	3.974	9.791	9.428	16.351*	13.327
	r≤ 2	1.312	1.312	0.363	0.363	3.023	3.023
SPI	r=0	33.02*	18.5	36.693**	23.156*	35.291*	26.85**
	r≤ 1	14.521	13.59	13.537	8.461	8.438	8.414
	r≤ 2	0.932	0.932	5.076*	5.076*	0.024	0.024

Notes: * (**) indicates significance at 5% (1%) level. Critical values are based on Osterwald-Lenum (1992). P = Philippines; S = Singapore; M = Malaysia; I = Indonesia; T = Thailand.

The above approach has produced results by focusing on the cointegration of two I(1) series and does not examine if the market is cointegrated with more than one countries. As highlighted earlier, omitting such relationship might give rise to model misspecification and produce biased findings. To overcome this issue, next we run the analysis under multivariate cointegration and the results are presented in Tables 5a and 5b. Table 5a shows that for the full sample only few markets have long-run relationship with each other, specifically Singapore is cointegrated with other ASEAN markets except Philippines; Malaysia is cointegrated with Thailand. The relationship differs during the pre- and post-crisis whereby more countries are cointegrated with each other. The results thus confirm previous studies that show the impact of financial crisis and show that ASEAN markets are cointegrated with more than one market. Similarly, the results from Table 5b highlight the impact of financial crisis and the significance of employing multivariate cointegration. Cointegrating relationships between the markets have increased during the post-crisis compared to the full sample and pre-crisis period. During the post-crisis period the results show that Japan is cointegrated with all the countries except for Singapore; this demonstrates the increasing influence of Japan on ASEAN countries relative to US. In general, results from Table 5 show that some of the ASEAN markets are integrated regionally and globally, however the integration is not fully complete, which supports the benefits gain for portfolio diversification in these markets. The results under multivariate approach also show more cointegrating relationship than the bivariate analysis, thus reflecting that ASEAN markets are cointegrated with more than one market regionally and globally.

Table 5b

Multivariate cointegration test between ASEAN and global stock market indices for full sample, pre- and post-crisis

Countries	Null	Full sample		Pre-crisis		Post-crisis	
		Trace	Eigen value	Trace	Eigen value	Trace	Eigen value
AUWJ	r=0	170**	57.63*	193.65**	52.479*	428.90**	135.31**
	r≤ 1	112.01	44.794	141.17**	39.048	293.59**	89.275**
	r≤ 2	67.221	24.052	102.12*	36.602	204.32**	81.902**
	r≤ 3	43.169	21.272	65.518	32.178	122.42**	57.247**
	r≤ 4	21.897	13.784	33.340	16.232	65.168**	31.240*
	r≤ 5	8.1129	3.7242	17.108	9.712	33.928*	21.760*
AUW	r=0	130.6*	56.2**	139.86**	41.141	281.91**	79.118**
	r≤ 1	74.347	25.470	98.722*	36.812	202.81**	73.933**
	r≤ 2	48.877	20.631	61.910	29.443	128.88**	57.886**
	r≤ 3	28.246	19.159	32.467	15.595	70.994**	29.702**
	r≤ 4	9.087	3.927	16.873	9.808	41.291**	25.456**
	r≤ 5	5.160	3.403	7.065	4.735	15.836*	15.311*
AUJ	r=0	122.34	44.145	132.262*	38.323	257.02**	89.945**
	r≤ 1	78.196	30.018	93.940	36.832	167.07**	70.095**
	r≤ 2	48.178	20.227	57.108	24.021	96.979**	42.852**
	r≤ 3	27.951	19.942	33.087	16.079	54.128*	31.537*
AWJ	r=0	106.52	33.456	131.626*	39.866	290**	97.740**
	r≤ 1	73.064	28.236	91.760	33.054	192.26**	78.366**
	r≤ 2	44.829	21.285	58.706	22.661	113.89**	55.034**
	r≤ 3	23.543	16.477	36.045	19.235	58.857**	29.798*
AU	r=0	87.573	32.132	97.72*	36.691	101.292*	41.832*
AW	r=0	86.933	27.284	105.21**	37.391	211.68**	70.638**
	r≤ 1	59.649	25.004	67.818	30.294	141.04**	63.957**
	r≤ 2	34.645	19.649	37.525	21.385	77.084**	39.744**
	r≤ 3	14.996	11.443	16.139	10.127	37.341**	25.210*
AJ	r=0	72.703	25.110	93.734	33.602	122.14**	44.223*
	r≤ 1	47.593	21.657	60.132	22.568	77.917**	33.294
MTISU	r=0	73.96*	36.15*	71.147*	39.624**	78.388**	35.200*
MTISW	r=0	64.833	26.818	59.739	30.809	80.646**	34.039*
MTISJ	r=0	63.898	30.628	60.122	21.131	85.695**	41.207**
MTISJW	r=0	91.609	39.69*	83.796	33.805	118.24**	49.570**
	r≤ 1	51.924	23.118	49.991	20.944	68.670*	30.210
MTISJU	r=0	107**	56.1**	95.109*	41.501*	115.96**	53.658**
MTISW U	r=0	113**	114**	96.956*	42.153*	99.300*	38.427
MTIPW	r=0	61.641	25.333	79.926**	35.301*	137.65**	65.442**
MTIPW	r≤ 1	36.307	19.836	44.625	28.852*	72.209**	46.419**
MTIPJ	r=0	52.466	24.245	67.686	27.987	89.434**	40.787**
	r≤ 1	28.221	18.563	39.699	24.153	48.648*	25.619

Table 5b (continued)

Countries	Null	Full sample		Pre-crisis		Post-crisis	
		Trace	Eigen value	Trace	Eigen value	Trace	Eigen value
MTIPJW	r=0	79.927	30.583	104.731**	36.835	111.27**	42.052*
	r≤ 1	49.343	21.809	67.896	32.542	69.220*	29.967
MTIPWU	r=0	83.02	31.491	103.3**	38.624	96.899*	38.615
MTSPU	r=0	61.745	22.350	82.176**	29.543	82.541**	49.684**
	r≤ 1	39.394	18.943	52.632*	23.877	32.857	14.849
MTSPW	r=0	64.978	27.127	78.768**	27.810	87.023**	46.679**
	r≤ 1	37.851	17.883	50.957*	24.550	40.345	18.025
MTSPJ	r=0	49.033	21.793	65.216	24.139	97.371**	46.567**
	r≤ 1	27.240	17.419	41.077	19.187	50.804*	26.373
MTSPJW	r=0	86.251	32.655	98.178*	28.803	125.63**	48.963**
	r≤ 1	53.596	19.901	69.375*	27.471	76.664**	29.682
MTSPJU	r=0	96.48*	43.36*	99.220*	29.211	119.69**	53.817**
	r≤ 1	53.118	19.910	70.009*	25.222	65.873	27.906
MTSPWU	r=0	101.3*	48.0**	100.80*	32.403	121.89**	58.886**
	r≤ 1	53.257	19.208	68.401	28.406	63.000	21.269
	r≤ 2	34.049	17.024	39.994	19.703	41.731	18.322
	r≤ 3	17.025	8.621	20.292	13.107	23.409	11.996
	r≤ 4	8.405	4.927	7.184	6.249	11.413	6.749
	r≤ 5	3.478	3.478	0.935	0.935	4.664*	4.664*
MISPU	r=0	72.38*	31.584	79.620**	32.866	91.479**	47.754**
MISPW	r=0	66.202	26.771	65.340	26.319	133.68**	51.587**
	r≤ 1	39.431	21.820	39.021	24.709	82.097**	42.143**
	r≤ 2	17.611	11.896	14.312	9.215	39.954**	22.184*
	r≤ 3	5.715	4.088	5.098	5.040	17.770*	17.317*
MISPJ	r=0	58.598	25.14	69.934*	26.363	96.500**	49.650**
MISPJW	r=0	87.813	34.650	93.126	30.404	209.13**	87.047**
	r≤ 1	53.163	26.035	62.721	25.038	122.08**	63.918**
	r≤ 2	27.128	17.275	37.684	20.744	58.160**	33.441**
MISPJU	r=0	99.44*	42.70*	94.144	32.360	107.57**	46.391**
MISPWU	r=0	111**	54.9**	107.055**	37.573	143.55**	55.462**
	r≤ 1	56.035	25.101	69.482*	29.014	88.091**	38.769*
	r≤ 2	30.934	20.139	40.468	25.034	49.322*	23.126
MTIJ	r=0	37.554	20.617	36.464	16.432	49.176*	27.405*
MTSU	r=0	60.2**	29.73*	60.592**	37.676**	47.823*	27.697*
	r≤ 1	30.51*	17.118	22.916	15.483	20.126	8.667
	r≤ 2	13.389	8.704	7.433	7.373	11.460	7.194
	r≤ 3	4.68*	4.68*	0.059	0.059	4.266*	4.266*
MTSW	r=0	52.02*	20.923	50.881*	30.834*	48.946*	25.539
MTSW	r≤ 1	31.1*	14.901	20.047	11.185	23.407	10.764

Table 5b (continued)

Countries	Null	Full sample		Pre-crisis		Post-crisis	
		Trace	Eigen value	Trace	Eigen value	Trace	Eigen value
MTSW	r≤ 2	16.2*	12.554	8.862	8.400	12.642	7.768
	r≤ 3	3.643	3.643	0.462	0.462	4.875*	4.875*
MTSJ	r=0	44.042	27.88*	43.521	19.420	53.229*	28.735*
	r≤ 1	16.161	11.571	24.101	13.474	24.494	10.358
	r≤ 2	4.590	4.055	10.627	8.190	14.136	8.802
	r≤ 3	0.535	0.535	2.436	2.436	5.334*	5.334*
MTPU	r=0	46.525	20.051	44.174	20.203	39.060	15.855
	r≤ 1	26.474	16.687	23.971	14.540	23.205	12.088
	r≤ 2	9.787	8.424	9.431	8.185	11.118	6.054
	r≤ 3	1.363	1.363	1.246	1.246	5.064*	5.064*
MTPW	r=0	46.929	19.279	53.560*	26.923	43.71	19.666
	r≤ 1	27.650	13.568	26.638	18.650	24.052	10.873
	r≤ 2	14.082	12.468	7.988	7.817	13.180	8.211
	r≤ 3	1.615	1.615	0.170	0.170	4.969*	4.969*
MTPJ	r=0	43.963	23.534	42.125	21.351	53.860*	27.105*
	r≤ 1	20.429	14.841	20.774	15.540	26.755	11.759
	r≤ 2	5.588	3.712	5.235	4.519	14.996	9.680
	r≤ 3	1.876	1.876	0.716	0.716	5.316*	5.316*
MSIU	r=0	47.181	26.145	50.748*	30.262*	55.364**	34.460**
MSIW	r=0	48.32*	25.642	45.640	28.576*	58.038**	34.931**
MSIJ	r=0	37.448	16.691	44.534	18.338	46.731	28.411*
MSPU	r=0	50.82*	23.654	51.711*	26.238	63.897**	48.946**
MSPJ	r=0	36.747	17.113	54.616**	24.005	63.768**	43.223**
	r≤ 1	19.634	12.796	30.611*	19.194	20.545	10.323
MSPW	r=0	46.028	17.966	46.672	28.407*	63.446**	45.721**
	r≤ 1	28.062	15.889	18.266	13.943	17.725	9.436
	r≤ 2	12.173	8.249	4.323	4.273	8.289	7.533
	r≤ 3	3.925*	3.925*	0.050	0.050	0.755	0.755
MIPW	r=0	39.193	22.534	43.557	26.983	53.174*	29.780*
MIPJ	r=0	39.851	20.679	56.360**	25.545	53.780*	33.799**
	r≤ 1	19.173	12.819	30.816*	21.001*	19.981	11.914
STIU	r=0	44.833	27.29*	43.573	31.796*	58.284**	27.813*
	r≤ 1	17.547	10.318	11.777	8.476	30.472*	23.718*
STIW	r=0	50.76*	21.960	36.563	20.114	50.755*	21.960
STIJ	r=0	34.724	16.915	36.286	16.266	53.493*	30.606*
STPUS	r=0	46.746	22.954	61.877**	25.312	49.923*	24.454
	r≤ 1	23.792	12.791	36.565**	20.245	25.469	18.442
	r≤ 2	11.002	6.933	16.321*	14.583*	7.027	3.948
	r≤ 3	4.068*	4.068*	1.737	1.737	3.079	3.079
STPW	r=0	53.32*	25.646	52.639*	26.321	52.536*	23.450*
SPIU	r=0	55.0**	29.74*	55.065**	27.617*	56.267**	37.754**

Table 5b (continued)

Countries	Null	Full sample		Pre-crisis		Post-crisis	
		Trace	Eigen value	Trace	Eigen value	Trace	Eigen value
STPJ	r=0	26.805	16.915	56.025*	25.883	62.270**	26.013
	r≤ 1	9.890	7.229	30.142*	18.023	36.257**	20.713
	r≤ 2	2.661	2.326	12.119	8.057	15.544*	12.119
	r≤ 3	0.336	0.336	4.062*	4.062*	3.424	3.424
SPIW	r=0	47.29*	25.806	43.312	26.829	64.709**	32.854**
	r≤ 1	21.485	16.237	16.483	11.307	31.854*	16.286
	r≤ 2	5.248	4.157	5.176	5.061	15.569*	14.975*
SPIJ	r=0	39.188	20.332	49.295*	20.010	56.313**	29.866*
TIPW	r=0	39.470	19.349	48.449*	32.724**	38.288	21.790
MTW	r=0	26.179	13.566	18.979	10.679	27.388	11.811
	r≤ 1	12.612	10.820	8.300	7.483	15.577*	9.819
	r≤ 2	1.792	1.792	0.817	0.817	5.759*	5.759*
MTU	r=0	24.934	14.735	18.669	9.216	22.259	9.484
	r≤ 1	10.199	8.677	9.453	7.217	12.775	8.418
	r≤ 2	1.522	1.522	2.237	2.237	4.357*	4.357*
MTJ	r=0	31.02*	20.642	22.812	13.011	32.080*	18.698
	r≤ 1	10.380	7.404	9.801	7.101	13.382	8.555
	r≤ 2	2.976	2.976	2.700	2.700	4.827*	4.827*
MSW	r=0	36.8**	20.351	37.557**	28.792**	20.220	15.043
	r≤ 1	16.46*	11.953	8.765	8.759	5.177	4.264
	r≤ 2	4.50*	4.50*	0.006	0.006	0.912	0.912
MSU	r=0	41.4**	27.8**	34.436*	18.512	20.715	15.520
	r≤ 1	13.570	12.245	15.925*	13.655	5.195	4.078
MSJ	r=0	21.286	11.039	27.830	16.022	31.523*	19.978
MPU	r=0	30.19*	19.927	20.722	13.869	13.931	8.276
MPJ	r=0	29.78*	15.656	31.898*	19.009	27.417	16.738
STW	r=0	25.978	15.621	26.574	18.429	33.583*	22.609*
STU	r=0	21.971	11.648	19.077	16.508	36.709**	25.914**
STJ	r=0	11.996	7.529	27.209	13.299	33.523*	17.127
	r≤ 1	4.467	3.924	13.910	8.403	16.396*	12.207
	r≤ 2	0.542	0.542	5.507*	5.507*	4.189*	4.189*
SPW	r=0	33.63*	17.736	28.229	17.321	28.504	22.775*
	r≤ 1	15.9*	11.084	10.908	10.850	5.729	4.496
	r≤ 2	4.811*	4.811*	0.058	0.058	1.233	1.233
SPU	r=0	37.6**	22.58*	34.959*	16.618	27.745	23.097*

Table 5b (continued)

Countries	Null	Full sample		Pre-crisis		Post-crisis	
		Trace	Eigen value	Trace	Eigen value	Trace	Eigen value
SPU	r≤ 1	14.986	9.676	18.341*	14.445*	4.648	3.421
	r≤ 2	5.310*	5.310*	3.895*	3.895*	1.227	1.227
SPJ	r=0	25.022	18.671	36.235*	19.980	36.668**	23.940*
	r≤ 1	6.350	5.619	16.256*	14.509*	12.728	11.388
SIW	r=0	30.34*	21.86*	27.777	17.520	41.690**	31.145**
SIU	r=0	26.992	22.29*	19.945	15.451	38.622**	31.186**
SIJ	r=0	22.278	13.173	23.489	12.623	33.511*	26.417**
TIJ	r=0	20.807	15.824	21.431	12.861	27.107	22.020*
TPU	r=0	27.196	20.229	32.489*	20.224	23.257	16.130
TPJ	r=0	20.807	15.824	26.257	18.182	34.803*	18.469
	r≤ 1	4.983	3.234	8.075	5.094	16.334*	14.311*

Notes: * (**) indicates significance at 5% (1%) level. Critical values are based on Osterwald-Lenum (1992). P = Philippines; S = Singapore; M = Malaysia; I = Indonesia; T = Thailand; U = United States; W = World; J = Japan.

4. Conclusions

In this study, we examine regional and global integration on five major ASEAN countries by analyzing the cointegration between stock markets. Our main empirical findings are as follows: First, some of the ASEAN markets are found to be both regionally and globally integrated, which suggests that they are not completely segmented by national borders. Second, the findings reveal the influence of global markets on the ASEAN markets, specifically the increasing influence of Japan relative to US. Next, on the impact of the financial crisis, this study supports the evidence by Gerlach et al. (2006) who found that the Asian crisis has generated a structural break that caused a shift in the model of their study. Finally, the results suggest that it is more appropriate to employ multivariate approach to examine integration on ASEAN markets. Although the study shows that ASEAN markets are regionally and globally integrated, however, the integration is not fully complete, thus reflecting some diversification benefits in these markets and also the ability to influence their markets quite independently from the influence of global stock market. From the asset pricing perspective, the findings suggest the importance of regional and global markets especially the Japanese market as risk factors in ASEAN markets.

This study could be enhanced by examining the role of economic integration since it can provide channels in linking the financial markets even in the presence of foreign exchange restrictions on international capital flows (Phylaktis and Ravazzolo, 1999). Study on ASEAN markets is very appropriate for this issue due to increasing trends in trade activities across ASEAN markets and other countries such as Japan and China.

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