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Stock Market Integration in the ASEAN-5[1]

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Abstract

This paper aims to investigate the degree of stock market integration in the ASEAN region, both internally and externally, in relation to global markets: in particular those of the United States and Hong Kong. There are three main findings in the paper. First, this paper investigated long-run integration using Engle and Granger cointegration and found that evidence of cointegration is stronger in the case of internal region integration than in the external region one. Moreover, the cointegration tests with structural breaks revealed that there was additional supporting evidence for the long-run relationship among ASEAN-5 markets. In most cases, structural breaks were found during the period of the Asian financial crisis in 1997. Second, the results of the short-run market correlations showed that Singapore had the highest co-movement with global markets, especially that of Hong Kong. In addition, Indonesia appeared to be less integrated with other markets, especially outside the region. Moreover, the time-varying patterns of short-run correlations were found to show an increasing trend, both inside and outside region. Finally, this paper found that financial market factors, i.e. the size of market capitalization and the degree of exchange rate volatility, were important in determining the level of stock market integration. Trade links were another important factor; bilateral trade between specific partners yielded stronger evidence for determining the level of integration than the trade openness of each country. Moreover, the similarity in fundamental macroeconomic factors only had a minor effect on determining the degree of stock market integration.

KEYWORDS: Stock market integration; Cointegration: Dynamic Conditional Correlation; ASEAN-5
JEL Classification: C22, E44, F02, G15

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Introduction

International financial integration provides various benefits to a country, such as a lower cost of capital, enhanced risk-sharing, improved capital allocation and an impetus for financial product innovation. Although greater integration brings numerous benefits, the reverse capital flows and risk spillover during the financial crisis clearly demonstrate that financial liberalization and integration are not without risk. Mitigation of these risks by avoiding financial integration is not a viable option due to the trend of global financial deregulation, innovation and liberalization; better preparation and regional cooperation are more appropriate.

Since the late 1980s, the easing of rules and regulations has stimulated the movement of capital flows into the Asian region and hence catalyzed the rapid growth in the economy. Growth in the region has led to high levels of foreign direct investment, which in turn has led to soaring asset prices and has encouraged corporate spending, all of which is funded largely by borrowing from banks. Specifically, with this easing of regulations, short-term foreign debt is the first choice for financing in the fixed exchange rate regime. Unfortunately, the recovery of the United States' economy in the mid-1990s made it a more attractive investment destination, and hence led to a stronger U.S. dollar. As a result, the Asian countries which relied heavily on exports reported a dramatic drop in export growth, finally causing individuals and companies to default on debt obligations. Panic among lenders and foreign investors who attempted to withdraw their money put depreciative pressure on the exchange market. To prevent currency values from collapsing, governments raised domestic interest rates and started intervening in the exchange market. When it became clear that the tide of capital outflow would not be stopped, governments finally allowed their currencies to float. Consequently, foreign currency-denominated liabilities grew substantially in domestic currency terms, causing more bankruptcies and further deepening the crisis. The aftermath of the Asian financial crisis encouraged the region's policymakers to rethink their strategies for financial liberalization and to reconsider any further steps towards financial integration. Besides increasing cross-border information and communication, several important regional cooperation programs were developed, such as the Chiang Mai Initiative (CMI) and the Asian Bond Markets Initiative (ABMI), with the aim of reducing economies' reliance on external funding and increasing financial resilience (Plummer and Wignaraja, 2006).

There have been almost two decades of regional cooperation; however, empirical results on financial integration usually show that Asian financial markets appear to have a higher degree of integration with global markets than with each other (Kim et al., 2006). In particular, correlation between regional stock markets is relatively lower than that between them and developed markets such as in the US and Europe. In addition, Asian investors typically allocate more of their portfolio investment in developed markets than within the region, although sometimes they choose to invest in their own country rather than go global, which is known as being "home-biased" (French and Poterba, 1991). Park (2013) found that the degree of integration in Asian financial markets had accelerated in recent years; however, these markets remain less integrated with their region than with global markets. Hence, these results may possibly explain why Asian stock markets are more sensitive to global financial market shocks than to regional shocks.

Recently, the high rate of Asian economic growth, together with the development of regional collaboration, have enhanced regional integration. In addition, the recent financial turmoil in developed markets has attracted capital flows into emerging countries. The financial markets are becoming more of a single global market, as investors are seeking higher returns in developing markets and a chance for diversification (Bekaert and Harvey, 1995; World Bank, 1997). Given this pattern, this paper aims to investigate the degree of stock market integration by using data from the five original members of the Association of Southeast Asian Nations (ASEAN-5)[4]. This study uses monthly data from January 1988 to September 2017 to estimate the level of integration both in the short run and long run. The longitude data will enable us to establish the extent of stock market integration and how it has evolved over time. In addition, understanding the patterns of financial integration is not the ultimate goal for policymakers; it is necessary to understand the determining factors of the patterns in order to design proper policies. Therefore, factors including trade data, macroeconomic variables, and stock market characteristics are examined in the paper.

The paper is organized into five sections. The literature review is found in section 2, while the methodology is summarized in section 3. The empirical results and discussion are presented in section 4, and section 5 is the conclusion.

Literature Review

Financial integration is the process by which countries deregulate in order to allow cross-border capital flows; their market consequently becomes more closely integrated with other markets within the region or with those at the global level. In the academic literature, the term “financial integration” has numerous associated terms, such as financial openness, market interdependence, stock market synchronization and financial service liberalization. In addition, the term “financial market” is a broad term that could refer to the stock market, bond market or money market, for example. Nevertheless, empirical evidence for financial integration is typically found in the bond markets (Plummer and Click, 2003) and stock markets (e.g. Ng, 2002; Click and Plummer, 2005).

Many papers have examined whether financial markets are segmented or integrated. Some empirical research has applied cointegration tests to measure the degree of long-run co-movement between the markets; for example, Ng (2002), Click and Plummer (2005) and Hinojales and Park (2011). Another important strand of literature uses correlations between financial markets to represent short-run interdependence; for example, Narayan et al. (2014). In this section, the relevant literature and methodology used are reviewed, first for the long-run perspective, then for the short-run.

[4] ASEAN was founded on 8 August 1967 with five members: Thailand, Malaysia, Singapore, Indonesia and the Philippines. Currently, there are 10 members, including Brunei (joined in 1984), Vietnam (joined in 1995), Laos and Myanmar (joined in 1997) and Cambodia (joined in 1999).

Long-run co-movements in market returns

The issue of stock market integration has been extensively studied using the cointegration technique. Kasa (1992) applied the cointegration test and found that the stock markets of the United States, Japan, the United Kingdom, Germany and Canada exhibited weak long-run relationships between 1974 and 1990. Choudhary (1994) was also unable to find evidence of a long-run relationship between G-7 countries. However, several studies have documented the existence of such a relationship among developed markets; for example, Hamao et al. (1990) and Corhay et al. (1993).

Integration in less developed regions has also been explored, with mixed results. Chen et al. (2002) found that the long-run relationship in Latin America was the result of deregulation, privatization, and trade alliances. Integration in emerging East Asian stock markets has gained attention in recent years, given the relatively progressive phase of financial deregulation and liberalization in the region. Chung and Liu (1994) tested the long-run relationship between the United States, Japan, Taiwan, Hong Kong, Singapore and South Korea by applying the Johansen cointegration test. They found that all the stock markets, excluding the United States and Taiwan, shared common stochastic trends. However, using data from 1989 to mid-1995, DeFusco et al. (1996) concluded that there was no cointegration relationship between the United States, Korea, the Philippines, Taiwan, Malaysia and Thailand. Similarly, Ng (2002) found no long-run relationship between the ASEAN-5 countries (Thailand, Malaysia, Singapore, Indonesia and the Philippines) over the period 1988-1997. Nevertheless, the existence of such a relationship over the period 1986-1996 between the ASEAN-5, apart from the Philippines, was reported by Sharma and Wongbangpo (2002).

In summary, the situation of stock market integration in ASEAN-5 before the pre-1997 Asian financial crisis is not clear. In addition, several studies have shown that ASEAN-5 markets appear to be more integrated after the crisis than before it; for example, Click and Plummer (2005). Moreover, Chen et al. (2009) report that ASEAN-5 were more integrated than the pre- 1997 period and that the structural break around the Asian financial crisis affected the cointegrating relationships. Similarly, Chien et al. (2015) showed there were structural breaks in cointegration between China and the ASEAN-5 stock markets.

Short-run co-movements in market returns

Rather than testing market co-movement in the long run, several papers have focused on testing short-run co-movement among markets. Correlation analysis has generally been used in traditional studies of stock market integration; a significant correlation figure is interpreted as evidence of market integration. However, the shortcoming of correlation analysis is that it could be spurious because of short-term trading noise. In addition, by comparing the correlation between sub-periods, an increase in correlation is usually taken as evidence of market convergence or that markets have become more closely linked. It is generally agreed that stock markets become more integrated as a consequence of the trend towards financial deregulation and liberalization; therefore, the patterns of markets co-movement have been changing over time.

Indeed, several empirical studies have documented that the correlations between stock returns are time-varying, with evidence of an increasing trend during crisis and market downturns (Longin and Solnik

1995). To investigate the changing correlation patterns, some papers have divided data into sub-samples; for example, Chen et al. (2002) partitioned the main sample into periods before and after the Asian and Russian financial crises. Despite its simplicity, this methodology may cause confirmation bias. Engle (2002) introduced the time-series econometrics technique called dynamic conditional correlation (DCC), which allows for time-varying characteristics. This method follows the multivariate GARCH approach to estimate mean and variance equations for a set of variables using an equation system. Therefore, conditional variance for each series, and covariance between series, can be estimated simultaneously. While the DCC–GARCH model takes into account the volatilities of each variable, it also allows for time-varying characteristics by assigning lower weights to observations occurring in the more distant past. This property is one of the model's advantages over simple rolling correlation analysis. Narayan et al. (2014) applied Engle's DCC model and found that for the period from 1 January 2001 to 31 March 2012, the emerging Asian markets were most integrated with China, while least integrated with the United States.

Methodology

This paper focuses on financial integration in ASEAN-5 by using stock market returns and then terming these as stock market integration. The evolution of integrating patterns over the period 1988 to mid-2017 are comprehensively examined both in the long- and short-run. The cointegration technique is applied to test long-run integration, while the short-run is investigated by using correlation analysis.

Cointegration Test

Long-run relationships are tested using the cointegration technique. In this framework, stock markets are integrated if their return movements share a common stochastic trend over long-term horizons. The absence of cointegration implies market segmentation. The test for a long-run relationship between pairs of markets can be estimated from the following equation:

$$Y_{1,t} = \alpha_1 + \alpha_2 Y_{2,t} + u_t,$$

where $Y_{1,t}$ and $Y_{2,t}$ are market indices of countries 1 and 2, respectively. When the variable is non-stationary, standard OLS will lead to a spurious relationship. Engle and Granger (1987) introduced a method to test the long-run relationship between non-stationary variables by testing the stationary property of its residual ($\hat{u}_t$). If the Augmented Dickey Fuller test (ADF test) confirms the stationary property of the residual, the two series are cointegrated. Engle and Granger's cointegration test allows non-stationary data to be used so that spurious results are avoided; however, such a test cannot show whether stock markets have become more integrated. This is because the cointegration test assumes the time-invariance of the cointegrating relationship. Hence, it cannot detect whether the stock markets are gradually moving towards greater integration (Ng, 2002).

Chien et al. (2015) addressed the issue that long-run market integration may change over time, with possible structural breaks or shifts in the relationships. In an attempt to estimate alternative cointegration tests, many studies have added dynamic components (e.g. Saikkonen, 1991). Others have been more

concerned with structural change, such as Gregory and Hansen (1996). Specifically, Gregory and Hansen include a dummy variable representing a structural break into the cointegrating regression, as follows:

$$Y_{1,t} = \alpha_1 + \alpha_2 Y_{2,t} + \beta D_t + u_t,$$

where $D_t = \begin{cases} 1 & \text{if } t > \tau \\ 0 & \text{otherwise} \end{cases}$ and τ is the break date. In this approach, the null hypothesis of no cointegration with structural breaks is tested against the alternative of cointegration. The single break date in these models is endogenously determined.

In summary, the Engle and Granger cointegration test is first applied to test long-run relationships in ASEAN region, both internally and externally, in relation to global markets. Since many emerging countries have witnessed major structural changes during the last three decades, the Gregory and Hansen cointegration test is also applied to confirm long-run relationships.

Correlation test

Besides long-run relationships, short-run ones between each market pair are tested using static correlation. Then the dynamic conditional correlation (DCC) patterns of correlations are also estimated by Engle's DCC model[5]. The DCC model applies the multivariate GARCH model to simultaneously estimate the conditional variance $(q_{i,i,t})$ for each series and conditional covariance $(q_{i,j,t})$ between series. Subsequently, conditional correlations $(\rho_{i,j,t})$ are computed from the following equation,

$$\rho_{i,j,t} = \frac{q_{i,j,t}}{\sqrt{q_{i,i,t}} \cdot \sqrt{q_{j,j,t}}}.$$

These dynamic conditional correlations $(\rho_{i,j,t})$ are used to measure the degree of short-run co-movement in stock market returns. In addition, the trend regressions are then applied to confirm the statistical pattern of the time-varying correlations. Specifically, the following equation is estimated,

$$\rho_{i,j,t} = \gamma_{i,0} + \gamma_{i,1} \mathrm{Trend}_t + v_t.$$

Determinants of Stock Market Integration

Finally, this paper applies the panel data regressions to explore the determinants of stock market integrations. Factors including stock market characteristics and trade and macroeconomic fundamentals are used in the study. The equations and variables are provided together with the results in section 4.

Empirical Results

Data

Stock market integration was investigated both between the five ASEAN countries and between them and other countries globally. The monthly stock index data of ASEAN-5 (Thailand (TH), Malaysia (MY), Indonesia (IN), the Philippines (PH) and Singapore (SG)) were obtained from Datastream. In addition, the United States (US) and Hong Kong (HK) were used as proxies for global or advanced markets. All variables were in the natural logarithm and the sample period covered January 1988 to September 2017, yielding 357 months.

[5] The approach used in this paper closely follows that of Engle (2002).

Table 1 Descriptive Statistics for Monthly Stock Market Returns

	TH	MY	IN	PH	SG	US	HK
Mean	0.012	0.005	0.006	0.004	0.005	0.007	0.007
Median	0.015	0.009	0.011	0.010	0.010	0.010	0.011
Maximum	0.694	0.294	0.332	0.248	0.284	0.265	0.106
Minimum	-0.379	-0.285	-0.316	-0.274	-0.359	-0.348	-0.186
Std. Dev.	0.088	0.065	0.078	0.063	0.085	0.071	0.041

Note: Market returns from January 1988 to September 2017. Total observations 357 months.

Table 1 shows the descriptive statistics of monthly market returns. The average monthly market returns within the ASEAN-5 countries ranged from 0.4% for PH to 1.2% for TH, while those of the US and HK were 0.7%. Corresponding to the highest average monthly market returns, TH had the highest monthly standard deviation, at 8.8%. Overall, the ASEAN-5 countries had higher volatility than the advanced markets (HK and US), with HK having the lowest monthly standard deviation, at 4.1%.

To test for stationarity, ADF unit root tests with a null hypothesis of non-stationarity were performed under three alternative models – with constant (w/c), with constant and trend (w/c&t), and without constant and trend (w/o c&t). As can be seen in Table 2, the unit root tests at level show evidence of unit roots in all the stock market indexes, except for the w/c&t of MY and of SG. However, the results from the first differences of log of the market index (market returns) indicate that they were stationary at the 1% level of significance in each case.

Table 2 Unit Root Test

Panel A: At Level							
	TH	**MY**	**IN**	**PH**	**SG**	**US**	**HK**
w/c							
ADF t-stat	-1.623	-2.172	-1.560	-0.882	-2.355	-1.444	-2.025
w/c&t							
ADF t-stat	-1.734	-3.565**	-2.841	-1.807	-3.377*	-1.882	-2.589
w/o c&t							
ADF t-stat	0.905	1.080	1.819	1.479	1.169	2.862	1.663
Panel B: At First Difference							
	TH	**MY**	**IN**	**PH**	**SG**	**US**	**HK**
w/c							
ADF t-stat	-16.966***	-10.768***	-15.734***	-16.805***	-17.209***	-18.035***	-18.061***
w/c&t							
ADF t-stat	-16.942***	-10.772***	-15.729***	-16.782***	-17.205***	-18.029***	-18.082***
w/o c&t							
ADF t-stat	-16.953***	-10.691***	-15.522***	-16.717***	-17.168***	-17.650***	-17.928***

Notes: ***, **, * Significant at the 1%, 5% and 10% levels, respectively.

Results of the cointegration tests

First, the long-run relationships between the stock markets were investigated using the Engle and Granger (1987) cointegration test. In particular, outside region relationships between ASEAN-5 and the US and ASEAN-5 and HK, and within the ASEAN-5 countries relationships, were tested separately; the results are summarized in Table 3, panels A and B, respectively. Interestingly, Table 3 Panel A shows that only SG had a long-run relationship with HK over the sample period. None of the ASEAN-5 had a long-run relationship with the US. The results of cointegration within the region reveal that there were long-run relationships between MY and the PH and between MY and SG, as the null of no cointegration was rejected at the level of 5% significance. Moreover, there was marginal evidence of a long-run relationship between IN and SG.

Table 3 Results of the Engle and Granger (1987) cointegration tests

Panel A: Outside region

	TH		MY		IN		PH		SG	
	coeff	t-stat	coeff	t-stat	coeff	t-stat	coeff	t-stat	coeff	t-stat
C	5.525	18.035	3.027	15.771	-2.717	-6.686	2.185	7.868	3.752	27.460
US	0.161	3.598	0.557	19.918	1.406	23.745	0.818	20.203	0.560	28.129
ADF	-1.615		-2.654		-1.345		-1.301		-2.831	
C	4.163	11.561	1.267	7.322	-5.556	-12.240	0.117	0.402	2.297	21.376
HK	0.262	6.850	0.594	32.265	1.328	27.499	0.816	26.457	0.564	49.317
ADF	-1.484		-2.154		-1.848		-1.385		-3.152**	

Panel B: Inside region

	TH		MY		IN		PH		SG	
	coeff	t-stat	coeff	t-stat	coeff	t-stat	coeff	t-stat	coeff	t-stat
C			2.524	11.640	-1.698	-2.926	1.467	4.660	4.679	20.348
TH			0.651	19.944	1.297	14.849	0.952	20.085	0.439	12.673
ADF			-1.928		-0.784		-1.336		-1.898	
C	1.075	3.855			-7.649	-21.572	-1.520	-7.954	1.930	18.087
MY	0.812	19.944			2.127	41.109	1.359	48.735	0.827	53.088
ADF	-1.788				-2.293		-3.373**		-3.426**	
C	4.587	33.052	4.158	63.056			3.968	37.129	5.243	88.952
IN	0.295	14.849	0.388	41.109			0.552	36.043	0.340	40.199
ADF	-1.724		-2.925				-2.119		-3.089*	
C	2.280	10.507	1.862	18.173	-4.166	-13.525			3.466	29.252
PH	0.559	20.085	0.640	48.735	1.423	36.043			0.530	34.877
ADF	-1.915		-3.902***		-2.423				-2.759	
C	1.238	2.909	-1.308	-8.516	-11.419	-25.029	-3.309	-10.400		
SG	0.710	12.673	1.074	53.088	2.415	40.199	1.461	34.877		
ADF	-1.295		-3.417**		-2.659		-1.964			

Notes: The critical values are from MacKinnon (2010): -3.9001, -3.3377,and -3.0462 at significance levels of 1%, 5%, and 10%, respectively. ***, **, * Significant at the 1%, 5% and 10% levels, respectively.

Since the sample period encompassed several economic and financial crises, it was important to ensure the cointegration relationships with structural breaks. Therefore, the methodology of Gregory and Hansen (1996) was employed, with the null of no cointegration against the alternative hypothesis of cointegration with level shift. Table 4 shows the results of the Gregory and Hansen cointegration tests for both inside and outside region cases.

When considering the possibility of structural breaks in the cointegration relationships, there were additional long-run relationships between ASEAN-5 countries. Specifically, there was such a relationship between TH and MY and one between TH and IN. The empirical evidence shows that the main structural break around the Asian financial crisis did affect the stability of long-run co-movement between stock markets within ASEAN-5. Moreover, over the sample period, there is no evidence of a long-run relationship between ASEAN-5 and countries outside the region, the US and HK in particular.

Table 4 Results of the Gregory and Hansen (1996) cointegration tests

Panel A: Outside region					
Test statistics	**TH**	**MY**	**IN**	**PH**	**SG**
With US					
ADF	-3.298	-3.510	-4.049	-2.990	-4.129
	1997M02	2008M05	2006M05	1997M01	2005M09
Za	-20.766	-18.033	-25.072	-17.569	-25.736
	1997M02	2007M06	2006M05	1997M01	2005M08
Zt	-3.303	-3.290	-3.948	-3.015	-3.826
	1997M02	2007M06	2006M05	1997M01	2005M08
With HK					
ADF	-2.955	-3.658	-3.807	-3.052	-4.757**
	1996M08	1997M01	1992M05	2010M11	2005M05
Za	-17.883	-26.211	-26.615	-17.413	-32.966
	1996M07	1997M01	1992M06	2010M11	2005M08
Zt	-2.998	-3.707	-3.770	-2.955	-4.170
	1996M07	1997M01	1992M06	2010M1	2005M08
Panel B: Inside region					
Test statistics	**TH**	**MY**	**IN**	**PH**	**SG**
With TH					
ADF		-4.629**	-4.175	-3.800	-4.150
		1996M04	1997M06	1996M08	1998M01
Za		-39.441*	-34.508	-26.026	-25.111
		1996M04	1997M06	1996M08	1997M02
Zt		-4.570*	-4.245	-3.806	-3.586
		1996M04	1997M06	1996M08	1997M02

Test statistics	TH	MY	IN	PH	SG
With MY					
ADF	-4.469**		-3.878	-3.809	-4.756**
	1996M04		2005M07	2012M11	1998M11
Za	-37.706		-27.010	-25.908	-43.788**
	1996M04		2005M07	2012M07	1997M12
Zt	-4.405*		-3.824	-3.772	-4.808**
	1996M04		2005M07	2012M07	1997M12
With IN					
ADF	-4.305	-3.661		-3.142	-4.628**
	1997M06	1992M08		2002M12	1992M07
Za	-36.290*	-24.387		-18.069	-35.814
	1997M06	1992M04		2001M11	1992M07
Zt	-4.365*	-3.559		-3.188	-4.314
	1997M06	1992M04		2002M07	1992M07
With PH					
ADF	-4.114	-4.429*	-4.268		-4.211
	1996M08	1999M08	2004M12		1999M12
Za	-28.872	-31.379	-27.304		-29.383
	1996M07	1999M08	2004M04		1999M08
Zt	-4.125	-4.406*	-4.338		-4.078
	1996M07	1999M08	2004M12		1999M08
With SG					
ADF	-3.085	-4.503*	-4.144	-3.130	
	1996M04	1997M09	2008M03	1999M08	
Za	-19.820	-38.732*	-31.859	-18.914	
	1997M02	1997M12	2008M02	1999M07	
Zt	-3.111	-4.532*	-4.182	-3.090	
	1997M02	1997M12	2008M02	1999M07	

Notes: The numbers in the first row are test statistics, while those in the second rows are the estimated structural break dates. The critical values are from Table 1 in Gregory and Hansen (1996). In particular, -5.13, -4.61 and -4.34 are critical values for ADF t-stat and Zt at 1%, 5% and 10% significance levels, respectively. -50.07, -40.48 and -36.19 are critical values for Za at 1%, 5% and 10% significance levels, respectively. ***, **, * Significant at the 1%, 5% and 10% levels, respectively.

Taken together, the results reveal that there are cointegration relationships between ASEAN-5 stock markets, but the possibility of structural breaks should be a concern. Specifically, the 1997 Asian financial crisis affected the stability of long-run relationships between stock markets. However, the long-run relationships within ASEAN-5 were relatively low, which is consistent with the findings of several studies, such as that of Click and Plummer (2005). In addition, the results show that there was no cointegration relationship between ASEAN-5 and the US, even if the structural break in the relationship is considered. Only SG and HK

exhibit a long-run relationship over the sample period. Contrary to Kim et al. (2006) and Hinojales and Park (2011), the results show that regional financial integration tends to involve more integration internally than with the global market over the long run.

Results of the correlation tests

Besides long-run relationships, short-run co-movements between stock market returns from January 1988 to September 2017 are worthy of exploration. Table 5 presents the static correlation between ASEAN-5 and externally, and that between ASEAN-5 countries. All pairs of market co-movements are significant at the 1% level, which indicates short- run relationships between markets.

Notably, SG and HK have the highest correlation, whereas IN and the US have the lowest correlation. In addition, IN appears to have fewer short-run relationships with other markets, especially outside the region. Among the ASEAN-5 countries, Singapore has the most short-run relationships with other markets, both inside and outside the region. The results are consistent with the fact that SG is the financial center of Asia. Interestingly, the static correlation shows that the short- run co-movements between ASEAN-5 and HK were stronger than those between ASEAN-5 and the US.

Table 5 Static Correlation

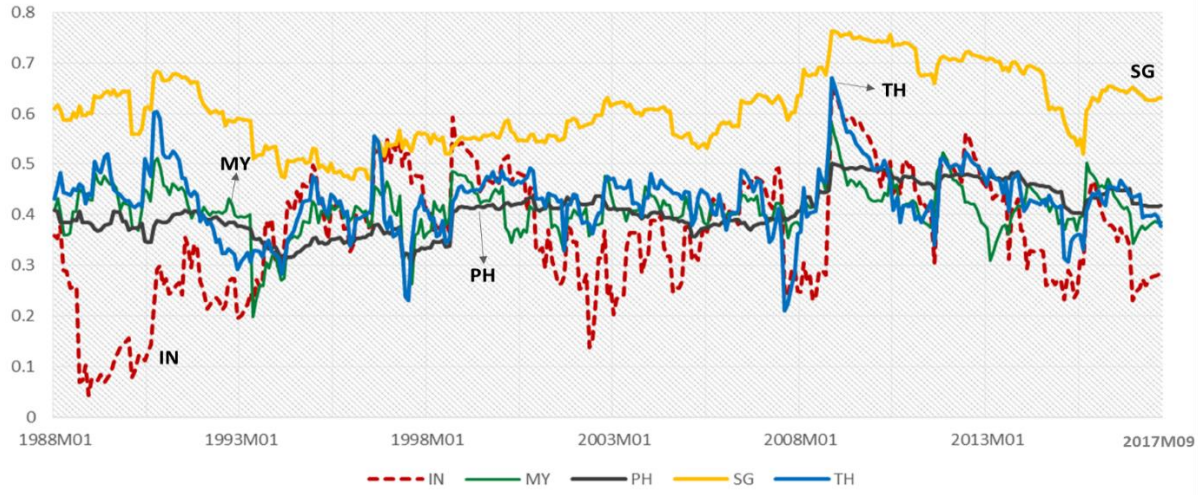
	MY	IN	PH	SG	US	HK
TH	0.578	0.486	0.592	0.644	0.460	0.518
MY		0.434	0.559	0.667	0.408	0.571
IN			0.497	0.473	0.364	0.373
PH				0.655	0.429	0.545
SG					0.636	0.755
US						0.603

Note: The numbers in the first row represent the static correlation, while those in the second row represent the t-statistics. *** denotes the 1% significance level.

In addition to the static short-run co-movement, a simple model of dynamic conditional correlation (DCC) was applied to allow for time-varying characteristics. The time-varying correlations pattern both within the region and outside the region are presented in Figures 1-3.

As can be seen in Figures 1 and 2, the short-run co-movement between markets changes over time. Consistent with the static correlation, SG exhibits the highest time-varying correlation with the US and HK, while IN seems to be less integrated than the others. The time-varying correlation between the PH and the US is around 0.4 and is stable over the sample period. However, the time-varying correlations between TH and HK are very volatile (rising from about 0.1 in late 1989 to 0.75 in January 1994) before the Asian financial crisis. During the crisis, they gradually decreased from October 1996 and suddenly dropped to less than 0.1 within a few months. However, they took about 6 months to return to their initial level.

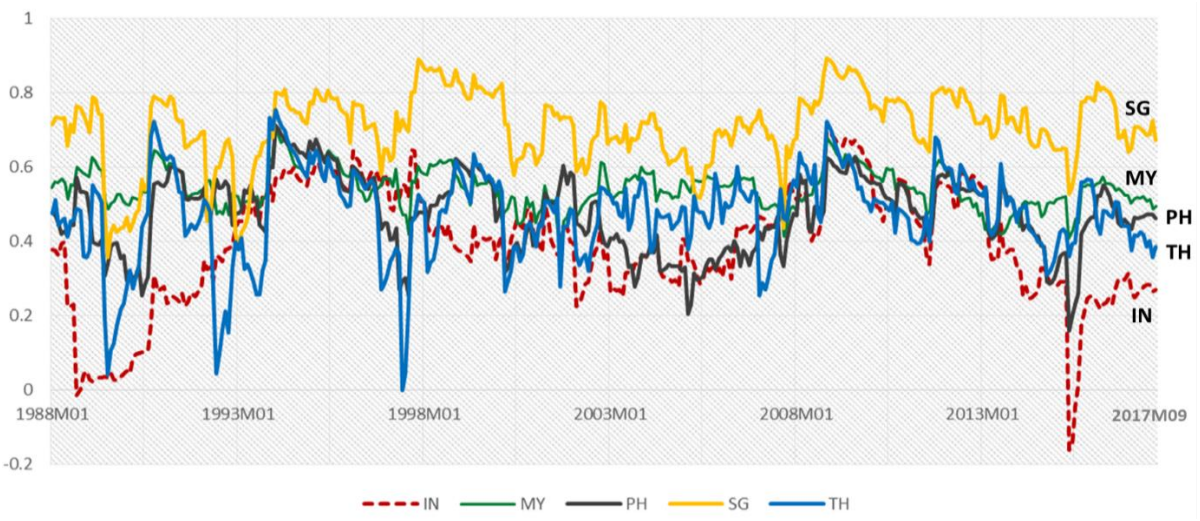
Figure 1 Dynamic Conditional Correlation: Outside region against the United States



Source: Authors' calculation

Interestingly, they were less volatile after the Asian financial crisis and remained stable during the 2008 global crisis. In the time-varying correlations between IN and countries outside the region, there are noticeable upward trends in the correlations, especially before the Asian financial crisis. During this crisis, they dropped by about a half and rebounded after a few years. Compared to other ASEAN-5 countries, SG has the highest correlation with stock markets outside the region, especially HK. Moreover, there are noticeable upward trends in the correlations between SG and the US after the Asian financial crisis.

Figure 2 Dynamic Conditional Correlation: Outside region against Hong Kong



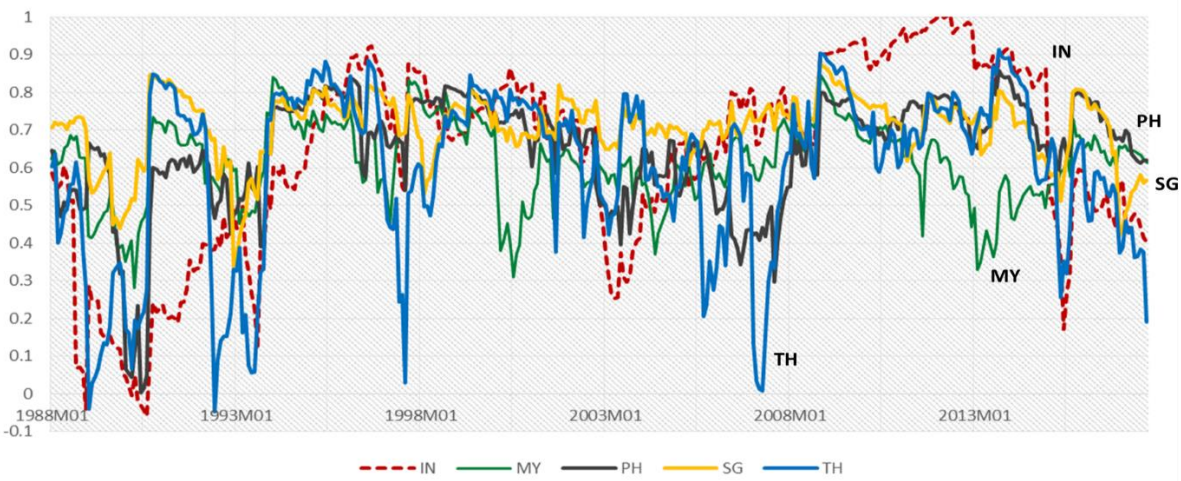
Source: Authors' calculation

The time-varying correlations between ASEAN-5 countries are shown in Figure 3; it can be seen that TH displays the greatest fluctuation pattern. The big jump in correlations during 1990 was the result of financial liberalization. However, the drop in 1992 coincided with a period of political uncertainty. Specifically, there was a protest against General Suchinda, who had been appointed Prime Minister, but who had not been elected. The widespread protest resulted in 10 people killed and a no-confidence motion. In addition, there

was a significant drop in correlations between TH and other countries during the Asian financial crisis, and again during the global financial crisis.

For IN, the dip in correlations with other markets in mid-1989 also coincided with political uncertainty the country. During that period, the government took strong action to suppress the protesters. Meanwhile, there was growing concern as to the sustainability of the rupiah and the dollar peg. However, after Indonesian economic reform in 1990, achieved by reducing regulations and tariffs to attract private investment, correlations with other markets subsequently started to increase. Similar to IN, the PH experienced a sharp drop during 1989-1990 due to political uncertainty. Immediately after the economic reform of mid-1990, correlations with other markets, both within the region and outside it, began to increase. These patterns suggest that the IN and PH stock markets were more integrated with other markets, because foreign investors were more confident about investing in these countries. In the case of MY and SG, the time-varying correlations show a similar pattern, in which SG has low volatility. This is not surprising, due to the fact that the two countries share a large amount of trade activity and are geographically linked.

Figure 3 Dynamic Conditional Correlation: Inside region among ASEAN-5



Note: Inside region DCC are the time-varying correlations between the market returns of country i and the average of other market returns, apart from country i.

Source: Authors' calculation

Overall, the results from DCC reveal the evolving patterns of correlations between markets over time. Several ASEAN countries, IN, the PH and TH in particular, experienced a big drop in correlations due to political uncertainty, which affected the confidence of foreign investors. In addition, the financial markets became more integrated after 1990 due to greater political stability and financial liberalization. In the following section, trend regressions were conducted to confirm the statistical patterns.

Results of the trend regressions

To confirm the changing patterns of correlation over time, trend regressions were estimated; the findings are summarized in Table 6. Panel A presents the outside region trend regression results. In general, there are significant positive trends between ASEAN-5 stock markets and global markets, including those of the US and HK. However, only the correlations between MY and HK exhibit a negative trend.

Table 6 Panel B presents the inside region trend regression results. For IN, there are significant positive trends with other countries. The PH also exhibits a significant positive trend with TH. However, there is a significant negative trend in correlation between TH and MY and between SG and MY. Moreover, there is no significant trend in correlation between SG and TH, between MY and the PH, and between SG and the PH.

Overall, SG has been more integrated with global markets, especially that of HK, than with those within the region. Nevertheless, these findings are consistent with other studies (e.g. Park, 2013) in terms of identifying the increasing patterns in stock market integration between ASEAN-5 and global markets.

Table 6 Trend Regression

Panel A: Outside region

	TH		MY		IN		PH		SG	
	coeff	t-stat	coeff	t-stat	coeff	t-stat	coeff	t-stat	coeff	t-stat
c	0.418	60.888	0.401	80.634	0.288	23.563	0.354	99.447	0.548	82.557
US	6.59E-05**	1.983	5.89E-05**	2.447	0.42E-05***	7.080	0.30E-05***	17.440	0.34E-05***	10.677
R^2	0.011		0.017		0.124		0.46		0.243	
c	0.445	34.342	0.568	101.164	0.358	-10.685	21.288	45.801	0.668	64.348
HK	0.14E-05**	2.269	-0.14E-05***	-5.070	0.17E-05**	29.069	2.117***	-2.701	0.0002***	4.2163
R^2	0.014		0.068		0.012		0.020		0.048	

Panel B: Inside region

	TH		MY		IN		PH		SG	
	coeff	t-stat	coeff	t-stat	coeff	t-stat	coeff	t-stat	coeff	t-stat
c			0.510	61.842	0.341	15.369	0.398	16.399	0.556	31.855
TH			-0.0001***	-4.062	0.0007 ***	6.887	0.0006 ***	5.491	-6.24E-06	-0.074
R^2			-1.928		0.044		0.118		0.078	
c					0.396	23.028	0.495	29.729	0.684	67.618
MY					0.0004 ***	4.411	-7.40E-05	-0.918	-0.0003 ***	-5.120
R^2					0.052		0.002		0.069	
c							0.327	28.935	0.440	30.719
IN							0.001 ***	23.33	0.0004 ***	5.507
R^2							0.605		0.079	
c									0.587	88.394
PH									2.70E-05	0.841
R^2									0.002	

Note: ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

Determinants of stock market integration

In this section, this paper examines the factors determining the degree of stock market integration. Specifically, the following panel regression is estimated:

$$\mathrm{corr}_{ij,t} = \alpha_i + \beta X'_{i,t} + \varepsilon_{i,t},$$

where $\mathrm{corr}_{ij,t}$ is the DCC between countries i and j at time t, while X'_t is the matrix of determinant factors, including bilateral trade (BTR)[6], trade openness (OPEN)[7], stock market capitalization (MCAP), exchange rate volatility (FXVOL), short-term interest rate differential (r), and inflation rate differential (inf), respectively. Data were obtained from the CEIC database, apart from BTR. FXVOL was estimated from the GARCH model. Due to the different scale of data, BTR and MCAP were standardized by subtracting their means and dividing these by their standard deviation. For outside region against US, the $\mathrm{corr}_{ij,t}$ is the DCC between each of the ASEAN-5 markets and the US, while for outside region against HK, the $\mathrm{corr}_{ij,t}$ is the DCC between each of the ASEAN-5 markets and Hong Kong. For inside region among ASEAN-5, the $\mathrm{corr}_{ij,t}$ is the DCC between country i and the average of ASEAN-5 apart from country i. This study also includes the time trend variables (TREND) in the regression to control for the increasing trends in stock market correlation found in section 4.4. The panel regression results with fixed effects are summarized in Table 7.

Table 7 Results of panel regression on determinants of dynamic conditional correlation.

	Outside region against US		Outside region against HK		Inside region among ASEAN5	
	coeff	S.E.	coeff	S.E.	coeff	S.E.
C	0.302***	0.021	0.499***	0.032	0.589***	0.049
BTR	-0.004***	0.006	0.049***	0.012	0.062***	0.020
OPEN	-0.005***	0.011	-0.016***	0.016	-0.072***	0.024
MCAP	-0.045***	0.007	-0.076***	0.012	-0.102***	0.018
FXVOL	0.581***	0.347	1.560***	0.526	2.016***	0.751
R	-0.002***	0.001	0.002***	0.002	-0.002***	0.004
Inf	0.003***	0.001	-0.001***	0.001	-0.000***	0.003
TREND	0.002***	0.000	0.001***	0.000	0.003***	0.001
Adj.R^2	0.693		0.565		0.150	
F-test for Fixed Effect	40.338 (0.000)		18.994 (0.000)		15.003 (0.000)	

Notes: ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively. The F-statistics are reported for fixed effects, with the p-value in parentheses.

As can be seen in Table 7, the panel regression results yield significant power in explaining the changes in the degree of correlation over time (time-series dimension) and the differences in the degree of correlation between each member of ASEAN-5 (cross-section dimension), as R-squared is high in each case.

[6] BTR is the sum of exports and imports between country i and country j. The data were collected from the IMF's Directory of Trade Statistics.

[7] OPEN is the sum of a country's exports and imports scaled by GDP.

However, the R-squared of the outside region regressions (0.69 and 0.56 for the regressions against US and HK, respectively) is higher than that of the inside region (0.15). The results show that these fundamental factors can explain the degree of stock market integration with advanced countries better than that within the ASEAN-5 region. The F-test for fixed effects also shows the validity of the application of the fixed effect model in the panel regression[8].

Next, this study considers the effects of each explanatory variable on the degree of dynamic conditional correlations. As can be seen in Table 7, the empirical results show that the MCAP and FXVOL are two important factors that have a significant effect on stock market integration in each case. The estimated coefficients of MCAP are negative, which implies that countries with large market capitalization (e.g. IN) tend to have lower correlation with other markets, either within the ASEAN region, or externally. For the FXVOL, the ASEAN stock markets tend to be more integrated when exchange rate volatility increases. Considering the impact of BTR, its estimated coefficients are significant at the 1% level for outside region against HK and for inside region. The signs of the coefficients are positive, as expected, which implies that stock market integration is positively associated with trade integration. However, in the case of outside region against the US, BTR is not a significant factor.

OPEN is only significant in the inside region case; it is not a significant factor determining the level of stock market integration with advanced markets. However, the OPEN coefficient is significant for the inside region regression; the relationship sign is in contrast to the hypothesis that countries with a high degree of trade openness tend to have a high level of market integration. A similar result is also found in Narayan et al. (2014) in the case of ASEAN countries. They explain that the degree of bilateral trade between particular countries is more appropriate to determine market integration than countries' overall trade openness in case of the ASEAN-5 countries.

Finally, these findings show that the similarity in fundamental macroeconomic factors has only a marginal impact on stock market integration in the ASEAN-5 countries. In particular, the coefficients of R are not significant in any of the cases. In addition, the inf is statistically significant only in the case of outside region against HK, where a negative relationship is found. The similarity in fundamental macroeconomic factors (inflation) increases the degree of market correlations between the ASEAN-5 countries and Hong Kong.

Taken together, the empirical results show that financial market factors, e.g. size of market capitalization and degree of exchange rate volatility, are important factors that determine the degree of stock market integration. Trade links are another important factor; bilateral trade between specific partners yields better power in determining the level of integration than the trade openness of each country. Lastly, the similarity in fundamental macroeconomic factors has only a small effect on determining the degree of stock market integration.

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[8] In this paper, the numbers of the explanatory variables are larger than those of the cross-section unit. Therefore, the random effect model is invalid in this case, so this study only considers the fixed effect model in estimating the panel data regression.

Conclusion

The paper has aimed to investigate the degree of stock markets integration, both within the ASEAN-5 region and externally with global markets, in particular those of the United States and Hong Kong. The longitude data span January 1988 to September 2017, a period which covers several crises: the 1997 Asian financial crisis, the 2001 dotcom crisis, the 2008 global financial crisis, and the 2012 European debt crisis. Stock market integrations have been investigated in the long run using a cointegration test, and in the short-run using a correlation test. The factors determining the degree of stock markets integration have also been estimated. The key findings and policy implications are summarized below.

First, the Engle and Granger cointegration results show that ASEAN-5 markets were less integrated with global markets over the long-run, apart from the significant long-run relationship between Singapore and Hong Kong. For the inside region case, only long-run relationships between Malaysia and the Philippines, Malaysia and Singapore, and Indonesia and Singapore were found. However, once the possiblity of structural breaks is taken into consideration, the Gregory and Hansen cointegration test revealed that there were additional long-run relationships between ASEAN-5 markets. In addition, the 1997 Asian financial crisis affected the stability of long-run relationships between ASEAN-5 markets.

Second, with regard to short-run market integration, Singapore had the highest co-movement with global markets, especially Hong Kong. In addition, Indonesia appeared to be less integrated with other markets, especially outside the region. Moreover, time-varying patterns of short-run correlations were increasingly found, both inside and outside region.

Lastly, the empirical results also show that financial market factors, e.g. the level of market capitalization and the degree of exchange rate volatility, are important factors determining the degree of stock market integration. Trade links were also another important factor, in which bilateral trade between specific partners yielded better power in determining the level of integration than the trade openness of each country. Moreover, the similarity in fundamental macroeconomic factors had only a small effect on determining the degree of stock market integration.

With reference to the empirical results, the following implications are suggested:

(1) ASEAN-5 stock markets are moving towards an integrated rather than segmented market. Therefore, the degree of stock market integration affects the opportunities for international diversification benefits. Moreover, regional and global risk factors should be considered in addition to a country's own risk factors.

(2) The long-run relationships between ASEAN-5 stock markets are stronger than those with global markets. Therefore, the ASEAN countries should focus their financial market collaboration with other members under the Asian Economic Community (AEC) framework.

(3) The relationship between ASEAN-5 stock markets and global markets is important in the short-run due to the fact that the integration between markets has time-varying pattern. Therefore, indicators such as

exchange rate volatility, inflation differential, stock market capitalization and bilateral trade should be monitored.

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