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## Article

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## Article

# A Different View on ASEAN Capital Market Integration

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**Abstract:** Capital market integration has become an interesting research topic nowadays. Many studies have tried to explain this phenomenon using various methods. Here, we used sophisticated methods to explain capital market integration. This study aims to scrutinize the Association of Southeast Asian Nations (ASEAN) capital market integration. This study hopefully can enrich the different views regarding the capital market integration and fill the gap left by previous studies. The data used were the stock price index of the monthly closing data of the capital markets in ASEAN countries during the period of January 1999 to December 2020, obtained from Bloomberg and the Indonesia Stock Exchange. Data in this study were analyzed using the wavelet method. The results indicate that there is a long-term integration in the capital markets of ASEAN countries, and the highest level of integration was in the period during and about a year after the global crisis. Using the spectrum analysis, the results show that during period from 2008 to 2010, the level of integration reached its highest level.

**Keywords:** wavelet analysis; integration vs. segmentation; spectrum analysis; ASEAN capital markets; Indonesia Stock Exchange

**JEL Classification:** G10; G11; G15



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## 1. Introduction

Capital market integration is an interesting topic in the finance field and is widely discussed by many researchers. Capital market integration always moves dynamically along in time for several reasons. For example, due to increasingly advanced technology, investors can easily gain access and exchange information from one capital market to another; and the thinner the boundaries in the global financial sector, the flow of money can easily go from one country to another (Baele et al. 2004). The current capital market in Indonesia also tends to be integrated with other capital markets. There are many reasons for this, one of them was the removal of restrictions on foreign investor ownership of a public company in 1999 (Bilson et al. 2001; Muharam 1999; Suryanta 2011).

Various studies examining the integration of the Indonesian capital market with other capital markets have also been carried out, for example Palac-McMiken (1997), who conducted a study of the integration of several capital markets in ASEAN countries, such as the Jakarta Stock Exchange, Singapore Stock Exchange, Kuala Lumpur Stock Exchange, Philippines Stock Exchange, and Stock Exchange Thailand in the period before the Asian financial crisis. This study found that only the Indonesian capital market was not integrated with the other capital markets. This finding is also supported by Roca et al. (1998). In the period after the Asian financial crisis, Suryanta (2011) found consistencies with the findings of Palac-McMiken (1997), Kim and McKenzie (2008), and Roca et al. (1998). However, Robiyanto and Ernayani (2018) found relatively different results, where after the Asian financial crisis, the Indonesian capital market actually had the same movement

(co-movement) as the capital market in ASEAN countries. Meanwhile, [Muharam et al. \(2020\)](#) measured the degree of integration of capital markets in Asia using the Orthogonal GARCH approach, and found that the Indonesian, Philippine, and Malaysian capital markets were the capital markets that were segmented and were not integrated with the capital markets in Asia.

Based on this explanation, there is a diversity of research results related to the integration of the Indonesian capital market with capital markets in Asian countries. The variety of previous studies' results provide a gap to be solved, especially by using more sophisticated approaches to enrich the different views regarding capital market integration. There is a relatively strong analytical tool for predicting capital market integration—the wavelet analysis. The wavelet approach allows researchers to examine the behavior of a time series along with its frequency and space–time ([Mensi et al. 2018](#); [Power 2007](#)). This method has been used by [Das et al. \(2018\)](#) to examine the co-movement between gold and stock prices in ASEAN countries, and by [Mensi et al. \(2018\)](#) to examine the co-movement between gold and stock prices in BRICs countries. Unfortunately, this method is still relatively rarely used for predicting the level of capital market integration (only a few using this method, such as [Ranta \(2013\)](#) in studying the integration of several leading capital markets), although it is considered to have the ability to better explain the level of capital market integration ([Das et al. 2018](#); [Ranta 2013](#)).

This study uses the wavelet analysis to examine the integration of capital markets in ASEAN countries from January 1999 to December 2020. The wavelet analysis is performed using wavelet multiple correlation (WMC) and the spectrum analysis. The wavelet approach is presumed to be suitable for the capital integration analysis. By using this analysis, this study can hopefully fill some of the gaps of previous studies such as [Palac-McMiken \(1997\)](#), [Kim and McKenzie \(2008\)](#), [Muharam et al. \(2020\)](#), and [Roca et al. \(1998\)](#). The result of this study shows that long-term integration in the capital markets of ASEAN countries still exist, while the highest level of integration was in the period during and about a year after the global crisis (2008–2009). Hopefully, this study can sharpen the previous studies' findings regarding ASEAN capital market integration and can help researchers, practitioners, and authorities gain more insight into and the ability to formulate policies to cope with the issues examined.

## 2. Literature Review

### 2.1. Capital Market Integration

A general definition of the “financially integrated market” that is regularly used is the definition expressed by [Baele et al. \(2004\)](#), [Weber \(2006\)](#), and [Chen and Knez \(1995\)](#). They suggest the market for a financial instrument and service is fully integrated if all potential parties participating in the market share the same characteristics when confronting a single set of rules. For instance, when participants are willing to make a transaction of certain financial instruments/services, have access to all of the financial instruments/services and receive the same treatment. This is very likely to happen for capital markets in the ASEAN (Association of Southeast Asian Nations) region, because the ASEAN Economic Community (AEC) has been implemented ([Jarungkitkul and Sukcharoensin 2016](#); [Noman et al. 2017](#); [Robiyanto et al. 2016](#); [Volz 2013](#)). The implementation of the AEC would hypothetically improve ASEAN capital market integration ([Gugler and Vanoli 2017](#); [Robiyanto et al. 2016](#)) and economic cooperation ([Gugler and Vanoli 2017](#)).

Consistent with [Baele et al. \(2004\)](#), [Weber \(2006\)](#), and [Karolyi and Stulz \(1995\)](#); [Valle \(2000\)](#) suggest that the capital market can experience the same movement (co-movement) because of the underlying economic factors that reflect the financial conditions in the world in general, and systematically affect all markets. Deregulation and market liberalization, developments in communication technology and trading systems, innovation in financial products and services, and the increasing international activity of multinational companies also affect the capital market co-movement in various countries ([Chay and Eleswarapu 2001](#)).

Jorion and Schwartz (1986) also argued that the capital market is considered internationally integrated whenever assets with a similar risk are also traded with a similar price, despite being traded in various capital markets. This means that the risk and return apply internationally and the stock movements in the capital market are not only influenced by domestic factors, but by stock price movements in world capital markets (Kouki et al. 2011; Maghyreh et al. 2017; Pradhan et al. 2020; Qadan et al. 2019; Qarni et al. 2019; Robiyanto et al. 2019; Xu et al. 2019). In addition, Bekaert et al. (2007) stated that in a market that has a high level of integration and a contagion effect, it will move together and have a high level of association. Meanwhile, the opposite of an integrated capital market is segmented capital market. A capital market can be considered segmented if it has a low relationship with other stock markets (Bilson et al. 2001).

## 2.2. Capital Market Integration in ASEAN

Palac-McMiken (1997) conducted research on the integration of several capital markets in ASEAN countries, such as the Philippines Stock Exchange, Jakarta Stock Exchange, Singapore Stock Exchange, Kuala Lumpur Stock Exchange, and Stock Exchange Thailand, during the period of January 1987 to October 1995. By using a cointegration analysis, the results showed that all of the studied capital markets except for the Jakarta (Indonesia) Stock Exchange were related to each other. This study also found that the capital market in the period of 1987–1995 was a collectively inefficient market.

Roca et al. (1998) found results consistent with Palac-McMiken (1997). Roca et al. (1998) examined the relationship between several capital markets in ASEAN countries, similar to those studied previously during the period of 1988–1995. The results indicated that the Jakarta (Indonesia) Stock Exchange was not connected at all with the capital markets in other ASEAN countries, both in the long and short term. Furthermore, this study concluded that in the short term, all capital markets—except the Jakarta Stock Exchange—had a relationship with each other. Meanwhile, in the long term, all of the capital markets studied did not have any relationship between them.

Ibrahim (2006) conducted a study on the same capital markets using the research period from January 1988 to December 2003, but the analytical tool that was used was vector autoregressive (VAR). This study examined the influence of developed capital markets such as the United States capital market and the Japan capital market on ASEAN capital markets. It found that the United States capital market had a more dominant influence than the Japan capital market on the ASEAN capital markets. The existing empirical evidence also shows that the ASEAN capital markets are very vulnerable to international financial crises. This could be seen from the significant influence of the turmoil that occurred in the United States capital market, while the drastic positive changes in the developed capital markets did not have any significant impact.

Using more recent data that were also processed with VAR, Suryanta (2011) conducted research on capital market integration in several ASEAN countries such as for Indonesia, Malaysia, Singapore, Thailand, and Philippines. The data used in this study were from January 2004 to December 2009. The results were consistent with Palac-McMiken (1997), Click and Plummer (2005), and Roca et al. (1998), revealing that there was no co-movement and dynamic relationship between the Indonesian capital market and the Singapore, Thailand, Malaysia, and the Philippines capital markets. Furthermore, Suryanta (2011) also suggested that Indonesia's domestic factors influenced the Indonesian capital market more than the external factors.

Furthermore, Karim and Karim (2012) conducted more detailed research on the capital market integration in several ASEAN countries, such as Malaysia, Indonesia, Singapore, Thailand, and the Philippines, using the data from January 1988 to December 2010 that were divided into the periods before and after 1997, as well as the period after the financial crisis (sub-prime mortgage) in United States. Karim and Karim (2012) concluded that the capital markets in ASEAN countries tended to be integrated, especially after the sub-prime mortgage crisis in the United States. This is consistent with the results of Robiyanto and

Ernayani (2018), and Catherine and Robiyanto (2020), who used vector autoregression (VAR), and Robiyanto (2018), who used the DCC-GARCH method for investigating the integration of the Indonesian capital market with ASEAN and Asian countries, and found that the dynamic correlation of the Indonesian capital market with ASEAN countries tended to strengthen over time after the Asian financial crisis. These results were also consistent with those found by Muharam et al. (2020), who used the Orthogonal GARCH (OGARCH) method and found that the highest level of integration was found during the global financial crisis.

### 3. Method

#### 3.1. Data

This study uses the stock price index for the monthly closing data of ASEAN capital markets, such as the Jakarta Composite Index (JCI) from the Indonesia Stock Exchange (IDX), the Strait Times Index (STI) from the Singapore Stock Exchange (SSX), the Kuala Lumpur Composite Index (KLCI) from Kuala Lumpur Stock Exchange (KLSE), the SET Index (SETi) from the Stock Exchange Thailand (SET), and the Philippines Stock Exchange Index (PSEi) from the Philippines Stock Exchange (PSE) during the period of January 1999 to December 2020. The monthly closing of the stock index data for JCI, STI, KLCI, SETi, and PSEi were obtained from Bloomberg.

#### 3.2. Analysis Technique

This research used the wavelet analysis. For analyzing, encoding, compressing, reconstructing, and modeling the signals and images, wavelet analysis provides extremely strong problem-solving tools. MATLAB software was used to create many wavelet packages. Continuous wavelet transforms (CWT), and 1D and 2D discrete wavelet transforms (DWT) are all included in the wavelet toolbox. Mensi et al. (2018) and Power (2007) suggested that the wavelet analysis allows researchers to examine the behavior of a time series along with frequency and space–time. Das et al. (2018) explained that the wavelet correlation is an interaction between wavelet covariance  $[x(t), y(t)]$  and wavelet variance for  $[x(t)]$  and  $[y(t)]$ , where  $x(t)$  and  $y(t)$  are the stock indexes' time series. For the continuous transformations of  $W_x(r, s)$  and  $W_y(r, s)$ ,  $W_{xy}(r, s) = W_x(r, s)W_y^*(r, s)$ , where  $r$  denotes the position index and  $s$  is the scale. The asterisk (\*) denotes the complex conjugate. Furthermore, the wavelet coherence analysis (WCA) is one of the most frequently used forms of wavelet analysis used to measure the co-movement of two different markets using the space and time dimensions (Jena et al. 2018; Papiol 2018).

Antonakakis et al. (2018) suggested that the wavelet analysis could show information about the time and frequency series data. It could also be applied to non-stationary datasets. This study used the estimation of the wavelet coherence introduced by Li et al. (2015) of the cross-wavelet and auto-wavelet power spectrum, as follows:

$$R_{xy}^2(r, s) = \frac{|S(s^{-1}W_{xy}(r, s))|^2}{S(s^{-1}|W_x(r, s)|^2)S(s^{-1}|W_y(r, s)|^2)}$$

$R_{xy}^2(r, s)$  is the wavelet coherency.  $S$  is the smoothing operator. This formula gives a value between 0 to 1 in the time frequency window. Zero coherence indicates that there is no co-movement between the existing returns and currents, while the highest coherence implies there is the strongest co-movement between the two datasets. In the wavelet coherence plot, the red color indicates a strong co-movement, while the blue color indicates a weak co-movement. As it is not easy to distinguish positive and negative co-movements as the wavelet coherence is squared, this study uses a phase difference to provide information about the negative and positive co-movements as an indicator of the

relationship between two data sets, as used by [Antonakakis et al. \(2018\)](#). [Bloomfield et al. \(2004\)](#) formulated the phase difference relationship between  $x(t)$  and  $y(t)$  as follows:

$$\varphi_{xy} = \tan^{-1} \left( \frac{J\{S(s^{-1}W_{xy}(r,s))\}}{R\{S(s^{-1}W_{xy}(r,s))\}} \right), \text{ with } \varphi_{xy} \in [-\Pi, \Pi],$$

$J$  and  $R$  are equal to the imaginary transformation and the real part of the smoothed cross wavelet, respectively. Wavelet analysis in this study was conducted using MATLAB software.

#### 4. Results and Discussion

In order to understand the nature of the data used, descriptive statistics for the ASEAN stock price indexes studied are shown in Table 1. Table 1 shows that JCI's mean was higher than for the other ASEAN's stock markets, while the riskiest stock market was Stock Exchange Thailand with the highest standard deviation.

**Table 1.** Augmented Dickey–Fuller test statistics.

Description	JCI	STI	KLCI	SETi	PSEi
Mean	0.01228	0.00429	0.00514	0.00756	0.00666
Max	0.25813	0.24224	0.34228	0.30483	0.19993
Min	−0.31422	−0.23939	−0.18628	−0.30176	−0.24072
Stdev	0.06452	0.05694	0.05098	0.06742	0.05881

Source: Bloomberg, processed.

The wavelet analysis is a sophisticated analysis that needs some pre-testing steps. Before performing the wavelet analysis, the unit root test was first performed with an augmented Dickey–Fuller statistical test and Johansen cointegration analysis. [Kumar and Ajaz \(2019\)](#), and [Robiyanto and Ernayani \(2018\)](#) stated that this was done for the long-term cointegration of the capital market under study. The results of the unit root test can be seen in Table 2.

**Table 2.** Augmented Dickey–Fuller test statistics.

No.	Variable	Level **
1.	Jakarta Composite Index (JCI)	−12.87381 *
2.	Straits Times Index (STI)	−15.26061 *
3.	Stock Exchange of Thailand Index (SETi)	−15.58269 *
4.	Philippine Stock Exchange Index (PSEi)	−14.90462 *
5.	Kuala Lumpur Composite Index (KLCI)	−15.46599 *

\* level of significance at the 1%; \*\* level refers to the order of integration in unit root test. Note: None unit root found.

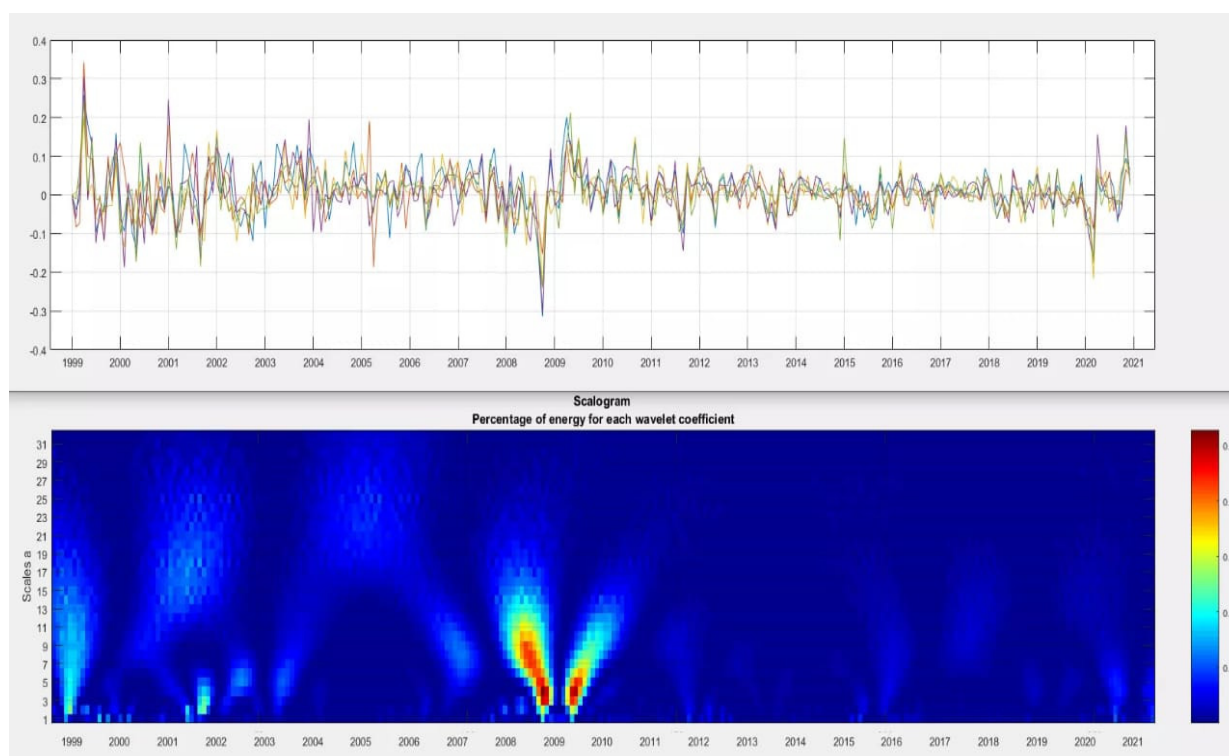
Based on Table 2, it can be seen that all of the augmented Dickey–Fuller tests were statistically significant at a significance level of 1%. This indicates that there was no unit root found in the variables used. The next stage was to perform the Johansen cointegration analysis in order to test whether a long-term cointegration existed. The results of the Johansen cointegration analysis can be seen in Table 3. The Johansen cointegration shows that there was a cointegration in the ASEAN capital markets studied (the probability value was less than 0.05), so that the wavelet analysis could be carried out. Wavelet coherency provided a much better measure of co-movement between the stock market returns. The results reveal that there was a cointegration of ASEAN capital markets studied at all of the existing levels. This is consistent with the findings of [Seth and Sharma \(2015\)](#), who found a long-term cointegration in Asian capital markets.

**Table 3.** Results of the Johansen cointegration analysis.

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.282853	86.11088	33.87687	0.0000
At most 1 *	0.234660	69.26579	27.58434	0.0000
At most 2 *	0.193034	55.54873	21.13162	0.0000
At most 3 *	0.157096	44.26360	14.26460	0.0000
At most 4 *	0.127766	35.40467	3.841466	0.0000

Max-eigenvalue test indicates 5 cointegrating equation(s) at the 0.05 level; \* denotes rejection of the hypothesis at the 0.05 level; \*\* MacKinnon et al. (1999) *p*-values.

Based on the wavelet analysis, Figure 1 displays the WMC scalogram and spectrum analyses of the ASEAN capital markets studied during the period of 1999 to 2020. This WMC value ranged from  $-0.3$  to  $0.35$ , which indicates that, in general, the level of integration between the capital markets in ASEAN regions tends to be low.

**Figure 1.** Scalogram and spectrum analysis.

The wavelet analysis could produce more precise results regarding the level of integration. In the period after the Asian crisis until the period of the global financial crisis in 2008, the level of capital market integration in ASEAN region is seen to be higher and more fluctuating than the period after the global financial crisis. This is different from the results of previous studies (Karim et al. 2011; Muharam et al. 2020; Robiyanto 2018), who generally found that the level of capital market integration in ASEAN before the global financial crisis tended to be lower than after the global financial crisis, because the speed of information transmission was faster in the period after the global financial crisis. This is in line with Horobet and Lupu (2009), who concluded that the speed of transmission could boost the integration.

However, based on the spectrum analysis conducted in this study, the volatility among stock markets in the ASEAN region tend to be higher and more fluctuated. This could be because the Asian Crisis produced some uncertainty, including political uncertainty and social unrest, in some ASEAN countries. Again, by using the spectrum analysis,

it can be seen that during the research period, the highest and most striking level of integration for the overall capital market in the ASEAN region was in 2008 to 2010, during the period of the global financial crisis and about one year thereafter. It is known that the global financial crisis created extreme fear due to the derivative (such as collateralized debt obligation (CDO) and collateralized mortgage obligation (CMO)), which led to the sub-prime mortgage crisis in 2008, later known as the global financial crisis (GFC), a severe worldwide crisis in financial sector often referred to as a black swan event (Bekiros et al. 2017; Estrada and Varga 2012). So, it is not surprising that short term shocks and some uncertainty were created in the one-year aftermath.

The result shows that during the period of the GFC (Majid and Kassim 2009; Karim et al. 2010) between July 2007 to December 2008, the peak was reached in September 2008 when Lehman-Brothers collapsed, and about one year after the global financial crisis the ASEAN capital markets tended to have the same direction of movement due to the global uncertainty as a result of the global financial crisis. In this context, the results of this study are able to support the research results by Muharam et al. (2020), who concluded that in the period of the global financial crisis, the highest level of capital market integration in the ASEAN region was found during the global financial crisis compared with the periods before and after.

## 5. Conclusions

This study uses wavelet analysis to examine the integration of capital markets in the ASEAN region through wavelet multiple correlation (WMC) and the spectrum analysis. We used the unit root test and Johansen cointegration analysis before conducting the wavelet analysis. Based on those analyses, the wavelet analysis was appropriate for use in this study. The results of this study indicate that the ASEAN capital market integration during the period of 1999 to 2020 had a low correlation trend and tended to lack intensity. By using a more detail analysis, the highest level of integration occurred in the period from 2008 to 2010, which was during the period of the global financial crisis and the year following it. This present study has more detailed results compared with the ones in previous studies, because it directly found the strongest level of integration using the spectrum analysis. The findings imply that the ASEAN capital markets are less integrated, and this condition will beneficial global portfolio formulation. However, during a crisis, due to higher degree of integration, the global portfolio formulation would have less benefit.

The results of the spectrum analysis specifically indicate that the period with the most striking level of integration is September 2008 (when Lehman-Brothers collapsed) to December 2008; unfortunately, this study still uses the monthly data from the research period. Therefore, it is suggested that future uses daily data to obtain more detailed results and adds several variants of the wavelet analysis. Other approaches, such as the ADCC-GARCH and other GARCH variants, are also applicable.

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